The contribution of processing fluency to preference: A comparison with familiarity-based recognition

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Abstract

There is a great deal of evidence supporting the idea that, when a stimulus is processed fluently, it is more likely to be judged as pleasant. However, this influence of fluency on preference judgement seems to depend on several experimental conditions. So we tried to better understand these conditions via a comparison with recognition and by manipulating some aspects of the procedure (test format) and material (similarity and figure-ground contrast of the stimuli). Two experiments showed that some conditions maximally induce the use of processing fluency in a preference judgement, as in a recognition task. We discuss the implications of these findings for the well-documented discrepancy-attribution hypothesis (Whittlesea & Williams, 1998, 2000).

Key words: Mere exposure effect, Familiarity, Recognition, Stimulus similarity, Fluency, Expectations

Prior work has demonstrated experimentally that various manipulations that enhance the experience of perceptual fluency (such as varying the visual clarity of test items) or conceptual fluency (such as varying the predictive level of conceptual context) influence how subjects respond on recognition memory tests. Stimuli that are perceived fluently relative to other stimuli presented in the same context are more likely to be judged as familiar, and thus as old, in a recognition task (Jacoby & Whitehouse, 1989; Rajaram & Geraci, 2000; Whittlesea, 1993; Whittlesea, Jacoby, & Girard, 1990). The same is true of other judgements or experiences, like judgements of preference (Bornstein & D'Agostino, 1992, 1994; Reber, Winkielman, & Schwarz, 1998; Seamon et al., 1983a; Whittlesea & Price, 2001), truth (Reber & Schwarz, 1999), fame (Jacoby, Woloshyn, & Kelley, 1989), perceptual characteristics (Goldinger, Kleider, & Shelley, 1998), frequency estimates (Reber & Zupanek, 2002; Wanke, Schwarz, & Bless, 1995), feelings of knowing (Koriat, 2000), stimulus duration (Masson & Caldwell, 1998), etc. To take the case of preference, there is a great deal of evidence supporting the idea that, when a stimulus is fluently processed, it is more likely to be judged as pleasant or preferred than less fluently processed stimuli (see Reber, Schwarz, & Winkielman, 2004). To date, the most extensively studied phenomenon has been the *mere exposure effect,* defined as an enhanced positive attitude towards a stimulus that has been processed earlier (Zajonc, 1968; for review, see Butler & Berry, 2004).

Whereas the precise nature of the relationship between processing fluency and recognition memory has been extensively investigated, this is not yet true of other judgemental tasks. In this study, we tried to better understand the conditions in which fluency has an impact on preference decisions via a comparison with recognition. More specifically, as regards recognition, the degree to which fluency plays a role in recognition decisions depends on several factors. The question that is addressed in this study is whether similar factors might mediate the influence of fluency on preference judgements. We first describe the factors that mediate the influence of fluency on recognition. Then we will address what is known about preference judgements.

The dual-process models of recognition memory (e.g., Atkinson & Juola, 1974; Jacoby & Dallas, 1981; Mandler, 1980; Tulving, 1985; see Yonelinas, 2002, for a recent review) assume that the recognition of prior events may use two separate processes: recollection (retrieval of contextual detail) and familiarity. According to the fluency account, conceptual or perceptual fluency can mediate successful familiarity-driven recognition (e.g., Rajaram, 1993; Rajaram & Geraci, 2000; Willems & Van der Linden, in press). However, there may be some circumstances in which people do not use fluency for recognition decisions. Firstly, some types of condition may encourage reliance on other processes than the perception of enhanced fluency. In fact, fluency-based recognition responses certainly correspond to feelings of intuiting, when recollection can seem be a more definitive basis for responding (Jacoby & Dallas, 1981). Thus, a recollection-based strategy will generally be chosen over a fluency-based strategy when distinctive cues are available or elaborative processing at the time of encoding is permitted. Secondly, sometimes fluency is not interpreted as a sign that the stimulus has been encountered in the past. Indeed, another element determining the role of fluency in recognition (e.g., Whittlesea & Williams, 1998, 2000, 2001a, b) consists of indirect factors such as the attributions and expectations developed by the participants. In this context, Whittlesea and Williams have proposed a discrepancy-attribution hypothesis, which states that enhanced fluency is unconsciously attributed to previous exposure to a stimulus and creates a feeling of familiarity, only when the individual is surprised by the ease with which he or she is able to process the item. In other words, familiarity is experienced when there is a discrepancy between the expected and the actual fluency of processing. Thus, Whittlesea and Williams suggest that it is not fluency per se that produces the feeling of familiarity, but rather the fact that the fluent processing occurs under unexpected circumstances. By contrast, when the source of fluency is more salient (e.g., seeing a picture that is much clearer than other pictures), the subject may formulate expectations regarding the fluency with which the stimulus should be processed, and this reduces the likelihood that fluency will serve as the basis of familiarity-based memory decisions.

Today the role of fluency in preference judgements is much less clear. A first problem with this relationship is that it does not seem to be direct and proportional (in the sense that low processing fluency leads to a small increase in preference whereas high processing fluency is reflected in a strong preference for a stimulus). For example, it has been shown that fluency due to previous exposure has the strongest influence on preference when the stimuli were previously presented for relatively short durations (see Bornstein, 1989) with low pre-exposure frequency (e.g., Van den Bergh & Vrana, 1998), or when the stimuli used are complex (Bornstein, Kale, & Cornell, 1990; Cox & Cox, 1988, 2002). In view of these observations, one interesting approach may be that, as with recognition, the enhanced influence of fluency is not systematic. Rather, the degree to which fluency plays a role in preference may depend on factors quite similar to the ones described above (i.e., the availability of other information and the role of expectations and attributions). First, it has been demonstrated that people rely on a variety of cues when making preference judgements. An interesting illustration of the diversity of the cues that may underlie such judgements is provided by studies of facial attractiveness. Indeed, numerous characteristics of shape (e.g., averageness, Langlois & Roggman, 1990; Rhodes, Sumich, & Byatt, 1999; prototypical facial proportions, Rhodes, Hickford, & Jeffery, 2000; and symmetry, Jones, Little, & Perrett, 2003) and some surface characteristics (e.g., skin texture and coloration, apparent health of skin, Jones, Little, Burt, & Perrett, 2004; Penton-Voak & Perrett, 2001) seem to influence subjects' liking of unfamiliar faces. Given the abundance of informative inputs for preference judgements, it seems obvious that the fluency effect may be limited by the fact that subjects can also rely on available and relevant cues other than fluency for their judgement. In agreement with this assumption, it should be noted that the fluency effect has been found to have the strongest influence when the stimuli are unfamiliar, neutral or presented for relatively short durations (see Winkielman, Schwarz, Fazendeiro, & Reber, 2003). Besides, the effect of repetition on preference decisions (i.e., mere exposure effect) has most often been investigated, on one hand, by using unfamiliar, non-representational stimuli (see Whittlesea & Price, 2001), and on the other hand, by using relatively short durations during the preference decision (e.g., 1 second, Seamon et al., 1995; Willems, Adam, & Van der Linden, 2002; 3 seconds, Seamon, Kena, & Binder, 1998) or asking subjects to make their decisions fast.

