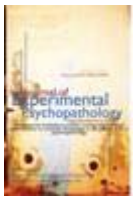
Journal of
Experimental Psychopathology
JEP Volume 8 (2017), Issue 3, 214-240
ISSN 2043-8087 / DOI:10.5127/jep.052715



Checking heterogeneity and its relationships with action identification level

[a,b,c]Belayachi, S., [a,b]Van der Linden, M.

[a] *Department of Psychology: Cognition and Behaviour, University of Liège, Liège, Belgium*

[b] *Department of Psychology, University of Geneva, Geneva, Switzerland*

[c] *Fund for Scientific Research – FNRS, Belgium*

Abstract

Consistent with the action identification theory proposal that some people identify their actions at a low-level (action processing regarding motor parameters) while others generally identify actions at a high-level (regarding goal features), and that a low-level of action identification leads to behavioral dysregulation (repetition, doubts about completion), checking proneness was found to be related to low-level action identification. Nevertheless, checking can be motivated by several factors (dysfunctional beliefs, incompleteness feelings). In the present research, we re-examine the level at which actions are identified by distinct subtypes of checking-prone participants. In Study 1, cluster analysis leads to the identification of four checking subtypes based on two dysfunctional beliefs domains (responsibility and perfectionism); our main results suggest that a low-level of action identification may characterize a checking subtype that is not motivated by responsibility related dysfunctional beliefs. Study 2 further reveals that anxiety features may characterize the checking subtype related to a low-level action identification.

Keywords: Obsessive-compulsive disorder; checking; heterogeneity; dysfunctional beliefs; action identification; action regulation; goal processing.

Correspondence to: Sanaâ Belayachi, Department of Psychology: Cognition and Behaviour, University of Liège, Liège, Belgium. Email: sanaa.belayachi@ulg.ac.be

Received 04-Jan-2016; received in revised form 08-Feb-2017; accepted 09-Feb-2017

Table of Contents

Introduction

Obsessions and compulsions are classically viewed as core features of a unique psychopathological condition, namely Obsessive-Compulsive Disorder (OCD). According to this classical conceptualization of Obsessive-Compulsive (OC) phenomena, obsessions are recurrent unwanted intrusive thoughts or images which provoke distress/anxiety and in response to which OCD patients feel compelled to perform mental or physical acts in a repeated or stereotyped way, well known as compulsions. This conceptualization of OC phenomena does not, however, account for the entire complexity surrounding clinical reality, which in fact points to an important heterogeneity in the factors underlying or accompanying OC symptoms (McKay et al., 2004).

Furthermore, there is evidence in favor of a within-OC dimension heterogeneity (Rasmussen & Eisen, 2002). Clinical heterogeneity has particularly been reported in the OC checking dimension (e.g., Ecker & Gönner, 2008; Pinto et al., 2007; Tolin, Brady, & Hannan, 2008); however studies examining cognitive mechanisms underlying compulsive checking did not systematically take such heterogeneity into account.

Phenomenological characteristics surrounding checking behaviors, including motivational features, can vary considerably across high-checking prone people. For example, one may feel responsible for the occurrence or the avoidance of threats and feel the need to check safety actions (e.g., stove, door) in order to avoid a feared harmful event (i.e., checking predominantly triggered by an inflated sense of responsibility; Salkovskis et al., 2000). Other people feel the need to do things perfectly in order to avoid failure (even in a small or insignificant way) because it is viewed as a sign of strong personal defeat; the ensuing checking behaviors concern a wide range of routine and basic actions, including reading (e.g., rereading passages multiple times in order to make sure they have been understood properly), writing (e.g., repeated checking work for typographical errors), dressing (e.g., checking that socks and pants are put on correctly) (i.e., checking mainly triggered by perfectionism; Frost & Steketee, 1997). Some people check their past actions because they frequently doubt whether they actually either performed the intended actions, or performed them correctly, and they subsequently fear the occurrence of potential catastrophes

due to their carelessness; related checking behaviors consist of making sure that some safety actions have been actually and properly done (i.e., checking triggered by both inflated responsibility and perfectionism; Attiullah, Eisen, & Rasmussen, 2000). Finally, some people have difficulties in experiencing a sense of task completion, generally for basic and routine actions; they encounter peculiar experiences of dissatisfaction during actions (i.e., feeling that something is wrong) with difficulties in identifying what really is wrong and consequently check and repeat these actions until they get the feeling that things are "just right" (i.e., checking motivated by incompleteness feelings; Coles, Heimberg, Frost, & Steketee, 2005; Summerfeldt, 2004).

What the above-mentioned checking situations have in common is that people feel the need to check or repeat their action despite the obvious goal achievement. In order to explain such phenomena, some authors proposed that defective action processing may prevent high-checking prone people from experiencing a sense of goal completion (e.g., Murayama et al., 2013; Pitman, 1987; Ursu, Stenger, Shear, Jones, & Carter, 2003). More particularly, it has been suggested that high-checking prone people may have an increased difficulty in processing their actions regarding goal-related features (Belayachi & Van der Linden, 2009; Boyer & Liénard, 2006; Jung et al., 2009; Kim et al., 2008; Purcell, Maruff, Kyrios, & Pantelis, 1998). Normally, people perform their actions with goal representations in mind so that actions are evaluated regarding the extent to which the actual end-state (i.e., action outcome) corresponds to the desired state (i.e., the pursued goal). In the case of checking, it has been suggested that a defective use of goal representations for guiding the course of action may undermine a sense of goal satisfaction which in turn promotes the need to check or repeat some routine actions (Belayachi & Van der Linden, 2009; Boyer & Liénard, 2006).

The goal processing deficit hypothesis in OC symptoms has been examined in the context of action identification theory (Belayachi & Van der Linden, 2009; Dar & Katz, 2005; Jamnadass, Badcock, & Maybery, 2014). This theory posits that any behavior can be identified within a cognitive hierarchy of meanings: the higher-level meanings relate to the desired goal and expected outcomes; the lower-level meanings, however, represent instrumental features and movement parameters (Vallacher & Wegner, 1987, 1989; Wegner & Vallacher, 1986, 1987). Vallacher and Wegner suggest that the level at which an action is identified may reflect the particular representation (movement parameters vs. abstract goal) used as a basis for processing and monitoring that action. For example, identifying the act of "locking the door" as "putting a key in the lock" shows that the instrumental representation is most accessible, whereas identifying this act as "securing the house" reflects the predominant accessibility of goal representation. When an act can be identified at both high and low levels (as in the case of habitual actions), people adopt higher (more meaningful) levels of action identification over lower-level ones; however, whenever an act becomes complex or has been disrupted, people tend to adopt lower levels. Vallacher and Wegner (1989) identified various differences in the way individuals understand their own actions according to their predominant level of action identification. Some people have the tendency to generally identify routine actions in relation to goals and outcomes (high-level of action identification); conversely, some people appear to identify routine actions preferentially according to mechanistic details and motor subcomponents (low-level of action identification). The authors also associated the preferential level of action identification with distinct modes of action. In particular, chronic low-level action identification may be related to more difficulty in adapting representations according to action constraints, leading people to have more disruption of the action flow (e.g., more attention focused on the details of performance, doubts about whether the action has been completed, increased 'signals of inconsistency and error', particularly during routine actions; Vallacher & Wegner, 1989).

In a previous study conducted in the context of this theory, checking symptoms (in a non-clinical sample) were found to be related to a lower ability to identify various habitual actions regarding goal and purpose (i.e., a low-level of action identification), due to an increased tendency to identify these actions primarily in terms of their procedural aspects and motor components (Belayachi & Van der Linden, 2009). On the other hand, a more recent study suggested that checking participants are in fact characterized by a high-level of action identification (i.e., focusing goal-related features) and that a low-level of action identification in checking might in fact depend on anxiety (Jamnadass et al., 2014). Nevertheless, these two studies contained numerous limits, including small sample size, weak effect sizes and more importantly did not take into account the well-acknowledged motivational heterogeneity within the checking dimension (Attiullah et al., 2000; Ecker & Gönner, 2008; Rasmussen & Eisen, 2002; Summerfeldt,

2004; Tolin et al., 2008). The aim of the present study was to re-examine the goal-processing deficit hypothesis in checking by assessing the level of action identification across various subtypes of checking.

More specifically, Study 1 aimed to better identify subgroups of checking according to the presence or the absence of dysfunctional beliefs and the type of those beliefs (i.e., related to responsibility or perfectionism), by using a validated statistical method for grouping procedure along pre-specified dimensions. In such analyses, clearly distinct groups are created by maximizing between-cluster differences and minimizing within-cluster variability for a chosen set of variables; boundaries are drawn around respondents such that each participant is in only one subgroup (e.g., Everitt, Landau, Leese, & Stahl, 2011). In this context, cluster analysis appear to be a promising procedure to identify subtypes of checking, as this method unambiguously allocates respondents to distinct subgroups (Calamari et al., 2004; Calamari, Wiegartz, & Janeck, 1999). Clusters identified as being based on responsibility and perfectionism dimensions could then be compared along the various action identification levels. Study 2 aimed to directly explore whether checking-prone people can be distinguished according to their level of action identification by means of cluster analyses (i.e., “low-level of action identification-related checking” vs. “high-level of action identification-related checking”) and to compare these checking profiles for various clinical characteristics frequently related to OC symptoms, with the hope that this may assist in identifying distinct subtypes of checking (i.e., anxiety levels, the co-occurrence of other OC dimensions, harm-avoidance and incompleteness features).

This issue will be examined in participants with sub-clinical levels of checking, consistent with the idea that checking can occur in most people with varying degree of severity. People with a sub-clinical level of checking have indeed been found to have clinical features and cognitive impairments similar to those identified in checking patients (for a review, see Abramowitz et al., 2014). It is in that context that analogue samples have been suggested to constitute a valid approach for studying cognitive and behavioural mechanisms hypothesized to be involved in the development and/or maintenance of clinically severe OCD symptoms (Abramowitz et al., 2014). This approach has also the potential benefit of overcoming some of the methodological problems linked to the use of clinical samples (i.e., ongoing pharmacological and psychological therapies could interact with dependent measures).

2. Study 1

As already mentioned above, dysfunctional beliefs, such as an inflated sense of responsibility for future negative outcomes and perfectionism, are thought to play a key role in the occurrence and maintenance of checking symptoms (e.g., Rachman, 2002; Salkovskis et al., 2000). In the particular case of checking, some studies have related these symptoms to perfectionism, in the absence of evidence of an inflated sense of responsibility (e.g., OCCWG, 2005; Julien, O’Connor, Aardema, & Todorov, 2006; Wu & Cortesi, 2009), while other studies suggest checking symptoms are predominantly related to an inflated sense of responsibility (e.g., Myers, Fisher, & Wells, 2008; Tolin, Woods, & Abramowitz, 2003). While some studies did not observe any association between checking and responsibility or perfectionism beliefs (e.g., Calamari et al., 1999; Miguel et al., 2000; Tolin et al., 2008), others report that checking could be connected to both responsibility and perfectionism-related beliefs (e.g., Attiullah et al., 2000; Lind & Boschen, 2009).

The variability of the results across all these studies suggests that there are several checking subtypes based on responsibility and perfectionism levels. Furthermore, dysfunctional beliefs are thought to constitute phenomenological features that may potentially help characterizing distinct OC subtypes rather than being causal factors per se. In that context and knowing that responsibility and perfectionism related features appear specifically relevant for the checking OC dimension, this first study aimed to identify distinct checking subtypes based on the level of responsibility and perfectionism beliefs. More specifically, we aimed to discriminate between participants with high levels of checking symptoms according to their scores on measures of both responsibility and perfectionism-related beliefs by using the cluster method, and then to compare the various subgroups of checking against the level of action identification measure. We also compared the various checking subtypes on a measure of anxiety in order to see whether low-level of action identification in checking is due to anxiety, as suggested by Jamnadass et al. (2014).

2.1. Method

2.1.1. Participants

One hundred and ninety-five French-speaking undergraduates (69 males and 126 females) aged between 18 and 30 (*M*: 22.13 years, *SD* = 2.34 years) participated in the study. Participants were randomly recruited from various faculties and schools of the university; they were not compensated for their participation.

2.2.2. Materials and procedure

Informed consent was obtained from all participants following a full explanation of the experimental procedure. Detailed written and oral instructions explained that participants would be asked questions about different aspects of routine actions. They were participating anonymously and on a volunteer basis. In an individual testing session, participants completed all the measures described below, as well as questionnaires and tasks unrelated to the present study. These measures were counterbalanced across subjects.

