Learning Faces: The Effects of Neutral vs. Sensational Information on Later Recognition

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ABSTRACT

This study demonstrates that semantic information can be used to familiarise unknown faces and to facilitate recognition. The trend in face recognition research has been to use famous faces as 'familiar' faces. The slightly less common approach has been to use the faces of subjects' family members. Both of these methods have profound limitations which have hindered the development of the field. This paper proposes a method of generating familiar face sets which are not plagued by the problems affecting famous and family face sets. Different types of semantic information were paired with unfamiliar faces, which were then taught to subjects. For the control group, neutral information was provided, while the two experimental groups received sensational information (favourably arousing for one group, and unfavourably arousing for the other). The extent of participants' familiarisation with their 'learned' face set was measured through reaction time, accuracy and response bias on recognition tasks. The data provided strong support for the hypothesis that unknown random faces can be raised to the threshold of familiarity with semantic information. The nature of the information paired with an unknown face had no significant effect on later recognition.

Keywords: face recognition; familiarity; arousal; latency; accuracy; response bias

This study is informed by knowledge and research from two disparate fields: that of face recognition and that of memory. Semantic information acts as the bridge between these fields. I aimed to establish whether semantic information can be used successfully to elevate a random unknown face to the threshold of familiarity. ‘Semantic information’ will be regarded as any information that confers meaning upon a stimulus. My study included three types of semantic information: neutral, ‘favourable sensational’, and ‘unfavourable sensational’. Each type of information was paired with unknown faces for different groups during the learning phase, and recognition tasks tested whether these faces had been familiarised. The research question for this project was two-fold: firstly, is sensational information more successful than neutral information at making an unknown face familiar? Secondly, does the type of sensational information (favourable or unfavourable) affect the familiarisation of the face to which it is related? A review of literature from the field of face recognition follows, after which the discussion will be directed to the topic of arousal and memory.

One of the cornerstones in the field of face recognition is the fact that faces are processed differently from other classes of objects (Gauthier & Nelson, 2001). There exists a neural circuit specialised in face recognition, including a particular region in the lateral fusiform gyrus, known as the ‘fusiform face area’. This region is activated by facial stimuli but not by non-face objects (Haxby, Hoffman, & Gobbini, 2000). It is thus commonly accepted that faces are neurologically ‘special’.

The brain is not only expert at differentiating between face and non-face objects, however, but also at distinguishing between different types of face stimuli (Gauthier & Nelson, 2001). Different brain regions are activated for familiar and unfamiliar faces on identical tasks. This has been revealed by observing the effect of familiarity on blood flow distribution in the brain (Dubois et al., 1999). Findings include the activation of the ‘fusiform face area’ for tasks involving both known and unknown faces, revealing this region to be critical in all types of face processing. In addition to the general arousal of the fusiform face area, certain additional brain structures are activated for tasks involving familiar and unfamiliar faces, suggesting that different brain processes are involved for different types of visual facial stimuli (Dubois et al., 1999).

The difference between familiar and unfamiliar faces manifests most clearly in tasks involving recognition. Bruce (1982) found that changes to angle and expression act as an impediment to recognition performance. In particular, she demonstrated that such changes impair both accuracy and speed of recognition for previously unfamiliar faces. The implication of this finding is that showing identical images of an unknown face at presentation and test facilitates recognition. Bruce (1982) also demonstrated that familiar faces are recognised more immediately and accurately than unfamiliar faces. However, manipulating face presentation had similar effects on reaction time (latency) for familiar as for unfamiliar faces. Recognition when no changes had been implemented was most rapid, followed by recognition when one change had been introduced; faces changed both in angle and expression were the least recognised most slowly. There was an interaction between the factors of familiarity and view change in terms of accuracy: familiar face recognition was not adversely affected by changes in angle or expression, but unfamiliar face recognition was. From Bruce's experiment, it can be concluded that faces can only be considered familiar when they are recognised accurately irrespective of changes.

