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Model of motivation in schizophrenia: Development and validation of a multifactorial intervention aiming to enhance daily functioning and quality of life

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by

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Preface

"Many schizophrenics in the later stages cease to show any affect for years and even decades at a time. They sit about the institutions to which they are confined with expressionless faces, hunched-up, the image of indifference." (Bleuler, 1911, 1950, p. 40).

"The patients appear lazy and negligent because they no longer have the urge to do anything either of their own initiative or at the bidding of another … In mild cases, where wishes and desires still exist, they will nevertheless do nothing toward the realization of these wishes." (Bleuler, 1911, 1950, p. 70).

Schizophrenia is a chronic and severe mental disorder affecting over 20 million people worldwide. Individuals with schizophrenia present a variety of symptoms, with common experiences including hallucinations and delusions. Such "positive" symptoms are commonly known. Many people with schizophrenia however suffer from "negative" symptoms, broadly defined as an absence or deficit in normal functioning and comprising both expressive and motivational deficits. While negative symptoms in schizophrenia have been documented for over a century, their treatment has long been overlooked.

Before I began researching negative symptoms in schizophrenia five years ago, I had heard that such symptoms were either untreatable or simply a problem for pharmacology to solve. Moreover, as they appeared to be overshadowed by positive symptoms, I had presumed that negative symptoms were somehow less important in the treatment of schizophrenia. As I studied the subject more deeply however, I quickly understood that these views were misguided. Negative symptoms, in particular motivational deficits, had a deleterious impact on daily functioning, well-being and physical health in schizophrenia. In addition, as psychotropic medications were still far from offering a satisfying treatment option and had little effect on improving quality of life, many studies pointed to the need for new interventions to treat negative symptoms. Having been largely ignored for much of the twentieth century, a resurgence in focus on negative symptoms was underway.

To play a role in the resurgence, I embarked on this doctoral project. I read the scientific literature on negative symptoms deeply and widely and built a strong theoretical understanding of motivational deficits based on the seminal work of Professor Ann Kring, Professor Deanna Barch and their colleagues. I was inspired by both Professor Jerome Favrod and Professor Dawn Velligan, two leading researchers in the field of negative symptoms, and learned much about their novel psychological interventions during my respective research sojourns with them in Lausanne, Switzerland and San Antonio, Texas. Moreover, the continuous contact with individuals with schizophrenia and other severe

mental disorders over the past five years allowed me to build the all-important bridge between theory and practice and proved invaluable in developing and refining the intervention presented in this dissertation.

This thesis comprises three sections: the theoretical section, the experimental section and the general discussion. In the theoretical section, I first review the literature concerning the conceptualisation, evaluation and impact of negative symptoms. Second, I analyse the main models that attempt to explain why negative symptoms develop and persist. Third, I outline treatment options currently available for negative symptoms and evaluate their strengths and weaknesses. Fourth, I introduce a multifactorial model of motivation in schizophrenia, as well as the new "Switch" intervention which targets motivational deficits and aims to enhance the daily functioning and quality of life in people with schizophrenia. In the experimental section, I present four studies which aim to validate both the Switch intervention and the multifactorial model which underpins it. In the final section, I integrate and discuss the findings of the four studies, highlight the strengths and weaknesses of the Switch intervention and the methods that were used to evaluate its benefits, and provide directions for future research.

Abbreviations

ABS	=	Asocial Beliefs Subscale
ACC	=	Anterior Cingulate Cortex
ACIPS	=	Anticipatory and Consummatory Interpersonal Pleasure Scale
ACT	=	Acceptance and Commitment Therapy
AES	=	Apathy Evaluation Scale
AR(1)	=	Autoregressive lag 1 model
BA	=	Behavioural Activation
BNSS	=	Brief Negative Symptom Scale
BPRS	=	Brief Psychiatric Rating Scale
CAINS	=	Clinical Assessment Interview for Negative Symptoms
CAT	=	Cognitive Adaptation Training
CBSST	=	Cognitive Behavioural Therapy and Social Skills Training
CBT	=	Cognitive Behavioural Therapy
CHR	=	Clinical High Risk of developing psychosis
DAS	=	Dysfunctional Attitude Scale
DBI	=	Demotivating Beliefs Inventory
DLPFC	=	Dorsolateral Prefrontal Cortex
DSM	=	Diagnostic and Statistical Manual of Mental Disorders
EEfRT	=	Effort Expenditure for Rewards Task
EMA	=	Ecological Momentary Assessment
EMI	=	Ecological Momentary Intervention
ESM	=	Experience Sampling Method
FEP	=	First-Episode of Psychosis
FROGS	=	Functional Remission of General Schizophrenia scale
GAP	=	Goal-setting and Planning
GMT	=	Goal Management Training
GSE	=	General Self-Efficacy scale

IMI-SR	=	Intrinsic Motivation Inventory for Schizophrenia Research
LARS	=	Lille Apathy Rating Scale
MAP-SR	=	Motivation and Pleasure Scale-Self Report
MATRICS	=	Measurement and Treatment Research to Improve Cognition in Schizophrenia
MEP	=	Multiple Episodes of Psychosis
MOVE	=	MOtiVation and Enhancement
NA	=	Network Analysis
NIMH	=	National Institute of Mental Health
NSA	=	Negative Symptom Assessment
OFC	=	Orbital Frontal Cortex
PANSS	=	Positive and Negative Syndrome Scale
PEPS	=	Positive Emotions Program for Schizophrenia
QFS	=	Questionnaire de Fonctionnement Social
RCT	=	Randomised Controlled Trial
SANS	=	Scale for the Assessment of Negative Symptoms
SARA-Q	=	Success And Resource Appraisals Questionnaire
SBI	=	Savouring Beliefs Inventory
SDS	=	Schedule for the Deficit Syndrome scale
SNS	=	Self-evaluation of Negative Symptoms
S-QoL	=	Schizophrenia Quality of Life questionnaire
SST	=	Social Skills Training
TAU	=	Treatment As Usual
TEPS	=	Temporal Experience of Pleasure Scale
tTMS	=	repetitive Transcranial Magnetic Stimulation
VAR	=	Vector Autoregressive Model

THEORETICAL SECTION

CHAPTER 1
Negative symptoms

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1. A brief history of the conceptualisation of negative symptoms

Conceptualisations of what we call schizophrenia today have been presented over centuries, and negative symptoms have been documented as early as the beginning of the 19th century (Dollfus & Lyne, 2017; Galderisi, Mucci, Buchanan, & Arango, 2018; Kirkpatrick, 2014b; Malaspina et al., 2014). John Haslam described mentally ill individuals with blunted sensitivity and affective indifference (Haslam, 1809). In the 20th century, Eugen Bleuler depicted individuals diagnosed with "dementia praecox" with expressionless faces and no inclination to do anything whatsoever, whether it be on their own initiative or at the incitement of others (Bleuler, 1911, 1950). Emil Kraepelin described the same individuals with emotional dullness, failure of mental activities and weakening of volition (Kraepelin, 1919).

Although the use of the terms positive and negative symptoms dates back centuries, it was not applied to schizophrenia specifically until the 1970s. In the 19th century, positive and negative symptoms were introduced by the neurologist John Russel Reynolds to illustrate the phenomena of epilepsy (Malaspina et al., 2014). Negative symptoms were then conceptualized as the failure of vital properties (e.g. paralysis and anaesthesia), whereas positive symptoms were described as an overload of vital properties (e.g. spasms or convulsions). These expressions were subsequently used to designate the phenomenon of mental illnesses, but sporadically and without a clear definition (e.g. Clouston, 1892), until John Hughlings Jackson applied Reynolds's distinction more formally to psychiatric phenomenon: negative symptoms represented a loss of normal function, whereas positive symptoms involved excess of normal activity (Foussias, Agid, Fervaha, & Remington, 2014; Malaspina et al., 2014). Finally, the soviet psychiatrist Andrei Vladimirovich Snezhnevsky first used the distinction of positive and negative symptoms in regard to schizophrenia

(Snezhnevsky, 1968). John Strauss, William Carpenter and John Bartko further formalised these expressions (J. S. Strauss, Carpenter, & Bartko, 1974).

Although negative symptoms have always been included in the descriptions of schizophrenia, their centrality in the symptomatology of the illness has varied across time. In the 19th century, renowned psychiatrists such as Bleuler and Kraepelin considered what corresponded in their descriptions to negative symptoms as being a core aspect of "dementia praecox" (Malaspina et al., 2014). They also considered those symptoms as being devastating for the individual's functioning. But around the middle of the 20th century, despite the assumed centrality of negative symptoms, positive symptoms took priority in the diagnosis of schizophrenia. Positive symptoms were then exclusively considered as the first rank symptoms of that disorder (Schneider, 1959), setting negative symptoms on the side for much of our history (Carpenter, Blanchard, & Kirkpatrick, 2015; Dollfus & Lyne, 2017). The resurgence of interest in negative symptoms took a few decades, mostly driven by the work of John Strauss and his colleagues who formally distinguished negative symptoms from the other symptoms observed in schizophrenia (J. S. Strauss et al., 1974). Furthermore, they reemphasized the significance of negative symptoms in the chronicity and the poor prognosis of the illness. Finally, Strauss and colleagues reintroduced the concept of primary and secondary symptoms that was already presented in Bleuler's conceptualization of schizophrenia (Malaspina et al., 2014). Carpenter and colleagues contributed to the validation of this distinction (Carpenter, Heinrichs, & Wagman, 1988). Primary negative symptoms ("deficit symptoms") are inherent to the pathophysiology of schizophrenia, whereas secondary negative symptoms can result from other factors, such as medication (i.e. side-effects), positive symptoms, or deprivation resulting from the condition. This distinction gradually led to the recognition of a subtype of schizophrenia, i.e. "deficit schizophrenia" (Kirkpatrick, Buchanan, McKenny, Alphs, & Carpenter, 1989), which further contributed to bringing attention back to negative symptomatology.

Around the same period, items assessing negative symptoms began appearing in broad scales of psychopathology, such as the Brief Psychiatric Rating Scale (BPRS; Overall & Gorham, 1962), and then became the focus of the Scale for the Assessment of Negative Symptoms (SANS; Andreasen, 1982). Although these advances brought attention to negative symptoms as a separate construct and potentially distinct therapeutic target, negative symptoms were – and still are – considered to be more difficult to evaluate compared to positive symptoms (Dollfus & Lyne, 2017). The inter-rater reliability of the assessment of negative symptoms was indeed poor compared to positive symptoms. This could have been due to the lack of a clear definition of negative symptoms and their continuity with common experiences in healthy individuals (Andreasen, 1997). Moreover, negative symptoms did not appear in the Diagnostic and Statistical Manual of Mental Disorders until poverty of speech was mentioned in the DSM-III (American Psychiatric Association, 1980) and flat (or inappropriate) affect in its revised version (American Psychiatric Association, 1987). It is only in the DSM-IV that negative symptoms appeared per se, including affective flattening, alogia and avolition (American Psychiatric Association,

1994). Therefore, only recently did it become widely accepted that negative symptoms represent a distinct dimension in the psychopathology of schizophrenia (Tandon et al., 2013). Consequently, in recent decades, clinicians were still more knowledgeable about positive symptoms, and better trained to evaluate and treat them (Galderisi, Faerden, & Kaiser, 2017). There was also a line of research suggesting that negative symptoms, due to their underlying neurophysiology, were not amenable to treatment (Azorin, Belzeaux, & Adida, 2014; Velthorst et al., 2015). Furthermore, misconceptions about negative symptoms and uncertainties about their management are still present today (Galderisi, Mucci, et al., 2018).

Since the beginning of the 2000s, awareness regarding negative symptoms and their understanding have greatly evolved. The National Institute of Mental Health (NIMH) Measurement and Treatment Research to Improve Cognition in Schizophrenia (MATRICS) defined negative symptoms, as well as impaired cognition, as "unmet therapeutic needs" and led to the organisation of a negative symptom consensus development conference (Buchanan et al., 2005; Kirkpatrick, Fenton, Carpenter, & Marder, 2006). The resultant consensus statement increased the appreciation of the heterogeneity of negative symptoms, comprising anhedonia, avolition, asociality, blunted affect and alogia (Kirkpatrick et al., 2006). Furthermore, it appeared that these symptoms clustered into two domains: motivational deficits and expressive deficits (see 2.1. Expression and motivation). Taking this distinction into account contributed to warrant progress in the study of underlying processes, of neurobiological substrates and of the development of tailored therapeutic interventions for negative symptoms (Galderisi, Mucci, et al., 2018; Kane, 2006). A new era had begun.

2. Heterogeneity and distinctiveness of negative symptoms

2.1. Expression and motivation

There has been divergence regarding which exact phenomena to incorporate in the category of negative symptoms (Emsley, Rabinowitz, & Torreman, 2003; Malaspina et al., 2014). The NIMH-MATRICS negative symptom consensus development conference issued a report on the domains of negative symptoms, reaching the following consensus: anhedonia, avolition, asociality, blunted affect and alogia are recognised as the five domains representative of negative symptoms (Kirkpatrick et al., 2006). This new conceptualisation reduces overlaps that previously existed between negative symptoms and others, such as depression, disorganisation or cognitive deficits (Marder & Galderisi, 2017). For example, attentional impairment is no longer considered part of negative symptoms, as it was in the SANS (Andreasen, 1982), because it has been consistently shown to be a more appropriate fit within the disorganisation dimension of schizophrenia (Peralta & Cuesta, 1995).

Factor analyses using different measurement scales consistently reveal the presence of two distinct – although interrelated – factors: expressive deficits and motivational deficits (see

Figure 1.1.). This two-factor structure appears to be highly replicable across various samples (e.g. those with or without a deficit syndrome) and medication status (Blanchard & Cohen, 2006; Kimhy, Yale, Goetz, McFarr, & Malaspina, 2006; Kirkpatrick, 2014a; Kirkpatrick et al., 1989, 2011; Kring, Gur, Blanchard, Horan, & Reise, 2013; Liemburg et al., 2013; Messinger et al., 2011; Nakaya & Ohmori, 2008; Peralta & Cuesta, 1995; Sayers, Curran, & Mueser, 1996; G. P. Strauss, Hong, et al., 2012). However, recent studies have shown that negative symptoms may be better understood using a 5-factor structure corresponding to the 5 domains of negative symptoms (G. P. Strauss et al., 2018), or a hierarchical model, including the five dimensions as first-order factors and the motivational and expressive deficits as second-order factors (Ahmed et al., 2019; Ang, Rekhi, & Lee, 2019). These changing conceptualisations reflect, of course, work in progress.
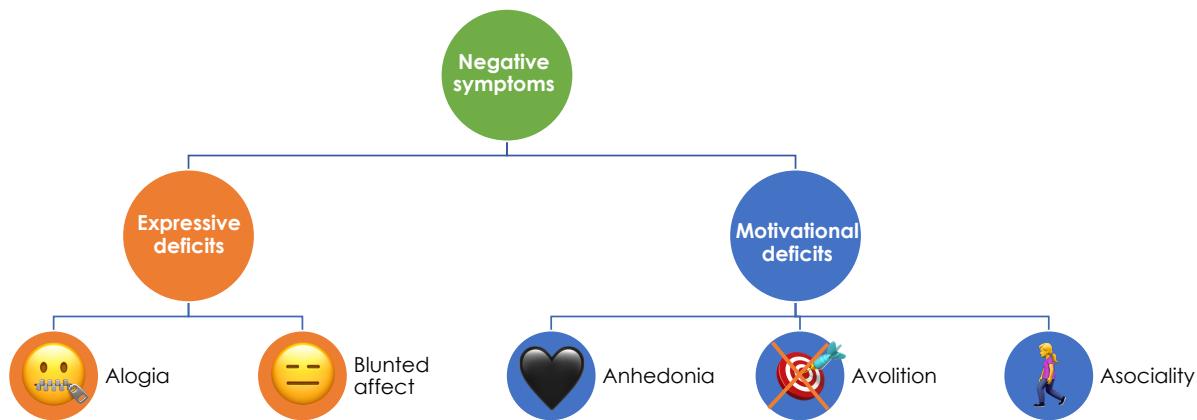
Figure 1.1. Representation of the five domains of negative symptoms, belonging to the two overarching expressive and motivational domains.

This distinction between the motivational and the expressive dimensions of negative symptoms have led to the identification of different subgroups among individuals with schizophrenia (G. P. Strauss et al., 2013). Strauss and colleagues conducted cluster and discriminant function analyses that revealed two subgroups with either predominant motivational or expressive deficits. The subgroup that exhibited more motivational deficits generally presented a more pathological profile, and also demonstrated worse social functioning (e.g. less likely to be employed and to complete a high-quality work). This association between functional outcomes and motivational deficits specifically has been widely supported (see 4.2. Quality of life and functional outcomes) and justifies the focus on these symptoms in particular.

2.1.1.   Expressive deficits

Expressive deficits refer to diminished (affective) expression, including blunted affect and alogia. This dimension is sometimes referred to as "expressivity" or "diminished expression". Expressive deficits include both blunted affect and alogia.

Blunted affect

"Blunted affect"[1], "affective flattening", or "blunted expression" refer to the reduction in the intensity and range of emotional expression in three modalities: facial expression, vocal expression, and expressive gesture (e.g. body language) (Millan, Fone, Steckler, & Horan, 2014).

Regarding the facial modality, it has been consistently observed that individuals with schizophrenia display diminished facial expression (Kring & Elis, 2013; Kring & Moran, 2008). As reviewed by Kring and colleagues, this diminished facial expression has been observed both in terms of frequency and intensity, whether it be spontaneously or in response to a variety of situations and evocative stimuli (e.g. film clips, music, pictures, odours, food, social interactions), across various methods to measure facial expression (e.g. observational coding systems, electromyography), and regardless of medication status. The very subtle facial expressions of individuals with schizophrenia are nonetheless coherent with the valence (negative or positive) of the stimuli (e.g. unobservable contraction of the zygomatic muscle when exposed to pleasant stimuli) (Kring & Moran, 2008).

As for vocal expression, a recent systematic review and meta-analysis (Parola, Simonsen, Bliksted, & Fusaroli, 2020) found that individuals with schizophrenia showed significantly less pitch variability, i.e. less inflection variability. Another meta-analysis that included objective analyses of natural speech found that speech variability (both in pitch and emphasis, i.e. variability in volume or intensity) was moderately impaired in individuals with schizophrenia, compared to healthy controls (Cohen, Mitchell, & Elvevåg, 2014). For example, a study observed a global impairment of prosody in individuals with schizophrenia, with deficits in the various acoustic parameters (e.g. intonation, fluency, variations in pitch, variations in volume, pauses) (Trémeau, 2006).

Finally, individuals with schizophrenia exhibit a general reduction in expressive gestures, i.e. hand gestures, eye gaze, head movements (e.g. nodding), and body movements (e.g. shrugging, leaning back or forward), which might alter social interactions (Marder & Galderisi, 2017).

It is important to note that the above findings do not support the hypothesis that blunted affect reflects a diminished emotional experience, as individuals with schizophrenia appear to have intact hedonic experiences (Kring & Elis, 2013; Kring & Moran, 2008) (see 2.1.2. Motivational deficits, Anhedonia).

Alogia

The alogia domain (or "poverty of speech") refers to the reduced verbal expression, and captures both quantity of speech (number of words that are expressed) and its spontaneous

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[1] "Flat affect" refers to extreme blunted affect (Marder & Galderisi, 2017).

elaboration (Marder & Galderisi, 2017). The systematic review and meta-analysis (Parola et al., 2020) mentioned in the previous section, also reported that individuals with schizophrenia had a much lower proportion of spoken time (i.e. percentage of time talking), a lower speech rate (i.e. number of words per second or minute), and made longer pauses (i.e. silence) compared to healthy controls. Another meta-analysis (Cohen et al., 2014) which included studies using objective analyses of natural speech, also found that general speech production was largely impaired in schizophrenia. Speech production included different characteristics, i.e. total number of words spoken, proportion of spoken time, speech rate, average utterance length, number of pauses, average pause length, variability in pause time across the speech sample, and time to initiate speech from the beginning of the recording.

2.1.2. Motivational deficits

The motivational dimension of negative symptoms has been referred to in many different ways, including "anhedonia/asociality" (Blanchard & Cohen, 2006), "amotivation" (Foussias, Siddiqui, Fervaha, Agid, & Remington, 2015), "experiential deficits" (Forbes et al., 2010), "motivation and pleasure" (Kring & Barch, 2014), "motivational negative symptoms" (Granholm, Holden, & Worley, 2018; Green & Horan, 2015; Reddy et al., 2014), "apathy/avolition" (Galderisi et al., 2017), and "apathy" (Del-Monte et al., 2013). In the literature, the terms "amotivation", "apathy", and "avolition", are often interchangeable, all referring to a decrease in self-initiated and goal-directed behaviours (Foussias & Remington, 2010). However, amotivation and apathy generally encompass a broader definition, with a consideration of not only behavioural aspects, but also the loss, lack or absence of emotion, feeling, interest, or concern (Kos, van Tol, Marsman, Knegtering, & Aleman, 2016). The dimension of motivational deficits is generally comprised of anhedonia, avolition and asociality.

Anhedonia

Anhedonia refers to the diminution in the ability to experience pleasant emotions. According to the latest research, this construct should be divided into two types of experiences (Gard, Kring, Gard, Horan, & Green, 2007; Horan, Kring, & Blanchard, 2006; Kring & Barch, 2014; G. P. Strauss & Gold, 2012), which have distinct neural substrates (B. Zhang et al., 2016). The first is consummatory anhedonia ("in-the-moment anhedonia", "liking"), which refers to a reduced experience of pleasure while participating in an enjoyable activity (e.g. enjoying the music at a concert). The second type of anhedonic experience is anticipatory anhedonia ("appetitive anhedonia", "wanting"), which refers to a failure to derive pleasure from anticipating future pleasant events (e.g. looking forward to a concert).

The study of anhedonia in schizophrenia has produced diverging results. Certain studies found no diminished experience of consummatory pleasure in individuals with

schizophrenia when they were exposed to pleasant stimuli (Kring, Germans Gard, & Gard, 2011), while other findings point to a deficit in that ability (G. P. Strauss, Wilbur, Warren, August, & Gold, 2011). The dominant understanding today is that individuals with schizophrenia are able to experience pleasure in the present moment (consummatory pleasure), but that they experience a deficit in the anticipation of pleasure (Foussias & Remington, 2010; Frost & Strauss, 2016; Kring & Barch, 2014; Llerena, Strauss, & Cohen, 2012; Marder & Galderisi, 2017; J. Wang et al., 2015). The anticipation of pleasure is essential to motivate behaviours aimed at experiencing future pleasant activities (Frost & Strauss, 2016; G. P. Strauss, Waltz, & Gold, 2014), hence the presence of anhedonia in the construct of motivational deficits.

Avolition[2]

Avolition is generally defined as a reduction in the initiation and maintenance of goal-directed behaviours (Marder & Galderisi, 2017). There is a distinction between the actual activity (i.e. the self-initiated engagement in goal-directed behaviours), and the interest and desire a person could manifest regarding certain goals (Kirkpatrick et al., 2011; Kring et al., 2013). For example, a person could go to a day-care centre every day, but attend the workshops given there with no real interest, being present just to pass the time. Or on the contrary, a person could manifest a certain interest in painting, for example, but not do any painting at home or at the local community centre.

Asociality

Asociality ("social amotivation" or "social withdrawal") is defined as the diminution in social initiative (Marder & Galderisi, 2017). There is, however, a distinction between the visible behavioural aspects of social withdrawal (e.g. little engagement in social activities) and the more internal aspect of it, i.e. the lack of interest or desire for various types of social contact, or the low valuation of them (Kirkpatrick et al., 2011; Kring et al., 2013). The latter is generally referred to as social anhedonia (Barkus & Badcock, 2019; Blanchard, Horan, & Brown, 2001). A recent review indicated that individuals with schizophrenia experienced diminished pleasure from social situations which appeared to be related with a reduced desire to engage in interpersonal interactions, i.e. more social withdrawal (Barkus & Badcock, 2019). However, they also found that alongside social anhedonia, individuals with schizophrenia reported feelings of loneliness, suggesting that they nonetheless have a need for social connectedness. Reddy et al. (2014), for example, showed that individuals with schizophrenia and negative symptoms could show different profiles. One subgroup was characterized by avoidance tendencies. They were interested in social relationships but

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[2] Note that avolition is sometimes referred to as "amotivation" or "apathy" (Marder & Galderisi, 2017), which could be confused with the overarching dimension of motivational deficits.

would avoid them because they were considered as anxiety-inducing and aversive. The other subgroup was characterized by a lack of approach motivation. These individuals did not value close relationships, showed limited interest in people and a diminished drive to build close relationships. Finally, a recent study evaluating social anhedonia and asociality in daily life (see 3.4. Ambulatory assessment) found that individuals with schizophrenia, compared to healthy controls, spent less time in structured social situations, such as work, but as much time in unstructured social situations, such as visits and conversations (Kasanova, Oorschot, & Myin-Germeys, 2018). Furthermore, as opposed to other findings, individuals with schizophrenia reported similar hedonic experience in both types of social situations. These results show the complexity of asociality symptoms and of the different profiles that can be observed.

2.2.   Primary and secondary

As mentioned in the first section of this chapter (1. A brief history of the conceptualisation of negative symptoms), a distinction was made between symptoms idiopathic to schizophrenia, and symptoms that appear to be secondary to other factors, such as depressive symptoms, upsetting positive symptoms, suspicious withdrawal, extrapyramidal side-effects from anti-psychotic drug treatment, and environmental deprivation (Carpenter et al., 1988; Fervaha, Foussias, Agid, & Remington, 2014a) (see Figure 1.2.). Symptoms that seem to be inherent to schizophrenia are called primary negative symptoms, whereas those that prove to be the consequences of other symptoms or conditions are referred to as secondary negative symptoms. Thus, for example, secondary negative symptoms may respond to the treatment of depression or positive symptoms, or the reduction in extrapyramidal side-effects, or an increase in environmental stimulations. Primary negative symptoms, on the contrary, persist in the absence of these sources of secondary negative symptoms. This distinction led to the introduction of a subtype of schizophrenia, namely deficit schizophrenia (or deficit syndrome) (Carpenter et al., 1988; Kirkpatrick et al., 1989). A recent meta-analysis reported that deficit schizophrenia appeared in general in one individual with schizophrenia out of three (López-Díaz, Lara, & Lahera, 2018). Individuals with deficit schizophrenia present primary and enduring negative symptoms (lasting for at least 12 months), in contrast to individuals with nondeficit schizophrenia whose negative symptoms are transient. This categorization appears to be quite reliable and stable over the life-time (G. P. Strauss, Harrow, Grossman, & Rosen, 2010). Furthermore, it is supported by the observations of distinct etiological, neurological, biological, and pathophysiological correlates and differing courses of the illness (Ahmed, Strauss, Buchanan, Kirkpatrick, & Carpenter, 2018; Bucci & Galderisi, 2017; Kirkpatrick, 2014b; Kirkpatrick & Galderisi, 2008).
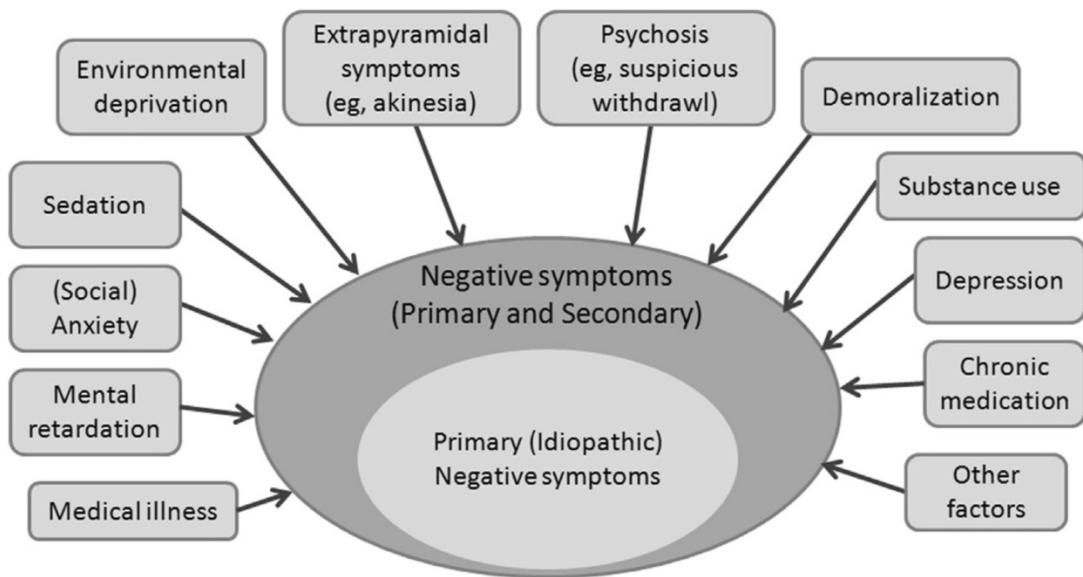
Figure 1.2. Illustration of potential sources of secondary non-idiopathic negative symptoms (Fervaha et al., 2014a)[3].

This distinction is of importance for the care of individuals with schizophrenia, as it implies the identification of different underlying causes, and therefore the deployment of different treatment approaches. However, in clinical practice as well as in research conditions, it may actually be difficult to distinguish between primary and negative symptoms, all the more so as they can co-exist (Sarkar, 2015). In this context, new categories emerged: prominent negative symptoms, predominant negative symptoms and persistent negative symptoms (Mucci, Merlotti, Üçok, Aleman, & Galderisi, 2017). *Prominent negative symptoms* are characterized by the presence of at least three symptoms that are at least moderate, or at least two symptoms that are at least moderately severe (Mucci et al., 2017). *Predominant negative symptoms* represent a slightly narrower category, with symptoms that are prominent, but also preponderant relative to positive symptoms (and possibly other symptoms, such as depressive or extrapyramidal symptoms), which might have to be under a certain threshold according to certain definitions (Bucci & Galderisi, 2017; Mucci et al., 2017). This categorisation has indeed been described with different criteria regarding the number or the severity of the symptoms required, without a clear consensus (e.g. Rabinowitz et al., 2013; Stauffer et al., 2012). For both prominent and predominant negative symptoms, the duration of the symptoms is not considered in the inclusion criteria. Finally, *persistent negative symptoms* represent prominent negative symptoms that have endured for at least 6 months (as opposed to 12 months for the deficit syndrome category), including both primary and secondary negative symptoms, provided the latter have not been responsive to traditional

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[3] Reproduced with permission from "Impact of primary negative symptoms on functional outcomes in schizophrenia," by G., Fervaha, G. Foussias, O. Agid, and G. Remington, 2014. *European Psychiatry*, *29*(7), p. 450. Copyright 2014 by Elsevier Masson SAS.

treatment for the sources of secondary symptoms (e.g. antipsychotic or antidepressant treatment) (Buchanan, 2007). Persistent negative symptoms' criteria may actually be more or less restrictive, either including or excluding secondary negative symptoms (e.g. Chang et al., 2011; Galderisi, Mucci, et al., 2013). Generally, the inclusion criteria for persistent negative symptoms follow the same definition as prominent negative symptoms, but exclusive criteria may set a threshold for positive, depressive and extrapyramidal symptoms (Bucci & Galderisi, 2017).

The use of stricter criteria regarding negative symptoms, and therefore the decrease of variability in negative symptoms profiles, reduces confounds in research findings. For example, taking into account the stability of negative symptoms, such as in the criteria for the deficit syndrome or for persistent negative symptoms, may reduce the possibility of a random improvement in an experimental or control intervention (Mucci et al., 2017). Furthermore, using thresholds for positive or depressive symptoms, for example, would enable a "cleaner" investigation of negative symptoms' underlying processes and pathophysiology.

2.3. Negative symptoms and links to other symptoms

The distinction between primary and negative symptoms reveals, on the one hand, the distinctiveness, and on the other hand, the relatedness of negative symptoms with other symptoms. Studies have consistently shown that negative symptoms were indeed distinct from positive symptoms, affective symptoms (such as depression or anxiety), disorganisation and neurocognitive deficits (Blanchard & Cohen, 2006; Foussias et al., 2014), albeit at the same time, there are associations with those other symptoms.

2.3.1. Positive symptoms

Positive symptoms such as paranoia can result in social withdrawal, which could be confounded with asociality. However, positive symptoms would explain only 12% of the variance in negative symptoms (Blanchard et al., 2020), and in general, those symptoms are recognised as independent phenomena. The associations between positive and negative symptoms are indeed weak (positive correlations under .35), whether the latter are measured with the earlier scales (e.g. Addington & Addington, 1991; Dazzi, Shafer, & Lauriola, 2016; Lançon, Aghababian, Llorca, & Auquier, 1998; Wallwork, Fortgang, Hashimoto, Weinberger, & Dickinson, 2012), or the more recently developed scales (e.g. Blanchard et al., 2017; Kring et al., 2013; Mucci et al., 2019). Furthermore, positive and negative symptoms show distinct neurological underpinnings (Vanes et al., 2019). Finally, a recent meta-analysis looking at genes related to different symptom profiles revealed that there were distinct genes and ontologies for negative and positive symptoms (A. C. Edwards et al., 2016).

2.3.2. Depressive symptoms

Although negative symptoms and depressive symptoms share certain features, such as reduced motivation, reduced activity, and lack of energy, there seems to be only a modest overlap between depressive and negative symptoms (Dazzi et al., 2016; Kirkpatrick et al., 2011; Kring et al., 2013; Krynicki, Upthegrove, Deakin, & Barnes, 2018; Rabany, Weiser, Werbeloff, & Levkovitz, 2011). A recent meta-analysis on the question indicated that there was a small significant association between negative and depressive symptoms (C. J. Edwards, Garety, & Hardy, 2019). More precisely, a non-reciprocal association was observed: those with higher levels of depressive symptoms also showed higher levels of negative symptoms, whereas those with higher levels of negative symptoms presented lower levels of depressive symptoms. Depressive symptoms might in some cases act as drivers for secondary negative symptoms. However, studies that take into account the distinction between primary and secondary negative symptoms consistently report that individuals presenting with primary negative symptoms show low levels of co-occurring depressive symptoms (Kirkpatrick, 2014b).

2.3.3. Deficits in neurocognition and social cognition

Although negative symptoms and neurocognitive deficits appeared to be related (Buchanan et al., 2005), it is today understood that they are separate, with only small if any overlaps between these two symptoms (Capatina & Miclutia, 2018; Foussias et al., 2014). The use of older assessment scales, such as the Positive and Negative Syndrome Scale (PANSS) (Kay, Fiszbein, & Opler, 1987) or the SANS (Andreasen, 1982), which include items closely related to neurocognition (e.g. abstract thinking, stereotyped thinking, attention) might explain the stronger relations observed in earlier studies (Farreny, Usall, Cuevas-Esteban, Ochoa, & Brébion, 2018; P. D. Harvey, Koren, Reichenberg, & Bowie, 2006). Moreover, the potential co-occurrence of negative symptoms and cognitive deficits does not seem to reflect a causal relationship between neurocognitive and negative symptoms (M. D. Bell & Mishara, 2006; P. D. Harvey et al., 2006).

Related to yet separate from neurocognition, social cognition is also considered to be distinctive from negative symptoms (Mancuso, Horan, Kern, & Green, 2011; Sergi et al., 2007). Social cognition incorporates the "mental processes that underlie social interactions, including perceiving, interpreting, and generating responses to the intentions, dispositions, and behaviours of others" (Green et al., 2008). These processes mostly differ from asociality, which refers to the social withdrawal and/or the lack of desire or indifference to have social interactions (Kirkpatrick et al., 2006). Thus, on the one side, social cognition reflects certain abilities (e.g. theory of mind, emotion recognition), on the other side, asociality reflects a motivation issue (Green, 2020). However, some recent research suggests that certain deficits in social cognitive processes would drive asociality (Pelletier-Baldelli & Holt, 2020), but this remains to be properly tested.

2.4.   Categorical and dimensional conceptualisations

The negative symptom construct has been conceptualised either categorically or dimensionally (Foussias et al., 2014; Galderisi, Bucci, et al., 2013). The categorical approach to negative symptoms is represented by the research line that regards the negative syndrome as a distinct category (i.e. deficit syndrome) within schizophrenia (Ahmed, Strauss, Buchanan, Kirkpatrick, & Carpenter, 2015). The dimensional approach views negative symptoms – as well as the deficit syndrome – across a continuum, where individuals differ on the level of severity (Foussias et al., 2014).

Cumulative work has enforced the validity of the categorical approach by identifying and validating subtypes of schizophrenia (deficit syndrome or persistent negative symptoms) that have distinct etiological, neurobiological, course-related and clinical profiles (Ahmed et al., 2018; Blanchard, Horan, & Collins, 2005; Buchanan, 2007; Hovington, Bodnar, Joober, Malla, & Lepage, 2012; G. P. Strauss et al., 2010). Those adhering to the categorical approach argue that it can have the advantage of reducing the heterogeneity observed in schizophrenia and to guide the selection of treatment options, provided that a few different categories show different symptom pathways (Ahmed et al., 2018).

In contrast, there are also evidence in favour of the dimensional approach. First, negative symptoms are continuously distributed from healthy individuals to those with a serious mental illness (Kaiser, Heekeren, & Simon, 2011; J. S. Strauss et al., 1974). Second, negative symptoms are not specific to schizophrenia and represent rather a transdiagnostic phenomenon (e.g. Möller et al., 2002; G. P. Strauss & Cohen, 2017). Recent years seem to have observed a move towards the dimensional approach, with a number of studies looking at various negative symptoms across different diagnostic categories (e.g. Braff, Ryan, Rissling, & Carpenter, 2013; Galderisi, Bucci, et al., 2013; Kirschner et al., 2020; Van Os & Reininghaus, 2016).

The debate about categorical or dimensional approaches has not yet been resolved. The categorical approach has significant limitations given its binary nature: it sets categorical limits between groups of individuals who exhibit similar symptoms, while including in the same category heterogenous groups of individuals (Guessoum, Le Strat, Dubertret, & Mallet, 2020). The dimensional approach, viewing symptoms on a continuum, allows the capture of more information compared to the categorical approach. Furthermore, this dimensional perspective leads to different research approaches: rather than investigating negative symptoms as a distinct category within schizophrenia, those symptoms are studied across disorders (e.g. Guessoum et al., 2020; Hägele et al., 2015; Reininghaus et al., 2016). Likewise, within a dimensional approach, treatment would be developed for the different negative symptoms transdiagnostically. A combination of those two approaches is nonetheless not incompatible, as seen in the study by Ahmed et al. (2015), where the deficit syndrome was validated as a distinct taxon, but where a dimensional approach (i.e. assessing the severity of symptoms on a continuum) allowed the prediction of psychosocial

outcomes, for example, within the deficit syndrome. Both perspectives have their advantages and limitations, and the debate continues today.

2.5. Conclusion regarding the conceptualisation of negative symptoms

The understanding of the complexity and distinctiveness of negative symptoms has greatly evolved in the last decade. First, the current definition of negative symptoms encompasses their heterogeneity with the identification of two over-arching – motivational and expressive – domains, as well as five distinct sub-domains. Moreover, these two dimensions have shown to be associated with different functional course (G. P. Strauss et al., 2013): those with more motivational deficits exhibit worse social functioning. Second, the negative symptomatology has shown to be a distinct domain within the construct of schizophrenia, with little overlaps with positive and depressive symptoms, and neurocognitive impairments. Finally, the study of negative symptoms provides evidence supporting both a categorical approach (i.e. with the identification of different subtypes of schizophrenia) and a dimensional approach (i.e. viewing negative symptoms on a continuum from normal to pathological, and across different diagnoses).

3. Assessment of negative symptoms

3.1. Interview and observation-based scales

Researchers have developed dozens of scales to assess negative symptoms, several of which have been translated and validated in many languages. This section focuses primarily on scales validated in French.

Negative symptom items were first integrated in multidimensional scales to assess mental illness such as in the BPRS (Overall & Gorham, 1962), and of general symptoms of schizophrenia such as in the PANSS (Kay et al., 1987). The SANS (Andreasen, 1982) is a landmark study as it was developed specifically to evaluate negative symptoms. After the development of the SANS, the Schedule for the Deficit Syndrome scale (SDS; Kirkpatrick et al., 1989) was created to diagnose deficit schizophrenia, mainly in the research field.

These first-generation scales have a number of limitations. First, the factor structure of the more general scales is less reliable, in part due to the small number of items. Second, assessments are mostly based on observations or reports from care providers or relatives, rather than the person actually being evaluated. Finally, the inclusion of certain items or subscales is not consistent with the current conceptualisation of negative symptoms; it implies overlap with other constructs (e.g. positive, neurocognitive, disorganised symptoms, or functional outcomes). This point is developed further in the description of these first-generation scales in the next subsections.

New scales were developed after the NIMH-MATRICS negative symptom consensus (Kirkpatrick et al., 2006) to specifically assess negative symptoms across five types of

symptoms. All scales measuring negative symptoms and that are available in French are outlined in Table 1[4]. These scales, as well as a number of scales focusing on amotivation and apathy, are elaborated in the next subsections.

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[4] Items from the abovementioned scales are grouped according to which domain of negative symptom they most closely relate (i.e. according to the item description in the original scales). Items that did not belong to one of the five domains according to the NIMH-MATRICS negative symptom consensus (Kirkpatrick et al., 2006) are italicized. Furthermore, items that were formerly included in negative symptom assessment but that do not belong to one of the five domains appear in the "other items" column.

Table 1

Characteristics of negative symptom assessment scales that have been translated or validated in French.

Scale	Expressive deficits items		Motivational deficits items			Other items	Comments
	Blunted affect	Alogia	Anhedonia	Avolition	Asociality		
BPRS (Overall & Gorham, 1962)	Blunted affect			*Motor retardation*	*Emotional withdrawal (i.e. difficulty in relating to the interviewer)*		No definite negative symptom subscale. The three items represent the ones usually included in a negative factor (Garcia-Portilla et al., 2015).
PANSS (Kay et al., 1987)	Blunted affect N1 (facial expression, communicative gestures) *(Motor retardation – G7)* *(Mannerisms and posturing – G5)*	Lack of spontaneity and flow of conversation N6		(Disturbance in volition – G13)	*Poor rapport N3* *Emotional withdrawal N2* Passive/apathetic social withdrawal N4 *(Active social avoidance G16)*	*Difficulty in abstract thinking N5* *Stereotyped thinking N7*	Most commonly used. Based on performance, observation of behaviours, care workers' or relatives' reports, but not subjective (internal) reports.

Items between brackets represent symptoms from the General (G) subscale of the PANSS, that have showed to load on the negative factor (Emsley et al., 2003; Liemburg et al., 2013).

Italics = symptoms that should not be part of negative symptoms, according to their contemporary definition (Kirkpatrick et al., 2006).

Table 1 *(continued)*

Scale	Expressive deficits items		Motivational deficits items			Other items	Comments
	Blunted affect	Alogia	Anhedonia	Avolition	Asociality		
SANS (Andreasen, 1982)	Unchanging facial expression *Decreased spontaneous movements* [a] Paucity of expressive gestures Poor eye contact Affective non-responsivity Lack of vocal inflections *Inappropriate affect* [b]	Poverty of speech *Poverty of content of speech* [c] *Blocking* *Increased latency of response*	Anhedonia-asociality: Recreational interests and activities Sexual interest and activity	Avolition-apathy: Grooming and hygiene Impersistence at work or school Physical anergia	Anhedonia-asociality: Ability to feel intimacy and closeness Relationships with friends and peers Recreational interests and activities Sexual interest and activity	Attention: *Social Inattentiveness* *Inattentiveness during mental state testing*	Most commonly used scale. Anticipatory anhedonia is not assessed. Includes items that are not considered as part of negative symptoms anymore. Translated (Lecrubier & Boyer, 1987), but not validated in French.

[a] Unspecific to negative symptoms, might be more relevant to depression; [b] Regarded as part of disorganisation; [c] Might be more relevant to formal thought disorder (e.g. derailment, circumstantiality), perseveration or anxiety (Marder & Galderisi, 2017).

Scale	Blunted affect	Alogia	Anhedonia	Avolition	Asociality	Other items	Comments
SDS (Kirkpatrick et al., 1989)	Restricted affect	Poverty of speech	*Diminished emotional range*	Curbing of interests Diminished sense of purpose	Diminished social drive		Mainly used to identify the deficit syndrome. More used in research than in clinical practice. More complex, requires more training.

Italics = symptoms that should not be part of negative symptoms, according to their contemporary definition (Kirkpatrick et al., 2006).

Table 1 *(continued)*

Scale	Expressive deficits items		Motivational deficits items			Other items	Comments
	Blunted affect	Alogia	Anhedonia	Avolition	Asociality		
BNSS (Kirkpatrick et al., 2011)	Facial expression Vocal expression Expressive gestures	Quantity of speech Spontaneous elaboration	Intensity of pleasure during activities Frequency of pleasurable activities Intensity of expected pleasure from future activities	Avolition: Behaviour Avolition: Internal experience	Asociality: Behaviour Asociality: Internal experience	Lack of normal distress	Differentiates behaviours and internal experiences. Evaluates intensity as well the frequency of pleasure. Differentiates between consummatory and anticipatory anhedonia.
CAINS (Kring et al., 2013)	Facial expression Vocal expression prosody Expressive gestures	Quantity of speech	Social Interactions: Pleasure past week Social Interactions: Expected pleasure Vocation Expected Pleasure Recreation Pleasure: Past Week Recreation Expected Pleasure	Vocation Motivation Recreation Motivation	Family: Closeness and Motivation Friendships: Closeness and Motivation		Does not consider separately internal experience and behaviours. Distinguishes anhedonia and motivation between different life domains. Translated in French, currently under validation (Raffard, Macgregor, Attal, Décombe, & Capdevielle, n.d.).

3.1.1.   Multidimensional scales

The BPRS was originally developed to evaluate pharmacologic treatment response on broad symptoms, common to schizophrenia spectrum disorders, as well as other mood or anxiety disorders with psychotic features (Overall & Gorham, 1962). There is no negative symptom subscale *per se* in the BPRS. However, the factorial structure of the BPRS (earlier and more recent versions) shows that a negative factor generally comprises only three items: "blunted affect", "emotional withdrawal", and "motor retardation". "Emotional withdrawal" is described in the BPRS as a deficiency in relating to the interviewer and interview situation, which could be the result of other symptoms such as paranoid ideations or disorganisation (Marder & Galderisi, 2017). "Motor retardation" is defined as the reduction in energy levels, which could be due to catatonia or depression. Furthermore, the BPRS does not assess alogia, anhedonia, avolition, nor asociality. Therefore, the items of the negative symptom factor of the BPRS do not appear to appropriately reflect the current conceptualisation of negative symptoms.

The PANSS was developed to assess positive, negative and general psychopathology (Kay et al., 1987). It is among the best validated and most popular rating instrument for assessing symptoms of schizophrenia (Allen & Becker, 2019; Depp, Loughran, Vahia, & Molinari, 2010). The PANSS evaluates negative symptoms through seven items: "blunted affect" (N1)[5], "emotional withdrawal" (N2), "poor rapport" (N3), "passive/apathetic social withdrawal" (N4), "difficulty in abstraction" (N5), "lack of spontaneity and flow of conversation" (N6), and "stereotyped thinking" (N7). However, different items seem to load on a negative symptom factor than those items originally included in the negative subscale (Lincoln, Dollfus, & Lyne, 2017). For example, in the consensus factorial structure suggested by Wallwork et al. (2012), a negative factor included "blunted affect" (N1), "emotional withdrawal" (N2), "poor rapport" (N3), "passive/apathetic social withdrawal" (N4), "lack of spontaneity and flow of conversation" (N6), "motor retardation" (G7), but not "difficulty in abstraction" (N5), nor "stereotyped thinking" (N7) which are supposed to be part of the negative symptom subscale of the PANSS. Difficulty in abstract thinking is now indeed subsumed in a cognitive factor (e.g. Fong, Ho, Wan, Siu, & Au-Yeung, 2015). Furthermore, the "motor retardation" item is part of the general psychopathology subscale of the PANSS. In the validation study of the French version of the PANSS (Lançon, Reine, Llorca, & Auquier, 1999), "active social avoidance" (G16) was also found to load on the negative symptom factor. However, certain items do not seem to properly reflect negative symptoms. For example, the item "lack of spontaneity and flow of conversation" (N6) encompasses different reasons for the decrease in normal flow of conversation, including apathy/avolition, but also defensiveness, paranoid avoidance, and cognitive impairment (Marder & Galderisi, 2017). Furthermore, different items from the PANSS, such as

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[5] The letter N indicates that the item belongs to the negative subscale of the PANSS, while the letter G indicates that it belongs to the general psychopathology subscale of the PANSS.

"emotional withdrawal" (N2), "poor rapport" (N3), and "passive/apathetic social withdrawal" (N4) are rated based on behavioural observation or on caregivers' and relatives' reports of the person's interest and emotional involvement in everyday life. Yet these items are conceptually defined in terms of internal experience (i.e. interests, empathy, closeness, affect) and should be evaluated through the person's report (Blanchard et al., 2020). Finally, the PANSS does not include items evaluating anhedonia. Although the PANSS is still widely used, especially in the pharmaceutical field, this scale does not appropriately measure negative symptoms as currently conceptualised.

3.1.2. Unidimensional scales focusing on negative symptoms

The SANS was developed to focus specifically on negative symptoms (Andreasen, 1982). It consists of 30 items and includes the five symptom domains which were later recognised in the NIMH-MATRICS negative symptom consensus (Kirkpatrick et al., 2006). However, the five domains of the SANS are organised in different subscales, which are "Affective flattening", "Alogia", "Avolition-apathy", "Anhedonia-asociality", and "Attention". The latter dimension is no longer considered as part of negative symptoms, as inattentiveness relates more to cognitive dysfunctions (Foussias & Remington, 2010). Furthermore, certain items included in the other subscales are no longer considered to properly evaluate negative symptoms. For example, "poverty of content of speech" might indeed result from anxiety, perseveration or formal thought disorder, rather than features of negative symptoms (Marder & Galderisi, 2017). Finally, the SANS does not distinguish between anticipatory and consummatory anhedonia.

The SDS is a more narrowly used instrument, as it was built to categorise individuals with schizophrenia into those with and those without deficit syndrome (Kirkpatrick et al., 1989). Thus, the specificity of the SDS is that it considers the duration of the symptoms, as well as the presence of potential sources of secondary negative symptoms. The SDS includes 6 items: "restricted affect", "poverty of speech", "diminished emotional range", "curbing of interests", "diminished sense of purpose", and "diminished social drive". "Diminished emotional range" is described in the SDS as the intensity and range of the person's subjective emotional experience and incorporates information regarding his or her ability to experience pleasure or dysphoria (Kirkpatrick et al., 1989). However, diminished negative affect does not reflect the current understanding of negative symptoms (Blanchard et al., 2020). Furthermore, there is no appropriate evaluation of anhedonia in the SDS. Overall, this scale shows very good psychometric properties, but is nonetheless limited in its use.

The different scales described above (BPRS, PANSS, SANS, SDS) show certain overlaps, notably alogia, but also considerable differences which reflects a lack of consensus on what constituted negative symptoms (Foussias & Remington, 2010). The conceptualisation of negative symptoms has greatly evolved since the first measurement scales were developed

and these first-generation scales do not reflect appropriately the recent findings regarding negative symptoms, namely regarding the distinction between the expressive and motivational domains. Furthermore, as mentioned in the introduction of this section, an important limitation of these earlier scales is their major reliance on observation (or performance, or caregivers' reports), rather than on an experiential report of the person (i.e. their feelings, subjective reports on their interests and desires). This results in two major problems. First, because only behaviours are rated (e.g. frequency of social contacts, number of activities undertaken), there might be an overlap between social and daily functioning on the one hand, and negative symptoms on the other (Blanchard et al., 2020; Garcia-Portilla et al., 2015; Marder & Galderisi, 2017). Second, certain behaviours might be better explained by features that do not reflect negative symptoms. For example, little social contact might be due to paranoid withdrawal rather than a lack of interest or an altered desire to engage in social relationships. A person might not be engaged in activities due to lack of opportunity (e.g. having limited financial means, living in a poor neighbourhood) rather than due to a lack of interest. The assessment of negative symptoms should thus include the person's internal experience in the assessment (i.e. questioning his or her desire or interest) in order to properly assess negative symptoms (Marder & Galderisi, 2017).

In view of these limitations, new measurements were developed to better reflect the modern understanding of negative symptoms, comprising expressive and motivational deficits and encompassing the person's subjective experience (Kirkpatrick et al., 2006). The Brief Negative Symptom Scale (BNSS; Kirkpatrick et al., 2011) and the Clinical Assessment Interview for Negative Symptoms (CAINS; Forbes et al., 2010; Horan, Kring, Gur, Reise, & Blanchard, 2011; Kring et al., 2013) were developed in this context and represent the second-generation scales for the assessment of negative symptoms.

The BNSS includes 13 items separated into subscales representing the five dimensions of negative symptoms, plus an additional item evaluating lack of normal distress. The anhedonia subscale distinguishes consummatory and anticipatory pleasure, as well as the intensity and frequency of pleasure experienced during activities. Various domains are considered relative to experienced and anticipated pleasure: social life, leisure, education/work, and physical sensations. Both the subscales of asociality and avolition consider separately internal experience (e.g. desire, interest) and actual behaviours (e.g. frequency of contact or activities). The blunted affect subscale includes the evaluation of facial, vocal and gesture expression. Alogia considers both quantity of speech and spontaneous elaboration. The item "lack of normal distress" comes in addition to the items from the motivational and expressive domains. It does not load on the latter two factors, but the item-total score correlation and the Cronbach's alpha suggest that lack of normal distress is part of the general construct of negative symptoms (Ang et al., 2019; G. P. Strauss, Keller, et al., 2012). Furthermore, this item can be useful to capture the reduction in duration and frequency of unpleasant emotions, and therefore identifying primary and enduring negative symptoms (Kirkpatrick, Buchanan, Ross, & Carpenter, 2001; G. P. Strauss & Gold, 2016).

The CAINS first emerged with a beta-version of 23 items (Forbes et al., 2010; Horan et al., 2011) that was then revised and trimmed through a data-driven iterative approach. The final version (Kring et al., 2013) is a 13-item scale that assesses the five consensus domains of negative symptoms and yields to two separate scores, one reflecting motivational deficits ("Motivation and Pleasure") and the other expressive deficits ("Expressivity"). Within the Motivation and Pleasure subscale, different life domains are considered separately: education/vocation, recreation and social. Although the CAINS considers both behaviours and inner experience, the evaluation does not result in separate scores.

In brief, both the BNSS and the CAINS include the five agreed-upon domains of negative symptoms. Moreover, they focus on the internal experience of the individual being interviewed (e.g. assessing interest and desire), going beyond sole behavioural observation by the interviewer and not relying on reports from care providers or relatives. Additionally, the ratings of both scales take into consideration the person's environment and the potential restricted access to activities or to social contacts. Psychometric measures show weak correlations with potential sources of secondary negative symptoms, e.g. depressive or positive symptoms (e.g. G. P. Strauss & Gold, 2016), which guarantees that the ratings reflect negative symptoms and not an overlap with other symptoms. More generally, both scales have excellent psychometric properties, with good internal consistency, convergent validity, discriminant validity, inter-rater agreement and test-retest stability (Blanchard et al., 2017; Kirkpatrick et al., 2011; Kring et al., 2013; Mucci et al., 2019; G. P. Strauss & Gold, 2016; G. P. Strauss, Keller, et al., 2012; Tatsumi, Kirkpatrick, Strauss, & Opler, 2020). In sum, the BNSS and the CAINS represent state of the art approaches to the evaluation of negative symptoms and have both been widely adopted in recent years.

3.1.3. Scales focusing on amotivation/apathy

Several scales focusing on apathy were developed and validated in samples including disorders other than the schizophrenia spectrum. For example, the Apathy Evaluation Scale (AES) was first developed and validated in a sample comprising individuals with neurological disorders (i.e. frontal lobe injury, stroke, Alzheimer's disease) and major depressive disorder (Marin, Biedrzycki, & Firinciogullari, 1991) before it was used in samples of individuals with schizophrenia (e.g. Da Silva et al., 2017; Faerden et al., 2009). The AES is an 18-item scale that evaluates "the diminution in the overt behavioural, cognitive, and emotional concomitants of goal-directed behaviour" (Marin et al., 1991, p. 145). The AES evaluates apathy in the areas of thought content (e.g. "S/he is interested in things"), emotional responsivity (e.g. "S/he approaches life with intensity"), and observable (overt) activity (e.g. "S/he has initiative"). There are three versions of the AES: the clinician-, informant-, and self-rating scales. The AES has been translated but has not been validated in French (Yazbek, Raffard, et al., 2014).

The Lille Apathy Rating Scale (LARS) is validated in French (Sockeel et al., 2006) and in schizophrenia (Yazbek, Norton, et al., 2014). The LARS is a 33-item scale that evaluates the cognitive, emotional and behavioural components of apathy and encompasses nine domains: everyday productivity, interests, taking initiative, novelty seeking, voluntary actions, emotional responses, concern, social life, and self-awareness. The structured interview is conducted either with the patient or an informant (care-giver version; Dujardin, Sockeel, Delliaux, Destée, & Defebvre, 2008). The LARS presents good psychometric properties (Dujardin et al., 2008; Sockeel et al., 2006; Yazbek, Norton, et al., 2014) and offers an in-depth evaluation of apathy.

3.2. Self-rating scales

As is the case for observation and interview-based rating scales, older self-rating scales such as the Subjective Experience of Deficits in Schizophrenia (Liddle & Barnes, 1988) and the Subjective Experience of Negative Symptoms (Selten, Sijben, van den Bosch, Omloo-Visser, & Warmerdam, 1993) do not appropriately reflect the current understanding of negative symptoms. In particular, these scales might not encompass adequately the evaluation of motivational deficits (Lincoln, Dollfus, et al., 2017).

There are two more recent scales that have been developed in light of the contemporary definition of negative symptoms. The Motivation and Pleasure Scale-Self Report (MAP-SR; Llerena et al., 2013) and the Self-evaluation of Negative Symptoms (SNS; Dollfus, Mach, & Morello, 2016). The MAP-SR is based on the CAINS and evaluates the same symptoms encompassed in its motivation and pleasure subscale. This scale has nevertheless not yet been validated in French. The SNS is a self-rating scale validated in French. It comprises 20 items, namely 4 items for each subscale: anhedonia (both consummatory and anticipatory), social withdrawal, diminished emotional range, avolition and alogia. The phrasing of questions is accessible and was inspired by verbatims of individuals with schizophrenia describing their symptoms (e.g. "When I imagine doing one thing or another, I don't feel any particular pleasure in the idea", "I find it difficult to meet the objectives I set myself") (Dollfus et al., 2016, p. 573). The psychometric properties of the validation studies, in particular the high convergence validity between the SNS and observer or interview-based ratings (SANS), suggest that individuals with schizophrenia present the ability to report their own experience accurately (Dollfus et al., 2016; Hervochon et al., 2018).

Finally, there are other self-rating scales focusing on motivation such as the Intrinsic Motivation Inventory for Schizophrenia Research (IMI-SR; Choi, Mogami, & Medalia, 2010) which is inspired by the Self-Determination Theory (Ryan & Deci, 2000). The latter approach posits that behaviours can be driven by intrinsic motivation, extrinsic motivation or amotivation. The IMI-SR focuses on intrinsic motivation and is more often used in the study of motivation for cognitive remediation. This scale comprises subscales of interest

and enjoyment, effort, and competence. The IMI-SR represents a certain move away from the negative symptom scales that focus on *a*motivation. Furthermore, studies that examine its association with those traditional assessments reveal mixed results, and no more than medium correlations (Luther, Firmin, Lysaker, Minor, & Salyers, 2018).

3.3. Laboratory assessment

Laboratory paradigms have been used to assess different negative symptoms separately. For instance, in order to evaluate emotional expression or reaction, some paradigms involve the presentation of stimuli evocative of various emotions in different modes (e.g. visual using images or films; taste using foods; smell using odours) (Kring & Elis, 2013). The evaluation focuses either on observable expressions (e.g. facial or vocal), mapping on expressive deficits, or on internal experience, mapping on hedonic and motivational deficits. The internal experience can be appraised through self-reports of subjective experience, or the measurement of physical responses (e.g. heart rate) or brain activation.

Other paradigms have attempted to assess motivation/avolition via tasks measuring physical or cognitive effort expenditure (e.g. Fervaha, Duncan, et al., 2015; Green & Horan, 2015; G. P. Strauss et al., 2016; Treadway, Buckholtz, Schwartzman, Lambert, & Zald, 2009). For example, the most widely used Effort Expenditure for Rewards Task (EEfRT; Treadway et al., 2009) is a decision-making task that measures the willingness to expend (physical) effort for a given monetary reward. This computerized task requires the individual, for each trial, to decide to exert a more or less effortful task. The "hard-trials" require the individual to make, for example, a high number of keystrokes with the little finger of their non-dominant hand, while the "easy-trials" require fewer keystrokes, with the index finger of the dominant hand. The hard-trials are associated with a higher monetary reward (between \$1.20 and \$4.30), while the easy-trials lead to a chance to win a lower reward (\$1). Furthermore, each trial is associated with a low (12%), medium (50%) or high (88%) probability to actually obtain the reward.

The EEfRT has shown some associations with measures of anhedonia and apathy (Gupta, Holshausen, Gou, & Bowie, 2014), but has generally not consistently mapped onto motivational negative symptoms (Blanchard et al., 2020; Luther, Firmin, et al., 2018). The lack of or weakness of association with traditional negative symptoms scales might be explained by the different timeframe of assessment: laboratory assessments measure in-the-moment processes (i.e. processes in play during the task), while traditional scales evaluating negative symptoms rely on retrospective reports regarding these processes (e.g. questions in interviews regarding interest in activities engaged in during the previous two weeks). Laboratory paradigms present this advantage of measuring real-time experiences and behaviours that relate to negative symptoms, without relying on recall abilities as interviews and self-rating scales do (Blanchard et al., 2020). They are also not limited by possible error in clinical judgment, limited insight from the participant, and social desirability that might

also be encountered in interview-based or self-reported assessments (Gupta et al., 2014). Laboratory paradigms are very interesting for fundamental research that aims, for example, to disentangle the contribution of various neurocognitive (e.g. impaired value representation, deficit in cognitive control) and neuro-affective processes (e.g. reactivity to positive stimuli, pleasure anticipation) in motivation (see Chapter 4 for some findings based on these paradigms). They lack nonetheless ecological validity (Blanchard et al., 2020) and are less suitable for clinical research. Finally, the sensitivity to change of some paradigms, such as the EEfRT has not been tested, which would be essential to consider their use in clinical trials.

3.4.   Ambulatory assessment

Traditional assessment scales that use interviews rely largely on retrospective recall, i.e. autobiographic memory, which can be impaired in individuals with schizophrenia (Berna et al., 2015). These interview-based assessments may therefore be more prone to error. They also take place outside the person's natural environment. Furthermore, those types of assessments only capture a general picture of a phenomenon that might actually fluctuate, depending on the context. Another approach to study negative symptoms without these biases is to use ambulatory assessments, i.e. measurements that take place in the daily life of the individual such as the Experience Sampling Method (ESM) or Ecological Momentary Assessment (EMA) (Myin-Germeys et al., 2009; Shiffman, Stone, & Hufford, 2008) [6]. This type of method involves the repeated measurements of in-the-moment thoughts, emotions, behaviours, physiological states and context (e.g. social contacts, activities) in the individual's natural environment, commonly using electronic (wearable) devices. This approach has been increasingly used in the last two decades, including in samples of individuals with schizophrenia spectrum disorders (Cho et al., 2017; Gard, Sanchez, Cooper, et al., 2014; Myin-Germeys et al., 2018; Oorschot et al., 2013). Moreover, the growth in smartphone use has made the approach very accessible and well accepted (i.e. there is no stigma related to using a smartphone).

Recently, Moran and colleagues have adapted the CAINS motivation and pleasure subscale to an ESM questionnaire (Moran, Culbreth, & Barch, 2017). Participants with schizophrenia received prompts to answer the ESM questionnaire 4 times per day, over 7 days. At each occasion, participants had to indicate their current activity, as well as the activities of the past and following two to three hours. Participants then had to indicate their motivation and pleasure levels for each activity that was reported. Moran and colleagues found a moderate correlation between the ESM questionnaire and the traditional clinician-rated CAINS scores and the MAP-SR (i.e. the self-report version of the motivational dimension of the CAINS). However, this association was moderated by the

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[6] ESM or EMA reflect more or less the same approach. The expression "ESM" is more used in Europe, whereas "EMA" is more common in Northern America.

presence of working memory deficits, indicating the possible impact of memory deficits on the recall of personal experiences that are evaluated in the traditional retrospective scales. Furthermore, the ESM questionnaire on motivational negative symptoms was correlated with the computer-based EEfRT, whereas the CAINS was not. As previously mentioned, the EEfRT measures in-the-moment processes, and might therefore have a similar assessment timeframe than ESM which would explain why their measures are correlated.

Another ambulatory assessment approach involves the objective evaluation of activity levels, through the use of wearable devices such as activity bands or smartwatches (Gupta et al., 2014; Wee et al., 2019). Not only does actigraphy have the benefit of providing an objective evaluation, but it is also non-invasive, accessible and affordable (Gupta et al., 2014). Furthermore, it is a passive assessment in the sense that the person does not have to do anything except wear the band or watch for the measure to be taken, as opposed to ESM questionnaires where the person has to be more active (i.e. reacting to prompts or proactively using the ESM app to report certain events). Recent studies have found that lower levels of motor activity were related to increased negative symptoms (as measured with the PANSS) (Shin et al., 2016; Walther, Ramseyer, Horn, Strik, & Tschacher, 2014) and motivational negative symptoms in particular (as measured with the BNSS) (Kluge et al., 2018). These results indicate that actigraphy could represent an appropriate proxy measure of motivational negative symptoms.

Other innovative approaches have been very recently used to evaluate expressive deficits in daily life (Cohen et al., 2020; Holmlund, Fedechko, Elvevåg, & Cohen, 2020). Cohen and colleagues employed an ambulatory recording method that allowed participants to provide videos of themselves in their natural environment (Cohen et al., 2020). The facial expressions on these videos were analysed by a program that uses predefined algorithms to integrate facial features. The voice recorded was analysed by a computer programme that quantifies different physical properties of speech. The facial and acoustic features were significantly different between participants with schizophrenia and healthy controls. These measurements also showed overall good convergent validity with the different subdomains of the BNSS. Some associations were nevertheless weak or unexpected. For example, increased paused times during the videos were associated with all subdomains of negative symptoms as measured with the BNSS, except for alogia. Such measurements appear to have good potential but are yet to be fully validated.

To date, studies that have used ambulatory assessments to appraise different types of negative symptoms have revealed that the behaviours and emotional experiences related to these symptoms were highly dynamic (Cohen et al., 2020; Moran et al., 2017), in contrast with the findings of interview-based assessment scales which show stability over time (e.g. Kirkpatrick et al., 2011). Thus, ambulatory assessments provide a different "resolution" compared to traditional clinical ratings due to the fact that they focus on a much larger and varied sample of experiences.

3.5.   Conclusion regarding the assessment of negative symptoms

There are various methods to evaluate the different dimensions of negative symptoms. The evaluation of these symptoms has seen important progress regarding the traditional interview-based scales, as well as the advancement of innovative approaches using a range of technologies. The recently developed interview-based assessments (i.e. CAINS, BNSS, MAP-SR, SNS) account for the heterogeneity of negative symptoms and for the subjective experience of the person being evaluated, while former rating scales (BPRS, PANSS, SANS) failed to do so adequately. Computer-based paradigms allow the deepening of our understanding of the processes that underlie negative symptoms, mainly motivational deficits. Their use is however more appropriate for fundamental research than in clinical trials, for which their lack of ecological validity is a limitation. With excellent ecological validity, ambulatory assessments, especially with the use of smartphones and wearable devices, open the possibility to assess negative symptoms, such as motivation, as they unfold in individuals' daily life and natural environment. All approaches have their advantages and drawbacks: an adequate combination of different approaches, depending on the goal of the study, could certainly enhance our understanding of negative symptoms, their underlying processes, and their evolution.

4.   Impact of negative symptoms

4.1.   Prevalence and course across lifespan

In general, more than 50% of individuals with schizophrenia present at least one negative symptom (Bobes, Arango, Garcia-Garcia, & Rejas, 2010; Sicras-Mainar, Maurino, Ruiz-Beato, & Navarro-Artieda, 2014). The prevalence of negative symptoms can however be approached from different perspectives, for example looking across the different stages of the illness (e.g. Sauvé, Brodeur, Shah, & Lepage, 2019). Furthermore, prevalence in longitudinal studies can reveal the course of negative symptoms throughout the different phases of the schizophrenia spectrum disorders. Another approach is to look at prevalence rates of the motivational and expressive dimensions of negative symptoms separately. Finally, prevalence studies can take into account negative symptoms in general, or focus on primary symptoms or the deficit syndrome exclusively (e.g. López-Díaz, Lara, & Lahera, 2018). A recent review (Sauvé et al., 2019) has provided a very comprehensive account of the prevalence of negative symptoms by combining most of these perspectives (all except the longitudinal approach). In that review, negative symptoms were defined in the light of the NIMH-MATRICS negative symptom consensus (Kirkpatrick et al., 2006), while at the same time studies using different measurement scales were included. Furthermore, this review involved studies that implicated mainly individuals with a diagnosis of schizophrenia, but also individuals with other schizophrenia spectrum disorders (e.g. schizoaffective, schizophreniform), for which similar phases have been identified (i.e. prodromal, first episode, multiple episodes of psychosis). The prevalence of negative

symptoms for the different phases of schizophrenia spectrum disorders is reported below, in line with the review by Sauvé et al. (2019). For each phase, the prevalence of the different dimensions of negative symptoms and of persistent or primary negative symptoms is then detailed. Finally, the course of negative symptoms within each phase is described, when longitudinal studies are available.

Already in the prodromal phase, a majority of individuals at clinical high risk of developing psychosis (CHR) present with various negative symptoms (Sauvé et al., 2019). A number of negative symptoms indeed predate the onset of schizophrenia and are often the most described phenomenon prior to the observation of positive symptoms (Foussias et al., 2014; Lyne et al., 2018). Furthermore, around 50% of individuals at CHR present with symptoms of avolition and asociality, whereas alogia and blunted affect are present in around 15% and 20% respectively (Sauvé et al., 2019). Of particular interest, in a longitudinal study, it was observed that motivational negative symptoms were present in around one out of two individuals who transited to a schizophrenia spectrum disorder (Lyne et al., 2014). Moreover, negative symptoms have shown to be a risk factor for transition to psychosis (Fusar-Poli et al., 2020; Valmaggia et al., 2013; T. Zhang et al., 2020), as have certain motivational negative symptoms such as asociality (Fulford, Piskulic, et al., 2018; Healey et al., 2018; Velthorst et al., 2009). Asociality in the prodromal phase might also be a risk factor for recurrent episodic relapse (Sauvé et al., 2019). A recent study also indicated that anhedonia was prominent in the prodromal phase, although prevalence was not reported (Pelizza et al., 2020). Finally, persistent negative symptoms were observed in 6.1% of individuals at CHR (Yung, Nelson, McGorry, Wood, & Lin, 2019).

According to the Sauvé et al. (2019) review, there is a drop in the prevalence of negative symptoms observed in individuals with first-episode of psychosis (FEP): anhedonia is present in around 26%, avolition in 28%, asociality in 34%, alogia in 8% and blunted affect in 9% of FEP individuals. Moreover, the presence of persistent negative symptoms is observed in 7-34% of FEP individuals (Sauvé et al., 2019). In a longitudinal study following two thousand individuals with FEP over two years (Abdin et al., 2017), different trajectories of general negative symptoms (using the PANSS) were observed. A large majority (84%) of the participants showed an early response and stable trajectory, showing low levels of negative symptoms at baseline, improvement at three months, followed by a stabilisation in the remaining months. The other trajectories were observed in individuals with higher negative symptoms, who showed either an early response followed by a relapse trajectory, or a slower response and no response trajectory, or a delayed response trajectory. In another longitudinal study focusing on individuals in early psychosis (average of 1.7 psychotic episodes), different trajectories of negative symptoms (using the PANSS) were found (Stiekema et al., 2018). A majority (around 60%) of individuals presented low and stable motivational and expressive negative symptoms over time (3 and 6-year measurements), while around 25% showed an improvement at 3-year follow-up, followed by a stabilisation at 6-year follow-up. However, around 15% of the participants showed a worsening of their negative symptoms at the 3-year follow-up and a maintenance of that worsened level at the

6-year follow-up. Finally, in a recent 10-year follow-up study focusing on apathy using the AES in a FEP sample (Lyngstad et al., 2020), apathy levels reduced over time. At baseline, high levels of apathy were observed in 60% of the sample. At the 6 and 12-month follow-up assessments, high levels of apathy were present in 50% and 35% of the sample respectively. Apathy then stabilised at the 10-year follow-up. Additionally, Lyngstad and colleagues observed that higher levels of apathy at baseline were associated with higher levels at the 10-year follow-up. Taking the results of these three studies together, it appears that lower baseline negative symptoms evolve in a more positive manner compared with severe baseline negative symptoms, which may stagnate or worsen.