Behavior Identification Form (BIF, Vallacher & Wegner, 1989). The BIF is an instrument designed to measure individual differences in action identification level across an array of routine actions (i.e., level of personal agency). Each item of the BIF consists of an action followed by two alternatives or "identities," one of which is lower and one higher in level. For each action, participants had to choose the alternative that best described the action they would carry out. The number of high-level identities chosen defined the subjects' level of agency. The French version of the BIF is a 23-item instrument that has been validated in a previous study intended to replicate Vallacher and Wegner's (1989) study of level of agency (Belayachi & Van der Linden, unpublished results). In this replication study, the French version of the BIF had very good internal consistency (.90); exploratory factor analysis revealed the existence of one factor, suggesting that the French version of the BIF is a one-dimensional scale. In the present study, the BIF showed good internal consistency: .88, which is comparable to that observed in the Belayachi and Van der Linden study.

Obsessive-Compulsive Inventory – Revised (OCI-R, Foa et al., 2002). The validated French version of the OCI-R (Zermatten, Van der Linden, Jermann, & Ceschi, 2006) is a self-report questionnaire that consists of 18 items evaluating six OCD dimensions (three items per dimension): Checking, Washing, Obsessing, Hoarding, Ordering and Neutralizing dimensions. Participants were asked to determine to what extent the situation described in each particular statement had distressed them during the past month, using a 5-point scale (0 = "not at all"; 4 = "extremely"). Total scores range from 0 to 72; scores for the OCI-R subscales range from 0 to 12. The French version of the OCI-R has good overall psychometric properties and a factorial structure that is identical to that observed in Foa et al.'s (2002) original English version (Zermatten et al., 2006*a*). In the present study, Cronbach's alphas indicated good to acceptable internal consistency for all the measures (OCI-R total score: .83; Checking: .78; Washing: .69; Ordering: .82; Obsessing: .83; Hoarding: .78), except for the Neutralizing subscale which showed problematic reliability (α = .58). The Neutralizing dimension of the OCI-R tool appeared problematic in several studies, probably because the related items are in fact assessing various dimensions (e.g., Belayachi & Van der Linden, 2010; Tolin et al., 2008; Zermatten & Van der Linden, 2008). Thus, Neutralizing scores will not be used in our reported results. It is worth noticing that the range of scores obtained on each OCD measure included scores comparable to those observed in clinical samples (OCI-R total score: 1–46; Checking: 0–12; Washing: 0–9; Obsessing: 0–10; Ordering: 0–12; Hoarding: 0–12).

The Obsessional Beliefs Questionnaire-44 (OBQ-44, OCCWG, 2005). The French version of the OBQ-44 (Julien et al., 2006) consists of 44 obsessional beliefs, which are rated on a 7-point scale (1 = "disagree very much" to 7 = "agree very much"). This questionnaire assesses three belief domains associated with OCD: responsibility/threat estimation (i.e., OBQ-44 responsibility; 16 items, score range 16–112); perfectionism/certainty (i.e., OBQ-44 perfectionism; 16 items, score range 16–112); and importance/control of thoughts (i.e., OBQ-44 thought; 12 items, score range 12–84). The current study focuses on the two OBQ-44 subscales that assess beliefs related to personal responsibility and perfectionism, respectively. In addition, we compute the OBQ-44 total score, which ranges from 44 to 308. The psychometric properties of the French version of the OBQ-44 have been found to be comparable to those observed in the original version (Julien et al., 2006). In the present study, Cronbach's alphas indicate very

good internal consistency for all the OBQ-44 measures of interest (OBQ-44 total score: .94; OBQ-44 responsibility: .90; OBQ-44 perfectionism: .89).

State-Trait Anxiety Inventory (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). The French version of the STAI (Bruchon-Schweitzer & Paulhan, 1993) is composed of 40 items that measure two aspects of anxiety. The first set of 20 items assesses the respondents' state of anxiety at the time of the testing session (i.e., STAI-S), while the last 20 items constitute a self-reported measure of general anxiety (i.e., STAI-T). Each statement is rated on a 4-point scale (1 = "not at all" to 4 = "very much so"); 10 items are reverse-scored in the STAI-S and 9 items are reverse-scored in the STAI-T. For each anxiety inventory, scores are summed, with total possible scores ranging from 20 to 80; there is no total score. In the present study, we only use the STAI-T, which shows a strong internal consistency (.91).

*Table 1: **Study 1**: Mean scores and SD for the measures of action identification (BIF), dysfunctional beliefs (OBQ-44 responsibility and perfectionisms subscales), OCD dimensions (Checking, Washing, Ordering, Obsessing, Hoarding) and OC severity (OCI-R total scores), and trait anxiety (STAI-T) in the entire sample, and for each checking cluster and the control group.*

Dependent variables	Whole sample score (*n* = 195)	Checking clusters				
		Responsibility-related checking (*n* = 21)	Perfectionism-related checking (*n* = 20)	High-beliefs checking (*n* = 22)	Low-beliefs checking (*n* = 17)	Control group (*n* = 28)
BIF	14.83 (3.89)	16.19 (2.91)	15.00 (2.85)	17.32 (3.27)	13.35 (3.43)	15.68 (4.64)
OCI-R Checking	2.57 (2.66)	4.14 (1.85)	5.45 (2.28)	5.41 (2.82)	5.24 (2.61)	0.29 (0.46)
OCI-R Washing	1.52 (2.03)	2.43 (2.25)	2.75 (2.02)	2.50 (2.46)	1.59 (1.91)	0.29 (0.60)
OCI-R Ordering	3.75 (3.02)	4.67 (2.46)	4.80 (2.52)	6.05 (3.43)	4.47 (3.37)	0.68 (0.90)
OCI-R Obsessing	2.45 (2.43)	3.71 (2.99)	2.50 (2.26)	2.68 (2.01)	3.12 (2.93)	0.64 (0.91)
OCI-R Hoarding	3.97 (2.86)	4.62 (2.64)	4.50 (2.65)	5.91 (2.96)	4.71 (3.42)	0.86 (1.08)
OCI-R Total score	15.11 (9.02)	20.81 (6.43)	22.00 (6.30)	24.05 (7.21)	20.41 (10.58)	2.75 (1.51)
STAI-T	41.56 (9.80)	45.43 (7.93)	45.30 (10.59)	44.73 (9.67)	41.12 (8.78)	35.31 (7.70)
OBQ-44 Responsibility	48.83 (15.73)	58.91 (5.66)	47.75 (8.19)	71.18 (7.54)	34.82 (9.25)	41.18 (15.40)
OBQ-44 Perfectionism	53.04 (15.76)	52.72 (6.36)	65.34 (6.22)	74.14 (8.64)	39.35 (6.59)	41.82 (13.06)
OBQ-44 Total score	131.25 (36.71)	145.23 (15.10)	141.74 (16.52)	185.85 (16.03)	96.53 (16.70)	106.00 (29.95)

Note: BIF = Behavior Identification Form, OCI-R = Obsessive-Compulsive Inventory Revised, STAI-T = State-Trait Anxiety Inventory (Trait anxiety form), OBQ-44 = Obsessional Beliefs Questionnaire-44.

2.2. Results and discussion

2.2.1. Preliminary analyses

Table 1 summarizes the mean scores, SD, for the measures of the level of action identification, OC dimensions and OC severity, anxiety and dysfunctional beliefs, and Table 2 sums up the intercorrelations between those measures in the overall sample. An inspection of the correlations reveals that the level of action identification was correlated with dysfunctional beliefs (i.e., the OBQ-44 responsibility subscale and the OBQ-44 total score) but also with checking scores; there was no association between the level of action identification and the other measures of OC symptoms. All the OC measures were related to each measure of dysfunctional beliefs. In addition, the checking dimension was highly correlated with the other OC measures and the three OBQ-44 measures correlated significantly with each other. Finally, there was no association between level of action identification and anxiety (i.e., STAI-T), while anxiety did correlate with the OCD measures, as well as with the measures of dysfunctional beliefs.

*Table 2: **Study1**: Inter-correlations between the measures of action identification (BIF), dysfunctional beliefs (OBQ-44 responsibility and perfectionisms subscales), OCD dimensions (Checking, Washing, Ordering, Obsessing, Hoarding) and OC severity (OCI-R total scores), and trait anxiety (STAI-T) in the entire sample.*

	BIF	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
OCI-R Checking (1)	**0.16**	–	–	–	–	–	–	–	–	–
OCI-R Washing (2)	−0.02	**0.42**	–	–	–	–	–	–	–	–
OCI-R Ordering (3)	0.09	**0.43**	**0.30**	–	–	–	–	–	–	–
OCI-R Obsessing (4)	0.06	**0.17**	0.11	0.11	–	–	–	–	–	–
OCI-R Hoarding (5)	0.10	**0.28**	**0.23**	**0.25**	0.12	–	–	–	–	–
OCI-R Total score (6)	0.13	**0.74**	**0.60**	**0.69**	**0.45**	**0.60**	–	–	–	–
STAI-T (7)	−0.02	**0.26**	**0.24**	0.13	**0.50**	**0.19**	**0.41**	–	–	–
OBQ-44 Responsibility(8)	**0.22**	**0.21**	**0.30**	**0.20**	**0.29**	**0.22**	**0.38**	**0.32**	–	–
OBQ-44 Perfectionism(9)	0.09	**0.27**	**0.31**	**0.29**	**0.15**	**0.15**	**0.36**	**0.29**	**0.64**	–
OBQ-44 Total score (10)	**0.18**	**0.27**	**0.33**	**0.29**	**0.26**	**0.18**	**0.41**	**0.34**	**0.89**	**0.87**

Note: Bold values indicate correlations significant at $p < .05$; BIF = Behavior Identification Form, OCI-R = Obsessive-Compulsive Inventory Revised, STAI-T = State-Trait Anxiety Inventory (Trait anxiety form), OBQ-44 = Obsessional Beliefs Questionnaire-44.

2.2.2. Group constitution and cluster analyses

Considering the possible heterogeneity of the checking dimension and the potentially confounding influences of correlations between symptoms (OC subtypes and dysfunctional beliefs), zero-order correlations alone cannot determine the extent to which checking participants' level of action identification may vary as a function of their motivational reasons for checking (i.e., dominated by dysfunctional beliefs or not). Hence, to address this question more directly, we first divided the overall sample into two groups – those high on checking symptoms (High-checking, $n = 80$) and those low on checking symptoms (Low-checking, $n = 115$) – on the basis of the median sample value for the OCI-R checking subscale (*Mdn* = 2). The mean checking score was 5.12 (*SD* = 2.45) in the high-checking group and .85 (*SD* = .80) in the low-checking group. The high-checking group was then cluster-analyzed on the basis of checking participants' scores on the OBQ-44 subscales, in order to identify subgroups of checking subjects (defined by differences in the strength of OC-related beliefs). As we were interested only in dysfunctional appraisals concerning the outcomes of one's action, rather than the consequences of one's thoughts, cluster analyses were based only on the participants' subscores on the responsibility and perfectionism OBQ-44 subscales, following the recommendations of Clatworthy, Buick, Hankins, Weinman and Horne (2005).

We first conducted a hierarchical agglomerative cluster analysis in order to explore the possible number of clusters from the data (Ward's method, based on squared Euclidian distance measures). Visual inspection of the dendrogram and agglomeration coefficients obtained with this method indicated a four-cluster solution. We then computed an iterative partitioning method (*K*-means) of clustering, which requires that the number of clusters is specified in advance, permitting maximization of the similarity of cases within each cluster and the dissimilarity between clusters. Since the hierarchical agglomerative clustering method seems to identify four distinct groups of checking based on responsibility and perfectionism-related beliefs, the *K*-means was set to a 4-cluster solution. In order to examine the stability of the cluster solution structure, we explored the agreement between the Ward's method results and the *K*-means clustering solutions using Cramer's V test allowing us to determine whether similar clusters are present regardless of the algorithm used to derive them. This analysis indicated a good agreement between the two methods (Cramer's V = .82, $p < .001$), thereby supporting the four-cluster solution. Finally, we explored the extent to which clusters are separated by the severity of the dysfunctional beliefs-related variables. For that purpose, scores on the responsibility and on the perfectionism subscales were entered into discriminant function analysis, where the identified clusters served as the grouping variable. Discriminant function analysis indicated that the four clusters were adequately separated in discriminant function space (see Fig. 1) and that, overall, 95.2% of the cases were correctly classified.