Bruce's (1982) findings provide the background to a critical step in my methodology: to know if I had successfully raised the previously unknown faces to the level of familiarity, it was necessary to include conditions which challenge recognition. It has been found that faces are orientation-sensitive and that inversion impairs face recognition (Bartlett & Searcy, 1993; Hancock, Bruce, & Burton, 2000; Leder & Carbon, 2006). Recognition of faces is, in fact, more impaired by inversion than recognition of other classes of objects (Yin, 1969). Bartlett and Searcy (1993) concluded that the effect of inversion was task-dependent: it was contingent on what type of judgment the viewer was required to make. Familiarity judgments are significantly challenged by inversion, possibly because inversion disrupts the holistic processing used to recognise upright faces (Tanaka and Farah, 1993). Furthermore, Ellis, Shepherd and Davies (1979) demonstrated that familiarity judgements were impaired by the presentation of 'internal features' and ‘external features’ only. Internal features include the eyes, nose, and mouth, while external features include the forehead, hairline, jaw and ears. Ellis, Shepherd and Davies (1979) found that the presentation of ‘internal features only’ rendered faces harder to recognise than when they were presented as a whole, while ‘external features only’ made the recognition task even more difficult.

Based on the above findings, faces appeared in the following forms during the recognition phase of this experiment: normal portrait, inverted, internal features only, or external features only. These presentation manipulations were included to challenge recognition and thus highlight differences in familiarity levels among faces which the participants had learned (the ‘learned’ face set), faces with which they were already familiar (the ‘known’ face set), and faces which they had never seen before (the ‘unknown’ face set). Of these face sets, it was predicted known faces would elicit superior recognition, followed by learned faces, followed by unknown faces, and that these discrepancies would be particularly evident in the most challenging recognition conditions: inverted and ‘outside features only’. Ability to recognize a face quickly and accurately in these conditions indicates true familiarity with that face.

Distinguishing between familiar and unfamiliar faces is one of the critical tasks in social interaction. The transition from unfamiliarity to familiarity can be induced by repeated exposure, as demonstrated by Dubois et al. (1999). The effect of pairing semantic information with unknown face stimuli has also been seen to increase familiarity. One approach to demonstrate this has been semantic priming. McNeill and Burton (2002) employed semantic priming to shed light on the storage and retrieval of information that renders a person familiar or unfamiliar. They used pairs of closely associated individuals as stimuli, with one member of the pair acting as the prime for the other. It was found that previous exposure to semantic information about an associated individual facilitated faster familiarity judgments. For example, participants were able to generate the name of the target individual significantly more promptly when provided with an associated name as a prime. McNeill and Burton (2002) concluded that semantic and familiarity judgments are facilitated by semantic priming.

Johnston and Bruce (1994) reached a similar conclusion. They based their experiment on the Bruce and Young model of face recognition (1985, as cited by Johnston & Bruce, 1994), which posits that there is a critical distinction between 'visually derived semantic codes' and 'identity specific semantic codes'. The former can be retrieved irrespective of whether a stimulus is familiar or not. For example, it is possible to ascertain sex and approximate age from an unfamiliar face. This ability to derive generic information from an unknown face (face perception) is distinct from the ability to identify an individual (face recognition) (Roth and Bruce, 1995). The latter ability is facilitated by 'identity specific semantic codes'. 'Identity specific semantic codes' incorporate information which can only be known through familiarisation with a person, for example, biographical details. In associative priming, 'identity specific semantic codes' are activated by exposure to a prime that is closely associated with the stimulus, allowing the stimulus to register as familiar more quickly when it is presented (McNeill & Burton, 2002). In accord with this idea, Johnston and Bruce (1994) found that the time taken to make a familiarity decision is less for a primed target than for an unprimed target, even if the latter is better known. Thus, a semantic relationship between two entities facilitates faster recognition of one when the other is used as a prime.

If semantic information can be used so effectively to influence familiarity judgments after priming, it is plausible that it can be used to raise a previously unknown face to the threshold of familiarity. This principle informed the method of face-learning that I employed in my experiment. By presenting a brief semantic profile for unknown faces, I hoped to entrench 'identity specific semantic codes'. These would be activated when the learned faces were presented later and would thus facilitate recognition. I planned to bridge the gulf between unfamiliar and familiar faces through semantic information. I aimed to determine whether this mode of face-learning could elevate previously unknown faces to the threshold of familiarity, such that they surpassed random unknown faces on measures of recognition performance.

The success of this method of face-learning could provide an answer to a fundamental problem in the field of face recognition: the acquisition of faces familiar to participants. Two different approaches have been used in the previous research: a) the faces of individuals known to participants have been used, and b) the faces of celebrities have been used. Both approaches, however, have considerable limitations. Finding faces of people intimately known to the participant involves the use of family photo archives. Such resources are often inaccessible, however, and this method may be intrusive to the participant, and labour-intensive for the researcher. Bruce (1982) used an alternative method: the familiar faces belonged to faculty from the psychology department of Nottingham University, where the subjects were students. While this method avoids the problems presented by rifling through family photo albums, it cannot guarantee the level of familiarity connected with family members. Participants may be vaguely familiar with the faces of faculty members, but they may only know these individuals 'by sight' and may not have access to semantic codes for them. 'Identity specific semantic codes', as demonstrated to facilitate recognition in the study by Johnston and Bruce (1994), should ideally be present for familiar faces.