Negative symptoms appear to be more prevalent in individuals who have had multiple episodes of psychosis (MEP) than in individuals with FEP (Sauvé et al., 2019). Anhedonia was present in 57%, avolition in 73%, and asociality in 48% of young individuals with MEP. Alogia had a prevalence of 33% in young individuals with MEP. Blunted affect had a prevalence of 41% in young individuals, but of 23% in older individuals with MP. Regarding the deficit syndrome, its prevalence ranged from 8 to 25% in younger individuals with MEP, and from 37 to 64% in older individuals with MEP. This increased prevalence does not align with the decrease in symptoms over the course of several years observed in the longitudinal studies in samples of FEP mentioned in the previous paragraph. Of course, these results are cross-sectional and cannot be adequately compared to those longitudinal studies. However, given the span of some of the aforementioned longitudinal studies (6 to 10 years), these FEP participants would have probably experienced additional psychotic episodes during the course of the study (i.e. therefore transiting to the MEP status) and one might have expected an increase in negative symptoms. Since the review by Sauvé and colleagues looked at studies between 1989 and 2015, it is possible that the higher prevalence of negative symptoms in individuals with MEP echoes the paucity of adequate treatment for negative symptoms. With more appropriate medical and psychological treatment, it is possible that negative symptoms mostly decrease, as observed in the more recent longitudinal studies described above (Abdin et al., 2017; Lyngstad et al., 2020; Stiekema et al., 2018). The discrepancy in these findings calls for further investigation of the course of negative symptoms.

Looking at the course of negative symptoms is important for at least two reasons. First, it allows predictions to be made about recovery or deterioration in particular samples (e.g. negative symptoms in the prodromal phase, deficit schizophrenia) and thus to target those who need greater care to reduce the impact of negative symptoms, namely on functional outcomes (see 4.2. Quality of life and functional outcomes). Second, investigating the initial onset of negative symptoms and how they develop may help identify the nature of their cause (i.e. genetic, developmental, environmental) which is a question that remains elusive (Lyne et al., 2018). Studies on the prevalence of negative symptoms across the different stages of the illness may indirectly inform on the onset and course of negative symptoms, but they remain cross-sectional observations. On the one hand, according to the review by Sauvé et al. (2019), there is a higher prevalence of negative symptoms in the CHR and in

the chronic stages (multiple episodes of psychosis), compared to FEP, i.e. a drop after the onset of schizophrenia, followed by a deterioration in the later phases of the life course. On the other hand, some longitudinal studies found a general improvement in negative symptoms (e.g. Abdin et al., 2017; Lyngstad et al., 2020; Stiekema et al., 2018).

In a recent systematic review focusing on the course of negative symptoms, large inconsistencies were reported and the need for more longitudinal studies was stressed (Lyne et al., 2018). According to that review, some studies point at a stabilisation over time, others find fluctuations, improvement, or on the contrary, an accruement. It seems that the results vary depending on the length of the study, the instruments used to assess negative symptoms (and their potential to discriminate expressive and motivational symptoms), the samples characteristics (e.g. deficit schizophrenia, FEP), and the presence and nature of treatment (e.g. treatment as usual, drugs, psychosocial intervention). For example, and as one would expect, in a subgroup of individuals with deficit syndrome, negative symptoms appear to persist throughout the course of the illness (Buchanan, 2007). Conversely, in a meta-analysis looking at change over time in various conditions (including drug and non-drug interventions, treatment as usual and placebo), negative symptoms, both motivational and expressive, reduced significantly in almost all samples of individuals with schizophrenia, across all types of intervention (Savill, Banks, Khanom, & Priebe, 2015).

In sum, the prevalence and the course of negative symptoms remains somewhat unclear and has to be thoroughly investigated, as it might evolve over time with the development of new treatments and psychosocial interventions. That said, the results converge to show that negative symptoms, and in particular motivational deficits, are largely present in individuals witch schizophrenia spectrum disorders, even at the prodromal phase before transition to psychosis, and throughout the different later phases. Finally, it should be noted that negative symptoms are not only present in schizophrenia spectrum disorders, but they have been observed among the general population (Werbeloff et al., 2015) and in other disorders such as major depressive, bipolar, post-traumatic stress, and neurological disorders (Foussias et al., 2014; G. P. Strauss & Cohen, 2017). The prevalence of negative symptoms in these disorders varies greatly (between 21 and 89%), but are generally less severe, not as long-lasting and less trait-like compared to schizophrenia (for a review, see Foussias et al., 2014).

4.2. Quality of life and functional outcomes

Quality of life is defined by the World Health Organisation as "an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns" (WHOQOL Group, 1998, p. 551). Quality of life thus reflects a subjective evaluation rooted in the individual's particular social, environmental and cultural context. Quality of life is sometimes referred to as "life satisfaction". It usually encompasses different parts of one's life, including

psychological well-being, physical health, social relationships and environmental domains (e.g. security, financial resources, opportunities). As opposed to subjective quality of life, functional outcomes usually represent an "objective" estimation of real-life functioning and social role fulfilment and are sometimes incidentally referred to as "objective quality of life" (Katsching, 2006; Narvaez, Twamley, McKibbin, Heaton, & Patterson, 2008). Functional outcomes relate to the impact an illness has on daily functioning, and to an individual's recovery (Remington, 2010). They may encompass different areas such as participation in activities of daily living (i.e. autonomy), vocational functioning or social functioning. Indisputably, quality of life and functional outcomes are of great importance from a recovery perspective and in the development of interventions that aim to support individuals to live a more fulfilling and satisfying life.

Both quality of life and daily functioning are affected in schizophrenia. The quality of life of individuals with schizophrenia has been reported to be low (M. S. Ritsner & Gibel, 2007) compared to healthy controls (Dong et al., 2019; Prouteau, Grondin, & Swendsen, 2009), as well as compared to other psychotic disorders (Saarni et al., 2010). Furthermore, individuals with schizophrenia experience poor functional outcomes (Jobe & Harrow, 2005). They face difficulties in daily activities, whether it be regarding independent living (e.g. managing household, paperwork, cooking…), social functioning, leisure, or educational and professional activities (Galderisi et al., 2014; Hunter & Barry, 2012; Larøi & Van der Linden, 2013; Rosenheck et al., 2006; Semkovska, Bédard, Godbout, Limoge, & Stip, 2004; Wiersma et al., 2000). In line with these poor functional outcomes, a recent study using ESM found that, relative to healthy controls, individuals with schizophrenia engaged significantly less in productive activities (vocational, self-care, household chores, leisure), had fewer social interactions, and reported more non-productive activities (e.g. watching TV, resting, hanging out) (Granholm et al., 2019).

Understanding what predicts lower quality of life and deficits in functional outcomes is essential in order to build appropriate therapeutic interventions for individuals with schizophrenia. Few studies have looked at the contributors of quality of life, while a large number of studies have aimed to reveal the best predictors of functional outcomes, as is described below.

As shown in a recent systematic review (Nevarez-Flores et al., 2019), quality of life in individuals with schizophrenia spectrum disorders is best predicted by negative symptoms, along with depression (Alessandrini et al., 2016; Fervaha, Agid, Takeuchi, Foussias, & Remington, 2016; Fitzgerald et al., 2001; Saarni et al., 2010) and poor functional outcomes (Alessandrini et al., 2016; Sicras-Mainar et al., 2014). Within negative symptoms, motivational deficits have shown to best predict quality of life (W. C. Chang, Wong, et al., 2019; Foussias, Mann, Zakzanis, van Reekum, & Remington, 2009; Savill et al., 2016).

Poor functional outcomes have also reliably been associated with negative symptoms. Indeed, a review (Lang, Kösters, Lang, Becker, & Jäger, 2013) preceding the NIMH-MATRICS negative symptom consortium found that negative symptoms (as measured with

the BPRS, PANSS or SANS) predicted poor long-term outcomes. More recent studies using the PANSS have also found an association between negative symptoms and functional outcomes, both on cross-sectional (Hunter & Barry, 2012; Menendez-Miranda et al., 2015) and longitudinal levels (Marchesi et al., 2015). This relationship has been found to be significant even in primary negative symptoms, i.e. when controlling for the impact of sources of secondary negative symptoms (depressive, anxiety, positive and extrapyramidal symptoms) and in anti-psychotic free individuals (Fervaha et al., 2014a). Furthermore, in line with these latter findings, individuals with the deficit syndrome or persistent negative symptoms appear to have poorer functional outcomes compared to individuals with milder or transient negative symptoms (Fenton & McGlashan, 1994; Galderisi, Bucci, et al., 2013; Hovington et al., 2012; Kirkpatrick et al., 2001; Tek, Kirkpatrick, & Buchanan, 2001). This was also the case in CHR (Devoe et al., 2020), which underlines the necessity of addressing severe negative symptoms even before the onset of schizophrenia.

Within the construct of negative symptoms, numerous studies have found an association between motivational deficits and functional outcomes and quality of life, using different measures (BNSS, CAINS, SANS or AES), and both cross-sectionally (Blanchard et al., 2017; Konstantakopoulos et al., 2011; Kring et al., 2013; Mucci et al., 2019; Rocca et al., 2014; G. P. Strauss et al., 2013) and longitudinally (W. C. Chang, Hui, Chan, Lee, & Chen, 2016; Fervaha, Foussias, Agid, & Remington, 2014b; Fulford, Piskulic, et al., 2018; Glenthøj, Kristensen, Wenneberg, Hjorthøj, & Nordentoft, 2020; Savill et al., 2016). For instance, Rocca et al. (2014) found that, compared to positive and depressive symptoms, motivational deficits (as measured with the SANS) were the strongest predictors of quality of life (related to social relationships), of functional outcomes (socially useful activities, personal and social relationships, and self-care) and of single-status (so that higher scores in motivational deficits were associated with a higher probability of being single). In another study, Blanchard et al. (2017) found that motivational deficits (motivation and pleasure subscale of the CAINS) were strongly associated with different areas of daily functioning: socially useful activities, personal and social relationships, self-care and disturbing behaviours. These associations were all stronger for motivational deficits compared to expressive deficits. Finally, in a large multicentre and multinational study evaluating the BNSS (Mucci et al., 2019), the avolition subscale was found to account for most of the explained variance of psychosocial functioning.

These associations between motivational deficits and functional outcomes and quality of life have also been found across the different phases of the schizophrenia disorder, including in individuals at CHR (W. C. Chang et al., 2018; Gerritsen et al., 2020; Glenthøj et al., 2020) and in individuals who experienced their first episode of psychosis (or "early schizophrenia") (Ergül & Üçok, 2015; Evensen et al., 2012; Faerden et al., 2010, 2009; Fervaha et al., 2016, 2018; Fervaha, Foussias, Agid, & Remington, 2013, 2015; Lyngstad et al., 2020, 2018). Of particular interest, a recent study used a network analysis approach to evaluate the whole psychopathology in FEP (W. C. Chang, Wong, et al., 2019). Network

analyses assess the simultaneous interactions between different variables and reveal their mutual interactions. A large array of variables was incorporated in the analyses, including symptoms, premorbid and onset characteristics, cognition, subjective quality-of-life and psychosocial functioning. Chang and colleagues found that motivational deficits had a central function in the whole psychopathology network, being the variable the most connected to other variables in the network, and therefore possibly the most influential. Furthermore, psychosocial functioning was most strongly connected to motivational deficits and only weakly associated with other variables. Subjective quality of life was, however, not directly associated with motivational deficits, but instead with depressive symptoms – which is in line with results from a review of the question in general samples of individuals with schizophrenia (Nevarez-Flores et al., 2019). Finally, in another recent and large study of individuals with MEP (or "chronic schizophrenia") using network analyses, social relationships and work skills (i.e. functional outcomes) were associated with motivational deficits (Galderisi, Rucci, et al., 2018). In sum, these various studies conducted in samples representing different stages of the schizophrenia spectrum disorders consistently find a significant association between motivational deficits and various functional outcomes (i.e. social functioning, work, everyday life), and quality of life to a lesser degree.

The association between negative symptoms and functional outcomes have not only been found in the various stages of schizophrenia, but also in other disorders. As reported in a review by Foussias et al. (2014), studies including individuals with disorders other than schizophrenia found a similar associations between functional outcomes and negative symptoms, and motivational deficits in particular. Herbener and Harrow (2004), for instance, observed associations between negative symptoms and functional outcomes in other psychotic disorders (including bipolar disorders) and major depressive disorders, although those associations were less strong in magnitude. Another study including individuals with major depressive disorders reported that improvement in functioning was predicted by improvement in apathy (Rothschild, Raskin, Wang, Marangell, & Fava, 2014).

Finally, a number of studies have compared the relative contribution of both motivational and neurocognitive deficits in the prediction of functional outcomes. A recent meta-analysis (Najas-Garcia, Gómez-Benito, & Huedo-Medina, 2018) found that both deficits were associated with functional outcomes, but the association with motivational deficits was stronger. Furthermore, several studies have found that motivational deficits appear to mediate the association of both neurocognition and social cognition with functional outcomes (Couture, Granholm, & Fish, 2011; Gard, Fisher, Garrett, Genevsky, & Vinogradov, 2009; Green, Hellemann, Horan, Lee, & Wynn, 2012; Nakagami, Xie, Hoe, & Brekke, 2008). This latter finding suggests that cognitive remediation might not be enough to positively impact daily functioning, but that reducing motivational deficits might be essential in succeeding to do so.

To summarize, functional outcomes and quality of life are both severely affected in schizophrenia. There is a clear implication of motivational negative symptoms in functional outcomes of individuals with schizophrenia disorders, across different stages of the disorders, and in individuals with other disorders. This relationship was observed using various scales, using cross-sectional, longitudinal and network analyses. Furthermore, motivational deficits predict functional outcomes above and beyond the contribution of other factors (e.g. depression, positive symptoms, neurocognitive deficits). Similarly, associations have been found between motivational deficits and quality of life as well, although functioning and depressive symptoms also seem to play an important role in subjective quality of life.

4.3. Health and societal cost

Schizophrenia is associated with various costs, both health and non-health related costs. As reported in a recent systematic literature review, strong associations have been found between negative symptoms and overall health care costs (Germain et al., 2019). Regarding mental health care, negative symptoms have been found to be associated with worse clinical outcomes, i.e. with a higher probability of hospital admission, a longer duration of hospital stays, and a higher probability of readmission following discharge (Patel et al., 2015). Regarding physical health, the health status of individuals with schizophrenia is generally poor, with high rates of obesity and medical comorbidities which also impact daily functioning (P. D. Harvey & Strassnig, 2012). Moreover, negative symptoms do not need to be severe nor numerous to be associated with poor health. Indeed, one study (Sicras-Mainar et al., 2014) in a large sample of individuals with schizophrenia found that the presence of at least one negative symptom was associated with an increased risk of presenting different health conditions: arterial hypertension, diabetes, dyslipidaemia (i.e. abnormal levels of lipids in the blood), obesity, and bronchial asthma. As a consequence, the presence of negative symptoms was also related to an increase in healthcare costs: individuals with schizophrenia and negative symptoms used healthcare resources (mostly primary care) more than individuals who did not present negative symptoms. Finally, regarding non-health related costs, schizophrenia is considered as the eighth cause of handicap in individuals between 15 and 44 years of age (Charrier, Chevreul, & Durand-Zaleski, 2013). The functional disability associated with the negative symptoms of schizophrenia, which often leads to unemployment, is responsible for important societal costs, largely above the sole costs for the treatment of the psychotic symptoms (P. D. Harvey & Strassnig, 2012). Targeting negative symptoms to address those important health and societal costs are therefore essential.

4.4.   Conclusion regarding the impact of negative symptoms

Negative symptoms, and more particularly the motivational dimension of those symptoms, are prevalent in varying degree across the course of schizophrenia spectrum disorders, as well as in other disorders, albeit to a lesser degree. These symptoms have consistently been found to be important predictors of functional outcomes and quality of life, regardless of the measurement scale used, and in both cross-sectional and longitudinal studies. This association between motivational deficits and functional outcomes and quality of life has been found in various types of samples, including individuals in the prodromal phase of schizophrenia, in early and chronic schizophrenia, as well as in individuals with other disorders (e.g. bipolar and major depressive disorders). Finally, negative symptoms are associated with increased societal costs, due to their impact on health, clinical and functional outcomes.

5.   General conclusion

Despite their clear presence in the first descriptions of schizophrenia spectrum disorders, negative symptoms have been in the shadow of other symptoms, such as hallucinations and paranoia, for most of the last century. In recent decades however, negative symptoms have regained the interest of the scientific community. As a result, their conceptualisation has improved greatly, with an increased recognition of the heterogeneity as well as the uniqueness of negative symptoms. This improved conceptualisation has driven the development of more appropriate measurements that account for the heterogeneity of negative symptoms and that encompass the person's subjective experience. Furthermore, innovative measurements, such as laboratory and ambulatory assessments, have emerged and have already demonstrated their ability to capture underlying processes of negative symptoms, as well as their fluctuation in the course of daily life. A plethora of studies have confirmed how negative symptoms, and motivational deficits in particular, were highly prevalent even in the prodromal phase of schizophrenia, and also highly predictive of quality of life as well as of functional, health and clinical outcomes. In view of the prevalence and the debilitating nature of motivational negative symptoms, it is essential to understand their underlying processes in order to develop treatment and interventions that target these specific processes. Detangling how these complex symptoms work, how underlying and associated processes are related and contribute to the development and maintenance of these symptoms has been central in the research field over the last decade. In the next chapter, several models aiming to better understand (motivational) negative symptoms are presented.

CHAPTER 2
Models of negative symptoms

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There are two main approaches that have looked into why negative symptoms develop. The first perspective was driven by the cognitivist Aaron T. Beck and his colleagues Neil A. Rector, Neal Stolar and Paul Grant (see 1. The cognitive perspective). Their cognitive model of the development of negative symptoms mainly considers that negative symptoms stem from distorted beliefs and biased expectations. The second approach is mainly driven by the psychologists Ann M. Kring and Deanna M. Barch, who take a neuro-affective perspective on the development of motivational deficits (see 2. The neuro-affective perspective). Their model of motivation looks at the course of the experience of pleasure and how affected hedonic and neurocognitive abilities impact motivation and goal-directed behaviours.

1. The cognitive perspective

1.1. Cognitive model of negative symptoms

In the 1980s, Beck (1983) suggested that a wide range of mental disorders aside from depression and including schizophrenia could be affected by the presence of dysfunctional attitudes which interfere with a healthy adjustment to various life situations. Later on, and in line with the diathesis-stress model[7] (Zubin & Spring, 1977), Rector described how the negative symptoms of schizophrenia could result from complex interactions between stress caused by adverse life events and predispositional vulnerabilities (e.g. genetic factors,

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[7] The diathesis-stress model (also known as the stress-vulnerability model, paradigm or theory), posits that mental health or physical disorders result from the interaction between predispositions (i.e. individual vulnerabilities or "diathesis") and environmental stressors (e.g. psychological or social factors), which will precipitate or facilitate the development of the disorders (Zubin & Spring, 1977).

obstetric complications resulting in abnormal neurodevelopment) (Rector, 2004). More precisely, structural abnormalities of the brain and aberrant connectivity between certain brain regions (i.e. vulnerabilities) would lead to weakened integrative functioning, limited processing resources and neurocognitive impairments in individuals with schizophrenia. Such limitations would make them more prone to experience stressful life events such as academic failure which would then facilitate negative symptoms such as withdrawal (Rector, Beck, & Stolar, 2005). Additionally, certain dysfunctional attitudes are believed to be part of predispositional personality traits, present prior to the onset of schizophrenia (A. T. Beck & Rector, 2005). From that perspective, negative symptoms would represent an exacerbation of these traits: as critical cognitions about the self, the others, the world or the future exacerbate, negative symptoms worsen on a continuum from mild to more severe, and from transient to enduring (Rector et al., 2005).

Different domains of negative symptoms could be facilitated and maintained by the presence of certain dysfunctional beliefs, expectancies and appraisals (see Figure 2.1.) (A. T. Beck & Rector, 2005; Rector et al., 2005). These dysfunctional cognitions concern different areas: pleasure, social relationships, performance and goal attainment, and available resources.
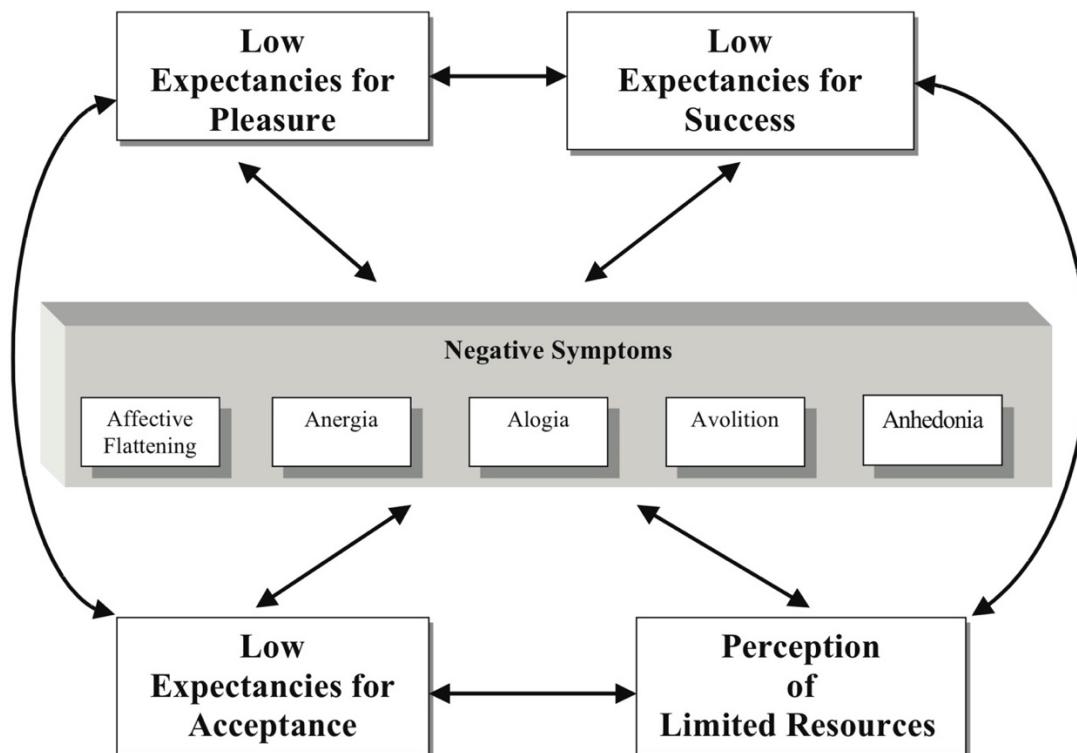
Figure 2.1. Cognitive expectancies in the production of negative symptoms (Rector et al., 2005)[8].

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[8] Reproduced with permission from "The Negative Symptoms of Schizophrenia: A Cognitive Perspective," by N. A. Rector, A. T. Beck, and N. Stolar, 2005. *The Canadian Journal of Psychiatry*, *50*(5), p. 254. Copyright 2015 by SAGE.

Low expectancies for pleasure refer to the low level of anticipated enjoyment regarding activities that individuals with schizophrenia would actually derive pleasure from if engaged in these activities (Rector et al., 2005). In parallel, there also seems to be a higher expectation for displeasure (i.e. negative emotions) in individuals with schizophrenia. Regarding social relationships, certain individuals with schizophrenia tend either to devaluate the importance of (close) social contacts, or perceive them as threatening (related to positive symptoms) (Rector et al., 2005). For example, individuals presenting with paranoia might end up avoiding social contact in order to reduce the stress induced by positive symptoms. Furthermore, they might have low expectancies for acceptance (e.g. thinking that they will be rejected) which will further induce social withdrawal. In the area of performance and goal-attainment, defeatist performance beliefs represent thoughts that are critical regarding one's ability to successfully perform certain tasks (Grant & Beck, 2009). They include the perception of one's performance as being substandard, which can affect self-image and feed into avoidance and disengagement (Rector et al., 2005). Low expectancies of success (i.e. beliefs of a low probability of attaining future goals or of being successful) and a reappraisal of achievements as inferior or worthless also contribute to increased passivity. Finally, perception of limited resources reflects, in part, objective cognitive impairments. Individuals with schizophrenia and negative symptoms might nevertheless underestimate their available resources, which would also result in lower engagement in effortful activities. On top of actual limited resources, individuals with schizophrenia with negative symptoms might also overestimate the cost related to the effort needed to achieve certain goals.

In Rector and colleagues' (2005) perspective, negative symptoms have different roles that will result in their maintenance. First, negative symptoms have a protective role. The general withdrawal characteristic of these symptoms would serve as a protective reaction against anticipated negative evaluations and expected failure (Rector, 2004). Alogia, diminished expressiveness, diminished drive, and general apathy would result from an attempt to protect self-esteem. Withdrawal could also protect against the putative threat of overwhelming positive symptoms, such as hallucinations. Positive symptoms have indeed shown to be the source of secondary negative symptoms (Ventura et al., 2004). However, it appears that the *beliefs* the person holds regarding the hallucinations are more predictive of consequential withdrawal, than the occurrence of positive symptoms themselves (A. T. Beck & Rector, 2005). Second, Beck and Rector (2005) suggest that the emotional, behavioural and social disengagement might also be a manner to spare (perceived) limited resources. Continuous withdrawal and avoidance might in turn further contribute to not only the anticipation of failure and low perceived self-efficacy, but also to the progressive hopelessness and actual deconditioning (i.e. resources become indeed more limited).

1.2. Cognitive model of development and maintenance of negative symptoms

Inspired by Rector, Beck and Stolar's cognitive approach of negative symptoms (A. T. Beck & Rector, 2005; A. T. Beck, Rector, Stolar, & Grant, 2009; Rector et al., 2005), Velligan

and colleagues (2014) proposed a model that clearly describes how negative symptoms initially develop and how they are maintained, via a particular reinforcing loop (see Figure 2.2.).
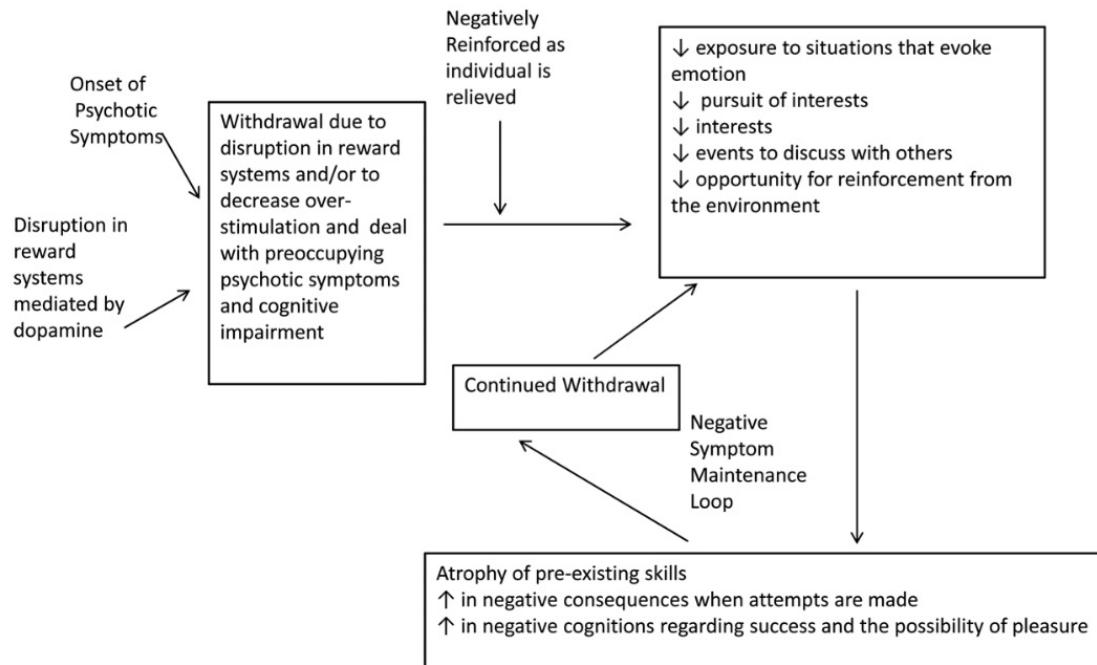
Figure 2.2. The negative symptom maintenance loop (Velligan et al., 2014)[9].

Velligan and colleagues (2014) focused particularly on the maintenance loop that stems from the original development of negative symptoms. In their model, general behavioural, emotional and social withdrawal (i.e. negative symptoms) lead to a reduced exposure to social relationships, to activities and to an environment that have become overwhelming. This has the benefit of reducing the distress that is experienced, and the general withdrawal is thus reinforced. This is likely to result in decreased exposure to a variety of circumstances that evoke emotions (including also positive, rewarding and reinforcing situations), in diminished pursuit of interests and later impoverishment of these interests, and consequently, in diminished events and topics to discuss with others. Moreover, a progressive impoverishment of (vocational or social) skills occurs, which will limit job and relationship opportunities and further support the perception of limited resources. Withdrawal is thus maintained as a protective mechanism. Finally, this general reduction in reinforcing positive experiences is likely to impact daily functioning and quality of life.

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[9] Reproduced with permission from "Integrated psychosocial treatment for negative symptoms,", by D. Velligan, N. Maples, D. L. Roberts, and E. M. Medellin, 2014. *American Journal of Psychiatric Rehabilitation*, *17*(1), p. 5. Copyright 2014 Taylor and Francis Group.

In line with the cognitive perspective, Velligan and colleagues (2014) suggest that dysfunctional attitudes contribute to the maintenance of negative symptoms, by further reducing the general engagement in (social) activities. Moreover, they propose that certain negative beliefs may stem from the stigma particularly associated with schizophrenia, or from the early and cumulative experience of failures in various situations. Indeed, given that a first episode of psychosis generally appears in young age (before adulthood), skills necessary for a functional and flourishing life may not have been attained, were soon lost as a result of disengagement, or were originally impaired as a result of neurocognitive deficits. Failure is thus more probable. Furthermore, the authors consider difficulties in anticipating future enjoyment as another factor for reduced engagement in activities, as individuals would not see the effort to engage as worthwhile. Finally, the reduced engagement in activities, leading to an impoverishment of skills, may also result in more failures when attempts are made. This would in turn reinforce negative beliefs regarding personal resources and mastery, beliefs that will lead to even more withdrawal, and thus closing the negative symptom maintenance loop.

1.3. Validation of the cognitive perspective on negative symptoms

The cognitive approach of negative symptoms has found empirical support in numerous studies that have looked at various dysfunctional attitudes such as negative beliefs about the self, defeatist performance beliefs, low expectancies of success, asocial beliefs, and low expectancies for future pleasure. Most of the studies have examined the relationship between negative symptoms and one of those dysfunctional beliefs, using separate scales (see 1.3.1. Beliefs about the self: self-esteem and self-efficacy to 1.3.4. Beliefs about future pleasure). Before turning to a review of the evidence found for each domain of dysfunctional attitudes, it is worth presenting findings from a recently developed scale that integrated different dysfunctional beliefs.

The Demotivating Beliefs Inventory (DBI) (Pillny, Krkovic, & Lincoln, 2018) was developed in light of the cognitive model of negative symptoms and selected items from various scales: the Rosenberg Self-Esteem Scale (Rosenberg, 1965), the Dysfunctional Attitude Scale (DAS; Weissman & Beck, 1978), the Asocial Beliefs Subscale (ABS; Grant & Beck, 2010), the Social Self-Efficacy subscale of the Self-Efficacy Scale (Sherer et al., 1982), and the Temporal Experience of Pleasure Scale (TEPS; Gard, Gard, Kring, & John, 2006). The final version of the DBI consists of 41-items that evaluate three constructs, according to factorial analyses: self-defeating beliefs (e.g. "If I do not do as well as other people, it means I am an inferior human being", "I certainly feel useless at times"), social indifference beliefs (e.g. "Making new friends isn't worth the energy it takes", "I cannot trust other people because they might be cruel to me"), and pleasure expectancies (e.g. "I look forward to a lot of things in my life", "I get so excited the night before a major holiday I can hardly sleep"). The validation study of the DBI showed that all three factors were moderately associated with motivational deficits – using the Motivation and Pleasure Scale-

Self Report (MAP-SR) – in patients with schizophrenia (Pillny et al., 2018), even when controlling for the impact of depression (Pillny, Schlier, & Lincoln, 2020). These results are probably a good and simple summary of the results presented below.

1.3.1.   Beliefs about the self: self-esteem and self-efficacy

Various studies have investigated the links between self-esteem or self-efficacy and negative symptoms. In a study examining self-esteem in individuals with schizophrenia (Barrowclough et al., 2003), positive self-evaluation was found to be related with fewer negative symptoms, while negative self-evaluation was not correlated with negative symptoms (PANSS). In another study using a longitudinal design, change in both positive and negative beliefs about the self were associated with change in negative symptoms (PANSS) in a sample of individuals with first-episode psychosis (Palmier-Claus, Dunn, Drake, & Lewis, 2011). Another study in a sample of individuals at clinical

 of developing psychosis revealed that lower levels of self-esteem were associated with higher negative symptoms (Benavides, Brucato, & Kimhy, 2018).

Similar research has also established that self-efficacy is associated with general negative symptoms (Pratt, Mueser, Smith, & Lu, 2005; Vaskinn, Ventura, Andreassen, Melle, & Sundet, 2015), or motivational deficits (W. C. Chang et al., 2017; Ventura et al., 2015). The Self-Efficacy Theory (Bandura, 1997) posits that beliefs of success or efficacy, regardless of actual skills and capabilities, are necessary for a person to be motivated to initiate activities and to face challenges. Correspondingly, (motivational) negative symptoms have shown to mediate the relationship between self-efficacy and functional outcomes in individuals with schizophrenia. Self-efficacy has also shown to moderate the relationship between functional capacity (i.e. the capacity to perform various functional behaviours) and real-world functioning, so that functional capacity was related to real-world functioning only when self-efficacy was high (Cardenas et al., 2013). These results suggest that such beliefs about self-efficacy may explain why some individuals with schizophrenia are able to function well but do not translate their capabilities into real-world functioning. Moreover, it implies that improving functional capacity (e.g. with skill-training) might not be sufficient to improve functional outcomes if beliefs about the self are dysfunctional.

1.3.2.   Defeatist performance beliefs and low expectancies of success

Various studies have looked at dysfunctional attitudes regarding performance and success, through cross-sectional, longitudinal and interventional designs, in various samples and using different measurements. On this latter point, the many studies that have examined defeatist performance beliefs have used the DAS (Weissman & Beck, 1978). The DAS is a 40-item self-rating scale that produces a total score representing cognitive distortions in seven value systems: approval, love, achievement, perfectionism, entitlement, omnipotence

and autonomy. A 15-item subscale was later subtracted from the DAS to represent defeatist performance beliefs (Grant & Beck, 2009). This subscale evaluates the endorsement of overgeneralized and defeatist attitudes regarding one's capability to perform goal-directed tasks (e.g. "If you cannot do something well, there is little point in doing it at all", "People probably think less of me if I make mistakes and fail")[10]. A few studies have also used the Success And Resource Appraisals Questionnaire (SARA-Q) (Couture, Grant, Beck, & Morrison, 2007). The SARA-Q is a 25-item self-report measure that evaluates negative expectancies for success and perception of limited cognitive resources (e.g. "I can't think as well as other people", "If I try to be more active, it will probably turn out badly", "I'm not very good at following through what I set out to achieve").

First, in respect of defeatist performance beliefs, Rector (2004) showed that defeatist performance beliefs were specifically associated with negative symptoms (as measured with the PANSS). He suggested that individuals who interpret, for example, their need for help or their performance in a critical way, considering that they do not meet their own or others' (unrealistic) expectations, are less prone to engage (e.g. in a performance-based activity) and more disposed to renounce. Later on, a meta-analysis (Campellone, Sanchez, & Kring, 2016) that included ten cross-sectional studies, reported a significant small association ($r =$ .24) between defeatist performance beliefs and negative symptoms (using mostly the SANS, but also the CAINS, the BNSS, and the BPRS), as well as between defeatist performance beliefs and functional outcomes ($r = -.27$). Moreover, although depression has shown to be related to defeatist performance beliefs, two studies included in the meta-analysis indicated that the relationship between defeatist performance beliefs and negative symptoms remained significant after controlling for depression (A. T. Beck, Grant, Huh, Perivoliotis, & Chang, 2013; Couture, Blanchard, & Bennett, 2011). Of interest, Beck et al. (2013) showed that individuals with deficit schizophrenia, i.e. who present persistent and primary negative symptoms, endorsed defeatist beliefs to a greater extent compared to non-deficit participants. However, we found mixed results in a sample of individuals with persistent negative symptoms (Thonon, Li, & Velligan, 2017). These participants only slightly endorsed defeatist performance beliefs. Furthermore, there was only a small correlation at trend level between defeatist performance beliefs and the motivation factor of the BNSS ($r = .25, p = .08$), but not with the CAINS nor with the Negative Symptom Assessment (NSA; Axelrod et al., 1993).

Some studies have looked at the interactions between defeatists beliefs and other variables. For instance, path-analyses in a recent study revealed a pathway that linked neurocognition and functional outcomes (i.e. social life, self-care, vocational and leisure activities) through functional skills, defeatist performance beliefs and motivation (Thomas, Luther, Zullo,

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[10] There are two versions of the subscale evaluating defeatist performance beliefs. One version is based on the original validation study (Weissman & Beck, 1978), while the other one was derived from the factorial analysis of a later validation study (Cane, Olinger, Gotlib, & Kuiper, 1986). Both versions contain 15 items, of which 12 are the same. The two versions are thus highly similar.

Beck, & Grant, 2017). Finally, in a recent study using an effort-expenditure paradigm (Reddy et al., 2018), defeatist performance beliefs were found to moderate the relationship between motivational negative symptoms (CAINS) and the willingness to exert higher levels of effort on the cognitive task (in order to obtain higher rewards): individuals with schizophrenia and high motivational deficits were less willing to exert increased levels of effort, but only in the presence of high levels of defeatist performance beliefs.

Support for the cognitive model of negative symptoms has also come from clinical trials investigating the effect of cognitive behavioural therapy. For instance, a combination of cognitive behavioural therapy and social skills training (CBSST), which focused, in part, on dysfunctional thoughts, appeared to have a greater benefit relative to a control condition, especially for participants with more severe defeatist attitudes (Granholm, Holden, Link, McQuaid, & Jeste, 2013). In this study, a reduction in severity of defeatist performance beliefs was linked to better functioning 9 months after the end of treatment, but only in the group receiving CBSST. In a later study (Granholm, Holden, Link, & McQuaid, 2014), CBSST lead to significantly higher improvement namely on motivational deficits and defeatist performance beliefs relative to a control intervention (i.e. active goal-focused supportive contact). However, it was not clear if the change in functioning and motivational deficits resulted from an improvement in dysfunctional attitudes and self-efficacy, or from behavioural activation related to the trained skills. In secondary analyses, Granholm, Holden, & Worley (2018) used multilevel mediation analyses that indicated that defeatist attitudes mediated the effect of the treatment group on experiential negative symptoms and functional outcomes. Conversely, Pillny and Lincoln (2016) did not find similar results when evaluating the effects of a CBT intervention – targeting namely defeatist beliefs – on functional outcomes and motivational deficits (using the BNSS). On a cross-sectional level, they found that the link between defeatist performance beliefs and functioning was fully mediated by motivational deficits. However, while they observed that the reduction in motivational deficits predicted improvement in social functioning after 6 months of psychosocial intervention, change in defeatist performance beliefs was not found to be associated with improvement in the motivational factor, nor with social functioning. Few studies have looked at the mechanisms of change and therefore future studies should continue to investigate the role of cognitive therapy in improving dysfunctional beliefs and impacting motivation and functional outcomes.

Other studies have investigated defeatist attitudes in samples of individuals with schizotypy or individuals at clinical high risk for psychosis (CHR). Higher levels of defeatist performance beliefs were observed both in individuals with schizotypy (Luther et al., 2016) and in individuals at CHR (Perivoliotis, Morrison, Grant, French, & Beck, 2009). These results support the idea that dysfunctional beliefs may appear before the onset of schizophrenia and thus may represent a predispositional trait (A. T. Beck & Rector, 2005).

Second, related to – but somewhat distinct from – defeatist performance beliefs, low expectancies for success have also been shown to be related with negative symptoms (Cox,

Jolley, & Johns, 2016; Huddy, Drake, & Wykes, 2016). For example, Huddy et al. (2016) found that individuals with schizophrenia had lower performance expectancies compared to healthy controls. These reduced lower performance expectancies were correlated with more severe general negative symptoms (PANSS) and social functioning (i.e. social withdrawal). They also suggested that the lack of experience on various daily-life situations might be related with those expectancies, which is in support of the maintenance loop of the cognitive model (Rector et al., 2005; Velligan et al., 2014): the less experience, the lower expectancies of success, and the lower these expectancies are, the lower the probability to engage in future experiences will be.

In line with these findings, one longitudinal study found that individuals with schizophrenia who exhibited low expectancies for success did not see their negative symptoms reduce at a follow-up of 18 months, whereas those with moderate to high expectancies for success at baseline experienced a reduction in negative symptoms (Luther et al., 2015). In another study (Couture, Blanchard, et al., 2011) that looked at negative expectancies of success as well as at defeatist performance beliefs, the correlation with motivational deficits was stronger with the former than with the latter. Furthermore, the association between defeatist performance beliefs and motivational negative symptoms was no longer significant after controlling for negative expectancies of success. This suggests intricate relationships between different types of dysfunctional beliefs (e.g. overgeneralisation beliefs about performance *vs.* beliefs about one's personal competence and resources). More studies looking at the relationships between different types of dysfunctional attitudes are necessary in order to better understand how they may impact negative symptoms.

1.3.3. Asocial beliefs

Beliefs regarding social interactions (e.g. social interest) have generally been investigated using the ABS, which Grant and Beck (2010) derived from the Revised Social Anhedonia Scale[11] (Eckblad, Chapman, Chapman, & Mishlove, 1982). The ABS contains 15 items that evaluate the preference for involvement with others (e.g. "I prefer hobbies and leisure activities that do not involve other people", "Making new friends isn't worth the energy it takes").

Asocial beliefs have been found to be related to negative symptoms and (social) functioning. For instance, individuals with deficit schizophrenia endorsed asocial beliefs more than individuals with less severe negative symptoms (A. T. Beck et al., 2013). Furthermore, Grant and Beck (2010) found that asocial beliefs correlated with social functioning (i.e. social withdrawal, interpersonal communication, prosocial behaviour) and

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[11] As Grant and Beck (2010) indicated "the Social Anhedonia Scale may be mislabelled since the items in general reflect negative social attitudes and behaviours rather than anhedonia. As such, a subset of its items represents beliefs and preferences germane to social isolation" (p. 66).

negative symptoms (as measured with the SANS, excluding the attention subscale) in individuals with schizophrenia. Furthermore, they reported that asocial beliefs strongly predicted social functioning one year later, whereas social functioning at baseline did not significantly predict asocial beliefs one year later, suggesting that asocial beliefs play a causal role in the development of deficits in social functioning. In another longitudinal study, a pathway linked asocial beliefs to functional outcomes, through motivation[12] (Thomas et al., 2017). Finally, another recent study (Le, Holden, Link, & Granholm, 2018) also showed that asocial beliefs moderated the relationship between neurocognitive impairments (i.e. deficit in social cognition) and social competence, such that the neurocognitive impairments were less likely to impact social competence in individuals with schizophrenia who exhibited greater interest in socialising. This suggests that this greater interest in social relationships would lead to increased engagement in social interactions, which would then result in more opportunities to practice social skills and therefore higher levels of competence, despite the presence of impairments in social cognition.

1.3.4.   Beliefs about future pleasure

Evidence supporting the influence of anticipatory beliefs regarding pleasure are more difficult to identify. Indeed, there is a large body of literature regarding anticipatory anhedonia, but there has sometimes been a confusion between *anticipatory pleasure* (i.e. the experience of pleasure in anticipation of a future event) and *pleasure anticipation* (i.e. the belief that pleasure will be experienced during a future event, the prediction or expectation of pleasure) (Barsics, Van der Linden, & D'Argembeau, 2016; Baumgartner, Pieters, & Bagozzi, 2008; Berridge, 2004; Hallford & Sharma, 2019). Some studies have used the TEPS (Gard et al., 2006) to examine beliefs about future pleasure. The anticipatory pleasure subscale of the TEPS (e.g. "I look forward to a lot of things in my life") has shown to be correlated with motivational negative symptoms in individuals with schizophrenia (Chan, Wang, et al., 2010; Da Silva et al., 2017; Gard et al., 2007). Yet the anticipatory pleasure subscale of the TEPS does not measure beliefs about expectancies or the prediction of potential future pleasure, but rather measures the disposition to experience anticipatory pleasure. By contrast, the Savoring Beliefs Inventory (SBI; Bryant, 2003) evaluates attitudes towards savouring present, past or future positive experience (e.g. "I don't like to look forward too much"), but there appears to be only one study (Cassar, Applegate, & Bentall, 2013) that has examined these attitudes in relation with negative symptoms, and that found

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[12] In this study, note that motivation was measured with the Penn Motivation Inventory (Luther, McCole, Bertolami, Beck, & Grant, n.d.), which includes two subscales: self-directed (i.e. self-initiation and maintenance of task-related behaviours) and other-directed motivation (i.e. perception of the need of others to engage in task-related behaviours).

that anhedonia[13] was significantly predicted by the propensity of and attitudes towards savouring (SBI). Thus, to date, there is only little evidence that has exhibited a relationship between beliefs or expectancies of future pleasure and negative symptoms in individuals with schizophrenia. More studies are required to investigate the interactions between the two components of pleasure anticipation (anticipatory pleasure and expectancies of pleasure) and their relation with negative symptoms.

1.4. Conclusion about the cognitive model of negative symptoms

The cognitive perspective offers an explanation for the development and maintenance of negative symptoms, though with an increased focus on motivational deficits. In the cognitivist view, dysfunctional attitudes already represent predispositional traits in individuals who eventually develop schizophrenia (Rector et al., 2005). At the same time, dysfunctional attitudes contribute to the apparition and exacerbation of negative symptoms: dysfunctional attitudes about performance and success and a low sense of self-efficacy aggravate the disengagement from goal-directed behaviours (i.e. avolition), such as leisure, educational or vocational activities; low expectancies about acceptance and social disinterest worsen social withdrawal; and low expectancies of pleasure may contribute to anhedonia. Thus, it appears that negative symptoms are maintained through the influence of dysfunctional beliefs and expectancies (Velligan et al., 2014).

Studies evaluating different dysfunctional attitudes in relation to negative symptoms and/or functional outcomes have quite consistently found a relationship between the two, although the relationship appears to be small to moderate in magnitude (Campellone et al., 2016). Longitudinal studies have also suggested a causal relationship with, for example, dysfunctional beliefs preceding social withdrawal (e.g. Grant & Beck, 2010). Furthermore, certain interventional studies have found that the reduction of dysfunctional beliefs was responsible for the improvement in motivational deficits and functional outcomes (Granholm et al., 2018). These results corroborate the cognitive model that views dysfunctional attitudes as important contributors to the development and persistence of negative symptoms. Thus, reducing the various dysfunctional attitudes that individuals with schizophrenia experience may influence their motivation and their engagement in overall goal-directed behaviours (e.g. effortful behaviours, social relationships, pleasant activities).

2. The neuro-affective perspective

The last decade has seen the emergence of new theoretical frameworks that account for the motivational negative symptoms observed in schizophrenia. These theoretical frameworks

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[13] Anhedonia was measured with the Introvertive Anhedonia Scale, from the Oxford-Liverpool Inventory of Feelings and Experiences (Mason, Claridge, & Jackson, 1995). The Introvertive Anhedonia Scale measures the lack of enjoyment from social activity and physical intimacy.

have developed based on evidence from affective and cognitive neuroscience (Barch & Dowd, 2010; Gold, Waltz, Prentice, Morris, & Heerey, 2008; Kring & Barch, 2014; Kring & Elis, 2013). Authors have essentially examined the hedonic and neurocognitive aspects of impaired approach motivation and impaired goal-directed behaviours. The models described below progressively integrate more and more complexity based on the available evidence at the time of their development.

2.1.   Deficits in the representation of the reward value

Gold and colleagues (2008) compiled the findings of numerous studies to provide an understanding of how the reward system in individuals with schizophrenia is affected and how this translates to deficits in motivation. The reception of a reward is ordinarily associated with a hedonic response, and abnormality in the reward system is therefore intuitively considered to be related to anhedonia and motivational deficits more generally.

First, motivational deficits could be explained by a lack of sensitivity to rewards or pleasant stimuli, i.e. anhedonia. There were large inconsistencies between studies regarding hedonic experience in individuals with schizophrenia, reporting either significant anhedonia or a normal hedonic experience, relative to healthy controls. Interview-based measurement and self-reports using questionnaires such as the Chapman Physical and Social Anhedonia scales[14] (Chapman, Chapman, & Raulin, 1976) have revealed the presence of significant levels of anhedonia in individuals with schizophrenia (e.g. Burbridge & Barch, 2007). On the contrary, studies using laboratory paradigms where participants have to rate their experience of positive emotions when presented with evocative stimuli (e.g. images) consistently show a high degree of similarity between individuals with schizophrenia and healthy controls (e.g. Horan, Green, Kring, & Nuechterlein, 2006). Gold et al. (2008) suggested that this apparent contradiction could be explained by differences in methodologies: laboratory paradigms present emotionally evocative stimuli, while questionnaires (e.g. rating statement such as "Beautiful scenery has been a great delight to me") require that the person "invoke an internal representation of the experience in question and make a judgment about the affective value of that internally generated and maintained representation" (p. 837). Thus, Gold and colleagues hypothesized that individuals with schizophrenia might have difficulties generating and evaluating hedonic representations.

Gold and colleagues (2008) tested this hypothesis with a laboratory paradigm in which various stimuli (neutral, positive, negative) were presented under two conditions. One condition (evoked condition) required the participants to indicate (by making speeded

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[14] These scales assess self-reported deficit in the ability to experience positive emotions from typically pleasurable physical stimuli (e.g. food, settings, and sex) and nonphysical social stimuli (e.g. talking, spending time with others).

button-pressing) that they wished to increase the viewing of the presented stimulus. The other condition (representational condition) required participants to indicate if they wished to view that stimulus again later, but by making speeded button-pressing 3 seconds *after* the stimulus had been gone. Thus, in this latter condition only, the decision implied to mentally represent the stimulus. The authors reported three important findings. First, regardless of the condition, individuals with schizophrenia showed less difference in their responses as a function of the valence of the stimuli (i.e. they reacted more similarly across the neutral, positive, and negative stimuli) compared to healthy controls. Second, compared to healthy controls, individuals with schizophrenia showed less correspondence between how they had rated (or valued) the different stimuli and their desire to view them for longer periods of time or more often (i.e. their rates of speeded button-pressing). This lower degree of correspondence was associated with deficient working memory functioning. Finally, the difference in degree of correspondence between the groups was augmented in the representational condition, i.e. the condition in which they had to invoke internal representations, instead of reacting to presented stimuli. Taken together, these findings suggest that, even if individuals with schizophrenia have a similar response to stimuli and even if they value those stimuli the same way as healthy controls do, this valuation does not fully guide motivated behaviours (e.g. seeking to be more exposed to pleasant stimuli).

Building on those findings, Heerey, Robinson, McMahon, and Gold (2007) compared the performance of individuals with schizophrenia with healthy controls on a delay-discounting task. The task consisted of asking participants to choose between rewards that were immediate but smaller, or rewards that were delayed but larger. Results showed that participants with schizophrenia discounted the value of delayed rewards more steeply compared to healthy controls, i.e. they chose immediate rewards more often. Steeper discounting of future reward's value was also associated with impaired working and episodic memory, indicating again that aspects of affective processing and decision-making may be related to cognitive functioning. The authors suggested that working memory may be implied in the integration of multiple elements (i.e. different values and delays) and may be implied in the use of the motivational salience of a reward, and that difficulties in this integration might impair decision-making capacities and the selection of reward-directed behaviours.

To test this hypothesis, Heerey, Bell-Warren, and Gold (2008) used an elaborate probabilistic decision-making paradigm in which participants had to choose to play with one of two gambles that differed in the reward's magnitude, in the probability of winning, in the loss's magnitude and in the probability of losing. Plus, for half of the trials, the probability of winning/losing the second gamble was uncertain. Thus, in this paradigm, there were multiple components that were required to be integrated in order to make optimal choices. Findings showed that, first, participants with schizophrenia made less optimal choices given the expected value of each gamble (i.e. the probability of winning multiplied by the value of the win, minus the probability of losing multiplied by the value of the loss). Second, whereas participants with schizophrenia valued potential rewards

similarly to controls, they appeared to have difficulties using the information about reward's value in their decision, and they seemed to underestimate the losses. Finally, and confirming their hypothesis, less optimal choices in participants with schizophrenia were associated with impaired working memory.

Relatedly, reward learning[15] could also be expected to contribute to motivational deficits in schizophrenia (Gold et al., 2008). Indeed, the engagement in rewarding behaviours supposes that a certain behaviour or cue will lead to the rewarding outcome. Reinforcement learning operates on two timescales: rapid learning and gradual learning. Rapid learning, on the one hand, is needed to adequately face novel situations or changing outcomes. It has been mostly investigated with probabilistic *reversal* learning paradigms[16], which implies that responses have to be readjusted when the contingency suddenly reverses (i.e. previously rewarded stimuli or responses are then punished). Individuals with schizophrenia were shown to be less able to reverse previously learned associations, indicating a severe impairment in rapid learning (Waltz & Gold, 2007). This impairment might be caused by a difficulty in using negative feedback in order to change their previously rewarded response (Prentice, Gold, & Buchanan, 2008). Gradual learning, on the other hand, involves a longer accumulation of reinforcement contingencies to facilitate decision-making. This learning system is often evaluated via probabilistic learning tasks. In such tasks, stimulus-response pairings are learned by using the feedback (i.e. correct *vs.* incorrect) following each response (e.g. left or right button-pressing). Individuals with schizophrenia show close to intact gradual learning of more advantageous choices of stimuli or behaviours (Morris, Heerey, Gold, & Holroyd, 2008). They take, nonetheless, longer to learn the contingency, compared to healthy controls. Furthermore, they may be more impaired on reward-driven learning than punishment-driven learning, such that they learn from negative feedback, but show reduced learning from positive reinforcements (Waltz, Frank, Robinson, & Gold, 2007). In other words, they are able to learn what *not to do* in order to avoid undesired outcomes (punishments), but have difficulties learning what *to do* in order to obtain rewarding outcomes. This is exactly the pattern that is expected to be observed in individuals with impaired approach motivation, under real-world conditions. It should be noted that these deficits have been shown to be correlated with negative symptoms, but not with measures of cognitive skills, indicating that these deficits do not reflect an impairment in general neurocognitive abilities (G. P. Strauss, Frank, et al., 2011; Waltz et al., 2007).

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[15] Reinforcement or reward learning refers to how individuals create associations between, on the one hand, cues or stimuli (e.g. shapes, colours in laboratory paradigms), or behaviours (e.g. button pressing) that are originally neutral and, on the other hand, rewarding outcomes or punishments.

[16] The Wisconsin Card Sorting Test (WCST; Milner, 1963), for example, requires the participants to classify cards according to different criteria (i.e. colour, shape, number) that are unknown to them. The only feedback participants receive is whether the classification is correct or not. The classification criteria change every ten cards and thus requires that the participant adapt to that change.

In sum, Gold and colleagues (2008) investigated the subjective response to reward, the impact of rewards on decision-making, and the role of rewards on guiding learning. First, they suggested that individuals with schizophrenia present normal responses to positive emotions when presented to stimuli that evoke positive emotions. Second, they demonstrated that, despite intact in-the-moment pleasure experience, there is an incongruence between their subjective valuation of stimuli and their decision-making, so that they do not necessarily select the actions that will lead to the rewards that they value. Third, they found that the decision-making of individuals with schizophrenia may be affected by the impaired representation of the value of different choices and response options. Fourth, they report that individuals with schizophrenia are impaired on rapid learning paradigms, based on trial-to-trial feedback, but not on progressive learning paradigms. Additionally, they might be more able to learn from punishment than from rewards. Reinforcement learning should facilitate adaptive behaviours in real-life, and impairments in those learning systems might compromise adaptive behaviours, even in the presence of intact hedonic experience. Finally, Gold and colleagues' findings, taken together, suggest abnormal functioning of the orbital and dorsal prefrontal structures of the brain, which are determinant in the ability to represent the value of outcomes and action plans, as well as in the updating of these representations (Gold et al., 2008). According to the authors, difficulties in generating, accessing, and maintaining mental representations of affective value (e.g. rewards) might be key in the impaired motivation observed in individuals with schizophrenia.

2.2. Reward to outcome translation

Barch and Dowd (2010) reviewed findings regarding reward processing impairments, combining observations from brain imaging studies and behavioural performance in various laboratory paradigms. The model they proposed extended the findings of Gold and colleagues (2008) and was also inspired by the work of Wallis regarding deficits in decision-making (Wallis, 2007). Barch and Dowd's model includes four main components which are believed to be mediated by distinct neural mechanisms, and that reflect the translation of hedonic or reward information into action plans and goal-directed behaviours (see Figure 2.3.).
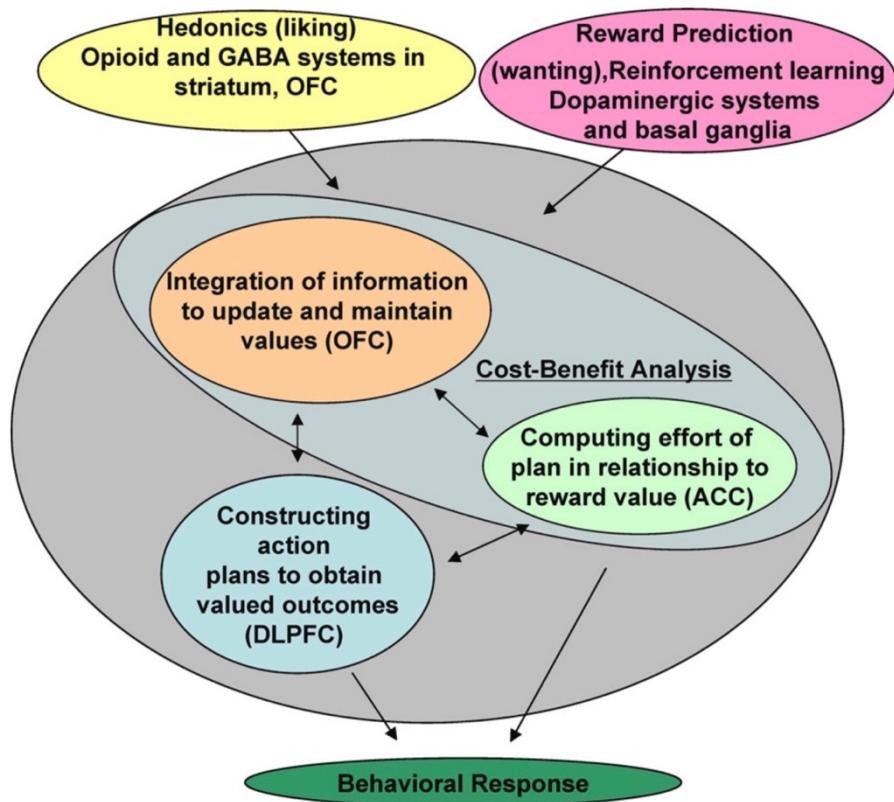
Figure 2.3. Rewards to outcome translation (Barch & Dowd, 2010)[17].

The first component of the model refers to the ability to feel pleasure or pleasant emotions when presented with stimuli or events that are supposed to be pleasurable: hedonics or "liking" which is thought to be mediated by the activation of the opioid and gamma amino butyric acidergic (GABA) systems in the striatum and their projections to the orbital frontal cortex (OFC) (Barch & Dowd, 2010, p. 920). As previously reviewed by Gold and colleagues (2008), there is evidence that hedonic abilities are relatively preserved in individuals with schizophrenia, i.e. they respond to presented pleasant stimuli in the same way as healthy controls, based on their self-reports of emotions. Barch and Dowd (2010) underline, nonetheless, some findings that revealed reduced striatal response in individuals with schizophrenia. They suggest that the magnitude of this response and the "liking" abilities might vary as a function of the severity of negative symptoms, and anhedonia in particular. This first component will feed a later process which is the cost-benefit analysis.

The second component refers to reward prediction or "wanting". This mechanism is believed to be mediated by the dopamine system in the midbrain, namely, in the striatum and the basal ganglia. The study of reward prediction was based on research that used reinforcement learning paradigms, as described above (see 2.1. Deficits in the

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representation of the reward value). Barch and Dowd (2010) suggested that there might be a reduction in the anticipatory activation of the striatum in individuals with schizophrenia, which would reflect impaired reward prediction. Again, the magnitude of the reduction may be related to the severity of motivational negative symptoms.

The third component implies a cost-benefit evaluation. The cost reflects the effort required to obtain a certain reward, whereas the benefit represents the value of the reward. Effort computation had not been appropriately evaluated in schizophrenia at the time when Barch and Dowd (2010) proposed their model. Basic research on effort computation found an association with the dorsal anterior cingulate cortex (ACC) (Salamone, Correa, Farrar, & Mingote, 2007). Barch and Dowd reviewed some evidence for ACC dysfunctions in schizophrenia, which suggested possible impairments on that level of the cost-benefit evaluation. As for value computation, Gold and colleagues (2008) established that individuals with schizophrenia presented deficits in value representation. Furthermore, this cost-benefit implies the integration of information coming from various sources. The OFC is implied in the maintenance and update of the value, as well as in the integration of the different rewarding features of a stimulus (e.g. a glass of juice) with the internal state of one's organism (e.g. being thirsty). Thus, the OFC supports a sort of "working memory for value", and there is extensive evidence for OFC dysfunctions in schizophrenia and good indications of an association of these dysfunctions with negative symptoms (Barch & Dowd, 2010).

The fourth and last component represents goal-directed planning. Barch and Dowd (2010) refer to a large body of research establishing the implication of the dorsolateral prefrontal cortex (DLPFC) in the cognitive dysfunctions observed in individuals with schizophrenia, namely, regarding impaired cognitive control, such as goal maintenance and planning. They suggest that the altered functioning of the DLPFC could be implicated in a deficit in translating internal representations of reward into goal representations, goal planning, and goal-directed behaviours.

In sum, Barch and Dowd (2010) have proposed a model that hypothesises the role of distinct dysfunctional neural mechanisms in the impaired translation of reward information into goal-directed actions. They suggested that dysfunctions in the striatal regions may be responsible for reward prediction ("wanting") deficits in individuals with schizophrenia and their difficulties in using value information regarding anticipated rewards to guide motivated behaviours. They also suggested that these difficulties may stem from impairments in cost-benefit estimations, although findings were less clear at that time. Furthermore, Barch and Dowd highlighted the evidence showing that action planning was impaired in schizophrenia and that this might stem from deficiencies in the maintenance of goal representations. The authors provided a clearer understanding of the underlying neural mechanisms of reward processing deficits in individuals with schizophrenia, while at the same time underlining areas to be further examined to better understand their impaired approach motivation.

2.3.   Time course of emotion

Kring and Elis (2013) have provided a comprehensive review regarding emotion deficits in individuals with schizophrenia and in relation with negative symptoms. Both motivational and expressive negative symptoms involve deficits in emotional processes. Motivational deficits involve impairments in internal experience, whereas expressive deficits involve impairments in the outward expression of emotions. These deficits may interfere with the functional role of emotions, that is, help prepare the individual to react to challenges or various events in the environment. Thus, for example, individuals with schizophrenia may be less inclined to recognize problems, may be less motivated to seek or maintain social relationships, or less able to take optimal decisions. Drawing upon their own work and upon the review of extensive translational research[18], Kring and Elis established that individuals with schizophrenia are impaired in the perception (Chan, Li, Cheung, & Gong, 2010) and expression (Kring & Moran, 2008) of emotions, but that they appear to have intact emotional experience (Cohen, Minor, & Najolia, 2010; Kring & Moran, 2008). The latter appeared contradictory with research findings indicating high prevalence rates of anhedonia in individuals with schizophrenia.

In order to make sense of these apparently contradictory results, Kring and Caponigro (2010) investigated the temporal course of emotion and argued that a distinction should be made between in-the-moment, consummatory pleasure, and anticipatory pleasure. Individuals with schizophrenia are able to derive pleasure when they are presented with pleasant stimuli, but they report and exhibit difficulties in anticipating (i.e. predicting) that future stimuli or events will be pleasurable, as well as difficulties in feeling pleasure in anticipation. These impaired anticipatory hedonic capacities would explain why they do not seek to engage in behaviours that would lead to those pleasurable outcomes (Gard et al., 2007). These affective capacities actually require a number of neurocognitive processes, such as episodic memory (drawing on past experiences to anticipate similar future experiences), maintenance of an emotional state, and imagination (Kring & Elis, 2013). Thus, in Kring and Elis's view, emotional and neurocognitive functions are highly interrelated and are supported by overlapping brain regions (e.g. striatum, amygdala, ACC, DLPFC).

Kring and Caponigro (2010) presented a model of the temporal experience of pleasure (see Figure 2.4.). This model includes various hedonic processes, namely, anticipatory, consummatory and remembered pleasure. A pleasant experience may start from anticipatory pleasure (including both hedonic experience and prediction), which will activate a state of motivation to engage in goal-directed behaviour in order to obtain the

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[18] Translational research represents work spanning different types of disciplines and research (e.g. clinical, neuroimaging, basic) within a particular theme or field, aiming to translate this work's findings into the enhancement of interventions and general best practices in the health care delivery system (Rubio et al., 2011).

anticipated pleasure. While reaching the goal in question, pleasure is experienced (i.e. consummatory pleasure). The experience is maintained and can be remembered, so that it can be reactivated when anticipating a similar situation again.
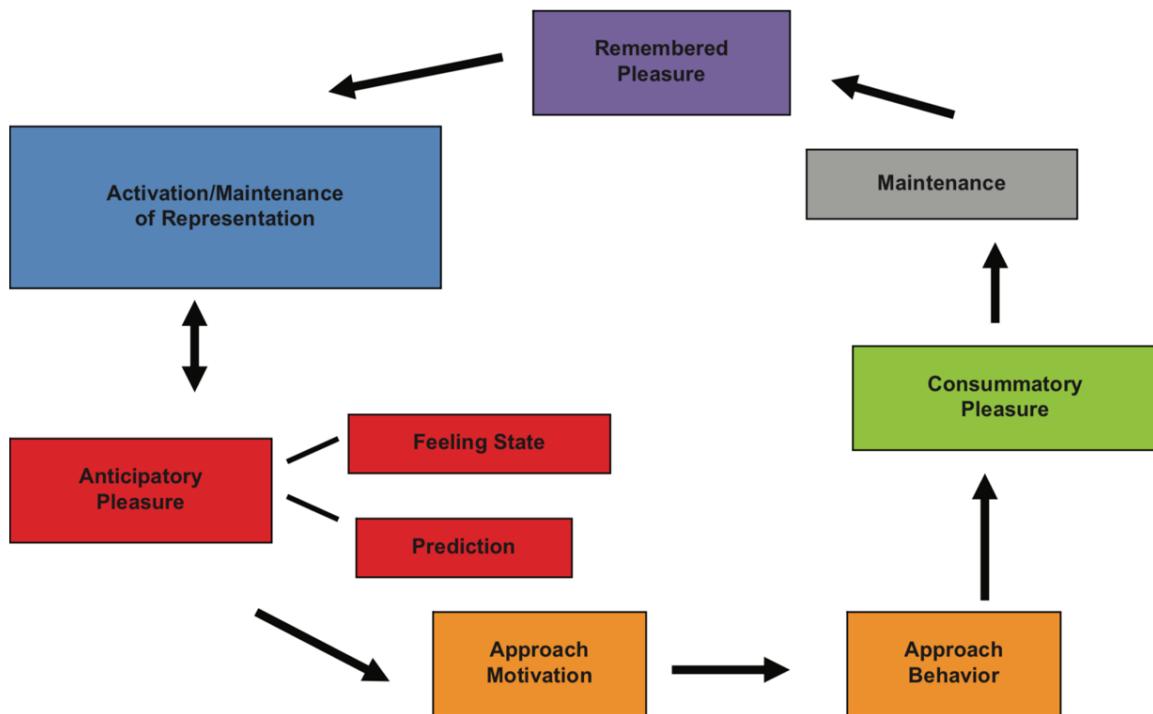
Figure 2.4. The temporal experience of emotion (Kring & Caponigro, 2010)[19].

This model is based on cumulative work from cognitive neuroscience in animals as well as in humans (Kring & Caponigro, 2010; Kring & Elis, 2013). Regarding consummatory pleasure, although research has shown intact experience of consummatory pleasure in individuals with schizophrenia, studies using brain imaging with a high temporal resolution have shown that the emotional response is not maintained for a very long time in individuals with schizophrenia, suggesting deficient cognitive control (Gard et al., 2011; Horan, Wynn, Kring, Simons, & Green, 2010; Ursu et al., 2011). These deficits in maintaining and savouring emotional experiences may disrupt the construction of memories. Also, abilities to anticipate future events and experiences might rely on the ability to remember the past, i.e. on those latter memories (Schacter, Addis, & Buckner, 2007). Deficiency can thus occur at different stages in the course of pleasure experience, and hinder approach motivation.

In sum, the model presented by Kring and colleagues (Kring & Caponigro, 2010; Kring & Elis, 2013) manages to reconcile the apparently contradictory results from former studies

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[19] Reproduced with permission from "Emotion in Schizophrenia: Where Feeling Meets Thinking", by A. Kring and J. Caponigro, 2010. *Current Directions in Psychological Science, 19*(4), p. 257. Copyright 2010 Sage Publications Inc. Journals.

regarding emotional deficits in schizophrenia. Furthermore, the temporal course of emotion and the identification of where deficits appear, provides a coherent explanation as to why individuals with schizophrenia do not seek ("wanting") pleasurable stimulations, while they do experience these stimulations as pleasant ("liking") – albeit only for a short while, as they present deficits in cognitive control needed for the maintenance, remembrance and anticipation of pleasure.

2.4.   Integrative neuro-affective model

This last model represents a comprehensive integration of the theoretical frameworks proposed by Gold, Barch, Kring and their colleagues (Barch & Dowd, 2010; Gold et al., 2008; Kring & Caponigro, 2010; Kring & Elis, 2013). Kring and Barch (2014) adopted a translational approach, basing their hypotheses regarding the emotional and motivational underpinnings of negative symptoms on the findings from affective science and cognitive neuroscience. Their model (see Figure 2.5.) takes into account, on the one hand, the deficits in reward learning and impairments in reward representation in particular (Gold et al., 2008) and, on the other hand, the temporal course of emotional experience (Elis, Caponigro, & Kring, 2013; Kring & Elis, 2013), while at the same time integrating the behavioural manifestations of motivational deficit with their neural underpinnings (Barch & Dowd, 2010).
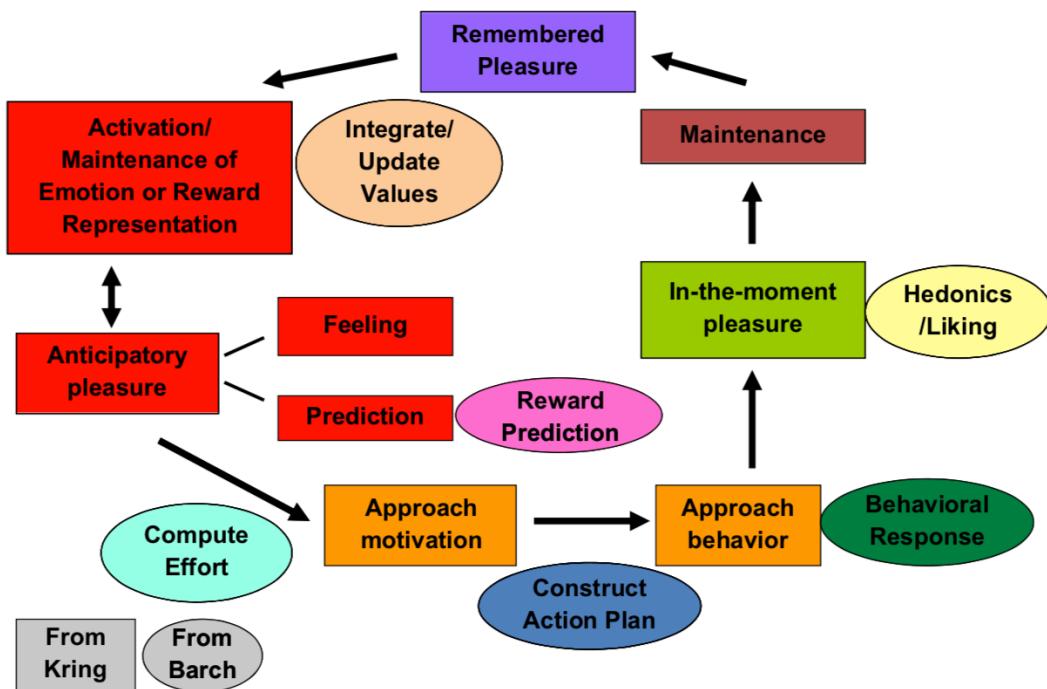
Figure 2.5. Integrative neuro-affective model (Kring & Barch, 2014)[20].