Moreover, the same attribution mechanisms as in recognition may also act in preference judgements. Indeed, as mentioned above, the mere exposure effect is often greater when stimuli are presented subliminally in the exposure phase than when they are presented supraliminally. Bornstein and D'Agostino (1992, 1994) suggested that, in the latter case, subjects undoubtedly realise that their performance may be affected by the previous exposure. Consequently, they discount the fluency of processing to some degree when making a preference decision. Along these lines, some authors have suggested that, once fluency experience is elicited by repetition or other manipulation, its impact on preference judgements could be moderated by attributional processes (Bornstein & D'Agostino, 1994; Van den Bergh & Vrana, 1998), but also by the amount of fluency subjects expected (Butler, Berry, & Helman, 2004; Reber et al., 2004; Willems & Van der Linden, in press; Winkielman et al., 2003). In this vein, Willems and Van der Linden (in press) observed that manipulating the fluency of previously seen stimuli with an additional variation in picture clarity during the preference test influences the mere exposure effect. Indeed, the influence of pre-exposure was reduced when targets were presented with low picture clarity and enhanced with high clarity. However, this influences preference only when the manipulation is imperceptible. When it is less subtle, the ease of processing resulting from picture quality seem be expected and consequently is perceived as uninformative. Moreover, the processing fluency was attributed totally to the picture quality manipulation and, accordingly, undermined the effect of enhanced fluency due to pre-exposure. To date, the importance of expectations has not been explored very much, but it definitely deserves more attention. In addition, earlier findings showed that, even when a feeling of fluency might be expected, some fluently processed stimuli may continue to elicit a preference, such as after an obvious supraliminal presentation phase, of the kind that has been used in some mere exposure paradigms (e.g., Seamon et al., 1995). Consequently, the nature of the connection between ease of processing and preference judgements and the importance of additional indirect factors seem to be complex and are worth studying.

In sum, in light of this overview of the literature on the contribution of enhanced fluency to preference judgements and recognition decisions, we suggest that the degree to which fluency plays a role in preference and recognition depends on a number of similar conditions. These conditions may include, first, situations where cues other than fluency are unavailable or difficult to use and, second, situations where unexpected fluency captures the attention and thus is more likely to be used for recognition and preference judgements.

From this perspective, in our first experiment, we investigated whether varying the amount of available information influenced participants' reliance on fluency for preference responses, as it does for recognition responses. In order to examine this hypothesis, we varied the degree of material similarity by creating two material sets: *less similar* (S–) and *highly similar* (S+) unfamiliar faces. We compared the performance for unfamiliar S– and S+ faces in preference and recognition tasks. In order to measure the contributions of recollection and familiarity, we applied the Remember/Know procedure to the recognition task. This procedure is an interesting method for measuring familiarity and the contribution of fluency. Indeed, prior research has shown that conceptual or perceptual fluency can mediate successful Know responses (e.g., Rajaram, 1993; Rajaram & Geraci, 2000; Willems & Van der Linden, in press). For example, Rajaram (1993) found that masked primes reliably increased Know responses to both studied and non-studied test stimuli; that is, a preview of an old or new test item increased the probability that participants would know that the stimulus had been presented on the study list. Similarly, Willems and Van der Linden (2006) observed that an imperceptible manipulation of picture clarity at the test time seems have a direct impact on Know responses. Finally, we decided to explore the effect of test format on the heuristic choice. In fact, because the feeling of enhanced fluency is probably not absolute but relative (i.e., the fluency is only experienced in comparison to the relative difficulty of processing other items), it might be easier to assess small but reliable differences in fluency in the context of a forced-choice (2AFC) task than in a yes-no (YN) task.[1] In summary, we expected that (1) the fluency resulting from previous exposure should be a more salient cue for the very similar set (stronger mere exposure effect and more Know responses in recognition); (2) a greater mere exposure effect and more correct Know responses would be evident in the forced-choice than in the yes-no test format.

In Experiment 2, we added an unexpected fluency condition in order to test the discrepancy-attribution hypothesis (Whittlesea & Williams, 1998, 2000, 2001a, b). Thus, we manipulated the subjects' expectation of fluency by manipulating an additional fluency source at the test time (i.e., some pictures were presented with higher quality than other pictures). We hypothesised that perceptual fluency should be attributed to preference only if there is a discrepancy between expected fluency and actual fluency, in exactly the same way as for familiarity-based recognition. In other words, we anticipated obtaining a stronger preference when participants did not expect to process pictures efficiently, i.e., when stimuli are presented with a low picture quality.

Experiment 1

Method

Subjects

Ninety-six undergraduate students from the University of Liège were volunteers in this experiment. There were 48 men and 48 women. Their mean age was 21.01 years old (*SD* = 1.72).

Materials

The stimuli were morphed faces. From an original set (an experimental database created at the University of Sheffield, UK) of 240 faces (male, front view, without any facial expression or distinguishing characteristics such as a beard, glasses or long hair, and with the same figure-ground contrast), two sets of 60 morphed faces were created by morphing 120 pictures with one master picture in each set (see Fig. 1). Each morphed face was created by including a certain percentage of the shape and surface features of the master face. The degrees of similarity of the two sets were respectively 55% (*S*+, the 60 morphed faces shared 55% of the features of the master face: they were highly similar, see Fig. 1a) and 20% (*S*–, the 60 morphed faces shared 20% of the features of the master face: they are less similar, see Fig. 1b). Because the morphing procedure can impair the quality of the picture, it was necessary to use morphed faces for the S– set, rather than pictures of unmorphed faces, in order to make the S– set as comparable as possible to the S+ set.

INSERT FIGURE 1 ABOUT HERE

Each of the two sets was randomly divided into two subsets of 30 faces that could be used in the preference and recognition tests (with random counterbalancing between subjects).

Consequently, we had four subsets of 30 faces (Pref/S–, Rec/S–, Pref/S+, Rec/S+). Half of the subjects were presented with the two S– subsets (Pref/S– and Rec/S–) and the other half were presented with the two S+ subsets (Pref/S+ and Rec/S+).

In addition, each of these four subsets was randomly divided into two lists of 15 stimuli (A and B). For half of the subjects, list A served as target stimuli and list B as distracters. The other half of the subjects were presented with the reverse design.