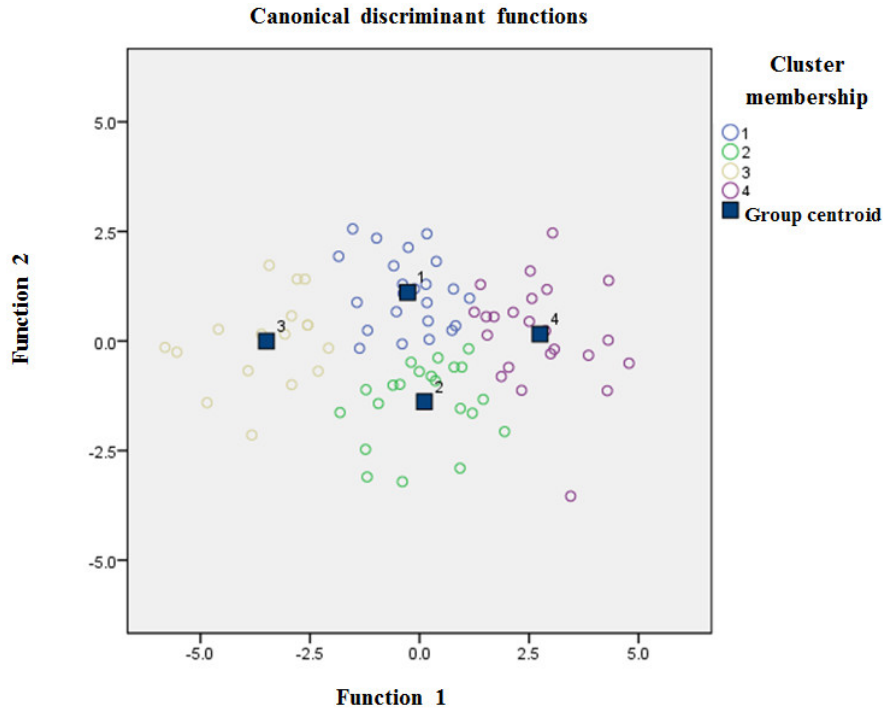


Figure 1. Four-cluster solution plotted in discriminant function space (Study 1)

Overall, this procedure showed that, of the 80 checking-prone participants, 21 were assigned to cluster 1, 20 participants were assigned to cluster 2, 17 participants were assigned to cluster 3, and 22 participants were assigned to cluster 4. As can be seen in Figure 1, participants from cluster 1 are characterized by higher scores on the responsibility subscale than on the perfectionism subscale ("Responsibility-related checking"). Participants assigned to cluster 2 are characterized by higher levels of perfectionism than responsibility-related beliefs ("Perfectionism-related checking"). Participants in cluster 3 are characterized by lower scores on both the responsibility and perfectionism subscales ("Low-beliefs checking"). Finally, cluster 4 identifies a subtype of checking symptoms characterized by high scores on both the responsibility and perfectionism subscales ("High-beliefs checking").

In order to further characterize the various checking profiles by comparing these checking subtypes to people with low-level of OC propensity, a control group was created based on the OCI-R total scores of participants from the Low-checking group. This control group consisted of individuals with OCI-R total scores in the lowest quartile of the distribution (score < 6; n = 28). Descriptive statistics for each group on all the variables of interest are reported in Table 1 and group profiles according to their scores on each measure of interest are depicted in Figure 2.

2.2.3. Cluster characterization

All five groups (low-belief checking, responsibility-related checking, perfectionism-related checking, responsibility/perfectionism-related checking, and the control group) were compared on the dysfunctional beliefs measures (i.e., responsibility and perfectionism OBQ-44 subscales), on the level of action identification scores (i.e., mean scores on the BIF) and on anxiety scores (i.e., STAI-T), by means of one-way analyses of variance (ANOVAs). Any group effect has been further examined by means of LSD post hoc tests with Benjamini–Hochberg corrections in order to control for false discovery rate (Benjamini & Hochberg, 1995). Results of post-hoc tests are summarized in Table 3.

Group comparison on responsibility measure. There was a significant effect of group on the responsibility-related beliefs OBQ-44 subscale, $F(4, 103) = 41.71$, $p < .001$, $\eta^2p = .62$ (a large effect size, according to Cohen's criteria). Post hoc tests indicated that the "High-beliefs" group had OBQ-44 responsibility scores that were significantly greater than for the remaining groups. Similarly, the "Responsibility-related belief group" had significantly greater OBQ-44 responsibility scores as compared to the other groups, except the "high-beliefs" group. Finally, the "Perfectionism-

related beliefs" and the "Low beliefs" groups had OBQ-44 responsibility scores that were comparable to that observed in the control group.

Group comparison on perfectionism measure. There was a significant effect of group on the perfectionism-related beliefs OBQ-44 subscale, $F(4, 103) = 59.08$, $p < .001$, $\eta^2p = .70$ (a large effect size, according to Cohen's criteria). Post hoc tests indicated that the "High-beliefs" group had OBQ-44 perfectionism scores that were significantly greater than for the remaining groups. Similarly, the "Perfectionism-related belief group" had significantly greater OBQ-44 perfectionism scores as compared to the other groups, except the "high-beliefs" group. Additionally, the "Responsibility-related beliefs" group had greater OBQ-44 perfectionism scores as compared to the "Low beliefs" group and the control group. Finally, the "Low beliefs" group had OBQ-44 perfectionism scores that were comparable to that observed in the control group.

Group comparison on action identification measure. There was a significant effect of group on the level of action identification measure $F(4, 103) = 3.23$, $p = .02$, $\eta^2p = .11$ (a medium effect size, according to Cohen's criteria). Post hoc analyses indicated that the mean action identification scores were significantly smaller for the "Low beliefs" group as compared to the "Responsibility-related beliefs" and the "High-beliefs" groups. The lower level of action identification in "Low beliefs" group as compared to the control group was marginally significant, while the "Low-beliefs" group had action identification scores that were comparable to the "Perfectionism-related beliefs" group. Interestingly, there was a trend towards significance for the comparison between perfectionism related beliefs and the high-beliefs group suggesting that participants in the perfectionism group tended to have lower action identification scores as compared to the high-belief group. There were no other significant group differences.

Group comparison on anxiety measure. Finally, there was a significant effect of group on STAI-B scores, $F(4, 103) = 5.95$, $p < .001$, $\eta^2p = .19$ (a medium effect size, according to Cohen's criteria). Post hoc analyses indicated that the mean anxiety scores were comparable across the four checking groups and that the control group had significantly lower anxiety scores than all the checking groups, except for the low-beliefs group which was only marginally significant.

*Table 3. **Study 1**: Summary of post-hoc group comparisons on the dysfunctional beliefs measures (responsibility and perfectionism OBQ-44 subscales), on the level of action identification scores (BIF scores) and on trait anxiety scores (STAI-T)*

		P-Values (FDR corrected)
DV: OBQ-44 Responsibility		
Responsibility-related checking	Perfectionism-related checking	.013
	Low-beliefs checking	<.001
	High-beliefs checking	.003
	Control group	<.001
Perfectionism-related checking	Low-beliefs checking	.004
	High-beliefs checking	<.001
	Control group	.707
Low-beliefs checking	High-beliefs checking	<.001
	Control group	1
High-beliefs checking	Control group	<.001
DV: OBQ-44 Perfectionism		
Responsibility-related checking	Perfectionism-related checking	<.001
	Low-beliefs checking	<.001
	High-beliefs checking	<.001
	Control group	.001

Perfectionism-related checking	Low-beliefs checking	<.001
	High-beliefs checking	.038
	Control group	<.001
Low-beliefs checking	High-beliefs checking	<.001
	Control group	1
High-beliefs checking	Control group	<.001
DV: BIF		
Responsibility-related checking	Perfectionism-related checking	1
	Low-beliefs checking	.034
	High-beliefs checking	1
	Control group	1
Perfectionism-related checking	Low-beliefs checking	.553
	High-beliefs checking	.096
	Control group	1
Low-beliefs checking	High-beliefs checking	.002
	Control group	.087
High-beliefs checking	Control group	.295
DV: STAI-T		
Responsibility-related checking	Perfectionism-related checking	1
	Low-beliefs checking	.404
	High-beliefs checking	1
	Control group	<.001
Perfectionism-related checking	Low-beliefs checking	.486
	High-beliefs checking	1
	Control group	<.001
Low-beliefs checking	High-beliefs checking	.851
	Control group	.081
High-beliefs checking	Control group	<.001

Note: Bold values indicate group differences significant at $p < .05$ after Benjamini–Hochberg corrections; BIF = Behavior Identification Form, STAI-T = State-Trait Anxiety Inventory (Trait anxiety form), OBQ-44 = Obsessional Beliefs Questionnaire-44.

In summary, Study 1 allowed the identification of four consistent checking subtypes that were being differentially associated with dysfunctional beliefs (responsibility-related checking, perfectionism-related checking, responsibility/perfectionism-related checking and low-belief checking). Most importantly, participants from the low-belief checking group were characterized by a low level of action identification (i.e., based on movement parameters rather than on goal pursued) as compared to the control group, the responsibility-related belief group and the responsibility/perfectionism group. On the other hand, the subgroup of checking participants characterized by both responsibility and perfectionism related beliefs appeared to have a high-level of action identification (i.e., goal-related focus). The fact that a subgroup of checking is characterized by goal related action identification is consistent with the results reported in the Jamnadass et al. (2014) study in which the authors reported checking participants identifying actions mainly at a high-level.

Jamnadass et al. (2014) further reported that the level at which actions are identified in checkers depends mostly on anxiety scores. More particularly, the authors observed that checkers with high scores on anxiety measures were also those who identified their actions at a low-level, whereas checkers with low scores on anxiety measures tended to identify their actions at a high-level. In light of the Jamnadass et al. (2014) suggestion that anxiety decreases the

level at which actions are identified in checking participants, one would expect higher anxiety scores in the low-beliefs checking subtype (which was characterized by a low-level of action identification) as compared to the high-beliefs checking subtype (which showed a tendency for a high-level of action identification). However, all checking subgroups had comparable levels of anxiety in our study, which does not support the proposal of Jamnadass et al. (2014) that a low-level of action identification in checking depends on anxiety level.

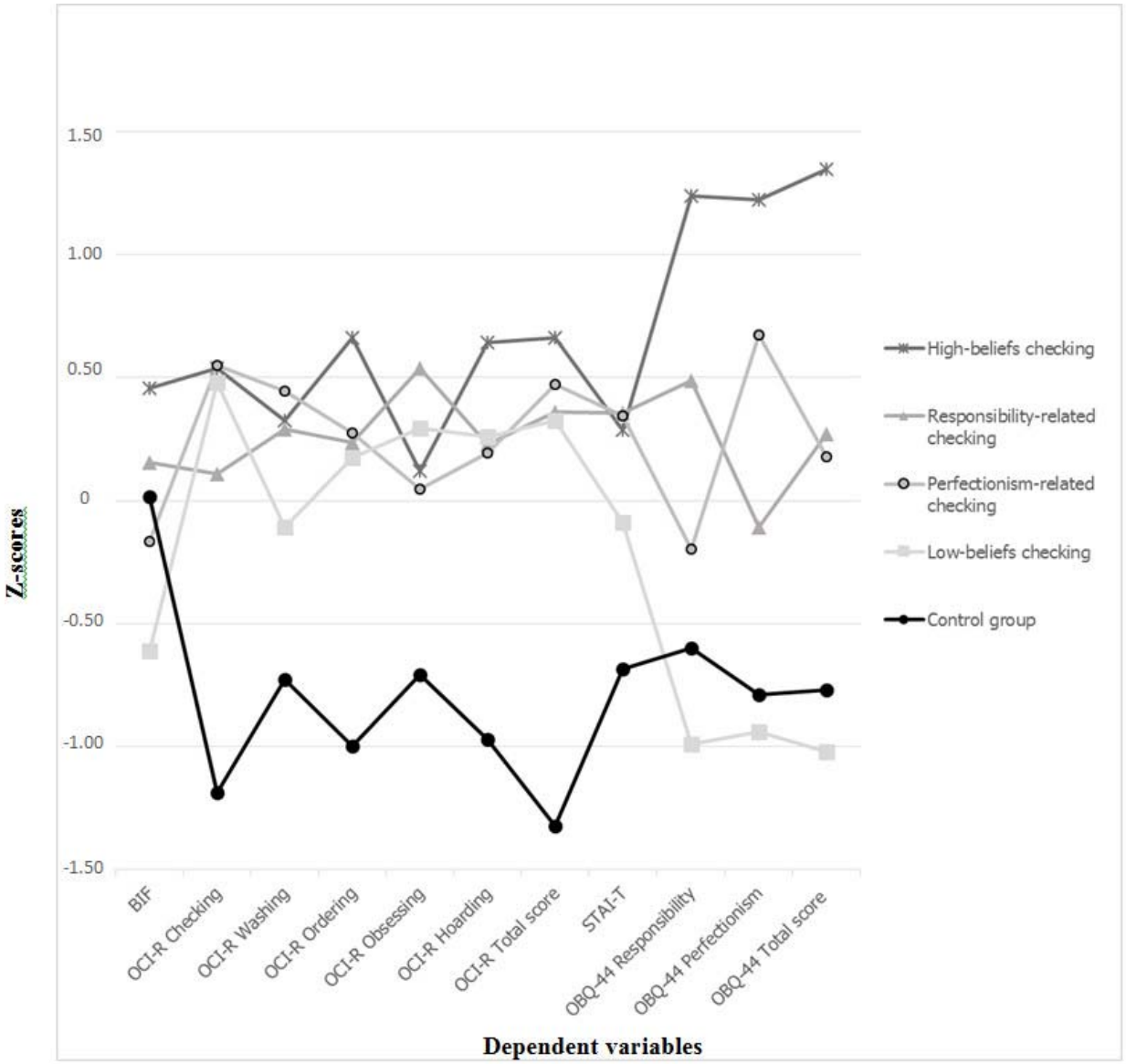


Figure 2. Means of each checking clusters and the control group for the (Z–transformed) measures of action identification, dysfunctional beliefs, OCD dimensions and anxiety (Study 1)

3. Study 2

The results of Study 1 revealed that checking-prone participants without dysfunctional beliefs are characterized by a low-level of action identification (i.e., movement-related focus). On the other hand, there was a subgroup of checking participants appearing to have a high-level of action identification (i.e., goal-related focus). Consistent with that observed by Jamnadass et al. (2014), it seems that there are two types of checkers: those characterized by a low-level of action identification and those characterized by a high-level of action identification. Nevertheless, phenomenological characteristics that may distinguish these two subtypes of checking remain unclear.