As described before, this model assumes that in-the-moment, consummatory pleasure is intact, but that deficits emerge in anticipatory pleasure, both on the level of the prediction that future outcomes will be pleasurable, and on the affective level, i.e. the experience of pleasure in anticipation of these outcomes. Furthermore, motivation to engage or not in goal- or reward-directed behaviours will be influenced, not only by the value of the predicted outcome (i.e. value computation), but also by the estimated effort necessary to reach that outcome (i.e. effort computation). Value computation involves the combination of the affective information from pleasure anticipation with other information such as the delay before the outcome can be reached, the value of other possible outcomes, and the changing contingencies (e.g. a certain behaviour no longer leads to rewarding outcomes). This kind of "working memory for value" that involves the ability to integrate, maintain and update information coming from different sources, has consistently shown to be impaired in individuals with schizophrenia. Effort computation had already been presumed to play a role in motivation and goal-directed behaviours (Barch & Dowd, 2010; Gold et al., 2008), but it had only been examined through animal studies. At the time when Kring and Barch (2014) proposed their model, two studies (Barch, Treadway, Schoen, & Dowd, 2014; Gold et al., 2013) using laboratory paradigms of effort-based decision-making showed that individuals with schizophrenia were less willing than healthy controls to exert higher effort to obtain higher rewards, even when the probability to obtain that reward was certain. Furthermore, this pattern was associated with worse functional outcomes in individuals with schizophrenia.

If the decision has been taken to engage in the behaviour that will probably lead to the reward, an action plan is constructed and actions are taken to obtain the reward. However, the impairments in the DLPFC may hinder the translation of the cost-value estimation into goal representations, and the lack of maintenance of those representations in individuals with schizophrenia affect the implementation of goal-directed behaviours. If the action plan is implemented and in-the-moment enjoyment occurs when the reward is obtained, the impaired maintenance of such experience will hinder the construction of memories, and therefore hinder the possibility of these memories to guide future behaviours in the pursuit of rewarding goals.

The deficits in the various steps of this model may interact, such that deficits in anticipation and maintenance of emotional experience hinder the valuation and prediction of the reward, thus skewing the cost-value computation towards less willingness to expend efforts. The ensemble of impairments observed at the different steps of the model of Kring and Barch (2014) may prevent the optimal modulation of behaviours to obtain rewarding outcomes and thus would explain the impaired functional outcomes that are observed in individuals with schizophrenia.

2.5.   Conclusions about the neuro-affective perspective on motivational deficits

The different frameworks and models described above provide a complex neuro-affective perspective on the motivational deficits of schizophrenia. Gold and colleagues (2008) highlighted the importance of impaired value representation in decision-making and reinforcement learning. They provided evidence that individuals with schizophrenia have deficits in generating, accessing and maintaining representations of the goal's value. Barch and Dowd (2010) articulated these latter findings with other research in a model comprising four components: "liking", reward prediction (including reinforcement learning), cost-benefit analysis, and goal planning. The model reflects the translation of reward representation to goal-directed behaviours. The different components' neural underpinnings – including the striatum and prefrontal cortex – reveal the interactions of both neurocognitive and affective mechanisms. As for Kring and Elis (2013), they placed emotional deficits on a timeline, revealing deficits in anticipatory pleasure (feeling pleasure in anticipation), pleasure anticipation (prediction), maintenance of emotional experience and remembrance of emotional experience. Finally, Kring and Barch (2014) associated their findings with additional evidence from translational research, basic research regarding emotions and cognitive neuroscience. Their neuro-affective model considers both the different components from reward representation to goal-planning and goal-directed behaviours, as well as the temporal course of emotion. In brief, individuals with schizophrenia are able to feel pleasure in the moment, but they have difficulties maintaining that feeling (i.e. savouring), which will make the construction of memories difficult. And since anticipating the future relies on past experiences, the original lack of maintenance of experience might have deleterious effects on the whole course of motivation. Furthermore, individuals with schizophrenia have difficulties in feeling pleasure in anticipation of future events and in predicting that these events will be pleasurable. These difficulties will affect goal (or reward) representation, and consequently will affect reward-learning. Furthermore, individuals with schizophrenia present deficits in the integration of information from different sources, such as the value of a reward, the probability to reach it, the delay before obtaining it, and the effort required. These impaired integration skills are probably due to working memory deficits. These impairments will impact decision-making, leading to an unwillingness to exert higher efforts in some cases. The lack of maintenance of the affective value of a reward may also affect the maintenance of motivation through the implementation of goal-directed actions. Furthermore, if the emotional experience during a pleasant event is not maintained, memories cannot be constructed properly and can therefore not guide future reward-driven behaviours. The amotivation loop is thus closed.

3. Conclusion about the different perspectives regarding motivational negative symptoms

The two cognitive and the neuro-affective frameworks presented in this chapter allow a better understanding of the development and/or maintenance of motivational negative

symptoms. The cognitive perspective on negative symptoms hypothesizes that dysfunctional attitudes, such as defeatist performance beliefs, low expectancies for success, acceptance and pleasure, impede motivation to engage in potentially pleasurable activities, social interactions and goal-directed behaviours in general. An extensive literature provides evidence in support of this cognitive approach. Concerning the neuro-affective perspective, a plethora of studies in affective and cognitive neuroscience have established the importance of interactions between emotional processes (e.g. experiencing pleasure, savouring, feeling pleasure in anticipation) and neurocognitive skills (e.g. cognitive control, working memory, planning) in the course of motivation and goal-directed behaviours.

Surprisingly, these two approaches have remained quite separate, almost hermetic to one another, although it is interesting to speculate as to possible associations. First, the low expectancies of pleasure could of course be related to anhedonia. To date, this association in schizophrenia is not clear. Low expectancies regarding pleasure could be secondary to less frequent pleasant experiences or to a difficulty in anticipatory pleasure. In the latter situation, if a person does not *feel* much pleasure in anticipation of a future event, it might make them *believe* that they will not experience much pleasure during that future event. Conversely, predicting an experience of low pleasure might also naturally impact anticipatory pleasure. This being said, there is enough evidence to propose that both anticipatory pleasure and pleasure anticipation (i.e. prediction) are affected in individuals with schizophrenia, and that both might be impacted by a lack of experience of pleasant events and/or dysfunctional attitudes.

Second, self-efficacy, defeatist performance beliefs, expectancies for success and perceived resources could all affect the cost-benefit analysis described in the neuro-affective approach. Low self-efficacy, high levels of defeatist performance beliefs, low expectancies for success and the perception of lack of resources could all skew the cost-benefit analysis in favour of a higher estimated effort. And if one believes they do not have the necessary cognitive or physical resources and are not capable of successfully achieving a certain effortful task, it is very likely that the person will not engage in that task, will drop out, or will resign themselves to performing at a lower level. Such associations have actually been observed, as described in the next paragraph.

Third, other types of dysfunctional attitudes could impede the in-the-moment enjoyment of pleasurable experiences. For instance, if one's attention is not focused on the current supposedly positive experience, but on their thoughts (e.g. ruminating) or on anxious or defeatist projections into the future, the pleasant experience may not be fully enjoyed, and therefore may not be maintained, nor properly remembered. Consequently, the putatively positive experience may not reinforce the engagement in similar behaviours that would have led to similar positive experiences. Similarly, when reminiscing about pleasant past events, one could reappraise these events as, for example, not as pleasant after all. Such dysfunctional cognitions have not been approached in the reviewed literature which focused more on expectancies (i.e. focusing on projection into the future, rather than on

remembrance), although we could hypothesize that they may also influence the course of motivation and goal-directed behaviours.

Only a few studies have looked at both neuro-affective processes and dysfunctional attitudes together, albeit only in the domain of beliefs regarding performance or success. For instance, Granholm and colleagues looked at effort allocation (as measured with pupillary responses) when performing a digit span task in association with defeatist performance beliefs (Granholm, Ruiz, Gallegos-Rodriguez, Holden, & Link, 2016). They found that individuals with schizophrenia who also had severe defeatist performance beliefs (and higher negative symptoms) did not exert more effort as the task's difficulty level increased from low to moderate, as opposed to both healthy controls and individuals with schizophrenia who had lower levels of defeatist performance beliefs who both showed increased effort.

Similarly Reddy et al. (2018), whose study was mentioned above, combined measurements typically used in the neuro-affective approach, namely an effort-based decision-making task with self-reports of defeatist performance beliefs. They found that those dysfunctional attitudes moderated the association between negative symptoms and performance on the decision-making task, such that as motivational deficits and defeatist performance beliefs both increased, the willingness to apply more effort decreased.

In another study regarding learning abilities in individuals with schizophrenia, Choi, Fiszdon, and Medalia, (2010) found that expectations of success (or a feeling of self-competency) during a specific learning-task was related to how participants valued the task: if the task was perceived as worthwhile or useful, expectations of success on the task were greater, which was in turn related to increased persistence of learning effects at follow-up. This suggests that the valuation of a certain task and beliefs regarding self-competency are important predictors of the motivation to learn in individuals with schizophrenia. This study is important as it combines beliefs about one's competency on a particular task and the value attributed to that task. However, it would be valuable to extrapolate such results to a task that is more relevant to everyday life.

In sum, these few studies show that dysfunctional attitudes regarding one's self-efficacy, performance or chance of success, may all predict effort expenditure (including in the context of learning). Only one study (Cassar et al., 2013) looked at both expectancies of success and savouring variables (i.e. savouring beliefs and propensity measured with the SBI) in relation to negative symptoms. In the context of everyday tasks, anhedonia was found to be predicted by savouring beliefs and estimated difficulty of the everyday tasks, but not by the expectancies of success. This result appears to differ from other studies, although this could be driven by the different methodological approaches. There is clearly a need for more studies that investigate both cognitive and affective variables together and in relation to motivational negative symptoms.

There are also few studies looking at other dysfunctional attitudes (e.g. regarding pleasure and social contact), and in relation to the experience of (positive) emotions, in relation to value or goal representations, and in association with effort estimation or exertion in more ecological and valued activities (e.g. leisure, physical activity, social interactions). Such studies are essential in order to explore the interactions between these different processes and their possible primacy or causal role. Furthermore, this research must leave the laboratory and enter the real world in order to more straightforwardly develop useful psychosocial interventions in daily life.

CHAPTER 3
Interventions for negative symptoms

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Negative symptoms are considered both as an important barrier to functional remission and as a critical unmet therapeutic need (Galderisi, Mucci, et al., 2018; Lutgens, Gariepy, & Malla, 2017; Marder & Galderisi, 2017). The first section of this chapter provides a general overview of various treatment options for negative symptoms, as outlined in several reviews and meta-analyses. In general, these studies identify the need to further investigate the efficacy of interventions on primary negative symptoms, and above all, to develop interventions expressly designed to address these symptoms (Lutgens et al., 2017; Veerman, Schulte, & de Haan, 2017; Velthorst et al., 2015). The second section highlights some key psychological interventions not originally designed for the treatment of negative symptoms but which have nonetheless been evaluated for their efficacy to alleviate such symptoms. The third and final section focuses on two important psychological interventions that expressly target negative symptoms.

1. General overview of treatment options for negative symptoms

Multiple reviews and meta-analyses have examined the efficacy of medical treatment, psychological and psychosocial interventions, as well as other therapeutic approaches offered to individuals with schizophrenia spectrum disorders. Some reviews have considered a variety of approaches and others have focused on specific interventions (e.g. psychological interventions). This section provides an overview of available treatment options for negative symptoms, albeit with a focus on psychological interventions, given the scope of this thesis.

A recent comprehensive review (Veerman et al., 2017) gathered results from reviews and meta-analyses between 2007 and 2017, assessing the various pharmacological, psychological and other interventions used to treat negative symptoms. The review aimed to outline effective treatments for *primary* negative symptoms, i.e. the symptoms that are idiopathic to the disorder and not secondary to other symptoms, such as depressive, positive or

extrapyramidal symptoms (Buchanan, 2007; Kirkpatrick, Mucci, & Galderisi, 2017). The efficacy of treatments on negative symptoms might, in some cases, simply result from the treatment of sources of secondary negative symptoms (e.g. treating depression or paranoia) and not from a specific effect on primary negative symptoms. Delineating effective treatments for primary negative symptoms proved to be near impossible, since few studies have made a distinction between primary and secondary negative symptoms or control for sources of secondary negative symptoms; even more problematic was the fact that few studies have focused on negative symptoms as their main outcomes. The findings from the review thus generally refer to unspecified negative symptoms. Furthermore, given the lack of studies investigating primary negative symptoms, the general conclusion was that, at the time of the review, no treatment yielded convincing and consistent evidence for their efficacy to address primary, persistent or predominant negative symptoms. However, the review outlined several useful observations regarding different interventional approaches and highlighted some evidence of modest, generally short-term, efficacy for the treatment of general negative symptoms.

In Veerman and colleagues' (2017) view, the most probable effective method to reduce primary negative symptoms is to foster preventive approaches. Shorter durations of untreated psychosis are indeed related (on a cross-sectional level) to less severe negative symptoms, and are also predictive of less severe negative symptoms and of better functional outcomes at short- and long-term follow-up (Boonstra et al., 2012; Penttilä, Jääskeläinen, Hirvonen, Isohanni, & Miettunen, 2014; Perkins, Gu, Boteva, & Lieberman, 2005; Souaiby, Gaillard, & Krebs, 2016). Early detection and early treatment are thus essential. Early intervention may encompass different approaches (e.g. pharmacological treatment, psychosocial interventions) provided that the intervention limits the duration of untreated psychosis.

In respect to pharmacological treatment, a large meta-analysis based on 168 studies concluded that available treatments had limited if any impact on negative symptoms. All studies included were randomised controlled trials (RCTs) and examined first- and second-generation antipsychotics, antidepressants, glutamatergic medications and different combinations of pharmacological agents. Most of the pharmacological treatments were found to significantly reduce negative symptoms, albeit not in a clinically meaningful manner due to the small changes on the symptom rating scales (PANSS, BPRS, or SANS). Veerman and colleagues (2017) reported that an add-on treatment of aripiprazole (i.e. atypical antipsychotic), antidepressant or topiramate (usually used in the treatment of epilepsy) could be useful. Furthermore, they did not find convincing evidence for a superiority of second-generation over first-generation antipsychotics in the treatment of negative symptoms (Fusar-Poli et al., 2015; R. C. Harvey, James, & Shields, 2016).

Regarding psychological and psychosocial interventions, the systematic review of Veerman and colleagues (2017) observed little consistent evidence for the efficacy of cognitive behavioural therapy (CBT) (Lutgens et al., 2017; Velthorst et al., 2015) and other types of

psychological interventions (e.g. family-based intervention, integrated psychosocial therapy, mindfulness) (Fusar-Poli et al., 2015; Khoury, Lecomte, Gaudiano, & Paquin, 2013) on negative symptoms. The different psychological interventions generally produced small to modest short-term efficacy with a high degree of heterogeneity. For example, in the meta-analysis by Lutgens and colleagues (2017), the selected RCTs found that negative symptoms could be reduced by using different approaches, particularly when including CBT and interventions based on skills-training. The results were nonetheless inconsistent and the impact varied widely in magnitude (pooled standardized mean differences ranging from -2.90 to 0.47). In Velthorst and colleagues' (2015) meta-analysis that focused exclusively on CBT, only small effects were found, both when negative symptoms were the main target and when they were assessed as secondary outcomes. Conversely, Riehle, Pillny, and Lincoln's (2017) systematic review yielded different conclusions. Their review focused on studies (RCTs and uncontrolled trials) looking expressly at the efficacy on negative symptoms. Moreover, their review considered the efficacy of interventions on the different dimensions – motivation and expression – of negative symptoms separately. Their findings indicate that a few interventions including CBT and social-skills training had a positive impact on motivational deficits, with effect sizes ranging from medium to large. This was found to be especially true for interventions based on the new conceptualization of negative symptoms consisting of different domains (expressive and motivational) and for interventions focusing on the emotional dysfunction that can be experienced (e.g. Favrod et al., 2015). Studies that have evaluated the efficacy of psychological interventions specifically for the treatment of negative symptoms will be further discussed in the next section (see 2. Psychological interventions evaluated for their efficacy in the treatment of negative symptoms).

Interventions taking a neurological or neurocognitive approach to negative symptoms, namely brain stimulation and cognitive remediation, have also been considered in different meta-analyses. For instance, repetitive Transcranial Magnetic Stimulation (rTMS) aims to increase activity in various parts of the brain (e.g. the dorsolateral prefrontal cortex and the medial frontal gyrus) believed to underlie certain negative symptoms. Yet this approach has not shown consistent efficacy for the treatment of negative symptoms across different meta-analyses; some found a small to moderate improvement (Dlabač-de Lange, Knegtering, & Aleman, 2010; Shi, Yu, Cheung, Shum, & Chan, 2014), while others observed no significant reduction in negative symptoms (Freitas, Fregni, & Pascual-Leone, 2009; Fusar-Poli et al., 2015; He et al., 2017). Another approach is cognitive remediation, which aims to train various neurocognitive skills (e.g. memory, cognitive flexibility, planning) in individuals with neuropsychiatric disorders. Since neurocognitive deficits have shown to be associated, albeit weakly, with negative symptoms in schizophrenia (Buchanan et al., 2005; Capatina & Miclutia, 2018), cognitive remediation was considered as an option for their treatment. Working memory deficits, for example, which have shown to be involved in motivational deficits in schizophrenia (G. P. Strauss et al., 2014), have been identified as a potential target for cognitive remediation in order to reduce negative

symptoms. However, cognitive remediation has generally demonstrated only weak benefits for the management of negative symptoms (Cella, Preti, Edwards, Dow, & Wykes, 2017; Veerman et al., 2017).

Finally, other interventions, namely physical exercise and music-based therapy, which were not initially intended for the treatment of negative symptoms, have quite consistently shown to have a positive impact on these symptoms (Veerman et al., 2017). As reported in several meta-analyses (Dauwan, Begemann, Heringa, & Sommer, 2016; Firth, Cotter, Elliott, French, & Yung, 2015), physical exercise has revealed a positive small to moderate impact on negative symptoms. Another recent meta-analysis (Sabe, Kaiser, & Sentissi, 2020) found that this was particularly the case for aerobic (*vs.* non-aerobic) physical exercise. Furthermore, although the studies comprised in this meta-analysis did not include participants for their predominant or primary negative symptoms, additional analyses suggested that the positive effects on negative symptoms were not secondary to an improvement on positive or depressive symptoms. How physical exercise impacts negative symptoms remains nevertheless unclear. Meanwhile music-based therapy, which can involve passive listening or active participation, appears to be a beneficial adjunction for the treatment of negative symptoms, as reported in several meta-analyses (Lutgens et al., 2017; Tseng et al., 2016). Moreover, a recent review (Riehle et al., 2017) suggests that music-based therapy has higher benefits for the expressive factor of negative symptoms. It is again unclear how this approach alleviates negative symptoms.

In sum, the various therapeutic approaches – pharmacological, psychological, cognitive remediation, rTMS and others – that have been evaluated in reviews and meta-analyses have not yet demonstrated their efficacy on primary negative symptoms, but some interventions might have a small to moderate impact on secondary negative symptoms (Veerman et al., 2017). A functional analysis (Lincoln, Riehle, et al., 2017; Raffard, De Connor, Yazbek, Décombe, & Bortolon, 2020) of negative symptoms could help in identifying triggers (e.g. defeatist beliefs, paranoia, depression, deficit in social cognition) and could therefore help deciding on which intervention to offer (e.g. CBT, antidepressant, social skills training) to target these sources of secondary negative symptoms. However, for those symptoms which are primary, more severe, longer lasting and having generally a greater negative impact on functional outcomes (Galderisi et al., 2017), further research is needed to demarcate effective treatment options.

Several limitations can be derived from the comprehensive review by Veerman and colleagues (2017) and the numerous meta-analyses they referred to. First, the vast majority of the interventions assessed were rarely specifically designed for the treatment of negative symptoms, but primarily targeted other symptoms such as positive and depressive symptoms. Second, and relatedly, negative symptoms were rarely the primary outcome of clinical studies. Furthermore, as Veerman and colleagues clearly emphasised, the failure to distinguish between primary and secondary negative symptoms is problematic as the specificity of the intervention cannot be guaranteed. In the various studies included in the

different meta-analyses, participants were generally selected for their positive symptoms, rarely for their negative symptoms, and samples consequently varied in terms of symptom severity, persistence, resistance, or their primary or secondary nature (Lutgens et al., 2017). Improvements in negative symptoms that have been reported may thus not reflect a specific effect on primary negative symptoms, but result from an amelioration of other symptoms that represent sources of secondary negative symptoms (e.g. reduction in positive symptoms or depressive symptoms) (Carpenter & Buchanan, 2017; Wykes, Steel, Everitt, & Tarrier, 2008). Third, an important limitation on the assessment of negative symptoms is the absence of a distinction between the different dimensions of negative symptoms (Aleman et al., 2017). This is problematic because, as mentioned earlier (see Chapter 1), expressive and motivational deficits appear to have different underlying pathophysiological mechanisms (Marder & Galderisi, 2017) and are associated with different functional outcomes (G. P. Strauss et al., 2013). It is thus essential to use scales that allow the evaluation of both factors, and to create interventions that are specifically designed for particular dimensions of negative symptoms or for individual symptoms (e.g. anhedonia).

On a related matter, while the aim is to ameliorate negative symptoms because they are important predictors of functional outcomes and quality of life, few studies have explored these outcomes. Yet considering functional or quality of life is at least as important as looking at symptomatic remission. A recent meta-analysis (Valiente, Espinosa, Trucharte, Nieto, & Martínez-Prado, 2019) investigating the effects of psychological interventions on quality of life found that they produced on average a significant but small effect (Cohen's d = 0.22, p = .0005). Importantly, the meta-analysis observed a moderating effect of the aim of the intervention, so that interventions with the main aim of improving well-being had a significantly higher effect (Cohen's d = 0.51, p < .0001) compared with interventions that targeted symptom reduction or increased functioning which did not produce benefits on quality of life. Another recent meta-analysis focused on the effects of CBT on functioning, distress and quality of life (Laws, Darlington, Kondel, McKenna, & Jauhar, 2018). In general, CBT for psychosis had a significant small effect on functional outcomes (Hedge's g = 0.25, p < .001) which was not consistently maintained at follow-up. Moreover, they found no significant effects of CBT in reducing distress and ameliorating quality of life. Quality of life and functional outcomes, along with negative symptoms, should be a primary focus in the studies evaluating the effects of psychological interventions.

To summarise, in the light of the reviews and meta-analyses mentioned above, studies examining treatments for negative symptoms, primary or secondary, have produced mixed results. Most of the treatments show significant effects on negative symptoms, although these effects are inconsistent, small, generally short-term (there are also few reports of long-term effects) and they may have little clinical significance (Fusar-Poli et al., 2015). Furthermore, the failure to distinguish between primary and secondary negative symptoms makes it difficult to determine whether those interventions have a specific effect on these symptoms (Veerman et al., 2017). Additionally, the failure to distinguish between the different dimensions of negative symptoms may hide differentiated effects of some

interventions (Riehle et al., 2017). Therefore, new interventions should be developed based on recent progress in the understanding of negative symptoms (see Chapter 2) and should consider the distinct domains – expressive and motivational – of negative symptoms. Finally, interventions should also focus on improving functional outcomes and quality of life and validation studies should incorporate measures of these outcomes.

2. Psychological interventions evaluated for their efficacy in the treatment of negative symptoms

Most of the psychological interventions included in the aforementioned reviews and meta-analyses were not intended to address negative symptoms and most of the validation studies only looked at negative symptoms as secondary outcomes. However, several psychological interventions, despite not being originally designed for negative symptoms, have been evaluated for their efficacy on these symptoms and considered these symptoms as main outcomes. Studies evaluating CBT, behavioural activation and the training of social skills are presented in the next subsections.

2.1. Cognitive Behavioural Therapy

The underlying assumption of CBT interventions is that negative symptoms result from and are maintained by the presence of dysfunctional attitudes (A. T. Beck & Rector, 2005; Rector, 2004). For example, defeatist beliefs or a low sense of self-efficacy affect motivation and reduce the engagement in goal-directed behaviours. Cognitive behavioural interventions generally comprise discussion techniques (e.g. cognitive restructuring), role-plays, and behavioural experiments that aim to challenge the dysfunctional beliefs that underlie negative symptoms. As mentioned earlier in this chapter (see 1. General overview of treatment options for negative symptoms), Velthorst and colleagues (2015) indicated that CBT did not yield significant benefits for the treatment of negative symptoms. However, CBT used to focus on positive symptoms and adapting this approach to negative symptoms might show better results. Several studies have done so and investigated negative symptoms as primary outcomes.

In a study by Klingberg and colleagues (2011), CBT was adapted to the treatment of negative symptoms, including cognitive restructuration to address dysfunctional beliefs. An RCT was conducted to evaluate the efficacy of CBT in comparison with cognitive remediation in individuals with schizophrenia. The participation in around 17 sessions of CBT produced significant though small positive effects on negative symptoms (PANSS and SANS) and did not demonstrate to be more effective than cognitive remediation. Another RCT (Grant, Huh, Perivoliotis, Stolar, & Beck, 2012) that aimed to evaluate the efficacy of CBT was conducted in individuals with schizophrenia and prominent negative

symptoms[21]. The intervention focused on recovery and targeted dysfunctional beliefs. Participants attended weekly sessions for up to 18 months (between 16 to 81 sessions). Compared to participants in the treatment as usual (TAU) condition, participants following the CBT intervention showed significant positive effects on avolition-apathy – but not on anhedonia-asociality (SANS) – as well as on functional outcomes. However, it was not clear what drove this improvement: the reduction in defeatist beliefs, the activation and engagement in goal-directed activities, or the reduction in positive symptoms that was also significant. Another study (Staring, Ter Huurne, & van der Gaag, 2013) evaluated the effects of CBT in individuals with schizophrenia who presented negative symptoms that were not secondary to positive symptoms. The CBT intervention focused on targeting dysfunctional beliefs and was followed by 21 participants for around 17 to 20 sessions. There was a significant decrease in both negative symptoms (PANSS) and dysfunctional beliefs (about cognitive abilities, social performance, positive emotions, social exclusion and internalized stigma). Furthermore, the change in negative symptoms was partially explained by the reduction of dysfunctional beliefs, which supports the cognitive model of negative symptoms (Rector et al., 2005).

In general, CBT has not proven to be more effective for negative symptoms than active control conditions (Riehle et al., 2017). As suggested in a recent review of available interventions for negative symptoms (Raffard et al., 2020), the target of CBT might relate more to the depressive factors of motivational deficits. Studies that evaluate the effects of CBT on negative symptoms should further investigate the mechanisms of change and appropriately control for the impact of depressive symptoms.

2.2. Behavioural activation

Behavioural activation (BA) was developed for the treatment of depression and there is extensive evidence for its efficacy in reducing depressive symptoms (Ekers et al., 2014; Simmonds-Buckley, Kellett, & Waller, 2019). BA aims to increase the engagement in potentially rewarding and reinforcing activities (e.g. social, leisure, physical activities) and reducing avoidance behaviours in order to increase positive affects and improve quality of life. Given the overlap between certain negative and depressive symptoms such as reduced activity (Krynicki et al., 2018), it is reasonable to presume that BA could be beneficial for individuals with schizophrenia who present negative symptoms, especially motivational deficits. BA could disrupt the maintenance loop of negative symptoms, where avoidance (i.e. withdrawal) has been reinforced by the reduction of distress generated by positive

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[21] Participants were selected on the basis of their negative symptoms and excluded if presenting acute psychotic symptoms (any PANSS positive symptom with a score of 6 or 7, i.e. the maximum score on that scale), severe depression (as indexed by a score of 6 or 7 on the depression item (G6) of the PANSS), or moderate extrapyramidal symptoms. Note that these are very strict criteria which may not exclude the presence of less severe positive or depressive symptoms which could be the sources of secondary negative symptoms.

symptoms, for example, but has created a cascade of disengagement and deconditioning (i.e. erosion of functional and social skills) (see Chapter 2, 1. The cognitive perspective). To date, only two studies have evaluated the efficacy of BA in samples of individuals with schizophrenia, taking negative symptoms as primary outcomes.

In the first pilot study (Mairs, Lovell, Campbell, & Keeley, 2011), BA was evaluated in a sample of 8 individuals with schizophrenia. Participants followed around 15 sessions (in a 6-month period) of the BA treatment which included activity monitoring, identification of activities, activity hierarchy (i.e. based on difficulty and potential of reinforcement), and goal planning. After the end of the intervention, moderate to large improvements were observed on negative symptoms (SANS and SENS), as well as on depressive symptoms and functional outcomes. At the 2-month follow-up, the effects on negative symptoms were moderate and maintained in one third of the sample, and the effects on depression and functional outcomes became small. This study was nevertheless limited by the lack of independence of the evaluators[22], the absence of a control group, and the lack of specificity of the effects. The benefits observed on negative symptoms could indeed be partially secondary to the effects on depressive symptoms.

In the second, non-randomised pilot study (K.-H. Choi, Jaekal, & Lee, 2016), motivational interviewing and BA were combined in a single intervention approach (mBA) and evaluated in a sample of 47 individuals with schizophrenia and mild to moderate negative symptoms. Participants were assigned to either mBA (10 sessions) or TAU. The mBA included goal setting, goal planning, monitoring of activities (and reminiscence of pleasant and meaningful activities), problem-solving and, to a lesser extent, social skills training. Participants in the mBA group showed improvements on the PANSS negative, on BNSS motivation and expressive subscales, and on depressive and cognitive symptoms subscales of the PANSS. Participants in the control condition did not show any significant improvements on these symptoms or showed a deterioration (e.g. for depression). Moreover, mixed results were found regarding motivational deficits as measured with the BNSS, as improvements on this subscale were not maintained when considering baseline cognitive symptoms.

These studies offer preliminary evidence for the efficacy of BA for individuals with schizophrenia, but its specificity should be established for primary negative symptoms. Furthermore, the mechanisms through which BA could operate on negative symptoms should be examined.

2.3. Social skills training

Interventions aiming to improve social skills were not originally designed to address negative symptoms, but rather to reduce interpersonal deficits when patients returned to

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[22] The evaluations were conducted by the main investigator, the first author of the study.

the community in the context of deinstitutionalization in the 1970s (Turner et al., 2018). However, as concluded in different reviews (Lincoln & Pedersen, 2019; Turner et al., 2018), Social Skills Training (SST) has shown its efficacy on unspecified negative symptoms, and demonstrated its superiority in comparison with active control conditions. There are various elements that can be incorporated in SST, but this approach generally aims at refining assertiveness, improving verbal and non-verbal communication, reducing social distress, and promoting adequate responses according to the social context. Different techniques have been used in SST such as role-play, modelling, rehearsal, and group discussion and reflections. Moreover, social-cognitive skills training targets additional skills related to social cognition, such as emotion identification and theory of mind. Some training has also included CBT elements, such as cognitive restructuring or behavioural experiments, to address dysfunctional beliefs related to social relationships.

For instance, Granholm, Ben-Zeev, and Link (2009) developed a group programme combining cognitive behavioural therapy and social skills training (CBSST). Relative to participants in a control group (i.e. active goal-focused supportive contact), participants in the CBSST group saw a significantly higher improvement at the end of the intervention and at follow-up, namely on motivational deficits (SANS) and functional outcomes (Granholm et al., 2014). Interestingly, in secondary analyses, Granholm, Holden, and Worley (2018) found that defeatist attitudes mediated the effect of the treatment group on motivational negative symptoms and functional outcomes. However, it is not clear if it is the direct effect of CBT techniques, such as cognitive restructuring, that had an impact on dysfunctional beliefs, or the practicing of social skills which may have challenged these beliefs, leading in turn to a higher motivation to engage in social situations, and thus in a decrease in social withdrawal (Granholm & Harvey, 2018). However, the mechanisms through which SST impact negative symptoms need to be clarified (Turner et al., 2018).

3. Psychological interventions specifically designed for negative symptoms

3.1. The MOtiVation and Enhancement (MOVE) program

3.1.1. Development of the program

The MOVE program was designed by Velligan and colleagues to address persistent negative symptoms and their functional consequences in individuals with schizophrenia (Velligan et al., 2014; Velligan, Roberts, et al., 2015). MOVE is one of the first interventions that was specifically designed for addressing negative symptoms. Furthermore, its development was based mostly on the cognitive model of the development and maintenance of negative symptoms (Rector et al., 2005; Velligan et al., 2014), which identifies biological, cognitive and psychosocial mechanisms that contribute to the development and maintenance of negative symptoms (see Chapter 2, Figure 2.2. The negative symptom maintenance loop). In this model, dysfunctional beliefs and impairments in anticipatory pleasure contribute to the maintenance of negative symptoms. Furthermore,

the progressive decline of various skills (e.g. social, work) may increase the likelihood of failures, and consequently result in more defeatist beliefs, and increasing difficulties in engaging in various goal-directed behaviours.

The MOVE program is a manualised intervention that is delivered in the individual's home environment and community (including, for example, shops, restaurants, activities). It combines different empirically supported intervention strategies from behavioural and skill-building approaches: antecedent control, identifying and addressing deficits in anticipatory pleasure, in vivo emotional processing, in vivo skill building and CBT strategies. Each strategy addresses a specific part of negative symptoms or resulting functional deficits.

First, antecedent control makes use of cues in the person's usual environment using different supports (e.g. signs, alarms, checklists) in order to bypass the difficulties in motivation or in the initiation of specific behaviours. These cues are also used to prompt homework assignments. Velligan and colleagues have demonstrated that this type of strategy, i.e. Cognitive Adaptation Training (CAT), has beneficial effects in individuals with schizophrenia, in terms of motivational deficits and functional outcomes (Velligan et al., 2000, 2008, 2009; Velligan, Tai, et al., 2015).

Second, to address deficits in anticipatory pleasure, the MOVE therapists ask participants to what extent they believe they will experience pleasure in a chosen future activity. During the activity in question, they are then asked how much pleasure they are actually feeling. Any discrepancy engenders a discussion to raise awareness about how it can interfere with their engagement in activities that would make them experience a better life. The ratings of these experiences (before and during the activity) are saved, in order to be reviewed at future similar occasions. Pictures from the activities accomplished are also saved to later elicit pleasure and encourage the initiation of similar activities. Velligan and colleagues (2014) piloted these strategies over various activities, in 10 participants with schizophrenia and persistent negative symptoms. After three months, they found an increase in anticipatory pleasure and in the number of social and leisure activities engaged in by the participants.

Third, the MOVE program also addresses emotional processing and expression difficulties. MOVE therapists help participants develop their ability to label their own emotions during their various interactions, and also use photographs or sound recordings of these interactions to illustrate the emotions that were experienced. They also use computerized exercises to train the identification of emotions in others (i.e. facial expressions, voice modulations), which were inspired from existing social cognition training programs (Roberts et al., 2014; Roberts & Penn, 2009). Furthermore, they encourage role-play to train participants to display emotions in social interactions and provide them with strategies to tackle emotion-processing difficulties in social relationships.

Fourth, skill-building involves the training of both social skills (Bellack, Mueser, Gingerich, & Agresta, 2004) and independent living skills (Liberman, Glynn, Blair, Ross, & Marder,

2002). Social interactions that are relevant to the person's needs are role-played. For non-social situations, for example doing the laundry, the different steps needed to complete the task are written down and rehearsed. MOVE therapists use techniques such as overlearning, modelling and shaping – which may occur in the specific natural environment, when possible – in order to increase successful completion of the tasks.

Fifth, self-defeating thoughts are addressed using CBT (A. T. Beck et al., 2009). MOVE therapists help in the identification and the challenging of dysfunctional cognitions. Moreover, the increased engagement and success in new behaviours that are encouraged through the other strategies of MOVE (e.g. environmental cues, skill-building) serve as arguments against the defeatist beliefs.

The different strategies offered in the MOVE program are often used in combination, within the same activity (Velligan et al., 2014; Velligan, Roberts, et al., 2015). For example, before a new skill is being trained in a real-life situation (e.g. returning a purchase in a shop), the emotions experienced and anticipated can be discussed, as well as the possible defeatist beliefs. After completion of the activity, the emotions that were actually experienced can be compared to what was anticipated. The social interactions can also be reviewed. Thus, the integration of the multiple strategies of MOVE aim to increase the initiation of adaptive behaviours, success, and enjoyment, creating a positive feedback loop which leads to an increased willingness to engage in new activities, therefore leading to more opportunities to experience various emotions. The initial use of external cues to foster certain behaviours that can be progressively dropped when the person experiences a higher sense of self-efficacy that supports intrinsic motivation. The sense of self-efficacy increases over the successful completion of chosen tasks. This greater productivity and self-efficacy are thought to increase the desire to share these successes with others, which would in turn increase social contacts. In sum, the MOVE programme is tightly related to the cognitive model of negative symptoms and is built to interrupt their maintenance.

3.1.2. Validation

Only one study has investigated the efficacy of MOVE. A randomised pilot study (Velligan, Roberts, et al., 2015) was conducted to evaluate its feasibility and efficacy in individuals with schizophrenia who met the criteria for persistent negative symptoms (Buchanan et al., 2005). Fifty-one participants were randomised into the MOVE intervention or into TAU (medication and case management). MOVE was provided for approximately 1.25 hours, around once a week, for a period of 9 months, and in participants' homes and communities. Participants were assessed at baseline, at three- and six-months into the intervention, and at the end of the intervention. Assessments included the NSA (Axelrod, Goldman, & Alphs, 1993), the BNSS (Kirkpatrick et al., 2011) and the CAINS (Kring, Gur, Blanchard, Horan, & Reise, 2013). Evaluators were blinded to participants' treatment condition. Repeated measures for mixed-effects models were conducted, using baseline scores as

covariates. The analyses indicated a significant interaction (Group by Time) effect for the NSA at the 9-months assessment time, showing a moderate treatment effect (between-group Cohen's d = 0.50) of the MOVE condition. The TAU group showed a worsening of their negative symptoms. Post-hoc analyses showed trends for an interaction (Group by Time) effect only for the socialisation and motivation factors of the NSA, while no effects were found for the other factors (i.e. emotion, communication, and psychomotor speed). In secondary analyses, no effect was found for the BNSS, whereas an interaction (Group by Time) effect was observed for the CAINS (at the 9-month assessment time), showing a significant and moderate decrease in negative symptoms (d = 0.50) in the MOVE condition. With respect to the acceptability of the intervention, the dropout rate for the MOVE program was higher than in the TAU condition, which could be explained by the high demanding and activating nature of the intervention for participants with severe negative symptoms.

3.1.3. Conclusion

The MOVE program (Velligan et al., 2014; Velligan, Roberts, et al., 2015) has significant strengths. First, it is specifically designed for negative symptoms, it draws upon solid scientific evidence, and it targets both the motivational and expressive dimensions of these symptoms. Second, MOVE brings different strategies proven to be beneficial in the participants' home environments which increases the likelihood of generalising skills to other daily life situations and of transfer to functional outcomes – which was nevertheless not evaluated in the pilot study.

The study investigating the efficacy of MOVE (Velligan, Roberts, et al., 2015) was the first of its kind to follow strict inclusion criteria in order to evaluate the efficacy of an intervention on persistent negative symptoms. However, the improvement in negative symptoms did not appear before 9 months of intervention, it was relatively small, and partly driven by a worsening of symptoms in the control group, as noted by the authors. Furthermore, although the intervention targeted all negative symptom dimensions, improvement was only observed in motivational deficits and asociality, as measured with the NSA. Surprisingly, no significant benefits were found on the BNSS, yet this scale has shown to be sensitive to change (Kirkpatrick et al., 2018). Given the multicomponent nature of the intervention, it would be useful to investigate which module drove the observed ameliorations. Finally, Velligan and colleagues' study is limited by the absence of functional outcomes and quality of life measures. It would have been valuable to evaluate how the reduction in negative symptoms translated to functional outcomes and life satisfaction.

3.2. The Positive Emotions Program for Schizophrenia (PEPS)

3.2.1.   Development of the program

Favrod and colleagues (Favrod et al., 2015; Nguyen et al., 2016) developed an intervention that aimed to reduce anhedonia and motivational deficits in schizophrenia. PEPS was designed to increase the frequency, intensity and duration of positive emotions, in accordance with the model of the temporal experience of emotion by Kring and colleagues (Kring & Caponigro, 2010; Kring & Elis, 2013). The intervention relies on five techniques that have already proven to be effective in enhancing positive emotional experience (Bryant & Veroff, 2007; Quoidbach, Berry, Hansenne, & Mikolajczak, 2010), namely: savouring pleasant moments, anticipating future pleasant moments, savouring past pleasant moments, sharing and celebrating with others, and expressing positive emotions. Furthermore, in accordance with the cognitive perspective on negative symptoms, the intervention also addresses defeatist beliefs.

PEPS is provided through 8 one-hour weekly sessions in a group setting of 5 to 10 participants. The facilitator uses PowerPoint presentations enriched with visual and audio media (i.e. pictures and sound recordings) throughout the sessions. Each session typically starts with a 5-minute relaxation or meditation exercise. Then, the group facilitators review the homework from the previous session. This is followed by an exercise that focuses on challenging various defeatist beliefs (experienced by the two fictitious characters of the PEPS programme, Jill and Jack), for which participants have to propose alternative, more positive thoughts. The session then continues with the training of a particular skill depending on the session's theme (i.e. the five techniques). To train in-the-moment savouring skills, participants are invited to focus their attention on the positive emotions they experience when they are looking at a beautiful picture of the countryside (projected on a big screen), for example, or while listening to soothing music. Pleasure anticipation is trained via multisensory imagery of future events, which goes through different senses and positive emotions. Training the savouring of past positive events involves the mindful reminiscence of the events, with a focus on the pleasant features of the memory. Communicating and celebrating positive experiences with others allows individuals to capitalise on the experience of positive moments. Participants are invited to describe positive events to each other during the session. The outward expression of positive emotions is trained by inviting participants to imitate the facial expressions of actors who smile and to focus on the feelings that this exercise generates. The last session of PEPS reviews all the skills that have been learned throughout the programme.

Of note, PEPS follows a psychoeducational model proposed by Kolb and Kolb (2009), which sees the learning process as a translation from experience to personal knowledge. PEPS thus involves, for each strategy that is taught, different learning techniques: concrete experience (e.g. a mindfulness exercise), reflective observation (e.g. sharing what was experienced during an exercise, listening to the experience of others), abstract conceptualisation (e.g. the facilitator explains the rationale for the skill that is taught), and

active experimentation (i.e. homework, training of the skill in real-life conditions). Furthermore, in a collaborative and egalitarian approach, the group facilitators participate in the different exercises.

3.2.2. Validation

The validation of PEPS started with the evaluation of a beta-version of the programme in a sample of health-care professionals (Nguyen et al., 2016). An improved version was then piloted in individuals with schizophrenia (Favrod et al., 2015), before being validated in an RCT (Favrod, Nguyen, Chaix, et al., 2019) and finally in a field test (Favrod, Nguyen, Tronche, et al., 2019).

In a first study (Nguyen et al., 2016), a beta-version of PEPS (1.0) was tested in volunteer health-care professionals (psychiatrists, psychologists, nurses, occupational therapists, and social workers), through one-day training sessions. Feedback from the professionals was collected in order to improve the intervention (PEPS 1.1). Furthermore, pre- and post-intervention measurements were taken to evaluate the impact of the intervention on the Savoring Beliefs Inventory (SBI; Bryant, 2003), the Temporal Experience of Pleasure Scale (TEPS; Gard et al., 2006) and the Anticipatory and Consummatory Interpersonal Pleasure Scale (ACIPS; Gooding & Pflum, 2014b, 2014a). Version 1.0 of PEPS led to significant improvements on both the anticipatory and consummatory pleasure subscales of the TEPS, on the SBI, but not on the ACIPS. The version 1.1 of PEPS included improvements accounting for these findings, and was then tested in a new sample of participants. This 1.1 version lead to significant improvements on all the measures, suggesting that PEPS had the potential to impact positive emotions.

Next, a pilot study (Favrod et al., 2015) evaluating the feasibility and efficacy of PEPS (version 1.2) was conducted on 31 participants with schizophrenia who presented at least mild symptoms of anhedonia (a score of at least 2 on the anhedonia subscale of the SANS). Participants were evaluated before and after the intervention on various measures: the SANS, the Calgary Depression scale for Schizophrenia (CDSS; Addington, Addington, & Maticka-tyndale, 1993), and the SBI (Bryant, 2003). After attending the intervention, participants showed a significant and moderate reduction on the anhedonia-asociality (Cohen's $d = 0.50$) and avolition-apathy ($d = 0.57$) subscales of the SANS, and a significant and large reduction on depressive symptoms ($d = 0.91$). No significant improvements were found for the affective blunting and alogia subscales of the SANS, nor for savouring beliefs. Overall, this first pilot study yielded encouraging results. Furthermore, the intervention was well appreciated and the dropout rate was low (16%).

Following this pilot study, an RCT (Favrod, Nguyen, Chaix, et al., 2019) was conducted in outpatients with schizophrenia or schizoaffective disorder, and again presenting at least mild symptoms of anhedonia. Eighty participants were randomised either to PEPS and TAU, or to TAU alone (case management and community treatment). They were

interviewed by independent evaluators, blinded to treatment allocation, before and after the intervention, as well as at a 6-month follow-up. After the intervention, participants in the PEPS group showed a significantly higher improvement on the anhedonia/apathy factor of the SANS (between-group Cohen's d = -0.55, p = .014), and even when depressive, psychotic and extrapyramidal symptoms were added as covariates in the analyses of variance. Further improvement was observed at follow-up (d = -0.76, p = .001). Note that when looking at the scores on the separate subscales, the improvements were moderate and significant for the anhedonia-asociality subscale, but small and not significant for the apathy-avolition subscale of the SANS. Additionally, at the post-intervention assessment, the TEPS scores revealed a significantly higher improvement in the PEPS participants both on consummatory and anticipatory pleasure. At the follow-up assessment, there was a significantly higher improvement in the PEPS participants regarding TEPS consummatory pleasure subscale, ACIPS group social interactions subscale, and the SBI total score and in-the-moment pleasure subscale (all effect sizes were in the moderate range). These results suggest that PEPS is beneficial in reducing symptoms of anhedonia, with an apparently particular effect on the consummatory (in-the-moment) dimension of pleasure. This study shows some meaningful strengths, with an adequate control group, a blinding procedure, the control of potential sources of secondary negative symptoms, and follow-up assessments.

Finally, a field test (Favrod, Nguyen, Tronche, et al., 2019) was conducted in order to evaluate the impact of PEPS in more natural conditions. Twenty-one participants (mostly outpatients) followed the 8 sessions of PEPS. Both the anhedonia/apathy (i.e. the motivational factor) and the expressive factors of the SANS improved significantly after the intervention. The self-reported scales (TEPS, SBI) showed some small but not significant changes, except for the SBI in-the-moment enjoyment, which improved significantly and moderately after the intervention. Furthermore, there was a significant and moderate improvement on functional outcomes, which suggests that skills taught during the intervention may transfer to social functioning.

In sum, Favrod and colleagues (Favrod, Nguyen, Chaix, et al., 2019; Favrod et al., 2015; Favrod, Nguyen, Tronche, et al., 2019) have shown that PEPS can significantly improve pleasure in individuals with schizophrenia or schizoaffective disorder who present symptoms of anhedonia. Their intervention appears to have a particular effect on consummatory anhedonia, and may have an effect on other negative symptoms (e.g. expressive deficits, avolition), as well as on social functioning.

3.2.3. Conclusion

There are important strengths that should be highlighted regarding PEPS. First, this intervention combines components of both the neuro-affective and the cognitive perspectives on negative symptoms. The intervention indeed targets both defeatist beliefs

and the temporal course of emotions. Second, the group format of PEPS follows a particular pedagogical approach, with an experiential model of learning (Kolb & Kolb, 2009) that inspired the way the intervention was provided and which should increase its learning potential. Third, PEPS is a very accessible intervention. Not only is the whole programme available for free on the internet[23], but it is also accessible to mental-health professionals with various levels of expertise. Group facilitators received a one-day training and two one-hour supervision sessions during the running of PEPS (Nguyen et al., 2016). Furthermore, the intervention is quite short, as it takes only two months with one-hour weekly sessions, making it easily usable in various settings (e.g. for short-term hospitalisations, for outpatients in community settings).

Favrod and colleagues' findings are particularly encouraging as they show that anhedonia is not an untreatable experiential abnormality, but that it can be treated with emotion regulation training (Favrod, Nguyen, Chaix, et al., 2019). However, their results mainly show an improvement on consummatory pleasure and not particularly on anticipatory pleasure nor reminiscence; and the improvement in the experience of pleasure does not seem to reliably extend to an increase in motivation, according to the Scale for the Assessment of Negative Symptoms (SANS). That said, the measures that were used in their different studies present several flaws. First, the SANS does not account for the distinction between consummatory and anticipatory anhedonia, and does not appropriately evaluate motivational deficits (see Chapter 1). Second, the self-report measures that were used (i.e. SBI, TEPS, ACIPS) might not appropriately assess the skills that were trained during PEPS. Indeed, as suggested in a meta-analysis (Visser, Chapman, Ruiz, Raugh, & Strauss, 2020), such scales rely on hypothetical reports that do not rely on the person's actual emotional experience (whether it be in the present moment, in anticipation or in reminiscence of future events). Some items evaluate a certain *propensity* to experience pleasure (in different timeframes, present, past, future), while other items index *beliefs* regarding the experience of emotions: thus, they might not assess the person's hedonic capability. Finally, and as suggested by the authors (Favrod, Nguyen, Chaix, et al., 2019), although anhedonia and amotivation are supposed to be related, reducing anhedonia by improving the experience of pleasure might not be sufficient to increase motivation. Other processes or skills (e.g. goal and values identification, goal planning, problem solving, action initiation) might have to be targeted in order to observe a significant change in motivation and the initiation of goal-directed behaviours.

4. Conclusion regarding available treatment options for negative symptoms

The reviews and meta-analyses regarding the efficacy of various interventions for the treatment of negative symptoms are unanimous: there is a need to develop and validate

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[23] http://www.seretablir.net/outils-interventions/peps/

interventions that specifically target idiopathic negative symptoms. The study of various interventions (e.g. pharmacological, psychological, neural stimulation, cognitive remediation) has generated inconsistent results regarding their efficacy on negative symptoms. While some interventions seem to produce an effect – albeit small and generally short-term – on secondary negative symptoms, their efficacy on primary negative symptoms still needs to be demonstrated. Some psychological interventions that had not been expressly designed for negative symptoms (e.g. CBT, SST, BA) appear to have a positive impact on negative symptoms, but this impact might be mostly driven by an improvement on sources of secondary negative symptoms such as depressive or positive symptoms. The rationale for some of these interventions (e.g. CBT for dysfunctional attitudes, BA for inactivity, SST for social withdrawal) aligns nonetheless with the understanding of how negative symptoms manifest or are maintained. For example, it seems reasonable to propose cognitive restructuring to reduce the deleterious effects of dysfunctional beliefs on motivation. The use of BA may increase engagement in meaningful goal-directed activities, which is a clear deficit in individuals with schizophrenia and severe negative symptoms. The training of social skills may be an appropriate approach to reduce social withdrawal, especially if the latter is driven by defeatist beliefs regarding one's social competence. Thus, these psychological interventions might be useful to reduce negative symptoms.

The recent evolution regarding the understanding of negative symptoms has provided useful models for the development of interventions targeting the underlying processes of negative symptoms. Two interventions have been designed expressly for these symptoms in light of the cognitive and neuro-affective models of negative symptoms: MOVE and PEPS.

Velligan and colleagues' intervention (Velligan et al., 2014; Velligan, Roberts, et al., 2015), MOVE, was created mostly based on the cognitive model (Rector et al., 2005) and targets all five dimensions of negative symptoms. However, the RCT that evaluated its efficacy in individuals with persistent negative symptoms did not find all dimensions to be improved using the NSA, CAINS and BNSS. Indeed, solely the motivational deficits and asociality subdomains as measured by the NSA improved. Furthermore, the observed effect is quite small and may not be clinically significant: the NSA baseline average score of approximately 3 reduces to 2.85 (out of a scale ranging from 1 to 6) after 9 months of intervention. Furthermore, no measurements were taken to attest for an effect on functional outcomes or quality of life. It is unclear why MOVE did not lead to more convincing results, given its strengths, namely the fact that its different modules are provided to the participants in their natural environment, and integrated into their activities. One possible explanation is that individuals with schizophrenia and severe negative symptoms might need more time to benefit from a psychological intervention. Future studies with follow-up assessments might be useful in that regard.

As for Favrod and colleagues' intervention (Favrod et al., 2015; Nguyen et al., 2016), PEPS, it was mostly inspired by the temporal course of emotion (Kring & Caponigro, 2010; Kring & Elis, 2013), a neuro-affective perspective on negative symptoms and anhedonia in particular. Different savouring skills are taught during this short group programme. Dysfunctional attitudes are also targeted, namely with cognitive restructuring techniques. The PEPS programme has been validated through different studies as a beneficial intervention that can significantly improve anhedonia, and consummatory pleasure in particular, even when sources of secondary negative symptoms are accounted for. Furthermore, these improvements are maintained at follow-up (Favrod, Nguyen, Chaix, et al., 2019) and there is some preliminary evidence for a transfer to social functioning (Favrod, Nguyen, Tronche, et al., 2019). However, its benefits on the experience of pleasure in other time frames (future pleasure anticipation and past positive events reminiscence) still need to be demonstrated, perhaps using more suitable assessment tools. Furthermore, the improvement in anhedonia and consummatory pleasure did not consistently result in a decrease of motivational deficits, which suggests that other therapeutic strategies might need to be used in order to observe increased motivation and goal-directed behaviours.

To date, there is still little evidence for the effectiveness of one therapeutic approach over another for the treatment of (primary) negative symptoms, and this is partly due to a number of different aspects such as methodological limitations. First, future studies should look into the specificity of psychological interventions for the treatment of negative symptoms (or dimensions of negative symptoms) by considering the latter as main outcomes and also by considering the impact of sources of secondary negative symptoms. Second, appropriate assessment scales that reflect the current understanding of negative symptoms and distinguish between expressive and motivational deficits (e.g. BNSS, CAINS) are advocated. Given the heterogeneity of negative symptoms, it is possible that different interventions may have an impact on distinctive dimensions of negative symptoms. Third, few studies have investigated the mechanisms of action of therapeutic interventions. Again, given the heterogeneity and complexity of negative symptoms, it is reasonable to hypothesise that change occurs when several mechanisms are at play (e.g. increase in pleasure anticipation, reduction in dysfunctional beliefs or the distress they provoke), and therefore – in respect to the content of interventions – that change occurs when different strategies (e.g. multisensory imagery, cognitive restructuring) are implemented. Fourth, clinical trials could also be improved by not only focusing on the short-term effects, but also on the long-term effects. Indeed, the maintenance of the potential benefits of an intervention is fundamental. Furthermore, it may take more time for a beneficial impact to appear for some negative symptoms (see for example Favrod, Nguyen, Chaix, et al., 2019; Velligan, Roberts, et al., 2015). Follow-up assessments are therefore recommended. Finally, efficacy studies should also investigate the generalisation of the potential benefits to functional outcomes and the impact on participants' life satisfaction, i.e. their perceived quality of life.

CHAPTER 4
Switch

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The intervention presented in this chapter, "Switch", was developed with the aim of reducing motivational negative symptoms so as to ameliorate daily functioning and quality of life in individuals with schizophrenia. The first section details the theoretical model that underpins this intervention and that is inspired by the cognitive and neuro-affective models described in Chapter 2. The second section describes the Switch intervention which integrates, extends and sharpens the interventions outlined in Chapter 3.

1. The three-level, multifactorial model of motivation

Designing an intervention that specifically targets motivational negative symptoms required a clear map of processes related to motivation. Functional and dysfunctional processes were described in the two types of models presented in Chapter 2, i.e. the cognitive model and the neuro-affective model. These models however have proceeded in parallel with little scientific interaction. The three-level model presented in this chapter attempts to reconciliate both the cognitive and the neuro-affective perspectives of motivation in schizophrenia (see Figure 4.1.). Moreover, this model incorporates other elements not identified in the cognitive and neuro-affective models but that were essential to support motivation. Thus, the two levels at the foundation of the model were personal goals and values and self-esteem. Initiation skills needed to implement an action plan, such as prospective memory abilities, were included in the third level of the model to complement the numerous affective, cognitive and behavioural processes identified in previous models. The three-level, multi-factorial model that ensued is presented in Figure 4.1. and detailed below.
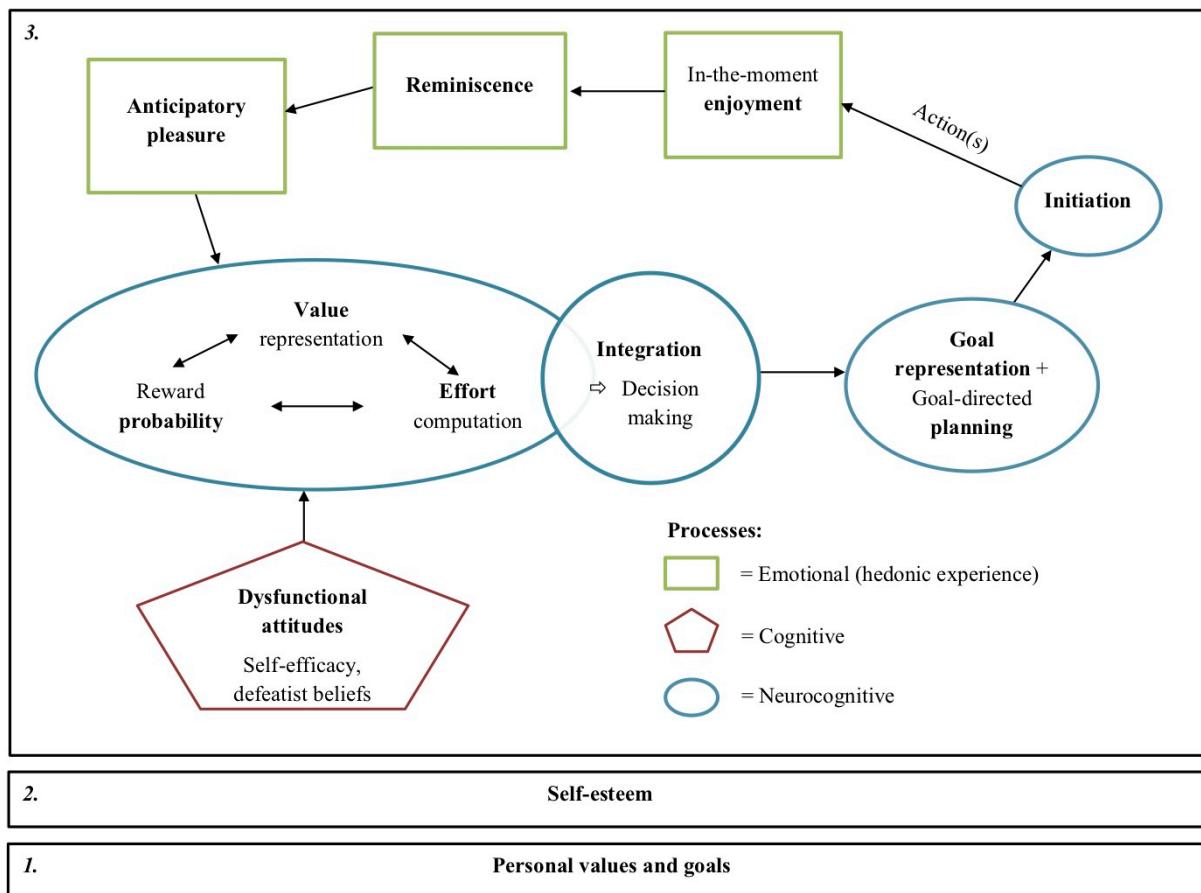
Figure 4.1. The three-level multifactorial model of motivation in schizophrenia.

The first two levels of the model comprise two interacting elements: **personal values and goals** on the first level and **self-esteem** on the second. Personal values and goals are essential to motivate and guide behaviours (Kasser, 2002), while self-esteem must be sufficient to engage in goal-directed behaviours. In addition, moving towards meaningful goals and values enhances self-esteem by bringing hope to the person and increases a feeling of agency (Cheavens, Feldman, Woodward, & Snyder, 2006). From the cognitive perspective, lowered self-esteem resulting from difficulties in daily life related to schizophrenia leads to dysfunctional attitudes (e.g. defeatist beliefs) that contribute to social withdrawal and inactivity (A. T. Beck et al., 2009). This withdrawal has a protective role against additional rejection and failure which would further affect self-esteem. Given its protective effect, withdrawal is maintained and tends to generalise across other situations. Thus, it is essential to break that vicious circle and (re)engage individuals in meaningful values and goals, which is the main goal of the Switch intervention.

The third level of the model narrows in on a specific goal chosen by the individual and goes through the processes that support motivation and goal-directed behaviours, as well as potential obstacles. This level mainly relies on the model proposed by Kring and Barch

(2014) (see Chapter 2). **Anticipatory pleasure** ("looking forward") focuses on sensations and emotions that can occur in anticipation of an activity or a reward. The next process is more cognitive and implies the consideration and integration of three elements: the **value** representation (i.e. how important the goal/reward is), the **probability** of reaching the goal/reward, and the **effort** required to reach it. These three elements vary depending on internal variables (e.g. how tired or hungry the person feels) or external factors (e.g. the weather). All three elements can interact. For example, the value of the goal/reward may vary depending on the probability of reaching it or the effort that is required: if the goal appears to be too effortful (high effort) or impossible to reach (low reward probability) its importance might be discounted (e.g. "I can do without this, after all"), even momentarily (e.g. "I really want to do this, but I'll do it later"). If the effort required is too high, and the resources of the person too low to exert this effort, the probability to reach the goal/reward will of course be lowered. The value-effort-probability **integration** of a chosen goal thus involves the consideration of various factors and leads to a decision. In the case of a decision towards goal-engagement, the goal is mentally represented ("**goal representation**") and goal-directed **planning** ensues. Next, the action plan moves into the **initiation** phase. While making progress towards the goal or when the goal has been reached (i.e. success), in-the-moment **enjoyment** can be experienced. Finally, this experience of goal-progress or success can lead to **reminiscence**, which can feed further projection into the future (e.g. remembering a pleasant activity and looking forward to repeating it).

Dysfunctional attitudes can influence all processes described above. Beliefs of low future pleasure can hinder the process of positive projection into the future. Dysfunctional attitudes can affect the three elements of the value-effort-probability equation: an individual might have a sense of low self-efficacy and believe they will not be able to exert the effort required to reach the goal (impacting effort estimation, and consequently estimation of the probability to reach the goal), or they might believe that engaging in a particular action is not worth it (impacting the value representation). Discouraging beliefs can also occur during planning (e.g. "I can't plan for this goal; therefore, it's going to be impossible to achieve it", "There are too many steps") and initiation (e.g. "I feel tired now, I'll do it later", "I'm not ready"). In-the-moment enjoyment can be hindered by biases towards negative elements of the experience. Finally, reminiscence can also be affected by biases that generate negative feelings such as discouragement (e.g. "It was not that difficult to achieve this, anyone can do it", "Where does it take me anyway? I'm still miles away from my goal").

In order to keep the third level of the model clear and simple, it is presented as a circle that moves from one process to another in sequence. In reality, the course of these processes is likely to be more complex.

First, one could start from various places within the model. For instance, the present enjoyment of a certain activity and the remembered pleasure of a past event could motivate an individual and in turn feed anticipatory pleasure and expectancies for future pleasure

(e.g. "I am enjoying this movie very much, I would love to see another one with that handsome actor"; "I remember liking to take walks in the forest when I was younger, maybe I could check where the closest woods are for a next walk").

Second, the different processes may overlap and some elements may appear at different stages of motivation and goal-progress. For example, representing the value of a certain action or goal can stem from anticipatory pleasure (e.g. feeling energized after going for a walk highlights the value of good health), as well as forming part of a value-effort equation (e.g. the value of health has a certain importance, which is relative to the effort that is required to walk). Focusing on value representation at different times can also be useful to maintain motivation to reach a goal (i.e. reminding oneself of values that motivate certain actions, sometimes difficult to put in place but required to reach a valuable goal).

Third, back-and-forth can occur within the model. For instance, when assessing the effort required, some planning might already be involved, whereas when planning is complete, the effort previously estimated might be updated (e.g. one might realise that reaching a chosen goal will not be that effortful after all). Finally, certain processes can vary in importance depending on the chosen goal. For example, a value-effort computation might not be needed for a highly-motivating activity because the balance heavily leans towards the high value that the activity brings. Similarly, a goal that is easy to obtain may need only minimal planning.

Thus, in real-life circumstances, this simplified visual model does not reflect the complexities of the course and fluctuations of motivational processes but allows easier navigation for users. Indeed, the model aims to be a compass guiding motivation from its premises (e.g. identifying what is important to us, where we want to go, looking forward to do something) to goal-attainment (i.e. translating motivation into real actions), and during the maintenance of goal-directed behaviours. It is thus both a theoretical model that aims to provide an understanding of the course of motivation and its deficits, as well as a practical model that aims to lead the psychotherapeutic intervention and provide guidance in the choice of strategies to use at various stages of motivation and goal-directed behaviours. Two versions of the same model were therefore created: one more complex and detailed for researchers and therapists (see Figure 4.1.), and a simpler and more practical model for therapists and patients (see Figure 4.2.). The latter consequently outlines strategies that can be implemented at the different stages of motivation and goal-directed behaviours.
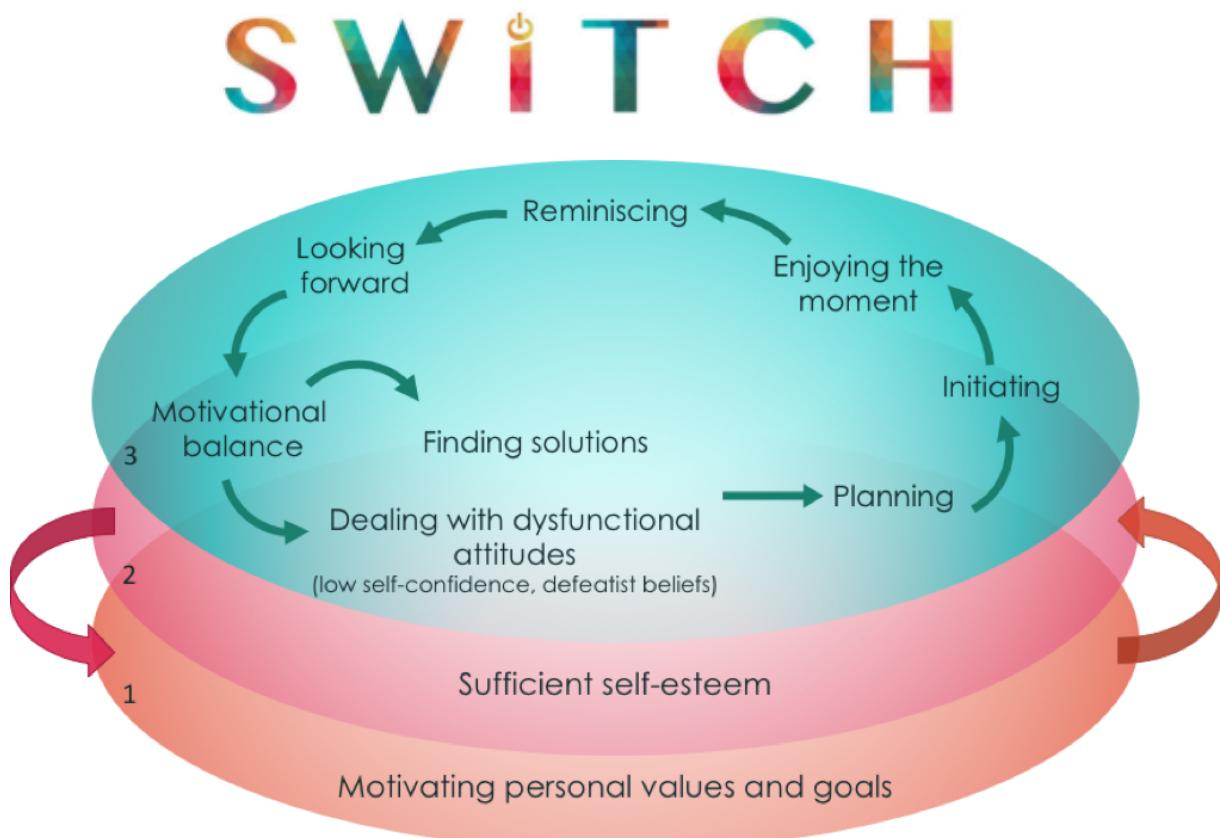
Figure 4.2. Three-level multifactorial model of motivation in schizophrenia (therapist and patient version).

To explain the model to therapists and patients, an example such as the following is used. Jane's value is "good health". She wants to be in good shape and is thinking of starting swimming again. She does not necessarily have the highest level of self-esteem but understands that following her goals and values will enhance her self-esteem. She anticipates how swimming might feel on different levels: the sensations of lightness and freedom in the water, the cool and refreshing temperature of the water, the dampened sounds when underwater, and the sense of pride leaving the pool. Swimming is quite important for her and she therefore values it highly. However, it requires a lot of effort and she is not sure that it will be possible to go to the local pool given the restricted opening hours (probability estimation). Several thoughts cross her mind: "Am I going to make it in time?" (cognition affecting probability estimation); "Is it worth going for only 30 minutes of swimming?" (cognition affecting value representation); "I am so heavy and slow" (cognition affecting effort estimation). Fortunately, she has followed the Switch intervention and knows how to tackle these discouraging thoughts. Next, she starts planning the different steps required to go to the swimming pool, finds solutions to some

issues (e.g. asking her sister to drop her off at the pool), puts a few reminders on her phone to ensure the different steps will be initiated (e.g. taking the towels out of the washing machine, putting them in the dryer). And there she is, enjoying swimming. While returning home, she bumps into a friend who notices her wet hair. Jane explains her experience at the swimming pool (reminiscence) and already looks forward to the next visit (anticipatory pleasure). Jane's friend admires her courage for going for an early swim and compliments her (boosting self-esteem).

This three-level multifactorial model underlines the complexity of motivation and goal-attainment and thus the fact that numerous and diverse variables are implicated. The model can help identify difficulties, but also certain processes that are unaffected and that represent strengths on which to rely on. However, many of the elements described in the model represent difficulties in individuals with schizophrenia, beginning with personal goals which are generally driven by avoidance or boredom rather than fulfilment of autonomy and competency (Gard, Sanchez, Starr, et al., 2014). Individuals with schizophrenia also generally exhibit lower self-esteem compared to healthy controls (Moritz et al., 2010). At the third level of the model, anticipatory pleasure can be impeded in schizophrenia (Kring & Elis, 2013; Raffard, Esposito, Boulenger, & Van der Linden, 2013), which, in turn, can affect the representation of the value related to a certain goal (Kring & Barch, 2014). Individuals with schizophrenia evidence abnormal cost-value computation (Fervaha, Graff-Guerrero, et al., 2013). A lower break-point (i.e. the point at which a person is not willing to exert extra effort to obtain a higher reward) is observed in individuals with schizophrenia (Marder & Galderisi, 2017). They might overestimate the effort required to reach a certain goal and underestimate the probability to reach it (Gold, Waltz, & Frank, 2015; Reddy, Horan, & Green, 2015). Furthermore, they might have difficulties integrating the value magnitude of future rewards (Vignapiano et al., 2016). Dysfunctional attitudes, such as defeatist (performance) beliefs or other demotivating beliefs, can further affect anticipatory pleasure (Pillny et al., 2020; G. P. Strauss & Gold, 2012) and motivation (Beck, Himelstein, & Grant, 2019; Campellone, Sanchez, & Kring, 2016; Couture, Blanchard, & Bennett, 2011). If a decision has been made to engage towards a certain goal, deficits in planning skills (Siddiqui et al., 2019) and maintaining goal representation can be an obstacle to goal-directed behaviours (Barch, Pagliaccio, & Luking, 2015). Moreover, individuals with schizophrenia often show initiation difficulties (Rinaldi & Lefebvre, 2016) and tend to have difficulties with carrying out planned actions (Lui et al., 2015; Y. Wang, Chan, & Shum, 2018). Finally, in-the-moment enjoyment is generally intact in schizophrenia, although savouring and remembered pleasure are often affected (Kring & Barch, 2014). In the next section, these impairments will be detailed in parallel with a presentation of Switch's modules.