The second approach, involving famous faces, accommodates this requirement, but has its own pitfall: most celebrity faces are distinctive. Bruce, Burton, and Dench (1994) examined the correlation between a face's deviation from the 'typical' face template and its ratings on distinctiveness and memorability measures. They found that distinctive faces are more memorable and concluded that distinctiveness is a significant mediating factor in the process of face recognition. Thus, superior recognition of famous faces may not, in fact, reflect a subject's level of familiarity with that face, but rather that face's level of distinctiveness.

Bruce (1982) used the faces of famous actors and politicians in an earlier study (1977, as cited in Bruce, 1982), and pointed out three further limitations of celebrity faces as stimuli: a) they may be more attractive on average, which has been shown to facilitate recognition (Davies, 1978, as cited in Bruce, 1982), b) they are often photographed in a manner which enhances their attractiveness, and c) they cannot be manipulated as easily as unfamiliar faces, as the photographs will not have been taken for the purpose of the experiment. Thus, neither of the existing approaches to obtaining familiar faces is ideal. Meeting the requirement for true familiarity through 'identity specific semantic codes', while ensuring that the familiar face set does not differ in intrinsic memorability from the unfamiliar face set, is a tall order for any researcher. My findings can potentially offer a solution to this problem. If a previously unknown random face can be truly familiarised by pairing it with semantic information, then this method can be used to generate familiar face sets for future research in face recognition.

Semantic information has been shown to have a substantial effect on face recognition, as demonstrated in the priming studies mentioned above. The effect of different types of semantic information on face recognition, however, is unchartered territory. Semantic information facilitates memory of faces, but the type of information that most successfully enhances face recognition is unknown. This study aims to fill this theoretical gap in the field of face recognition. What *is* known that all stimuli are not remembered equally successfully. Bradley, Greenwald, Petry, and Lang (1992) examined this phenomenon with regard to visual stimuli. In particular, they investigated the effect of pictures on memory when the images varied along the dimensions of arousal and emotional valency (pleasantness or unpleasantness). Participants' recall of sixty photographic images was tested both immediately after seeing them, and one year later. The authors found that increased arousal had a significant effect on memory of images both in the short and long-term, but that pleasantness was insignificant in this regard. From this the authors concluded that arousal facilitates superior memory performance. Furthermore, on a recognition task, arousing stimuli were recognised faster than neutral stimuli. Thus, high arousal enhanced memory and facilitates recognition. Although pleasantness did not yield consistently significant results, the authors concluded that the 'dimensions of valence and arousal are both salient at encoding' (1992, p.387).

Like the research of Bradley, Greenwald, Petry, and Lang (1992), my experiment integrated the dimension of arousal. Sensational information was paired with unknown faces and presented to two experimental groups. This sensational information was more arousing than the neutral information presented to the control group. I predicted that the groups provided with more arousing information in relation to the unknown faces would learn these faces more successfully and perform better on recognition tasks than the 'neutral' information group.

The inclusion of arousing information in my experiment was further informed by the findings of Eysenck (1976). Eysenck's literature review on the relationship between arousal and retention is considered seminal in the field of memory. 'Item arousal' pertains to arousal elicited by the material to which the subject is exposed. This is this type of arousal which I hoped to induce in subjects in the 'sensational' groups, through the presentation of sensational information. Within the category of 'item arousal', Eysenck reviewed studies of paired association, free recall and recognition. Though paired association was not facilitated by arousal, results across studies indicated that recall and recognition were enhanced by arousal. For example, in a study by Maltzman, Kantor, and Langdon (1966, as cited in Eysenck, 1976), recall of high arousal words was considerably superior to recall of low arousal words. From his review of other studies investigating this phenomenon, Eysenck concluded that arousal significantly facilitates retention of information. In sum, Eysenck's findings strongly suggest that high arousal at encoding facilitates memory of material after both short and long retention intervals.