All stimuli were presented on a 17" colour monitor running at 60 Hz, approximately 70 cm from the subject. The faces were about 9 cm high and 6 cm wide. They appeared on a black background, which yielded a pronounced figure-ground contrast. Each picture was made equivalent in file size (201 kB) and was presented using E-Prime software (Psychology Software Tools, Inc.). Low room illumination conditions were used throughout the experiment.

Design and procedure

The experimental set-up resulted in a three-factor design, with the first between-subject factor being the similarity condition (S+ versus S–). The second between-subject factor was the format of the task (yes-no versus forced-choice format). The third factor, which was manipulated within subjects, was the type of test (preference versus recognition). Therefore, there were four between-subject conditions: two conditions involving only S+ faces (one using a YN test format and one using a 2AFC format) and two conditions with only S– faces (YN and 2AFC).

Incidental study phase. Participants were told that the study involved ‘face perception’, and that they were going to see 30 faces, two times. After viewing three examples, they were asked to estimate the age of each of the 60 target faces presented by responding *less than 30 years old* or *more than 30 years old*. This task ensured that the subject remained focused throughout the presentation. No mention was made of any subsequent memory test.

Subjects were then presented with 30 faces, twice each, in two random series of 30. Each study stimulus was presented at the centre of the screen for 2,500 ms, followed by a 2,500-ms interval.

Preference judgement. In the test phase of the YN preference judgement, subjects were presented with 30 faces, consisting of 15 previously shown faces randomly intermixed with 15 novel distracter faces. Each item was presented for 2 seconds, followed by a self-spaced interstimulus interval of approximately 1 to 2 seconds. Subjects were asked to examine each face and to decide whether *the face is pleasant, yes or no*. In the 2AFC preference judgement, 15 target-foil pairs were presented. Both faces were presented to the subject simultaneously. The side of the screen in which the target stimulus was displayed was counterbalanced and randomised over trials. Subjects were asked to examine each pair and *to choose the face they liked best*.

Recognition judgement. In the test phase of the YN recognition task, participants saw a random list of 15 target faces and 15 distracter faces, which had not yet been used for the preference judgement. For each face, participants had to say whether they had seen it before. In the 2AFC recognition task, participants saw 15 target-distracter pairs and were asked to choose the stimulus that they had seen during the exposure phase.

In addition, for both test formats, the subjects were asked to make a Remember-Know-Guess response. Written instructions explaining Remember (R), Know (K), and Guess (G) responses were given to the participants (see Appendix). Participants entered their recognition responses on the computer keyboard and made the R-K-G judgements orally.

The participants were tested individually. Half of the subjects were presented with the preference judgement first and then with the recognition judgement. The other half of the subjects performed the recognition judgement task before the preference judgement.

Results and discussion

An α level of .05 was adopted for all inferential statistics, and their actual significance is reported whenever the level was below .10.

As the order of the tasks had no effect on preference and recognition scores (*Ps* > .05), we did not consider this variable in the following analyses.

Recognition performance. In order to compare 2AFC and YN tasks, we calculated *d'* scores (see Table 1).[2] The mean proportion of hits and false alarms on the YN tasks and the proportion of correct responses on the 2AFC tasks are presented in Table 1.

INSERT TABLE 1 ABOUT HERE

An ANOVA with Similarity of the stimuli (S+ versus S–) and Format of the task (2AFC versus YN) as between-subject variables was conducted on these *d'* scores. It revealed an advantage for the YN format ($F(1, 92) = 16.56$, $MSe = 9.53$, $p < .001$), and an advantage for less similar material ($F(1, 92) = 4.67$, $MSe = 2.69$, $p = .03$). Thus, as was logically to be expected, when we considered global recognition performance without distinguishing between the different recognition processes, we observed more correct recognition memory for the less similar material than for the very similar material.

Remember, Know, and Guess. Separate ANOVAs with Format and Similarity as between-subject variables were performed for each response type (see Table 2).

INSERT TABLE 2 ABOUT HERE

Regarding R responses for targets (hits), we observed only a main effect for similarity ($F(1, 92) = 6.34$, $MSe = 0.14$, $p = .01$), regardless of test format, showing that participants reported proportionally more R responses for S– than S+ stimuli. Analysis of R responses for distracters (false alarms) also revealed that participants reported more R false alarms with the 2AFC than the YN task format ($F(1, 92) = 3.58$, $MSe = 0.01$, $p = .06$); and with S+ than S– material ($F(1, 92) = 9.59$, $MSe = 0.03$, $p = .002$). This confirms that remembering is a more appropriate retrieval process for S– than S+ material and for the YN format than the 2AFC one. This effect of similarity can be explained in terms of the reduced distinctiveness of the material and of the increased interference. Indeed, increasing the average similarity of items increases overlap and interference (Norman, O'Reilly, & Huber, 2000), thus decreasing the distinctiveness (i.e., non-overlap) of memory traces. These results are therefore consistent with the very widespread idea that recollection-based recognition involves the retrieval of distinctive or qualitatively specific information about individual items (e.g., Hintzman & Curran, 1994; Norman & O'Reilly, 2003; Rajaram, 1996).

For K responses, conversely, participants reported more correct responses for S+ material than S– items ($F(1, 92) = 5.58$, $MSe = 0.07$, $p = .02$), regardless of test format. Analysis of false responses showed that participants reported more K false alarms with the YN than the 2AFC format ($F(1, 92) = 19.30$, $MSe = 0.10$, $p < .001$), and for S+ material than S– items ($F(1, 92) = 3.04$, $MSe = 0.02$, $p = .08$). Jacoby, Yonelinas, and Jennings (1997) have suggested that, if recollection and familiarity are independent processes that operate in parallel, the contribution of familiarity to recognition is understated by the proportion of K (familiar) responses. When familiarity for targets was measured by their Independence Remember/Know (IRK) procedure (Familiarity = K/ 1 – R), the analyses revealed no significant effect. For distracters, the analyses showed that distracters were more likely to be perceived as familiar in YN tasks than in 2AFC tasks ($F(1, 92) = 18.37$, $MSe = 0.12$, $p < .001$). A significant interaction ($F(1, 92) = 3.87$, $MSe = 0.02$, $p = .05$) showed also that participants experienced significantly more familiarity for distracters with S+ than S– material in the YN condition ($F(1, 92) = 6.15$, $p = .01$), but not in the

2AFC task (F= 0.09). Globally, these findings thus indicate that the accuracy of familiarity was practically unaffected by the degree of similarity of the faces in 2AFC tasks. In the YN tasks, participants produced more familiarity responses for highly similar distracters than for less similar ones, but this was not the case in the 2AFC task. These findings are consistent with previous data showing that familiarity contributes more to correct recognition in forced-choice tasks than in yes-no recognition memory (Bastin & Van der Linden, 2003; Parkin, Yeomans, & Bindschaedler, 1994).[3] In fact, increasing item similarity could make both studied items and distracters more fluent. Although similar distracters will also be fluent, they should be reliably less fluent than studied items. Thus, familiarity should greatly benefit from use of the 2AFC procedure, which allows subjects to tune into the small but reliable fluency differences that exist between these items.