2. The Switch intervention

2.1. General approach

"Switch" refers to a device which turns something on and off, but also relates to change, to shifts. The goal of the Switch intervention is to turn on motivation and turn-off elements that may undermine motivation. Switch does not merely aim to reduce motivational negative symptoms: above all, it aims to *shift* one's way towards goals and values that are meaningful to oneself. Thus, Switch intends to bring a substantive change in daily life and, in that sense, belongs to the recovery tradition (Anthony, 1993; Martin & Franck, 2013). The recovery movement attaches more importance to autonomy, personal thriving, and the reduction of distress related to symptoms, rather than of symptoms *per se*. In our approach, the end goal is to enhance quality of life and daily functioning by tackling one of their most important barriers: motivational negative symptoms. Furthermore, in line with the recovery approach, Switch relies on principles of positive psychology (Cheavens et al., 2006). Although the model on which Switch is based identifies processes that might be dysfunctional, it also highlights processes that are functional and that represent strengths and resources on which to lean on to build motivation. The intervention focuses more on the training and improvement of these processes and related skills, rather than on the reduction of symptoms. Finally, an important focus of the Switch intervention is on personal resources, goals, and values and their progress – rather than exclusively their attainment – in order to live a fulfilling life.

The engagement of individuals in goals and values that contribute to their well-being necessarily implies the experience of pleasant emotions. Feeling pleasant emotions is of course beneficial not only in the present moment: positive emotions have a protective effect when the person is confronted with stressful or difficult situations (Tugade & Fredrickson, 2007). Furthermore, positive emotions are associated with higher cognitive flexibility, which allows one to better cope in difficult situations (Ashby, Valentin, & Turken, 2002). Furthermore, experiencing positive emotions stimulates approach-behaviours, which are in turn related to self-efficacy and self-esteem (MacAulay, McGovern, & Cohen, 2014). Increasing the experience of positive emotions thus seems important to support engagement (i.e. approach behaviours) in meaningful goals and to manage obstacles to goal attainment. Switch promotes this focus on positive emotions, with positive therapeutic attitudes and a focus on goals that generate positive emotions, especially at the beginning of the therapy. A first goal should not be to lose weight, for example, as there is little intrinsic pleasure to losing weight. The focus could instead be on well-being (if better health is the value behind the goal of losing weight), and therefore on goals such us doing more physical activity, eating more healthily, or taking better care of one's physical appearance. These examples have a higher potential for intrinsic pleasure than the idea of losing weight, which may not happen for some time and thus generate frustration and other unpleasant emotions.

Likewise, Switch also adopts a progressive approach: the goals that are chosen should be progressive in their difficulty. This might imply subdividing general long-term goals into smaller, more accessible and short-term goals. The success related to the achievement of these different sub-goals will feed self-efficacy to reach higher-level goals.

Finally, Switch aims to increase autonomy and agency. The goal is for individuals to progressively integrate and master the Switch model in order to use strategies appropriately when faced with various challenges and to generalise their use in daily life. Thus, once all strategies have been presented during the Switch intervention, the therapist encourages the individual to move through the model on their own and choose the adequate strategy according to their goal, resources, needs and any obstacles met along the way.

2.2. Multiple "ingredients"

Given the multifactorial nature of the model for Switch, the intervention similarly integrates strategies that target the various elements of the model. The intervention strategies used have generally been validated separately (e.g. the use of cognitive restructuring alone). This separate validation might be problematic as there can be dysfunctions in different processes related to motivation, and targeting only one of those processes might not resolve all the obstacles that affect the translation of motivation into goal-directed behaviours. The particularity of Switch is the combination and adaptation of strategies in order to potentialize its efficacy to enhance motivation and daily functioning. Moreover, Switch is inspired by some therapeutic approaches that have not been used specifically with individuals with schizophrenia.

Like the Switch model itself, the different strategies (i.e. the different modules described in the next sub-sections) may not need to be followed in strict order, except for the first two levels (personal goals and values and self-esteem) that should be addressed from the start of the intervention, and should be kept in mind throughout the intervention. The modules are presented in the order of the model, but in real circumstances it is necessary to adapt the order and introduce the strategy according to what the person brings to the session in terms of goals, needs and resources.

Although neurocognitive impairments are not the main focus of Switch, they are taken into consideration as they may hinder the learning process of the strategies offered in the intervention. A few strategies are put in place to avoid certain cognitive obstacles. For example, the therapist repeats information, and makes sure that the participant has understood what has been communicated. Thus, not only does the therapist recap information, but also asks the participant to "rehearse" what has been explained. In order to bypass some memory deficits, key information is provided to participants in written form in a "participant booklet" (see Annexe 1). Furthermore, a set of reminder cards are provided which contain a short summary of each strategy of the Switch intervention (see Annexe 2). Finally, some neurocognitive functions are the focus of certain Switch modules: problem

solving (module 2.2.6. Solution seeking), planning (module 2.2.7. Planning) and prospective memory (module 2.2.8. Initiation).

The next sections describe the rationale for each module and provide a brief description of strategies used in each module. There is a particular focus on strategies that are new, that have been adapted to the intervention, or that have not been used in addressing the particular dysfunctions found in schizophrenia. Particularities of the different versions – individual sessions and group settings – of the Switch programme are described in the relevant papers (see Experimental section of the thesis).

2.2.1.   Personal goals and values

In theory

Goals and values both provide a "direction" in the motivational process: they guide the person's actions, behaviours and attitudes (Kasser, 2002; Schwartz & Bilsky, 1987). Although they are strongly related, goals and values have different scopes. Goals represent *specific* objectives to be achieved and which realisation or attainment is absent in the present moment (Bach, 2015). Values represent *general* life directions that transcend specific situations (Schwartz & Bilsky, 1990), which can always be followed in the present moment via a large array of actions that are constantly available (Bach, 2015; Hayes, 2004; Hayes, Strosahl, & Wilson, 1999). For example, the goal of obtaining a degree may or may not be achievable in the future, whereas the value of learning is always achievable in the present, in various ways and with any means (e.g. reading something on the Internet, asking questions to people, observing one's environment).

The pursuit of all goals or values do not have the same influence on motivation and well-being. There is a distinction between intrinsic and extrinsic goals and values (Kasser, 2002). Extrinsic goals (or values) refer to those goals that are usually means to achieve something else (e.g. wealth) or that depend on others (e.g. being famous) (Lekes, Hope, Gouveia, Koestner, & Philippe, 2012). According to Self-Determination Theory, intrinsic goals (or values) are those that have the power to inherently satisfy basic psychological needs for autonomy (i.e. to experience a sense of volition, the ownership of one's behaviour), competence (i.e. to experience achievement or a sense of effectiveness) and relatedness (i.e. to experience reciprocal, genuine, meaningful or caring relationships) (Deci & Ryan, 2000). The attainment or pursuit of intrinsic goals (or values) is related to better psychological health and well-being, due to their higher potential to satisfy basic psychological needs. Simply reflecting on one's intrinsic values, as opposed to extrinsic goals such as making money, induces more well-being (Martela, Bradshaw, & Ryan, 2019; Van Hiel & Vansteenkiste, 2009) and leads to a higher commitment to those values (Lekes et al., 2012; Miller & Rollnick, 2013). Intrinsic goals and values are therefore more adaptive and are encouraged throughout the Switch intervention.

As mentioned in Chapter 1 (see 4.2. Quality of life and functional outcomes), goals reported by individuals with a diagnosis of schizophrenia lack direction and agency and are more driven by boredom (i.e. "passing time"), by the avoidance of a punishment, and less motivated by the fulfilment of autonomy and competency (Gard, Sanchez, Starr, et al., 2014). Defining goals and values that are intrinsically motivating may thus be a challenge, but Switch proposes a variety of tools to help.

In practice

The identification of personal goals and values represents the indispensable first step of the Switch intervention. The therapist first describes how identifying and following (and not necessarily achieving) goals and values are important for well-being. There are then different tools to investigate goals and related values.

Values are explored through open questions (e.g. "what are important principles that guide your life?", "what is the most important to you in life?") or structured questionnaires, such as the Valued Living Questionnaire (Wilson, Sandoz, Kitchens, & Roberts, 2010) or the Portrait Values Questionnaire (Schwartz et al., 2001). Another method is to ask the participant to remember a moment when they felt particularly happy and serene (Monestès & Villatte, 2011; Wilson & DuFrene, 2009). The goal is then for the participant to vividly imagine the scene and to connect to sensations and emotions that reveal what really mattered to them. Values can also be derived from an exploration of personal goals (e.g. "What are your goals for the next few weeks/months/years?"). For example, the goal of leaving the hospital and finding an apartment may underline the value of autonomy. In turn, focusing on that value can broaden the possible goals (e.g. "what are different ways for you to feel more autonomous?"), for example by revealing goals that are more accessible and obtainable in the short term (e.g. "doing the cooking by myself"). Thus, goals can inform values, and values can inform goals (see Figure 4.3.). The Switch therapist helps the participant build this connection between personal goals and values in order to maintain motivation. Furthermore, the focus on the value and process of satisfying the value (e.g. cooking as a way to satisfy need for autonomy) rather than on the attainment of the goal (e.g. succeeding in the cooking) has a more positive impact on motivation (Eswara Murthy, Villatte, & McHugh, 2019).
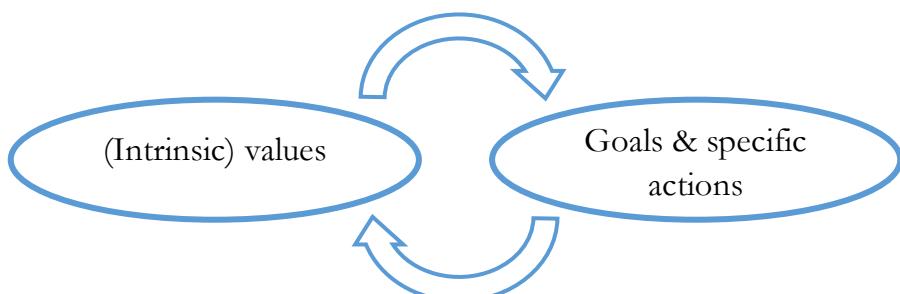
Figure 4.3. Reciprocal associations between values and goals.

Many other strategies can be used to explore what is important for participants and what direction they would like to take. For example, the therapist could ask participants what they dream of, what their ideal day would look like, what they would do if they won a hundred million euros (see Villatte, Villatte, & Hayes, 2016), where they picture themselves in a few years, or what they do on a regular day and why they do it. The answers to those questions are starting points to explore values and accessible goals.

We also developed a tool (the "benefit-cost cards"; Thonon, Groux, Nguyen, & Favrod, 2016)[24] to explore rewards sought by the participant. The participant looks through a pile of 38 illustrated cards with various rewards (e.g. "being cosy at home", "feeling loved", "creativity") and picks those that they would seek in their daily life. The advantage of such a tool is twofold. First, it helps participants who have difficulties verbalizing when, for example, identifying values and goals. Second, it helps show to the participant with a visual support (i.e. a selection of cards placed on the table) that there are generally a lot of elements that are important in their life and that there is a larger horizon of possibilities ahead compared to what they previously thought.

In sum, the goal of this first step is to take time to find a particular direction. The focus on one or more values is necessary. There can be either concrete actions or a particular goal to be planned for (see 2.2.7 Planning) in order to bring the person closer to their value(s). The translation of values or overarching goals to concrete representations, plans and actions might be impaired in individuals with schizophrenia (Kring & Barch, 2014). Training that ability by exploring possibilities to pursue values and goals is therefore essential. This training is initialized with the exploration of values and goals and deepened in the planning stage.

2.2.2.   Self-esteem

In theory

Self-esteem refers to a general and relatively stable perception of the self, including positive and negative evaluations and feelings that one develops regarding him- or herself (Rosenberg, 1979). Self-esteem presents motivational characteristics as one will try to gain self-respect as well as avoid self-contempt (Sörgaard et al., 2002). Higher self-esteem is indeed related to less avoidance and more approaching personal goals (Heimpel, Elliot, & Wood, 2006). Thus, it is not surprising that this construct has shown to be a predictor of functional outcomes (Roe, 2003; Vracotas, Iyer, Joober, & Malla, 2012) and change (Miller & Rollnick, 2013). However, individuals with schizophrenia present lower levels of self-esteem (Hall & Tarrier, 2003; Moritz et al., 2010).

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[24] For a detailed description of that tool, see Annexe 3.

While self-esteem is relatively stable, it has been shown to significantly improve with therapeutic interventions (Borras et al., 2009; Gumley et al., 2006). Furthermore, CBT specifically targeting self-esteem showed significant benefits also on negative symptoms and functional outcomes (Hall & Tarrier, 2003; Sönmez et al., 2014, 2020).

In practice

Switch aims to progressively increase self-esteem, which is an ongoing focus of the intervention. Moreover, low self-esteem is not taken as an insurmountable barrier to goal and value pursuit. Participants in Switch are told that they will move towards their values and goals even if they have low self-esteem. They are also told that moving towards something meaningful will give them hope and show them that they are able to be actors of their lives, thus increasing their self-esteem.

In order to increase self-esteem during Switch, the therapist supports a positive self-evaluation through formal exercises (e.g. identification of personal qualities, cognitive restructuring) as well as by informally praising participants. For example, participants were invited to investigate their successes, even small ones, to indicate different qualities and strengths ("I am good at …") and to provide very specific examples of how those positives characteristics develop in their daily lives (e.g. "Last Monday, I did some gardening for my sister all afternoon. That shows that I am a helpful person"). The goal of such exercises is to provide evidence of the qualities through the person's actions, and thus to reinforce the belief that they present these qualities (Hall & Tarrier, 2003). Moreover, throughout the intervention, the therapist highlights the qualities revealed by the actions that participants casually report. In addition, the therapist draws associations that can be made between the qualities and strengths of the person on the one hand, and personal goals and values on the other (e.g. "You seem quite good at this: that can certainly be useful for pursuing this particular goal"). Finally, the therapist frequently summarises the progress of participants. This has a double benefit: participants receive a broad picture of their success which is helpful for self-esteem, and it reveals that the therapist paid attention to their lives and that they are esteemed by the therapist.

Note that stigma – as well as "self-stigma" or "internalized stigma" – can be an important factor affecting self-esteem (Corrigan, Watson, & Barr, 2006; Karakaş, Okanlı, & Yılmaz, 2016). Stigmatisation and internalised stigmatisation, mediated by self-esteem, impedes recovery, functional outcomes and well-being (Link, Struening, Neese-Todd, Asmussen, & Phelan, 2001; Morgades-Bamba, Fuster-Ruizdeapodaca, & Molero, 2019; Picco et al., 2016; Vass et al., 2015). In case of internalized stigmatisation, psychoeducation and normalisation strategies are used in the Switch programme.

2.2.3. Anticipatory pleasure

In theory

Projecting oneself into the future, such as looking forward to something pleasant (i.e. a reward), implies the creation of sensory, as well as value and hedonic representations in the brain (Grabenhorst, 2014). The representations of future pleasure are key in motivation and necessary to drive goal-directed and rewarding behaviours (Engel, Fritzsche, & Lincoln, 2013). However, there is cumulative evidence for an impairment of anticipatory pleasure in individuals with schizophrenia: they commonly present anticipatory anhedonia (for a review and meta-analysis, see Hallford & Sharma, 2019; Visser, Chapman, Ruiz, Raugh, & Strauss, 2020). In addition, individuals with schizophrenia experience difficulties projecting themselves into the future, whether it be for positive or negative events, which may be understood as a sort of disengagement with their future (Goodby & MacLeod, 2016). These impairments in future projection that individuals with schizophrenia experience, and anticipatory pleasure in particular, are related to motivational deficits (Foussias & Remington, 2010; Raffard et al., 2013). Their difficulties in anticipating that a particular behaviour will lead to pleasure or success will indeed impact their tendency to engage in those rewarding behaviours. It is thus essential to train these anticipation skills in order to increase the probability of engaging in rewarding activities.

As a reminder, anticipation of pleasure can entail both a cognitive component, i.e. the *prediction* of a future pleasant experience (anticipated emotions or expectancies), and an affective component, i.e. the *affective response* to imagining the future pleasant experience (anticipatory pleasure) (Barsics et al., 2016; Baumgartner et al., 2008; Hallford & Sharma, 2019). Although distinct, both processes may be partially related. For instance, one might feel intense fear in anticipation of a certain event (strong anticipatory affective response) but not actually anticipate feeling such intense fear once the event occurs (prediction or anticipation of low affective response). On the other hand, predicting that one might not feel much pleasure in a future activity might transfer to reduced anticipatory pleasure (i.e. low affective response).

Previous studies have identified efficient strategies that increase pleasure anticipation skills. Most notably, Favrod and colleagues developed a programme that aims to increase the experience of positive emotions (Favrod, Giuliani, Ernst, & Bonsack, 2010; Favrod et al., 2015; Favrod, Nguyen, Chaix, et al., 2019; Nguyen et al., 2016) (see Chapter 3). The training of anticipatory pleasure involves multisensory imagery based on pictures, on future activities listed by the participants, or on past experiences that are reminisced to feed the projection into the future. The different trials undertaken to evaluate the efficacy of the programme provided evidence for an increase in anticipatory pleasure and/or a reduction in anhedonia and amotivation symptoms (Favrod et al., 2010, 2015; Favrod, Nguyen, Chaix, et al., 2019). Other interventions used imagery to improve the anticipation of pleasure, although with samples with different diagnoses. For example, in a sample of individuals with major depression, training activities aiming to enhance the details and vividness of

mental imagery for episodic future thinking increased the anticipation of how pleasant or rewarding those future events would be (Hallford, Sharma, & Austin, 2019). A brief internet-based positive imagery intervention was also found to have positive effects on anhedonia in individuals with depressive symptoms (Blackwell et al., 2015; Pictet, Jermann, & Ceschi, 2016). In another study (Renner, Ji, Pictet, Holmes, & Blackwell, 2017), repeated engagement in positive mental imagery led to increased behavioural activation in participants with depression, compared to a control condition. Finally, a recent study (Renner, Murphy, Ji, Manly, & Holmes, 2019) in healthy volunteers revealed that multisensory imagery into planned rewarding activities increased motivation, anticipated pleasure and anticipated reward for these activities, as well engagement in these activities. Thus, the use of (multisensory) imagery appears to have multiple benefits for motivation and related processes and could be used with individuals with schizophrenia.

In practice

In the Switch programme, the anticipation of pleasure is trained via guided multisensory imagery. This type of projection of future activities or goals include not only visualising the scene (i.e. the participant, the context, the actions), but also imagining as vividly as possible the sounds, physical sensations, smells, flavours, pleasant emotions and constructive thoughts related to the activity/goal. The imagery evokes the senses in order to increase the possibility of experiencing pleasure and to help identify what modality generates the more pleasure and consequently has the higher motivational power. Concretely, the Switch therapist guides the person through the different modalities, encouraging a detailed and vivid imagery, and provides a digital recording of generic guided multi-sensory imagery (see Participants booklet for details, Annexe 1).

This multisensory imagery is used principally to increase anticipatory emotions, i.e. to increase the experience of positive emotions in the present moment in order to boost motivation for future activity. Additionally, as the future events imagined during the exercises involve success or the attainment of pleasure, the imagery also targets the more cognitive component of pleasure anticipation, i.e. the prediction or expectancy of success or pleasure. For instance, imagining the pleasant emotions, thoughts, sensations evoked from sharing a cup of coffee with a friend increases both the experiential component of pleasure anticipation (e.g. imagining the warmth of the cup, the smile on our face, the calm, the joy), and the cognitive one (e.g. "I am capable of going out of my home to have a coffee", "I am able to enjoy such social contact"). Furthermore, the imagery can be focused either on the progress (e.g. preparing a cake, doing physical activity) or on the result (e.g. eating the cake, feeling fitter). Note that a focus on the process may be more beneficial (Pham & Taylor, 1999) as certain goals are not guaranteed to be attained (e.g. losing 8 kilos) and the process might require much motivation (e.g. participating in a spinning class every week). The idea is to develop intrinsic motivation for the processes in question and not only a motivation for the result which may or may not be attained.

Thinking about positive future events via imagery has several benefits for the development of motivation and well-being. First, positive projection into the future has the benefit of increasing the occurrence of positive emotions in the present moment and consequently positive mood (Sheldon & Lyubomirsky, 2006). Second, by bringing pleasure or success to the "here and now", imagery renders future rewards more present and therefore more tangible, attainable and motivating. Imagery thus builds a bridge between the present situation (absence of goal achievement) and possible future actions (Blouin-Hudon & Pychyl, 2017; Cox et al., 2016). Furthermore, the anticipatory pleasant emotion ("anticipatory pleasure") might influence the beliefs that such a pleasant emotion will occur (prediction of future pleasure; "pleasure anticipation"). Third, imagery helps highlight the importance (value) of the reward or goal sought, which is important for the value-effort-probability integration processes (see 2.2.4. Effort-value-probability integration). Fourth, imagery helps build a concrete goal representation (see 2.2.7. Planning), which will help build an action plan to reach the goal in question and maintain motivation throughout the progress towards the goal. Finally, imagery focusing on the process (*vs.* the result) has shown to facilitate action initiation and to increase performance, acting as a sort of virtual training (Pham & Taylor, 1999). Thus, the use of multisensory imagery has many advantages for different processes underlying motivation and goal-directed behaviours.

2.2.4.   Effort-value-probability integration

In theory

The decision to engage in a certain supposedly rewarding behaviour depends on multiple factors: the subjective *value* that one attributes to the reward, the *effort* required to reach it, and the *probability* to reach that reward (Fervaha, Duncan, et al., 2015). This integration[25] is complex and the resulting impaired decision making and lack of motivation may be due to dysfunctions of these different factors.

Value

The representation of the value of a certain reward is subjective (i.e. it varies between individuals) and is not absolute (i.e. it varies within individuals, as it can vary depending on the circumstances). It implies the integration of various information, including the hedonic features of the reward (e.g. the relaxing feeling of swimming), the person's current state (e.g. tiredness), and the availability of other possible rewards (e.g. watching TV, going for a walk) (Barch, Pagliaccio, Luking, Moran, & Culbreth, 2019).

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[25] Note that these estimations and integrations are not necessarily conscious and that, as human beings, whether perfectly healthy or ill, it is not assumed that we make absolute and errorless computations and equations of the different parameters that are described in this section.

Individuals with schizophrenia present deficits in the representation of the value of a stimulus or a (future) event, including difficulties in generating, accessing, maintaining and updating the mental representations (Barch & Dowd, 2010; Gold et al., 2012, 2008; Kring & Elis, 2013; G. P. Strauss et al., 2014). Furthermore, individuals with schizophrenia have difficulties using the reward's value to optimize decision-making (Saperia et al., 2019). These critical impairments in value representation may be responsible for their reward-learning deficits, i.e. the difficulties in drawing the associations between certain behaviours or cues and their ensuing positive outcomes, i.e. their rewards (Gold et al., 2012, 2008; G. P. Strauss et al., 2015). Reward-learning deficits thus result in a lower likelihood to engage in actions that are associated with positive outcomes (Brown et al., 2015). Note that these learning difficulties mostly apply to rewards and not to losses (Brown et al., 2015; Waltz et al., 2007). Individuals with schizophrenia are indeed more able to learn from actions that lead to negative outcomes (i.e. punishment) or to the avoidance of these negative outcomes. They are therefore more motivated by loss avoidance than reward gain (i.e. resulting in diminished approach motivation).

Furthermore, the reward value can be discounted due to different factors: the *effort* required to obtain it ("effort discounting"; see below, Effort) (Hartmann, Hager, et al., 2015), the *probability* to obtain it (see below, Probability) (Husain & Roiser, 2018), and the *delay* until the reward can be obtained ("delay" or "temporal discounting") (Massar, Libedinsky, Weiyan, Huettel, & Chee, 2015). Regarding the latter, the longer the delay between a cue or an action and the reward, the more the value of the reward is depreciated, and even more so in individuals with schizophrenia and severe negative symptoms (Bartolomeo, Chapman, Raugh, & Strauss, 2020; Heerey, Matveeva, & Gold, 2011; Heerey et al., 2007). This would explain why individuals with schizophrenia prefer to engage in actions related to goals that are achievable in the short-term, albeit that are less rewarding (Ahn et al., 2011).

Effort

The lower engagement in rewarding, goal-directed behaviours might also be due to decision-making that is guided less by the expected value of the reward (the "value-expectancy", i.e. the magnitude of the value times the probability to obtain it) and more by the estimated effort associated with the behaviour (Treadway, Peterman, Zald, & Park, 2015). To evaluate this, several studies have used a performance-based task such as the Effort Expenditure for Rewards Task (EEfRT; Treadway, Buckholtz, Schwartzman, Lambert, & Zald, 2009) that requires participants to decide for each trial to either allocate lower effort (e.g. button clicking with the index finger of the dominant hand) to obtain a lower reward, or to allocate higher effort (e.g. button clicking with the little finger of the non-dominant hand) to obtain a higher reward. In a study by Fervaha and colleagues (2013), the EEfRT was modified to adapt the difficulty of the task based on the individual performance on a training task. Thus, this adaptation controlled for motor slowing and limited the impact of subjective effort estimation. Also, before completing the task,

participants reported their subjective valuation of the monetary rewards which demonstrated that individuals with schizophrenia and healthy controls both valued the rewards in the same way. The results of that study revealed that individuals with schizophrenia exerted greater effort significantly less often than healthy controls for high-value rewards, whether the probability of obtaining the reward was uncertain (50% probability) or high (88% probability). Practically, even if they are certain to obtain a highly-valued reward and even in conditions where the effort required is adapted to their performance, individuals with schizophrenia will not expend increased effort, as if higher efforts always outweighed the value and the probability of the reward (i.e. the expected value). Similar findings have been found in studies using a cognitive task (e.g. a working memory task varying in the cognitive loads) (W. C. Chang, Chu, et al., 2019). Moreover, motivational deficits have shown to be associated with lower effort expenditure in both physical effort (Fervaha, Duncan, et al., 2015; Gold et al., 2013; Serper, Payne, Dill, Portillo, & Taliercio, 2017; G. P. Strauss et al., 2016) and cognitive effort tasks (W. C. Chang, Chu, et al., 2019; Culbreth, Westbrook, & Barch, 2016; Wolf et al., 2014). This reduced willingness to exert effort in situations where the value-expectancy is high (i.e. high value and high probability) could be explained by the learning deficit described above: individuals with schizophrenia present reward-learning deficits, but intact learning from punishment (Waltz et al., 2007). Thus, if effort is considered as a sort of punishment (i.e. a cost or an outcome to avoid), effortful behaviours will be avoided. Additionally, if the value of the reward is not well represented (Gold et al., 2012), it might not be salient enough relative to the estimated effort to guide the decision to engage in a potentially rewarding behaviour.

Another hypothesis for the lower engagement in effortful behaviours lies in the *estimation* of the effort. Gold et al. (2013) found that individuals with schizophrenia, particularly those with negative symptoms, were less likely to exert high efforts to obtain high value rewards, even in the 100% probability conditions. The authors concluded that individuals with schizophrenia may have impairments in the estimation of the cost of the effortful action. A hypothesis for this impaired effort evaluation is that individuals with schizophrenia may overestimate the "cost" of that effort (Gold et al., 2015). In a study using Experience Sampling Method (ESM), individuals with schizophrenia indeed showed not to accurately estimate how effortful or difficult a certain goal would be to achieve (Gard, Sanchez, Cooper, et al., 2014). In another study (Bentall et al., 2010), individuals with more avolition symptoms perceived simple everyday tasks as more difficult and less probable to be achieved successfully, and this was associated with less effort on those tasks.

Finally, an alternative hypothesis to lower effort expenditure is that effort may not be overestimated but actually "costs" more or may be more aversive to individuals with schizophrenia compared to healthy controls. In a study evaluating the exertion of cognitive effort (Culbreth et al., 2016), those with higher negative symptoms discounted reward valuation more steeply based on the effort required, i.e. they engaged in less rewarding behaviours. The authors suggested that the effort required for more rewarding behaviours was costlier for individuals with schizophrenia and negative symptoms. However, the

findings from Fervaha et al. (2013) suggest that this hypothesis may not hold, given that individuals with schizophrenia still chose to exert less effort than controls, while the task was adapted to their personal performance.

Probability

In general, a lower probability to obtain a certain reward will decrease its expected value, whereas a higher probability will increase it. However, as mentioned above, even in trials in which there is a high probability of obtaining a high value reward, individuals with schizophrenia are less often willing to exert the required high effort compared to healthy controls (Fervaha, Graff-Guerrero, et al., 2013; Gold et al., 2013; Serper et al., 2017). This could be due to an underestimation or lack of consideration of the probability to obtain a certain reward. Another hypothesis is that effort evaluation impacts probability estimation, so that individuals with schizophrenia underestimate the probability they will achieve the task, given the effort required. Such underestimation could be due to personal dysfunctional attitudes (see 2.2.5. Dysfunctional attitudes).

Other factors

There are two other factors that may impact the effort-value-probability integration: objective obstacles and dysfunctional attitudes.

Objective obstacles can stem from the effort-value-probability integration. For example, a person's goal is to swim, which is important for their health (i.e. high value). But there is no bus that would take them directly to the swimming pool and they have no car (i.e. objective obstacle). Consequently, the effort required to reach the goal is considerably increased as the person will have to walk, ride their bike, or take a bus to reach their destination, i.e. increasing the travelling time, increasing thus the "delay discounting" effect and also decreasing the probability to reach the goal.

Dysfunctional attitudes have been associated with motivational deficits and functional outcomes, using self-reported measures (Campellone et al., 2016). Furthermore, defeatist performance beliefs, for example, have been found to be related to effort allocation performance-based paradigms (Granholm et al., 2016; Reddy et al., 2018). Reddy et al. (2018) found that individuals with schizophrenia who presented both more motivational deficits and high levels of defeatist performance beliefs were less willing to exert efforts to attain more important rewards. Lower perceived personal competency (or lower self-efficacy) has also shown to be related to lower engagement in effortful tasks (J. Choi, Fiszdon, et al., 2010; Serper et al., 2017). Demotivating thoughts and low self-efficacy could decrease the valuation of a reward (e.g. "It's not worth swimming if I can't swim well"), increase the estimation of the effort (e.g. "It is too difficult for me to walk to the swimming

pool"), and consequently reduce the estimated probability to reach the reward (e.g. "I'm not going to succeed").

Summary

In sum, individuals diagnosed with schizophrenia show particular deficits in the estimation of the value, probability and effort that inform decision-making regarding the engagement in goal-directed behaviours. Impaired value representation and a higher aversion to effort might be the drivers of those deficits (Albrecht, Waltz, Frank, & Gold, 2016). As a consequence, effort might generally be more salient and decision-making may therefore be more effort-driven than reward-driven. Effort evaluation impacts the valuation and probability of the reward and results in a selection of less effortful, albeit less rewarding, behaviours. Dysfunctional attitudes might aggravate that bias by bringing a focus on the cost, i.e. the efforts required to reach a goal, and by reducing the probability to attain that goal. Thus, no matter how important or valuable a certain action/goal is, and no matter how certain it is to obtain the expected reward or to reach the goal in question, if it requires increased effort, some individuals with schizophrenia will prefer less effortful actions, leading to less fulfilling outcomes, ultimately leading to lower daily functioning and a less satisfying quality of life.

In practice

In the Switch programme, we suggest different ways to manage this value-effort-probability equation. The main goal is to emphasize the value representation, i.e. the importance of the goal, to help the person appropriately using the information about future rewards to optimize decision making and to guide engagement in goad-directed actions. This emphasis on the value representation is achieved through imagery, motivational interviewing and the decisional balance tool. This combination of strategies gives more weight to the value of the goal, relative to the effort required to achieve it. The anticipation of future rewards may indeed reduce the estimated effort to attain it (Geaney, Treadway, & Smillie, 2015). Other goals of this Switch module are to reduce the impression of effort, and increase the objective or estimated probability to attain a given reward.

First, *multisensory imagery*, as described in the previous section (see 2.2.3. Anticipatory pleasure) can also be used to help generate mental representations of the value of a certain goal and of its rewarding features. The imagery will help to increase the salience of the goal's value. It is also the occasion to build bridges between certain actions (imagery focused on the process) and the positive outcomes (imagery focused on the result) and thus address reward-learning impairments. As previously mentioned, using imagery helps to elicit pleasant emotions and a representation of the reward in the present moment, and thus affects the delay-discounting effect (Benoit, Gilbert, & Burgess, 2011; Peters & Büchel, 2010). The use of a picture of an object that reflects the value of the goal and that can be

placed as a cue in the person's usual environment can also serve as a strategy to help increase the salience of the goal's value.

Second, *motivational interviewing* techniques can also be useful (Miller & Rollnick, 2013). In the Switch programme, motivational interviewing mostly implies the verbalisation of all reasons why the goal in question is important, what the values that underlie the goal are, and eventually what (personal) resources can be put in place to progress towards that goal. This will also help reduce the estimation of effort by highlighting the means the person possesses to reach the chosen goal.

Third, the use of a "*decisional balance*" can be informative to identify arguments why the goal is important to the person (i.e. the reward's value), but also to recognise those reasons why the person has not yet engaged in that goal. For the Switch programme, we developed a simplified version of a decision balance: the "motivation switch" (see Figure 4.4.). This table is used to identify, in the left column, the reasons why the person would *not* engage in a certain activity (including potentially discouraging thoughts, required effort, obstacles), and in the right column, all the reasons why she or he would engage in that activity. Additionally, the middle column was used to indicate quick solutions for smaller identified obstacles. The solutions and pros represent the "ON" part of the switch, which is highlighted relative to the cons, which represents the "OFF" part of the switch. Note that the cons column potentially includes obstacles and dysfunctional attitudes that need further attention and that are addressed through more in-depth strategies (see 2.2.5. Dysfunctional attitudes and 2.2.6. Solution seeking).

SWITCH

The motivation switch

Chosen activity/goal:

....

Cons, obstacles, required efforts, drawbacks, negative thoughts…	➔ Solutions (quick fixes)	Pros, motivations, advantages, values
OFF	**ON**	

Figure 4.4. The motivation switch.

A complementary approach used to highlight a certain goal's value is to focus on reducing the estimation of effort by strategies such as effort re-evaluation and planning. The re-evaluation strategy implies engaging the person in an action which effort was previously estimated and then to invite the person to re-evaluate the effort based on their experience. This may lead to a realisation that the effort was not as important, or that it did not "cost" as much, leading to a lower computed effort that could generalise to other activities. On the contrary, if the effort was as intense as expected, the person can realise that they were able to expend that effort (increasing the estimation of the probability to reach the reward, e.g. "I'm able to expend a lot of effort, therefore, I can reach my goals"). Planning strategies can also help to reduce estimated effort. By breaking down larger, long-term and more complex goals into smaller, short-term steps or sub-goals, the high effort required for the larger goal is divided into lower-effort steps that are more accessible and that lead to rewards obtainable in a shorter term (Gard, Sanchez, Cooper, et al., 2014).

Finally, to enhance the probability of goal achievement, the therapist will focus on emphasizing the links between the person's actions and its positive outcomes, thus supporting reward-learning (e.g. "when you went out for coffee last time, you had a pretty good time. How much fun do you think you could have if you were going out for coffee again?"). Additionally, obstacles that objectively reduce the probability to engage in a rewarding behaviour are addressed by solution-seeking strategies (see 2.2.6. Solution seeking). Finally, dysfunctional attitudes (e.g. defeatist performance beliefs) that further affect decision-making are addressed in the next section (see 2.2.5. Dysfunctional attitudes).

In sum, these different strategies are used to emphasize the goal's value, reduce the salience and estimation of effort, and increase the probability of reaching the goal in question. Thus, this set of complementary strategies aims to guide decision-making so as to increase motivation, and thus the chances of engaging in potentially effortful, but above all, rewarding goal-directed behaviours.

2.2.5.   Dysfunctional attitudes

In theory

Dysfunctional attitudes are believed to play an important role in the development and maintenance of motivational negative symptoms in schizophrenia (A. T. Beck, Himelstein, & Grant, 2019) (see Chapter 2). These dysfunctional attitudes encompass beliefs or schemas about the self (i.e. self-efficacy, a feeling of personal competency), the other (i.e. the world or external situations) and the future (e.g. defeatist performance beliefs). They hinder the expectation of pleasure (e.g. "I won't enjoy swimming"), social connectedness or acceptance (e.g. "I look weird and people will reject me") and success (e.g. "I don't swim fast enough").

Individuals with schizophrenia endorse more dysfunctional beliefs about themselves (e.g. regarding skills, interpersonal abilities or self-worth) compared to healthy controls, even

more so when they present more severe negative symptoms (Lincoln, Mehl, Kesting, & Rief, 2011). Furthermore, the association between low self-efficacy and impaired daily functioning has been shown to be mediated by negative symptoms (Pratt et al., 2005; Vaskinn et al., 2015) and in particular their motivational factor (W. C. Chang et al., 2017; Ventura et al., 2014).

A recent meta-analysis found that defeatist beliefs about future performance or success (i.e. defeatist performance beliefs) were associated with motivational negative symptoms and daily functioning in schizophrenia (Campellone et al., 2016). Furthermore, as for self-efficacy, motivational deficits mediate the relationship between defeatist performance beliefs and functional outcomes (Pillny & Lincoln, 2016). Moreover, in a recent study in a non-clinical sample, defeatist performance beliefs were found to mediate the association between self-efficacy beliefs and negative symptoms (Luther, Coffin, et al., 2018). Thus, the relationships between various dysfunctional attitudes and negative symptoms seem to be intricate.

Addressing dysfunctional attitudes is crucial in cognitive behavioural therapy (CBT) and relies chiefly on cognitive restructuring (J. Beck & Beck, 2011). The premise of such an approach is that changing cognitions (i.e. thoughts, beliefs, schemas) will change emotions and behaviours. Addressing demotivating thoughts, for example, will help to eliminate certain obstacles to goal-directed behaviours. Several studies have indeed found CBT to be effective on dysfunctional attitudes and negative symptoms (Granholm et al., 2018; Grant et al., 2012; Staring et al., 2013). In Granholm et al. (2013), a combination of cognitive behavioural therapy and social skills training (CBSST), which focused in part on the cognitive restructuring of dysfunctional thoughts, appeared to have a greater benefit relative to a control condition especially for participants with more severe defeatist attitudes. In a later study, Granholm et al. (2014) found that CBSST lead to a significantly higher improvement namely on motivational deficits and DPB relative to a control intervention.

An alternative to CBT to cope with dysfunctional thoughts is cognitive defusion, which comes from Acceptance and Commitment Therapy (ACT; Hayes, Strosahl, & Wilson, 1999). Instead of aiming to change the content of negative thoughts, cognitive defusion aims to alter how one relates to one's negative thoughts. There is some evidence that ACT as a whole is a feasible and reasonable treatment approach for individuals with schizophrenia (Vaessen et al., 2019; Yıldız, 2020) and that it may have positive benefits for negative symptoms (White et al., 2011). There is no evidence of the use of the cognitive defusion technique by itself in individuals with schizophrenia. However, cognitive defusion has been shown to be effective in reducing the frequency of negative thoughts and their believability in a non-clinical sample (Larsson, Hooper, Osborne, Bennett, & McHugh, 2016) as well as in individuals with elevated depressive symptoms (Masuda et al., 2010).

In practice

Switch uses two main approaches to reduce dysfunctional attitudes in its participants: cognitive restructuring and cognitive defusion.

Cognitive restructuring, a key ingredient of CBT, aims to identify, challenge and eventually change the content or the credibility of dysfunctional beliefs (irrational or maladaptive thoughts). Cognitive restructuring relies on various techniques such as Socratic questioning (Froján-Parga, Calero-Elvira, & Montaño-Fidalgo, 2011), thought recording, identification of cognitive biases, examination of evidence for and against the thoughts, and listing of alternative beliefs that are more rational and more constructive. Detailed description of these techniques are beyond the scope of this thesis and are described elsewhere (Clark, 2013; Cottraux, 2011; Leahy & Rego, 2012; Tai & Turkington, 2009). Various techniques are used by Switch therapists. Participants are provided with exercise sheets used to identify a certain dysfunctional belief (plus optionally the context of appearance and related emotions) and to generate alternative thoughts (plus optionally their impact on emotions and behaviours).

A complementary approach to cognitive restructuring is *cognitive defusion* (Hayes, Levin, Plumb-Vilardaga, Villatte, & Pistorello, 2013; Hayes, Pistorello, & Levin, 2012; Hayes et al., 1999). This approach aims to alter the attitude that one holds regarding dysfunctional cognitions by reducing the extent to which they are perceived as truths: thoughts are not facts and they do not need to guide behaviours. Cognitive defusion implies the distancing from one's negative cognitions, while at the same time, accepting their presence. Cognitive defusion and acceptance help to bring the focus back to the present moment and on personal goals and values. The key messages of this approach in Switch are: "your negative thoughts are not facts", "you don't have to act on them" and "bring your attention back on your goals and values". Psychoeducation is provided to present concepts related to cognitive defusion and acceptance to participants. Metaphors used in ACT (e.g. Monestès & Villatte, 2011) are also used to present concepts related to cognitive defusion (distancing, acceptance, non-judging, mindfulness). To foster cognitive defusion, various techniques are employed. Therapists instruct participants to add the prefix "I am having the thought that…" in front of the dysfunctional belief in order to encourage distancing. Furthermore, short mindfulness meditations are provided to bring awareness of the thoughts and to induce acceptance, distancing, and being centred in the moment. Mindfulness has been used with individuals with schizophrenia and its practice has been associated with reduced dysfunctional attitudes (Chadwick, 2014; Chadwick et al., 2016; Tabak, Horan, & Green, 2015). Mindfulness interventions have also been shown to help reduce negative symptoms (Khoury et al., 2013).

2.2.6. Solution seeking

In theory

The ability to solve problems or seek solutions is essential to address various obstacles that prevent us from attaining or progressing towards our goals. In particular, the ability to generate alternative ideas or solutions to face a problematic situation by thinking in multiple directions, i.e. divergent thinking, has shown to be essential for successful social and daily functioning (Nemoto, Kashima, & Mizuno, 2007; Nemoto et al., 2009). Several studies have found that individuals with schizophrenia have difficulties in interpersonal problem-solving skills (Zanello, Perrig, & Huguelet, 2006) and in divergent thinking (Jaeger, Tatsuoka, Berns, & Varadi, 2006; Pillny et al., 2020). The impairments in interpersonal problem-solving skills and divergent thinking are moreover related to negative symptoms (Jaeger et al., 2006; Zanello, Perrig, et al., 2006) and divergent thinking deficits are also associated with community functioning (Takeshi, Nemoto, Fumoto, Arita, & Mizuno, 2010). This provides more reasons to focus on those skills in an intervention that aims to reduce negative symptoms and enhance daily functioning.

Nemoto et al. (2009) found that increasing the abilities in divergent thinking with an 8-week cognitive training programme may lead to reduced negative symptoms and increased community functioning. Another cognitive training programme focused on planning and problem-solving was found to improve those skills as well as functional capacity, particularly for individuals with schizophrenia who had executive deficits (Rodewald et al., 2014, 2011).

In practice

The solution-seeking or problem-solving strategy that is proposed in the Switch programme is based on the work from D'Zurilla and colleagues (D'Zurilla & Goldfried, 1971; Nezu & D'Zurilla, 1981; Nezu, Nezu, & D'Zurilla, 2007). Their problem-solving process model involves a five-step procedure, from problem definition to solution evaluation. Participants to the Switch intervention are provided with a table that involves following the first three steps of this procedure (see Annexe 1).

The first step requires a precise definition of the problem(s) and description of the goal to be reached. Several questions are asked to specify the problem(s): In what context does the problem appear? What are the hypothesized causes of the problem? What are the negative consequences of that problem? It is essential to define the problem and the goal in concrete terms as it determines the efficacy of the next steps (Nezu & D'Zurilla, 1981).

The second step involves the generation of an unlimited number of potential solutions (D'Zurilla & Nezu, 1980), thus supporting divergent thinking. The participant is told not to judge the solutions at this moment but to instead let their imagination run free.

The third step involves the evaluation of the different solutions and the selection of the most optimal ones. The criteria for the evaluation and selection of the solutions are: their potential to solve the problem (e.g. the solution solves the problem only partly); their feasibility or accessibility (depending on the person's means or abilities); their short-term consequences; their long-term consequences. Each criterion receives a score (-1, 0, 1) and the best solution is selected based on the higher total score.

The fourth step consists in planning the different actions required to apply the chosen solution (see 2.2.7. Planning). This requires participants to foresee what resources will be necessary and to guarantee that the various actions will be actually implemented (see 2.2.8. Initiation).

The fifth and final step evaluates the solution's efficacy: Did the solution resolve the problem and allow one to reach the goal? If not, what went wrong (back to step 1)? What other solutions can be put in place (step 3)?

2.2.7.   Planning

In theory

Planning and initiating goal-directed behaviours are critical skills through which motivation translates into actions. However, individuals with schizophrenia appear to have deficits in planning, which have been observed on laboratory tasks such as the Tower of Hanoi or the Zoo map (Knapp, Viechtbauer, Leonhart, Nitschke, & Kaller, 2017; Thai, Andreassen, & Bliksted, 2019), on ecological paradigms using multitasking in virtual environments (Laloyaux, Van der Linden, Nuechterlein, Thonon, & Larøi, 2018; Siddiqui et al., 2019), and in activities of daily living (Semkovska et al., 2004; Seter, Giovannetti, Kessler, & Worth, 2011). They usually take more time to complete the given task, make more errors, and the sequencing of their actions is less optimal. Furthermore, they appear to spend less time planning (Seter et al., 2011). These deficits in planning skills have been shown to relate to motivational negative symptoms and daily functioning (Aubin, Stip, Gélinas, Rainville, & Chapparo, 2009; Liemburg et al., 2015; Siddiqui et al., 2019). Finally, the ability to generate actions to reach a goal, which is an essential part of goal-planning, is impaired in individuals with schizophrenia and is related to motivational deficits and negative symptoms in general (Hartmann, Kluge, et al., 2015).

Interventions that target planning skills generally involve common ingredients that include goal identification and the preparation of a sequence of different actions (or sub-goals) that are required to reach that goal. Goal management training (GMT) has shown to be effective in improving executive functioning in various samples (Stamenova & Levine, 2019) including samples of individuals diagnosed with schizophrenia (Katz & Keren, 2011; Levaux et al., 2012). GMT involves thorough goal planning (goal definition, listing of sub-tasks and learning of the action plan) as well as a metacognitive element: individuals are trained to "stop and think" and orient their attention towards the goal and its progress.

Other studies have used the Goal-setting and Planning (GAP) intervention, which focuses on goals that are intrinsically motivating or pleasant (MacLeod, Coates, & Hetherton, 2008). The GAP was found to improve life satisfaction, reduce hopelessness and increase positive affect in samples of healthy individuals (MacLeod et al., 2008), individuals with depression (Coote & Macleod, 2012) and individuals with schizophrenia (Farquharson & MacLeod, 2014; Ferguson, Conway, Endersby, & MacLeod, 2009). Following such an intervention, participants with a diagnosis of schizophrenia also showed increased positive future thinking and fewer negative symptoms (Ferguson et al., 2009) as well as higher expectations regarding their efficacy and the probability of goal attainment (Farquharson & MacLeod, 2014). Developing goal setting and planning abilities appear therefore to be essential to improve daily functioning and quality of life.

In practice

The various planning interventions offered in the literature generally rely on similar components (Ferguson et al., 2009; B. Levine et al., 2000; MacLeod et al., 2008; Miller & Rollnick, 2013) that were also used in the planning module of the Switch programme: goal setting and goal representation; listing and ordering of sub-goals, and task definition and action-plan.

Goal setting and goal representation

As personal goals and values have previously been identified, this module narrows in on a chosen goal or value and aims to define it precisely. The more specific the goal is, the easier the planning will be. At this stage, multisensory imagery can again help identify what the person exactly wants and help them develop a clear goal representation that will help guide the subsequent steps. If a mental representation is difficult to generate, a picture or an object can be used.

Throughout the different modules of Switch, the focus is often returned to the chosen goals and values in order to foster goal-directed actions. Furthermore, note again that the focus of Switch is on goal progress rather than goal attainment. Successful goal pursuit defined as goal advancement, rather than goal attainment, is associated with higher levels of subjective well-being (Klug & Maier, 2015).

Listing and ordering of sub-goals

Switch participants are invited to write down (on sticky notes) all the steps they consider necessary for their goal progress or attainment. They can then order the sticky notes (e.g. in a logical order or an order representing the progressive difficulty of the different actions or behaviours, such as a physical workout routine). Some sub-goals will require additional

sub-tasks. The use of sticky notes makes this process much easier than writing, erasing and rewriting lists on a sheet of paper.

Task definition and action-plan

Each sub-goal (or task) must be clearly defined to increase the chances of the participant realising them. In this way, the participant will know exactly *where*, *when*, *how*, and if applicable, *with whom* they will perform the task. Problem-solving strategies might also be useful at this stage. The resulting action-plan has to be short and clear in the person's mind. It can be combined with different strategies to ensure action initiation (see 2.2.8. Initiation). Note that particular effort is made in the Switch intervention to ensure action plans include intrinsically motivating actions.

2.2.8.   Initiation

In theory

To be motivated, to have decided to reach a certain goal and to have a plan are necessary but not sufficient conditions: action initiation is crucial to ensure the action plan is implemented and does not simply remain words, thoughts, and intentions (Brandstatter, Lengfelder, & Gollwitzer, 2001). Individuals with schizophrenia show initiation difficulties in certain circumstances. First, in those with negative symptoms, the initiation of action is compromised in situations where the action in question has to be driven by personal goals (i.e. self-initiated actions), whereas actions in responses to stimuli in the environment (i.e. stimulus-driven actions) may be intact (Rinaldi & Lefebvre, 2016). Several studies have found that, in individuals with negative symptoms and higher levels of apathy, initiation was less impaired when guided by cues (e.g. semantic cues in fluency task or metronome rhythm in a tapping task) (Langdon, McLaren, Polito, Coltheart, & Ward, 2007; Rinaldi & Lefebvre, 2015). Thus, goal-directed behaviours (i.e. self-initiated actions) might be supported by the placement of relevant cues in the environment so as to trigger the desired behaviours.

A similar aspect of initiation of goal-directed actions concerns prospective memory, i.e. the ability to remember to carry out intended actions at a certain time in the future. Recent meta-analyse and reviews of the literature have indicated that individuals with schizophrenia presented severe impairments in prospective memory (Y. Wang et al., 2018; Zhou et al., 2019). The impairments particularly concern prospective memory based on time (i.e. remembering to do something at a precise time or after a certain period), but also on activity (i.e. remembering to do something at the end of an activity), and on event (i.e. remembering to do something when a particular cue appears, e.g. in a particular context or in the presence of a certain person). Prospective memory is recognized to comprise two components: a *prospective* component which refers to the ability to remember to initiate the intended action

in the future, and a *retrospective* component which refers to the ability to remember the what and when of the future action (L. Liu et al., 2020). It is not clear if individuals with schizophrenia are impaired regarding the prospective (e.g. Henry, Rendell, Kliegel, & Altgassen, 2007; Raskin et al., 2014), the retrospective (L. Liu et al., 2020), or both components (Woods, Twamley, Dawson, Narvae, & Jeste, 2007). The impairments observed in time-based and activity-based memory tasks (Y. Wang et al., 2018; Zhou et al., 2019) suggest impairments in the prospective component. Several studies that have focused on event-based prospective memory have found that individuals with schizophrenia had difficulties in cue identification (i.e. the event that should trigger the intended action; e.g. a bakery), as well as in the retrieval of the intention (i.e. what to do; e.g. buying bread) (D. Liu et al., 2017; Woods et al., 2007). These difficulties suggest impairments in the retrospective component of prospective memory.

Prospective memory deficits have shown to be correlated with negative symptoms (Y. Wang et al., 2009; Zhou et al., 2019). They may also play an important role in the difficulties faced in activities of daily living (Au et al., 2014; Ordemann, Opper, & Davalos, 2014; Twamley et al., 2008). Furthermore, prospective memory deficits (time- and event-based in particular) may represent primary impairments (not secondary to other cognitive impairments). For instance, impairments were found in individuals with first-episode schizophrenia and otherwise intact cognitive functioning (Lui et al., 2015). Another study found that other cognitive deficits failed to explain the magnitude of prospective memory deficits in individuals with schizophrenia (Henry et al., 2007). Deficits in prospective memory are thus important intervention targets, which are often not considered in therapeutic programmes aiming to improve negative symptoms and daily functioning.

Implementation intention (if-then plans, see next section, In practice) has shown to be effective to support goal attainment (Gollwitzer & Sheeran, 2006), including in individuals with mental health problems such as schizophrenia (Brandstatter et al., 2001; Toli, Webb, & Hardy, 2016). A systematic and meta-analytic review indicated that implementation intention significantly improved prospective memory performances in healthy young and older adults (X.-J. Chen et al., 2015). Benefits on prospective memory abilities were also found in young individuals with early psychosis (Khoyratty et al., 2015) and individuals with schizophrenia (T. Chen et al., 2019).

In practice

The Switch programme includes different strategies to support the initiation of future goal-directed behaviours, including cues, reminders and alerts, as well as the implementation intention strategy.

Cues, reminders and alerts

Certain cues in the environment can trigger behaviours that are desired to evolve into habits (e.g. a glass of water next to bed to drink water from the start of the day; a hairband that is an arbitrary reminder of an important value). However, it is important that the cue appears salient in the environment as individuals with schizophrenia exhibit difficulties in detecting cues (Woods et al., 2007). Cues can also take the form of alerts and reminders which have shown to be useful in enhancing prospective memory (e.g. Henry, Moore, Terrett, Rendell, & Scott, 2019). New technologies such as smartphones allow individuals to have a "personal assistant" accompanying them everywhere. In the Switch programme, we also rely on technology and invite participants to use their smartphones to set alarms, to create reminders (i.e. an alarm with specific instruction or a "notification") that will trigger a certain action from the action-plan, and to create and check lists (e.g. with the different steps to reach a goal or with a list of various actions that represent enactment of personal values). Such cues might be a good way to bypass the deficits in both components of prospective memory: a sounding alarm is a solution to the failure in cue identification and in remembering to perform the future task, while the text-based notification contains the "what" of the task (i.e. what precisely needs to be done).

Implementation intention

A more complex strategy also used in the Switch programme is implementation intention (Gollwitzer, 1999; Gollwitzer & Oettingen, 2013). This technique relies on planning in advance a behaviour to be initiated in a future situation, and to create a mental association between that particular situation and the chosen behaviour: "If/when I encounter situation X, then I will perform behaviour Y". Furthermore, the created association between the situation and the behaviour helps the initiation of the behaviour, as the person no longer has to decide what to do in that given situation and thus does not have to rely on "top-down" executive functions which may be impaired. With a good implementation intention, there is an automatization of the behaviour (X.-J. Chen et al., 2016). For example, as part of the goal of starting to play the guitar again, a person could plan to ask a particular person the details of their guitar teacher. The implementation intention could be: "When I see Sasha tomorrow at the community centre, I will ask her for the details of her guitar teacher".

The trigger for the behaviour can be something visible in the environment (e.g. an object, a person, a particular situation), or some internal state (e.g. feeling stressed, ruminating, being hungry, craving a cigarette). Likewise, the behaviour can be overt (e.g. drinking a glass of water) or internalized (e.g. focusing the attention on breath, directing the attention on the present moment). When the triggers are determined in advance, they are more salient in the environment once they appear (Gollwitzer & Sheeran, 2006).

The implementation intention strategy is complemented by imagery to increase the likelihood of behaviour initiation (X.-J. Chen et al., 2015). Indeed, by imagining the

situation X, the salience of the cue will be increased, which is important given the difficulties in cue identification that have been observed (D. Liu et al., 2017; Woods et al., 2007). Furthermore, imagining the behaviour Y increases its retrieval and its actual performance (X.-J. Chen et al., 2015; Pham & Taylor, 1999).

2.2.9.   Present enjoyment

In theory

As mentioned earlier, individuals with schizophrenia do not appear to have impairments in consummatory pleasure, i.e. the ability to enjoy pleasant stimulations, as demonstrated by laboratory-based tasks (Kring & Barch, 2014; G. P. Strauss & Gold, 2012). However, a recent meta-analysis indicated that self-reported levels of consummatory pleasure were reduced in individuals with schizophrenia or schizotypy (Visser et al., 2020). Furthermore, individuals with schizophrenia might have difficulties in savouring or maintaining pleasant emotions (Kring & Barch, 2014).

Pleasure is the product of experiencing positive emotions, and increasing the occurrence of such experiences should lead to increased well-being. Furthermore, savouring the present moment is associated with positive affect, happiness and life satisfaction (Hurley & Kwon, 2012; Jose, Lim, & Bryant, 2012; Seligman, Rashid, & Parks, 2006). Moreover, being present predicts well-being and, as suggested by Quoidbach, Berry, Hansenne, and Mikolajczak (2010), can be fostered by a mindful approach in daily life, in which one directs attention on the present moment and distances oneself from thoughts unrelated to the current activity or situation.

In a study examining self-reported mindfulness, individuals with schizophrenia showed lower levels of mindfulness compared to healthy controls (Tabak et al., 2015). Furthermore, in those with schizophrenia, mindfulness was associated with less dysfunctional beliefs, and some components of mindfulness were also related with self-reported motivation.

On a therapeutic level, mindfulness interventions have proven to be feasible and beneficial for individuals with schizophrenia, namely regarding mindful awareness (Louise, Fitzpatrick, Strauss, Rossell, & Thomas, 2018) and negative symptoms (Khoury et al., 2013). Furthermore, change in mindfulness skills (i.e. observing, describing, acting with awareness, and accepting without judgement) was correlated with change in depression in individuals with schizophrenia (White et al., 2011).

In practice

Opportunities to focus on pleasant experiences mostly occur outside of the therapeutic sessions and the focus on present enjoyment is limited in the Switch programme. However, Switch intends to increase the opportunities of pleasant experiences by increasing rewarding goal-directed behaviours. Furthermore, mindfulness training is used in Switch to

increase the likelihood of savouring outside of the sessions, during the activities taking place in the person's usual environment. The training takes the form of short meditation sessions combined with relaxation to induce a calming and pleasant experience on which the attention is directed and which can be savoured. The participants are also invited to train a mindful attitude and savour chosen activities outside of the therapy (e.g. while going for a walk in the fields, while taking a shower, while eating). Mindful awareness is also fostered during the Switch sessions in which the therapist focuses on the person's feelings during the session (e.g. when laughing with the therapist). Finally, when participants are invited to reminisce about recent past personal events, the therapist enquires about the mindful attitude during the reported activities (e.g. "Were you focused on that activity? Where was your mind wandering?") and ensures attention is redirected towards positive aspects of the experience in case of dysfunctional thoughts ("I achieved my goal, but anyone could have done it").

2.2.10.   Reminiscence

In theory

According to several meta-analyses (Berna et al., 2015; Y. Zhang, Kuhn, Jobson, & Haque, 2019), the memory of personal past events, i.e. autobiographical memory, is severely impaired in individuals with schizophrenia. They report fewer specific memories (i.e. events that occurred at a specific time and place, and that lasted less than a day), which are less vivid (i.e. poorer in sensory, emotional, perceptual or contextual details), and also report lower conscious recollection (i.e. the awareness of the self in the mental time travelling and the feeling of reliving past events).

The ability to recall personal past experiences and to imagine future potential experiences share neurofunctional and cognitive features (Fornara, Papagno, & Berlingeri, 2017). It has been suggested that our ability to project into the future (imagine, simulate and predict possible events) relies upon our aptitude to remember the past (Schacter et al., 2007). An association between the specificity of autobiographical memories and the ability to generate future possible events has been observed in one study evaluating individuals with schizophrenia (X. Chen et al., 2016). However, other recent studies found such an association only in healthy controls and not amongst individuals with schizophrenia, suggesting that the latter experience a lack of continuity in their sense of self, between their past and future self (Allé et al., 2016; Barry, Hallford, Del Rey, & Ricarte, 2020). Barry et al. (2020) suggest that individuals with schizophrenia might have difficulties retrieving past personal events and integrating them into imagined future events. Going a step further, Herbener et al. (2007) suggest that this failure to integrate positive past experiences may lead to anticipatory anhedonia and motivational deficits, by reducing the long-term emotional and motivational power of those experiences. Reminiscence should therefore be

enhanced, not only to improve autobiographical memory, but also for its relation to anticipatory functions, and therefore decision-making and goal-directed behaviours.

Autobiographical memory can be enhanced with cognitive training (Y. Zhang et al., 2019), for example via the use of a written diary requiring one to describe specific autobiographical memories (Blairy et al., 2008). Interventions aiming at enhancing the frequency, specificity or vividness of autobiographical memory can have important positive consequences aside from enhancing the ability to recall autobiographical memories. For example, reminiscing about past positive personal events (through mental imagery or memorabilia) increases happiness, especially when the reminiscence is vivid (Bryant, Smart, & King, 2005) and focused on sensory and bodily experience (Gadeikis, Bos, Schweizer, Murphy, & Dunn, 2017; Nelis, Holmes, Palmieri, Bellelli, & Raes, 2015). Furthermore, Memory Specificity Training (MeST), which aims to reduce over-general recalling of events associated with emotional disorders (e.g. rumination), also leads to improved problem-solving abilities as indicated in a recent meta-analysis (Barry, Sze, & Raes, 2019). In another study, participants experienced increased self-efficacy and motivation, as well as decreased negative mood, following an intervention that involved the generation of positive memories linked to activities that participants want to repeat in future (C. J. Edwards, Garety, & Hardy, 2020). Finally, in a study investigating both reminiscence and projection into the future (Painter & Kring, 2016), individuals with schizophrenia appeared to have difficulties drawing from the past and generating detailed and rich projections into the future. However, when cued to recall and describe specific past events prior to a task of projection into the future, individuals with schizophrenia were able to report as much current and anticipated pleasure than healthy controls. Inciting auto-biographical memories might support more detailed projection into the future and more anticipatory pleasure, which closes the motivation loop.

In practice

Every session in Switch is an occasion to foster autobiographical memory by inviting the person to recall a recent past event in a vivid and sensory way (e.g. asking details about thoughts, feelings, sensations) and using imagery in certain cases to foster a richer recollection. Furthermore, participants are asked to increase the occurrences of positive reminiscence outside the therapy, for example by the use of a diary, by sharing personal experiences with others (e.g. giving someone a call), by displaying memorabilia or photos in their usual environment, or by other means that induce positive reminiscence (e.g. listening to a specific piece of music, going back to certain places). Reminders or alerts are used to trigger reminiscence in the person's daily life (e.g. setting a notification every night to be reminded to take a few minutes to look back at positive past events).

3. Conclusion

The development of the Switch intervention first began with the elaboration of a model that is based on extensive research, including various models that had been validated in schizophrenia. The result of this is a three-level model that combines both the cognitive (Rector et al., 2005) and neuro-affective perspectives (Kring & Barch, 2014). Furthermore, it also incorporates elements from general motivation theories (Deci & Ryan, 2000; Kasser, 2002), with the inclusion of personal goals and values at its foundations. The three-level model thus comprises a large and varied number of factors that are related to motivation and goal-directed behaviours and considered to be mostly dysfunctional in individuals with schizophrenia spectrum disorders.

The Switch intervention that emerged from that model combines integrated strategies that address all elements identified in the model, and all strategies serve the advancement towards the person's goals and values. Motivation can indeed be affected at different stages towards goal attainment and Switch provides strategies to tackle the various obstacles that may appear along the way. Each process has thus been thoroughly analysed (i.e. looking at what dysfunctions exactly) in order to select and adjust the most appropriate strategies for the intervention. Switch has the unique advantage of integrating these strategies into one complete and comprehensive programme, and it potentializes the efficacy of the intervention by targeting the many known difficulties in motivation.

Switch is a unique intervention which shares common features with other interventions. First, it belongs to the third wave of the cognitive behavioural approach (with a focus on cognitions, behaviours, and also emotions) in addition to the recovery movement (with a focus on increasing autonomy and well-being in an individualized manner). Second, Switch uses strategies that have been validated separately before (e.g. cognitive restructuring, implementation intention) and elements of interventions that have proven to have a beneficial effect in other clinical populations (e.g. depression). Acceptance and Commitment Therapy, CBT or Implementation Intention, for example, have inspired some modules of Switch but, taken separately, do not integrate all the strategies that Switch offers. Other interventions, such as Behavioural Activation, are based on different models but that are not specifically validated for the use in patients with schizophrenia and motivational deficits. Finally, existing interventions (e.g. Favrod et al., 2019, 2015; Velligan et al., 2015) that target motivational deficits in particular may follow a similar model to Switch but do not include all the factors present in the Switch model.

In sum, Switch is a comprehensive, multi-factorial, and integrative intervention that has been designed in a systematic way, specifically for the motivational deficits observed in schizophrenia spectrum disorders. Given the important associations between those deficits and both functional outcomes and quality of life, Switch aims to more directly improve those outcomes by increasing the engagement in fulfilling personal goals and values.

EXPERIMENTAL SECTION

Introduction

This experimental section is comprised of the different studies that were conducted to fulfil the main aim of this thesis: validate Switch as a useful intervention for the enhancement of motivation, functional outcomes and quality of life.

Study 1 is a pilot study that evaluates the effects of Switch provided in individual sessions over the course of approximately one year. The main aim of this study was to evaluate the feasibility of the intervention and the evaluation protocol, the acceptability and the preliminary efficacy of the Switch intervention. Switch was provided through one-hour sessions, once a week for the first six months, and then twice to once a month for the following six months. The evaluation procedure included traditional (interview and self-rated scales) measurements of symptoms, functional outcomes, quality of life and processes related to motivation (e.g. savouring beliefs and tendencies, dysfunctional attitudes).

Study 2 aims to pursue the validation of Switch, albeit delivered in a more condensed format (one-hour sessions, twice a week for two months), in a more naturalistic setting, and through case-studies. Furthermore, the evaluation procedure is very different from Study 1, as it includes Experience Sampling Method (ESM) and actigraphy. Participants used a smartphone to reply to a questionnaire that was sent several times a day before the start of the intervention, throughout the intervention and at a follow-up period. The questionnaire evaluates various processes related to motivation and goal-directed behaviours, as identified in our model (see Chapter 4). Furthermore, we also used actigraphy to collect longitudinal data of daily step-count, i.e. an objective measure that has shown to be good proxy for motivational deficits (Gupta et al., 2014). This approach was taken in order to explore how the various processes related to motivation and goal-directed behaviours interacted and evolved across time, allowing to generate hypotheses on possible mechanisms of change. In terms of the intervention, elements of Ecological Momentary Intervention (EMI) were used in order to increase the generalisability of the learnings.

Study 3 presents preliminary results of the efficacy of the Switch intervention delivered in a group format, provided twice a week for two months and also using EMI. The evaluation procedure in this study is exactly the same as in Study 2. Furthermore, the group included participants with diagnoses other than schizophrenia, as similar motivational deficits have been observed in major depressive and bipolar disorders (G. P. Strauss & Cohen, 2017). Thus, Study 2 contributes to evaluate the external validity of the Switch intervention.

Finally, in **Study 4,** we conducted network analyses based on the ESM data collected at the baseline of Study 2 and Study 3. The goal of this study was to appraise the dynamics of the processes related to motivation and goal-directed behaviours. We generated two types of network, one "contemporary" network which looks at the relationships between the different variables in the same timeframe, and a "temporal" network which presents the relationships between the different variables at a given timeframe and the following timeframe, thus providing an indication of the direction of the relationships.

Supplementary material is available at the end of Study 1, Study 2 and Study 3.

STUDY 1

Switch, a new Intervention that targets Motivational Negative Symptoms in people with Schizophrenia: an uncontrolled Pilot Study

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Abstract

Objective: People diagnosed with schizophrenia experience difficulties in their daily life, which is best explained by motivational negative symptoms. This study explores the feasibility, acceptability and efficacy of Switch, a new multifactorial intervention that targets motivational deficits. *Method:* Eight participants with schizophrenia or schizoaffective disorder followed around 30 individual sessions of Switch over 12 months. Participants and their informants were interviewed at baseline (T0), at 6 months (T1), at the end of the intervention (T2) and at 6 months follow-up (T3). *Results:* T0-T1 paired sample *t*-tests showed large improvements on motivational deficits, general negative symptoms, and apathy and functional outcomes (both as rated by informants). At T2 and T3, moderate to large improvements were maintained. Switch was well accepted by participants. *Conclusions:* This preliminary investigation provides evidence that Switch may be a feasible, acceptable and effective intervention specifically designed to target motivational deficits and improve daily functioning.

Keywords: Motivation, therapy, apathy, daily functioning, quality of life, rehabilitation

STUDY 1

1. Introduction

People diagnosed with schizophrenia face difficulties in daily functioning and lower quality of life, which are best predicted by negative symptoms and motivational deficits in particular (Foussias et al., 2014; Savill et al., 2016). However, few effective interventions for negative symptoms, such as motivational deficits, exist. A large meta-analysis found that pharmacological treatments had very limited impact, if any at all (Fusar-Poli et al., 2015). As for non-pharmacological interventions, some show a limited impact (Lutgens et al., 2017), while others show more encouraging findings (Riehle et al., 2017). These mixed results can be explained by a number of reasons. First, the psychological interventions utilized in studies were not always specifically designed for the treatment of negative symptoms, but targeted other symptoms, such as positive and depressive symptoms which are potential sources of secondary negative symptoms (Carpenter & Buchanan, 2017). Second, for those interventions that did target negative symptoms, they did not necessarily focus on the same aspects (e.g. either dysfunctional beliefs, anhedonia, or social withdrawal), leading to varied results. Finally, models of negative symptoms have not always been the foundation of the developed psychosocial interventions. However, for example, model-based interventions would ensure that underlying processes are targeted (e.g. Favrod et al., 2019). Thus, to enhance the development and validation of negative symptom interventions, a number of changes need to occur. First, negative symptoms should be the primary focus of clinical trials (Lutgens et al., 2017). Second, measurements that clearly distinguish between expressive and motivational deficits should be used (Foussias et al., 2014). Finally, interventions should be based on models that identify the underlying processes of motivational negative symptoms, i.e. the domain believed to impact functional outcomes the most.