There is substantial evidence to support the claim that arousal has an effect on memory. The semantic information presented to the neutral group and the sensational groups should therefore differ along this dimension. However, a stumbling block is presented by the lack of research connecting arousal with semantic information, particularly in a social capacity. Although we all know from experience that certain types of information are easier to remember than other types—for example, it's easier to recall a piece of gossip about someone than it is to rattle off his or her family tree—this phenomenon is profoundly underreported in the psychological literature.

What *is* known is that there are differences in the retention of neutral and controversial material, as revealed in a classic study by Alper and Korchin (1952). Male and female subjects were presented with a controversial letter regarding the admission of females to all-male institutions of higher education. The letter contained many provocative statements and employed unfavourable female stereotypes. Subjects were tested on successive reproduction of its content. The results indicated that male subjects retained more of the controversial content of the passage and represented it more accurately than did female subjects. There was no statistically significant difference between the genders in the recall of neutral information. The general attitude of the passage was biased against women. Thus, their inferior recall of the information supports the theory that individuals selectively retain information which is in accord with their own attitudes and values, and selectively forget that which is not. This study indicates that controversial material stimulates a different type of recall than neutral material, and that memory for controversial information is more subjective and less consistent than memory for neutral information.

A similar result was obtained by Levine and Murphy (1943). A group of five pro-Communist subjects and a group of five anti-Communist subjects were presented with two texts, one in support of communism and one in opposition to it. As predicted, the pro-Communist group was more accurate in the recall of the material that supported their beliefs, while the same was true of the anti-Communist group. Although these studies are dated and the controversial information they contained is now obsolete, a trend can be observed in their results: people tend to process information from their own frame of reference. From this it seems logical that information which involves the contravention of social norms ('unfavourable sensational') or provokes any sort of value judgment should have the same effect on memory as controversial material: it should stimulate subjective processing.

Sensational information is more likely than neutral information to elicit a reaction from the viewer, because it provokes judgments and breeds opinions. Sensational information demands subjective engagement from the viewer. This stimulates attention and heightens arousal. I expected the sensational information to be more easily remembered, and the faces connected with this information to be more successfully familiarised. Insofar as recognition performance demonstrates familiarity, I predicted that faces paired with sensational information would become *as* familiar to participants as celebrity faces which were already well-known to them. By establishing the effects of different information on memory through the medium of face recognition, I hoped to fill in, at least partially, this surprising lacuna in the psychological literature.

In conclusion, two main points emerge from the face recognition literature and are directly related to my investigation: a) unfamiliar and familiar faces are processed differently, and b) semantic information can increase a face's level of familiarity. Given this information, it is feasible to expect that semantic information can raise a previously unknown face to the threshold of familiarity. This informs the primary hypothesis of this experiment: that the recognition performance for learned faces will be raised significantly above that of unknown, random faces. From the literature on arousal and memory, it is evident that arousing stimuli are processed differently to neutral stimuli. Arousal focuses attention, which enhances memory. By providing a stimulus which is emotionally arousing and grabs the viewer's attention, I expected the viewer's memory of that stimulus to be superior. From the preceding information follows the second hypothesis of this experiment: faces paired with arousing information will be raised to familiarity more successfully than faces paired with neutral information. If 'learned' faces are successfully elevated to the familiarity level of 'known' faces, a new method of face familiarisation will be conceived—the difficulty of generating familiar face sets which are truly familiar, easy to create and not inherently memorable will be overcome.

METHODS

Participants were required to attend two 45 minute sessions on consecutive days: the first day involved the creation of a 'learned' and 'known' face set, while the second day involved recognition. Participants were randomly assigned to one of three learning conditions: neutral, positive sensational and negative sensational. This determined what type of information they would receive in relation to the faces they would 'learn'. Participants remained blind to their condition and the design. During the experiment, participants were exposed to a group of celebrity faces, a group of previously unknown faces that they learned, and a group of unknown faces with which they remained unfamiliarised. Hence, each participant had a ‘known’ face set, a ‘learned’ face set and an ‘unknown’ face set. The ‘known’ celebrity faces provided a baseline of familiarity against which to compare the learned faces, while the unknown faces acted as distractor faces during the recognition tasks. All faces were varied in how they were presented during the recognition phase of the experiment, appearing in one of four manipulation presentations: upright portrait, inverted, inside features, outside features.

Design

Information condition (positive sensational vs. negative sensational vs. neutral) was the between-groups variable. Face type (known vs. learned vs. unknown) and presentation manipulation (upright portrait vs. inverted vs. inside features vs. outside features) were within-groups variables.