In this second study, we aimed to better characterize checking related to a low-level of action identification regarding experiential features (by contrast to study 1 which focused on the belief level). Indeed, it has been suggested that

distinct OC subtypes can be identified regarding two experiential features that may constitute two core motivational dimensions: harm avoidance (the immediate feeling of danger) and incompleteness (i.e., the immediate feeling of goal dissatisfaction) (Summerfeldt, 2004). Although harm avoidance has been conceptually related to responsibility beliefs and incompleteness to perfectionism, it is possible that experiential constructs are better to grasp the effect of goal processing on immediate action experience rather than beliefs. If, as we suggest, a low-level of action identification is indeed related to impaired action processing in a subtype of checking, then we should expect that checking characterized by a low-level of action identification is also characterized by high scores on the incompleteness measure and low scores on harm avoidance measure (which might be related to responsibility concerns). Additionally, anxiety has been proposed by Jamnadass et al. (2014) to be an important factor for distinguishing checkers with high level of action identification to those with a low-level of action identification, although we failed to replicate their findings in Study 1. If the Jamnadass et al. (2014) suggestion that low-level of action identification is related to anxiety rather than to checking per se, then we should observe higher anxiety scores in participants characterized by a low-level of action identification, regardless of their checking proneness.

Thus, the aim of this second study was to better grasp clinical features that characterize checking related to high-level of action identification and those specific to checking related to low-level of action identification. For that purpose, a large number of participants were clustered according to both their level of checking and their level of action identification to directly compare them against various clinical features (i.e., anxiety, harm avoidance propensity, incompleteness feelings and other OC dimensions co-occurrence).

3.1. Method

3.1.1. Participants

Four hundred and seventy-five French-speaking undergraduates (182 males and 293 females) aged between 18 and 35 (*M*: 22.36 years, *SD* = 3.07 years) participated in the study. Participants were recruited from various faculties and schools of the University of Liège and University of Geneva; they were not compensated for their participation.

3.1.2. Materials and procedure

Informed consent was obtained from all participants following a full explanation of the experimental procedure. Detailed written and oral instructions explained that participants would be asked questions about different aspects of routine actions. They were participating anonymously and on a volunteer basis. In group testing session, participants completed all the measures described below, as well as questionnaires unrelated to the present study. These measures were counterbalanced across subjects.

Behavior Identification Form (BIF, Vallacher & Wegner, 1989). The BIF was administered in order to assess the level of action focus. In this sample, the French version of the BIF had very good internal consistency (.91), which is comparable to that observed in the Belayachi and Van der Linden replication study (unpublished results).

Obsessive-Compulsive Inventory – Revised (OCI-R, Foa et al., 2002). The French version of the OCI-R (Zermatten et al., 2006*a*) was administered in order to assess six OC measures (Checking, Washing, Ordering, Obsessing and Ordering dimensions and OC severity as measured by OCI-R total scores). Cronbach's alphas indicated good to acceptable internal consistency for all the measures (OCI-R total score: .86; Checking: .74; Washing: .73; Ordering: .79; Obsessing: .78; Hoarding: .72). The range of scores obtained on each OCD measure included scores comparable to those observed in clinical samples (OCI-R total score: 1–56; Checking: 0–12; Washing: 0–12; Obsessing: 0–12; Ordering: 0–12; Hoarding: 0–12).

Obsessive-compulsive trait core dimension questionnaire (OC-TCDQ; Summerfeldt, Kloosterman, Antony, & Swinson, 2014). The French version of the OC-TCDQ (Belayachi, Laloyaux & Vander Linden, unpublished results) is a 20-item self-report questionnaire assessing two motivational dimensions of OC symptoms: Harm Avoidance (10 items) and Incompleteness (10 items). For each statement, participants were asked to determine to what extent the situation applied to them, using a 5-point scale (1 = "never applies me"; 5 = "always applies to me"). Scores for the harm avoidance checking and incompleteness subscales range from 10 to 50. The French version of the OC-TCDQ has good overall psychometric properties and a factorial structure that is identical to that observed in Summerfeldt

et al. (2014). In the present study, Cronbach's alphas indicated very good internal consistency for the two motivational dimension measures (harm avoidance: .89; incompleteness: .88).

State-Trait Anxiety Inventory (STAI; Spielberger et al., 1983). The French version of the STAI (Bruchon-Schweitzer & Paulhan, 1993) is composed of 40 items that measure two aspects of anxiety. The first set of 20 items assesses the respondents' state of anxiety at the time of the testing session (i.e., STAI-S), while the last 20 items constitute a self-reported measure of general anxiety (i.e., STAI-T). Each statement is rated on a 4-point scale (1 = "not at all" to 4 = "very much so"); 10 items are reverse-scored in the STAI-S and 9 items are reverse-scored in the STAI-T. For each anxiety inventory, scores are summed, with total possible scores ranging from 20 to 80; there is no total score. In the present study, we use only the STAI-T, which shows a strong internal consistency (.90).

*Table 4: **Study 2**: Mean scores and SD for the measures of action identification (BIF), OCD dimensions (Checking, Washing, Ordering, Obsessing, Hoarding) and OC severity (OCI-R total scores), OC motivational traits (OC-TCDQ harm and incompleteness subscales) and trait anxiety (STAI-T) in the entire sample, and for each cluster.*

Dependent variables	Whole sample score (*n* = 475)	Checking clusters				
		Non-checking middle identification (*n* = 135)	Non-checking high-identification (*n* = 96)	Checking low-identification (*n* = 83)	Checking high-identification (*n* = 99)	Non-checking low-identification (*n* = 62)
BIF	14.61 (4.33)	13.79 (1.67)	19.39 (1.86)	12.53 (2.74)	17.42 (2.17)	7.26 (2.35)
OCI-R Checking	2.67 (2.52)	0.99 (0.81)	1.00 (0.83)	6.25 (2.72)	4.26 (1.11)	1.58 (1.26)
OCI-R Washing	1.62 (2.23)	0.96 (1.62)	1.01 (1.95)	2.66 (2.71)	2.40 (2.36)	1.39 (2.00)
OCI-R Ordering	3.45 (2.75)	2.69 (2.19)	2.64 (2.56)	5.11 (2.88)	4.39 (2.96)	2.65 (2.18)
OCI-R Obsessing	2.63 (2.63)	1.93 (2.10)	1.75 (1.97)	4.02 (3.24)	3.22 (2.69)	2.71 (2.63)
OCI-R Hoarding	3.76 (2.66)	3.10 (2.45)	3.00 (2.41)	4.92 (2.78)	4.77 (2.48)	3.23 (2.58)
OCI-R Total score	15.42 (9.99)	10.36 (6.27)	10.15 (6.70)	25.28 (11.00)	21.08 (8.11)	12.32 (7.52)
STAI-T	40.54 (9.39)	39.21 (9.42)	37.07 (8.16)	45.34 (10.46)	41.90 (8.08)	40.24 (8.81)
OC-TCDQ Harm	21.79 (7.25)	19.39 (6.10)	18.99 (5.99)	25.88 (7.95)	25.00 (6.51)	20.73 (7.23)
OC-TCDQ Incompleteness	24.55 (7.42)	22.27 (6.38)	21.07 (5.65)	29.33 (7.79)	28.75 (7.06)	21.81 (5.40)

Note: BIF = Behavior Identification Form, OCI-R = Obsessive-Compulsive Inventory Revised, STAI-T = State-Trait Anxiety Inventory (Trait anxiety form), OC-TCDQ = Obsessive-compulsive trait core dimension questionnaire.

3.2. Results and discussion

3.2.1. Preliminary analyses

Table 3 summarizes the mean scores, SD, for the measures of the level of action focus, OC dimensions, OC motivational dimensions and anxiety. Table 4 shows the intercorrelations between those measures in the overall sample. An inspection of the correlations reveals that the level of action focus was slightly correlated with anxiety and obsessing measures; there was no association between the level of action focus and the measures of OC symptoms, OC motivational dimensions and anxiety. All six OC measures (i.e., the OCI-R checking, washing, ordering, obsessing and hoarding subscales and the OCI-R total score) were related to each measure of OC motivational dimension (i.e., harm avoidance and incompleteness subscales of the OC-TCDQ). In addition, the five OC measures were highly intercorrelated and the two OC-TCDQ subscales correlated significantly with each other. Finally, the measure of anxiety (i.e., STAI-T) correlated with the six OC measures, as well as with the measures of OC motivational dimensions.

3.2.2. Group constitution and cluster analyses

In order to identify subgroups of participants according to both their proneness to checking and their level of action focus, the entire sample was cluster-analyzed on the basis of participants' scores on the BIF and the checking OCI-R subscale. The clustering method was exactly the same as that used in Study 1. A hierarchical agglomerative cluster analysis (Ward's method, based on squared Euclidian distance measures) indicated a five-cluster solution based on the level of action focus and checking scores. Cramer's V indicated an acceptable agreement between the Ward's method results and the *K*-means clustering solutions (Cramer's V = .76, $p < .001$), thereby supporting the five-cluster solution. Finally, a discriminant function analysis indicated that the five clusters were adequately separated in discriminant function space (see Figure 3) and that, overall, 92.8% of the cases were correctly classified.

Table 5. ***Study 2:*** *Inter-correlations between the measures of action identification (BIF), (Checking, Washing, Ordering, Obsessing, Hoarding), and OC severity (OCI-R total scores), OC motivational traits (OC-TCDQ harm and incompleteness subscales) and trait anxiety (STAI-T).*

	BIF	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
OCI-R Checking (1)	−0.02	–	–	–	–	–	–	–	–
OCI-R Washing (2)	0.03	**0.40**	–	–	–	–	–	–	–
OCI-R Ordering (3)	0.03	**0.41**	**0.36**	–	–	–	–	–	–
OCI-R Obsessing (4)	**−0.09**	**0.34**	**0.31**	**0.29**	–	–	–	–	–
OCI-R Hoarding (5)	0.04	**0.31**	**0.25**	**0.21**	**0.36**	–	–	–	–
OCI-R Total score (6)	0.00	**0.71**	**0.65**	**0.67**	**0.69**	**0.61**	–	–	–
STAI-T (7)	**−0.09**	**0.30**	**0.18**	**0.21**	**0.54**	**0.31**	**0.44**	–	–
OC-TCDQ Harm (8)	0.00	**0.41**	**0.31**	**0.30**	**0.64**	**0.40**	**0.60**	**0.61**	–
OC-TCDQ Incompleteness (9)	0.03	**0.48**	**0.37**	**0.58**	**0.49**	**0.37**	**0.68**	**0.41**	**0.63**

Note: Bold values indicate correlations significant at $p < .05$; BIF = Behavior Identification Form, OCI-R = Obsessive-Compulsive Inventory Revised, STAI-T = State-Trait Anxiety Inventory (Trait anxiety form), OC-TCDQ = Obsessive-compulsive trait core dimension questionnaire.