This study aims to explore the validity of a new intervention, "Switch", that targets motivational negative symptoms and that addresses the limitations mentioned above. Switch aims to "turn on" motivation and "turn off" what hinders motivation. It is a multifactorial intervention that is based on a model of motivation and goal-directed behaviours (see Figure 1). The model that strongly influenced the development of Switch was the one proposed by Kring and Barch (2014). Their model integrates findings from neuroscience and follows the emotional/hedonic, neurocognitive and behavioural course of motivation, from anticipatory pleasure to reminiscence, through value-effort computation, planning, goal-directed behaviour and in-the-moment liking. The model presented here adds multiple elements to the processes identified by Kring and Barch: Dysfunctional attitudes, such as lack of confidence or self-efficacy (Medalia & Brekke, 2010), discouraging beliefs (Rector et al., 2005), and action (self)initiation, which refers to the ability to spontaneously carry out certain actions (Rinaldi & Lefebvre, 2016). Furthermore, the first two levels of this three-level model are also novel. These levels are fundamental in terms of motivation and include, on the first level, personal values and goals, and on the second level, self-esteem. The third level narrows in on a chosen value or

goal and targets the processes that underpin motivation and engagement towards that value or goal. These emotional, neurocognitive and cognitive processes are presented in a sequence, although there can be overlaps and back-and-forth movements in the model, and one can start at different places. For example, a first step could be pleasure or reward anticipation ("looking forward"), which is mainly sensory. The next process is more cognitive and implies the computation of the value of the goal (how important is the potential reward), the effort (or the cost), and the probability to reach the goal. Dysfunctional attitudes (e.g. defeatist beliefs and low self-efficacy) can impact all processes and hinder motivation. When a decision to commit to a certain goal has been reached, the goal has to be mentally represented and planned for. Next, the action plan has to be initiated. While advancing towards or reaching the chosen goal, in-the-moment enjoyment occurs. Lastly, the experience of reaching one's goal is recalled (reminiscence), which can feed further anticipation.
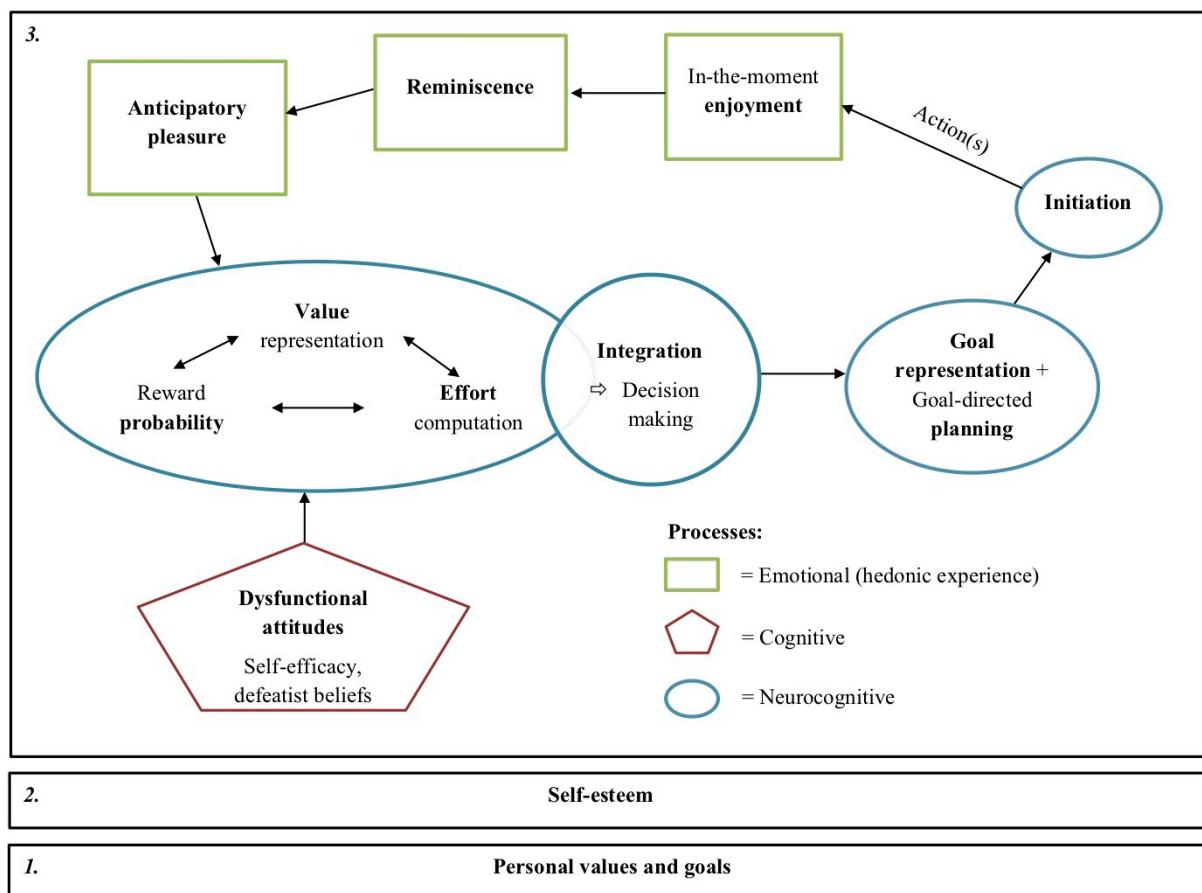
Figure 1. Multilevel model of motivation in schizophrenia.

Switch was specifically developed to tackle all of the difficulties involved in motivation. Thus, the potential of the intervention is maximized as strategies are available across all

processes (e.g. Chen et al., 2019; Farquharson & MacLeod, 2014; Favrod et al., 2019), from the premises of motivation to goal attainment and maintenance.

The main aim of the present study was to explore the efficacy, feasibility and acceptability of Switch in a sample of individuals with schizophrenia spectrum disorders. We hypothesized that motivational deficits would show a significant decrease after the intervention and that functional outcomes and quality of life would improve. Finally, limited improvement on expressive deficits and depressive symptoms (i.e. a source of secondary negative symptoms) would provide preliminary evidence for the specificity of Switch.

2. Methods

2.1. Study design

A pre-post comparison within subject design was used. There were 4 evaluations: at baseline, before the intervention (T0); at mid-term (T1; after 6 months of intervention); at the end (T2; after 12 months of intervention); and at follow-up (T3; 6 months post-intervention).

2.2. Participants

Participants were recruited via referral in psychiatric wards, and social and functional rehabilitation centres. Inclusion criteria consisted of: age between 18 and 65, DSM-V criteria for schizophrenia or schizoaffective disorder. Exclusion criteria consisted of: presenting an unstable clinical picture; evidence of a significant change in medication within one month prior to baseline assessment; having a history of severe brain trauma or epilepsy; mental retardation; and moderate or severe substance use disorder other than tobacco.

Eighteen participants entered the study. Ten were excluded for the following reasons: exclusion criteria (mental retardation; $n = 1$); drop out after enrolment ($n = 2$); drop out after 7 sessions because of professional training starting ($n = 1$); drop out after 13-14 sessions ($n = 4$); non-adherence with the intervention protocol ($n = 2$). All participants were given a complete description of the study, and written informed consent was obtained. The study was approved by the University Hospital Ethics Committee.

2.3. Intervention: Switch

Switch was provided by three experienced psychologists who received an extensive manual (available in French from the first author) and who attended 5 half-day workshops in order to learn about the theory underlying the Switch model and the various strategies used to support motivation and goal-directed behaviours. Further supervision was provided regularly to assure that Switch was delivered appropriately. Participants' needs and progress

were then examined and strategies to support them were discussed. In order to ensure therapists' fidelity to the Switch protocol, the therapists were asked to fill in a chart after every session detailing which strategies were used with the participants.

Switch was delivered in individual sessions, and followed a progressive decrease of frequency: one hour per week for the first 6 months (number of sessions before the mid-term evaluation: $M = 20.88$, $SD = 1.55$); an hour every fortnight between the 6th and 9th months; an hour every three weeks between the 9th and 12th months. In total, participants who completed the intervention received approximately 30 sessions ($M = 30.14$; $SD = 1.57$).

The first sessions were dedicated to building a therapeutic alliance and identifying personal resources, goals and values (i.e. addressing the first levels of the motivation model, see Figure 1). Strategies were then taught in order to help the person to engage in behaviours directed towards the chosen goals and values (i.e. moving to the third level of the model). Multisensory "imagery" was used to help to look forward into the future (i.e. pleasure anticipation). This type of projection into future actions/goals included visualising the scene (i.e. the person her/himself, the context, the actions), but also imagining the possible sounds, physical sensations, smells, pleasant emotions, constructive thoughts, etc. The imagery thus goes through all senses, so as to increase the chance of feeling pleasure and to help identify what modality generates the most pleasure – and consequently that has the higher motivational power. The imagery could focus on the process (e.g. baking a cake) or the result (e.g. eating the cake). A restructured decisional balance tool was used to address the effort-value computation. This tool helps to detect all the reasons why the person would not engage in a certain activity (including discouraging thoughts, required effort), and all the reasons why she/he would engage in that activity. Additionally, a column was used to note quick solutions for the smaller obstacles that were identified. The cons' column potentially included obstacles and dysfunctional attitudes that required further attention. Solution-seeking strategies can then be used. Furthermore, significant discouraging thoughts and low self-efficacy were challenged using cognitive restructuring (e.g. generating more constructive thoughts) and/or a cognitive defusion approach (e.g. using metaphors, training mindfulness). Help in planning and initiation strategies (e.g. electronic reminders, implementation intention) addressed the subsequent steps in the model. Finally, participants were invited to use various reminiscence strategies (e.g. sharing of experience with others, keeping a diary, looking at photos) to increase positive memories and boost motivation for new goals.

Each participant learnt the different strategies at their own pace, in a way that was tailored to their individual needs and goals, while at the same time all participants were exposed to all the strategies. Participants were provided with a folder that contains a rationale for each strategy and offers exercises that help implement the strategies in their home. They were also provided with audio files for some of the strategies (e.g. cognitive defusion, mindfulness), including one file guiding them through multisensory imagery (projection

into the future). In agreement with the participants, some were encouraged via SMS when they were required to engage in an action or when accomplishing a goal (personalized SMS including encouragements and congratulations). At the end of the first 6 months of the intervention, participants had learnt all of the strategies and they were given small cards containing the key elements of each strategy. During the following months and up to the end of the intervention, the goal was to incite autonomy in using the various strategies.

2.4. Measures

Assessments were completed by independent, trained evaluators. Participants were told to refer to the last few weeks when answering questions of the following scales:

Brief Negative Symptoms Scale (BNSS). The French version of the BNSS was used (Mucci et al., 2019). This scale assesses expressive and motivational negative symptoms. There are 13 items that are scored from 0 to 6 (0 = no impairment; 1 = very slight; 2 = mild; 3 = moderate; 4 = moderately severe; 5 = marked; 6 = severe). The Expressive deficit factor includes the following subscales: Blunted affect (facial expression, vocal expression, expressive gestures) and Alogia (quantity of speech, spontaneous elaboration). The Motivational deficit factor includes the following subscales: Anhedonia (intensity of pleasure during activities, frequency of pleasure, intensity of expected pleasure from future activities), Asociality (behaviour, internal experience), Avolition (behaviour, internal experience). The BNSS possesses excellent internal, convergent and discriminant validity (Mucci et al., 2019).

Brief Psychiatric Rating Scale, expanded version (BPRS). The Depression and anxiety subscale (anxiety, depression, suicidality, guilt) of the French version of the BPRS was used (Mouaffak et al., 2010). The scores range from 1 (symptom absent) to 7 (symptom extremely severe). The instructions from the scales, anchor points and administration manual were thoroughly and rigorously followed. The BPRS possesses good inter-rater reliability and the different factors have good internal consistency (Mouaffak et al., 2010).

Schizophrenia - Quality of Life questionnaire (S-QoL; Auquier et al., 2003). The S-QoL is a 41-item questionnaire that evaluates life satisfaction regarding psychological well-being, self-esteem, family relationships, relationships with friends, resilience, physical well-being, autonomy and sentimental life. Items are rated on a 5-point Likert scale (1 = much less satisfied than expected; 2 = less satisfied than expected; 3 = slightly less satisfied than expected; 4 = as satisfied as expected; 5 = more satisfied than expected). The S-QoL shows good internal and convergent validity, and good test-retest reliability (Auquier et al., 2003).

Informants were selected based on their ability to provide information about the participant's daily functioning. They included family members (parent or partner) or staff members (nurse, psychologist, psychiatrist, or other), who were questioned on two scales:

Lille Apathy Rating Scale – Informant version (LARS-i ; Dujardin, Sockeel, Delliaux, Destée, & Defebvre, 2008). The LARS-i is a semi-structured interview designed to evaluate the cognitive, emotional and behavioural dimensions of apathy in schizophrenia, via the following subscales: Everyday productivity, Interests, Initiatives, Novelty seeking, Voluntary actions, Emotional responses, Concern, Social life, Self-awareness. The total score ranges from -36 to 36 ([-36;-22] = absence of apathy; [-21;-17] = tendency towards apathy; [-16;-10] = moderate apathy; [-9;36] = severe apathy). The LARS-i shows high internal consistency, concurrent validity, and test-retest and inter-rater reliability (Dujardin et al., 2008).

Functional Remission of General Schizophrenia (FROGS; Llorca et al., 2009). The FROGS evaluates level of functioning in 5 different domains: Daily life, Activities, Relationships, Quality of adaptation, and Health and treatment. Via a semi-structured interview, each of the 19 items is assessed on a 5-point scale: 1 = does not do; 2 = does partially; 3 = does a significant part; 4 = does almost all of it; 5 = does perfectly. The total score ranges from 19 to 95. The threshold score for remission is 61. The FROGS possesses high internal consistency and good concurrent validity (Llorca et al., 2009).

Acceptability and feasibility were examined. After 6 months of the intervention, participants gave an anonymous feedback via a 12-item questionnaire assessing their satisfaction with Switch, e.g. evaluating its usefulness, accessibility, and pleasantness (inspired from Oei & Shuttlewood, 1999). Each item was assessed on a 5-point scale (1 = Totally disagree to 5 = Totally agree).

2.5. Analyses

Paired sample *t*-tests were used to compare participants' progression on symptoms, functional outcomes and quality of life between baseline and mid-term evaluation (T0-T1), end of intervention (T0-T2) and follow-up (T0-T3). Considering the pilot nature of the study and the sample size, analyses focused more on effect sizes than on the statistical significance of the findings. Cohen's d_s standardized mean differences were calculated to provide effect sizes (with pooled standard deviation as the denominator). Confidence intervals (CI; 95%) of Cohen's d_s were used to interpret the precision of the effect.

Supplementary data and analyses are available at http://hdl.handle.net/2268/246436.

3. Results

3.1. Participants

The eight male participants were 38.75 year of age on average (SD = 7.55) and had been ill for 12.25 years on average (SD = 4.74). Their average education level was 12.50 years (SD = 2.77). Six participants lived with their family or partner, one lived in a supervised housing

and one in a hospital. Participants who were excluded did not differ from those who were included in the analyses, both in terms of sociodemographic (Fisher's exact tests) and clinical characteristics (independent sample *t*-tests, all *p*>.05).

At baseline (see Table 1), Switch participants exhibited, on average, moderate negative symptoms, with motivational deficits ranging from mild to moderately severe. They showed mild depressive symptoms (i.e. manageable, non-overwhelming symptoms). According to their informants, participants had, on average, severe levels of apathy, and their daily functioning was acceptable (i.e. in general, they perform sufficiently or satisfyingly).

3.2. Primary outcomes

At T1, after 6 months of intervention (see Table 1), we observed a significant improvement with large effect sizes on motivational deficits (BNSS Mot, *d* = 1.33, 95% *CI* [1.07; 1.59]), apathy (LARS-i, *d* = 1.00, CI [0.80; 1.20]) and functional outcomes (FROGS, *d* = 0.82, CI [0.62; 1.02]). Lower CI also indicated a large impact, except for functional outcomes for which the lower CI indicated at least a moderate improvement.

At T2, at the end of the intervention, the large improvement regarding motivation and apathy was maintained (BNSS Mot, *d* = 0.95, CI [0.72; 1.17]; LARS-i, *d* = 0.76, CI [0.56; 0.96]), with CI indicating at least moderate improvement. Improvements on functional outcomes were in the moderate range (FROGS, *d* = 0.41, CI [0.20; 0.63]). However, CI for the FROGS indicated only a slight to moderate improvement.

At T3, the improvement in motivation was still moderate (BNSS Mot, *d* = 0.56, CI [0.26; 0.86]), ranging from slight to large. Informants still observed significant and large improvements in apathy (LARS-i, *d* = 0.92, CI [0.67; 1.17]) and moderate to large improvements in functional outcomes (FROGSN *d* = 0.71, CI [0.45; 0.96]).

No improvement was found at any time regarding quality of life.

3.3. Specificity

At T1, after 6 months of intervention (see Table 1), expressive deficits showed a significant and large decrease (BNSS Exp, *d* = 0.97, CI [0.81; 1.13]). However, only slight to very slight improvements in expressive deficits were observed at T2 (*d* = 0.39, CI [0.25; 0.54]) and T3 (*d* = 0.26, CI [0.08; 0.44]). At T1, Depression decreased slightly (BPRS Dep, *d* = 0.39, CI [0.23; 0.54]). At T2, there was a significant and large improvement in Depression (*d* = 1.27, CI [1.02; 1.52]), which was maintained at T3 (*d* = 1.19, CI [0.96; 1.42]).

Table 1

Clinical characteristics, functional outcomes and quality of life before the intervention (T0), at 6 months (T1), at the end of the intervention (T2), and 6 months after the intervention (T3). Paired sample t-tests and Cohen's d effect sizes.

	T0	T1	T2	T3	T0-T1		T0-T2		T0-T3	
	n = 8	*n* = 8	*n* = 7	*n* = 7	t	d	t	d	t	d
	M (SD)	M (SD)	M (SD)	M (SD)	*df* = 7		*df* = 6		*df* = 6	
BNSS Mot	3.32 (0.55)	2.45 (0.76)	2.55 (1.04)	2.92 (0.88)	2.65**	1.33	2.34*	0.95	1.33	0.56
BNSS Exp	2.87 (0.94)	1.92 (1.02)	2.49 (1.04)	2.60 (1.18)	3.15**	0.97	1.28	0.39	0.50	0.26
LARS-i	-1.75 (10.22)	-11 (8.12)	-9.86 (11.20)	-11.33 (10.73)	2.65**	1.00	1.74	0.76	3.30**a	0.92
FROGS	58.13 (8.49)	64.88 (7.93)	61.57 (8.16)	64.67 (10.27)	-2.17*	0.82	-1.12	0.41	-1.61a	0.71
S-QoL	3.28 (0.62)	3.21 (0.41)	3.28 (0.63)	3.30 (0.83)	0.26	0.13	0.24	0.01	0.18	0.02
BPRS Dep	3.25 (1.58)	2.69 (1.25)	1.74 (0.36)	1.81 (0.47)	1.31	0.39	2.82**	1.27	2.27*	1.19

Sig. (2-tailed): * *p* < .10; ** *p* < .05.

Note: BNSS = Brief Negative Symptom Scale; Mot = Motivational deficits (mean); Exp = Expressive deficits (mean); LARS-i = informant version of the Lille Apathy Rating Scale (total); FROGS = Functional Remission of General Schizophrenia (total); S-QoL = Schizophrenia Quality of Life (mean); BPRS Dep = Depression and anxiety subscale of the BPRS (mean); a *df* = 5.

3.4. Acceptability and feasibility

On average, participants attended 30.14 sessions (*SD* = 1.57) over a one-year period. After 6 months of intervention, the 12-item feedback questionnaire revealed that participants felt that Switch supported their motivation to move towards personal goals (*M* = 4), that it was useful regarding their needs (*M* = 4), that its goal was clear (*M* = 3.75), and that it brought something more compared to other interventions (*M* = 4). Participants also reported that they enjoyed participating in Switch (*M* = 3.87). They found that their therapists were attentive (*M* = 3.87), competent and knew what they were talking about (*M* = 4.75). All of the participants would recommend Switch to others (*M* = 4.12). Participants did not report that they had to force themselves to come to the sessions (*M* = 1.87), nor did they find the intervention to be too long (*M* = 2.12) or too difficult to follow (except for one participant) (*M* = 2.37). Half of the participants reported applying what they learned from Switch to their daily life, while the other half was more mitigated (*M* = 3.37).

4. Discussion

The aim of the present study was to explore the efficacy, acceptability and feasibility of Switch, a new intervention that targets motivation in individuals diagnosed with schizophrenia or schizoaffective disorder. The goal of the intervention is to help them to engage in actions and goals that are meaningful in regard to their personal values, and thus to enhance their quality of life. Switch merges cognitive, behavioural and 3rd wave techniques to tackle the obstacles related to motivation and goal-directed behaviours. The current study provides preliminary evidence for the efficacy, feasibility and acceptability of Switch for the treatment of motivational negative symptoms in individuals with schizophrenia.

As hypothesized, in this preliminary investigation, Switch showed a positive impact on motivational negative symptoms, but also on functional outcomes and apathy (both as rated by informants). Large improvements were already observed after 6 months of weekly interventions. Participants' motivational deficits went from moderately severe to mild/moderate, and their severe apathy improved to moderate apathy. Furthermore, functional outcomes increased to reach remission levels. At the end of the intervention, the substantial improvement was maintained for both motivational deficits and apathy. Informants' ratings of functional outcomes showed that progress remained in the moderate range and that the remission threshold was maintained. At follow up, motivation improvement remained within moderate levels, while apathy and functional outcomes showed even further improvements. In sum, both patients' and informants' experience and observations provide preliminary evidence for the efficacy of Switch on motivational deficits and functional outcomes. However, improvements regarding motivation and functional outcomes were not as clearly maintained as expected when the frequency of Switch sessions decreased and after it ended.

Results showing a lack of positive effect on quality of life are not in line with our hypothesis. This is surprising, given the improvement on depressive symptoms, which are also known to be linked to subjective quality of life (W. C. Chang, Wong, et al., 2019). One explanation for this lack of result is that participants in our sample considered their quality of life to be just slightly less satisfying than they expected.

Regarding the specificity of the intervention, this preliminary investigation suggests that Switch has exclusive effects on motivational negative symptoms. First, there was no consistent improvement on expressive deficits. Second, depression symptoms improved, but not synchronously with negative symptoms: negative symptoms decreased already after 6 months of intervention, while depression decreased after 12. This decrease in depressive mood may have been fostered by an increased engagement in meaningful activities.

Participants reported great satisfaction with Switch and with the therapists who delivered it. Furthermore, the fact that all participants attended a minimum of 13 sessions and that

the ones who completed the intervention attended around 30 sessions is another good indicator of the acceptability and feasibility of the intervention.

This pilot study exhibits several strengths. First, Switch was built on strong theoretical grounds, with the development of a well-thought-out model that lead to a comprehensive intervention that targets the various difficulties related to motivation faced by individuals with schizophrenia. Second, state-of-the-art assessment tools for negative symptoms (i.e. BNSS, LARS) were used to distinguish the two domains of negative symptoms and to better reflect the internal experience of the participants. Third, interviews with staff or family members allowed an external appreciation of the effect of the intervention on daily functioning and apathy. Finally, the procedure included long-term follow-up measurements.

Several limitations are worth mentioning. First, the results should be interpreted with caution as the sample was very small. In future studies, a minimum of 34 participants would be needed to detect a significant ($\alpha = .05$) moderate effect ($d = 0.5$) with appropriate power ($1-\beta = .80$). Second, there was no control condition and the evaluators, although independent of the intervention, were not blind. Finally, it is not clear if only certain specific aspects of the intervention are responsible for the positive impact, or if it is the combination of strategies that explains its efficacy. Future studies should examine the processes that are associated with motivation and that might be responsible for the improvement.

4.1. Conclusions

Switch may be an acceptable and effective intervention that provides patients and therapists with a compass that guides motivation and engagement in personal goals and values. Switch is based on a comprehensive theoretical model of motivation, and the use of multiple strategies to target the various processes identified in that model might explain the specific effects we found on motivation and daily functioning.

Study 1: Supplementary Material

1. Switch's model

Figure S1. Switch's model (simplified version) that can be used by therapists and patients/clients.

The model on which the Switch intervention is based is described in detail in the Introduction of the article. Figure S1 presents a simplified and more practical version of that model, which can be used in the therapeutic context. Instead of showing the (neuro)cognitive, emotional and behavioural processes that are related to motivation and goal-directed behaviours (see Figure 1 in the article), this model provides a type of compass that guides the choice of strategy that can be used to tackle the various challenges found on the way to goal attainment. The strategies are briefly explained in the article. An extensive manual is available in French from the first author.

2. Supplementary results

2.1. Secondary outcomes

2.1.1. Measures

The results presented in Table S1 include secondary analyses on the motivation subscales (Anhedonia, Asociality and Avolition) of the Brief Negative Symptom Scale (BNSS; Kirkpatrick et al., 2011; French version: Mucci et al., 2019), as well as on the positive

subscale of the Brief Psychiatric Rating Scale (BPRS; Ventura et al., 1993; French version: Mouaffak et al., 2010), which were both rated based on interviews (for a description of these two scales, please refer to the main part of the article). Self-rating scales were used to evaluate changes in functioning and life satisfaction, as well as in processes believed to be related with motivational deficits and goal-directed behaviours.

The Social Functioning Questionnaire (Questionnaire de Fonctionnement Social – QFS; Zanello, Weber Rouget, Gex-Fabry, Maercker, & Guimon, 2006) is a 16-item self-report questionnaire that evaluates social functioning during the two preceding weeks. Eight domains are addressed: activity (professional, educational, volunteering), household, leisure, family and couple relationships, other social relationships, financial and administrative management, general health, and society and information (e.g. checking the news). For each domain, two questions are asked, one that evaluates the frequency of the behaviours (e.g. "how often have you engaged in leisure activities?") and the other that evaluates the degree of satisfaction with each domain (e.g. "how satisfied have you been with your leisure activities?"). Each question is rated on a 5-point Likert scale ranging from 1 ("never" or "very unsatisfied") to 5 ("everyday" or "very satisfied"), where higher scores indicate better functioning. The QFS is very simply phrased and is easy to use. It was used in this protocol in order to have the participants' view on their functioning, whereas the Functional Remission for General Schizophrenia (FROGS; Llorca et al., 2009) was administered to informants.

The General Self-Efficacy scale (GSE; Schwarzer & Jerusalem, 1995; French translation: Dumont, Schwarzer, & Jerusalem, 2000) evaluates the extent to which participants view themselves as capable to achieve various behaviours (e.g. new or challenging tasks). The ten items of the GSE are rated on a 4-point Likert scale, ranging from "Totally false" to "Totally true". Thus, the higher the score, the higher the feeling of self-efficacy.

The Dysfunctional Attitude Scale (Weissman & Beck, 1978; French translation: Bouvard et al. 1994) is a 40-item self-rating scale that produces a total score representing cognitive distortions (assumptions and beliefs) in seven value systems: approval, love, achievement, perfectionism, entitlement, omnipotence and autonomy. Each item is rated on a 7-point Likert scale with higher scores indicating elevated dysfunctional beliefs.

The Savoring Beliefs inventory (Bryant, 2003; French version: Golay, Thonon, Nguyen, Fankhauser, & Favrod, 2018) is a 24-item self-rating measure designed to assess attitudes towards and tendency to savouring positive experiences, in the three temporal orientations, past, present and future (8 items each). Half of the items are positively-phrased (e.g. "I can feel joy of anticipation"), while the other half are negatively-phrased (e.g. "I don't like to look forward too much"). Participants indicate, on a 7-point Likert scale, the extent to which they agree with the different statements. For each subscale – past, present and future – the sum score of the negatively-phrased items was subtracted from the sum score of the positively-phrased items.

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2.1.2. Results

Table S1 presents the results of the aforementioned measures.

2.2. Qualitative data

At the end of the Switch intervention, participants reported that they used a number of different strategies that were included in Switch. Taken together, participants reported using all the strategies except for reminiscence and initiation strategies (post-its, alerts, implementation intention). The strategies that were reported to be most often used by participants were cognitive restructuring and planning one's goals.

Participants were asked an open-ended question about how they benefitted from Switch. Comments resulting from this question were grouped into the following themes:

Self-esteem and agency: "I have power over things", "I realize I have goals", "I am able to take action/to have an effect on my life", "I can actually manage my illness", "I have those qualities" (referring to an exercise that asked the participant to identify his/her strengths).

Cognitive restructuring: "The program allowed me to put things into perspective", "It opened my eyes for certain things".

Cognitive defusion: "I still have negative thoughts, discouraging ones, but I do not pay attention to them in the same way", "The craving dissipates", "The (unpleasant) emotions flow past", "I am more anchored in the present"

Positive focus: "Switch = forget the bad things and focus on the positive!", "The therapy was centred on the future more than on the past. That was good."

Therapeutic relationship: "You took the time to respond to my messages, not just with a standard message. Your response was personalised". "It was good to be taken as we are, without overly insisting when there are difficulties… without blaming".

Neurocognitive: "I can concentrate better", "I have a better memory".

Table S1

Clinical characteristics, functioning, and processes related to motivation, before the intervention (T0), at 6 months (T1), at the end of the intervention (T2), and 6 months after the intervention (T3). Paired sample t-tests and Cohen's d effect sizes.

	T0	T1	T2	T3	T0-T1		T0-T2		T0-T3	
	$n = 8$	$n = 8$	$n = 7$	$n = 7$	t	d	t	d	t	d
	M (SD)	M (SD)	M (SD)	M (SD)	df = 7		df = 6		df = 6	
BNSS Anhedonia	4.04 (0.55)	2.83 (1.15)	2.43 (1.29)	3.43 (0.99)	2.52**	1.34 [1.06; 1.62]	4.10***	1.62 [1.39; 1.84]	1.62	0.76 [0.49; 1.02]
BNSS Asociality	2.69 (1.03)	2.13 (0.83)	2.79 (0.70)	2.43 (0.89)	1.20	0.60 [0.34; 0.86]	0.179	0.08 [-0.18; 0.35]	0.89	0.46 [0.17; 0.75]
BNSS Avolition	2.88 (0.69)	2.19 (1.03)	2.50 (1.38)	2.64 (0.99)	1.768	0.78 [0.55; 1.01]	0.795	0.26 [0.07; 0.45]	0.55	0.17 [-0.01; 1.84]
BPRS - Positive	1.62 (0.70)	1.77 (.46)	1.43 (0.24)	1.53 (0.43)	-0.52	0.24 [0.00; 0.49]	1.20	0.37 [0.13; 0.61]	0.59	0.16 [-0.11; 0.34]
LARS-p	-12.50 (7.73)	-17.88 (6.85)	-15.43 (7.25)	-15.57 (10.23)	2.07*	0.74 [0.55; 0.92]	0.63	0.39 [0.05; 0.73]	0.88	0.34 [0.13; 0.56]
QFS - Frequency	3.59 (0.35)	3.77 (0.45)	3.55 (0.57)	3.75 (0.45)	-0.86	0.43 [0.17; 0.69]	0.16	0.09 [-0.21; 0.38]	-0.72	0.39 [0.10; 0.69]
QFS - Satisfaction	3.50 (0.42)	3.59 (0.50)	3.54 (0.65)	3.70 (0.62)	-0.45	0.20 [-0.03; 0.44]	-0.14	0.07 [-0.19; 0.33]	-0.77	0.38 [0.11; 0.65]

	T0	T1	T2	T3	T0-T1		T0-T2		T0-T3	
	n = 8	*n* = 8	*n* = 7	*n* = 7	t	d	t	d	t	d
	M (SD)	M (SD)	M (SD)	M (SD)	df = 7		df = 6		df = 6	
GSE	2.69	2.75	2.80	2.86	-0.48	0.24	-0.60	0.29	-0.77	0.43
	(0.33)	(0.14)	(0.44)	(0.46)		[-0.02; 0.51]		[0.03; 0.56]		[0.13; 0.73]
DAS	3.74	3.28	3.25	3.30	1.10	0.57	1.14	0.53	0.81	0.45
	(0.83)	(0.81)	(1.04)	(1.09)		[0.30; 0.84]		[0.28; 0.78]		[0.15; 0.76]
SBI - Anticipation	0.25	1.25	0.64	0.75	-0.90	0.45	-0.35	0.19	-0.38	0.21
	(2.38)	(2.07)	(1.71)	(2.48)		[0.19; 0.71]		[-0.10; 0.48]		[-0.09; 0.50]
SBI - Present	-0.25	0.16	0.61	0.79	-0.47	0.23	-0.61	0.33	-0.72	0.39
	(2.11)	(1.28)	(3.03)	(3.16)		[-0.03; 0.49]		[0.04;0.63]		[0.09; 0.69]
SBI - Past	2.66	1.37	1.64	2.04	1.65	0.82	1.12	0.60	0.59	0.32
	(1.72)	(1.37)	(1.65)	(2.20)		[0.56; 1.09]		[0.31; 0.89]		[0.02; 0.61]

Sig. (2-tailed): * p < .10; ** p < .05; *** p < .001

Note: BNSS = Brief Negative Symptom Scale (mean); BPRS – Positive = Brief Psychiatric Rating Scale, Positive subscale (mean); LARS-p = patient version of the Lille Apathy Rating Scale (total score); QFS = Questionnaire de Fonctionnement Social (mean); GSE = General Self-Esteem (mean); DAS = Dysfunctional Attitude Scale (mean); SBI = Savoring Beliefs Inventory (sum score of the negatively-phrased items subtracted from the sum score of the positively-phrased items).

STUDY 2

Idiographic analyses of motivation and related processes in participants with schizophrenia following a therapeutic intervention for negative symptoms

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Abstract

Background: Motivational negative symptoms hinder quality of life and daily functioning of individuals with schizophrenia spectrum disorders. A recently developed intervention, Switch, has shown promising effects on negative symptoms and functional outcomes. Switch targets multiple cognitive, emotional and behavioural processes associated with motivation and goal directed behaviours. We aimed to investigate its effects on motivation and associated processes in a naturalistic setting, and to explore the dynamics between the processes. *Methods*: We used a single case approach ($n = 3$), with a pre-post and follow-up assessment design, which also included ambulatory assessments (experience sampling method, ESM; and step count). We computed autoregressive lag 1 models to evaluate the effects of the intervention on daily motivation levels and related processes, descriptive pie-charts, and vector autoregressive modelling to reveal the dynamics of the processes over time. *Results*: The intervention was beneficial for each participant according to traditional evaluations of motivational negative symptoms, apathy, daily functioning and quality of life. The effects on the ESM variables revealed distinct outcomes for each individual. The dynamics between the various processes differed between participants, and fluctuated within participants (when comparing baseline, intervention phase, and follow-up). *Conclusions*: This study used an innovative approach to look at the effectiveness of an intervention. The intervention seems to lead to meaningful improvements in motivational negative symptoms and functional outcomes. The mechanisms of change need to be further investigated.

Keywords: apathy; intervention; ecological momentary assessment; timeseries analyses, dynamics; single case.

STUDY 2

1. Background

Negative symptoms are highly prevalent in individuals with schizophrenia (Sauvé et al., 2019). These symptoms are generally understood as comprising two factors: expressive deficits, including blunted affect and alogia; and motivational or experiential deficits, including anhedonia, avolition, and asociality (Horan et al., 2011; G. P. Strauss et al., 2013). Motivational negative symptoms appear to be the main obstacle to daily functioning (A. T. Beck, Himelstein, Bredemeier, Silverstein, & Grant, 2018; Fervaha, Foussias, et al., 2015) and quality of life (Savill et al., 2016). To date, psychological interventions as well as pharmacological treatments have shown limited or inconsistent effects on negative symptoms (Fusar-Poli et al., 2015; Lutgens et al., 2017). One way of remedying this is to better understand the underlying processes of motivation in schizophrenia in order to provide tailor-made interventions that focus on those particular processes.

In a previous study (Thonon, Levaux, Della Libera, & Larøi, 2020), we presented a model of motivation in schizophrenia that integrates various emotional/hedonic, (neuro)cognitive and behavioural processes that are related to motivation and goal-directed behaviours and that are often dysfunctional in individuals with schizophrenia. This model was predominantly inspired by the model developed by Kring and Barch, which follows the course of hedonic processes, from the anticipation of a reward to its obtainment (Kring & Barch, 2014). The model we describe here integrates additional processes (e.g. dysfunctional attitudes) and furthermore is multilevel. Figure 1 presents this three-level model. The first two levels are at the foundation of the model and include personal values and goals on the first level, and self-esteem on the second level. The third level narrows in on a chosen value or goal, and targets those processes that underpin motivation. It starts with the anticipation of pleasure, which is mainly sensory. The next step is largely cognitive and requires an estimation of the effort, the value and the probability of attainment of the chosen goal. These processes can be influenced by dysfunctional attitudes (e.g. defeatist beliefs or low self-efficacy) and thus potentially altering the decision to take action. Once the motivated decision has been taken, planning skills come into play, as well as action initiation abilities. In-the-moment enjoyment occurs while advancing towards or reaching the chosen goal. Finally, the experience of successfully moving towards one's goal can be recalled (reminiscence) and can feed further anticipation (for a more detailed description and an illustration, see Thonon et al., 2020).
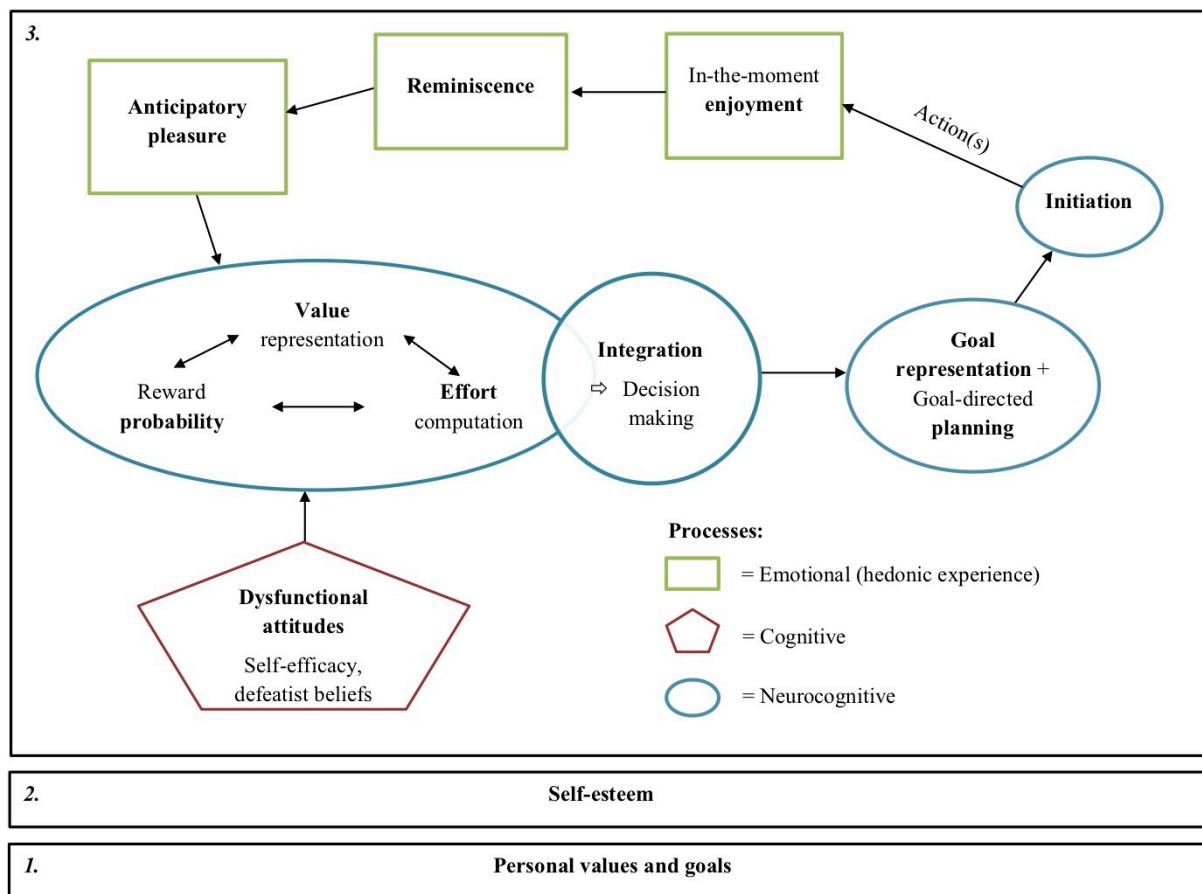
Figure 1. Three-level model of motivation (reproduced with permission from Thonon et al., 2020).

We developed an intervention, Switch, that targets the multiple elements and processes identified in the aforementioned model (Thonon, Levaux, et al., 2020), using various strategies that have proven to be beneficial as delivered separately or in other clinical populations (e.g. Farquharson & MacLeod, 2014; Favrod, Nguyen, Chaix, et al., 2019; Gollwitzer & Sheeran, 2006; Granholm et al., 2014; Hayes et al., 2012; Renner et al., 2017). A pilot study was conducted with 8 participants with schizophrenia spectrum disorders who followed Switch for a year (30 sessions on average). We found significant moderate to large positive effects on motivational negative symptoms and functional outcomes. The novelty of the Switch intervention is that it is specifically designed to address motivational negative symptoms and therefore the multiple and various processes related to these symptoms. The strength of Switch is also its recovery approach (Anthony, 1993), with a focus on autonomy and personal resources, goals, and values.

In the current study, we wished to further validate Switch, however, using a different set-up by providing the intervention twice a week for two months, in order to meet certain time constraints of psychiatric health care. Additionally, we aimed to better understand the dynamics of processes related to motivation across time. In order to do this, we used a single case design which allows a thorough investigation of mechanisms of change by

applying repeated measurements of the processes of interest (Bentley, Kleiman, Elliott, Huffman, & Nock, 2019). The high internal validity of this approach can even further improve by including intensive repeated assessment, such as the Experience Sampling Method (ESM; (Myin-Germeys et al., 2018, 2009) or other ambulatory assessment strategies that imply continuous and objective measurement of activity (Shiffman et al., 2008; Teicher, 1995). Such intensive repeated assessment can help understand the dynamic interconnections between the variables of interest over time. Furthermore, ESM diminishes the risk of retrospective recall biases, and allows a more natural and nuanced evaluation of emotions, cognitions and behaviours in everyday life and in the person's real environment (*vs.* laboratory and clinical settings) (Shiffman et al., 2008).

The first aim of this study was to evaluate the effectiveness of a shorter version of the Switch intervention in individuals with schizophrenia and schizoaffective disorder provided in a naturalistic setting. We expected (1) an improvement on motivation/apathy, quality of life and functional outcomes (primary outcomes), after the intervention and/or at follow-up; (2) an improvement on the various cognitive, emotional and behavioural processes identified in our model and targeted in the intervention (ESM variables), during the intervention and/or at follow-up; (3) an increase in step count as this has been shown to be an objective proxy measure of negative symptoms (Kluge et al., 2018), during the intervention and/or at follow-up. Second, we aimed to explore the dynamics of the processes associated with motivation (ESM variables) before the intervention, during the intervention and at follow-up.

2. Methods

2.1. Participants

Participants were recruited in March 2019, via referral from a mental health community centre in the French speaking community of Belgium, where the recruitment, assessments and intervention took place. Inclusion criteria for the present study were: aged between 18 and 65, met DSM-5 criteria for schizophrenia or schizoaffective disorder (American Psychiatric Association, 2013) and a good understanding of French. Exclusion criteria were: presented an unstable clinical picture (i.e. no acute positive symptoms); evidence of a significant change in medication within one month prior to baseline assessment; history of severe brain trauma or epilepsy; comorbid intellectual disability; and moderate or severe substance use disorder other than tobacco (according to the DSM-5; i.e. showing 4 or more symptoms). The head psychiatrist from the mental health community centre was familiar with the inclusion and exclusion criteria of the study and other relevant details (e.g. the need for participants to provide informed consent). Thereafter, out of a pool of 60 patients, six candidates who fulfilled the criteria were contacted, introduced to the study and asked if they accepted to be contacted by the main investigator. Three accepted. Next, the main investigator contacted these three candidates by phone and presented the study. The

participants were then seen in person and received a thorough explanation of the evaluation protocol, the intervention and their rights as participants in the study. They were invited to read the information sheet (including repetitive disclosure and emphasis of key points, as recommended by (Kaup, Dunn, Saks, Jeste, & Palmer, 2011), ask any questions that they might have, and sign the informed consent if they accepted to participate. Three participants enrolled in the study and were assigned to the Switch intervention in April 2019. One participant was lost to follow-up in October 2019.

The study was approved by the Liege University Hospital Ethics Committee (B707201629105). Sociodemographic and clinical characteristics of the participants are reported in Table 1.

Table 1

Sociodemographic characteristics

Individual	2i-1	2i-2	2i-4
Age	29	34	39
Gender	Female	Male	Female
Diagnosis	SZ	SZ	SZ
Illness duration (years)	10	10	7
Education (year)	10	12	14
Living Conditions	With partner	Supervised housing	With family
Work	/	/	/
Switch (number of sessions + booster session)	12 + 1	15 + 1	10 + 0
Medication / dose / CPZeq	Aripiprazole / 2.5 mg/day / 50 mg	Aripiprazole / 200 mg/month / 142.86 mg	Olanzapine / 350 mg/3 months / 277.47 mg

CPZeq = Chlorpromazine equivalents (mg/day) (Gardner, Murphy, O'Donnell, Centorrino, & Baldessarini, 2010).

2.2. Study design and procedure

Participants underwent three types of evaluation: traditional assessment scales of motivational deficits, apathy, quality of life and daily functioning; ambulatory assessment including ESM (i.e. questionnaires); actigraphy (step count). Participants were evaluated on the traditional assessment scales before the intervention (Pre), after the 2-months

intervention (Post), and 3-months after the end of the intervention (Follow-up). ESM and actigraphy were used before (T0), during (T1), and after the intervention (T2), as well as at follow-up (T3). Figure 2 provides a visualisation of the study design and procedure. Participants received feedback on all evaluations at the end of the study.
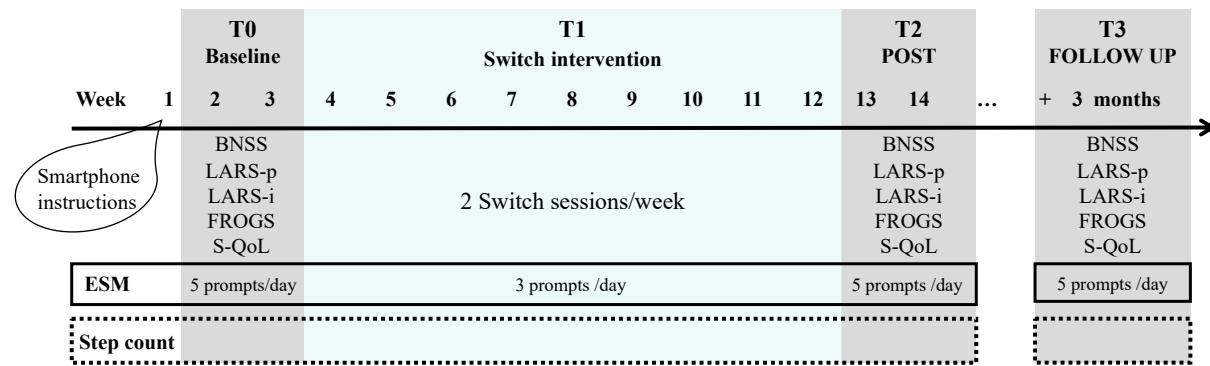
Figure 2. Design of the study and assessment procedure. BNSS = Brief Negative Symptom Scale; LARS = Lille Apathy Rating Scale patient and informant; FROGS = Functional Remission of General Schizophrenia, S-QoL = Schizophrenia Quality of Life questionnaire.

2.3. Traditional evaluation (primary outcomes)

Assessments were completed by trained evaluators. Participants were told to refer to the last 2 weeks when completing the following scales:

Brief Negative Symptoms Scale (BNSS) (Kirkpatrick et al., 2011). The French version of the BNSS was used in this study (Mucci et al., 2019). The BNSS assesses expressive and motivational negative symptoms. Only the BNSS – Motivation subscale was used, which is the mean of the following subscales: anhedonia (intensity of pleasure during activities, frequency of pleasure, intensity of expected pleasure from future activities), asociality (behaviour, internal experience), avolition (behaviour, internal experience). Each item is scored from 0 to 6 (0 = no impairment; 1 = very slight; 2 = mild; 3 = moderate; 4 = moderately severe; 5 = marked; 6 = severe). A blinding procedure was used: participants' interviews were recorded and each video or sound recording was evaluated at the end of the study by two independent evaluators who were unaware of the recordings' assessment time. The BNSS possesses excellent internal, convergent and discriminant validity (Mucci et al., 2019), excellent test-retest and interrater reliability (Kirkpatrick et al., 2011), and good sensitivity to change (Kirkpatrick et al., 2018).

Lille Apathy Rating Scale – Patient version (LARS-p) (Sockeel et al., 2006). The LARS is a semi-structured interview that evaluates the different dimensions (cognitive, emotional and behavioural) of apathy through the following subscales: everyday productivity, interests,

taking initiatives, novelty seeking, voluntary actions, emotional responses, concern, social life and self-awareness. The total score ranges from -36 to 36 ([-36; -22] = absence of apathy; [-21; -17] = tendency towards apathy; [-16; -10] = moderate apathy; [-9; 36] = severe apathy). The LARS-p possesses a high level of inter-rater reliability and satisfactory internal consistency (Yazbek, Norton, et al., 2014).

Schizophrenia - Quality of Life questionnaire (S-QoL) (Auquier et al., 2003). The S-QoL is a 41-item questionnaire that evaluates life satisfaction regarding psychological well-being, self-esteem, family relationships, relationships with friends, resilience, physical well-being, autonomy and sentimental life. Items are rated on a 5-point Likert scale (1 = much less satisfied than expected; 2 = less satisfied; 3 = slightly less satisfied; 4 = as satisfied; 5 = more satisfied). The total score ranges from 0 to 100, higher scores indicating better subjective quality of life. The S-QoL shows good internal and convergent validity, excellent test-retest reliability (Auquier et al., 2003), and good sensitivity to change (Lançon, Reine, Simeoni, Aghababian, & Auquier, 2007).

Informants were interviewed to provide an external understanding regarding participants functioning. The informant for participant 2i-1 was her husband; the informant for participant 2i-2 was the head of his supervised housing; participant 2i-4 did not wish to involve an informant. Informants completed the following two scales:

Lille Apathy Rating Scale – Informant version (LARS-i) (Dujardin et al., 2008) (see the patient version for a description). The LARS-i shows high internal consistency and concurrent validity, as well as high levels of test-retest and inter-rater reliability (Dujardin et al., 2008).

Functional Remission of General Schizophrenia (FROGS) (Llorca et al., 2009). The FROGS is a measure of daily life outcomes, which evaluates level of functioning in 5 different domains: daily life, activities, relationships, quality of adaptation, and health and treatment. Via a semi-structured interview with the informant, each item is assessed on a 5-point scale: 1 = does not do; 2 = does partially; 3 = does a significant part; 4 = does almost all of it; 5 = does perfectly. The total score ranges from 19 to 95. The threshold score for remission is 61 (Boyer et al., 2013). The FROGS possesses high concurrent validity and internal consistency (Llorca et al., 2009).

2.4. Ambulatory assessment (secondary outcomes)

ESM questionnaire

Prior to the start of the study, the participants received extensive explanations regarding the ESM procedure. Participants installed the MetricWire app (https://metricwire.com/) and were logged in with a sham email address. Participants filled in an example-questionnaire with the investigator who explained all the questions and their possible answers.

For the 14 consecutive days of the baseline phase, participants were prompted by the app MetricWire five times a day at pseudo-random time points, within 3-hour time frames between 7.30 a.m. and 10.30 p.m. Each prompt invited the participant to open the app and answer the questionnaire referring to what he/she was experiencing just before the prompt. The participants had 20 minutes to fill in the questionnaire and they received a reminder after 10 and 15 minutes. During the two months of intervention, in order to reduce the burden on the participants, the number of prompts was reduced to three per day, within 5-hour time frames. After the end of the intervention, participants were prompted again 5 times per day for another 2 weeks. As participants did not complete enough questionnaires after the end of the intervention, the post-assessment ESM observations (T2) were not taken into consideration.

Table 2 presents the ESM questionnaire that was developed based on the different variables included in the motivation model described in the introduction. It was created following guidelines from Kimhy et al.(Kimhy, Myin-Germeys, Palmier-Claus, & Swendsen, 2012). The questionnaire included 14 questions, plus three optional branched questions, i.e. determined by the participant's answer to a previous question.

Table 2

ESM Questionnaire

Variables	Questions	Rating
Mood	I feel…	1-7 Likert; 1 = Unhappy; 4 = Neutral; 7 = Happy
Discouraging beliefs	Discouraging thoughts are crossing my mind.	1-7 Likert; 1 = Not at all true; 7 = Totally true
Coping (only if Q3 > 4).	How am I dealing with these thoughts?	I'm not. / I'm distancing myself from them. / I'm trying to use more constructive thoughts. / I'm looking for concrete solutions. / Other:
Coping (other)	You indicated "other". What precisely do you do to deal with these discouraging thoughts?	Free text
Confidence	I feel confident.	1-7 Likert; 1 = Not at all true; 7 = Totally true
Motivation	I feel motivated.	1-7 Likert; 1 = Not at all true; 7 = Totally true
Energy	I have energy.	1-7 Likert; 1 = Not at all true; 7 = Totally true
Social	Who am I with?	Stranger(s), other / Acquaintance(s) / Colleague(s) / Friend(s) / Family / Partner / I'm alone

Variables	Questions	Rating
Activity	What am I doing?	Nothing / Rest, passive activity (TV, internet, reading...) / Transport / Hygiene, household, grocery, meal / Social activity/interaction / Leisure / Physical activity / Work, study, training, attending a workshop / Other
Activity (other)	Specify your activity:	Free text
Initiation	Select the option that best corresponds with your situation:	I am the one who spontaneously started this activity. / Someone else encouraged me to start this activity. / I am not doing anything in particular.
Present enjoyment	I feel some pleasure in what I am doing.	1-7 Likert; 1 = Not at all true; 7 = Totally true
Wanting to give up	I feel like giving up this activity.	1-7 Likert; 1 = Not at all true; 7 = Totally true
Activity's meaning (value)	This activity is important to me.	1-7 Likert; 1 = Not at all true; 7 = Totally true
Effort	This activity requires some effort.	1-7 Likert; 1 = Not at all true; 7 = Totally true
Reminiscence	Since the last prompt, I have been recalling pleasant past events.	1-7 Likert; 1 = Not at all, I have been thinking of *unpleasant* events; 4 = I have not been particularly thinking about the past; 7 = Absolutely, I have been thinking a lot about pleasant past events.
Projection into the future	Since the last prompt, I have been looking forward to some activities or events.	1-7 Likert; 1 = Not at all, I have been *apprehending* the future; 4 = I have not been particularly thinking about the future; 7 = Absolutely, I have been greatly looking forward to the future.

Note: Items have been translated from French into English.

Italics: conditional questions (branching).

The categorical ESM outcomes of interest were: activity's meaning, motivation, mood, confidence, and savouring. Activity's meaning, effort, energy, mood, and confidence represent each a single item from the ESM questionnaire. Motivation is a composite measure of the items motivation and wanting to give up (reverse coded). Savouring is a composite measure of present enjoyment, reminiscence, and projection into the future.

Nominal ESM outcomes of interest were coping strategies (in the presence of discouraging beliefs), social contact, activity and initiation. For further details and label descriptions of the ESM measures, please refer to Table 2.

Step count

Participants were provided with an activity band (MiBand 3, Xiaomi) which they had to wear at all times (day and night) during the different phases of the study (baseline, intervention, post-measurement, and follow-up). The band is waterproof and has a battery autonomy of approximately 20 days. A MiFit sham account was created in order to synchronize the activity band with the app on the participant's smartphone. The MiFit app provided the total amount of steps per day.

2.5. Intervention

Switch was delivered by the main investigator, a trained psychologist and psychotherapist. The individual sessions lasted 1 hour and were given twice per week for 2 months, in the participants' local mental health centre.

The first sessions were dedicated to building a therapeutic alliance, getting to know the person and identifying personal resources, goals and values (i.e. addressing the first two levels of the motivation model, see 1. Introduction). Strategies were then taught in order to help the person to engage in behaviours directed towards these chosen goals and values (i.e. moving to the third level of the model). Multisensory "imagery" was used to help to look forward to the future (i.e. pleasure anticipation). This type of projection into future actions/goals included not only visualising the scene (i.e. the person her/himself, the context, the actions), but also imagining the possible sounds, physical sensations, smells, flavours, pleasant emotions, constructive thoughts, etc. The imagery thus goes through the different senses, in order to increase the possibility of experiencing pleasure and to help identify what modality generates the more pleasure – and consequently that has the higher motivational power. The imagery could focus on the process (e.g. baking a cake) or the result (e.g. eating the cake). A restructured decisional balance tool was used to address the effort-value computation. The "motivation's switch", as can be seen in Figure 3, was used to identify all the reasons why the person would not engage in a certain activity (including potentially discouraging thoughts, required effort), and all the good reasons why she/he would engage in that activity. Additionally, a column was used to indicate quick solutions for the smaller obstacles that were identified. The solutions and pros represent the "ON" part of the switch, which is highlighted relative to the cons' column, which represents the "OFF" part of the switch. The cons column potentially included obstacles and dysfunctional attitudes that needed further attention. Participants were then guided in solution-seeking strategies. Furthermore, significant discouraging thoughts and low self-efficacy were challenged using cognitive restructuring (e.g. generating more constructive thoughts) and/or a cognitive defusion approach (e.g. using metaphors, training mindfulness). Help in planning and initiation strategies (electronic reminders, implementation intention, post-its…) addressed the subsequent steps in the model. Finally, participants were invited to use various reminiscence strategies (e.g. sharing of experience

with others, keeping a diary, looking at photos, buying souvenirs) to increase positive memories and boost motivation for new actions or goals to engage in.

Chosen activity/goal:

....

Cons, obstacles, required efforts, drawbacks, negative thoughts…	→	Solutions (quick fixes)	Pros, motivations, advantages, values
OFF	ON		

Figure 3. The motivation's switch. Updated version of the decisional balance.

Each participant learnt the different strategies in relation to their individual goals and needs. A folder which presented the rationale for each strategy was given to the participants. Take-home assignments were given and stored in the same folder. Participants were also given small cards (that could fit in their wallet) containing the key elements of each strategy. Furthermore, during the last three weeks of the intervention, the participants received daily triggers (via the MetricWire app) inviting them to look forward to coming events/activities (morning trigger) and to look back at their day and reminisce about positive incidents (evening trigger). The morning trigger included an mp3 that could be listened to from the app and that provided a guided multi-sensory projection into the future. Finally, a booster session took place around 45 days after the end of the intervention, consisting mainly of a reminder of the different strategies and a troubleshooting of possible obstacles.

The complete manual for the Switch intervention and the participant booklet (both in French) can be requested from the first author.

2.6. Analyses

2.6.1. Aim 1: treatment effects of Switch on motivation and related processes

We used effect size coefficients to report changes in BNSS, LARS-p, LARS-i, FROGS and S-QoL scores. We created effect size coefficients for the composite scores of motivation/apathy and of QoL/functioning. Motivation/apathy represented the mean of four scores from the BNSS-Motivation (i.e. two scores from the two blinded evaluators), the LARS-p and LARS-i. QoL/functioning included the two scores from the S-QoL and

the FROGS. First, all variables were rescaled to fit a 7-point Likert-scale (0 to 6) in order to have comparable scores amongst the different scales and to compute effect sizes. The following equation was used to calculate the Cohen's d statistics effect size coefficient: $\frac{\overline{X_0} - \overline{X_1}}{S_{pooled}}$, where S_{pooled} equals $\frac{\sqrt{(n_0-1)(SD_0)^2+(n_1-1)(SD_1)^2}}{n_0+n_1-2}$, where n represents the number of observations (i.e. 4 observations for Motivation/Apathy, and 2 observations for QoL/functioning) and SD the within-person standard deviation. This coefficient thus takes into account the number of observations and the standard deviation within each phase (pre and post, or pre and follow-up) and within each participant.

To further investigate the effects of the intervention, we examined whether Switch had an effect on the ESM variables during the intervention and at follow-up. In a first step, we calculated the means and standard deviations per phase. Additionally, we performed unequal variances t-tests and computed the Cohen's d statistics (with pooled standard deviation as the denominator) to estimate effect sizes. In a second step, we fitted eight separate autoregressive lag 1 (AR(1)) models using the *lm* function in R (version 3.6.1). Dependent variables were the outcomes of interest, whereas independent variables were the lag of the dependent variables and the intervention phase, thus representing the autoregressive parameter and the mean intervention effect for each intervention phase respectively. Given that the AR(1) model assumes identical distribution of the errors throughout time, we lagged the independent variable within day and phase, resulting in a missing value for the lag at the first prompt of the day, as well as at the first prompt of a new phase. After each model, we performed a test for homoscedasticity after removing outliers, using the *outlierTest* function of the *car* package in R. In case residuals appeared to be heteroscedastic, the initial model (with outliers) was refitted using robust standard errors, by defining the robust variance-covariance matrix as argument using the function *vcov* of the *stats* package in R. For the analyses in both steps (*t*-tests, Cohen's *d*, and AR(1) models), baseline scores were taken as the reference group. Finally, we investigated – in descriptive pie charts – how nominal ESM variables evolved throughout the intervention. All analyses were performed for each participant individually.

2.6.2. Aim 2: dynamics between motivation and related processes

To explore the dynamics of the processes associated with motivation, we used individual network representations based on vector autoregressive (VAR) modelling. We computed network models for each phase separately (baseline, intervention and follow-up). We used the *graphicalVAR* package ver. 0.2.2 (Epskamp, van Borkulo, et al., 2018) to estimate the temporal and contemporaneous models and to obtain a visual representation using the *qgraph* package ver. 1.6.4 (Epskamp, Cramer, Waldorp, Schmittmann, & Borsboom, 2012). The nodes in the networks represent the variables, whereas the edges (i.e. the lines) represent the associations between the variables. In the temporal network, the edges are directed and indicate which variable predicts other variables in the next timepoint. In the

contemporaneous network, the edges represent partial correlations between the variables, after controlling for all the other variables in the same timepoint and also in the previous timepoint. All associations reported and represented on the models are significant ($p<.05$).

We also calculated plots representing rolling means (or "moving averages") which can be found in supplementary material, Figure S1 The course of the different processes – during baseline, intervention and at follow-up – was plotted using the *rollapply* function from the *emaph* package ver. 1.0.0 (Ruwaard, Kooistra, & Thong, 2018). This provides rolling means, i.e. the means of each variable as it progresses over time. A rolling mean smooths the time-series, thus making it easier to detect any evolution (e.g. trend and periodicity) and to reveal any associations between variables.

3. Results

Detailed descriptions of (1) the effects of Switch on motivation and related processes and (2) their dynamics are presented below for each participant individually. Results on the traditional assessment scales (BNSS, LARS, FROGS, S-QoL) are presented for each participant in Table 3.

Table 3

Pre, post and follow-up scores on the traditional assessment scales and effect size coefficients for the change in the composite scores.

		Pre T0	Post T2	Follow-up T3	*ES* T0-T2	*ES* T0-T3
2i-1	BNSS-Mot[a]	1.79		1.07		
	LARS-i	-27		-32		
	LARS-p	-23		-18		
	Motivation/Apathy	1.35		0.99		0.73
	S-QoL	66.34		71.70		
	FROGS	70		86		
	QoL/Functioning	3.75		4.58		0.37
2i-2	BNSS-Mot[a]	3.43	2.29	3.5		
	LARS-i	-11	-15	-23		
	LARS-p	-17	-21	-16		
	Motivation/Apathy	2.63	1.89	2.43	1.40	0.15
	S-QoL	62.93	61.46	65.37		
	FROGS	64	72	77		
	QoL/Functioning	3.39	3.65	3.99	2.37	1.54

		Pre	Post	Follow-up	*ES*	*ES*
		T0	T2	T3	T0-T2	T0-T3
2i-4	BNSS-Mot	4[a]	3.14[b]			
	LARS-p	8	-14			
	Motivation/Apathy	3.89	2.49		4.34	
	S-QoL	35.12				
	FROGS	46	60			

Notes: BNSS-Mot = Brief Negative Symptom Scale – Motivation (mean score); LARS = Lille Apathy Rating Scale informant (i) and patient (p) (total scores); FROGS: Functional Remission of General Schizophrenia (total score); S-QoL = Schizophrenia Quality of Life (total score); italics = composite variables; bold = large effect sizes.

ES = effect size; maximum likelihood estimator, using pooled standard deviation as the denominator.

[a] BNSS Motivation average score of the two blinded evaluators.

[b] Participant 2i-4 was not filmed at T2. The BNSS Motivation was scored by one independent evaluator unaware of her score at baseline.

3.1. Participant 2i-1

3.1.1. Aim 1: treatment effects of Switch on motivation and related processes

At baseline, participant 2i-1, a 29-year-old female, presented with mild motivational negative symptoms according to the BNSS, and no apathy according to the LARS. She was not assessed directly at post-measurement, potentially due to a relapse which she reported later. However, her scores at follow-up showed that motivational deficits reduced to a minimal level according to the BNSS. The score at the LARS-i also reduced. Overall, we observed a medium to large effect size coefficient for the motivation/apathy composite score at follow-up. Participant 2i-1 also reported a slightly higher quality of life. The FROGS score revealed a considerable increase in functioning. Overall, we observed a small to medium effect size coefficient for the QoL/functioning composite score at follow-up.

The effects on the ESM variables for participant 2i-1 are presented in Table 4. During the intervention phase, our analyses showed a significant increase in effort ($t(df)$ = 3.69(101); $p<.001$; d = .64), and a significant effect of the intervention on this score (b = .82, p = .029). Energy ($t(df)$ = 2.28(113); p = .025; d = .42), mood ($t(df)$ = 4.87(97); $p<.001$; d = .85), confidence ($t(df)$ = 3.44(98); $p<.001$; d = .60), and savouring ($t(df)$ = 2.91(106); p = .004; d = .52) scores were significantly better. Further, there was a significant intervention effect for mood (b = 1.19, $p<.001$), confidence (b = 0.64, p = .008), and savouring (b = 0.44, p = .025).

Based on the pie-charts that are presented in Figure 4, it appears that participant 2i-1's discouraging beliefs decreased during the intervention and at follow-up. Further, when experiencing discouraging beliefs, she appeared to cope better during the intervention and at follow-up. The occurrences of "no coping" indeed decreased. Finally, she appeared to

use a more varied set of coping strategies, namely, she started using cognitive restructuring strategies during the intervention and she increased their use at follow-up. Regarding social contact, at baseline, participant 2i-1 spent most of her time in the company of other people (varying from strangers to relatives). During the intervention and at follow-up, she seemed to spend even more time in the company of other people. Regarding activities, participant 2i-1 reported that most of the time she was resting or doing a passive activity and, next in line, reported activities related to household chores. During the intervention, the proportion of passive activity decreased in favour of more social and leisure activities. This was not observed at follow-up. Finally, at baseline, participant 2i-1 was rarely not doing anything in particular and only occasionally needed someone to encourage her to engage in a certain activity. She showed even more self-initiation during the intervention and at follow-up.

3.1.2. Aim 2: dynamics between motivation and related processes

Based on the network analyses that are presented in Figure 5, it appears that during the baseline phase, participant 2i-1's discouraging beliefs were significantly auto-correlated ($r = .31$; see the autoregressive loop in the Baseline Temporal model). This indicates that the more she had discouraging beliefs, the more she would have discouraging beliefs also at the next time of measurement. These discouraging beliefs appeared to co-occur with lower mood ($r = .26$) (see Baseline Contemporaneous model) and appeared to impact subsequent levels of energy ($r = -.17$), feelings of confidence ($r = -.18$) and savouring processes ($r = -.15$) (see Baseline Temporal model). During the intervention, these associations decreased. Indeed, discouraging beliefs were no longer significantly autocorrelated, and were only slightly and negatively associated with subsequent savouring processes ($r = -.09$) (see Intervention Temporal model). This was mostly maintained at follow-up. At follow-up, motivation was shown to be significantly associated with the activity's meaning, i.e. the more she was motivated, the more meaningful was the activity she was engaged in ($r = .16$). Furthermore, both motivation and activity's meaning became predictive of engagement in later effortful activities ($r = .30$ and $r = .17$, respectively, see Follow-up Temporal model).

Table 4

Participant 2i-1: Descriptive statistics regarding the different outcomes at baseline, during the intervention and at follow-up; Cohen's d coefficients; AR(1) models b coefficients.

		Mean	SD	t	df	d	CI lower	CI upper	b
Activity's meaning	T0	5.13	1.64						
	T1	5.53	1.24	1.66*	110	0.28	-0.04	0.60	0.32
	T3	5.06	1.46	-0.23	112	-0.04	-0.41	0.33	-0.23
Motivation	T0	4.77	1.34						
	T1	4.57	1.33	-0.92	135	-0.15	-0.47	0.17	0.24
	T3	4.84	1.17	0.30	112	0.05	-0.32	0.43	0.21
Effort	T0	4.44	2.13						
	T1	5.56	1.43	3.69****	101	0.64	0.32	0.97	0.82**
	T3	3.98	2.40	-1.07	101	-0.20	-0.58	0.17	-0.74
Energy	T0	4.48	1.53						
	T1	4.82	1.20	1.48	113	0.25	-0.07	0.57	0.39
	T3	5.08	1.26	2.28**	113	0.42	0.04	0.79	0.46
Mood	T0	5.13	1.73						
	T1	4.55	1.97	-1.95*	146	-0.31	-0.63	0.01	-0.39
	T3	6.33	0.86	4.87****	97	0.85	0.47	1.24	1.19****
Confidence	T0	5.08	1.38						
	T1	4.74	1.31	-1.56	130	-0.26	-0.58	0.07	-0.08
	T3	5.76	0.71	3.44****	98	0.60	0.22	0.98	0.64***
Savouring	T0	4.29	1.12						
	T1	4.53	1.02	1.41	127	0.23	-0.09	0.55	0.40*
	T3	4.78	0.67	2.91***	106	0.52	0.14	0.90	0.44**
Steps	T0	4949	1800						
	T1	3846	2492	-1.91*	36	-0.47	-1.06	0.11	-616.78
	T3	3926	1699	-1.65	30	-0.58	-1.32	0.15	-755.84

Significance levels: * *p* < .10; ** *p* < .05; *** *p* < .01; **** *p* < .001

Notes. SD = standard deviation; *t* = t-value for difference in mean between T0-T1 and T0-T3; *df* = degrees of freedom; *d* = Cohen's d; *CI* = confidence intervals of the *d* coefficient; *b* = AR(1) model's b coefficient (General Least Squares); T0 = baseline; T1 = intervention; T3 = follow-up.