Finally, to consider the effect of test Format and Similarity on the heuristic (recollection versus familiarity-based recognition) adopted by the participants, global production scores (hits + false alarms) were calculated for each type of response. For the global production of R responses, we observed no significant effect, showing that the test format and similarity did not influence the total use of recovered details. Thus, surprisingly, recollection processes are here a retrieval mode used in all conditions, i.e. regardless of their efficiency. One explanation could be that the difficulty level was very great for both stimuli sets. Indeed, given this kind of complex unfamiliar stimulus coming from a single category (Caucasian young men) and with a completely uniform presentation format (i.e., all the stimuli were black-and-white photographs, in front view, the same size, without any contextual features, etc.), it should be quite difficult to discriminate one face from another. To respond to this evident difficulty, the participants could ‘by default’ attempt to find some critical feature in order to discriminate new from old stimuli (Whittlesea & Price, 2001). On the contrary, for the overall production of K responses, participants used more familiarity-based responses for S+ material than S– items ($F(1, 92) = 12.05$, $MSe = 0.18$, $p < .001$). Thus, the perceptual similarity and the lack of distinctive features in the set of faces that shared 55% of their features seemed to encourage the participants to capitalise more on familiarity-based decisions. So although subjects used the recollection strategy as much in the less similar condition as in the highly similar condition (despite the fact that recollection seemed less accurate), a greater degree of similarity led people to rely more on a fluency strategy for the highly similar condition than for the less similar one.

Finally, there was a main effect for Format on the false G responses ($F(1, 92) = 46.86$, $MSe = 0.31$, $p < .001$), indicating that there were more erroneous G responses in the 2AFC tasks than in the YN tasks. There was a main effect for Format on the global use of G responses ($F(1, 92) = 18.34$, $MSe = 0.26$, $p < .001$), with subjects guessing more frequently in the forced-choice format.

Mere exposure effect. In order to find out whether the mere exposure effect was present in the two test formats, we calculated the difference between liked targets and liked distracters and examined whether this difference was greater than zero.

INSERT TABLE 3 ABOUT HERE

In the YN preference judgements, the mean difference between the proportion of liked targets and the proportion of liked distracters was .02 ($SD = .29$) for the S– set of stimuli and .07 ($SD = .2$) for the S+ set. The difference was marginally greater than zero for S+ faces, with a medium effect ($p = .06$, $d = .34$), but not for S– ones for which effect sizes was small ($p > .1$, $d = .06$). In the 2AFC preference judgements, the mean difference between the proportion of liked targets and the proportion of liked distracters was .03 ($SD = .21$) for the S– set of stimuli and .275 ($SD = .35$) for the S+ set. This difference was significant for S+ stimuli, with large effect ($p <$

.005, d = .81), but not for S– ones for which size effect was small ($p > .1$, d = 16). We expected that the mere exposure effect would be greater for highly similar stimuli than for less similar stimuli. Our results confirmed this prediction. This stronger preference effect could be explained by the fact that processing fluency resulting from previous exposure becomes more salient than the other available features that may possibly influence preference, such as facial shape and surface characteristics (e.g., symmetry, averageness, facial proportion, and skin texture).

Nevertheless, the absence of the mere exposure effect for the less similar faces was unexpected. Indeed, one might wonder why we did not observe a preference effect for the less similar faces, while this effect was found for more heterogeneous unfamiliar faces (e.g., Willems, Adam, & Van der Linden, 2002). One important difference between the Willems et al. (2002) work and the current study is that in the former the stimuli were presented subliminally (17 ms), whereas the latter presented the stimuli supraliminally (2,500 ms). This difference is critical, as it is possible that subjects use different strategies to perform the preference task when they are aware that the stimuli have been presented before. More specifically, the failure to obtain a mere exposure effect for less similar faces in this experiment might be due to relatively good recollection (because of distinctiveness and encoding time), leading subjects to expect fluency as a result of obvious prior presentation and consequently not to rely on this fluency (see Bornstein & D'Agostino, 1992, 1994) and to turn to other inputs in order to formulate a preference judgement.

As regards the highly similar condition, the difference between the fluency of processing of a target and the fluency of processing of its corresponding distracter was probably weaker than in the S– distracters. Indeed, the highly similar distracters include 55% of features that had already been seen and the less similar ones only 20%. In addition, some findings suggest that the fluency-based preference induced by repeated exposure may generalise onto novel stimuli that are physically or structurally similar to those presented previously (e.g., Gordon & Holyoak, 1983). Nevertheless, with recollection making a lesser contribution, one can imagine that this slight difference in fluency highlighted items which all looked the same to them. So a small but unexpected and surprising degree of fluency might influence the preference decision. In our second experiment, we further examined the influence of expectation.

Finally, when one considers only the highly similar material (for which we observed a significant mere exposure effect), the *d*' scores was marginally greater in the 2AFC task than in the YN task ($t(46) = 1.773$, $p = .08$). This confirms that the fluency driving the preference is, for the most part, experienced for an item in comparison to the relative difficulty of processing other items.

Experiment 2

Most previous studies of the discrepancy-attribution hypothesis have used linguistic stimuli (words and non-words). In our second experiment, we explored the question of whether the perception of discrepancy is a heuristic that can be used for familiarity-based recognition of another type of stimulus: unfamiliar faces. We also investigated whether the perception of discrepancy could be attributed to preference. We addressed this issue by manipulating the subjects' expectation of fluency through variations in the quality of the target pictures (figure-ground contrast, luminosity, and posterisation). Some studies have demonstrated that increased picture quality leads to a linear increase in processing fluency (see Checkosky & Whitlock, 1973; Reber et al., 1998; Willems & Van der Linden, in press). Given such results, we assume that a perceptible decrease in processing fluency for some targets based on picture quality will lead subjects to expect a higher level of fluency for clear targets than for blurry targets. Further, we assume that repeated previous exposure will increase the fluency of target pictures to a level superior to the level that would be expected from poor-quality targets at the test phase but not from clear targets. This unexpected fluency could capture a subject's attention and might be used in the preference task or the recognition task.

In this experiment, we used the forced-choice format (which ensured that we observed a greater preference effect and more correct K responses) with less similar faces (with which we observed no mere exposure effect and fewer correct K responses in experiment 1).