Overall, this procedure showed that, of the 475 participants, 135 were assigned to cluster 1, 96 participants were assigned to cluster 2, 83 participants were assigned to cluster 3, 99 participants were assigned to cluster 4 and 62 participants were assigned to cluster 5. As can be seen in Figure 3, participants from cluster 1 are characterized by low scores on the checking subscale and middle scores on the action identification measure ("Non-checking middle identification"). Participants assigned to cluster 2 are characterized by low scores on the checking subscale and higher levels of action identification ("Non-checking high-identification"). Participants in cluster 3 are characterized by high scores on checking subscale and low-levels of action identification ("Checking low-identification"). Participants in cluster 4 are characterized by high scores on the checking subscale and high-levels of action identification ("Checking high-identification"). Finally, cluster 5 identifies a subgroup characterized by extremely low-levels of action identification and mixed scores on checking ("Non-checking low-identification"). Descriptive statistics for each group on all the variables of interest are reported in Table 3 and group profiles according to their scores on each measure of interest are depicted in Figure 4.

3.2.3. Cluster characterization

All five groups (Non-checking low-identification, Non-checking middle identification, Non-checking high-identification, Checking low-identification and Checking high-identification) were compared on all variables of interest by means of one-way analyses of variance (ANOVAs). Any group effect has been further examined by means of LSD Post hoc analyses with Benjamini–Hochberg corrections in order to control for false discovery rate (Benjamini & Hochberg, 1995). Results of post-hoc tests are summarized in Table 6.

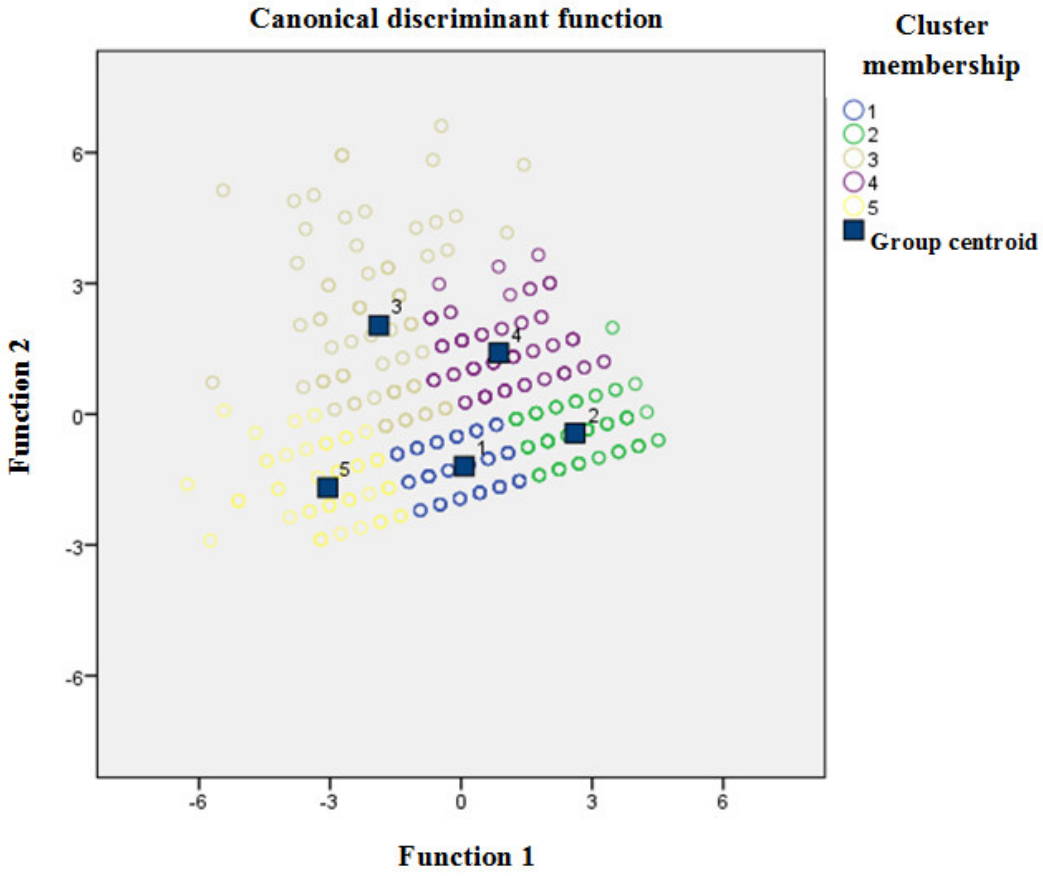


Figure 3. Five-cluster solution plotted in discriminant function space (Study 2)

3.2.3.1. Group comparison on clustering measures (action identification and checking)

Action identification scores. Results of this analysis showed that there was a significant effect of group on the level of action identification, $F(4, 470) = 376.20$, $p < .001$, $\eta^2p = .76$ (a large effect size, according to Cohen's criteria). Post hoc analyses indicated that cluster 5 ("Non-checking low-identification") had significantly lower levels of action identification than all other groups. Cluster 3 ("Checking low-identification") had significantly greater BIF scores than cluster 5 ("Non-checking low-identification") but significantly lower action identification levels than the "Non-checking middle identification", "Non-checking high-identification" and the "Checking high-identification" clusters. Cluster 1 ("Non-checking middle identification") had significantly greater BIF scores than clusters 3 ("Checking low-identification") and 5 ("Non-checking low-identification") but significantly lower scores than the "Non-checking high-identification" and the "Checking high-identification" clusters. Cluster 4 ("Checking high-identification") had significantly greater BIF scores than clusters 1, 3 and 5 but significantly lower scores than the "Non-checking high-identification" cluster. Finally, Cluster 2 ("Non-checking high-identification") had significantly greater BIF scores than all other groups.

Checking scores. There was a significant effect of group on checking scores, $F(4, 470) = 245.25$, $p < .001$, $\eta^2p = .68$ (a large effect size, according to Cohen's criteria). Post hoc analyses indicated that cluster 3 ("Checking low-identification") had significantly higher checking scores than all other groups. Cluster 4 ("Checking high-identification") had significantly lower checking scores than cluster 3 ("Checking low-identification") but significantly greater checking scores than the remaining non-checking clusters, suggesting that the combination of checking and low-level action identification goes along with increased checking severity. Cluster 5 ("Non-checking low-identification") had significantly lower checking scores than checking clusters 3 and 4 but significantly greater checking scores than the "Non-checking middle identification" and "Non-checking high-identification" , highlighting the fact that increased levels of checking scores are associated with a tendency to focus on motor parameters rather than on goal. Finally, cluster

1 (“Non-checking middle identification”) and cluster 2 (“Non-checking high-identification”) had comparable levels of checking scores.

3.2.3.2. Group comparison on the other OC dimensions

Washing scores. There was a significant effect of group on washing scores, $F(4, 470) = 13.91$, $p < .001$, $\eta^2p = .11$ (a medium effect size, according to Cohen’s criteria). Post hoc analyses indicated that cluster 3 (“Checking low-identification”) and cluster 4 (“Checking high-identification”) had comparable levels of washing and both groups had significantly greater washing scores than the remaining groups. Cluster 1 (“Non-checking middle identification”), 2 (“Non-checking high-identification”) and 5 (“Non-checking low-identification”) had comparable washing scores.

Ordering scores. There was a significant effect of group on ordering scores, $F(4, 470) = 18.94$, $p < .001$, $\eta^2p = .14$ (a medium effect size, according to Cohen’s criteria). Post hoc analyses indicated that cluster 3 (“Checking low-identification”) and cluster 4 (“Checking high-identification”) had significantly greater ordering scores than the remaining groups; whereas Cluster 1 (“Non-checking middle identification”), 2 (“Non-checking high-identification”) and 5 (“Non-checking low-identification”) had comparable ordering scores.

Obsessing scores. There was a significant effect of group on the obsessing measure, $F(4, 470) = 13.38$, $p < .001$, $\eta^2p = .10$ (a medium effect size, according to Cohen’s criteria). Post hoc analyses indicated that cluster 3 (“Checking low-identification”) had obsessing scores comparable to that observed in cluster 4 (“Checking high-identification”), but significantly greater obsessing scores than the remaining non-checking groups. Cluster 4 (“Checking high-identification”) had significantly greater obsessing scores than cluster 1 (“Non-checking middle identification”) and 2 (“Non-checking high-identification”), but comparable scores to cluster 5 (“Non-checking low-identification”). Interestingly, cluster 5 (“Non-checking low-identification”) had greater obsessing scores than cluster 2 (“Non-checking high-identification”) but scores that are comparable to cluster 1 (“Non-checking middle identification”). Finally, cluster 1 (“Non-checking middle identification”) and cluster 2 (“Non-checking high-identification”) had comparable obsessing scores.

Hoarding scores. Finally, there was a significant effect of group on hoarding proneness, $F(4, 470) = 13.42$, $p < .001$, $\eta^2p = .10$ (a medium effect size, according to Cohen’s criteria). Post hoc analyses indicated that cluster 3 (“Checking low-identification”) and cluster 4 (“Checking high-identification”) had comparable levels of hoarding and both groups had significantly greater hoarding scores than the remaining groups. Cluster 1 (“Non-checking middle identification”), 2 (“Non-checking high-identification”) and 5 (“Non-checking low-identification”) had comparable hoarding scores.

3.2.3.3. Group comparison on core motivational dimensions (harm avoidance, incompleteness)

Harm avoidance scores. There was a significant effect of group on harm avoidance scores, $F(4, 470) = 22.51$, $p < .001$, $\eta^2p = .16$ (a medium effect size, according to Cohen’s criteria). Post hoc analyses indicated that cluster 3 (“Checking low-identification”) and cluster 4 (“Checking high-identification”) had comparable harm avoidance scores and these two checking clusters had greater harm avoidance scores than the other groups. Cluster 1 (“Non-checking middle identification”), 2 (“Non-checking high-identification”) and 5 (“Non-checking low-identification”) had comparable harm avoidance levels.

Incompleteness scores. There was also a significant effect of group on the incompleteness measure, $F(4, 470) = 34.83$, $p < .001$, $\eta^2p = .23$ (a medium effect size, according to Cohen’s criteria). Post hoc analyses indicated that cluster 3 (“Checking low-identification”) and cluster 4 (“Checking high-identification”) had comparable levels of incompleteness and both had greater incompleteness scores than the other groups. Cluster 1 (“Non-checking middle identification”), 2 (“Non-checking high-identification”) and 5 (“Non-checking low-identification”) had comparable levels of incompleteness.

Hence, “Checking low-identification” and “Checking high-identification” had comparable levels of harm avoidance and incompleteness. This suggests that, contrary to our expectations, the two motivational core dimensions are not underlying distinct levels of action identification in checking.

3.2.3.4. Group comparison on anxiety levels

There was a significant effect of group on anxiety levels, $F(4, 470) = 10.70$, $p < .001$, $\eta^2p = .08$ (a medium effect size, according to Cohen's criteria). Post hoc analyses indicated that cluster 3 ("Checking low-identification") had significantly greater anxiety scores than the remaining groups. Cluster 4 ("Checking high-identification") had significantly greater anxiety levels than non-checking clusters (cluster 1: "Non-checking middle identification" and 2: "Non-checking high-identification"), except cluster 5 ("Non-checking low-identification").