Discouraging beliefs (DB) and Coping strategies

- No or low-intensity DB
- DB - defusion
- DB - concrete solutions
- DB - no coping
- DB - cognitive restructuring
- DB - moderate coping

Social environment

- In company
- Alone

Activities

- Nothing
- Transport
- Social activity
- Physical activity
- Rest, passive activity
- Hygiene, household, grocery, meal
- Leisure
- Work, study, training, workshop

Initiation

- I am doing nothing in particular
- Someone else encouraged me to do this
- I am the one who spontaneously started this activity
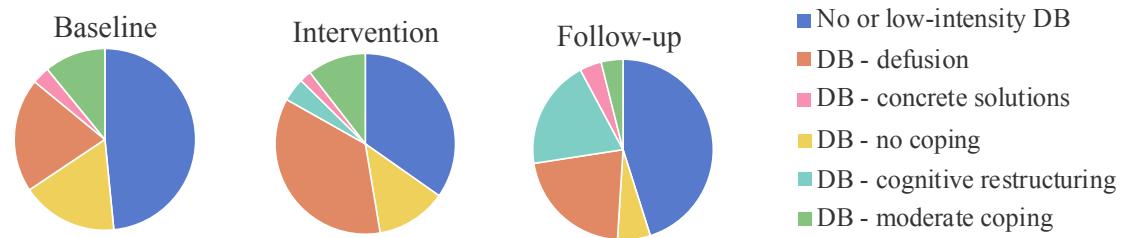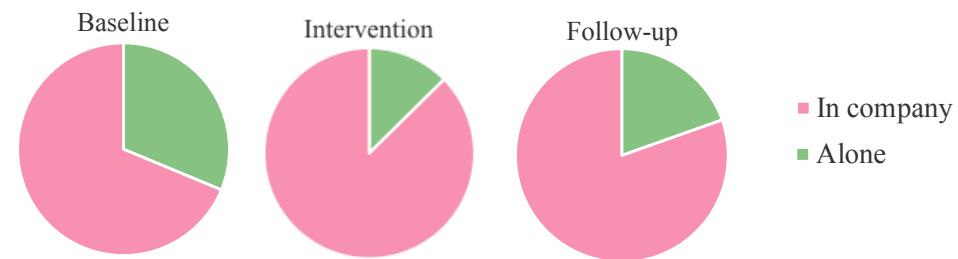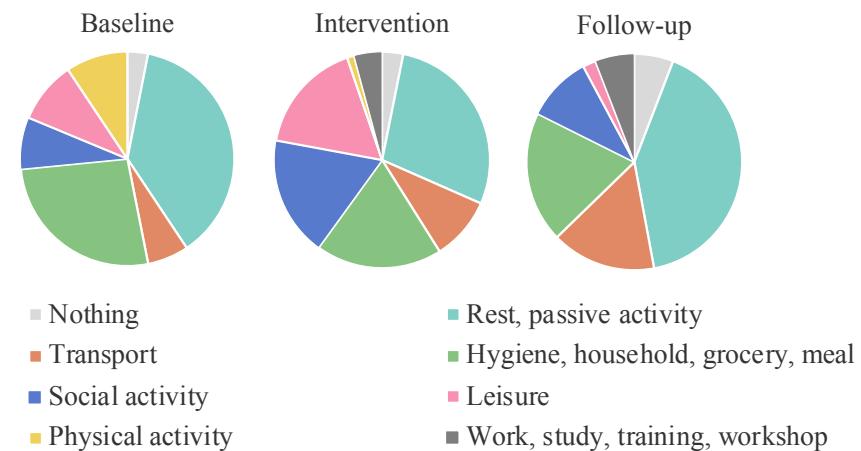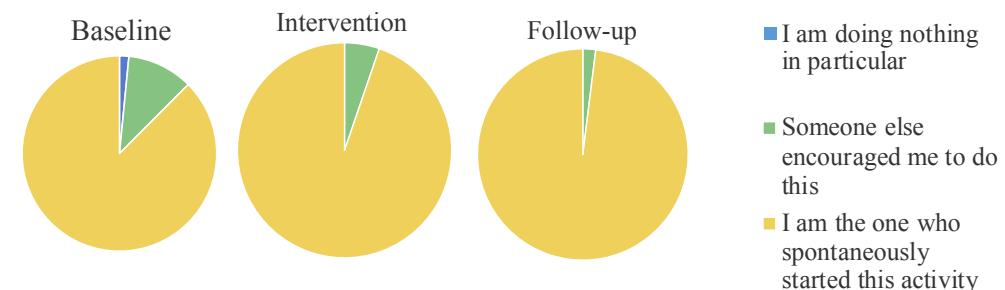
Figure 4. Pie charts for nominal variables of participant 2i-1.
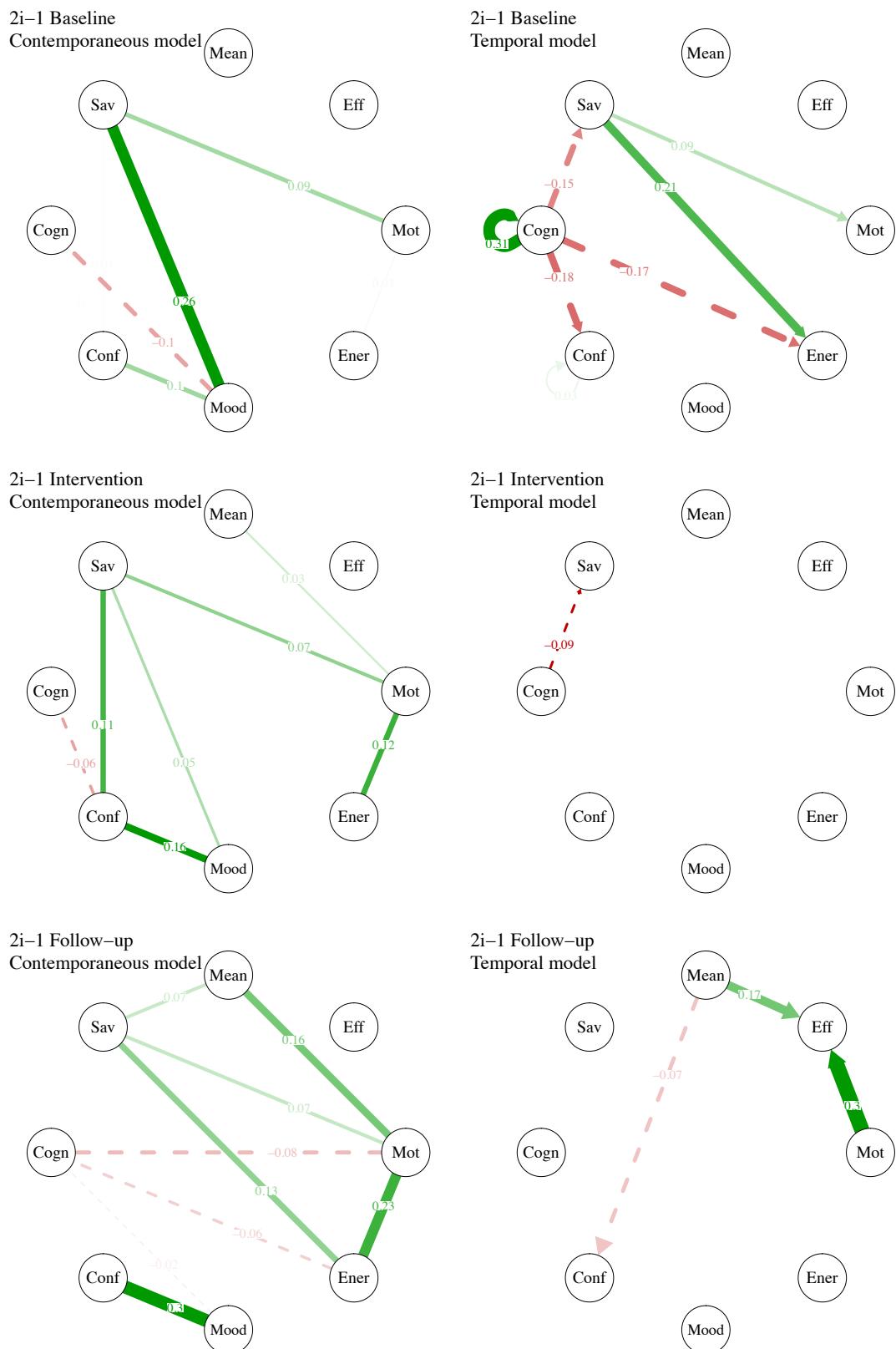
Figure 5. Network models of participant 2i-1. Positive associations appear in green (continuous lines) and negative associations appear in red (dashed lines). The stronger the relationships, the thicker the edges. Only associations with p-values < .05 are plotted. For a colour version of this figure, see the digital version of the paper.

3.2. Participant 2i-2

3.2.1. Aim 1: treatment effects of Switch on motivation and related processes

At baseline, participant 2i-2, a 34-year-old male, presented with moderate to moderately severe motivational negative symptoms according to the BNSS, and moderate apathy according to the LARS. At post-measurement, motivational deficits were evaluated as being mild, and apathy scores, both LARS-i and LARS-p, decreased. Overall, we observed a very large effect size coefficient for the motivation/apathy composite score at post-measurement. There was no improvement on quality of life. The FROGS score revealed a considerate increase in functioning. Overall, we observed a very large effect size coefficient for the QoL/functioning composite score at post-measurement.

At follow-up, the improvement on the BNSS and the LARS-p was no longer observed. However, the apathy score according to the participant's informant (LARS-i) reduced, reaching the threshold for "no apathy". Overall, there was no significant change for the motivation/apathy composite score at follow-up. Participant 2i-2 reported higher scores on quality of life (S-QoL). The FROGS score revealed further improvement in functioning. Overall, there was a very large effect size coefficient for the motivation/apathy composite score at follow-up.

The effects on the ESM variables for participant 2i-2 are presented in Table 5. During the intervention phase, his mood significantly worsened ($t(df) = -2.77(85)$; $p = .007$; $d = .86$), as well as savouring ($t(df) = -3.65(83)$; $p<.001$; $d = .65$). There was a significant intervention effect for mood worsening ($b = -.41$; $p = .09$), but not for savouring ($b = -.24$; $p = .12$).

At follow-up, participant 2i-2 engaged in significantly more effortful activities ($t(df) = 3.27(68)$; $p = .002$; $d = .76$). There was, however, no significant intervention effect for effort ($b = .76$; $p = .23$).

Based on the pie-charts that are presented in Figure 6, it appears that participant 2i-2 experienced more discouraging thoughts during the course of the intervention and at follow-up. He also reported more occurrences of not coping with these thoughts. Regarding social contact, he appeared to be alone most of the time, which did not change during the intervention or at follow-up. Regarding activities, there is no apparent change from baseline to the intervention phase. At follow-up, participant 2i-2 reported less passive activity and more daily life tasks and social interactions. Finally, regarding initiation, participant 2i-2 reported less often doing nothing in particular, especially at follow-up. Moreover, he reported slightly less occurrences where someone needed to encourage him to engage in a certain activity.

3.2.2. Aim 2: dynamics between motivation and related processes

Based on the network analyses that are presented in Figure 7, it appears that certain associations between the different variables persisted over the course of the intervention

and at follow-up. Namely, savouring processes were associated with mood at baseline ($r =$ .19), even more so during the intervention ($r = .36$) and at follow-up ($r = .21$). Furthermore, engaging in meaningful activities were associated with more effort at baseline ($r = .23$) and during the intervention ($r = .33$), but not at follow-up. At follow-up, motivation became significantly associated with mood ($r = .15$). The associations between the other processes were very weak.

Table 5

Participant 2i-2: Descriptive statistics regarding the different outcomes at baseline, during the intervention and at follow-up; Cohen's d coefficients; AR(1) models b coefficients.

|		Mean	SD	t	df	d	CI lower	CI upper	b
Activity's	T0	4.50	1.70						
meaning	T1	4.30	1.72	-0.65	78	-0.12	-0.48	0.25	-0.39
	T3	4.57	1.48	0.18	67	0.04	-0.44	0.52	-0.02
Motivation	T0	4.57	0.82						
	T1	4.32	0.74	-1.73*	71	-0.33	-0.70	0.03	-0.26*
	T3	4.30	0.64	-1.57	69	-0.36	-0.84	0.12	-0.30
Effort	T0	2.76	2.03						
	T1	3.04	1.91	0.76	73	0.14	-0.22	0.51	0.28
	T3	4.20	1.69	3.27***	68	0.76	0.26	1.25	0.76
Energy	T0	4.50	1.21						
	T1	4.22	0.94	-1.31	63	-0.27	-0.63	0.10	-0.34
	T3	4.77	0.43	1.31	54	0.27	-0.20	0.75	0.17
Mood	T0	4.00	0.91						
	T1	3.52	1.00	-2.77***	85	-0.49	-0.86	-0.12	-0.41*
	T3	3.87	1.14	-0.53	54	-0.13	-0.61	0.35	-0.10
Confidence	T0	4.31	0.90						
	T1	4.52	0.84	1.30	73	0.25	-0.12	0.61	-0.01
	T3	4.40	0.77	0.46	68	0.11	-0.37	0.58	-0.25
Savouring	T0	4.24	0.54						
	T1	3.86	0.59	-3.65****	83	-0.65	-1.03	-0.28	-0.24
	T3	4.16	0.62	-0.43	58	-0.14	-0.62	0.33	-0.06
Steps	T0	10904	7518						
	T1	11167	6397	0.13	21	0.04	-0.52	0.60	1129
	T3	12959	9407	0.62	21	0.25	-0.54	1.03	3488

Significance levels: * p<.10; ** p<.05; *** p<.01; **** p<.001

Notes. SD = standard deviation; *t* = t-value for difference in mean between T0-T1 and T0-T3; *df* = degrees of freedom; *d* = Cohen's d; *CI* = confidence intervals of the *d* coefficient; *b* = AR(1) model's b coefficient (General Least Squares); T0 = baseline; T1 = intervention; T3 = follow-up.

Discouraging beliefs (DB) and Coping strategies

Baseline   Intervention   Follow-up

- No or low-intensity DB
- DB - defusion
- DB - concrete solutions
- DB - no coping
- DB - cognitive restructuring
- DB - moderate coping

Social contact

Baseline   Intervention   Follow-up

- In company
- Alone

Activities

Baseline   Intervention   Follow-up

- Nothing
- Transport
- Social activity
- Physical activity
- Rest, passive activity
- Hygiene, household, grocery, meal
- Leisure
- Work, study, training, workshop

Initiation

Baseline   Intervention   Follow-up

- I am doing nothing in particular
- Someone else encouraged me to do this
- I am the one who spontaneously started this activity
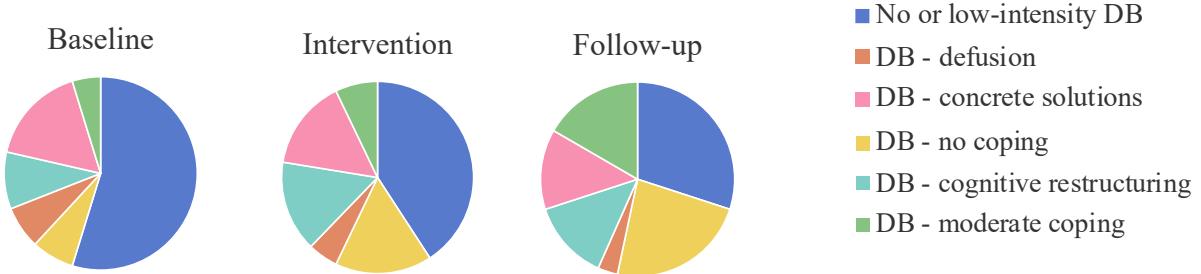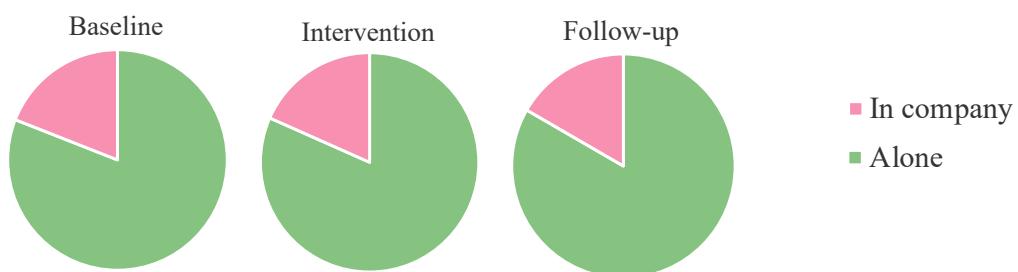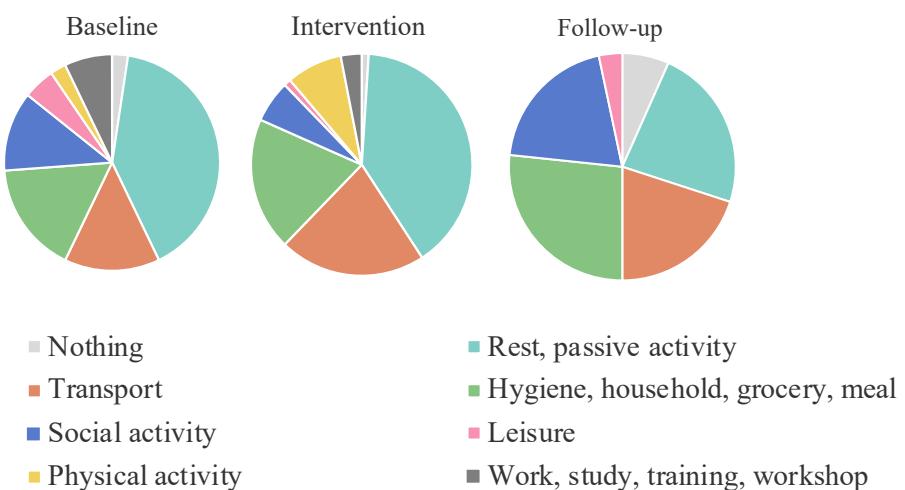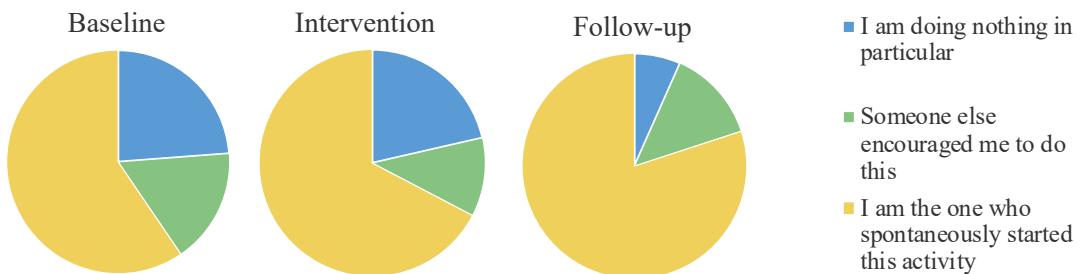
Figure 6. Pie charts for nominal variables of participant 2i-2

Figure 7. Network models of participant 2i-1. Positive associations appear in green (continuous lines) and negative associations appear in red (dashed lines). The stronger the relationships, the thicker the edges. Only associations with p-values < .05 are plotted. For a colour version of this figure, see the digital version of the paper.

3.3. Participant 2i-4

3.3.1. Aim 1: treatment effects of Switch on motivation and related processes

At baseline, participant 2i-4, a 39-year-old female, presented with moderately severe motivational negative symptoms according to the BNSS, and severe apathy according to the LARS-i. At post-measurement, motivational deficits were evaluated as being mild, and apathy ratings, accord to the LARS-p, reduced to moderate apathy. Everyday functioning also improved (according to the participant's responses on the FROGS), reaching almost the threshold for remission. She did not wish to continue the assessment at follow-up.

The effects on the ESM variables for participant 2i-4 are presented in Table 6. Her ESM data reveal very low levels of mood ($M = 1.79$, $SD = 1.28$) and savouring processes ($M = 2.20$, $SD = 1.03$). During the intervention phase, she reported significantly more meaningful activities ($t(df) = 2.36(51)$; $p = .022$; $d = .55$) and significantly more effortful activities ($t(df) = 2.31(62)$; $p = .024$; $d = .51$). There was a significant intervention effect on meaningful activities ($b = 92$; $p = .07$). Additionally, there was a significant intervention effect on savouring processes ($b = .52$, $p = .09$). Finally, her step count increased significantly ($t(df) = 2.71(13)$; $p = .024$; $d = 1.20$) and there was a significant intervention effect on steps ($b = 2270$; $p = .083$). Note that this was based on the data collected during baseline and the first 15 days of the intervention phase, as the step count could not be collected afterwards due to technical issues.

Based on the pie-charts that are presented in Figure 8, it appears that participant 2i-4 experienced more discouraging thoughts during the course of the intervention. However, during the course of the intervention, her use of coping strategies varied and she started using cognitive restructuring (i.e. using constructive thoughts more often). Regarding social contact, she appeared to be alone most of the time, which changed slightly during the intervention, where she was less alone. Regarding activities, participant 2i-4 reported – most of the time – doing nothing, resting or doing some passive activities. During the intervention, she reported less passivity and more activities such as domestic tasks, leisure and physical activity. Finally, regarding initiation, participant 2i-4 reported more self-initiation during the intervention phase.

3.3.2. Aim 2: dynamics between motivation and related processes

The network analyses that are presented in Figure 9 reveal quite important changes in the dynamics of the various processes comparing baseline and intervention phases. At baseline (see Contemporaneous model), we found associations between savouring processes and mood ($r = .27$), confidence and motivation ($r = .24$), discouraging thoughts and mood ($r = -.15$), and weaker associations between confidence and energy ($r = .10$), energy and motivation ($r = .09$), and discouraging thoughts and savouring ($r = -.05$). During the intervention (see Intervention, Contemporaneous model), savouring processes became more associated with energy ($r = .25$), discouraging thoughts ($r = -.24$) and motivation ($r =$

.09). This indicated that the more she used savouring skills (enjoying the present moment, looking forward to the future or reminiscing positively), the less she experienced discouraging thoughts, her energy levels increased, and she experienced more motivation – and vice versa. Furthermore, there was an increased association between energy and confidence ($r = .19$) and energy and motivation ($r = .28$), so that, the more she felt confident, the more she had energy and the more motivated she was. Moreover, the temporal influence of the different variables changed substantively (see Temporal models). At baseline, no variables predicted the other variables at the next time of measurement. During the intervention phase, motivation predicted later savouring ($r = .19$), discouraging thoughts became auto-correlated ($r = .32$) and predicted later mood ($r = -.26$), and confidence became also auto-correlated ($r = .23$) and was predicted by previous levels of energy ($r = .12$).

Table 6

Participant 2i-4: Descriptive statistics regarding the different outcomes at baseline, during the intervention and at follow-up; Cohen's d coefficients; AR(1) models b coefficients.

|		Mean	SD	t	df	d	CI lower	CI upper	b
Activity's meaning	T0	3.39	1.97						
	T1	4.22	1.12	2.36**	51	0.55	0.14	0.96	0.92*
Motivation	T0	4.04	1.19						
	T1	3.81	0.91	-1.03	62	-0.23	-0.63	0.18	0.09
Effort	T0	3.61	1.76						
	T1	4.37	1.34	2.31**	62	0.51	0.09	0.92	0.43
Energy	T0	3.21	1.28						
	T1	3.57	1.12	1.44	70	0.30	-0.10	0.71	0.34
Mood	T0	1.79	1.28						
	T1	1.78	0.86	-0.02	57	0.00	-0.41	0.40	0.35
Confidence	T0	3.61	1.03						
	T1	3.48	0.95	-0.63	73	-0.13	-0.54	0.27	0.02
Savouring	T0	2.20	1.03						
	T1	2.30	0.78	0.52	62	0.11	-0.29	0.52	0.45*
Steps	T0	1819	1303						
	T1	4267	2800	2.71**	13	1.20	0.33	2.07	2270*

Significance levels: * $p<.10$; ** $p<.05$; *** $p<.01$; **** $p<.001$

Notes. SD = standard deviation; t = t-value for difference in mean between T0-T1 and T0-T3; df = degrees of freedom; d = Cohen's d; CI = confidence intervals of the d coefficient; b = AR(1) model's b coefficient (General Least Squares); T0 = baseline; T1 = intervention; T3 = follow-up.

Discouraging beliefs (DB) and Coping strategies

Social contact

Activities

Initiation
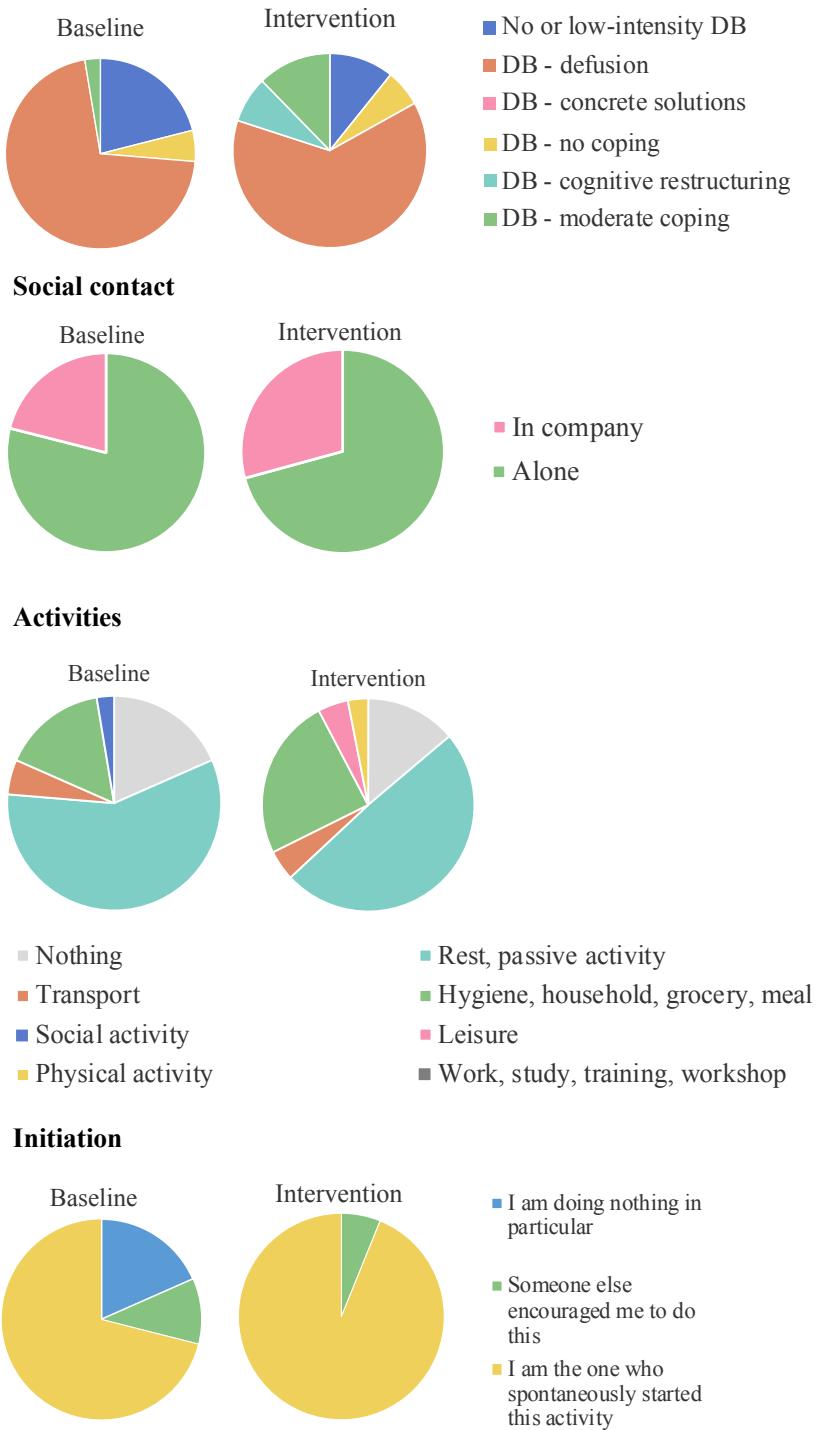
Figure 8. Pie charts for nominal variables of participant 2i-4
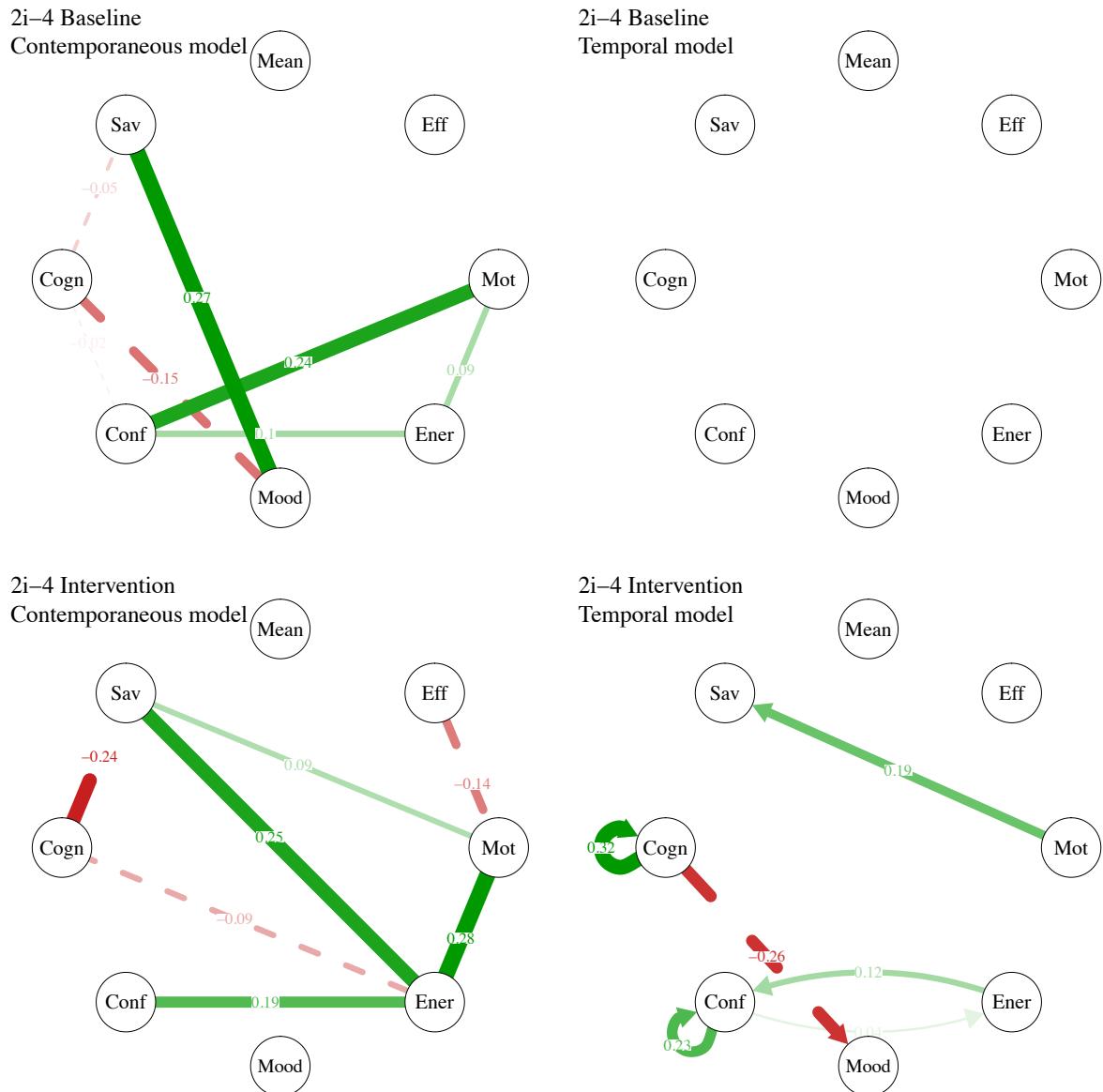
Figure 9. Network models of participant 2i-4. Positive associations appear in green (continuous lines) and negative associations appear in red (dashed lines). The stronger the relationships, the thicker the edges. Only associations with p-values < .05 are plotted. For a colour version of this figure, see the digital version of the paper.

4. Discussion

The aim of this study was to further validate Switch, an intervention that targets motivation in individuals with schizophrenia spectrum disorders. We wished to evaluate the effects of Switch on motivation, apathy, quality of life and daily functioning (primary outcomes), as well as on daily measures of various processes and outcomes related to motivation. Furthermore, we aimed to explore how the processes of interest were interrelated and developed throughout the course of the intervention, on an individual level.

STUDY 2

The first participant we presented, participant 2i-1, appeared to have benefitted the most from the intervention, showing improvement on both traditional evaluations of motivation/apathy and functioning, as well as on processes related to motivation as measured with the ESM. However, it is not straightforward to interpret her results, as she started relapsing towards the end of the intervention, potentially because she no longer adhered to her medication in the period previous to the start of the intervention. She participated thoroughly in the intervention, attending all sessions until the 12th session. She did not come to the last 4 sessions that were planned and progressively stopped both answering the ESM questionnaires and using the activity band. However, she did learn all the strategies that Switch offered and complied with the homework, as observed during the sessions. She was present at the booster session (around 2 months after her last session). During both the booster and feedback sessions, she mentioned that the strategies she learned in the Switch intervention allowed her to hold on, which in turn could avert a "complete crisis" and subsequent hospitalisation. Furthermore, her improvement on savouring processes, confidence and coping strategies in regard of discouraging beliefs points towards a specific effect of Switch. Finally, the change in the dynamics of the different processes is interesting: during and after the intervention, discouraging thoughts lost their impact on other processes (savouring, confidence, energy) related to motivation and goal-directed behaviours.

Regarding participant 2i-2, Switch had large positive effects based on the traditional evaluations of motivation/apathy and QoL/functioning. Surprisingly, these improvements did not translate into consistent improvements on daily life measures. On the contrary, daily measures showed that he was feeling slightly less motivated, sadder and experiencing more discouraging thoughts during the intervention. However, as he explained at different times (during the intervention and at the feedback session), feeling sad was an important change for him. He felt more alive, more sensitive and reassured that he could still feel emotions despite the medical treatment. It is possible that the study procedure and the intervention made him more aware of, and sensitive to, his emotions (see for example van Aubel et al., 2020; Widdershoven et al., 2019). Nonetheless, we would have hoped for an increase in *positive* emotions. Regarding the follow-up evaluation, we found out after the end of the study (during the feedback session) that he stopped taking his medication before the follow-up assessment, which renders the interpretation of the follow-up results difficult. Daily measurements at follow-up revealed that he was more active and showed more self-initiation, which was not in line with the results from the traditional evaluations.

Finally, participant 2i-4 also showed improvement based on the traditional scales. Important to note is that these results rely solely on her reports, as no informant was involved. This improvement was also perceived in the ESM: she reported engaging in more activities, which appeared to be more meaningful and more effortful. Additionally, her step count increased significantly. However, these improvements were not clearly accompanied by changes on the daily measures of processes related to motivation, except for savouring, but only marginally.

Of interest, the network models of each participant reveal important differences between the participants. On the one hand, such distinctions might explain the diverse responses to the intervention. On the other hand, the network models seem to develop similarly in one way: the interconnectedness of the different variables seem to increase over the different phases of the study. Previous studies have hypothesised that a tightly connected network of symptoms was associated with higher severity (Robinaugh, Hoekstra, Toner, & Borsboom, 2020). In our model, we did not use symptoms, but other psychological variables including functional processes. We might thus hypothesize that an increased connection between those variables is a sign of better functioning. This would have to be further explored, comparing samples of healthy individuals with samples of individuals with different mental disorders.

Overall, while the positive impact of Switch on usual measures of motivation, apathy and daily functioning was observed in each participant, this was not consistently translated by a change in daily life measurements of motivation and activity, or processes related to motivation and steps. It is plausible that the impact on certain daily life processes (i.e. measured with the ESM) develop on a longer term (Aleman et al., 2017; Li et al., 2016), or that the intervention itself would need to last longer in order for some cognitive or hedonic skills to improve for certain individuals. Indeed, the idiosyncratic analyses revealed very different dynamics between those processes and it appears that the intervention impacts each person differently. It is possible that the effects of Switch depend on baseline symptoms and how processes interact prior to the intervention. Further development of Switch could incorporate these individual differences by employing individual network analyses resulting from the ESM to adapt the intervention to the person's more central processes (e.g. Levinson, Vanzhula, & Brosof, 2018). Taking this a step further, Switch could benefit from an Ecological Momentary Intervention approach (I. H. Bell, Lim, Rossell, & Thomas, 2017), which would help individuals target the specific difficulties they meet in their daily lives by making use of a mobile intervention. Finally, weekly feedback on the ESM measures could also increase awareness of the measured processes and improve efficacy in the related skills (e.g. looking forward to the future, taking distance from discouraging thoughts) (see for example Kramer et al., 2014).

This study has several strengths, both on a methodological and a theoretical level. First, we used different types of instruments to evaluate the effects of our intervention, combining traditional scales (completed by both participants and informants) and blind evaluations for our main outcome (BNSS Motivation), daily subjective reports via online questionnaires (ESM), and daily objective measurements via step count. Furthermore, this evaluation procedure was re-applied three months later at follow-up. To the best of our knowledge, this is the first study to combine an idiographic approach with ESM in order to explore processes related to motivation during an intervention for individuals with schizophrenia. Such an approach enabled an uncovering of the all-important dynamics and connectedness between variables that greatly differ from one individual to another, and this with the help

of complex time series analyses. The use of ESM in clinical trials opens perspectives in the study of psychopathological phenomena, mediators of change, and potentially in the development of personalized interventions and interventions that are closely related to daily life functioning (Myin-Germeys et al., 2018, 2009). Another important strength of our study is the solid theoretical foundations of the Switch intervention. Switch was specifically designed to target motivational negative symptoms, but importantly was based on a multifactorial model of motivation that encompasses various cognitive, emotional and behavioural processes.

There are certain limitations worth noting. First, the study took place in a naturalistic setting, with clear ecological advantages (e.g. generalisability of the findings to similar settings), albeit also with some drawbacks such as lack of control on certain important factors (e.g. change in medication, relapse). Second, adherence to the assessment protocol was not complete for all participants, thus limiting certain interpretations. Third, analyses did not take into consideration the varying lag that spanned between two observations, which could alter the associations we found between the variables. To date, analyses that take into account minutes or hours, rather than the prompt index (i.e. the prompt number within a day) have not been developed. Furthermore, the number of observations per participant may have been too limited to test more complex models, including for example AR(1) models with interaction effects. More intensive data would also allow the use of models able to identify mechanisms of change (e.g. vector autoregressive moving average models for multivariate prediction). Finally, the VAR analyses computed to represent the network models do not include interaction effects. Therefore, firm inferences could not be drawn regarding the effects of the intervention on the changes in the dynamical networks.

4.1. Conclusions

Switch appears to be beneficial according to traditional measures of motivation/apathy and quality of life/daily functioning, and in some cases, regarding processes measured on a daily basis. The benefits were found in individuals with different levels (mild to severe) of severity of motivational negative symptoms and apathy. The mechanisms of change, however, could not be clearly identified. It is very plausible that the processes underlying the observed improvements vary from one individual to another. Future studies aiming to validate interventions for motivational negative symptoms should investigate the dynamics of processes related to motivation before and during interventions and, more specifically, aim to reveal these mechanisms of change. Such an approach would help the refinement of psychological interventions and guide the focus of those on strategies that target actual mechanisms of change.

Study 2: Supplementary material
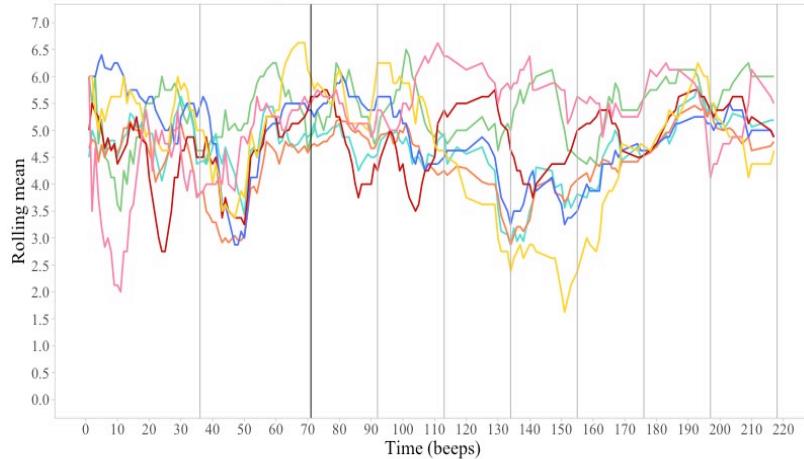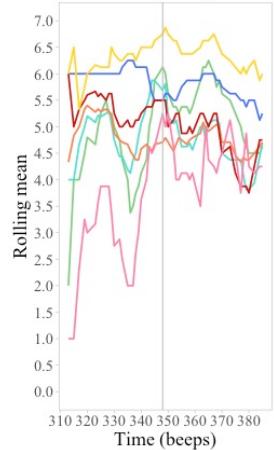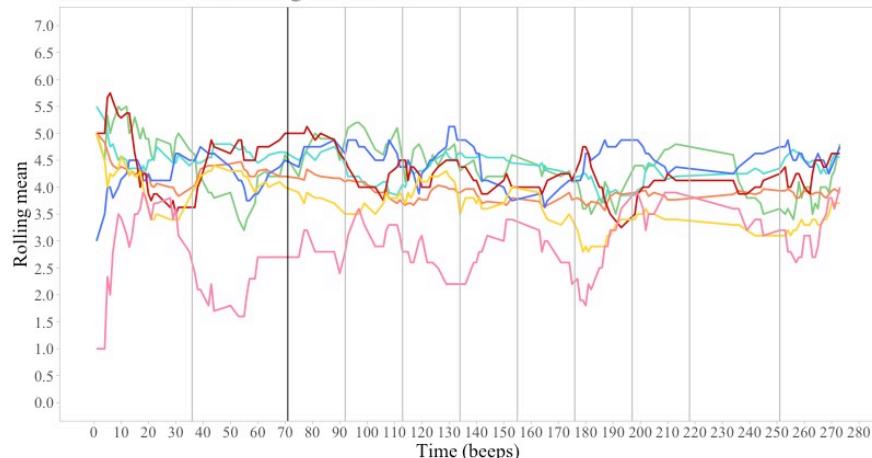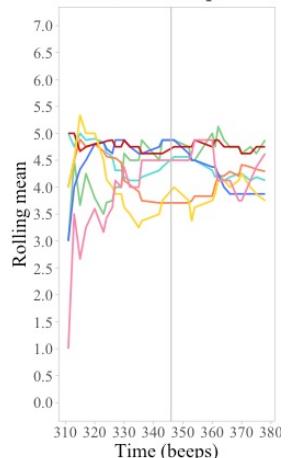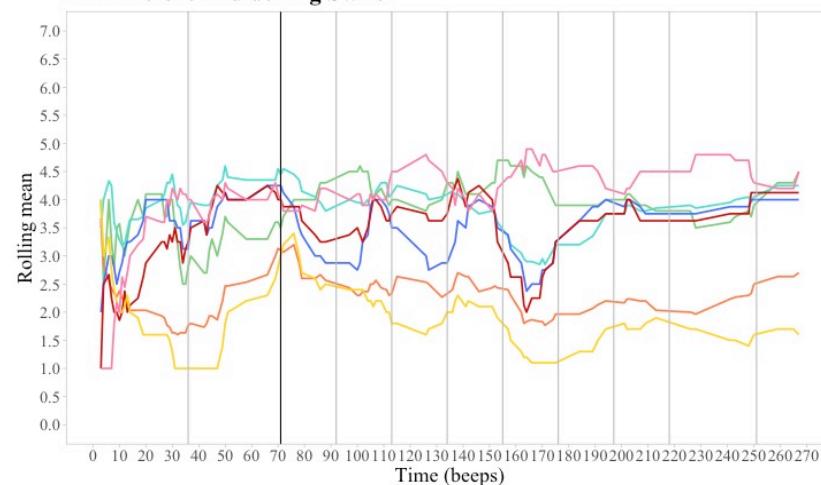
Figure S1. Evolution of ESM variables over time for each participant, using rolling means with an 8-prompt (8-beep) window: each point on the rolling mean plot corresponds to an aggregate of 8 observations centred at that point. The vertical hard line indicates the start of the intervention. The vertical grey lines separate each week.

STUDY 3

A group intervention for motivational deficits: Preliminary investigation of a blended care approach using ambulatory assessment

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Abstract

Objective: Motivational deficits are an important predictor of functional outcomes in individuals with a serious mental illness such as schizophrenia and mood spectrum disorders. The aim of the present study was to explore the feasibility, acceptability and preliminary efficacy of a group version of "Switch", a multifactorial intervention that targets motivational deficits, enriched with an ecological momentary intervention (EMI) approach (i.e. prompts on the participants' smartphone to encourage the use of trained strategies in their daily life). Furthermore, we wished to appraise the feasibility of the trial methods using continuous ambulatory assessment. *Method:* Eight participants with schizophrenia, schizoaffective or major depressive disorder entered the study. The intervention took place twice a week for two months. Assessment measures included traditional evaluations of motivational negative symptoms, apathy, quality of life and daily functioning, in addition to novel ambulatory assessment methods strategies, including the experience sampling method (ESM) to assess motivation and related processes, and actigraphy (daily step-count) to assess participants' activity level. *Results:* Participants attended on average 55% of the intervention and reacted to 50% of the EMI prompts. They completed 47% of the ESM prompts during the baseline, and 25% during the intervention phase. Four participants were considered as non-completers (followed less than 2/3 of the programme) and four were considered as completers. Only completers presented a decrease in amotivation/apathy and an improvement in functional outcomes after the intervention and at follow-up. Furthermore, mixed-effects ESM models showed significant interaction effects on multiple processes related to motivation, indicating improvements only in completers. Improvements consisted of: heightened motivation, increased engagement in meaningful and effortful activities, better mood, higher levels of confidence, increased frequency of projection into the future (pleasure anticipation) and of positive reminiscence. *Conclusions:* This preliminary investigation provides evidence that Switch may be an effective intervention, with specific effects on motivation and associated processes. Switch was also relatively well accepted by participants. Aspects to be improved in future studies (feasibility of both the intervention and the evaluation protocol) are discussed. Future studies should use similar designs with continuous daily evaluation in order to investigate the dynamics of mechanisms of change.

Keywords: Motivation, therapy, apathy, daily functioning, quality of life, rehabilitation

STUDY 3

1. Introduction

Motivational deficits are important predictors of functional outcomes and quality of life in individuals with schizophrenia (W. C. Chang, Wong, et al., 2019; Savill et al., 2016), and other disorders such as schizoaffective, major depressive and bipolar disorders (Foussias et al., 2014; Herbener & Harrow, 2004; Kingston et al., 2018; Lewandowski, Cohen, & Ongur, 2020). Yet, adequate treatment schemes for motivational negative symptoms have been largely lacking. In the past few years, however, new interventions that specifically target motivational deficits have been developed and tested (e.g. Favrod et al., 2019; Thonon, Levaux, Della Libera, & Larøi, 2020). For example, our research group has found promising results from the "Switch" intervention provided in individual sessions, with specific improvements on motivational negative symptoms and functional outcomes (Thonon, Levaux, et al., 2020), as well as particular effects on daily life measures of savouring abilities, cognition (e.g. discouraging beliefs), and the engagement in meaningful and effortful activities (Thonon, van Aubel, Lafit, Della Libera, & Larøi, n.d.).

In addition to this individual therapeutic format, we developed a version of the Switch intervention for group settings to meet the increased service demands that are being placed upon mental health systems (Burlingame et al., 2016). Providing interventions in a group setting might indeed be more cost-effective than in individual settings (e.g. Neufeld et al., 2020). Furthermore, group interventions have several interesting advantages in terms of outcomes (Borek & Abraham, 2018; Borek et al., 2019; DeLucia-Waack, Gerrity, Kalodner, & Riva, 2004), namely: participants can receive and provide peer-support (e.g. receiving and giving feedback that bolster self-efficacy); they interact with individuals who experience similar issues and this can have a normalizing effect; participants can learn from their peers (e.g. gaining new perspectives on a problem; developing alternative solutions); and group settings offer an opportunity to develop social skills. Finally, in order to enhance the acquisition and generalisation of certain skills taught during the intervention, we complemented the face-to-face group intervention with an ecological momentary intervention (EMI or mobile health intervention; Lindhiem, Bennett, Rosen, & Silk, 2015; Myin-Germeys, Klippel, Steinhart, & Reininghaus, 2016), by which participants were prompted (through their smartphones) to use the trained skills in their daily life. This type of blended care has already been shown feasible and effective in samples of individuals with schizophrenia (I. H. Bell et al., 2017; Depp, Perivoliotis, Holden, Dorr, & Granholm, 2019) and other mental health disorders (Erbe, Eichert, Riper, & Ebert, 2017).

The aim of the present study was to examine the feasibility, acceptability and preliminary efficacy of the Switch intervention provided in a group setting and complemented with EMI. Furthermore, we wished to evaluate the feasibility of an innovative study design that included the continuous evaluation of processes related to motivation, using the experience sampling method (ESM) (Myin-Germeys et al., 2009) and actigraphy (Wee et al., 2019), throughout the different phases of the study (baseline, intervention phase, post-intervention and follow-up). ESM involves the repeated self-evaluation of various

experiences (e.g. thoughts, emotions, behaviours), allowing the evaluation of phenomena as they unfold in a person's daily life. This approach shows high ecological validity, as the assessment is done recurrently (i.e. allowing a representative sample of the observed variables), in the person's natural environment, and in real time. The latter characteristic of ESM also has the benefit of reducing retrospective recall bias. We wished to use ESM throughout the different phases of the study (i.e. not only at baseline and post-intervention, but also during the intervention) to explore possible mechanisms of change related to improvement in negative symptoms and functional outcomes. As for actigraphy, a non-invasive wearable device (e.g. an activity band) allows for the objective recording of motor activity (e.g. step-count). Actigraphy has been shown to be a good proxy measure for motivational negative symptoms (Kluge et al., 2018). Evaluating the feasibility of such a study design is essential as, to the best of our knowledge, ambulatory assessments have never been used throughout the different phases of a clinical trial.

First, we hypothesized that, looking at traditional assessment scales, there would be an improvement in motivation, apathy, functional outcomes and quality of life after completing the Switch intervention (i.e. after attending at least two-thirds of the intervention; following Pos et al., 2019). Second, we expected improvement on daily life measures (ESM and actigraphy) that represent processes related to motivation and goal attainment (e.g. discouraging beliefs, savouring abilities, engagement in effortful activities, motor activity). Third, we wished to explore any possible differences between participants who completed the intervention and those participants who did not complete at least two-thirds of the intervention. Regarding feasibility and acceptability, we hypothesized that the intervention would be both well accepted (based on participants feedback) and feasible (based on intervention adherence, both face-to-face and EMI). Finally, we hypothesized that the ambulatory assessment procedure would be feasible, as indicated by a completion rate of at least one third of the ESM prompts (Delespaul, 1995) and by the adherence to the activity band (i.e. number of days when it was worn).

2. Methods

2.1. Participants

Participants were recruited via referral from a psychiatric day care and a psychiatric hospital in the French speaking community of Belgium, where both the assessments and intervention took place. Furthermore, Eligibility criteria included: (1) age between 18 and 65; (2) DSM-V criteria for schizophrenia or schizoaffective disorder (American Psychiatric Association, 2013); (3) a good understanding of French. The study was approved by the Liège University Hospital Ethics Committee (B707201629105).

The recruitment process involved the distribution of flyers (see supplementary material, Figure S1 and Figure S2) and an oral presentation of the goals of the intervention and the implications for participating in the study (i.e. number of sessions, schedule, evaluation

protocol). Switch was presented to 16 potential participants as an intervention that aimed to improve motivation to engage in the goals and values that are meaningful to them. Also, the targets of the intervention (i.e. the various processes involved in the model) were briefly presented. Twelve participants were then individually approached based on staff recommendations and participants availability on days of intervention. Nine individuals provided written informed consent to participate in the study. One did not commence the intervention. At the end of the study, the eight participants were divided into two groups: completers, i.e. those who participated in at least 10 sessions out of the 16 sessions; and non-completers, i.e. those who attended less than 10 sessions. Ten sessions were considered as the minimum number of sessions needed to go through the entire model and the different strategies. Furthermore, the same criterion (i.e. following two-thirds of an intervention) has been used in previous studies (e.g. Pos et al., 2019). The categorization between completers and non-completers was done in order to explore potential variables that could explain the drop out from, or reduced commitment to, the intervention. Sociodemographic and clinical characteristics of the two groups are reported in Table 1.

2.2. Study design and procedure

This study followed the same evaluation protocol as the one used in a previous study that evaluated the Switch intervention in individual sessions (see Thonon, van Aubel, et al., 2020). In short, three types of evaluation measures were used: traditional assessment scales of motivational deficits, apathy, quality of life and daily functioning; ambulatory assessment that included ESM questionnaires to evaluate the processes related to motivation and goal-directed behaviours; and actigraphy to measure step-count, as a proxy measure of motivational negative symptoms (Kluge et al., 2018). The traditional assessment scales were completed before and after the intervention, as well as at a three-months follow-up. The ESM and step-count started two weeks before the intervention (T0) and continued during the two months of intervention (T1), during two weeks after the intervention (T2), and during two weeks at follow-up (T3).

Table 1

Sociodemographic and clinical characteristics, and number of completed Switch sessions.

Participant	Non-completers					Completers				
	2g-1	2g-3	2g-5	2g-7	*M* (*SD*)	2g-4	2g-6	2g-8	2g-10	*M* (*SD*)
Age	40	29	28	28	31.25 (5.85)	47	26	25	46	36 (12.14)
Diagnosis	SZ	SZ	SZ	SZ		SZA	SZ	SZ	MDD	
Illness duration (years)	4	10	10	9	8.25 (2.87)	21	11	6	6	11 (7.07)
Antipsychotic Medication	Arip[a]	Arip[a]	Arip[a], Clot[a]	Arip[a]		Risp[a]	Cloz[a]	Arip[a], Ol[a], Pip[b]	Arip[a]	
Education (years)	14	9	6	12	10.25 (3.50)	12	9	6	8	8.75 (2.50)
Living conditions	Independent	Supervised housing	Psychiatric nursing home	Supervised housing		Psychiatric nursing home	With family	Psychiatric nursing home	Psychiatric nursing home	
Number of sessions + booster	9 + 0	6 + 0	3 + 0	7 + 1	6.50 (2.64)	14 + 0	14 + 1	10 + 0	11 + 1	12.75 (2.22)

Notes. Arip = Aripiprazole; Clot = Clotiapine; Cloz = Clozapine; Ol = Olanzapine; Pip = Pipamperone; Risp = Risperidone; [a] atypical antipsychotic; [b] typical antipsychotic.

2.3. Measures

2.3.1. Acceptability and feasibility

Acceptability and feasibility of the Switch intervention was evaluated based on the intervention (face-to-face) attendance rate, on the reaction rates to the EMI prompts (see 2.4 Intervention: Switch), i.e. the number of times participants opened the app when being prompted, and on participants' feedback regarding the intervention (open-ended comments collected during the last session of the group programme). Feasibility of the ESM study design was assessed based on the ESM completion rate and the number of days where the activity band was used.

2.3.2. Traditional measures

Participants completed the motivation dimension of the French version (Mucci et al., 2019) of the Brief Negative Symptoms Scale (BNSS-mot) (Kirkpatrick et al., 2011). The evaluator scored the BNSS based on video or audio recordings and was blind in terms of the time (pre, post and follow-up) of evaluation. Participants also completed the Schizophrenia - Quality of Life questionnaire (S-QoL) (Auquier et al., 2003). Informants (staff members) were interviewed to provide an external understanding regarding participants' level of functioning via (i) the informant version of the Lille Apathy Rating Scale (LARS-i) (Dujardin et al., 2008), which is a structured interview, and (ii) the Functional Remission of General Schizophrenia (FROGS) (Llorca et al., 2009), which is a semi-structure interview.

ESM questionnaire

During the baseline phase (2 weeks), participants received pseudo-random prompts, five times a day, from the MetricWire app (https://metricwire.com/). During the intervention (2 months), in order to reduce the burden on the participants, they received pseudo-random prompts three times a day. After the end of the intervention, participants were prompted again 5 times a day for another 2 weeks. Note that as none of the participants completed a sufficient number of prompts after the end of the intervention and at follow-up, the post-assessment ESM observations (T2 and T3) were not taken into consideration.

The ESM questionnaire (see Thonon, van Aubel, et al., 2020) included 14 questions, plus three supplementary (branched) questions, i.e. which appeared depending on participant's answer to previous questions. Variables measured via the questionnaire included Activity's meaning (how important is the activity), Motivation, Wanting to give up, Effort, Energy, Mood, Confidence, Discouraging thoughts, Present enjoyment, Projection into the future, Reminiscence. These variables were rated on a 7-point Likert scale (1 = Not at all true; 7 = Totally true). The questionnaire also included nominal variables: Coping (in the presence of discouraging thoughts), Social contact (who the person was with), Activities (what

she/he was doing), Initiation (was the activity initiated by her/himself or encouraged by someone else).

Step count

Participants were provided with an activity band (MiBand 3, Xiaomi) which they had to wear at all times, during the baseline, intervention, post-measurement, and follow-up phases of the study. The total amount of steps per day was collected through the MiFit app.

2.4. Intervention: Switch

The Switch intervention was created based on a model of motivation and goal directed behaviours and followed the same principles as previously described (Thonon, Levaux, et al., 2020; Thonon, van Aubel, et al., n.d.). Furthermore, different principles of learning were adhered to in order to enhance the potential of the intervention in the group format. First, we made sure that the different strategies provided in Switch could be assimilated through different learning processes, i.e. concrete experience, active experimentation, reflective observation, and abstract conceptualisation (for a description, see Kolb & Kolb, 2009). Second, the presentation was as interactive as possible (e.g. using serious games, requiring participants to move in the room during the session), using different medias (videos, images, sound clips, paper booklet, etc.), and varying the formats of the exercises (e.g. Hourst & Thiagarajan, 2019). For example, concerning this latter element, the learning usually started with individual reflexions, followed by sharing, experimenting and debriefing, both in pairs and in the whole group. This was done to stimulate peer support and to increase generalisation to everyday life, by learning from others' experiences. Finally, the therapists participated in most of the exercises themselves, to offer a model to follow (Nguyen, Favrod, Frobert, & Pellet, 2017) and to increase normalisation. Table 2 briefly summarizes the content of the different sessions.

Table 2

Content of the sessions of the Switch programme.

| Session	Brief content description
1	Presentation of the model and illustrations.
2	Self-esteem: identification of personal strengths, qualities, successes, resources.
3	Enjoying the present moment: introduction to mindfulness. [a]
	Values: identification of personal values.
4	Values and goals: identification of personal values and goals.
	Selection of one goal and a related value.

5	Planning: subdividing chosen goal into accessible sub-goals or steps.
6	Planning: creating an action plan.
	Action initiation: tricks to initiate an action plan.
	Looking forward to the future: multi-sensory imagery exercises to help projection into the future. [b]
7	Remembering: reminiscence training and rationale. [c]
	Motivational boost: "Switch" decisional balance and quick solution finding.
8	Dysfunctional attitudes: identifying discouraging thoughts.
	Action initiation: implementation intention.
9	Dysfunctional attitudes: coping with discouraging thoughts with alternative, more constructive thoughts (i.e. cognitive restructuring).
	Check-up: where do we stand regarding our goals/values?
10	Dysfunctional attitudes: coping with discouraging thoughts with cognitive defusion.
	Problem resolution: strategies to seek solutions.
11	Check-up: what have we learnt so far?
	Summary by the participants of the different strategies and a presentation of the reminder cards that were given to the participants.
	Choice of a goal to be followed by the whole group (e.g. organising an activity together).
12-15	Pursuit of personal goals and group goals.
	The participants were invited to explain which strategy to use in order to pursue their personal goal.
	The group goal was pursued by following the Switch model. Each participant was responsible for a certain task or for explaining and using a strategy regarding the goal.
	Progressively, the participants were invited to run certain exercises themselves: the mindfulness training at the beginning of each session and the projection into the future at the end of each session.
16	Completion of the group goal (e.g. picnic).
	Summary of the different strategies that were used regarding the group goal.
	Feedback from the participants.
17	Booster session: check-up and reminder of the different strategies.

[a] From this session on, each session started with a short mindfulness exercise, each time focusing on a different modality (e.g. physical sensations, sounds, thoughts, smells) or a mix.

[b] From this session on, each session ended with a multi-sensory projection exercise (imagery) to boost action initiation and goal attainment. The projection goes through different modalities (e.g. visualisation of the achieved goal or the process to attain it, imagining the sounds, the sensations, the thoughts), depending on the chosen action/goal/value.

[c] Already from the second session on, each session began with a reminiscence exercise, and focused on what had been done in the previous session and what participants had done since then.

The two-hour sessions (that included a 10-minute break) took place twice a week for two months. The booster session took place two months later. The intervention was administered by two experienced psychologists (both were trained psychotherapists). The rationale for each strategy and the trainings were presented through a PowerPoint presentation (all materials in French can be requested from the corresponding author). The participants were provided with a folder containing the rationale for the different strategies, as well as exercises to be completed during the sessions or at home. At the 11th session, they were also provided with small reminder cards (that could fit in a wallet), with a brief presentation of each strategy (e.g. what are my values? how can I cope with dysfunctional attitudes?). Finally, after one month of intervention, different prompts were sent through the ESM app to boost certain strategies outside of the face-to-face sessions, within participants' daily life environment (i.e. EMI). Participants were prompted in the morning and invited to look forward to upcoming events/activities (projection prompts). An mp3 could be listened to (via the app) to be guided into multi-sensory imagery (for projection into the future) (see Figure 1.). Moreover, a prompt was sent in the evening to invite participants to look back at their day and reminisce about past positive events during the day (reminiscence prompts). Finally, a prompt every two to four days enquired about participants' goal pursuit (action prompts), congratulating participants when actions had been initiated and encouraging them to initiate the action plan if it had not yet been done.
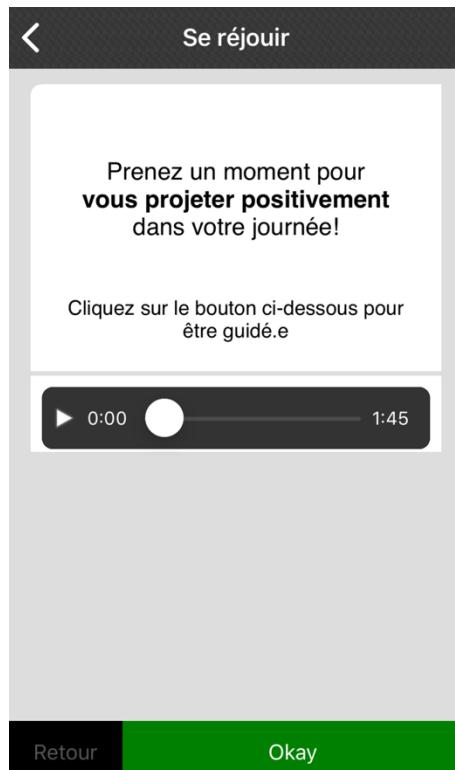
Figure 1. Screen shot of the morning prompt ("Take a moment to project yourself positively into your day. Click on the button below to be guided").

2.5. Analyses

We used charts and descriptive analyses to present absolute changes on scores from the BNSS, LARS-i, FROGS and S-QoL. We calculated Cohen's *d* coefficients based on paired-samples *t*-tests to provide effect sizes. Given the sample size, the significance of those tests was not considered. Results on the subscales of the BNSS can be found in Supplementary data (Table S1).

For step-count and ESM ordinal variables (i.e. with an answer format consisting of a 7-point Likert scale), we provided descriptive statistics for each group and for each phase. In order to evaluate the effects of the intervention on these outcomes, we conducted a repeated measures mixed-effects model for each outcome variable (steps and ordinal variables only), with fixed effects for the Phase (baseline = 0, *vs.* intervention = 1), the Group (non-completers = 0, *vs.* completers = 1), an interaction effect (Phase x Group), and random intercepts corresponding to the level of the individual[26]. Such models have the advantage of acknowledging individual differences. In the case of missing data, the analysis omitted the entire row including the missing observation. The *β* standardized coefficients in Table 4 indicate the magnitude of the effects. Finally, for nominal ESM variables, we created pie-charts for each group and for each phase.

3. Results

3.1. Participants

In Table 1, participants' sociodemographic characteristics and information regarding participation in the Switch intervention are presented. Clinical characteristics from baseline are presented in Figure 2. On a descriptive level, it appears that participants from the completers group were, on average, a little older, had been ill for longer, were less educated, had more severe motivational deficits and had lower levels of functioning. Completers also appeared to report fewer discouraging thoughts and more passive activities than non-completers (see Figure 3).

3.2. Acceptability and feasibility of the intervention and the evaluation procedure

Regarding the acceptability and feasibility of the Switch intervention, on average, participants who entered the intervention followed 9.5 sessions (*SD* = 3.85) out of the 17

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[26] Supplementary analyses were conducted using Number of sessions attended instead of Group (see supplementary material, Table S2). This was done to observe if there was a "dose-effect" of the intervention. Furthermore, the categorisation between completers and non-completers implied that the number of sessions attended by some participants differed only slightly (i.e. being just below or above the 10-session threshold). Thus, repeated measures mixed-effects model for each ordinal variable included fixed effects for Phase (baseline = 0, *vs.* intervention = 1) and Number of sessions, an interaction effect (Phase x Number of sessions), and random intercepts corresponding to the level of the individual.

sessions that were organised (56%, including the booster session). Within the non-completers, two participants (2g-3 and 2g-5) interrupted their participation after 6 and 3 sessions, respectively. The other non-completers did not actively drop out of the intervention, but came on an irregular basis: 2g-1 came approximately one session out of two, until the end of the intervention (excluding the booster session), whereas 2g-7 was unable to attend the last five sessions due to holidays, but was present for the booster session. On average, participants reacted to around 50% of the prompts: 39.08% of the projection prompts, 61.46% of the reminiscence prompts, and 58.33% of the action prompts. Finally, qualitative feedback from participants in response to several questions regarding their appreciation of the intervention can be found in Table 3. In general, the intervention appeared to be well appreciated. Furthermore, the advantages of the group format were raised. Also, several strategies that were taught during the programme were highlighted as being appreciated or useful: focusing on goals and planning, looking forward (or pleasure anticipation), coping with negative cognitions (namely via mindfulness and cognitive defusion), and problem solving (e.g. "give ideas to move forward" refers to the exercises to train solution seeking skills).

Table 3

Feedback provided by the participants (both completers and non-completers).

Participant	*What did you like about Switch?*	*What strategy did you find useful for your motivation?*	*What did you dislike?*
2g-1	"Coping with negative thoughts through mindfulness and focusing on our goals."	"Keeping the goals in mind."	"It was a bit long."
2g-4	"I was expecting from Switch to find new motivations in my life and it went well. The fact that we are several people in Switch is a good thing. The fact that we are all different, we can learn from the others."	"Putting on paper the goals that we like."	"You need to believe in it. Sometimes you have doubts."
2g-6	"Being in a group, the people in the group, highlighting our goals, being proactive, supporting each other, giving ideas to move forward. It's encouraging!"	"Writing down our goals."	"That some people left."
2g-10	"The method does work. The way of coping with negative thoughts, distancing from them. All the process. It takes some training to apply it to different parts of one's life, but it is worth doing this training because when we get used to it, it works. Now I know my projects will be realised."	"Looking forward, via the app. I really projected myself into the future. Mindfulness to cope with thoughts."	"You need to travel."

Regarding the feasibility of the evaluation protocol, it should be noted that one participant (2g-5) refused to adhere to both ESM and actigraphy measures (he did not wish to use this technology), one participant (2g-8) had technical issues with the MetricWire app that prevented the completion of the ESM, and one participant did not use the activity band (2g-4), for no particular reason. Regarding the adherence to the ESM, on average, participants completed 33.33 (SD = 4.32; min = 27; max = 40) prompts out of 70 in the baseline phase (48%), and 45.83 (SD = 12.83; min = 23; max = 58) prompts out of 180 in the intervention phase (25%). Adherence to the ESM procedure radically dropped at post-assessment and follow-up (<10% of completion rate). Note that one participant (2g-4) had health issues that prevented him to continue the evaluation, from post-assessment on, and one participant (2g-7) was re-hospitalized at follow-up due to drug consumption, which also prevented the continuation of the evaluation. Finally, regarding activity measures, at baseline, participants wore the activity band for the whole 14 days, except for one who missed one day (adherence of 99%). During the intervention phase, it is more difficult to estimate the number of days where the activity band was worn, as we encountered data collection issues with the Mi Fit app, which did not save all the data (probably due to synchronisation problems with the activity band). Nonetheless, on average, step-count was collected for 74% of the 60 days of the intervention phase.

3.3. Traditional measures

On a descriptive level (see Figure 2.), at post-assessment, non-completers' scores on BNSS Motivation increased (d = 0.88), showing a worsening of their motivational deficits, while completers' scores decreased (d = -1.73), indicating an important improvement. At follow-up, completers' scores still indicated a large improvement compared to baseline (d = -1.10). Regarding the LARS-i, non-completers' scores increased at post-assessment (d = 4.19), showing a substantial worsening of apathy, whereas completers' scores decreased (d = -1.05), indicating a reduction in apathy. At follow-up, the apathy scores of completers were still lower compared to baseline, indicating a maintenance of the improvement in the moderate range (d = -0.43). Regarding the FROGS, non-completers' scores decreased at post-assessment (d = -0.80), indicating a worsening of functional outcomes, whereas completers' scores increased (d = 0.59), showing improved functional outcomes. At follow-up, the completers' improvement was on average maintained (d = 0.75). As for the S-QoL at post-assessment, non-completers' scores only slightly increased (d = 0.23) and completers' scores increased moderately (d = 0.61), representing an improved quality of life. At follow-up, completers' scores no longer indicated an improvement (d = -0.17). Looking at the individual scores, however, there is no clear general worsening or improvement on quality of life, in either group.

A Non-completers

	Pre	Post
2g-1	3.43	4.57
2g-3		
2g-5	1.86	3.00
2g-7	1.86	2.29

	Pre	Post
2g-1	-6	14
2g-3	-25	-13
2g-5	-31	-18
2g-7	-27	-10

	Pre	Post
2g-1	54	55
2g-3	68	61
2g-5	65	64
2g-7	74	62

	Pre	Post
2g-1	39.02	56.10
2g-3	65.85	
2g-5	65.85	65.37
2g-7	87.80	80.00

B Completers

	Pre	Post	Follow-up
2g-4			
2g-6	3.71	2.71	3.14
2g-8	4.29	3.29	3.71
2g-10	5.00	4.71	4.71

	Pre	Post	Follow-up
2g-4	-23		
2g-6	-20	-19	-14
2g-8	3	-13	-3
2g-10	25	8	13

	Pre	Post	Follow-up
2g-4	52		
2g-6	59	53	65
2g-8	36	53	34
2g-10	32	42	45

	Pre	Post	Follow-up
2g-4	70.24		
2g-6	70.73		70.24
2g-8	57.56	70.73	60.00
2g-10	62.44	61.46	59.02

Figure 2. Legend on next page.

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Figure 2. Graphs representing scores at the different assessment points (pre, post, and follow-up) on the traditional measures, for non-completers (A) and completers (B). Each line represents a different participant. BNSS Motivation = Brief Negative Symptom Scale Motivation subscale (Mean); LARS-i = Lille Apathy Rating Scale informant version (Total); FROGS = Functional Remission of General Schizophrenia (Total), S-QoL = Schizophrenia Quality of Life questionnaire (Total out of 100).

3.4. Daily life measures

Descriptive statistics regarding the ESM outcomes and step-count are presented in Table 4, along with the interaction effects (Phase x Group) from the repeated measures mixed-effects models. There was a significant interaction effect on Activity's meaning, with completers engaging in more meaningful activities during the intervention, compared to non-completers who did not. There was a significant interaction effect on Motivation, in that motivation increased in the intervention phase in the completers group, whereas motivation decreased slightly in the non-completers group. The significant interaction effect on Wanting to give up indicates that completers were slightly more likely to want to give up what they were undertaking during the intervention phase, in comparison to non-completers who were slightly less likely to want to give up. There was a significant interaction effect on mood, so that mood increased during the intervention solely in the completers group. Mood did not appear to change in the non-completers. The interaction effect on Confidence indicates a trend towards increasing confidence during the intervention in the completers group, and decreasing confidence in the non-completers group. Finally, we found a significant interaction effect on Projection into the future and Reminiscence, indicating that the frequency of the use of both savouring skills increased during the intervention in the completers group, while it slightly decreased in the non-completers group. Note that there was also a significant phase effect for Energy, so that energy levels decreased slightly in both groups during the intervention phase (β = -0.17; p = .03). No significant effects were found for discouraging beliefs, present enjoyment, nor steps.

On a descriptive level (see Figure 3), coping strategies in the face of discouraging beliefs did not seem to change in either group. Non-completers appeared to spend more time alone during the intervention phase, while there was no apparent difference between phases regarding social contact in the completers' group. Activities did not appear to change for non-completers. Completers reported fewer occurrences of doing nothing at all, and more occurrences of resting or engaging in passive activities. Both groups appeared to report slightly more often doing nothing in particular during the intervention (see Figure 3, Initiation).

Table 4

Descriptive statistics of the different outcomes at baseline and during the intervention (means and standard deviations of both within-person means and within-person standard deviations) and repeated measures mixed-effects models of intervention effects (Phase x Group).

| Outcomes | Non-completers | | | | Completers | | | | X effect |
	Phase	M (SD)	SD (SD)		Phase	M (SD)	SD (SD)		β
Activity's meaning	T0	4.04 (1.80)	1.56 (0.95)		T0	4.08 (1.47)	0.98 (0.40)		
	T1	3.88 (1.71)	1.46 (1.07)		T1	4.91 (1.64)	0.66 (0.30)		0.29**
Motivation	T0	4.37 (2.57)	0.78 (0.38)		T0	4.29 (0.34)	1.25 (0.94)		
	T1	4.05 (2.39)	0.71 (0.44)		T1	4.50 (0.47)	1.06 (0.92)		0.28**
Wanting to give up	T0	3.51 (1.86)	1.57 (0.94)		T0	2.52 (1.13)	0.95 (0.40)		
	T1	3.07 (0.60)	1.57 (0.98)		T1	2.72 (1.31)	0.86 (0.24)		0.45***
Effort	T0	2.09 (0.48)	1.21 (0.60)		T0	2.62 (0.93)	1.11 (0.57)		
	T1	1.82 (0.85)	0.72 (0.69)		T1	3.00 (1.20)	0.98 (0.57)		0.40***
Energy	T0	4.39 (2.64)	0.68 (0.12)		T0	4.46 (0.54)	1.28 (0.79)		
	T1	4.02 (2.39)	0.64 (0.50)		T1	4.35 (0.61)	1.26 (1.11)		0.12
Mood	T0	4.08 (2.41)	0.83 (0.47)		T0	4.82 (0.50)	1.03 (0.76)		
	T1	4.00 (2.56)	0.55 (0.32)		T1	5.10 (0.64)	0.88 (0.56)		0.22**
Confidence	T0	4.32 (2.49)	0.52 (0.10)		T0	4.65 (0.55)	1.19 (0.98)		
	T1	4.04 (2.45)	0.61 (0.33)		T1	4.74 (0.71)	0.91 (0.79)		0.19*
Discouraging thoughts	T0	3.50 (2.74)	0.56 (0.08)		T0	2.55 (0.84)	1.12 (0.63)		
	T1	3.55 (2.95)	0.25 (0.22)		T1	2.50 (0.95)	0.89 (0.40)		-0.05
Present enjoyment	T0	3.89 (2.00)	1.15 (1.03)		T0	4.28 (0.05)	1.14 (1.07)		
	T1	3.84 (1.68)	1.35 (1.01)		T1	4.61 (0.30)	1.13 (1.04)		0.18
Projection into the future	T0	4.64 (2.71)	0.34 (0.30)		T0	3.23 (1.36)	0.99 (0.35)		
	T1	4.49 (2.86)	0.28 (0.25)		T1	5.01 (0.75)	1.07 (0.99)		0.93****
Reminiscence	T0	3.65 (1.62)	0.76 (0.28)		T0	3.68 (0.66)	1.17 (1.11)		
	T1	3.54 (1.93)	0.44 (0.14)		T1	4.73 (0.59)	1.23 (1.19)		0.65****
Steps	T0	9778 (1367)	5492 (907)		T0	9985 (6798)	6020 (4425)		
	T1	7933 (3345)	3334 (683)		T1	9618 (5694)	4974 (2522)		0.18

* p = .051, ** p < .05, *** p < .01, **** p < .0001

Notes. T0 = baseline; T1 = intervention; X effect = interaction (Phase x Group) effect; β = standardized beta-coefficient.