Method

Subjects

Twenty young adults were volunteers in this experiment. There were 10 men and 10 women. Most of them were undergraduate students from the University of Liège, Belgium. Their mean age was 21.9 years old (SD = 1.31).

Materials and procedure

The face set was the less similar set of faces from experiment 1. The experimental details were the same, with two exceptions: first, we used only the forced-choice format. Second, we introduced the clarity condition as a within-subject condition. Each picture underwent a 10% contrast and luminosity reduction and slight posterisation (increasing the pixel size and decreasing the clarity). These picture modifications were very subtle; thus, the decrease in quality could be perceived without necessarily being noticed (see Fig. 2).

INSERT FIGURE 2 ABOUT HERE

Face targets were randomly divided into two sets (A, B). Half of the subjects were presented with set A as the clear stimuli and set B as the blurred stimuli. The other half of the subjects were presented with the reverse design. Thus, each target was presented clear for half of the subjects and blurred for the other half.

Results and discussion

The proportions of correct responses for preference and recognition as a function of picture clarity are presented in Table 4.

INSERT TABLE 4 ABOUT HERE

Since the order of the tasks had no effect on preference and recognition scores (*Ps* > .05), we did not consider this variable in the following analyses.

Recognition performance. When considering the proportion of correct recognition responses, the recognition performance was identical for both clarity conditions ($p = .58$).

Remember, Know, and Guess. Separate ANOVAs with Clarity and Type of response as within-subject variables were performed for hits and false alarms (see Table 5).

INSERT TABLE 5 ABOUT HERE

For hit responses, we observed a main effect for Type of response ($F(2, 38) = 30.23$, $MSe = .79$, $p < .001$), with more R responses than K responses or G responses ($p < .01$), a Type of response × Clarity interaction ($F(2, 38) = 3.75$, $MSe = .07$, $p = .03$), but no effect for Clarity ($p > .1$). Planned comparisons showed no significant effect for R and G responses, but more correct K responses for blurred pictures than clear ones ($F(1, 19) = 7.92$, $p =.01$). When familiarity for targets was measured by the IRK procedure (Familiarity = K/ 1 – R, Jacoby et al., 1997), the analyses revealed a marginal difference for blurred and clear faces ($t(19) = 1.66$, $p =.06$). For false alarms, we observed no significant effects (*ps* >.05). Thus, we found that clarity did have an effect on performance, but only for familiarity. These data seem to indicate that familiarity-based recognition of old items is more accurate when fluent processing occurs in an unexpected condition. Indeed, in the case of blurred targets, the actual fluency probably diverged from the expected fluency for the poorer-quality pictures. This deterioration in the quality of target pictures might prompt participants to engage in an attributional process to explain their feeling of fluency. Since that feeling is not attributable to the test context (poor picture quality), participants explained it as resulting from another source such as a prior encounter in the context of recognition tasks.

Mere exposure effect. The mean proportions of target faces chosen in the preference judgement were .54 (SD = .18) for clear faces and .65 (SD = .15) for blurred faces. Subjects selected blurred targets in a proportion greater than chance, with large effect (estimated at .50, $p < .001$, $d = 1$) but this was not the case with clear targets, ($p > .05$, $d = .19$). Thus, again we did not observe an effect of repetition on preference responses for less similar material. However, when these same faces were presented with poorer picture quality, we noted a mere exposure effect. In other words, stimuli that are experienced as not being particularly well liked when presented in the clear condition (as in experiment 1), are experienced as well liked when presented in the blurred condition. Moreover, contrary to Experiment 1, we observed no condition effect on recollection. Thus, the success in obtaining a mere exposure effect for blurred faces might not be due to a less efficient recollection of these faces. Our findings therefore appear consistent with the account of the feeling of familiarity proposed by Whittlesea and Williams (1998) since the less fluent the stimulus was expected to be, the more it evoked a familiarity and preference response.

In summary, it seems that the discrepancy-attribution effect is a phenomenon that can be generalised to the feeling of familiarity measured by participants' subjective reports and to unfamiliar visual stimuli. Moreover, our results indicate that discrepancy attribution can also be extended to the mere exposure effect.

Conclusion

In two experiments, the influence of processing fluency due to pre-exposure on preference and recognition judgements was found to depend on relatively similar variables: the amount of information in the stimuli, the format of the test, and the picture quality of the target stimuli in the test phase.

In Experiment 1, the influence of processing fluency due to pre-exposure on recognition, and more particularly on preference judgement, was found to depend on the amount of distinctive information. In fact, as regards preference, processing resulting from repeated exposure influenced participants' preference decisions about very similar faces but not about distinctive faces. We suggested that several factors might explain these data. First, as with recognition, where fluency plays a dominant role only if conscious recollection fails to yield reliable memories (e.g., Jacoby et al., 1989), and if fluency is seen as a relevant source (e.g., Westerman,, Lloyd, & Miller, 2002), a fluency heuristic is probably not a 'by default heuristic' for preference responses. Rather, in spite of the strong links between fluency and positive affect (Harmon-Jones & Allen, 2001; Winkielman & Cacioppo, 2001), the impact of stimulus content itself (semantic content or objective critical perceptual features) certainly override the vague perception of processing quality quite often. Further, it is probable that the objective processing fluency (i.e., high or low speed, resource demands, accuracy of mental processes) that qualifies every cognitive act is a dimension that most often goes unnoticed and that does not lead to an experience of subjective fluency and consequently to a conscious subjective feeling of preference. Second, we suggested that, given that distinctive material was recollected more efficiently than similar material, participants might therefore be more aware of the impact of prior presentation and expect to feel more fluency for this distinctive material. In this case, fluency might be judged irrelevant for preference judgements (because it is attributed to repetition). Subjects would then turn to other available inputs to arrive at their preference judgements. This hypothesis concerning the role of expectation seems to be supported by the findings of Experiment 2. Indeed, although repetition did not influence preference judgements for distinctive material in Experiment 1, it did enhance preference when the picture quality for this material was lower, in Experiment 2. Thus, in spite of the efficient recollection of distinctive material, variable picture quality at test seems to lead participants to weight their expectations due to their awareness of prior repetition. Participants might expect to experience very little fluency for poorer-quality pictures and be taken by surprise at how fluently they could process these pictures; consequently, they might allocate a part of this fluency to preference, due to the surprisingly fluent processing of pictures that were poorer in quality but had been previously encountered.