*Table 6. **Study 2**: Summary of post-hoc group comparisons on the level of action identification scores (BIF scores), on OCD dimensions (Checking, Washing, Ordering, Obsessing, Hoarding), on OC motivational traits (OC-TCDQ harm and incompleteness subscales) and on trait anxiety scores (STAI-T).*

		P-Values (FDR corrected)
DV: BIF		
Non-checking middle identification	Non-checking high-identification	<0.001
	Checking low-identification	<0.001
	Checking high-identification	<0.001
	Non-checking low-identification	<0.001
Non-checking high-identification	Checking low-identification	<0.001
	Checking high-identification	<0.001
	Non-checking low-identification	<0.001
Checking low-identification	Checking high-identification	<0.001
	Non-checking low-identification	<0.001
Checking high-identification	Non-checking low-identification	<0.001
DV: OCI-R Checking		
Non-checking middle identification	Non-checking high-identification	1
	Checking low-identification	<0.001
	Checking high-identification	<0.001
	Non-checking low-identification	0.100
Non-checking high-identification	Checking low-identification	<0.001
	Checking high-identification	<0.001
	Non-checking low-identification	0.197
Checking low-identification	Checking high-identification	<0.001
	Non-checking low-identification	<0.001
Checking high-identification	Non-checking low-identification	<0.001
DV: OCI-R Washing		
Non-checking middle identification	Non-checking high-identification	1
	Checking low-identification	<0.001
	Checking high-identification	<0.001
	Non-checking low-identification	1
Non-checking high-identification	Checking low-identification	<0.001
	Checking high-identification	<0.001
	Non-checking low-identification	1

Checking low-identification	Checking high-identification	1
	Non-checking low-identification	0.005
Checking high-identification	Non-checking low-identification	0.042

DV: OCI-R Ordering

Non-checking middle identification	Non-checking high-identification	1
	Checking low-identification	<0.001
	Checking high-identification	<0.001
	Non-checking low-identification	1
Non-checking high-identification	Checking low-identification	<0.001
	Checking high-identification	<0.001
	Non-checking low-identification	1
Checking low-identification	Checking high-identification	1
	Non-checking low-identification	<0.001
Checking high-identification	Non-checking low-identification	<0.001

DV: OCI-R Obsessing

Non-checking middle identification	Non-checking high-identification	1
	Checking low-identification	<0.001
	Checking high-identification	<0.001
	Non-checking low-identification	0.747
Non-checking high-identification	Checking low-identification	<0.001
	Checking high-identification	<0.001
	Non-checking low-identification	0.283
Checking low-identification	Checking high-identification	0.524
	Non-checking low-identification	0.024
Checking high-identification	Non-checking low-identification	1

DV: OCI-R Hoarding

Non-checking middle identification	Non-checking high-identification	1
	Checking low-identification	<0.001
	Checking high-identification	<0.001
	Non-checking low-identification	1
Non-checking high-identification	Checking low-identification	<0.001
	Checking high-identification	<0.001
	Non-checking low-identification	1
Checking low-identification	Checking high-identification	1
	Non-checking low-identification	<0.001
Checking high-identification	Non-checking low-identification	0.002

DV: OC-TCDQ Harm

Non-checking middle identification	Non-checking high-identification	1
	Checking low-identification	<0.001
	Checking high-identification	<0.001
	Non-checking low-identification	1

Non-checking high-identification	Checking low-identification	<0.001
	Checking high-identification	<0.001
	Non-checking low-identification	1
Checking low-identification	Checking high-identification	1
	Non-checking low-identification	<0.001
Checking high-identification	Non-checking low-identification	<0.001
DV: OC-TCDQ Incompleteness		
Non-checking middle identification	Non-checking high-identification	1
	Checking low-identification	<0.001
	Checking high-identification	<0.001
	Non-checking low-identification	1
Non-checking high-identification	Checking low-identification	<0.001
	Checking high-identification	<0.001
	Non-checking low-identification	1
Checking low-identification	Checking high-identification	1
	Non-checking low-identification	<0.001
Checking high-identification	Non-checking low-identification	<0.001
DV: STAI-T		
Non-checking middle identification	Non-checking high-identification	1
	Checking low-identification	<0.001
	Checking high-identification	0.384
	Non-checking low-identification	1
Non-checking high-identification	Checking low-identification	<0.001
	Checking high-identification	0.002
	Non-checking low-identification	0.498
Checking low-identification	Checking high-identification	0.150
	Non-checking low-identification	0.010
Checking high-identification	Non-checking low-identification	1

Note: Bold values indicate group differences significant at $p < .05$ after Benjamini–Hochberg corrections; BIF = Behavior Identification Form, OCI-R = Obsessive-Compulsive Inventory Revised, STAI-T = State-Trait Anxiety Inventory (Trait anxiety form), OC-TCDQ = Obsessive-compulsive trait core dimension questionnaire.

To sum up, this second study suggests that checking prone participants related to a low-level of action identification are characterized by higher anxiety proneness as compared to checking participants characterized by a high-level of action identification. Interestingly, non-checking participants related to a low-level of action identification were also characterized by higher anxiety scores, as compared to the other non-checking clusters. These results are consistent with the Jamnadass et al. study. Finally, checking characterized by a low-level of action identification and checking characterized by a high-level of action identification had comparable levels of harm avoidance and incompleteness. This suggests that the two motivational core dimensions are not underlying distinct levels of action identification in checking.

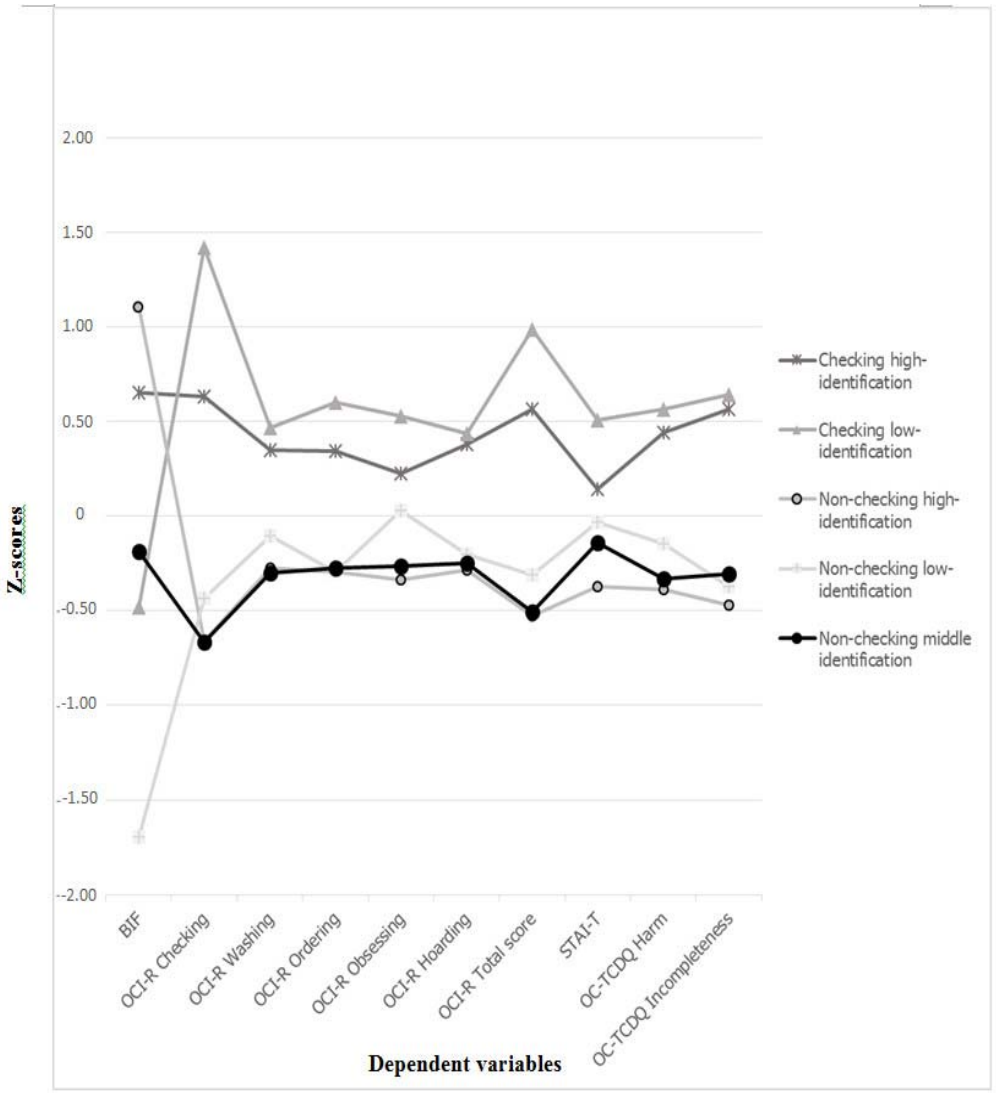


Figure 4. Means of each cluster for the (Z–transformed) measures of action identification, OCD dimensions, anxiety and OC motivational traits (Study 2)

4. General Discussion

This research aimed to explore the level (i.e., high-level goal aspects vs. low-level movement parameters) at which checking-prone participants identify various habitual actions and to further clarify the relationship between checking and action identification in the context of the heterogeneity within the OC checking dimension.

Our results can be summarized as follows: The first study allowed the identification of distinct checking subtypes according to the predominance of responsibility and perfectionism beliefs, which are consistent with the hypothesized heterogeneity within OC subtypes (Rasmussen & Eisen, 2002), and the checking subtype in particular (e.g., Ecker & Gönner, 2008; Tolin et al., 2008). In Study 1, our main results suggest that the hypothesized lack of goal processing (i.e., low-level of action identification) appears to be specifically connected to checking prone participants who are not motivated by responsibility related dysfunctional beliefs, consistent with the idea that within OCD dimensions heterogeneity implies, at least partly, distinct underlying cognitive factors. According to the action identification theory, low-level action representations guide actions when goal representations are absent during action processing (Wegner, Vallacher, Macomber, Wood, & Arps, 1984). From this perspective, checking, that is not connected to responsibility beliefs, can be conceptualized as a lack of action processing regarding goal-related information that normally triggers feelings of goal satisfaction and subsequent action closure. This could explain the repeated enactment of routine actions regardless of the obvious achievement of the goal. Further studies are also needed to clarify the connection between action identification and action monitoring. Indeed, what remains unclear is whether

action identification reflects a general problem in activating goal representations during action evaluation, which in turn disturbs action monitoring mechanisms or whether a general dysfunction of action monitoring mechanisms leads people to chronically focus on the details of action, since recurrent perception of error leads to spontaneous focus on motor parameters.

Hence, the results of Study 1 are in line with the idea that a lack of goal processing (i.e., a low level of action identification) might be connected with checking behaviors (Belayachi & Van der Linden, 2009; Belayachi & Van der Linden, 2015; Boyer & Liénard, 2006; Jung et al., 2009; Kim et al., 2008), and we further highlight the fact that such particularity might be specifically related to checking that occur in the absence of responsibility related beliefs.

This could be useful for clinicians as there is some evidence of poor efficacy of classical therapy (based on exposure and on beliefs changes) with some OC patients (i.e., those who do not experience fear or responsibility beliefs; Cottraux et al., 2001; Whittal, Thordarson, & McLean, 2005). In that context, the action identification measure could be an interesting diagnostic tool in order to improve psychological counselling, for example by building up a tailor-made therapeutic strategy consisting in training low-action identification in high-checking prone people to process their actions in terms of goal-related features (e.g., by focusing attention on action-effect related features). Our results may also explain, at least partly, inconsistent results across various studies on cognitive aspects of checking. Indeed, a lack of goal processing has been connected to a lower ability to remember whether previous intentions have been accomplished (i.e., defective memory) (Vallacher & Wegner, 1989). Interestingly, numerous studies have reported disturbed memory for motor actions in checking (e.g., Zermatten, Van der Linden, Larøi, & Ceschi, 2006), whereas other studies failed to replicate such findings (e.g., Hermans, Martens, De Cort, Pieters, & Eelen, 2003). Knowing that the extent to which episodes are encoded in terms of goal-related information may determine the richness of the resulting episodic encoding (Conway, 2001), one could argue that an impaired ability to process goal-related information during enactment might consequently impair how these actions are stored in memory in a subtype of checking that is characterized by a low-level of action identification. Further studies should directly explore the extent to which memory impairments in some checking behaviours are secondary to defective goal processing.

From Study 1 has emerged an intriguing pattern of apparently inconsistent results suggesting that participants from the perfectionism-related group, which had a level of action identification that was not statistically different from that observed in the low-beliefs group, was thus characterized by a low-level of action identification. Knowing that perfectionism is classically viewed as a set of beliefs, one could argue that such results exclude *de facto* the possibility that a low-level of action identification in chronic checking is characterized by an absence of dysfunctional beliefs. Nevertheless, looking in detail at BIF scores of the perfectionism related subgroup reveals that level of action identification in that checking subgroup was not particularly low, as it was comparable to the mean BIF score in the whole sample of Study 1 as well as to that reported in previous studies using BIF measure (see Vallacher & Wegner, 1989). By contrast, the mean BIF score of checking participants in the low-beliefs group was below the generally reported mean BIF score in the literature as well as in the whole sample of Study 1. Besides, perfectionism encompasses in fact multiple dimensions (Frost, Marten, Lahart, & Rosenblate, 1990), some of which are not connected with dysfunctional beliefs (e.g., chronic doubts about whether intended actions have been actually/properly performed, focus on details). Such heterogeneity in perfectionism cannot however be further examined by means of the OBQ-44 perfectionism subscale. Hence, future studies should be conducted in order to directly address this question by using other measures, such as the Frost Multidimensional Perfectionism Scale (FMPS, Frost et al., 1990) which is designed specifically to assess distinct dimensions of perfectionism. Using distinct perfectionism dimensions (i.e., related to beliefs vs. not related to beliefs) as clustering variables may help addressing this issue.