ESM: Non-completers: n = 3 (2g-1, 2g-3, 2g-7); Completers: n = 3 (2g-4, 2g-6, 2g-10)

Step-count: Non-completers: n = 3 (2g-1, 2g-3, 2g-7); Completers: n = 3 (2g-6, 2g-8, 2g-10)
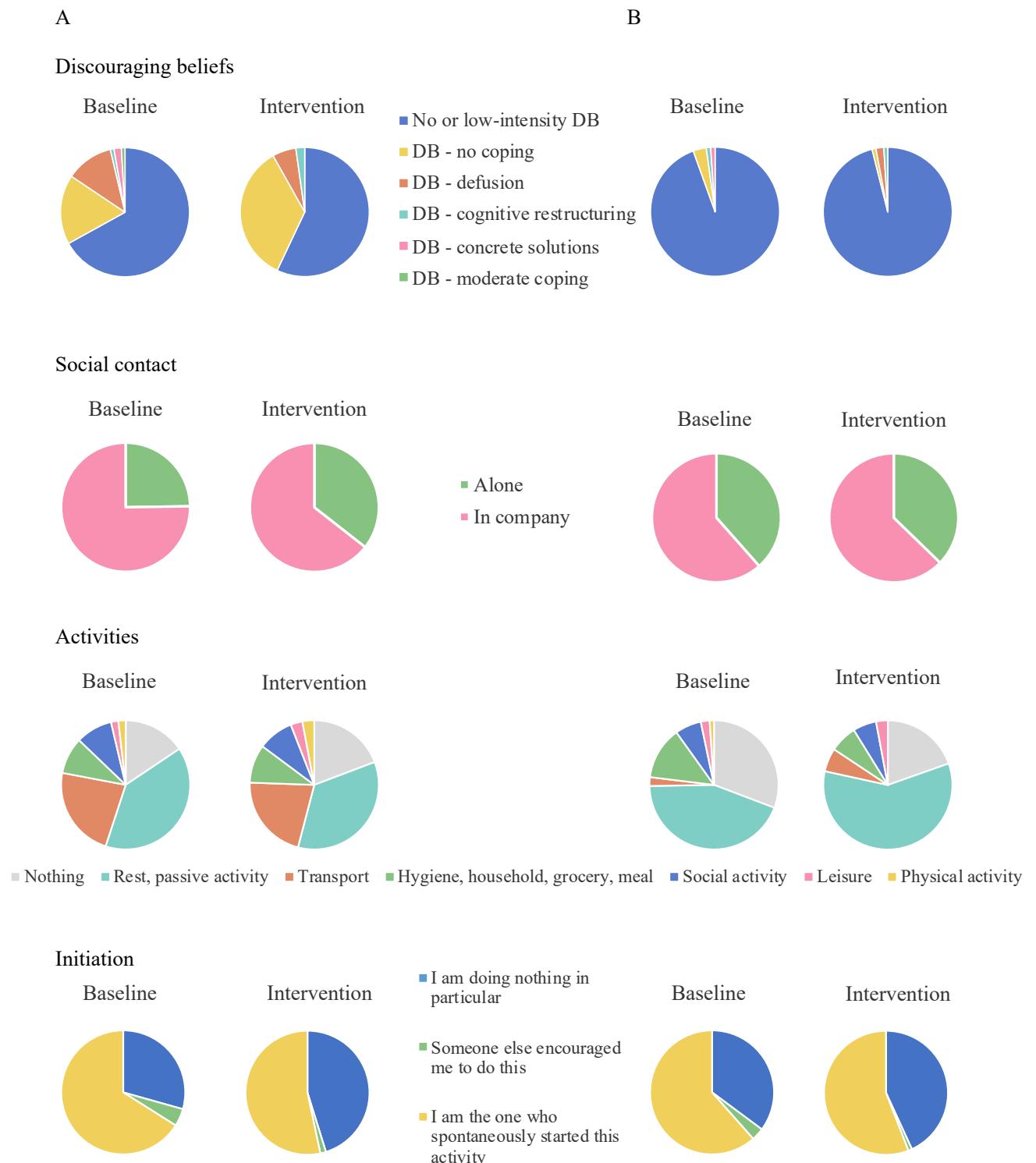
Figure 3. Pie charts representing change between baseline and intervention phases, in nominal variables of Coping strategies in case of discouraging beliefs, Social contact, Activities, and Initiation skills, for non-completers (A) and completers (B).

4. Discussion

This study aimed to explore the acceptability, feasibility and preliminary efficacy of the Switch intervention delivered in a group setting and enriched with EMI, as well as the feasibility of ambulatory assessment throughout the different phases of the study. Overall, our preliminary findings confirm most of our hypotheses, and shed some light on possible mechanisms of change regarding the improvement on motivation and functional outcomes.

First, regarding the efficacy of the intervention, taking the findings on traditional assessments together, individuals who completed the intervention showed a large improvement on motivation and apathy after the intervention as well as at follow-up, although to a lesser degree (moderate to large improvement). Non-completers on the other hand, showed a worsening of motivational deficits and apathy at post-assessment. We observed similar findings regarding daily functioning, where completers showed an improvement after the intervention and at follow-up, while non-completers showed worse functional outcomes at post-assessment. At baseline, completers had more severe symptoms, worse functional outcomes and lived in more supervised housing conditions compared to the non-completers. Those individuals with the most severe symptoms may be the ones who gain more from the intervention. Furthermore, the fact that more completers lived in supervised housing conditions might play a role in the adherence to the intervention, as members of the staff are more often present and therefore there may be more occasions for them to encourage and reinforce attendance (e.g. reminding them to leave in time, showing interest in their participation). Nonetheless, all participants (both completers and non-completers) received regular reminders of the intervention sessions via SMS. It is not clear why non-completers showed a deterioration in amotivation/apathy symptoms and daily functioning and whether this deterioration was a cause or result of the intervention drop-out or little adherence, or whether there is no association with treatment adherence. Quality of life did not seem to change in a coherent manner in either group. Although this does not concur with our hypotheses, this finding adds to previous literature showing that quality of life is a difficult target to ameliorate (for a review, see Laws, Darlington, Kondel, McKenna, & Jauhar, 2018).

Second, participants who completed the intervention showed a coherent pattern of improvement, not only on traditional assessments, but also on the ESM variables. Indeed, the decrease of motivational deficits and apathy, and the improvement on functional outcomes were concurrent with improvement on daily life variables during the intervention: namely, we observed increases in motivation, in engagement in meaningful and effortful activities, in mood, in confidence (although small in magnitude), and observed larger increases in savouring processes, i.e. projection into the future and reminiscence. Based on the significant interaction effects that were found in the mixed-effects models, these improvements may be attributable to the Switch intervention. It should be noted that the larger effects were found on the savouring skills that had also been the object of EMI (i.e. morning and evening prompts to encourage looking forward and reminiscence). Future

studies should use more complex modelling to test whether processes such as projection into the future (or pleasure anticipation), positive reminiscence and confidence (or self-efficacy) represent mechanisms of change responsible for the increase in motivation and goal-directed behaviours. On the contrary, it could be that the intervention supported more meaningful goal-directed behaviours, which might be the primary mechanism through which participants' motivation, confidence and savouring skills increased subsequently. Additional studies therefore need to focus on the dynamical relationships between those processes. Note that no effects were found regarding step-count. This could be due to a ceiling effect, given that participants already showed high numbers of daily steps (i.e. around 10 000 a day).

Regarding the feasibility and acceptability of the intervention, the level of adherence was moderate, including a reasonable actual dropout (25% actively interrupted their participation) and an average attendance rate of more than 50% of both the face-to-face group sessions and the EMI prompts. The attendance rate could nonetheless be improved. A number of participants had to travel to the venue where the intervention took place, which might have hindered participation. Providing the intervention in their home setting or in usual settings outside of the home (e.g. day centre) would potentially increase the attendance rate. Nevertheless, based on participants' feedback, the intervention was well accepted and well comprehended. Participants highlighted different strategies that had been taught, which points to the benefits of the multifactorial feature of the intervention. The group format also appeared to be well appreciated by some participants. Nevertheless, the group setting could have been a drawback for some other participants who are more inclined to upward social comparison (e.g. comparing themselves to individuals who are doing better in the group) (Festinger, 1954). This could have played a role in the adherence to the intervention and in the outcomes (Dibb & Yardley, 2006). For instance, a person who believes she/he is making less progress than the others could feel discouraged, which would have the opposite effect than the motivating effect expected from the Switch intervention. Thus, this kind of social comparison should be of particular focus as it may affect motivation. The Switch intervention could be improved by progressively adding EMI prompts, and extending those to other strategies (e.g. planning, coping with negative thoughts). This could build further bridges between the intervention and participants' daily life, increasing the mastering of the strategies taught during the intervention. Such EMI could continue after the end of the face-to-face group intervention, in order to ensure the maintenance of the benefits.

As for the feasibility of the study design, the adherence to the daily evaluation procedure (i.e. ESM and actigraphy) partly confirms our hypotheses as it was satisfactory during the baseline phase, but more problematic in the following phases of the study. Regarding ESM, the baseline completion rate of around 48% is comparable to some studies (e.g. Ben-Zeev, McHugo, Xie, Dobbins, & Young, 2012; van Os et al., 2017), but lower compared to others reporting an average response-rate of 70-80% (Kimhy et al., 2012). Nevertheless, it confirms our hypothesis and meets the recommendations of a completion rate of minimum

one-third of ESM prompts (Delespaul, 1995). The completion rate during the intervention phase (around 25%) is difficult to compare to other studies. Indeed, to the best of our knowledge, no previous study examining an intervention has included continuous ambulatory assessment (ESM or similar types of assessment strategies) during the intervention phase, whether it be for individuals with schizophrenia or another diagnosis. The only comparable study we can refer to (E. van Aubel, personal communication, June 26, 2020) has used 8 prompts per day, three consecutive day per week, during an 8-week intervention, in individuals at ultra-high risk for psychosis (CHR) or with first-episode of psychosis (FEP). Similar to our findings, participants in that study responded to 25% of the prompts. Study designs like the latter and the one in the present study are clearly more challenging for participants compared to the majority of studies that use ESM for isolated periods (i.e. only one assessment period) and for much shorter durations (e.g. a week) (Myin-Germeys et al., 2018). Nonetheless, the ESM completion rate during the intervention phase did not reach the requested minimum of 33% of valid responses. As for the activity band, its constant use during the baseline phase in all participants indicates a good level of acceptability and feasibility of this measurement strategy. The feasibility of the continuous evaluation protocol could nevertheless be improved. First, the ESM sampling frequency during the intervention phase could be the same as during the other phases (i.e. five prompts per day, instead of three per day). As opposed to what we originally assumed, a recent study observed that increased sampling frequency does not increase the burden of the procedure (Eisele et al., 2020). With only three prompts per day, there is an increased chance that participants simply missed the notifications or some of the notifications and were not even bothered by them. Second, the inclusion of these diverse evaluations (i.e. ESM and actigraphy) would have required more staff (Christensen, Barrett, Bliss-Moreau, Lebo, & Kaschub, 2003; WHO, 2016) in order to monitor and solve potential technical or adherence problems. For future studies, a research-assistant could be responsible for monitoring the ESM questionnaires adherence and for contacting participants in case of a certain number of continuous missed prompts, for example, or once in a while in order to prevent high numbers of missed prompts. Furthermore, a research-assistant could be present at the intervention sessions and be in charge of collecting step-count data, ensuring that activity bands were charged and used continuously. Finally, in order to increase the adherence to the ESM procedure, money incentive, regular drawings for small prizes, or occasional gift vouchers could be useful for future studies (Christensen et al., 2003).

This study is limited by its preliminary nature, namely regarding the small sample size. Furthermore, although the adherence to the ambulatory assessment was adequate for the whole sample, the low ESM completion rates for certain participants resulted in a reduced number of observations. Our results should thus be considered with caution. Another limitation concerns the design of our study, which does not allow distinguishing between the effect of the face-to-face intervention and the possible additional effect of the elements of EMI. Additionally, although general feedback from participants was collected, there was no feedback questionnaire in which participants could have indicated the usefulness of the

specific parts of the intervention (e.g. group dynamics, specific strategies, EMI elements). In future studies, the face-to-face group intervention condition could be compared with a condition in which a blended approach is taken, i.e. combining the regular intervention with EMI.

The design of our study is innovative and presents many strengths. First, we combined different types of evaluation, including continuous subjective (i.e. ESM) and objective (i.e. step-count) daily life measures, thus guaranteeing a high level of ecological validity (Shiffman et al., 2008). Pre-post traditional assessments, although important to provide a broad picture of change, do not capture the "film" of how change occurs (Wichers et al., 2011). Collecting intensive longitudinal data through ESM, not only during baseline and post-intervention, but also throughout the intervention, allows the all-important exploration of how and when change occurs, through which – interacting – mechanisms. This approach is essential to further refine therapeutic interventions (i.e. increasing the focus on processes responsible for the improvement on the desired outcomes). Future studies should include this kind of continuous, daily-life assessment to evaluate the contribution of possible mechanisms of change in the improvement on primary outcomes of motivation, daily functioning and quality of life. Second, the group intervention was designed in a very meticulous way: it is based on a theoretical model of motivation and goal-directed behaviours which allows targeting highly relevant skills to develop; the addition of EMI increases the likelihood to generalise these skills to daily life; and finally, techniques used for group facilitation were based on well-founded and validated techniques to support acquisition and foster interactive learning.

In conclusion, the Switch intervention, as delivered in a group format and combined with EMI, showed preliminary evidence of its benefits for individuals with moderately severe to severe negative symptoms, in terms of their motivational symptoms, their functional outcomes, their daily motivation, engagement in meaningful and effortful activities, mood, confidence and savouring skills. Future studies should include larger samples, a control condition and a randomisation procedure in order to further examine the efficacy and the internal validity of the Switch intervention. Furthermore, field tests should be performed in order to evaluate the effectiveness of the intervention, i.e. to evaluate if it works in real-world conditions and to assess its external validity (Ernst & Pittler, 2006). This is of particular importance since mental health services include users with motivational deficits and various diagnoses and comorbidities (e.g. patients with substance use disorders), who could benefit from the Switch intervention and who should be included in effectiveness clinical trials.

Study 3: Supplementary material

Table S1

Subscales of the BNSS at baseline (T0), after intervention (T2) and 3 months follow-up (T3). Cohen's *d* effect sizes.

	T0	T1	T2	T0-T2	T0-T3
	M (SD)	*M (SD)*	*M (SD)*	*d*	*d*
Non-completers					
n = 3					
BNSS Anhedonia	2.33 (1.15)	3.44 (1.39)		-1.36	
BNSS Asociality	2.17 (0.29)	2.83 (1.61)		-3.27	
BNSS Avolition	2.67 (1.15)	3.00 (1.32)		-0.41	
Completers					
n = 3					
BNSS Anhedonia	4.11 (0.96)	3.33 (1.00)	3.89 (0.51)	1.14	0.33
BNSS Asociality	4.33 (0.58)	3.50 (1.32)	3.83 (1.26)	2.04	1.22
BNSS Avolition	4.67 (0.76)	4.00 (0.87)	3.83 (1.04)	1.23	1.54

Sig. (2-tailed): * $p < .10$; ** $p < .05$; *** $p < .001$

Note: BNSS – Brief Negative Symptom Scale (Kirkpatrick et al., 2011); *d* = effect size coefficient, Cohen's d, with pooled standard deviation as the denominator.

Table S2

Repeated measures mixed models of intervention effects on ESM outcome variables with Phase and Number of sessions as independent variables.

Outcome	Fixed effects		
		β	p
Activity's meaning	Phase	-0.479	0.028
	N sessions	0.002	0.990
	Phase x N sessions	0.051	0.012
Motivation	Phase	-0.469	0.012
	N sessions	-0.040	0.766
	Phase x N sessions	0.042	0.012
Wanting to give up	Phase	-0.533	0.047
	N sessions	-0.064	0.517
	Phase x N sessions	0.0412	0.089
Effort	Phase	-0.607	0.015
	N sessions	0.023	0.792
	Phase x N sessions	0.064	0.005
Energy	Phase	-0.315	0.097
	N sessions	-0.021	0.872
	Phase x N sessions	0.019	0.263
Mood	Phase	-0.304	0.056
	N sessions	0.022	0.874
	Phase x N sessions	0.033	0.022
Confidence	Phase	-0.340	0.040
	N sessions	-0.005	0.970
	Phase x N sessions	0.027	0.071
Discouraging beliefs	Phase	0.060	0.645
	N sessions	-0.047	0.754
	Phase x N sessions	-0.005	0.681
Present enjoyment	Phase	-0.231	0.352
	N sessions	-0.012	0.908
	Phase x N sessions	0.030	0.183
Projection into the future	Phase	-1.236	0.000
	N sessions	-0.134	0.356
	Phase x N sessions	0.152	0.000

Outcome	Fixed effects		
		β	p
Reminiscence	Phase	-0.793	0.000
	N sessions	-0.040	0.718
	Phase x N sessions	0.098	0.000

Notes. N sessions = number of sessions; Phase = Baseline *vs.* Intervention

SWITCH

Un nouveau programme thérapeutique visant les difficultés de motivation afin d'améliorer la qualité de vie

Nous vous proposons de bénéficier d'une nouvelle intervention thérapeutique pour vous aider à dépasser vos difficultés de motivation. Avec Switch, l'idée, c'est de sortir du mode « off » et de **remettre l'interrupteur sur « ON »**.

L'intervention **Switch** est basée sur de nombreuses et récentes études scientifiques. Switch cible les pensées, croyances, émotions, comportements… qui sont en lien avec la **motivation**. Les difficultés de motivation peuvent parfois vous empêcher de vous engager dans des activités qui vous feraient du bien, qui vous permettraient d'avancer vers vos **objectifs** et vos **valeurs**. Le but de Switch est de relever ces barrières et d'**améliorer votre quotidien et votre qualité de vie** en vous aidant à vous engager dans vos projets.

Switch utilise des outils thérapeutiques qui ont déjà montré leur efficacité. Cette intervention est innovante car elle cible *tous les mécanismes* qui influencent la motivation. De plus, Switch s'adapte à **vos besoins et vos souhaits**.

Figure S1. Front side of the flyer used for the recruitment of participants.

Informations pratiques

L'intervention Switch est offerte gratuitement dans le cadre d'un projet de recherche scientifique. L'objectif de cette recherche est d'évaluer l'efficacité de Switch.

En pratique, nous vous offrons un **groupe thérapeutique d'environ 1h45, 2 fois / semaine** (mardi et jeudi 14h-16h), du 7 mai au 4 juillet.

Vous répondez à des questionnaires avant, pendant et après l'intervention (du 23 avril au 19 juillet), de manière à ce qu'on puisse vérifier si Switch a bien fonctionné comme on le souhaitait.

Cette recherche a été approuvée par les Comités d'Éthique Hospitalo-Facultaire Universitaire de Liège et de l'Intercommunale des Soins Spécialisés de Liège (ISoSL).

Information et inscription : Contactez **Quentin Longrée** qui vous mettra en lien avec **Bénédicte Thonon** et **Marie-Noëlle Levaux**.

Figure S2. Back side of the flyer used for the recruitment of participants.

STUDY 4

Motivation in schizophrenia: preliminary findings of a theory-driven approach using time-series network analysis

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Abstract

Motivational negative symptoms are an important obstacle to the daily functioning of individuals with schizophrenia. A better understanding of associated processes would help to identify targets for interventions. We used Experience Sampling Method (ESM) to assess the daily cognitive, behavioural and emotional/hedonic processes identified in a redefined theoretical model of motivation in schizophrenia. Further, we applied multilevel network analysis to explore in a preliminary way the potential causal factors that may influence the daily course of motivation. Using a 14-day paradigm ESM in 7 participants with schizophrenia spectrum disorders (276 observations), we examined the interplay between the processes derived from the proposed model. We estimated both contemporaneous and temporal networks using multilevel vector autoregressive analyses for time-series. The contemporaneous network showed that motivation was central and strongly related to levels of energy and (self-)confidence. The temporal network showed that savouring processes (i.e. reminiscence and projection into the future) were the most influential and had an impact on later motivation, mood, effort, energy, (self-)confidence, and dysfunctional beliefs. These findings provide preliminary evidence in favour of the motivational model presented in this study, shedding new light on the understanding of motivation in schizophrenia and specifically identifying energy levels, savouring skills and confidence as likely beneficial targets for interventions.

Keywords: ecological momentary assessment; mlVAR; amotivation; apathy; psychosis; savouring.

STUDY 4

1. Introduction

In the last decade, a number of studies have underlined the significant influence of negative symptoms, especially motivational deficits, on daily functioning and quality of life (e.g. Beck, Himelstein, Bredemeier, Silverstein, & Grant, 2018; Savill et al., 2016). However, there is still limited evidence for effective interventions that specifically target motivational negative symptoms (Lutgens et al., 2017). A better understanding of motivational deficits, and the dynamics of their underlying processes, is therefore needed in order to tailor interventions to enhance recovery.

Kring and Barch (2014) designed a model that identifies emotional/hedonic and neurocognitive processes that are essential to motivation and goal-directed behaviours and that are often dysfunctional in individuals with schizophrenia. Their model follows the course of motivation spanning from anticipatory pleasure (i.e. feeling in anticipation the pleasure of reaching a goal or obtaining a reward) to remembered pleasure (i.e. reminiscing about the attained goal), through effort-value computation (i.e. how much effort is needed to attain the goal and how much is this goal valued) and in-the-moment pleasure. However, their model does not include other processes known to hinder motivation and goal directed behaviours in schizophrenia: dysfunctional attitudes, such as lack of confidence or self-efficacy (Medalia & Brekke, 2010), and defeatist beliefs (Couture, Blanchard, et al., 2011; Rector et al., 2005); and action self-initiation, which refers to the ability to spontaneously carry out certain actions (Rinaldi & Lefebvre, 2016). Furthermore, behaviours of individuals with schizophrenia tend to be mostly driven by avoidance and boredom, which is associated with lower functioning (Gard, Sanchez, Starr, et al., 2014). A focus on personal goals and values seems therefore essential to guide motivation. Thus, in this study, we present a redefined model of motivation in schizophrenia (see Figure 1), that is essentially based on the model designed by Kring and Barch (Kring & Barch, 2014), but that complements it with the aforementioned elements.

The model of motivation proposed here combines three levels (see Figure 1). The first two levels are at the foundation and include personal values and goals on the first level, and self-esteem on the second level. The third level on a chosen value or goal and targets those processes that support motivation and engagement towards that value or goal. It starts with pleasure or reward anticipation (i.e. looking forward) which is mainly sensory. For example, one could look forward to going to the swimming pool and imagining the feeling of lightness in the water. The next step involves cognitive processes and implies the estimation of the value of the goal (e.g. how important is it to swim?), the effort (or the cost; e.g. taking the bus, being in front of other people), and the probability to reach that goal (e.g. depending on the bus schedule, the physical state). These processes can be influenced by dysfunctional attitudes (e.g. thinking that swimming for 20 minutes is not worth it, that we cannot swim well, or that we will never be able to wake up in time to catch the bus). If a decision is reached, the goal has to be mentally represented (e.g. swimming half an hour on Saturday morning), maintained and planned for (e.g. finding the long-unused swimmers,

looking for the bus schedule). Next, the action plan has to be initiated. While advancing towards or reaching the chosen goal, in-the-moment enjoyment occurs (e.g. feeling light in the water, feeling proud). Finally, the experience of successfully reaching one's goal (i.e. obtaining the reward) can be recalled (reminiscence) and can feed further anticipation (e.g. calling a family member, telling her/him about the success and enjoyment, and saying he/she might well go to the pool next week as well).
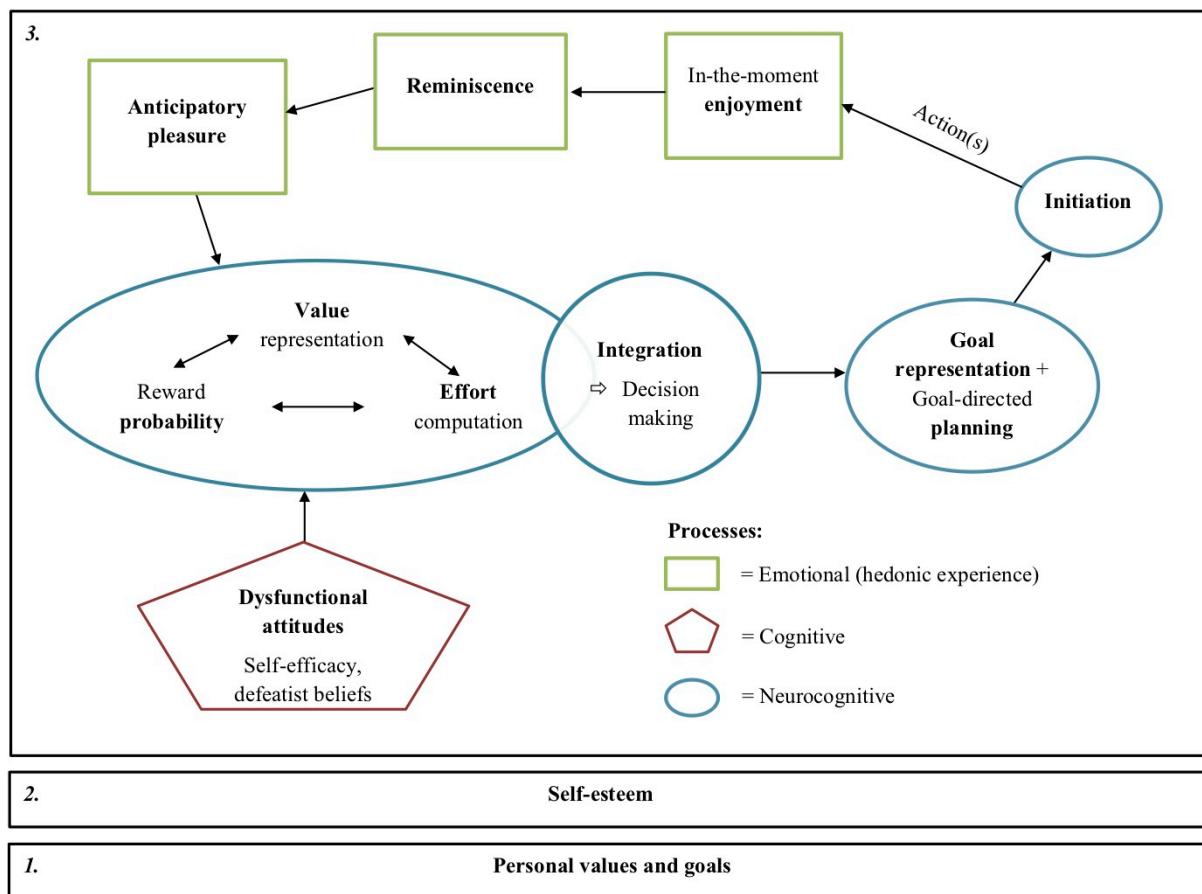
Figure 1. Three-level model of motivation (reproduced with permission from Thonon et al., 2020).

To date, studies in the schizophrenia field have not addressed together, in a comprehensive manner, multiple processes such as the ones designated in our model. Therefore, although it is known that individuals with schizophrenia can present difficulties in various processes related to motivation, it is unclear how these processes interact with one another, which processes are particularly influential and thus that would represent candidates for interventions. In order to shed some light on this, we propose to use novel types of analyses that have been developed to better apprehend the dynamics of psychological processes, specifically, network analyses (NA).

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Recently, NA have been used in an innovative manner in psychopathology to better grasp the interconnections of symptoms within syndromes or mental disorders (for reviews, see Contreras et al. 2019; Robinaugh et al. 2020). Only a few studies have used a network analysis approach and have focused on negative symptoms (S. Z. Levine & Leucht, 2016; G. P. Strauss, Esfahlani, Galderisi, et al., 2019). To our knowledge, no NA studies have considered the underlying processes of motivational deficits. Moreover, most studies using NA have used cross-sectional data, which does not provide insight regarding the potential (causal) relationships of the variables over time. Yet, NA using time-series data, such as the one produced by Experience Sampling Methodology (ESM; Myin-Germeys et al., 2018), can disclose the temporal and dynamic interactions between multiple psychological constructs (Epskamp, van Borkulo, et al., 2018). Uncovering the processes that influence the dynamics of motivation might provide empirical data to evaluate existing theories (Haslbeck, Ryan, Robinaugh, Waldorp, & Borsboom, 2019) and thus help identify targets for interventions.

This study followed a theory-driven approach and aimed to: 1) Conduct time-series NA of the different processes of the aforementioned motivation model in order to better understand the interconnections and dynamics of these processes in a sample of individuals with schizophrenia spectrum disorders; 2) Explore which processes are the most influential (i.e. their centrality) in the course of motivation and goal-directed behaviours.

2. Material and methods

2.1. Participants

We retrieved data from the baseline assessment of a clinical trial evaluating an intervention targeting motivational deficits in individuals with schizophrenia, schizoaffective, bipolar or major depressive disorders (Thonon, Levaux, van Aubel, & Larøi, n.d.; Thonon, van Aubel, Lafit, Della Libera, & Larøi, 2020). Eleven participants met DSM-V (American Psychiatric Association, 2013) criteria for schizophrenia or schizoaffective disorder. Exclusion criteria consisted of: (1) presenting an unstable clinical picture; (2) significant changes in medication during the month prior to the initial evaluation; (3) having a history of severe brain trauma or epilepsy; (4) comorbid intellectual disability; (5) moderate or severe substance use disorder other than tobacco (according to the DSM-V; i.e. showing 4 or more symptoms); (6) not adhering to the ESM protocol. Out of the 11 participants with schizophrenia or schizoaffective disorder, three did not answer any of the ESM questionnaires, and one showed no variance on one of the variables.

The present study included 7 participants who provided valid responses for at least one third of the ESM (following Aalbers et al. 2019) and who showed variance on all variables. Sociodemographic characteristics of the sample are reported in Table 1.

The study was approved by the University Hospital Ethics Committee (in accordance with the latest version of the Declaration of Helsinki). All participants gave written informed consent after extensive explanations regarding the procedures.

Table 1

Sociodemographic and clinical characteristics (*n* = 7)

Age, *M* (*SD*)	35 (7.62)
Gender ratio (F/M)	2/5
Years of education, *M* (*SD*)	11.57 (2.37)
Living Conditions, *n*	
Independent housing	2
With family/partner	2
Supervised housing	2
Hospital	1
Diagnosis (SZ/SZA)	6/1
Illness duration (years), *M* (*SD*)	12.57 (6.53)

SZ = Schizophrenia; SZA = Schizoaffective disorder

2.2. ESM procedure

Participants received detailed explanations regarding the ESM procedure. They installed the MetricWire app (https://metricwire.com/) on their smartphones. An example-questionnaire was filled in by the participants with the investigator's help, and each item and answer were explained. For 14 consecutive days, participants were signalled by the MetricWire app five times a day at pseudo-random times, within 3-hour intervals between 7.30 a.m. and 10.30 p.m. This semi-random prompting design prevents the participants from changing their behaviours in anticipation of a prompt (Verhagen, Hasmi, Drukker, van Os, & Delespaul, 2016). There was a total of 70 prompts. To be included in the current study, participants had to complete a minimum of one third of the 70 questionnaires (*M* = 34; *SD* = 11,77; *Min* = 28, *Max* = 64).

The ESM questionnaire was informed by the motivation model described in the introduction and developed following guidelines from Kimhy et al. (2012). The questionnaire included 14 questions, plus three optional questions that were conditional on the participant's response to the previous question (see Table 2). For the purposes of the present study, only variables with responses on a Likert-scale were used in the NA.

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Table 2

ESM Questionnaire

Variables	Questions	Rating
Mood*	I feel…	1-7 Likert; 1 = Unhappy; 4 = Neutral; 7 = Happy
Discouraging beliefs*	Discouraging thoughts are crossing my mind.	1-7 Likert; 1 = Not at all true; 7 = Totally true
Coping (only if Q3 > 4).	How am I dealing with these thoughts?	I'm not. / I'm distancing myself from them. / I'm trying to use more constructive thoughts. / I'm looking for concrete solutions. / Other:
Coping (other)	You indicated "other". What precisely do you do to deal with these discouraging thoughts?	Free text
Confidence*	I feel confident.	1-7 Likert; 1 = Not at all true; 7 = Totally true
Motivation*	I feel motivated.	1-7 Likert; 1 = Not at all true; 7 = Totally true
Energy*	I have energy.	1-7 Likert; 1 = Not at all true; 7 = Totally true
Social	Who am I with?	Stranger(s), other / Acquaintance(s) / Colleague(s) / Friend(s) / Family / Partner / I'm alone
Activity	What am I doing?	Nothing / Rest, passive activity (TV, internet, reading…) / Transport / Hygiene, household, grocery, meal / Social activity/interaction / Leisure / Physical activity / Work, study, training, attending a workshop / Other
Activity (other)	Specify your activity:	Free text
Initiation	Select the option that best corresponds with your situation:	I am the one who spontaneously started this activity. / Someone else encouraged me to start this activity. / I am not doing anything in particular.
Present enjoyment*	I feel some pleasure in what I am doing.	1-7 Likert; 1 = Not at all true; 7 = Totally true
Wanting to give up*	I feel like giving up this activity.	1-7 Likert; 1 = Not at all true; 7 = Totally true
Activity's meaning (value)*	This activity is important to me.	1-7 Likert; 1 = Not at all true; 7 = Totally true
Effort	This activity requires some effort.	1-7 Likert; 1 = Not at all true; 7 = Totally true

Variables	Questions	Rating
Reminiscence *	Since the last prompt, I have been recalling pleasant past events.	1-7 Likert; 1 = Not at all, I have been thinking of *unpleasant* events; 4 = I have not been particularly thinking about the past; 7 = Absolutely, I have been thinking a lot about pleasant past events.
Projection into the future*	Since the last prompt, I have been looking forward to some activities or events.	1-7 Likert; 1 = Not at all, I have been *apprehending* the future; 4 = I have not been particularly thinking about the future; 7 = Absolutely, I have been greatly looking forward to the future.

Notes: Reproduced with permission (Thonon, van Aubel, Lafit, Della Libera, & Larøi, 2020).

Items have been translated from French into English.

* Variables included in the analyses; *Italics:* conditional questions (branching).

2.3. Statistical analyses

2.3.1. Descriptive statistics

All ESM data analyses were carried out using R (version 3.6.1). Participant's mean and standard deviation on each variable was computed, providing a set of within-person means and within-person standard deviations for each variable. Based on these values, we estimated the average mean and standard deviation over all participants for each variable.

2.3.2. Assumptions

The distribution of every variable was evaluated through visual analyses of histograms and via Shapiro-Wilk normality tests for each variable and for within-person mean levels. We used the Kwiatkowski-Phillips-Schmidt-Shin unit root tests to assess the trend and level stationarity of each variable for each participant (following Aalbers et al. 2019; Jongeneel et al. 2019).

2.3.3. Network analyses

Time-series NA were conducted using the *mlVAR* package (version 0.4.4.; Epskamp, Waldorp, Mõttus, & Borsboom, 2018). We estimated two networks that capture two different timeframes in order to provide insight concerning the dynamics of ESM over time. The temporal network, which provides an estimation of time-lagged associations, indicates how a variable at time *t* is predicted by the same variable at *t-1* (autoregressive effects) or by all the other variables at *t-1* (cross-lagged effects). The contemporaneous network is estimated based on the residuals of the temporal network. It provides an estimation of the concurrent associations between the different variables and thus includes

all separate data points per variable. The associations take temporal effects into account and all other variables at the same timepoint in order to estimate a partial correlational network. In the estimation of both networks, we used orthogonal random effects as the number of variables was higher than 6 (Epskamp, Waldorp, et al., 2018).

We used the R package *qgraph* (version 1.6.4; (Epskamp et al., 2012) to obtain a visual representation of the temporal and contemporaneous networks described above. Such networks consist of circles which represent the nodes (the variables) and lines representing the edges, i.e. the associations between the variables. The temporal network shows directed associations between nodes, where arrows represent the direction of the potential prediction. Edges were selected as being significant only if both nodes could predict each other significantly, i.e. using an "AND-rule" to threshold significant edges.

2.3.4. Centrality

We used the *centralityPlot* function in *qgraph* to identify the importance of each variable in the network. We computed expected influence indices for the contemporaneous network (Robinaugh, Millner, & McNally, 2016), which provides an estimation of the relative strength of a node (i.e. the sum of the weights of the edges connected to it), while accounting for the presence of negative edges. For the temporal network, we computed in- and out-expected influence indices. In-expected influence shows which nodes are those most influenced by the rest of the nodes, while out-expected influence shows which nodes are the most important predictors of the other nodes.

3. Results

3.1. Descriptive statistics

Table 3 contains the mean and standard deviations of within-person means and standard deviations for all variables.

3.2. Assumptions

Shapiro-Wilk normality tests indicated that no variable followed a normal distribution (all ps < .001). Distributions varied across the variables. Shapiro-Wilk normality tests indicated that within-person mean levels were normally distributed for all variables ($p > .05$), except for Confidence ($W = 0.808$, $p = .049$) and Energy ($W = 0.795$, $p = .037$). Kwiatkowski-Phillips-Schmidt-Shin unit root tests indicated that the data was stationary (trend and level) for all variables and in all participants (all p-values > .05).

Table 3

Means and standard deviations of within-person means and within-person standard deviations per variable.

ESM variable	Within-person Means M (SD)	Within-person SDs M (SD)
Mood	3.93 (1.69)	1.08 (0.56)
Dysfunctional beliefs	3.96 (1.72)	1.21 (0.51)
Confidence	4.23 (1.34)	1.04 (0.64)
Motivation	3.93 (1.25)	1.23 (0.64)
Energy	4.07 (1.31)	1.19 (0.56)
Present enjoyment	4.04 (1.21)	1.13 (0.67)
Wanting to give up	3.02 (1.31)	1.42 (0.54)
Activity's meaning	4.35 (1.49)	1.42 (0.48)
Effort	2.82 (1.01)	1.51 (0.55)
Reminiscence	3.28 (1.31)	1.12 (0.64)
Projection into the future	3.26 (1.50)	1.13 (0.53)

Note. ESM = Experience Sampling Method. All variables have a potential score ranging from 1 to 7; *SD* = Standard Deviation.

3.3. Network analyses

The contemporaneous network (Figure 2) represents the relationships between variables in the same time of measurement. As we can see, Motivation is strongly associated with both Energy ($r = .543$, $p < .001$; all r coefficients represent partial correlations) and Confidence ($r = .327$, $p < .001$). High levels of energy thus co-occur with high levels of motivation, which, in turn, co-occur with high levels of confidence. Confidence is negatively associated with Effort ($r = -.158$, $p < .01$), that is, the higher the confidence, the lower the effort is estimated, and *vice versa*. Furthermore, the network shows that confidence is positively associated with Reminiscence ($r = .139$, $p < .05$). This means, the more one has been thinking about positive past events, the more confident he or she feels. On the contrary, the more one has been thinking about past negative events, the less confident he or she feels. Mood also co-occurs with Confidence ($r = .168$, $p < .01$) and Reminiscence ($r = .168$, $p < .01$), as well as with Present enjoyment ($r = .257$, $p < .01$) and Projection into the future ($r = .251$, $p < .001$). Mood is also negatively associated with Discouraging beliefs ($r = -.236$, $p < .001$). Present enjoyment is negatively associated with Effort ($r = -.138$) and Wanting to give up ($r = -.275$, $p < .05$). The more effort that is required, the less (present) pleasure

is reported, and the more one wants to give up what she or he is doing. On the other hand, the network demonstrates that more meaningful activities (higher levels on the Meaning variable) are positively associated with both higher levels of Present enjoyment ($r = .218$, $p < .001$) and higher levels of Effort ($r = .416$, $p < .001$).

The temporal network (Figure 2) shows how variables predict each other or themselves in the next timeframe ($t + 1$). Projection into the future, Reminiscence and Confidence all significantly predicted themselves at the next timeframe (respectively $r = .330$, $p < .001$; $r = .247$, $p < .05$; $r = .166$, $p < .05$). Reminiscence and Confidence were also significantly and bidirectionally associated ($r = .138$, $p < .05$ and $r = -.211$, $p < .05$), such as reminiscing more about past positive events would predict a higher level of confidence in the next timeframe, while higher level of confidence would predict less positive reminiscence in the next timeframe. Reminiscence was also a significant predictor of Motivation ($r = .183$, $p < .01$), Mood ($r = .178$, $p < .001$) and Energy ($r = .211$, $p < .01$), and negatively predicted Discouraging thoughts ($r = -.164$, $p < .01$). Thus, the more one reminisces about positive past events, the happier, the more motivated, the more energy and the less discouraged he or she will feel later on. Discouraging thoughts negatively predicted Present enjoyment ($r = -.160$, $p < .05$). Present enjoyment, Confidence and Mood predicted Wanting to give up (respectively $r = .169$, $r = .221$, and $r = -.281$, all $ps < .05$). Projection into the future predicted Mood ($r = .116$, $p < .05$) and Effort ($r = .230$, $p < .05$). Finally, Energy negatively predicted Activity's meaning ($r = .199$, $p < .05$).

3.4. Centrality

Based on the expected influence indices (centrality measures) related to the contemporary network (see Figure 2), Motivation can be seen as the most central variable in the contemporaneous network. Motivation is followed (in descending order) by: Activity's meaning, Mood, Energy and Confidence.

As shown in the centrality graphs related to the temporal network, the in-expected influence indicates that (in descending order of importance) Mood, Effort, Motivation, Confidence, Wanting to give up and, finally, Energy are the most influenced variables in the network. Out-expected influence shows that Reminiscence, followed by Projection into the future and Present enjoyment are the most influential processes in the network.
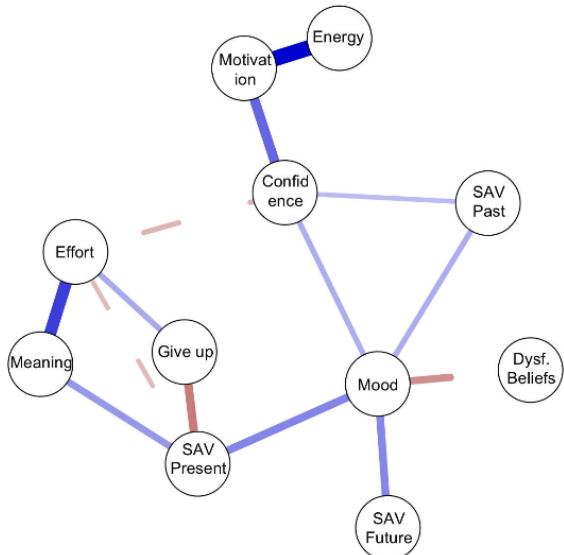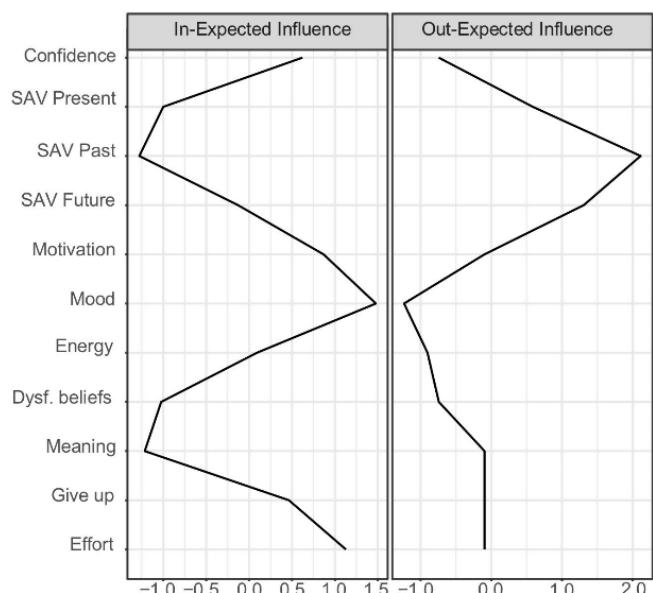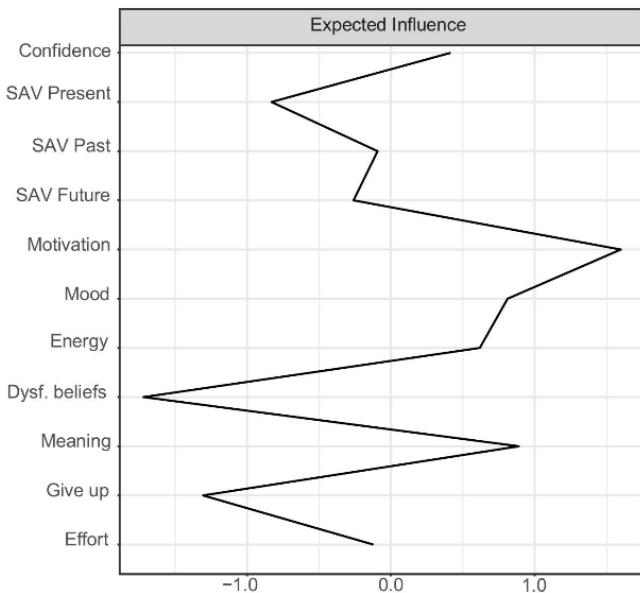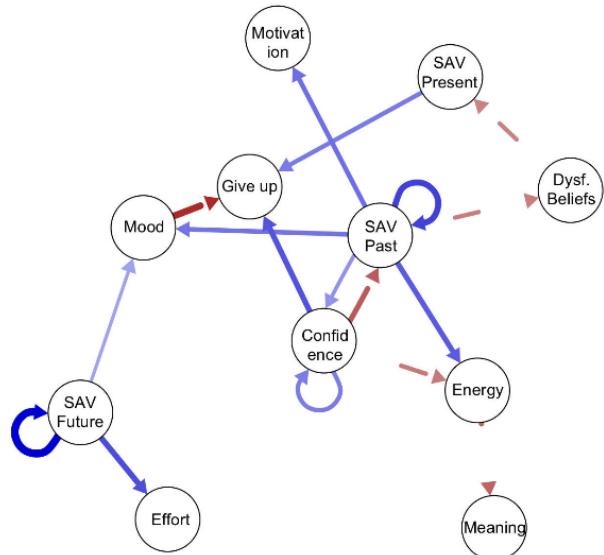
Figure 2. Contemporaneous network (top left), temporal network (Top right), expected influence coefficients for the contemporary network (bottom left) and in- and out-expected influence coefficients for the temporal network (bottom right). Only associations with *p*-values < .05 are plotted. Positive associations appear in blue (continuous lines) and negative associations appear in red (dashed lines). The stronger the relationships, the thicker the edges. In the temporal network, the edges are directed and therefore represented with an arrow. For a colour version of this figure, see the digital version of the paper.

Note: SAV Pres = Present enjoyment; SAV Past = Reminiscence; SAV Future = Projection into the future; Dysf. beliefs = Dysfunctional/discouraging beliefs; Meaning = Activity's meaning; Give Up = Wanting to give up.

4. Discussion

Using a network approach and ESM, this exploratory study investigated the temporal dynamic relationships of multiple cognitive, behavioural and emotional processes derived from our motivational model in a sample of individuals with schizophrenia spectrum disorders.

In the contemporaneous network, we found that Motivation, Activity's meaning and Mood were most central. Similar results stem from the temporal network, as Mood, Effort and Motivation appear to be the most influenceable variables. This is fundamental for those psychological interventions that aim at increasing engagement in meaningful – and potentially effortful – goals and values and to improving quality of life (i.e. well-being, of which mood is a good indicator (de Wit, de Haan, & Myin-Germeys, 2016). Based on the contemporaneous NA, we found that motivation is mainly associated with the amount of energy and confidence one experiences. Further, one may engage in more effortful activities if these activities are meaningful. Engaging in meaningful activities is moreover associated with increased present enjoyment, which is in turn related to better mood. Finally, looking forward to the future and having few discouraging thoughts is also linked to better mood. In the temporal NA, savouring skills appear to be the most influential processes. More specifically, reminiscing about positive past events could lead to increased motivation, better mood, higher levels of confidence and energy, and fewer dysfunctional beliefs such as discouraging thoughts. In that the variables Motivation, Mood, Confidence and Energy are central in the contemporaneous network, increasing reminiscence abilities could have an effect that spreads widely into the rest of the processes. Regarding positive projection into the future, it appears to be a key skill to improve, as it leads to a higher engagement in effortful activities (as seen in the temporal network), which could in turn be associated with an engagement in more meaningful activities (as seen in the contemporaneous network).

The results of our NA shed light on the understanding of motivation in schizophrenia, showing associations that had not been tested before, others that had been found in previous studies, but also questioning relationships that could not be replicated here. For example, energy or the lack of it (i.e. fatigue) has seldom been studied in association with negative symptoms. However, sleep disturbances are widely common in schizophrenia, they seem to be related to lower quality of life, and they are often overlooked, whereas there are options for treatment (Robertson, Cheung, & Fan, 2019). The strong association between energy and motivation in our findings calls for further investigations of the links between sleep disturbances, fatigue and negative symptoms. The association we found between motivation (or engagement in effortful activities) and (self-)confidence is in line with previous studies in schizophrenia (Medalia & Brekke, 2010; Pratt et al., 2005). However, it is surprising that dysfunctional attitudes, such as lack of self-confidence and discouraging beliefs, were not as influential in both networks, whereas dysfunctional attitudes have been central in leading theories regarding negative symptoms (A. T. Beck & Rector, 2005; Campellone et al., 2016; Couture, Blanchard, et al., 2011) and have been key

in a number of psychological interventions to date (Granholm et al., 2018; Grant et al., 2012). A hypothesis regarding this lack of influence of dysfunctional attitudes could be that they follow a different course compared to some other processes (e.g. savouring), that the analyses do not capture. For example, feeling confident might be more stable compared to transient reminiscence. However, discouraging beliefs can be as transient as other processes and if, on the contrary, they linger (i.e. resembling longer lasting rumination), this would have most probably been captured by higher scores on that item. Finally, savouring processes in the different temporal orientations (present enjoyment, pleasure anticipation and reminiscence) have previously shown to be associated with motivational deficits in schizophrenia (Da Silva et al., 2017; Kring & Barch, 2014; Raffard et al., 2010) and have been the target of recently developed interventions (e.g. Favrod et al., 2019, Thonon et al., 2020).

This study presents several strengths. To the best of our knowledge, this is the first study to apply time-series NA from a theory-driven approach to motivational negative symptoms in schizophrenia. The current findings show that the processes derived from our model are highly relevant for the development of motivation. Furthermore, the inclusion of non-symptom components (e.g. processes) may enrich the understanding of psychopathology and allow a holistic perspective in the study of psychopathology (Jones, Heeren, & McNally, 2017). Indeed, the processes described in our model go beyond the mere description of symptoms and include various cognitive, behavioural and emotional processes. This offers a more comprehensive understanding of what underlies the dynamics of motivation in schizophrenia and furthermore provides practical indications for interventions. Finally, the use of complex analyses enabled to shed light upon the more central processes related to motivational negative symptoms and, therefore, upon possible priority targets for interventions.

There are several limitations to this study. First, our sample is based on a small number of participants and thus results should be interpreted with caution. Future studies should include larger samples. Second, the variables were not normally distributed, which is not uncommon, but which warrants for further caution in the interpretation of the results. At present, it is unclear how the analyses used in this study can be reliable in the face of such assumption violation (Epskamp, Waldorp, et al., 2018). Third, although the networks that result from our analyses provide valuable information regarding which processes are related to motivation, they could have been more exhaustive. Indeed, the ESM questionnaire that was used did not include all the processes described in our model. For instance, we encourage future studies to include other core processes that are involved in motivation and goal-directed behaviours, such as planning. Another important issue with goal-directed motivation is the deficit in initiating actions. Although a question was asked regarding the latter, the rating scale differed from the other scales and was not included in the NA. In future studies, the inclusion of these more neurocognitive processes could enrich the understanding of motivation and goal-directed behaviours. Finally, it has been suggested

that Centrality index should be interpreted with caution (Bringmann et al., 2019) and future research in that field should clarify the benefits and limitations of such indices.

4.1. Conclusions

The present study was the first using ESM and a network approach to explore determinants of motivation in individuals with schizophrenia spectrum disorders. It mapped how key emotional and cognitive processes may contribute to the daily fluctuations of motivation at two different timeframes (contemporary and temporal). In line with recent studies on motivational negative symptoms (Kring & Barch, 2014), our preliminary findings suggest a central role of savouring skills (projection into pleasant future and past events) and (self-) confidence, all of which, importantly, can be trained and improved through certain types of psychological interventions. Finally, energy levels and fatigue should be further investigated in relation with motivational negative symptoms.

GENERAL DISCUSSION

General discussion

The main objective of this thesis was to develop and validate an intervention that targets motivational negative symptoms, in order to more directly improve daily functioning and quality of life of individuals with schizophrenia. Motivational deficits are indeed seen as the main obstacle to functional outcomes (Blanchard et al., 2017; Mucci et al., 2019) and are an important barrier to quality of life (Savill et al., 2016) in this population. Furthermore, until recently, negative symptoms were considered as being a critical unmet therapeutic need (Lutgens et al., 2017; Veerman et al., 2017). A few psychological interventions have been recently developed to address this matter, including the Switch intervention.

The Switch intervention was developed based on solid theoretical grounds. First, a model of motivation and goal-directed behaviours was restructured, based on cognitive (Rector et al., 2005) and neuro-affective (Kring & Barch, 2014) models of negative symptoms, as well as motivation theories (Deci & Ryan, 2000). This led to two three-level models: one complex, theoretical model that aims to identify the various emotional, hedonic, cognitive and behavioural components of motivation and goal-directed behaviours; another simpler, more practical model that aims to be used as a sort of "compass" to guide therapists and users (i.e. participants, patients or clients) through motivation and goal-directed behaviours. Second, the Switch intervention was then designed to address each of the elements (e.g. processes, deficits) of the theoretical model, through the ten approaches specified in the "Switch-compass". The result is a comprehensive, multi-factorial, recovery-oriented psychological intervention that specifically targets motivation and related processes.

The studies that were conducted across this doctoral project aimed to validate Switch as a beneficial intervention for motivational deficits in individuals with schizophrenia spectrum disorders. The first pilot study (Study 1) evaluated the feasibility, acceptability and preliminary efficacy of the Switch intervention in individuals with schizophrenia, through a one-year intervention. Study 2 looked at the effects of Switch in a more condensed format and used an intensive longitudinal assessment strategy in order to evaluate the fluctuations and interactions of the various processes related to motivation and goal-directed behaviours. Study 3 followed an identical approach, albeit evaluating the effects of Switch in a group format and in a sample of individuals with schizophrenia and other disorders. Finally, Study 4 involved network analyses on the data collected at the baseline assessments of Study 2 and Study 3. This last study aimed to explore the dynamics of various processes identified in our model, in order to generate hypotheses on possible mechanisms of change in the treatment of motivation and goal-directed behaviours in individuals with schizophrenia spectrum disorders.

This ensemble of studies provide preliminary evidence for the feasibility, acceptability and efficacy and effectiveness of Switch, and highlight the possible contribution of various processes in the enhancement of motivation. Note that efficacy and effectiveness are

somewhat different (Ernst & Pittler, 2006; Howard, Moras, Brill, Martinovich, & Lutz, 1996). The efficacy of a treatment represents its ability to produce the expected effects under ideal and standardized circumstances (e.g. using randomisation, controls, blinding, strict inclusion and exclusion criteria). The goal of efficacy trials is to evaluate if the intervention can work, i.e. if it produces the effects on the chosen outcome measures (often symptoms). Conversely, the effectiveness of an intervention refers to its ability to bring about the intended benefits in naturalistic settings; in other words, to examine if the intervention works in real-life conditions (i.e. with looser inclusion and exclusion criteria, with bias and confounders, with a less standardised intervention). Likewise, studies of the effectiveness of an intervention also examine its impact on everyday life. Both approaches are complementary, as the study of efficacy guarantees a high internal validity (i.e. ensuring that the effects are due to the treatment), whereas the study of effectiveness emphasizes external validity (i.e. the generalisability of the results to other settings, patients and therapists). Finally, efficacy and effectiveness are not dichotomous and rather exist on a continuum (Gartlehner, Hansen, Nissman, Lohr, & Carey, 2006). Thus, the studies presented in this thesis generally combine characteristics, advantages and limitations of both approaches.

1. General discussion of the findings

1.1. Does Switch work?

The goal of Switch is to address motivational deficits in order to improve daily functioning and quality of life. Across the first three studies that examined the efficacy and effectiveness of the intervention, Switch was provided via different formats but used the same ingredients, i.e. the ten strategies presented in the model. Did this intervention successfully reach its goal of enhancing motivation, functional outcomes and quality of life? Is there a particular format that works best? The following sections discuss these questions.

1.1.1. Motivational deficits

Does Switch have an effect on measures of motivational deficits? In each study, we observed meaningful changes on traditional measures of motivational deficits and apathy. In Study 1, large improvements on motivational negative symptoms and apathy – as measured with the Motivation subscale of the Brief Negative Symptom Scale (BNSS) and the Lille Apathy Rating Scale informant version (LARS-i) respectively – were observed after six and twelve months of intervention (i.e. after around 20 and 30 sessions, respectively). At the six-month follow-up assessment, improvements remained moderate (BNSS-motivation) to large (LARS-i). In the three cases from Study 2, similar results were found, with two participants showing large improvements on amotivation/apathy just after the intervention (i.e. after around 12 sessions), and one participant – who was not assessed just after the intervention – showing moderate to large improvements at the follow-up assessment. Finally, the group

intervention also yielded large improvements on the BNSS and the LARS-i after the intervention (i.e. after around 12 sessions), which were partly maintained at the three-month follow-up. Looking at the individual level, amongst those who attended the Switch intervention (both long and short versions, and both individual and group formats), only two participants (Study 1) did not improve on motivational deficits. In sum, around 85% of all the participants who completed the Switch intervention (across the three studies) benefited from it in terms of their motivational deficits, and around 70% maintained these benefits at follow-up (i.e. three or six months after the end of the intervention).

Is this effect specific to motivational deficits? In Study 1, measurements were taken for expressive deficits (BNSS-Expression), positive (BPRS-positive) and depressive (BPRS-depression) symptoms in order to evaluate the specificity of the intervention. Regarding expressive deficits, participants showed large improvements after 6 months of the intervention, although only weak improvements were observed at the end of the intervention and at follow-up. Switch was not specifically designed to reduce expressive deficits and these results are mostly in line with our expectations. Expressive deficits are distinct from motivational deficits, but forming part of negative symptoms, the improvement on expressive deficits is not surprising. The fact that the improvement was larger and more consistent on motivational deficits indicates that Switch succeeded to target motivational negative symptoms in particular. Concerning positive symptoms, exclusion criteria (i.e. no unstable clinical status) for all studies implied that participants could not be in a severe psychotic state. In Study 1, participants had no more than mild positive symptoms (BPRS-positive < 3) and had on average only very mild positive symptoms (BPRS-positive $M =$ 1.62). Switch did not show to have more than a weak – if any – effect on positive symptoms. Thus, the effects of the intervention on motivational negative symptoms would likely not be secondary to a reduction in positive symptoms. In respect to depressive symptoms, although participants were not excluded on the basis of these symptoms, our sample included participants who presented on average only mild depressive symptoms (BPRS-depression $M =$ 3.25) – although three participants presented moderate to moderately severe symptoms (BPRS-depression between 4 and 5). Given the overlaps between certain negative symptoms and depressive symptoms, it was expected that Switch would potentially impact the latter, although we hypothesized that the effects would be more limited compared to the effects on motivational deficits. Interestingly, a large improvement was observed on depressive symptoms, albeit only after 12 months of intervention and at follow-up. After 6 months of intervention, when large improvements were already observed on motivational deficits, depression reduced only slightly. This suggests that, not only did motivational deficits improve not secondarily to a reduction in depressive symptoms, but also that depressive symptoms might reduce secondarily to an enhancement of motivation (see for example Knittle, Gellert, Moore, Bourke, & Hull, 2019). It could be that the increased motivation, and more specifically the increase in occurrences of pleasurable experiences (i.e. reduction in anhedonia), might have driven the positive effects

on depressive symptoms. This would need to be reproduced in a larger sample, and using mediational analyses.

This issue of the specificity of the Switch intervention relates to the question of primary and secondary negative symptoms. We did not select our samples on the basis of criteria for deficit schizophrenia (Kirkpatrick et al., 2001) or persistent negative symptoms (Buchanan, 2007) (see Chapter 1). These criteria might be too restrictive and might have consequences on who gets treatment for their negative symptoms (Rabinowitz et al., 2013). As even mild negative symptoms can impact functional outcomes, such as social functioning (Strassnig et al., 2018), it seems important to have broader inclusion criteria to ensure that individuals with less severe negative symptoms also access treatment for these symptoms. That said, in most of our participants, motivational negative symptoms were at least moderately severe at study entrance and were likely to be mostly primary, as positive and depressive symptoms were generally very mild. The fact that we found positive effects of Switch on motivational negative symptoms in such a sample – without meaningful changes on positive symptoms and without initial changes on depressive symptoms – suggests that we succeeded in targeting core negative symptoms.

Does Switch have a particular effect on some subdomains of motivational deficits? Secondary analyses revealed different results between the three studies regarding anhedonia, asociality and avolition. In Study 1, after six months of intervention, the improvement observed on the BNSS-Motivation was driven by large improvements on the anhedonia subscale, and moderate to large improvements on the asociality and avolition subscales. After 12 months of intervention, however, the large improvement observed on the BNSS-Motivation was essentially driven by large improvements on the anhedonia subscale. At the six-month follow-up assessment, the moderate improvement observed on the BNSS-Motivation was related to large improvements on the anhedonia subscale, moderate improvements on the asociality subscale, but not meaningful improvements on the avolition subscale. These first results show a consistent impact of Switch on anhedonia, but no coherent or sustained impact on avolition and asociality. The results from the two other studies differ slightly. After attending the short version of Switch provided in individual sessions, improvements were observed on all three subscales, however, at follow-up, asociality and avolition improved, whereas anhedonia was not reduced. Similarly, the improvements observed after attending Switch in the group format were driven by large improvements on all three subscales. However, at the follow-up assessment, the improvements on the anhedonia subscale were weak, whereas the improvements on the asociality and avolition subscales were still large. At this stage, given the small samples, it is not clear if the difference in impact on the three subscales of the BNSS-Motivation is significant. Future studies are necessary to evaluate the distinct effect of Switch on the sub-domains of motivational negative symptoms.

In sum, our findings provide preliminary evidence for the efficacy and the effectiveness of Switch on motivational deficits in individuals with schizophrenia spectrum disorders and

prominent negative symptoms. Quite consistently, we found an improvement of these symptoms in participants attending the Switch intervention delivered in both relatively controlled and naturalistic settings, and regardless of the format (i.e. short or long versions, group or individual settings). Furthermore, the benefits of the intervention appear to apply to all three subdomains of motivational negative symptoms (anhedonia, asociality, and avolition). Future studies should investigate the efficacy of the Switch intervention in more controlled settings, e.g. using randomised controlled trials (RCTs). This would increase the internal validity of the Switch intervention. Furthermore, more studies are needed to continue validating the effectiveness of the intervention, provided by less highly trained therapists for instance, and provided to patients with less strict inclusion/exclusion criteria (e.g. patients with comorbidities).

1.1.2.   Functional outcomes and quality of life

Across the three studies that examined the efficacy/effectiveness of the intervention, we found that participants who attended the Switch intervention showed improved daily functioning, with the magnitude of the change ranging from small to very large. In Study 1, improvements were large after six months of the intervention, moderate after the end of the intervention, and moderate to large at follow-up. In the shorter version of Switch provided in individual sessions, a large improvement was also observed at the end of the intervention, and a small to large improvement at follow-up. Finally, in participants attending the group intervention, the improvement on functional outcomes was moderate just after the intervention, and moderate to large at follow-up. In general, around 70% of all the participants attending Switch showed an improvement on functional outcomes. As expected, it appears that the same participants who did not show a reduction of their motivational deficits also did not improve on functional outcomes. The relationship between change in motivational deficits and functional outcomes would need to be properly evaluated in a larger sample, using mediation analyses.

Regarding quality of life, our findings are mixed. In Study 1, quality of life did not change at any assessment time, even when looking at domain-specific quality of life. In the two other studies, some participants reported more satisfaction with their quality of life, while others did not report any meaningful change (just after the intervention or at follow-up). Regarding Study 1, the lack of effect is surprising, given the great improvements not only on motivational deficits, but also on depressive symptoms which are also important predictors of quality of life (Alessandrini et al., 2016). Furthermore, also in favour of our hypothesis, a recent longitudinal study (Gardsjord et al., 2016) indicated that a positive development of subjective quality of life in individuals with early schizophrenia was associated with a decrease in depressive symptoms, as well as an increase in daily activities. Thus, it would have been expected to see at least some enhancement on quality of life or its subdomains. However, it should be noted that participants in our samples were generally only slightly unsatisfied with their quality of life and thus, room for improvement was

limited. Furthermore, looking at the individual level in the sample from Study 1, we observed that the apparent lack of change in perceived quality of life might hide two distinct tendencies: a worsening and an improvement. A worsening of perceived quality of life was reported by two participants, which are the same participants whose motivational deficits and functional outcomes stagnated or worsened over the course of the intervention and at follow-up. On the contrary, the other six participants, whose symptoms and functional outcomes improved, appeared to report an enhanced quality of life. This suggests a link between improved symptoms and functioning on the one hand, and quality of life on the other hand, as observed in other studies (e.g. Gardsjord et al., 2016). It is unclear why some participants did not benefit from the Switch intervention. Nevertheless, the observations on an individual level revealing the enhanced subjective quality of life in a majority of participants are promising, as several studies have highlighted the stagnation or even worsening of quality of life in a majority of individuals with schizophrenia (Górna, Jaracz, Rybakowski, & Rybakowski, 2008; M. S. Ritsner, Lisker, & Arbitman, 2012). These opposite results (improvement *vs.* worsening) in Study 1 also point to the necessity, in future studies, to focus on clusters of participants showing distinct outcomes. This would help delineate particular profiles and investigate the possible factors (i.e. bio-psycho-social factors) explaining these diverging outcomes. Such an approach is important to bridge the gap between the nomothetic (i.e. group analyses) and idiographic (i.e. individual case studies) approaches (Clatworthy, Buick, Hankins, Weinman, & Horne, 2005). It is also useful for the adaptation of the therapeutic intervention to particular needs. For instance, subgroups of individuals might benefit from a focus on certain factors prior to others (e.g. reducing sleep disorders prior to enhancing motivation to engage in new and potentially effortful activities).

In Study 1, we also conducted secondary analyses in order to investigate daily functioning and life satisfaction from the participants' perspective and using a different assessment scale. As a reminder, we used the Social Functioning Questionnaire (Questionnaire de Fonctionnement Social – QFS; Zanello, Weber Rouget, Gex-Fabry, Maercker, & Guimon, 2006), which is a self-rating scale that measures, on the one hand, the frequency at which daily-life activities are carried out (e.g. household, leisure, social interactions), and on the other hand, the satisfaction regarding the different domains evaluated. Thus, this was a complementary measure to the Functional Remission of General Schizophrenia (FROGS; Llorca et al., 2009), which was completed by the informants. According to the QFS, participants considered that their functioning improved (small to moderate increase in frequency of activities) after 6 months of the Switch intervention and at follow-up, but not after 12 months of intervention. This is mostly in line with the results on the FROGS, for which large improvements were observed by the informants at the 6-month and follow-up assessments, but for which a moderate improvement was observed at the 12-month assessment. As for satisfaction, participants did not report any change during or after the intervention, but they found to be slightly more satisfied with their daily-life functioning at

the follow-up assessment, which indicates that life satisfaction might improve after a longer delay, i.e. after changes have rooted in daily life.

In sum, individuals who completed the Switch intervention showed moderate to large improvements regarding their real-life functioning across all three studies that examined the efficacy/effectiveness of the intervention. Furthermore, regarding quality of life, although no improvements were observed at the group-level in Study 1, observations at the individual-level revealed that the individuals whose motivational deficits and functional outcomes improved found their quality of life to increase as well.

1.2. How might Switch work?

Switch was designed to target the multiple processes believed to influence motivation and goal-directed behaviours, such as savouring (past, present and future), dysfunctional attitudes, planning, problem-solving and initiation abilities. It was hypothesized that including these different targets, rather than focusing on one or the other, would maximize the effects of the intervention. In the different studies that examined the efficacy/effectiveness of the Switch intervention, measures were taken to investigate the evolution of such processes during or after the intervention. These measures included traditional assessment scales as well as ESM questionnaires. The findings on both these measures provide indications on what processes changed in relation with improvements in motivational deficits. Furthermore, network analyses based on the ESM data provides additional information on how these processes influence each other, which helps generate hypotheses regarding possible mechanisms of change.

1.2.1. Use of traditional assessments in a pre-post design

In Study 1, some of the processes identified in our model were evaluated using existing self-rating scales. Regarding cognitive processes, secondary analyses (see Study 1: Supplementary material, 2.1.2. Results) revealed a progressive weak to moderate increase in self-efficacy (as measured with the General Self-Efficacy scale; Schwarzer & Jerusalem, 1995) and a moderate decrease in dysfunctional attitudes (Dysfunctional Attitude Scale, DAS; Weissman & Beck, 1978) throughout the different assessment times. Concerning savouring processes (Savoring Beliefs Inventory, SBI), there was a moderate improvement in attitudes towards pleasure anticipation, albeit only after six months of intervention. The improvement was only weak after 12 months of intervention and at follow-up. Attitudes towards consummatory pleasure (savouring in-the-moment pleasure) improved slightly after 12 months and at follow-up. Conversely, attitudes towards savouring the past worsened after 6 months of intervention, and then improved again after the end of the intervention and at follow-up. Taken together, these results indicate that processes that were targeted by the Switch intervention improved slightly to moderately during and after the intervention, which suggests that the improvement observed on motivational deficits

might be related to a change on these variables. However, other analyses such as mediation analyses would need to be used in future studies in order to answer this question. Such analyses would shed some light on the direction of the relationships between the variables at play. It would be expected that change on self-efficacy, dysfunctional beliefs and savouring would mediate the change in motivational negative symptoms.

Pre-post designs using traditional rating scales – measuring symptoms (e.g. the Brief Negative Symptom Scale; BNSS) or processes (e.g. SBI; DAS) – provide a general impression of what is measured and a general picture of change, but they are limited in different ways. First, these traditional measures rely on memory abilities to appraise experiences and behaviours that occurred in the last week or month, for example. Therefore, there can be various recall biases that come to play (e.g. recency, primacy, emotional congruence biases) (Shiffman et al., 2008). Furthermore, there is extensive research showing that individuals with schizophrenia present important memory deficits, including deficits in auto-biographical memory (Berna et al., 2015; Y. Zhang et al., 2019). Second, these measurements usually take place in a lab or an office, which is out of the person's usual living context. Third, these traditional scales that are used before and after an intervention do not capture the fluctuations of the phenomenon they intend to evaluate, while it is likely that most of them progress in a non-linear fashion (e.g. Ben-Zeev, McHugo, Xie, Dobbins, & Young, 2012). Finally, and relatedly, using pre-post designs does not enable the adequate measurement of *how* change occurs, as all the dynamics that develop *during* the intervention are not captured by measurements that are taken before and after that intervention. A solution to these limitations is to use the Experience Sampling Method (ESM; Myin-Germeys et al., 2018, 2009) or Ecological Momentary Assessment (EMA; Shiffman et al., 2008).