As mentioned above, these factors have been extensively investigated in the context of recognition, but not with other judgemental tasks (such as preference, truth, fame, perceptual characteristics, frequency estimates, feelings of knowing, stimulus duration, etc). Nevertheless, in light of this study, it is probable that the degree to which fluency plays a role in these kinds of judgement could depend on relatively similar conditions such as amount of available cues other than fluency and expectations. However, there may be some exceptions. For example, Reber et al. (Reber, Zimmermann, & Wurtz, 2004) showed that potential expectations about the processing quality of different stimuli (words, regular non-words, and irregular non-words) did not moderate the effects of fluency on duration judgements. These authors suggested that, during a recognition task, participants do not necessarily assess the experienced fluency immediately and do not infer familiarity directly from experienced fluency. On the contrary, participants may simply and directly transform experienced fluency into a duration evaluation, regardless of the actual source of the fluency. If this assumption is right, it will be a challenge for future research to discover in which kinds of judgement tasks people do not base their judgement on a direct assessment of processing fluency (such as recognition and preference) and in which kinds of tasks people assess fluency immediately and base their responses directly on experienced fluency (such as duration).

Author notes

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References

Atkinson, R. C., & Juola, J. F. (1974). Search and decision processes in recognition memory. In R. C. Atkinson, D. H. Krantz, *Contemporary developments in mathematical psychology: I. Learning, memory and thinking*. Oxford, England: W. H. Freeman.

Bastin, C., & Van der Linden (2003). The contribution of recollection and familiarity to recognition memory: A study of the effects of test format and aging. *Neuropsychology, 17*, 14-24.

Bornstein, F.R., & D'Agostino, P.R. (1992). Stimuli recognition and the mere exposure effect. *Journal of Personality and Social Psychology, 4*, 545-552.

Bornstein, R. F., & D'Agostino, P. R. (1994). The attribution and discounting of perceptual fluency: Preliminary tests of a perceptual fluency/attributional model of the mere exposure effect. *Social Cognition, 12*, 103-128.

Bornstein, R. F., Kale, A. R., & Cornell, K. R. (1990). Boredom as a limiting condition on the mere exposure effect. *Journal of Personality and Social Psychology, 58*, 791–800.

Bornstein, R.F. (1989). Exposure and affect: Overview and meta-analysis of research, 1968-1987. *Psychological Bulletin, 106*, 265-289.

Butler, L. T. & Berry, D. (2004). Understanding the relationship between repetition priming and mere exposure. *British Journal of Psychology*, *95*, 467-487.

Butler, L. T., Berry, D., & Helman, S. (2004). Dissociating mere exposure and repetition priming as a function of word type. *Memory and Cognition, 5,* 759-767

Checkosky, S. F., & Whitlock, D. (1973). Effects of pattern goodness on recognition time in a memory search task. *Journal of Experimental Psychology, 100,* 341-348.

Cox, D. S., & Cox, A. D. (1988). What does familiarity breed? Complexity as a moderator of repetition effects in advertisement evaluation. *Journal of Consumer Research, 15*, 111–116.

Cox, D. S., & Cox, A. D. (2002). Beyond first impressions: The effects of repeated exposure on consumer liking of visually complex and simple product designs. *Journal of the Academy of Marketing Science, 30*, 119–130.

Goldinger, S. D., Kleider, H. M., & Shelley, E. (1999). The marriage of perception and memory: Creating two-way illusions with words and voices. *Memory & Cognition*, *27*, 328-338.

Gordon, P.C., & Holyoak, K.J. (1983), Implicit Learning and Generalization of. The 'Mere Exposure' Effect. *Journal of Personality and. social psychology, 45*, 492-500

Harmon Jones, E., & Allen, J. J. B. (2001). The role of affect in the mere exposure effect: Evidence from psychophysiological and individual differences approaches. *Personality and Social Psychology Bulletin, 27*, 889–898.

Hintzman, D. L. (2001). Similarity, global matching, and judgments of frequency. *Memory and Cognition, 29,* 547-556.

Hintzman, D. L., & Curran, T. (1994). Retrieval dynamics of recognition and frequency judgments: Evidence for separate processes of familiarity and recall. *Journal of Memory and Language, 33*, 1-18.

Jacoby, L. L., & Whitehouse, K. (1989). An illusion of memory: False recognition influenced by unconscious perception. *Journal of Experimental Psychology: General*, *118*, 126–135.

Jacoby, L. L., Kelley, C. M., & Dywan, J. (1989). Memory attributions. In F.I.M. Craik, H.L. Roediger, *Varieties of memory and consciousness: Essays in honour of Endel Tulving.* (pp. 391-422). Hillsdale, NJ, England: Lawrence Erlbaum Associates.

Jacoby, L. L., Woloshyn, V., & Kelley, C. (1989). Becoming famous without being recognized: Unconscious influences of memory produced by divided attention. *Journal of Experimental Psychology: General, 118,* 115-125.

Jacoby, L. L., Yonelinas, A. P., & Jennings, J. M. (1997). The relation between conscious and unconscious (automatic) influences: A declaration of independence. In J. W. Schooler & J. D. Cohen (Eds.), *Scientific approaches to consciousness*. (pp.13 47). Hillsdale, NJ, England: Lawrence Erlbaum Associates, Inc.

Jacoby, L.R., & Dallas, M. (1981). On the relationship between autobiographical memory and perceptual learning. *Journal of Experimental Psychology: General, 3*, 306-340.

Jones, B. C., Little, A. C., & Perrett, D. I. (2003). Why are symmetrical faces attractive? In S. Shohov, *Advances in psychology research, Vol. 19.* (pp. 145-166). Hauppauge, NY, US: Nova Science Publishers.

Jones, B. C., Little, A. C., Burt, D., & Perrett, D. I. (2004). When facial attractiveness is only skin deep. *Perception, 33*, 569-576.

Koriat, A. (2000). The feeling of knowing: Some metatheoretical implications for consciousness and control. Consciousness and Cognition, 9, 149–171.

Langlois, J. H., & Roggman, L. A. (1990). Attractive faces are only average. *Psychological Science, 1,* 115-121.

Macmillan, N. A. & Creelman, C. D. (1991). *Detection theory: A user's guide*. Cambridge: Cambridge University Press.

Mandler, G. (1980). Recognizing: The judgment of previous occurrence. *Psychological Review, 87*, 252-271.

Masson, M. E. J., & Caldwell, J. I. (1998). Conceptually perceptual misattributions. *Acta Psychologica, 98,* 183-210.

Norman, K.A., & O'Reilly, R.C. (2003). Modelling hippocampal and neocortical contributions to recognition memory: A complementary learning systems approach. *Psychological Review, 110*, 611-646.

Norman, K.A., O'Reilly, R.C., & Huber, D.E. (2000). Modeling neocortical contributions to recognition memory. Poster presented at The Cognitive Neuroscience Meeting, San Francisco, 2000.

Parkin, A.J., Yeomans, J., & Bindschaedler, C. (1994). Further characterization of the executive memory impairment following frontal lobe lesions. *Brain and Cognition, 26*, 23-42.