The second study further highlighted that checking participants related to a low-level of action identification (i.e., lack of action processing regarding goal-related features) are also characterized by high-levels of anxiety. Furthermore, Study 2 revealed that anxiety also increased in the subgroup of non-checking participants characterized by an extremely low-level of action identification (i.e., Non-checking low-identification" subgroup). The connection between anxiety and low-level action identification we observed is consistent with the Jamnadass et al. (2014) study showing that checking participants with high-levels of anxiety are also characterized by low-levels of action identification. High-levels of anxiety have been reported to lead individuals to focus their attention on details, favoring local perceptual information processing (e.g., Boyer & Liénard, 2006; Derryberry & Reed, 1998). Furthermore, anxiety has been

connected to defective action monitoring comparable to that observed in OC phenomena (i.e., increased error signaling; Moser, Moran, & Jendrusina, 2012). Hence, one could argue that anxiety might play a key role in defective goal processing in some checking profiles, as suggested by Jamnadass et al. (2014). Nevertheless, if a low-level of action identification is indeed due to anxiety, Non-checking participants characterized by an extremely low-level of action identification in Study 2 should have reported anxiety levels comparable to that observed in the checking low-identification cluster, which was not the case. Furthermore, if anxiety is directly responsible for low-level of action identification, then checking participants characterized by a low-level of action identification (not related to dysfunctional beliefs) in Study 1 should have had higher anxiety scores than the other checking subgroups, which was not the case since they had levels of anxiety comparable to that observed in the other checking subgroups. One possible explanation for the connection between anxiety and action identification is that a low-level of action identification, which has been related to increased action dysregulation and general dissatisfaction with one's efficiency, could lead to higher anxiety in some people. However, the link between anxiety and action identification is speculative in both the present research and in the Jamnadass et al. (2014) study as the methods used across the two research projects were not tailored to find any causal explanation. Thus, future studies should be conducted in order to directly determine whether anxiety per se leads to low-levels of action identification or whether an increased difficulty in experiencing goal completion and related doubts could lead some people to develop anxiety symptoms.

In study 2, we also expected that checking prone participants with low-level of action identification are also those characterized by an increased tendency to experience incompleteness phenomena, in line with the suggestion that checking behaviors not motivated by harm avoidance and responsibility beliefs stem in fact from incompleteness feelings (e.g., Coles, Heimberg, Frost, & Steketee, 2005; Summerfeldt, 2004; Tolin et al., 2008), explaining the abnormal focus on the details of action in that type of checking (Summerfeldt, 2004). However, this hypothesis was not supported by our results. It is worth noticing that incompleteness dimension (INC) and the harm avoidance dimension (HA) as measured by the OC-TCDQ were highly correlated with each other in the present study as well as in other studies (magnitude of correlation ranging from .52-.76; Ecker, Kupfer, & Gönner, 2014; Pietrefesa & Coles, 2008, 2009). Although factorial analyses suggest that a two-factor model provides a better fit than a single factor model (Pietrefesa & Coles, 2008; Summerfeldt et al., 2014; Taylor et al., 2014), the two factors appear systematically highly correlated with one another suggesting that both convey to a similar phenomenon (e.g., premonition-like experiences). Furthermore, the INC dimension of the OC-TCDQ appears highly correlated with other harm avoidance measures in a recent research (Taylor et al., 2014). Hence, considering the very strong correlation between INC and HA, it is possible that incompleteness as measured by the OC-TCDQ does not allow for a clear distinction between harm avoidance related checking and a checking subtype characterized by a chronic low-level of action identification. Another possible explanation would be that checking related to low-level of action identification and checking connected to incompleteness reflect in fact distinct checking profiles: in the former case, checking convey difficulties in determining whether past actions have been actually or properly performed (i.e., doubt-related checking), while the latter conveys the immediate feeling that "something's wrong" with an ongoing action (i.e., error-related checking). If this is the case, the behavioral counterpart should varied such that in the first case checking may consist in interrupting an ongoing action in order to check whether previous actions have been done properly, which is consistent with the idea that goal processing and memory for actions might be interconnected, as suggested above; whereas, in the latter case, checking may consist in immediate "on-line" correction of action, which is consistent with the idea that incompleteness features are connected with impaired motor control mechanisms implicated in on-line monitoring during performance (Summerfeldt, 2004).

It is also worth noticing that the present research revealed the existence of a subtype of checking with a tendency to be characterized by a high-level of action identification (i.e., general tendency to process actions regarding to goal-features; Study 2), consistent with the results of Jamnadass et al. (2014), and the co-occurrence of an inflated sense of responsibility and perfectionism tended to go along with a high-level of action identification in a dysfunctional beliefs-based subtype of checking (Study 1). These results should be interpreted in conjunction with a study in which washing patients, which are often connected with responsibility concerns, have been reported to identify the habitual action of washing one's hands at a high-level as compared to non-OCD controls (Dar & Katz, 2005). Nevertheless Dar and Katz examined the identification of an action that is strongly linked to compulsive ritual-related concerns (i.e., washing). It would be interesting to see whether dysfunctional beliefs-based checking is connected with a general tendency to identify various habitual actions at a high-level or whether high level action identification in

connection with responsibility and threat concerns is specific to certain actions, such as security related actions (e.g., stove, window, door). As depicted in case reports, some patients check specifically significant actions (those with important negative consequences if not realized properly) while others repeat and check a wide range of basic actions (reading, shoelaces, socks, etc.). Hence, for some OC symptoms, action identification could be content-dependent (e.g., avoiding contamination, avoiding security related problems) rather than process-based (Dar & Katz, 2005). Nevertheless, there was no difference on action identification measure between the checking group related mainly to responsibility, the checking group related to responsibility and perfectionism and the control group in Study 1. This suggests that dysfunctional beliefs related checking does not go along with an extremely high level of action identification. Further studies should thus be conducted in order to examine these issues.

The present research points to the importance of taking the checking heterogeneity into account when examining the cognitive correlates of checking, in order to increase effect replicability. Indeed, the correlation between checking and action identification varied across the two studies, probably because it is not a linear relation between the general measure of checking and the measure of action identification. The connection between checking and low-level of action identification may mostly depend on the reason as to why one frequently check one's everyday behaviors (e.g., a chronic difficulty in determining whether an intended goal has been achieved vs. the general desire to control random threatening events). The failure of effect replicability in cognitive studies on checking is more the rule than the exception. Hence, as suggested by numerous studies, the motivational heterogeneity underlying OC symptoms might be systematically taken into account when it comes to examine specific factors potentially connected to checking.

Before concluding we should highlight the several limitations to this study. A first important limitation is the questionnaire based nature of the present study; a further empirical examination of the causal relationship between a low level of action identification and checking is needed. One way to examine this issue would consist in preventing people with low-checking propensity to process basic actions regarding goal-related features (by focusing on motor parameters/action details) and examining whether it may lead them to be less sure about their past performances and, if they are given the possibility of checking their past performances, to checking-like behaviours. Second, a lack of goal processing could be a side effect of other factors, such as attentional focus or the checking per se; this should also be explicitly examined in further studies. Third, although cluster analyses can be considered as a reliable tool for the assessment of various subtypes of OC symptoms, it is worth developing a reliable measure designed to more directly assess the various subtypes of checking (i.e., a measure of checking heterogeneity). Finally, our results should be replicated in a sample of people with more severe checking symptoms (i.e., OCD patients).

In conclusion, results of the present research suggest that peculiar action processing can be reported in a subtype of checking that is not connected to responsibility related beliefs. Besides, the question regarding perfectionism beliefs domain still requires further examination knowing the multidimensional aspect of the perfectionism concept. Across the two studies, we found evidence further supporting the hypothesized heterogeneity within the mechanism implicated in checking behaviors, highlighting the predominantly low-level of action identification that may characterize high-checking prone people with a subset of clinical characteristics (i.e., not connected with responsibility beliefs, potentially in association with some perfectionism related features, characterized by high-levels of anxiety). These results support the idea that some checking individuals perform actions that are disconnected from the goal they wish to achieve. This may explain why they have concerns about the details of their actions, and why they repeat them, even after achieving their goal. These findings are quite important because they may explain both inconsistent results in studies examining the defective action processing hypothesis in compulsive checking, and why cognitive interventions for OCD based on the idea that some dysfunctional beliefs, such as responsibility related beliefs, are triggering factors have not led to improvements in treatment efficacy (Cottraux et al., 2001; Whittal, Thordarson, & McLean, 2005). Knowing that it is possible to train people to identify their actions at a particular level, further studies should try to train the low-level of action identification-related checking subtype to process their actions in terms of goal-related features (e.g., by focusing attention on action-effect related features) in order to reduce doubts about goal satisfaction.

Acknowledgments

The collection of data was supported by a Concerted Research Action ARC 06/11-340 by the Ministry for Higher Education and Scientific Research of the French-speaking Community (Belgium), the Belgian Fund for Scientific Research (*F.R.S.-FNRS*, Belgium) and a grant from the Swiss National Science Foundation (FNS, Switzerland). The writing of this manuscript was supported by the Belgian Fund for Scientific Research (*F.R.S.-FNRS*, Belgium).

References

Abramowitz, J. S., Fabricant, L. E., Taylor, S., Deacon, B. J., McKay, D., & Storch, E. A. (2014). The relevance of analogue studies for understanding obsessions and compulsions. *Clinical Psychology Review*, *34*, 206–217. https://doi.org/10.1016/j.cpr.2014.01.004

Attiullah, N., Eisen, J. L., & Rasmussen, S. A. (2000). Clinical features of obsessive-compulsive disorder. *Psychiatric Clinics of North America*, *23*, 469–491. https://doi.org/10.1016/S0193-953X(05)70175-1

Belayachi, S., & Van der Linden, M. (2009). Level of agency in sub-clinical checking. *Consciousness and Cognition*, *18*, 293–299. https://doi.org/10.1016/j.concog.2008.06.005

Belayachi, S., & Van der Linden, M. (2010). The Relationship Between Internal Encoding Style and Obsessive–Compulsive Symptoms in a Subclinical Sample. *Behaviour Change*, *27*, 104–111. https://doi.org/10.1375/bech.27.2.104

Belayachi, S., & Van der Linden, M. (2015). Exploring the Parsing of Dynamic Action in Checking Proneness. *Behaviour Change*, *32*, 93–103. https://doi.org/10.1017/bec.2015.2

Benjamini, Y., & Hochberg, Y. (1995). Controlling the false discovery rate: a practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society. Series B (Methodological)*, 289–300.

Boyer, P., & Liénard, P. (2006). Precaution systems and ritualized behavior. *Behavioral and Brain Sciences*, *29*, 635–641. https://doi.org/10.1017/S0140525X06009575

Bruchon-Schweitzer, M., & Paulhan, I. (1993). Manuel de l'inventaire d'anxiété état-trait forme Y (STAI-Y). *Adapté Par Bruchon-Schweitzer et Paulhan. Paris*.