1.2.2. Use of continuous ambulatory assessment

As was described in the first Chapter (see 3.4. Ambulatory assessment), ambulatory assessment can be used to better capture the development of certain symptoms, processes and behaviours, in the moment when they occur and in their natural context. As a reminder, ESM or EMA (Myin-Germeys et al., 2009; Shiffman et al., 2008) involve the repeated measurement of in-the-moment thoughts, emotions, behaviours, physiological states and contexts (e.g. social contacts, activities) in the individual's natural environment, commonly using electronic wearable devices. The use of ESM produce intensive longitudinal data that has the potential to reveal the dynamics between different variables, i.e. how they interact over time. Thus, in the second and third studies of this thesis, this approach was taken to explore the dynamics of the various processes identified in our model of motivation and goal-directed behaviours. A questionnaire (see Study 1, 2.4 ESM questionnaire) was specifically created to evaluate motivation, engagement in meaningful activities, savouring (present, past, future), dysfunctional beliefs (and coping mechanisms), (self) confidence, initiation, effort, as well as other variables that are not present in our model, but that provide

a context for the reported behaviours, i.e. mood, energy level, social context, and current activity. Finally, in both Study 2 and Study 3, we used actigraphy to generate daily assessments of activity (i.e. step-count) as an objective, proxy measure for motivational negative symptoms (Gupta et al., 2014; Kluge et al., 2018).

Idiographic analyses

In Study 2 evaluating the short version of the Switch intervention provided in individual sessions, we used idiographic analyses in order to differentiate individual paths over the course of the baseline, intervention and follow-up phases. Several observations can be made regarding differences between and within participants, and between and within phases. A first general observation is that – without surprise – the various processes we measured fluctuated noticeably over time within participants, and within each phase of the study (see graphs representing rolling means in Study 2: Supplementary material).

Second, the dynamics between the various processes differed from one participant to another (see network analyses, Study 2, Figure 5, Figure 7 and Figure 9). Although some relationships appear to be similar between the different participants, for example between mood and savouring (in the contemporary networks), most are different. This indicates that motivation and goal-directed behaviours might be influenced by slightly distinct processes in different people, which would call for a more individualised therapeutic approach. For instance, for one person (e.g. 2i-1), it might be more important to insist on dysfunctional cognitions – that are auto-correlated over time – in order to reduce their impact on savouring processes, which could in turn have an effect on motivation. For another person (e.g. 2i-4), energy levels may have a more central role, influencing a large number of other variables in the network. Evaluating the factors that impact energy levels might help identify appropriate treatments, which would in turn positively affect variables influenced by energy levels (e.g. motivation, savouring, confidence). Of course, these hypotheses would need to be discussed with the person in order to guide the treatment choice.

A third observation concerns the evaluation of the effectiveness of the Switch intervention. Some processes evolve over the course of the intervention and at follow-up, but not always in the expected direction. The most striking changes appeared for one participant at the follow-up phase. Although there are several confounding factors that could be responsible for a change, several processes that are specifically targeted by the Switch intervention improved: savouring skills, self-confidence and cognitive regulation skills (e.g. generating more positive and motivating thoughts when experiencing dysfunctional beliefs). However, the other participants did not show obvious changes in these processes and even a worsening in some cases – while traditional assessments showed great improvements on motivational deficits and functional outcomes. This incongruence regarding results on the different types of measurement raises several questions.

Is one of the assessment methods not reliable, at least for some participants? For instance, it is possible that the insight of some participants sharpened during the course of the intervention, which might have led to artificial changes in the scores on the ESM variables (e.g. identifying more negative affects). Or, it is possible that the change occurred later in the intervention, instead of from the start of the intervention. Participants' adherence to the evaluation protocol reduced progressively, which is common (Rintala, Wampers, Myin-Germeys, & Viechtbauer, 2020) – especially for such a long study duration – but which might have resulted in a loss of relevant data, and therefore possibly a bias.

Do changes at different levels (i.e. general improvement of symptoms *vs.* change in daily-life processes) appear at different times? Intuitively, it could be hypothesized that change in several processes (micro level) precede the change observed on a more general (macro) level (i.e. measured with the traditional assessment post-intervention). Yet, no such pattern appeared in Study 2: motivational deficits (BNSS) improved after the intervention, while little if any improvements (ESM) were observed during the intervention phase. That said, it could be that the intervention had a direct effect on motivational deficits by increasing interest and engagement in social and other activities (i.e. reducing asociality and avolition), and by increasing the experience of pleasure (i.e. reducing anhedonia). In two participants, savouring processes indeed improved over the course of the intervention, although they worsened in one participant. There is not enough data to properly answer the question of different types of changes following different time-courses. Future studies should continue investigating how various processes change over the course of and after the intervention, while measuring more general changes (i.e. using traditional measurements post-intervention and at follow-up). This kind of approach is important to generate a clearer picture of change, both at micro and macro levels.

Are there other factors that were not assessed and that drove the changes? It is possible that the improvement observed in motivational deficits and functional outcomes resulted from factors unrelated to the content of the Switch intervention. Study 2 took place in a naturalistic setting, including participants whose medication changed over time. Two participants temporarily reduced their antipsychotic medication during or after the intervention, which may have biased some of our observations – although (second-generation) antipsychotic medication has generally not shown to produce changes on negative symptoms (Fusar-Poli et al., 2015; Veerman et al., 2017). The lack of control on such potential factors of change is a limitation.

Clearly, more research using various measurement types is needed to clarify how general, symptomatic improvement occurs and through which processes. The work that has been done in this study is a foretaste of what could and should be done on a larger scale and more systematically in any clinical trials. Such an approach would help refine interventions by confirming that improvements are the result of a change in the hypothesized underlying processes, i.e. the targets of interventions.

General discussion of the findings   -   How might Switch work?

The fourth and last observation regarding the effectiveness of the Switch intervention concerns the change in dynamics between the different processes evaluated. According to the individual network analyses we conducted on each participant, the dynamics appear to change from one phase to another in all participants and improvements appear to translate through a more connected, denser network (see contemporary networks, Study 2, Figure 5, Figure 7 and Figure 9). For instance, the participant (2i-1) who showed the greatest improvements on daily-life processes and outcomes also showed a denser network after the intervention, especially at follow-up. In this case, engaging in more meaningful activities was not related to any processes at baseline, whereas it was related to motivation during the intervention, as well as to savouring at the follow-up phase. At the follow-up phase, higher motivation was also associated with increased savouring and lower dysfunctional beliefs. The fact that these processes and outcomes were more connected might explain the improvement, such that improving one or the other process would extend to the rest of the network. Conversely, in the participants (2i-2 and 2i-4) who showed little or no improvements on the daily-life processes, engaging in more meaningful activities was associated with no variables in the network, or variables that did not appear to be influenceable by other factors in the model. For instance, engaging in more meaningful activities was associated with higher effort in one participant (2i-2), but higher effort was disconnected from the rest of the network. Based on these analyses, it is therefore difficult to identify a target to improve in order to help the person engaging in more meaningful activities, that would bring a change to their life satisfaction.

In conclusion, our findings regarding these idiographic analyses did not bring much clarity as to what processes are improved through the intervention, and thus to what may be potential mechanisms of change. Although all participants showed a reduction in motivational deficits and improved daily functioning, a significant improvement in related processes and a clear change in their dynamics was observed in only one participant. However, the apparent increase in density in the networks of all participants could be an important outcome. Studies have provided contrary interpretations regarding the density of networks (i.e. how tightly connected the different variables are). On the one hand, previous studies have hypothesised that a denser network of symptoms was associated with higher severity, as symptoms highly interconnected would reinforce each other (Galderisi et al., 2020; McNally, 2016; Robinaugh et al., 2020). On the other hand, in a recent study (G. P. Strauss, Esfahlani, Kirkpatrick, et al., 2019) comparing a network of negative symptoms between individuals with schizophrenia, bipolar disorder and healthy controls, the network was more densely connected in the schizophrenia group. The authors suggested that the different domains of negative symptoms may function more in isolation in schizophrenia, which would explain why these symptoms are so resistant: treating one domain of negative symptoms would not extend to other domains which thus remain unchanged. That said, in our study (Study 2), the networks did not include symptoms, but cognitive, behavioural and affective processes, which can be functional. It could be hypothesized that a higher density in the interconnections between such (functional)

processes would reflect better functioning. This would need to be investigated by comparing networks of these processes in samples of healthy individuals and individuals with schizophrenia spectrum disorder. It would be expected to see a denser network in healthy controls compared to individuals with schizophrenia.

Group analyses

In Study 3, which evaluated the efficacy of the Switch intervention in a group format, participants who completed the intervention were compared with individuals who did not fully complete the intervention. Using a repeated measures mixed-effects model for each (ordinal) variable of the ESM questionnaire, we found that completers improved on a number of variables from baseline to intervention phases, while non-completers did not, or showed a worsening. That is, during the intervention phase, completers were more motivated and engaged in more meaningful activities, but also more effortful activities – which might explain why they also reported more often to wanting to give up what they were currently doing. Moreover, their mood also improved during the intervention. In terms of processes that were targeted by Switch strategies, completers reported more occurrences of positive reminiscence and projection into the future, indicating improved savouring skills, although present enjoyment improved only weakly and not significantly. Regarding dysfunctional attitudes, there was also a trend towards increased confidence, but no change regarding discouraging thoughts. There was also no change, in either group, regarding energy levels. In sum, in these group analyses, the improvement observed on traditional assessments of motivation and functional outcomes converged with improvements on daily-life measures of motivation, goal-directed behaviours and mostly savouring processes.

In order to evaluate what precisely mediated the improvements in motivation and goal-directed behaviours, future studies should assess the contribution of change in the various processes targeted by Switch to change in the outcome variable using a time-lagged mediation model (see for example Van der Gucht et al., 2019). But here is a first problem: what is the outcome variable? Should the engagement in meaningful and effortful activities be considered as the end goal of the intervention? Would an increase in motivation, for example, or increase in positive projection in the future, or reduction in cognitive beliefs, then be considered as the mechanisms of change? Instead, it could be that engagement in more effortful and meaningful activities, which might have been initially extrinsically motivated (e.g. to please the therapists, to meet the group expectations) would represent the mechanism of change responsible for increases in confidence and savouring. Subsequently, increased confidence and savouring would boost motivation to engage in more meaningful and potentially more effortful activities. The matter appears to be more complex than a linear cause-effect relationship.

Network analyses provide an interesting approach to assessing the dynamics between processes as there is no distinction between dependent and independent variables. However, these analyses might not be appropriate for longitudinal data collected *during* the intervention, which are likely to violate some assumptions, such as stationarity and absence of trends (Epskamp, van Borkulo, et al., 2018). Recent models have been developed to account for these peculiarities, namely Time-Varying Autoregressive Models (Bringmann et al., 2017) which help investigate the change in dynamics that can appear, for example, during an intervention.

Another problem regarding the investigation of mechanisms of change concerns the interval considered between two measurement-times. Some factors might have an impact on one another within a small timeframe, while others might require a longer interval before an impact might be tangible. This could be accounted for with the help of a recently developed tool, the Differential Time-Varying Effect Models (Jacobson, Chow, & Newman, 2019), which helps identify the optimal lag (interval) structures in time-series data. In future studies, such complex models may shed some light on the changing dynamics between processes related to motivation and goal-directed behaviours.

1.2.3. Network analyses

In Study 4, the baseline data of both the first and second studies were used to evaluate the dynamics of the different variables at play. The network analyses that were computed on a sample of eight participants with schizophrenia spectrum disorders provide a glimpse of how the different processes interact and how motivation could potentially improve in order to live a more satisfying and more meaningful life. The resulting graph models and centrality metrics allow to draw hypotheses on which variables appear to be the most central and the most influential.

In the contemporary network, where links between the edges represent concurrent associations (i.e. relationships in the same timeframe), motivation was mostly related to the level of energy and to confidence, albeit to a lesser degree. The strong association with energy is surprising in some ways, and unsurprising in others. After all, it seems quite intuitive that if one lacks energy, it is likely that they will not feel very motivated for whatever they are required to do or even what they would like to do. This is also the reason why the item "energy" was included in the ESM questionnaire. Yet, it is surprising – and somewhat unsettling – to see that motivation is most strongly associated with a variable that was not part of our original Switch model and that was not specifically targeted in the Switch intervention. Furthermore, in the contemporary network, energy is only associated with motivation and not with any of the other variables, which leaves an uncertainty as to how to increase levels of energy. The direction of the association (in the contemporary model) is nonetheless uncertain, i.e. it is unclear if higher energy levels result in increased motivation or *vice versa* – or both, depending on the situation. For example, a person feeling

quite tired is encouraged by his/her friend to go out to a party. The idea of dancing really motivates him/her and they end up at the party, full of energy, hitting the dance-floor. However, it is possible that what allowed him/her to have the energy to go to the party was the resting time before the party, while preparing quietly to go out. Another day, a lack of energy would be the fatal obstacle to going out. In any case, if motivation relies mostly on energy, it is important to understand what might help increase energy levels, if motivation is not enough to do so. For instance, energy levels are most probably related to fatigue. Sleep disorders have been commonly reported in individuals with schizophrenia, although they are often overlooked (Robertson et al. 2019). Psychological interventions for sleep disruptions exist (Freeman et al., 2015), although there have been few studies on the effect of such intervention on negative symptoms.

The association between motivation and confidence in the contemporary network is in line with the cognitive approach to negative symptoms (Rector et al., 2005), which views dysfunctional attitudes, such as low level of self-efficacy, as a factor hindering motivation. However, dysfunctional beliefs were not associated with motivation, which runs against this cognitive perspective. Dysfunctional beliefs were only correlated with mood, which suggests that the association between these negative thoughts and motivation works through depressive features. As suggested in the graph, discouraging beliefs are only indirectly associated with lower motivation, through worse mood and lower confidence.

Other associations were observed on the contemporary model. There was also an indirect link between effort and motivation, through confidence, such that an effort that is estimated as smaller would relate to higher confidence, which would be associated with higher motivation – or that a higher estimated effort would relate to lower confidence, and therefore lower motivation. Finally, more meaningful activities were associated, on the one hand, with more pleasure, and on the other hand, with more effort which is, conversely, slightly correlated with less pleasure. Thus, the relationships between these different variables appear to be quite complex and not always straightforward.

What is observed in the temporal network is enlightening in terms of what could be targeted to observe improvements in motivation and related processes. The findings from these analyses revealed that savouring skills appear to be quite influential, especially positive reminiscence and projection into the future. Thinking back on past positive events seems to be what boosts later motivation, mood, confidence, energy, as well as future positive reminiscence (i.e. autocorrelation indicating a virtuous circle), and it is also what contributes to reducing later dysfunctional beliefs. On the contrary, thinking about past *negative* events would increase the likelihood of continuing to think about these upsetting events (i.e. autocorrelation, suggesting potential rumination), and would affect future motivation, mood, confidence, and energy. As for positive projection into the future, it appears to predict later positive projection (i.e. auto-correlation), as well as better mood and increased engagement in effortful activities in the next timeframe. On the contrary, anticipating future

events in a negative or anxious light would foster more negative anticipation, worse mood and less engagement in effortful behaviours.

Certain associations in the temporal network are somewhat less intuitive. For instance, high levels of confidence predict future lower levels of energy. This might be explained in the light of the observations made on the contemporary network: higher confidence is related with higher motivation, which is related with higher energy. It might be hypothesized that energy has then been "consumed", and that it is lower at the next assessment point. Furthermore, levels of energy predict the following engagement in meaningful activities: it might be that if energy is high at a certain point in time, it may be used then for various activities, and therefore at the next assessment point, there is less energy left to engage in meaningful activities. Thus, this may underline the importance of sparing energy for the time when meaningful activities are to be engaged in.

In sum, what appears to be key in improving motivation and the engagement in meaningful activities is energy levels, confidence, and positive anticipation and reminiscence. Surprisingly, according to centrality measures (see Study 4, Figure 2, bottom part), estimated effort and discouraging beliefs did not seem to have a great influence on motivation, nor in the networks in general (both contemporary and temporal networks). This runs against the prediction of both the neuro-affective (Kring & Barch, 2014) and cognitive (Rector et al., 2005) models, which posit that effort evaluation and dysfunctional beliefs, respectively, play an important role in motivation. That said, the way effort was assessed in our study differs greatly from how it has been usually measured in neuro-affective sciences, i.e. with effort-based decision-making tasks (e.g. Fervaha et al., 2015). Furthermore, on average, participants in our sample considered the activities that they engaged in as requiring little effort. It is possible that in more challenging activities, the estimated effort plays a bigger role in motivation and goal-commitment, which would then align with results found in effort-based decision-making paradigms.

1.2.4. Conclusion

To appreciate what processes the Switch intervention impacted, different approaches were used. The use of traditional assessments in Study 1 provided preliminary evidence for the efficacy of the Switch intervention on several processes that were targeted: self-efficacy, dysfunctional beliefs, and savouring processes (i.e. present enjoyment and positive projection into the future) were slightly to moderately improved. The use of ambulatory assessment allowing the evaluation of these processes in daily life led to mixed results. In Study 2, one participant showed significant improvements at follow-up regarding confidence and savouring skills (i.e. anticipation and reminiscence), another participant showed small improvements only on savouring skills, and a final participant showed a worsening of these skills. This suggests that the improvements observed on traditional assessments of motivation and apathy were not necessarily driven by a change in these

processes. However, in Study 3, completers who showed great improvements according to traditional assessments of motivation and functional outcomes also showed significant improvements on savouring skills, namely positive projection into the future and positive reminiscence, and increase in confidence – albeit on a trend level. Furthermore, secondary analyses indicated that the more Switch sessions were attended, the larger the benefits were on these processes. Taken together, these results suggest that the Switch intervention has a positive impact on certain savouring processes – namely positive projection into the future, and possibly present enjoyment and positive reminiscence – and certain cognitive processes, namely a general feeling of self-efficacy or confidence, and possibly dysfunctional beliefs, but not as measured in daily-life.

Regarding change in dysfunctional beliefs, it is possible that the intervention has an effect on the *relationship* that participants have with these negative thoughts, but not on the frequency of their occurrence. This would explain why a reduction was observed when using the DAS before and after the intervention in Study 1, but not when using daily-life measures of discouraging thoughts in the second and third studies. The DAS measures indeed more general statements regarding dysfunctional attitudes (e.g. "If you cannot do something well, there is little point in doing it at all"), while the ESM question taps into situation-specific cognitions (i.e. "Discouraging thoughts are crossing my mind"). Thus, it is possible that cognitive restructuring and cognitive defusion that are used in the Switch intervention foster a more positive and constructive attitude towards these negative thoughts, while at the same time do not necessarily reduce their frequency in daily life (at least not in the short term). However, there is no clear evidence of change in coping mechanisms – as measured with the ESM – when negative thoughts occur in daily life. Future studies should combine traditional and daily-life measures, including a questionnaire such as the Cognitive Emotional Regulation Questionnaire (Garnefski, Kraaij, & Spinhoven, 2001; Jermann, Van der Linden, D'Acremont, & Zermatten, 2006) and adding in the ESM questionnaire an item measuring the distress caused by the negative thoughts (e.g. van Aubel et al., 2020). This would allow the observation of whether there is a change in cognitive regulation strategies, and if dysfunctional beliefs cause less distress over the course of and after the intervention.

The results from Study 1, Study 2 and Study 3 can be appreciated in the light of the network analyses that were conducted in Study 4. In the temporal network analysis, savouring skills, namely positive reminiscence and projection into the future, appeared to have a particularly important role in predicting later motivation and engagement in effortful activities. It is thus not surprising that an improvement was observed on these variables (measured with the ESM questionnaire or the SBI) in participants who also showed improved motivational deficits and apathy after the Switch intervention. In the contemporary network analysis, confidence appeared to be associated with concurrent motivation, although energy levels seem to have a bigger impact on the latter. In Study 1, general self-efficacy increased slightly to moderately during and after the Switch intervention, which aligns with the findings from the network analysis. Additionally, daily-life measures of feeling confident increased slightly

during the individual and group interventions in some participants. In sum, it appears that processes that appeared influential in the network analyses improved in participants who benefitted from the Switch intervention. Do these processes represent the mechanisms of change through which Switch benefitted the participants? Possibly, but future studies with larger samples and more complex statistical analyses are needed to confirm these hypotheses.

The present studies are on the one hand limited by the small sample-size, and on the other by the types of analyses that are available to evaluate mechanisms of change. First, using pre-post and a randomized control design with larger samples would allow researchers to conduct mediation analyses and evaluate if the benefits on motivational deficits are driven by an improvement on certain factors, i.e. dysfunctional attitudes, savouring skills, or others, such as planning and initiation skills which were not measured here. Second, complex analyses for intensive longitudinal data are just emerging (e.g. Time-Varying Autoregressive Models, Differential Time-Varying Effect Models) and could be used in the future to better understand the changing dynamics in motivation and related processes.

1.3.   In what circumstance does Switch work?

After examining the efficacy and the effectiveness of the Switch intervention, it is important to comment on the differences between the various formats through which the intervention was provided, namely in terms of the duration of the intervention (2 *vs.* 12 months) and the individual and group settings. Directly comparing the findings from studies that examined the efficacy and effectiveness of the intervention is not straightforward, given the differences in duration and formats and given the small sample sizes. However, a few observations can be made regarding the length of the Switch intervention in relation to its effects, and the benefits of both individual and group formats.

1.3.1.   Length of the intervention

First, we can draw a few comparisons regarding the two studies investigating Switch administered through individual sessions. On the one hand, in Study 1, around 30 Switch sessions were delivered over a period of twelve months, starting with a frequency of once a week and progressively reducing to once every three weeks towards the end of the 12 months. The outcomes immediately after the most intensive part of the intervention (at 6 months into the intervention in Study 1, i.e. around 20 sessions) and the outcomes after the two-month condensed version of Switch (i.e. around 13 sessions) are quite similar, with meaningful improvements on both sides. We may think that some skills (e.g. savouring skills, coping with dysfunctional beliefs, planning) take longer to improve, requiring a "maturation" period. Logically, as time elapses, more occasions to train different skills in various circumstances should indeed appear. However, from the important improvements observed after the shorter albeit more intense version of Switch (Study 2), it appears that

the *frequency* of the training of these skills might be important. Although this was observed only in the two cases, this could have consequences on the way interventions are delivered. For instance, increasing the frequency of training might be essential for the different mechanisms to improve, and such increases could be achieved by training individuals in their natural environment using Ecological Momentary Intervention (EMI; Myin-Germeys et al., 2018). Also, increasing occasions of training could be combined with increasing the "maturation" period by extending EMI after the end of face-to-face interventions. This would also have the benefit of increasing the possibility of the transfer of skills to everyday life, as well as possibly smoothing the transition between the regular face-to-face meetings with the therapist to the period after such meetings have ended. This will be further discussed below (see 3.1.2. How it is delivered).

Second, in Study 3 which evaluated the group version of the Switch intervention, secondary analyses yielded interesting results. In these analyses, we used repeated-measures mixed-effects models for each variable of the ESM questionnaire, but instead of using the Group (i.e. completers *vs.* non-completers), we used Number of sessions as the independent variable, along with Phase (i.e. baseline and intervention). All the significant interactions we found in the main analyses were reproduced in these analyses, such that the more Switch sessions were attended, the greater the improvement during the intervention (e.g. more motivated, more engaged in meaningful activities, more savouring). This suggests again that the frequency of training of the various strategies taught during Switch might be critical. This might also point to the necessity of extending the length of certain group interventions (at least for participants that appear to need it) so as to obtain a greater benefit, instead of keeping them as short as possible for cost reasons. Again, the extension could take the form of ecological momentary intervention, which could start during the face-to-face group intervention and continue as long as people want or need them after the intervention.

Thus, to summarize, it appears that the frequency of Switch sessions may be an important factor to derive a larger benefit in respect to motivational deficits and related processes. Furthermore, ecological momentary intervention could enrich face-to-face individual or group sessions and offer the opportunity to increase the frequency of the training, to generalise the learnings in daily-life and in patients' natural environment, and to extend the duration of intervention at little cost.

1.3.2. Individual and group settings

Both individual and group therapies have advantages. An intervention provided in an individual setting of course allows for a more individualised treatment approach, which is essential given the heterogeneity of profiles encountered (Larøi & Van der Linden, 2013). Individual psychotherapy might indeed increase the likelihood of finding an agreement on the treatment goals and on the strategies to reach them (Horvath, Del Re, Flückiger, & Symonds, 2011) compared to a group intervention where strategies that are taught to the

group are set by the therapeutic programme. Furthermore, the therapeutic alliance might be greater in a single dyadic relationship than in group therapy involving many individuals and relationships (Delsignore et al., 2014), which may have a different impact on therapeutic outcomes (Horvath et al., 2011). However, a member-to-member alliance (related to group cohesion) can develop in group therapy and positively influence therapeutic outcomes (Marziali, Munroe-Blum, & McCleary, 1997). Furthermore, in group therapy, participants can benefit from more social support and network that they may lack in daily life (Johnson, Penn, Bauer, Meyer, & Evans, 2008). Group interventions also allow peer-learning and social-skills development (Borek & Abraham, 2018; DeLucia-Waack et al., 2004). Finally, group interventions might also be more cost-effective than individual psychotherapy (Neufeld et al., 2020).

Regarding the individualised feature of the Switch intervention, in both the individual and the group formats, participants were invited to develop their own individual goals to follow. However, it was more difficult in the group format to guide participants in the identification of their personal goals and values, and to follow up on their progression regarding the latter. In individual therapy, the strategies taught were provided in a more individualised way in the sense that the delivery order of the strategies corresponded more to the individual's needs and goals (i.e. depending on what the individual was bringing up during the session, one or another strategy was suggested, regardless of a predetermined order). In the group intervention, the strategies were taught in a predetermined order. Nevertheless, each strategy was used by each participant in relation to their own personal goals, thus keeping the intervention individualised to personal situations. Conversely, in some exercises, all participants were using the strategies to help each other in their goal-attainment, i.e. applying their learning to others' situations. For example, all members of the group generated ideas to help find solutions to problems raised by each participant. This approach potentializes the benefits of the group-format and fosters peer-support.

Comparing the efficacy of both formats of the Switch intervention (i.e. comparing Studies 2 and 3) would require more participants and a strict standardisation of both formats (e.g. same number of sessions, same duration). Comparing the efficiency (i.e. the capacity to produce an effect in the most economical way) of the individual and group formats nonetheless deserves comment. Group interventions are supposed to be more cost-effective than individual psychotherapy because several patients benefit from the intervention at the same time. However, in our experience, the time spent by the two therapists preparing and running the group therapy might not justify a preference for this format over the individual setting. For four hours of group therapy, two therapists were working around six hours each (including preparation time). Of course, in general the more participants, the more efficient (or cost-effective) the group intervention could be, although the more participants, the less attention the therapists can dedicate to each participant individually. Furthermore, for this type of complex intervention, it is difficult to imagine creating groups larger than eight participants. Thus, the choice of providing the Switch intervention in a group or in an individual format should probably not be driven by

concerns regarding cost but instead by the specific advantages that both formats bring, by practical constraints, or by patient preference.

1.4. How does Switch compare to other interventions?

Switch represents one of the few interventions specifically designed to address all or parts of negative symptoms. The existing interventions (Favrod et al., 2015; Velligan, Roberts, et al., 2015) are nevertheless founded on somewhat different approaches, inspired by different models of negative symptoms. Below, Switch is compared to other interventions in terms of their content and regarding their efficacy or effectiveness. Regarding the latter point, it is important to clearly stress that Switch, contrary to some interventions, has not yet been validated in a randomised control trial, but rather through several studies in more naturalistic settings. It is therefore difficult to compare the benefits of Switch relative to these interventions validated through RCT, although an attempt will be made in order to generate hypotheses regarding key ingredients for the treatment of motivational negative symptoms.

1.4.1. MOtiVation and Enhancement (MOVE)

From a content point of view, Switch and MOVE (Velligan et al., 2014; Velligan, Roberts, et al., 2015) share several features but are also distinct on many levels. First, MOVE is delivered in patients' usual environment (i.e. home and community), while Switch is provided in a typical mental health service environment (e.g. hospitals, day-care centres). Second, MOVE targets all negative symptoms, both expressive and motivational deficits. The Switch intervention focuses on the latter, as motivational deficits best predict functional outcomes and quality of life (see Chapter 1). Third, MOVE and Switch have somewhat different underlying models. For this reason, the two interventions cannot be directly compared. MOVE is based mostly on a cognitive perspective (Rector et al., 2005) and aims to disrupt the maintenance of negative symptoms. Likewise, Switch includes a cognitive approach, but also the neuro-affective perspective on motivational deficits (Kring & Barch, 2014).

To address motivational symptoms, Switch and MOVE use similar but also different therapeutic techniques. More specifically, in MOVE, antecedent control (e.g. list, signs, alarms) is intended to support the initiation of behaviours. Switch uses planning strategies and various techniques to increase the likelihood of behaviour initiation, such as reminders, alarms, lists that are similar to those in MOVE, but also implementation intention (X.-J. Chen et al., 2015; Gollwitzer & Sheeran, 2006). MOVE takes a cognitive approach to *pleasure anticipation* (i.e. challenging the beliefs regarding future low pleasure), whereas Switch takes an affective and multisensory approach to it, focusing more on *anticipatory pleasure* (i.e. increasing the multisensory experience of pleasure in anticipation of future events). Additionally, MOVE uses different techniques to tackle the maintenance of (social)

withdrawal and the deterioration of functional skills, namely CBT techniques to reduce the impact of self-defeating cognitions on motivation, and social and general skill-building training. In Switch, dysfunctional beliefs are also targeted via cognitive restructuring, but also via cognitive defusion, mindfulness and acceptance techniques. As for (social) withdrawal, Switch does not propose skill-building techniques *per se*, but difficulties such as lack of skills are addressed through problem-solving strategies. If skills can be trained directly during the sessions (e.g. making calls to look for volunteering jobs), the therapist would support this. If the therapy setting does not allow it (e.g. learning how to use a washing-machine), solutions would be sought to find help outside the intervention (e.g. "who could you ask to help you with this? Can we contact this person?").

Switch has a few additional points of attention to address motivational deficits. First, compared to MOVE, Switch appears to focus more on the identification of personal goals and values, which are at the basis of the three-level model. This focus constitutes an important part of the intervention, especially at its beginning (around 5 sessions in the long version of the intervention), but also throughout the intervention. Furthermore, these personal goals and values constitute the basis of all the techniques that are used in Switch in order to attain or progress towards them. Second, along with this work on goal and value identification, self-esteem also constitutes an important target in Switch, with strengths and resources that are identified and promoted throughout the intervention. These two components, goals/values and self-esteem, represent the guiding thread throughout the Switch intervention and this might have had a powerful impact on motivational deficits.

In sum, there are a number of similarities between the two interventions, although Switch might focus more on personal goals, values and resources, and uses a sensory and emotional approach to pleasure anticipation, rather than a more cognitive approach as in MOVE. The greatest difference is nonetheless that MOVE is provided in patients' homes and community environment, whereas Switch has so far been delivered in typical mental health service environments. However, Switch could be provided in individuals' usual environment as well, with little adaptation, which would certainly enhance the effects of certain strategies by applying them directly in their home. For example, the therapist could encourage the placement of visible cues in appropriate rooms to increase the initiation of a certain action-plan, as it is done in MOVE, or encourage the display of memorabilia and photos to increase positive reminiscence.

In terms of the efficacy of MOVE, it has been shown that improvements on negative symptoms in individuals with persistent negative symptoms were quite small. The reason for this is unclear. A hypothesis is that MOVE, by focusing on the maintenance loop of negative symptoms and on cognitive features of negative symptoms, targets more secondary negative symptoms. It is difficult to compare the efficacy of MOVE and Switch in terms of the magnitude of their effect, as the designs of the different studies were very different. However, the clinical meaningfulness of the results can be appraised. In their RCT, the participants assigned to the MOVE intervention saw their negative symptoms

reduce only after nine months, and the reduction was very small in magnitude, going from around 3 to 2.85 on the NSA (which ranges from 1 to 6). Plus, they did not find any significant effects on the BNSS total score. Looking at secondary analyses that were performed on the BNSS (D. Velligan, personal communication, July 2016), no significant effects on the motivation subscales of the BNSS were observed. However, there was a between-group effect at trend-level regarding the anhedonia subscale (the score in the MOVE group went from 2.98 at baseline to 2.68 at the 9-month assessment). As a reminder, after 6 months of the Switch intervention, participants showed moderate to large improvements on the BNSS-Motivation subscales (see Study 1: Supplementary Material, 2.1.2. Results). Note also that on the basis of the BNSS motivational subscale, our participants seem to have more severe symptoms at baseline, compared to the sample in the MOVE trial.

In sum, in Study 1, based on a small sample and a pre-post design, Switch appears to have a greater benefit than the MOVE programme. This could possibly be explained by the greater emphasis on personal goals and values, as well as by the training of positive projection into the future with a focus on sensory and emotional features. MOVE focuses more on antecedent control and skill training, which might not be enough to reduce anhedonia and increase intrinsic motivation to engage in meaningful activities.

1.4.2. Positive Emotions Program for Schizophrenia (PEPS)

The PEPS intervention (Favrod et al., 2015; Nguyen et al., 2016) aims to reduce anhedonia and motivational deficits, but has a particular focus on the former with a clear goal to augment the experience of positive emotions. As a reminder, this intervention is mostly based on the temporal course of emotion (Kring & Elis, 2013), i.e. the affective model of motivation in schizophrenia, but also incorporates a cognitive perspective (Rector et al., 2005) with an added focus on dysfunctional beliefs. Thus, PEPS and Switch have very similar foundations. However, PEPS is exclusively administered as a group intervention, while Switch is offered in both individual and group settings. Furthermore, PEPS is very short, with 8 one-hour group-sessions, compared to 16 two-hour sessions in the group version of Switch. In terms of content, both PEPS and Switch propose strategies to enhance savouring skills in the three temporal orientations (in-the-moment enjoyment, anticipatory pleasure, and positive reminiscence). Compared to MOVE, these two interventions address anhedonia on a more affective and sensory level, rather than on a cognitive level. However, dysfunctional beliefs (which can also include negative thoughts regarding future pleasure) are also addressed in both PEPS and Switch. In the former, these thoughts are mostly addressed with cognitive restructuring techniques (e.g. generating alternative, more positive thoughts) applied to the thoughts of the two fictive heroes of the programme. In Switch, cognitive defusion is another technique that is used to alleviate the impact of dysfunctional thoughts. Furthermore, Switch uses these techniques mostly by applying them to participants' reported thoughts. Additionally, Switch focuses also on the

identification of and progress towards personal goals and values, and includes techniques to train planning, problem-solving and initiation skills that are not addressed in PEPS.

It is difficult to compare the effectiveness or efficacy of Switch with PEPS, as the latter has been validated in larger, more controlled settings (Favrod, Nguyen, Chaix, et al., 2019), and using different scales for the measurement of the main outcomes. Furthermore, the formats of the interventions differ. However, some general observations can be drawn.

Both interventions (regardless of format and length) have shown to be beneficial for the overall motivational domain of negative symptoms. Looking at the subscales of the SANS, Favrod and colleagues found significant and moderate improvements on both anhedonia and avolition in their pilot study (Favrod et al., 2015) and their field test (Favrod, Nguyen, Tronche, et al., 2019). However, in their randomised control trial (Favrod, Nguyen, Chaix, et al., 2019), they reported that this general improvement was mostly driven by reduction in anhedonia, rather than in avolition.

In the studies evaluating Switch, the BNSS was used to evaluate the change in motivational deficits. We found that all three subdomains of motivational negative symptoms – anhedonia, avolition, asociality – improved, although in the pilot study, only improvements in the anhedonia subdomain were maintained with large effects, while the effects on asociality and avolition became insignificant or small to moderate in magnitude. However, in the group version of Switch, participants showed improvements on all three-subscales, but the improvement on anhedonia was not maintained at follow-up. Of course, the latter study included a very small number of participants, and general conclusions cannot be derived from its results.

Regarding results found on the SBI, in the different studies evaluating PEPS, there seems to be a consistent small to moderate effect on the present-moment (or consummatory) pleasure subscale (Favrod, Nguyen, Chaix, et al., 2019; Favrod, Nguyen, Tronche, et al., 2019), which appeared nonetheless only at follow-up in the randomised control trial. There were no or only small effects of PEPS on the anticipating and reminiscing pleasure subscales of SBI. In our pilot Study (Study 1), only moderate improvements were found on the anticipating subscale after six months of intervention, which were not maintained, and small to moderate improvements on present-enjoyment were found after 12 months of intervention and at follow-up. As discussed earlier (see Chapter 2, section 1.3.4. Beliefs about future pleasure), the SBI evaluates the attitudes regarding savouring, i.e. beliefs and to a lesser degree the ability to savour, and might therefore not be entirely suitable for evaluation if individuals are actually developing these savouring skills. Using ESM, we evaluated if participants were actually reminiscing and anticipating future pleasure events. In the group intervention (Study 3), we found these two processes improved the most over the course of the intervention.

With three validating studies, PEPS has proven to be an invaluable intervention to improve motivational negative symptoms, and mostly anhedonia, in a very short time. As for Switch,

several studies have obtained preliminary evidence for its efficacy and effectiveness in improving all three types of motivational deficits, albeit using a longer intervention. Both interventions focus on experiential deficits and offer therapeutic tools to increase the experience of pleasure while remembering past pleasant events, projecting into the future, and enjoying the present moment. The strategies used in both interventions make use of emotions and multiple senses, which might be a key ingredient to alleviate motivational – or "experiential" – negative symptoms. It remains to be clarified whether the addition of the several strategies provided in Switch that focus on goal-progress and attainment (i.e. identification of goals and values, problem-resolution, planning, initiation) have an added value for the reduction of motivational negative symptoms.

1.4.3. Other interventions

In the last few years, a number of psychological interventions have been tested for their efficacy in reducing negative symptoms, although they were not originally designed to address them. These include CBT (Staring et al., 2013), social skills training (SST; Granholm et al., 2014) and behavioural activation (BA) (K.-H. Choi et al., 2016) (see Chapter 3). Compared to Switch, these interventions have different underlying assumptions and goals regarding the treatment of negative symptoms. A systematic comparison of Switch with these interventions therefore does not seem appropriate. However, a few points are worth highlighting.

In accordance with the cognitive approach to negative symptoms (Rector et al., 2005), CBT aims to reduce dysfunctional attitudes that are thought to hinder motivation. Most of the CBT interventions tested for their efficacy to reduce negative symptoms have included therapeutic strategies that aim to challenge dysfunctional beliefs with cognitive restructuring and behavioural experiments (e.g. Staring et al., 2013). The Switch intervention integrates this approach, although it goes beyond the cognitive approach by addressing neuro-affective dysfunctions that are believed to also affect motivation. For instance, Switch not only targets expectancies of low pleasure but also trains anticipatory pleasure by using multisensorial imagery. Numerous trials have evaluated the efficacy of CBT but meta-analyses indicate no consistent evidence for CBT improving motivational negative symptoms (Veerman et al., 2017; Velthorst et al., 2015).

With the aim of reducing interpersonal deficits, SST has shown to significantly reduce negative symptoms (Lincoln & Pedersen, 2019; Turner et al., 2018). The strategies used in SST usually include role-play, for example, or modelling with the aim of enhancing verbal and non-verbal communication, improving assertiveness, reducing social distress, and promoting adequate responses according to the social context. In trials that specifically investigated the effects of social skills training on negative symptoms, SST was merged with CBT techniques (CBSST; Granholm, Ben-Zeev, & Link, 2009). In fact, defeatist attitudes were shown to mediate the effect of CBSST on motivational negative symptoms and

functional outcomes (Granholm et al., 2018). It is nevertheless unclear if the benefits that were found on negative symptoms result from improved social skills and therefore more positive social experiences, or decreased dysfunctional beliefs (Granholm & Harvey, 2018). Compared to the Switch intervention, SST offers a completely different approach to the treatment of motivational negative symptoms. However, some mechanisms of change might overlap, as defeatist beliefs are targeted in both approaches.

The goal of BA is to increase the engagement in rewarding activities, decrease the engagement in activities that maintain depression and to reduce avoidance behaviours (Dimidjian, Manuel, Martell, Muñoz, & Lewis, 2011; N. S. Jacobson, Martell, & Dimidjian, 2001; Lejuez, Hopko, Acierno, Daughters, & Pagoto, 2011). The main ingredients of BA are psychoeducation regarding how depression works, activity monitoring (i.e. listing of all activities undertaken during the day), identification of important life domains and personal values, and activity planning (i.e. selection of rewarding activities that meet personal values) (Blairy & Wagener, 2018). There are, however, different existing protocols, some of which include different strategies such as problem solving, social skills training, rewards, and implementation intention (Dimidjian et al., 2011). Given the variety of protocols that have been used, it is difficult to compare BA to the Switch intervention. However, despite different underlying theoretical models, both interventions have similar aims, with an important focus on improving quality of life. Thus, both emphasize the work on personal values and on the engagement in actions and activities that will fulfil these values. Both approaches also use strategies to insure the initiation of the action plan. There is little more to say about the efficacy of BA for schizophrenia than what was already mentioned in Chapter 3 (see 2.2 Behavioural activation): there is to date only limited evidence for the positive effects of BA on motivational negative symptoms. Future studies are required to investigate the efficacy of BA and its mechanisms of change in individuals with schizophrenia.

In summary, looking at these different cognitive and/or behavioural approaches, there appear to be different paths to treat negative symptoms, each with varying degrees of success. The positive effects that CBT and CBSST have on negative symptoms suggest that changing dysfunctional attitudes, such as defeatist performance or asocial beliefs, is a key ingredient. However, the few studies (Granholm et al., 2018; Staring et al., 2013) that have looked into mediators of change only included dysfunctional attitudes in their analyses of mediation. Furthermore, the results indicated that these dysfunctional attitudes only partially mediate the reduction in negative symptoms. Thus, other mechanisms of change are at play and need to be uncovered. For instance, another mechanism of change could be behavioural activation, which would lead to positive experiences that could precede the change in dysfunctional beliefs. However, other ingredients might also be necessary to positively impact motivational deficits. An increase in hedonic capacities, for example, improvement in value representation, or increased focus on personal values might be necessary for change. Most likely and as suggested in our model, different mechanisms

interact and might be necessary to create a positive effect on motivation and engagement in meaningful and life-changing goals.

2. Strengths and limitations

2.1. Switch

The Switch intervention encompasses several strengths. First, it was specifically designed for the treatment of motivational negative symptoms, i.e. the symptoms that are known to represent important barriers to functional outcomes (Blanchard et al., 2017; Mucci et al., 2019) and quality of life (Savill et al., 2016). Second, its development was based on a comprehensive model of motivation, incorporating both cognitive (Rector et al., 2005) and neuro-affective (Kring & Barch, 2014) perspectives, as well as components of general motivation theories (Deci & Ryan, 2000). The result is a multi-factorial intervention, which uses various strategies that target the cognitive, affective and behavioural processes identified in the model. Additionally, the Switch model offers a practical "compass" to guide motivation and goal-directed behaviours, for both therapists and participants (or patients, clients, users). Third, the different strategies used in Switch are applied in an individualised manner, to serve individuals' goals, values and needs. Furthermore, provided there is access to a smartphone and an appropriate ESM app, the intervention can be "taken home", with the use of prompts in individuals' daily life (i.e. ecological momentary intervention). Fourth, the intervention can be delivered either in individual or group settings, adapting to clinical needs and requirements (e.g. group format in short hospital stays). Finally, as the model for the Switch intervention encompasses several processes that are also impaired in other diagnoses (e.g. major depressive or bipolar disorders), it may also be useful as a transdiagnostic therapeutic intervention. This is important, as Switch therapists would not only be trained to provide an intervention for individuals with one exclusive disorder, but for an intervention that will be useful for a wide category of difficulties.

The drawback of the multifactorial nature of the Switch intervention is its complexity. First, it takes time to teach the different modules or strategies of the intervention. Around 16 sessions were considered to be the minimum. Furthermore, some of our findings show that the more sessions, the higher the benefit (see Study 3: Supplementary material). Second, from the participants' perspective, the different modules represent many components to learn and remember. Third, from a therapist perspective, the Switch intervention requires extensive training and supervision.

That said, these limitations are not insurmountable. Regarding the length of the intervention, the different strategies taught in Switch could be continued by using EMI after a short version of face-to-face intervention. This blended-care approach has become more and more common (e.g. Schlosser et al., 2018; Vaessen et al., 2019; van Aubel et al., 2020) and, with the wide and accessible use of smartphones, it may soon leave the research

setting and be used in the clinical field. Such an approach would also leave more time for participants to learn and remember the different strategies. Moreover, using the different techniques in real-life environments would likely increase learning retention, thus addressing the second issue regarding memorising. Concerning the latter issue, Switch included different retention strategies, for example, the use of reminder cards which briefly explained how to use the different key strategies. Furthermore, the Switch model can itself be used as a reminder of the various strategies. Progressively, participants were invited to "navigate" the model themselves and identify what they could put in place to help boost their motivation and progress towards their goals. Finally, as for the therapists' intensive training, it may represent a cost (i.e. in terms of time and finance) but is mainly an asset. After being trained for providing the Switch intervention, therapists become more knowledgeable about the very important and transversal topic of motivation, and for which impairments are very common across diagnoses (e.g. major depressive or bipolar disorders) and in the general population (e.g. procrastination). Furthermore, the mastering of the practical model (the "Switch compass") provides an overall view of an individual's difficulties and resources and can be very useful for therapy. Thus, it helps easily identify what to target and how to manage it, and to always keep in mind two fundamental elements, i.e. goals and values, as well as self-esteem. The compass promotes resilience when faced with participants' difficulties, while keeping personal goals and values in sight.

Another difficulty regarding the Switch intervention that was commonly experienced by the therapists concerned participants' personal goals and values. First, it was sometimes difficult to identify one or two meaningful goals and values. While some participants seemed to know quite clearly where they wanted to go, for others this seemed to be previously unexplored territories. For the latter, what they wanted for themselves appeared to be a question that had long not been asked. Moreover, some goals identified by participants appeared to be imbued with social pressure or social desirability (e.g. "I want to find a good job", "I need to find a wife and build a family"). Thus, it was necessary – and sometimes quite a challenge – to disentangle what could be meaningful goals that would satisfy *their* personal values and not values of their families or medical staff. Switch conveys a set of different tools to explore personal goals and values (see Chapter 4, 2.2.1. Personal goals and values). One advantage of our approach is that participants generally realise that there is a wide range of goals that they could progress towards, opening the realm of possibilities and eliciting hope. However, the difficulty was then to pick a goal that would both bring a significant change in their lives and be attainable.

Second, another difficulty was to follow the same one or two goals from the beginning to the end of the intervention. Participant priorities changed, making it difficult to maintain direction. A solution to this was to focus mainly on values, which can be experienced in everyday life through many small, different, but accessible actions or goals. For instance, the value of autonomy can be supported not only by the huge goal of moving into an independent apartment – which may be hard to reach and not necessarily under the person's control – but for example by cooking, cleaning or managing a budget

independently. In sum, goal-progress or goal-attainment seemed in some cases to go astray. Even if it allowed all participants to use different Switch strategies and progress in various life domains, for some it seemed that no domain was improved in a meaningful way. This might explain why we found benefits on daily functioning, but not consistently on quality of life. Perhaps Switch could target specific themes that provide a clear direction from the start of the intervention. Selected themes could be the related life domains that are known to be related to quality of life or that are particularly affected in individuals with schizophrenia, for example social relationships and physical health. These suggestions will be discussed below (see 3.1. Improvement of the Switch intervention).

2.2. Methodology

The studies that evaluated the efficacy and effectiveness of the Switch intervention possess many strengths, most of which address limitations of previous studies that evaluate the efficacy of interventions for the treatment of negative symptoms.

First, in all three studies, we used the BNSS (Kirkpatrick et al., 2011) which represents a state-of-the-art measurement for negative symptoms. In most studies – even recent ones – that have evaluated the effects of interventions on negative symptoms, older scales (e.g. PANSS, SANS) that do not appropriately measure the different dimensions of negative symptoms have been used (see for example the following reviews: Fusar-Poli et al., 2015; Lutgens et al., 2017). On the contrary, the BNSS evaluates separately the motivational and expressive dimensions of negative symptoms and incorporates the evaluation of the person's subjective experience (i.e. feelings of pleasure, interest, motivation), as recommended by the NIMH-MATRICS consensus on negative symptoms (Kirkpatrick et al., 2006). The use of a recent scale was essential to evaluate the particular effects of Switch on motivational deficits in particular.

Second, we included measures of daily functioning and subjective quality of life, as their enhancement is the ultimate goal of the Switch intervention. Functional outcomes and quality of life are not commonly considered in clinical trials (Laws, Darlington, Kondel, McKenna, & Jauhar, 2018; Valiente, Espinosa, Trucharte, Nieto, & Martínez-Prado, 2019). Most focus exclusively on symptom change, while it is well established that symptom remission is only part of functional recovery (Lahera et al., 2018).

Third, we included follow-up assessments between 3 and 6 months after the end of the intervention. Most of clinical trials only include post-intervention evaluations, which test short-term efficacy of a treatment (Veerman et al., 2017). Long-term evaluations are required to evaluate the maintenance or development of improvements (i.e. certain changes may sometimes appear later, after a gestation period).

Finally, in the second and third studies, we followed an innovative approach with the use of repeated, ambulatory measurements, i.e. ESM and actigraphy, to explore the dynamics

of motivation and related behaviours in the daily lives of participants. These ambulatory assessments have a number of qualities that are worth focusing on.

Ecological momentary assessment (EMA) or ESM using smartphones have a number of advantages (Myin-Germeys et al., 2009; Shiffman et al., 2008). First, the approach is ecological in the sense that the evaluation takes place in the person's natural environment, allows the collection of a sample of the measured phenomenon in various situations (i.e. different activities, places, social contact) rather than only the laboratory context, and thus encompasses the context of the person evaluated. Second, emotions, cognitions and behaviours are evaluated in-the-moment and are thus not subject to retrospective biases. Third, given the repeated evaluations, ESM can capture the intra-individual dynamics of the measured phenomenon. Analyses on the resulting longitudinal data can reveal the variability, or on the contrary, the stagnation of certain variables, as well as the conditions in which change can occur. Thus, ESM could provide a high-definition evaluation of the dynamics through which change appears. This is essential in the exploration of mechanisms of change and in the development and refinement of psychotherapeutic interventions. The studies that we conducted are a first step in that direction and future studies should continue using an ESM approach to reveal how change arises.

Actigraphy is another kind of ambulatory assessment with many advantages. First, it is an objective evaluation of activity which is unaffected by memory biases, low insight, social desirability or clinical judgment (Trull & Ebner-Priemer, 2013). Second, the use of an activity watch or pedometer is non-invasive, accessible and affordable (Gupta et al., 2014). Third, it is a passive evaluation in the sense that the person does not need to be proactive for the measure to be taken (i.e. they just need to wear the electronic device); it might therefore be less affected by motivational deficits. Finally, the use of step-count can be considered an appropriate proxy measure of motivational negative symptoms (Gupta et al., 2014; Kluge et al., 2018).

In Study 2, Study 3 and Study 4, we used a questionnaire that was specifically designed for the purpose of these studies. The questionnaire included items that related to almost all of the processes that are included in our model and targeted in the Switch intervention. Such an approach is quite novel. In the context of case studies, the use of individualised assessment scales is common, with the selection of items that are relevant for the patient's therapeutic goals. However, a questionnaire that is precisely designed to evaluate the different mechanisms targeted by an intervention is rare but has important benefits for the understanding of how the intervention may work. Future studies would benefit from using continuous assessment such as ESM before, but also *during* the intervention, in order to develop hypotheses on the time course of change and how mechanisms of change evolve. This would apply to group analyses, but also to single-case designs (Bentley et al., 2019), as we did in Study 3 and Study 2 respectively.

There are obvious limitations regarding our methods, such as the small sample sizes, and the absence of a control group and a randomisation procedure in the pilot study (Study 1).

This is nonetheless a necessary step before dedicating more resources in a more complex study design. Future studies should evaluate the efficacy of Switch in larger samples and using a more controlled setting. This would also allow the use of various statistical analyses that would result in more solid conclusions. For instance, in an RCT, mixed-effects regression with repeated measures analyses could be conducted to evaluate group differences over time, by treatment group (Switch *vs.* active control group), and with baseline symptoms (negative, positive and depressive) as covariates.

Regarding the Study 2 and Study 3, as intensive longitudinal measures have seldom been used in the way we did (i.e. throughout the intervention), the available analyses (e.g. vector autoregressive models) did not allow us to capture the *changing* dynamics between the variables we measured. Therefore, the mechanisms of change of the Switch intervention could not be appropriately evaluated. Furthermore, some more complex types of analyses (e.g. Time-Varying Autoregressive Models) require a high number of observations (> 100) per participant, which were not collected in our various samples. Future studies should consequently ensure the collection of sufficient data by increasing the prompting-schedule (Eisele et al., 2020) and the adherence to the evaluation protocol (e.g. by giving monetary incentives).

Finally, the ESM questionnaire developed for Study 2, Study 3 and Study 4 may be limited by its uniqueness. Indeed, as the questionnaire was specifically designed for the evaluation of our model, it cannot be directly compared with the results found in other studies using ESM or traditional assessments scales. Additionally, we did not evaluate its convergent validity with validated measures of negative symptoms (e.g. BNSS) and related processes (e.g. DAS, SBI). To date, there has been little work conducted on the validation of ESM questionnaires or ESM items (Wright & Zimmermann, 2019)[27]. Regarding our ESM questionnaire, future studies should collect data in a sufficient number of participants in order to first evaluate the factorial structure of this particular ESM questionnaire, and second evaluate the association between the resulting factors and validated measures that would be the most appropriate to reflect these factors (e.g. the subscales of the BNSS, the subscales of the SBI, the DAS). That said, the findings from the network analyses in Study 4 suggest that we succeeded in evaluating a coherent complex of variables related to motivation and goal-directed behaviours, as revealed by the number of pertinent associations between the different items.

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[27] An open-access ESM repository (Kirtley et al., 2019) has recently been created with the aim of conducting a psychometric validation of ESM items. See https://www.esmitemrepository.com/

3. Future directions

3.1. Improvement of the Switch intervention

After evaluating the Switch intervention across multiple studies, a few changes may enhance its efficacy and effectiveness. These changes concern on the one hand the content of the intervention (i.e. what is delivered), and on the other the format of the intervention (i.e. how it is delivered).

3.1.1. What is delivered

Switch comprises an extensive set of strategies which are all believed to play a role in the enhancement of motivation and goal-directed behaviours. However, an increased focus on certain strategies could be more beneficial. This could be driven by both nomothetic (i.e. between-subjects) or idiographic (i.e. within-person) approaches. Furthermore, the personal goals and values that are that are the main focus of the intervention could link to particular themes in order to channel efforts in one direction.

First, the focus on particular therapeutic strategies in Switch could be informed by results derived from group analyses (i.e. the nomothetic approach). In Study 4, the network analyses conducted on the group-level showed that reminiscence and anticipation were the most influential variables, and predicted later motivation and engagement in more effortful activities. These results were found in a small sample and would need to be replicated. Nonetheless, they corroborate the findings from the neuro-affective approach to motivational deficits in schizophrenia (Kring & Barch, 2014). Conversely, dysfunctional beliefs in these network analyses appeared to have only a marginal role which runs against a strong body of scientific literature that finds dysfunctional beliefs to be related with negative symptoms (for a review, see Campellone, Sanchez, & Kring, 2016). Dysfunctional beliefs are quite spontaneously targeted in the Switch intervention, as these thoughts are noticeable and are a source of complaint. On the contrary, individuals rarely complain about a lack of savouring skills, as their absence is – by definition – not noticeable, and as individuals do not necessarily realise the benefit of savouring. It is therefore important to first emphasize the importance of savouring (past, present, future events), and second to train these abilities more and more formally (i.e. increasing the use of imagery, for instance, or of a diary). In the group version of Switch (Study 3), given the predetermined format of the programme, formal exercises were planned at each session to improve projection into the future and reminiscence. Moreover, participants were prompted via an app on their smartphone to take a minute or two to project themselves positively into the future and to reminisce about past positive events. In this study, these savouring abilities showed the largest improvements according to the results from the ESM questionnaire. These results from Study 3 and Study 4 underline the particular importance of these savouring skills. Future application of the Switch intervention should take this into account and insist on the training of positive future projection and reminiscence, at least in group interventions.

Second, in individual settings, the Switch intervention could be further refined by tailoring it to the person's particular profile (Bastiaansen et al., 2020). This profile could be appraised for example through the estimation of personalised network models (Epskamp, van Borkulo, et al., 2018) based on data collected through an ESM baseline. Such an idiographic network model could guide the intervention. Indeed, network analyses can produce information regarding the centrality of certain processes, i.e. their particular influential role on the other elements of the network. Thus, if these influential processes are addressed by the appropriate therapeutic strategy, their improvement may extent to other elements in the model. In Study 2, we showed how network models differed between participants and how it could possibly be used to further individualise treatment. Such an individualised approach based on network analyses still needs to be validated (Bortolon & Raffard, 2019).

Third, as suggested earlier, Switch could focus on particular themes that are important for a satisfying and meaningful life. Narrowing the focus of Switch on a particular theme would help participants identify and select their personal values and goals. Furthermore, and consequently, a narrower focus may improve the progression towards these particular goals, as the direction would be clearer. Many themes could be approached, but two themes appear particularly important for quality of life: physical health and social relationships. According to a recent meta-analysis, quality of life in individuals with schizophrenia is much lower compared to healthy controls, especially regarding physical health and social relationships (Dong et al., 2019).

Switch could have the particular aim of improving physical health, for instance, through the increase of physical activity. This would be important for various reasons. First, as reported in several meta-analyses (Ohi et al., 2019; Stubbs et al., 2016), individuals with schizophrenia are less physically active, particularly when negative symptoms are present (Gorczynski, Vancampfort, & Patel, 2018). Furthermore, this low physical activity has an impact on health, with consequences such as obesity, diabetes, and consequently higher morbidity (Sicras-Mainar et al., 2014). Second, physical activity is an important factor of both physical and mental health. Recent reviews and meta-analysis (Dauwan et al., 2016; Girdler, Confino, & Woesner, 2019) indicated that physical exercise has many benefits for individuals with schizophrenia spectrum disorders, namely regarding negative symptoms, quality of life, functional outcomes and depressive symptoms. Furthermore, increasing physical activity could alleviate the unwanted side effects of antipsychotic medication such as putting on weight (Bredin, Warburton, & Lang, 2013). Thus, there are important reasons for the promotion of physical exercise in individuals with schizophrenia, both in terms of the reduction of adverse effects of lack of physical activity and in terms of the varied benefits that physical exercise brings.

With respect to interventions, physical exercise programmes have been used in schizophrenia and have shown benefits in reducing negative symptoms (Dauwan et al., 2016; Firth et al., 2015). However, effort is still needed to enhance motivation and adherence towards engaging in physical activity (Tréhout & Dollfus, 2018). Furthermore,

in a recent study (Gorczynski et al., 2018) investigating correlates of physical activity in individuals with psychosis and diabetes, negative symptoms, low self-efficacy, and perceived barriers were associated with low physical activity. Conversely, perceived benefits of physical activity were not related with physical activity. This is not particularly surprising as value representation (i.e. in this case, the representation of benefits) has shown to be impaired in individuals with schizophrenia (Gold et al., 2008; Kring & Barch, 2014). Furthermore, as benefits of physical activity are partly long-term, the steeper value-discounting (i.e. temporal discounting) observed in individuals with schizophrenia (Bartolomeo et al., 2020; Heerey et al., 2011, 2007) may explain how awareness of the benefits of physical activity does not translate into an engagement in physical activity. In sum, the Switch intervention seems well placed to address these obstacles to physical activity. The various strategies used would be beneficial to increase self-efficacy (e.g. progressive increase of physical exercise), to emphasize the salience of the benefits of physical activity (e.g. working on personal goals and values; using multisensory imagery before and after the exercise), and to reduce barriers through problem-solving and initiation strategies.

Focusing on enhancing social life through the Switch intervention would be another important target for several reasons. First, asociality (i.e. social anhedonia, motivation and withdrawal) is highly prevalent in individuals with schizophrenia (Sauvé et al., 2019). Second, social disconnection or isolation is the norm rather than the exception in this population (Green et al., 2018). Social disconnection represents an objective and long-standing lack or reduction of social and family relationships, and of participation in social events. Third, loneliness, i.e. the subjective unpleasant feeling of social isolation, is highly prevalent and an overlooked complaint in individuals with schizophrenia (Badcock, Adery, & Park, 2020). Thus, despite the prevalence of asociality in schizophrenia, the prevalence of loneliness in this population suggests that they have a need and a desire for social connectedness (Barkus & Badcock, 2019). Asociality may therefore better reflect a diminished pleasure derived from social interactions rather than a lack of interest in social connectedness. This diminished social pleasure may then lead to social withdrawal and poorer social functioning (Badcock et al., 2020). Finally, these social dysfunctions (i.e. social anhedonia, isolation and loneliness) have been reported to have adverse consequences on both physical and psychological well-being (Fulford, Campellone, & Gard, 2018). Thus, it appears essential to increase positive social interactions in individuals with schizophrenia and to reduce the feeling of loneliness.

Within the domain of social interactions, interventions have generally targeted social skills (e.g. Granholm, Holden, Link, & McQuaid, 2014) and social cognition (Roberts et al., 2014), which have not always translated into better social functioning (Javed & Charles, 2018; Roberts & Velligan, 2012) and reduced loneliness (Lim, Gleeson, Alvarez-Jimenez, & Penn, 2018). Furthermore, recent studies have shown that social cognition performances (e.g. theory of mind, emotion recognition) were not associated with neither the quantitative nor qualitative aspects of social interactions in daily life (as measured with ESM) (Janssens

et al., 2012; Schneider, Myin, & Myin-Germeys, 2020). Another recent study suggested that social interest might be a more important determinant of social engagement and competence, whereas social cognitive skills might have a limited impact (Thomas et al., 2017). Finally, another study found no significant correlation between social cognition deficits and loneliness in individuals with schizophrenia (Trémeau, Antonius, Malaspina, Goff, & Javitt, 2016). These findings highlight the importance of targeting processes other than social (cognitive) skills, such as affective and motivational processes, with the aim of enhancing social interactions and reducing loneliness (Lim et al., 2018; Trémeau et al., 2016). The Switch intervention is an appropriate approach to promote positive social interactions as it could emphasize the motivational and hedonic aspects of social interactions. For instance, the work on personal goals and values could accentuate the motivational salience of building meaningful relationships. The module on self-esteem could alleviate self-stigmatisation that contributes to social withdrawal and a feeling of loneliness (Badcock et al., 2020; Chrostek, Grygiel, Anczewska, Wciórka, & Świtaj, 2016). The use of multisensory imagery could foster the positive projection into future social events, thus increasing pleasure anticipation and anticipatory pleasure. This would contribute to reducing anhedonia which has shown to be associated with loneliness (Badcock et al., 2015). Thus, the Switch intervention could offer an alternative or an adjunct intervention to existing approaches that aim at improving social skills and social cognition.

3.1.2. How it is delivered

Switch was given through face-to-face group or individual sessions within participants' usual care facilities. There are nevertheless other options worth exploring, namely providing Switch in individuals' home or community, as well as the use of electronic strategies.

First, as discussed earlier, the Switch intervention could be provided in individuals' home and community environment, as was the case for the MOVE programme. On top of the advantages already mentioned (see Chapter 3, 3.1. The MOtiVation and Enhancement (MOVE) program), it is important to note that such an approach aligns with the aims of the most recent reform of mental health services in Belgium: "Projet 107"[28]. In brief, and among its various goals, this reform aims to intensify ambulatory treatment, reduce hospitalisations and increase mental health services provided directly in the users' usual place of living. Thus, the Switch intervention delivered directly in people's home and community could contribute to this initiative and help to reduce the length of hospitalisation (see for example Chang & Chou, 2015). Furthermore, as negative symptoms are associated with a higher probability of hospital admission, a longer duration of hospital stays and a higher probability of readmission following discharge (Patel et al., 2015),

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[28] For details, see http://www.psy107.be/.

providing Switch in a home or community environment may further support a preventive approach.

Second, the growing use of smartphones also enables the extension of therapeutic interventions in individuals daily-life and natural environment, i.e. via the use of EMI. Switch already relies on EMI to increase the likelihood of participants using multiple strategies outside of the therapeutic context by prompting them in a *systematic* way, with the same notification sent to all participants at the same time (e.g. inviting them to reminisce about past positive events). However, new technologies and the use of algorithms could possibly increase the individualisation of EMI to individual needs, when and where these needs emerge. Individualised EMI would then involve suggesting a particular therapeutic strategy for a particular situation. There are two types of situations that could lead to *individualised EMI*: self-initiated or automated.

Self-initiated EMI would take place when, faced with a particular difficulty, a user would enter the ESM/EMI app, signal the difficulty in question and receive an appropriate tool to tackle the problem. For example, a person would like to go out for a coffee but does not have enough money for the trip to the city nor the hot drink. The app could propose the use of a problem-solving strategy. This approach is highly individualised and represents just-in-time intervention. However, given the nature of negative symptoms, it is likely that users would not use the app on their own initiative, not only because of initiation difficulties *per se*, but also because they might be less engaged in situations that could be problematic. For instance, there might be no problem or difficulty that arises if the person stays at home watching TV. Automated prompts, as well as systematic prompts, could thus be useful.

Automated EMI or activity-triggered EMI would rely on an objective, passive measure of a particular behaviour. For example, using actigraphy, users could be prompted (via a dedicated ESM/EMI app) when they have been stationary for too long. The prompt could be a simple invitation to be active (e.g. "It's time to move!", "What activity could you do?") or lead to a list of activities previously identified by the user. Conversely, an activity detected by the wearable device could trigger a rewarding message (e.g. "Congratulations! You are being active!", "Keep going! You're doing great!") and/or invite the person to reflect on the effects that the activity produces (e.g. feeling various positive emotions, having certain thoughts), on how it relates to personal values, and on when they could engage in physical activity again. In such EMI, the user does not have to be proactive.

Finally, *systematic prompts* would invite the person to engage in various functional behaviours on a fixed schedule (e.g. every night at 8pm). The functional behaviours would include projecting positively into the future, reminiscing about past positive events, focusing on present enjoyment, planning for meaningful goals, or initiating an action-plan. The latter three would directly increase the likelihood of engaging in various activities, and therefore, the likelihood of facing difficulties. This is where the individualised self-initiated EMI becomes more useful. Thus, individualised and systematic EMI are totally complementary.

These types of EMI could begin during the face-to-face intervention and continue afterwards in order to increase the frequency of learning, the generalisability of learnings to everyday situations, and the maintenance of improvements. A major benefit of EMI is that individuals can use the ESM/EMI app continuously and independently, and it can promote the development of healthy habits (e.g. taking a minute each morning to project positively in the future, taking a minute before going to sleep to reminisce about positive events of the day). Boost sessions are nonetheless useful to maintain motivation to use this kind of therapeutic tool and to resolve potential technical issues. Furthermore, during these boost sessions, the therapist could communicate feedback based on data collected via the ESM/EMI app and discuss their implications for personal improvement.

In sum, the use of such digital technology allows a person-centred and contextualised approach to therapy (Myin-Germeys, 2020). It clearly does not replace the therapeutic relationship but offers more tools to the therapist, increases the chances that skill learning will generalise to an individual's daily life, and may enhance an individual's feeling of agency as they progress on their own.

3.2. Who else could Switch be delivered to?

Switch has been mostly provided to individuals with schizophrenia spectrum disorders. However, given the transdiagnostic nature of motivational negative symptoms (G. P. Strauss & Cohen, 2017), it seems appropriate to evaluate if the Switch intervention could be offered to individuals with other diagnoses. Furthermore, given the presence of motivational deficits in individuals at CHR (Foussias et al., 2014; Lyne et al., 2018; Sauvé et al., 2019), it seems useful to assess the efficacy of the Switch intervention for these young individuals.

In recent years there has been increased interest in the study of specific motivational dysfunctions and their underlying processes with a transdiagnostic approach (e.g. Culbreth, Moran, & Barch, 2018; Hallford & Sharma, 2019; Lambert et al., 2018). For instance, reward learning has been studied in individuals with schizophrenia, depressive and bipolar disorders (Gu et al., 2020; Whitton, Treadway, & Pizzagalli, 2015). Results indicate that similar reward processing abnormalities arise in all three diagnostic groups. However, these abnormalities seem to result from pathological mechanisms that can be both common to different diagnoses (e.g. blunted reward anticipation in schizophrenia and depressive disorders) or unique to a particular disorder (e.g. reward hypersensitivity in bipolar disorder). Such findings indicate that psychotherapeutic intervention such as Switch might be beneficial for different diagnostic groups, while at the same time, certain adaptations might be required to target specific dysfunctions in certain diagnostic groups. For example, if individuals with bipolar disorder appear to be hypersensitive to rewards, emphasizing losses when making decisions might be an essential adjunct. More studies are needed to evaluate the different pathological mechanisms that result in motivational deficits in various

diagnoses, and to assess the appropriateness of providing a psychotherapeutic intervention such as Switch with a transdiagnostic approach.

A transdiagnostic approach to the treatment of motivational deficits is also important for practical reasons. In real-life settings, for example in psychiatric day care centres, selecting patients based on their diagnoses to build a therapy group is not always feasible nor appropriate. Diagnoses are not always used nor known by the patients themselves, and some patients might be left out if group interventions were based on diagnosis. The effectiveness of psychological interventions should therefore be evaluated for broader populations.

As for the use of the Switch intervention in individuals at CHR, it seems interesting for at least four reasons. First, as mentioned before, motivational deficits appear even before the onset of psychosis (Foussias et al., 2014; Lyne et al., 2018; Sauvé et al., 2019). Second, motivational deficits have been associated with worse functional outcomes even in individuals at CHR (W. C. Chang et al., 2018; Gerritsen et al., 2020; Glenthøj et al., 2020). Third, these symptoms are believed to be possible causal factors of the transition to psychosis (Fulford, Piskulic, et al., 2018; Healey et al., 2018; Velthorst et al., 2009; T. Zhang et al., 2020). Finally, a recent review on the prevention of psychosis underlined the lack of effective interventions for individuals at CHR. Interventions aiming at preventing the transition to psychosis and at ameliorating outcomes in individuals at CHR need to be validated. Switch could therefore be evaluated in terms of its efficacy in reducing motivation deficits and enhancing functional outcomes in this particular population, but also as a preventive approach in reducing the transition to psychosis.

4. Conclusion

Motivational negative symptoms are prevalent and are highly disabling symptoms of schizophrenia. They appear even in the prodromal phase of the illness. Furthermore, they represent an important barrier to functional outcomes and quality of life. For these reasons, the goals of this doctoral project were to develop and validate a psychological intervention that could alleviate these symptoms in a meaningful way. Thus, a first objective was to develop a model of motivation and goal-directed behaviour in schizophrenia that could integrate the complexity of the processes at play while providing a practical tool for therapists and patients. The three-level, multifactorial model thus combines both the cognitive (Rector et al. 2005) and neuro-affective (Kring and Barch 2014) perspectives, as well as elements of general motivation theory (Deci and Ryan 2000; Schwartz and Bilsky 1990). A second objective was to design an intervention based on this three-level model. The Switch intervention addresses all the elements of the model, using various therapeutic strategies previously validated in individuals with schizophrenia or in other populations. However, Switch does not merely compile a set of tools but sharpens them so as to tackle the exact dysfunctions that are observed in motivational deficits in schizophrenia. The final

objective was to provide a preliminary validation of the efficacy and the effectiveness of Switch, delivered in individual and group settings.

The first three studies of this thesis offer preliminary evidence for the efficacy and effectiveness of Switch in reducing motivational deficits, as well as in ameliorating functional outcomes and possibly quality of life. Furthermore, results from these studies indicate that Switch may also have positive effects on the cognitive processes but above all on the affective processes identified in the model. The contemporary network model computed in the fourth study highlights the importance of energy levels and confidence for concurrent motivation. Furthermore, in the temporal network model, positive reminiscence and positive projection into the future both predicted later motivation and engagement in effortful activities. In both network models, discouraging cognitions had a peripherical role in motivation and in the engagement in more effortful and meaningful activities.

Together these four studies provide preliminary evidence that Switch is a promising psychotherapeutic intervention that may increase motivation and guide individuals with schizophrenia on a more enjoyable and meaningful path, and emphasise the benefits of integrating various processes, with a particular focus on hedonic capacities. Future studies are nonetheless necessary to further investigate mechanisms of change. The continuous use of ambulatory assessment before, during and after the intervention is recommended to better understand when and how change occurs. Moreover, future trials in larger samples and more controlled settings, as well as field tests, would further validate the efficacy and effectiveness of Switch in individuals with schizophrenia and potentially other populations.

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