Penton Voak, I. S., & Perrett, D. I. (2001). Male facial attractiveness: Perceived personality and shifting female preferences for male traits across the menstrual cycle. In J.S. Rosenblatt, P.J.B. Slater, *Advances in the study of behavior* (pp. 219-259). San Diego, CA, US: Academic Press.

Rajaram, S. (1993). Remembering and knowing: Two means of access to the personal past. *Memory and Cognition, 21*, 89-102.

Rajaram, S. (1996). Perceptual effects on remembering: Recollective processes in picture recognition memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 22*, 365-377.

Rajaram, S., & Geraci, L. (2000). Conceptual fluency selectively influences knowing. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 26,* 1070-1074.

Reber, R., & Schwarz, N. (1999). Effects of perceptual fluency on judgments of truth. *Consciousness & Cognition*, *8*, 338-342.

Reber, R., & Zupanek, N. (2002). Effects of processing fluency on estimates of probability and frequency. In P. Sedlmeier, & T. Betsch (Eds.), Frequency processing and cognition (pp. 175–188). Oxford: Oxford University Press.

Reber, R., Schwarz, N., & Winkielman, P. (2004). Processing fluency and aesthetic pleasure: Is beauty in the perceiver's processing experience? *Personality and Social Psychological Review, 8*, 364-382.

Reber, R., Winkielman, P., & Schwarz, N. (1998). Effects of perceptual fluency on affective judgments. *Psychological Science, 9*, 45-48.

Reber, R., Zimmermann, T.D., & Wurtz, P. (2004). Judgments of duration, figure–ground contrast, and size for words and nonwords. *Perception & Psychophysics*, 66, 1105-1114.

Rhodes, G., Hickford, C., & Jeffery, L. (2000). Sex-typicality and attractiveness: Are supermale and superfemale faces super-attractive. *British Journal of Psychology, 91*, 125-140.

Rhodes, G., Sumich, A., & Byatt, G. (1999). Are average facial configurations attractive only because of their symmetry? *Psychological Science, 10*, 52-58.

Seamon, J. G., McKenna, P. A., & Binder, N. (1998). The mere exposure effect is differentially sensitive to different judgment tasks. *Consciousness and Cognition: An International Journal, 7*, 85-102.

Seamon, J.G., Brody, N., & Kauff, D.M. (1983). Affective discrimination of stimuli that are not recognized: Effects of shadowing, masking, and cerebral laterality. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 9*, 544-555.

Seamon, J.G., Williams, P.C., Crowley, M.J., Kim, I.J., Langer, S.A., Orne, P.J., & Wishengrad, D.L. (1995). The mere exposure effect is based on implicit memory: Effect of stimulus type, encoding conditions, and number of exposures on recognition and affect judgments. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 21*, 711-721.

Tulving, E. (1985). Memory and consciousness. *Canadian Psychology, 26*, 1-12.

Van den Bergh, O., & Vrana, S. R. (1998). Repetition and boredom in a perceptual fluency/attributional model of affective judgements. *Cognition and Emotion, 12,* 533-553.

Wanke, M., Schwarz, N., & Bless, H. (1995). The availability heuristic revisited: Experienced ease of retrieval in mundane frequency estimates. Acta Psychologica, 89, 83–90.

Westerman, D. L., Lloyd, M. E., & Miller, J. K. (2002). The attribution of perceptual fluency in recognition memory: The role of expectation. *Journal of Memory and Language, 47*, 607-617.

Westerman, D. L., Miller, J. K., & Lloyd, M. E. (2003). Change in perceptual form attenuates the use of the fluency heuristic in recognition. *Memory and Cognition, 31*, 619-629.

Whittlesea, B. W. A. (1993). Illusions of familiarity. *Journal of Experimental Psychology: Learning, Memory, & Cognition, 19,* 1235-1253.

Whittlesea, B. W. A., & Williams, L. D. (1998). Why do strangers feel familiar, but friends don't? A discrepancy-attribution account of feelings of familiarity. *Acta Psychologica, 98*, 141-165.

Whittlesea, B. W. A., & Williams, L. D. (2000). The source of feelings of familiarity: The discrepancy-attribution hypothesis. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 26*, 547-565.

Whittlesea, B. W. A., & Williams, L. D. (2001a). The discrepancy-attribution hypothesis: I. The heuristic basis of feelings and familiarity. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 27*, 3-13.

Whittlesea, B. W. A., & Williams, L. D. (2001b). The discrepancy-attribution hypothesis: II. Expectation, uncertainty, surprise, and feelings of familiarity. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 27*, 14-33.

Whittlesea, B. W. A., Jacoby, L. L., & Girard, K. (1990). Illusions of immediate memory: Evidence of an attributional basis for feelings of familiarity and perceptual quality. *Journal of Memory & Language*, *29*, 716-732.

Whittlesea, B. W., & Price, J. R. (2001). Implicit/explicit memory versus analytic/ nonanalytic processing: rethinking the mere exposure effect. *Memory and Cognition, 29*, 234-246.

Willems, S., & Van der Linden, M. (in press). Mere exposure effect: consequence of direct and indirect fluency-preference links. *Consciousness and Cognition.*

Willems, S., Adam, S., & Van der Linden, M. (2002). Normal mere exposure effect with impaired recognition in Alzheimer's disease. *Cortex, 38*, 77-86.

Winkielman, P., & Cacioppo, J. T. (2001). Mind at ease puts a smile on the face: Psychophysiological evidence that processing facilitation elicits positive affect. *Journal of Personality and Social Psychology, 81*, 989–1000.

Winkielman, P., Schwarz, N., Fazendeiro, T. A., & Reber, R. (2003). The hedonic marking of processing fluency: Implications for evaluative judgment, In K. C. Klauer, & J. Musch, (Eds.), *The psychology of evaluation: Affective processes in cognition and emotion.* (pp.189 217). Mahwah, NJ, US: Lawrence Erlbaum Associates.

Yonelinas, A. P. (2002). The nature of recollection and familiarity: A review of 30 years of research. *Journal of Memory and Language, 46*, 441-517.

Zajonc, R.B. (1968). Attitudinal effects of mere exposure. *Journal of Personality and Social Psychology Monograph Supplement, 9*, 1-27.