Calamari, J. E., Wiegartz, P. S., & Janeck, A. S. (1999). Obsessive–compulsive disorder subgroups: a symptom-based clustering approach. *Behaviour Research and Therapy*, *37*, 113–125. https://doi.org/10.1016/S0005-7967(98)00135-1

Calamari, J. E., Wiegartz, P. S., Riemann, B. C., Cohen, R. J., Greer, A., Jacobi, D. M., … Carmin, C. (2004). Obsessive–compulsive disorder subtypes: an attempted replication and extension of a symptom-based taxonomy. *Behaviour Research and Therapy*, *42*, 647–670. https://doi.org/10.1016/S0005-7967(03)00173-6

Clatworthy, J., Buick, D., Hankins, M., Weinman, J., & Horne, R. (2005). The use and reporting of cluster analysis in health psychology: A review. *British Journal of Health Psychology*, *10*, 329–358. https://doi.org/10.1348/135910705X25697

Coles, M. E., Heimberg, R. G., Frost, R. O., & Steketee, G. (2005). Not just right experiences and obsessive–compulsive features: Experimental and self-monitoring perspectives. *Behaviour Research and Therapy*, *43*, 153–167. https://doi.org/10.1016/j.brat.2004.01.002

Conway, M. A. (2001). Sensory–perceptual episodic memory and its context: Autobiographical memory. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *356*, 1375–1384. https://doi.org/10.1098/rstb.2001.0940

Cottraux, J., Yao, S. N., Lafont, S., Mollard, E., Bouvard, M., Sauteraud, A., … Dartigues, J.-F. (2001). A randomized controlled trial of cognitive therapy versus intensive behavior therapy in obsessive compulsive disorder. *Psychotherapy and Psychosomatics*, *70*, 288–297. https://doi.org/10.1159/000056269

Dar, R., & Katz, H. (2005). Action identification in obsessive-compulsive washers. *Cognitive Therapy and Research*, *29*, 333–341. https://doi.org/10.1007/s10608-005-4266-5

Derryberry, D., & Reed, M. A. (1998). Anxiety and attentional focusing: Trait, state and hemispheric influences. *Personality and Individual Differences*, *25*, 745–761. https://doi.org/10.1016/S0191-8869(98)00117-2

Ecker, W., & Gönner, S. (2008). Incompleteness and harm avoidance in OCD symptom dimensions. *Behaviour Research and Therapy*, *46*, 895–904. https://doi.org/10.1016/j.brat.2008.04.002

Ecker, W., Kupfer, J., & Gönner, S. (2014). Incompleteness and harm avoidance in OCD, anxiety and depressive disorders, and non-clinical controls. *Journal of Obsessive-Compulsive and Related Disorders*, *3*, 46–51. https://doi.org/10.1016/j.jocrd.2013.12.001

Everitt, B. S., Landau, S., Leese, M., & Stahl, D. (2011). Hierarchical clustering. *Cluster Analysis, 5th Edition*, 71–110. https://doi.org/10.1002/9780470977811.ch4

Foa, E. B., Huppert, J. D., Leiberg, S., Langner, R., Kichic, R., Hajcak, G., & Salkovskis, P. M. (2002). The Obsessive-Compulsive Inventory: development and validation of a short version. *Psychological Assessment*, *14*, 485–496. https://doi.org/10.1037/1040-3590.14.4.485

Frost, R. O., Marten, P., Lahart, C., & Rosenblate, R. (1990). The dimensions of perfectionism. *Cognitive Therapy and Research*, *14*, 449–468. https://doi.org/10.1007/BF01172967

Frost, R. O., & Steketee, G. (1997). Perfectionism in obsessive-compulsive disorder patients. *Behaviour Research and Therapy*, *35*, 291–296. https://doi.org/10.1016/S0005-7967(96)00108-8

Group, O. C. C. W., & others. (2005). Psychometric validation of the obsessive belief questionnaire and interpretation of intrusions inventory—Part 2: Factor analyses and testing of a brief version. *Behaviour Research and Therapy*, *43*, 1527–1542. https://doi.org/10.1016/j.brat.2004.07.010

Hermans, D., Martens, K., De Cort, K., Pieters, G., & Eelen, P. (2003). Reality monitoring and metacognitive beliefs related to cognitive confidence in obsessive–compulsive disorder. *Behaviour Research and Therapy*, *41*, 383–401. https://doi.org/10.1016/S0005-7967(02)00015-3

Jamnadass, E. S., Badcock, J. C., & Maybery, M. T. (2014). Subclinical checking is associated with a bias towards goal-directed (high-level) action identification. *Journal of Obsessive-Compulsive and Related Disorders*, *3*, 1–5. https://doi.org/10.1016/j.jocrd.2013.11.003

Julien, D., O'Connor, K. P., Aardema, F., & Todorov, C. (2006). The specificity of belief domains in obsessive–compulsive symptom subtypes. *Personality and Individual Differences*, *41*, 1205–1216. https://doi.org/10.1016/j.paid.2006.04.019

Jung, W. H., Gu, B.-M., Kang, D.-H., Park, J.-Y., Yoo, S. Y., Choi, C.-H., … Kwon, J. S. (2009). BOLD response during visual perception of biological motion in obsessive-compulsive disorder. *European Archives of Psychiatry and Clinical Neuroscience*, *259*, 46–54. https://doi.org/10.1007/s00406-008-0833-8

Kim, J., Blake, R., Park, S., Shin, Y.-W., Kang, D.-H., & Kwon, J. S. (2008). Selective impairment in visual perception of biological motion in obsessive-compulsive disorder. *Depress Anxiety*, *25*, E15–25. https://doi.org/10.1002/da.20402

Lind, C., & Boschen, M. J. (2009). Intolerance of uncertainty mediates the relationship between responsibility beliefs and compulsive checking. *Journal of Anxiety Disorders*, *23*, 1047–1052. https://doi.org/10.1016/j.janxdis.2009.07.005

McKay, D., Abramowitz, J. S., Calamari, J. E., Kyrios, M., Radomsky, A., Sookman, D., … Wilhelm, S. (2004). A critical evaluation of obsessive–compulsive disorder subtypes: symptoms versus mechanisms. *Clinical Psychology Review*, *24*, 283–313. https://doi.org/10.1016/j.cpr.2004.04.003

Miguel, E. C., do Rosário-Campos, M. C., Prado, H. da S., Do Valle, R., Rauch, S. L., Coffey, B. J., … others. (2000). Sensory phenomena in obsessive-compulsive disorder and Tourette's disorder. *The Journal of Clinical Psychiatry*, *61*, 150–156. https://doi.org/10.4088/JCP.v61n0213

Moser, J. S., Moran, T. P., & Jendrusina, A. A. (2012). Parsing relationships between dimensions of anxiety and action monitoring brain potentials in female undergraduates. *Psychophysiology*, *49*, 3–10. https://doi.org/10.1111/j.1469-8986.2011.01279.x

Murayama, K., Nakao, T., Sanematsu, H., Okada, K., Yoshiura, T., Tomita, M., … Kanba, S. (2013). Differential neural network of checking versus washing symptoms in obsessive-compulsive disorder. *Progress in Neuro-Psychopharmacology and Biological Psychiatry*, *40*, 160–166. https://doi.org/10.1016/j.pnpbp.2012.09.002

Myers, S. G., Fisher, P. L., & Wells, A. (2008). Belief domains of the Obsessive Beliefs Questionnaire-44 (OBQ-44) and their specific relationship with obsessive–compulsive symptoms. *Journal of Anxiety Disorders*, *22*, 475–484. https://doi.org/10.1016/j.janxdis.2007.03.012

Pietrefesa, A. S., & Coles, M. E. (2008). Moving beyond an exclusive focus on harm avoidance in obsessive compulsive disorder: Considering the role of incompleteness. *Behavior Therapy*, *39*, 224–231. https://doi.org/10.1016/j.beth.2007.08.004

Pietrefesa, A. S., & Coles, M. E. (2009). Moving Beyond an Exclusive Focus on Harm Avoidance in Obsessive-Compulsive Disorder: Behavioral Validation for the Separability of Harm Avoidance and Incompleteness. *Behavior Therapy*, *40*, 251–259. https://doi.org/10.1016/j.beth.2008.06.003

Pinto, A., Eisen, J. L., Mancebo, M. C., Greenberg, B. D., Stout, R. L., & Rasmussen, S. A. (2007). Taboo thoughts and doubt/checking: a refinement of the factor structure for obsessive–compulsive disorder symptoms. *Psychiatry Research*, *151*, 255–258. https://doi.org/10.1016/j.psychres.2006.09.005

Pitman, R. K. (1987). A cybernetic model of obsessive-compulsive psychopathology. *Comprehensive Psychiatry*, *28*, 334–343. https://doi.org/10.1016/0010-440X(87)90070-8

Purcell, R., Maruff, P., Kyrios, M., & Pantelis, C. (1998). Cognitive deficits in obsessive–compulsive disorder on tests of frontal–striatal function. *Biological Psychiatry*, *43*, 348–357. https://doi.org/10.1016/S0006-3223(97)00201-1

Rachman, S. (2002). A cognitive theory of compulsive checking. *Behaviour Research and Therapy*, *40*, 625–639. https://doi.org/10.1016/S0005-7967(01)00028-6

Rasmussen, S. A., & Eisen, J. L. (2002). The course and clinical features of obsessive-compulsive disorder. *Psychopharmacology: A Fifth Generation of Progress,* 1503–1608.

Salkovskis, P. M., Wroe, A. L., Gledhill, A., Morrison, N., Forrester, E., Richards, C., … Thorpe, S. (2000). Responsibility attitudes and interpretations are characteristic of obsessive compulsive disorder. *Behaviour Research and Therapy*, *38*, 347–372. https://doi.org/10.1016/S0005-7967(99)00071-6

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the state-trait anxiety scale*. Palo Alto, CA: Consulting Psychologists Press.

Summerfeldt, L. J. (2004). Understanding and treating incompleteness in obsessive-compulsive disorder. *Journal of Clinical Psychology*, *60*, 1155–1168. https://doi.org/10.1002/jclp.20080

Summerfeldt, L. J., Kloosterman, P. H., Antony, M. M., & Swinson, R. P. (2014). Examining an obsessive-compulsive core dimensions model: Structural validity of harm avoidance and incompleteness. *Journal of Obsessive-Compulsive and Related Disorders*, *3*, 83–94. https://doi.org/10.1016/j.jocrd.2014.01.003

Taylor, S., McKay, D., Crowe, K. B., Abramowitz, J. S., Conelea, C. A., Calamari, J. E., & Sica, C. (2014). The Sense of Incompleteness as a Motivator of Obsessive-Compulsive Symptoms: An Empirical Analysis of Concepts and Correlates. *Behavior Therapy*, *45*, 254–262. https://doi.org/10.1016/j.beth.2013.11.004

Tolin, D. F., Brady, R. E., & Hannan, S. (2008). Obsessional beliefs and symptoms of obsessive–compulsive disorder in a clinical sample. *Journal of Psychopathology and Behavioral Assessment*, *30*, 31–42. https://doi.org/10.1007/s10862-007-9076-7

Tolin, D. F., Woods, C. M., & Abramowitz, J. S. (2003). Relationship between obsessive beliefs and obsessive–compulsive symptoms. *Cognitive Therapy and Research*, *27*, 657–669. https://doi.org/10.1023/A:1026351711837

Ursu, S., Stenger, V. A., Shear, M. K., Jones, M. R., & Carter, C. S. (2003). Overactive action monitoring in obsessive-compulsive disorder evidence from functional magnetic resonance imaging. *Psychological Science*, *14*, 347–353. https://doi.org/10.1111/1467-9280.24411

Vallacher, R. R., & Wegner, D. M. (1987). What do people think they're doing? Action identification and human behavior. *Psychological Review*, *94*, 3–15. https://doi.org/10.1037/0033-295X.94.1.3

Vallacher, R. R., & Wegner, D. M. (1989). Levels of personal agency: Individual variation in action identification. *Journal of Personality and Social Psychology*, *57*, 660–671. https://doi.org/10.1037/0022-3514.57.4.660

Wegner, D. M., & Vallacher, R. R. (1986). Action identification.In R. M. Sorrentino & E. T. Higgins (Eds.), *Handbook of motivation and cognition: Foundations of social behavior* (pp. 550–582). New York: Guilford Press.

Wegner, D. M., & Vallacher, R. R. (1987). The trouble with action. *Social Cognition*, *5*, 179–190. https://doi.org/10.1521/soco.1987.5.3.179

Wegner, D. M., Vallacher, R. R., Macomber, G., Wood, R., & Arps, K. (1984). The emergence of action. *Journal of Personality and Social Psychology*, *46*, 269–279. https://doi.org/10.1037/0022-3514.46.2.269

Whittal, M. L., Thordarson, D. S., & McLean, P. D. (2005). Treatment of obsessive–compulsive disorder: Cognitive behavior therapy vs. exposure and response prevention. *Behaviour Research and Therapy*, *43*, 1559–1576. https://doi.org/10.1016/j.brat.2004.11.012

Wu, K. D., & Cortesi, G. T. (2009). Relations between perfectionism and obsessive–compulsive symptoms: Examination of specificity among the dimensions. *Journal of Anxiety Disorders*, *23*, 393–400. https://doi.org/10.1016/j.janxdis.2008.11.006

Zermatten, A., & Van der Linden, M. (2008). Phenomenal characteristics of memories of daily actions in checking-prone individuals. *Applied Cognitive Psychology*, *22*, 1099–1112. https://doi.org/10.1002/acp.1423

Zermatten, A., Van der Linden, M., Jermann, F., & Ceschi, G. (2006). Validation of a French version of the Obsessive–Compulsive Inventory-Revised in a non-clinical sample. *Revue Européenne de Psychologie Appliquée/European Review of Applied Psychology*, *56*, 151–155. https://doi.org/10.1016/j.erap.2005.07.003

Zermatten, A., Van der Linden, M., Larøi, F., &, G. (2006). Reality monitoring and motor memory in checking-prone individuals. *Journal of Anxiety Disorders*, *20*, 580–596. https://doi.org/10.1016/j.janxdis.2005.08.001