Table 1. Recognition as a function of test format and faces' similarity

	Highly similar material			Less similar material		
Format	Hits/Proportion correct	False alarms	*d'*	Hits/Proportion correct	False alarms	*d'*
2AFC recognition	.68 (.10)		.77 (.46)	.71 (.07)		.93 (.34)
YN recognition	.65 (.18)	.26 (.11)	1.34 (1.02)	.67 (.18)	.175 (.09)	1.62 (.95)

Table 2. Proportion of Remember-Know-Guess responses for targets and distracters as a function of test format and faces' similarity

		Highly similar material		Less similar material	
Task		Targets	Distracters	Targets	Distracters
2AFC	Remember	.28 (.13)	.11 (.07)	.39 (.11)	.07 (.08)
	Know	.30 (.14)	.05 (.04)	.23 (.09)	.04 (.04)
	Guess	.09 (.08)	.16 (.11)	.09 (.07)	.18 (.08)
YN	Remember	.32 (.17)	.08 (.04)	.37 (.14)	.05 (.03)
	Know	.24 (.09)	.13 (.11)	.21 (.12)	.09 (.08)
	Guess	.08 (.05)	.17 (.07)	.08 (.08)	.04 (.04)

Table 3. Preference as a function of test format and faces' similarity

	Highly similar material			Less similar material		
Format	Hits/Proportion correct	False alarms	*d'*	Hits/Proportion correct	False alarms	*d'*
2AFC	.64 (.17)	-	.51 (.78)	.52 (.11)	-	.15 (.40)
YN	.37 (.13)	.30 (.13)	.22 (.60)	.39 (.14)	.38 (.27)	.34 (1.35)

Table 4. Preference and recognition as a function of picture clarity.

	Clear Pictures	Blurred Pictures
Preference	.54 (.18)	.65 (.15)
Recogniti on	.68 (.24)	.71 (.10)

Table 5. Proportions of Remember-Know-Guess responses for targets as a function of the fluency expectation

	Clear target		Blurred target	
	Target	Distracter	Target	Distracter
Remember	.38 (.22)	.10 (.16)	.38 (.11)	.11 (.09)
Know	.17 (.12)	.12 (.12)	.27 (.13)	.08 (.09)
Guess	.13 (.11)	.11 (.15)	.07 (.09)	.11 (.09)

FIGURE TITLES

Figure 1a. Examples of S+ faces (55% of the features of a master face).

Figure 1b. Examples of S– faces (20% of the features of a master face).

Figure 2. Examples of clear and blurred faces.

Figure 1a.

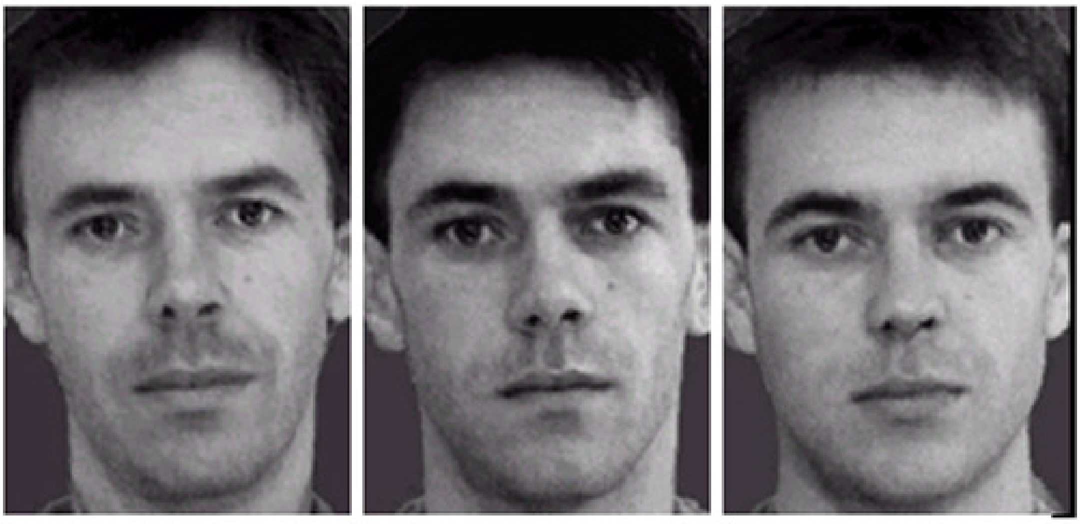

Figure 1b.

Figure 2.

APPENDIX

Remember–Know–Guess Instructions for the Yes-No Task (variations in the instructions for the Forced-Choice Task are presented in parentheses).

Remember

Often, when you recognise a face, you remember that you have seen it before and you remember the precise context you have seen it in. You may also remember an event, a feeling or a thought that occurred when you first saw this face. For example, when you saw that face for the first time, you found that he looked like your cousin or you noticed a particular feature. So we ask you to classify as ‘remember’ a ‘yes’ response (a response) for which you can retrieve information about the encoding context. An example in everyday life would be the following: you are walking in the street and you meet a person whom you recognise because you remember having seen him/her at your sister’s wedding, or because you remember having seen him/her in the bus last week.

Know

We ask you to classify a ‘yes’ response (a response) as ‘know’ if you do not remember any information associated with the face. You are sure that you have seen it before because you have a strong feeling of familiarity, but you do not remember any information encoded with the face, such as when you saw it or any element that you might have noticed. In everyday life, such a ‘know’ situation could be: walking in the street and meeting somebody you recognise. You know that you have seen him/her before, but you cannot remember who this person is or where and when you first saw him/her. The only thing you know is that this person seems familiar.

Guess

It is also possible that you may not remember any information encoded with the face and that you are not sure whether it is familiar. However, you are not certain that you have not seen it before either. In such a case, you can ‘guess’.

(You can guess if you do not remember any of the faces. If none of the faces seem familiar or if you do not remember any information about the learning context for any of them, you cannot respond that you ‘remember’ or ‘know’. Because you still have to choose one face, you can guess.)

NOTES

[1] In addition, there is a phenomenon known as the 'test-pair similarity effect', which shows that YN recognition accuracy decreases with increasing target/lure similarity, but 2AFC recognition accuracy is not affected or increases slightly with similarity (e.g., Hintzman, 2001; Norman & O'Reilly, 2003). This pattern can be explained by data showing that familiarity contributes more to correct recognition in 2AFC than in YN tasks (Bastin & Van der Linden, 2003; Parkin, Yeomans, & Bindschaedler, 1994) and by data showing that familiarity is less strongly affected by target/lure similarity than recollection is (Norman & O'Reilly, 2003).

[2] For YN tasks, the *d'* values were obtained from hits (liked target) and false alarms (liked distracter), and for the 2AFC tasks, they were computed from the proportion of correct responses by means of a corrected formula (Macmillan & Creelman, 1991).

[3] In addition, these findings provide evidence for the 'test-pair similarity effect', which shows that YN recognition accuracy decreases with increasing target/lure similarity, whereas 2AFC accuracy increases slightly or is not affected by similarity (e.g., Hintzman, 2001; Norman & O'Reilly, 2003).