Participants

A total of 56 undergraduate psychology students participated in the experiment in exchange for Student Research Participation credit. The mean age of the sample was 20.23 years.

Materials

The critical experimental stimulus for each participant was a set of 16 unknown faces that were randomly selected from the UCT database of student faces. These 16 faces were randomly paired with semantic information and became the participant’s ‘learned’ face set. All of the faces were high-quality photographs of white, female, UCT students. A set of celebrity faces and a second set of unknown faces from the UCT student database were also used in the experiment. These constituted the ‘known’ and ‘unknown’ face sets for participants respectively. All of the celebrities were young, white females, making them similar to ‘learned’ and ‘unknown’ face samples. All face images were edited to remove background material and clothing below the neckline. The images were standardized to have a height of 10cm and were pasted against a white background.

The software designed for the face familiarisation project conducted by Nunez, Schmidt and Tredoux (personal communication, 2007) was reused in this experiment. Data collection took place in the ACSENT laboratory at the University of Cape Town. Desktop PCs running custom software were used in all of the experiments.

Procedure

Known face assignment phase

Upon arriving, participants were seated at a computer and presented with an envelope containing 30 colour pictures of celebrity faces (shown from a frontal viewpoint), each one with a number in the bottom right hand corner. The first task involved ‘celebrity matching’, where participants had to enter the number of the celebrity face next to the corresponding name on the computer screen. It was emphasized that participants should first match the celebrities with whom they were most familiar. Participants were encouraged to employ a method which facilitated this, such as spreading the pictures out on the desk in front of them. This was an important step, as the first sixteen faces correctly identified by each participant would serve as the ‘known’ face set for him or her. Thus, the ‘known’ face set differed for each participant, making it impossible that inherent memorability of the ‘known’ face set could skew the results. Participants were given five minutes to complete the celebrity matching task, and were instructed ahead of time to match as many as they could within the time limit.

Learning phase

When the celebrity task was over, the participants moved onto the ‘learning’ phase. This involved viewing and attempting to memorise 16 faces that the participant had never seen before. Each face appeared in colour and was shown from a frontal viewpoint and a three-quarters viewpoint (see Appendix A), allowing the participant to form a three-dimensional mental representation of each face (Hancock, Bruce, & Burton, 2000). The set of 16 was randomly selected for each participant. Each face was accompanied by a sentence containing information about that person, henceforth to be referred to as a 'profile'. The nature of the profile information was determined by the learning condition (positive sensational, negative sensational, neutral) to which the participant had been randomly assigned at the start of the experiment. In addition to remembering each face, participants were required to memorise the information presented with each face. Faces, profiles and names were randomly matched by the computer to create a face set unique to each participant. As with the 'known' celebrity face set, this eliminated the possibility of inherent face set memorability accounting for successful familiarisation. By using a unique face set for each participant, I could be confident that any familiarisation effects were truly due to participant learning, and not a confounding variable such as inherent memorability.

In the neutral (control) condition, the profile information was designed to be plausible, but impartial, neither provoking judgements nor stimulating particular interest (see Appendix B). The positive and negative sensational profiles, however, were designed to stimulate interest, heighten arousal and thus facilitate memory (Eysenck, 1976) (see Appendix C). Prior to beginning data collection, the researcher had generated an array of profiles for possible inclusion in the experiment. Each profile was evaluated in terms of plausibility, sensationalism and positivity or negativity respectively. Profiles which scored highly on all three of these criteria were retained and included in the experiment. It is important to note that profiles were designed to be mutually exclusive in terms of the information they contained. Any informational overlap would threaten to contaminate the participant's memory and was thus avoided.

Participants experienced three learning sessions, two of ten minutes and one of five minutes. During the learning sessions, they were able to browse through the profiles in their own time, using the arrow keys. Between the learning sessions were testing sessions. These consisted of multiple choice type questions, in one of two forms. The first showed a single face, and required the participant to decide whether any of five statements were true in relation to that person. A 'none of these is correct' option was included in all cases. The second form presented a single statement, such as 'This person is addicted to gambling', and the subject had to select one of four faces to match to the statement. Again, a 'none of these is correct' option was always included. After completing all three learning and testing phases, participants were permitted to leave and reminded to return for the second session the following day.

Recognition phase

Upon returning for the second session, each participant's unique data set was retrieved by entering his or her student number. The session commenced with a two minute slide show, including faces from the participant's learned face set, the participant's celebrity face set (the first sixteen identified correctly), and faces completely unknown to the participant. Each face was shown for two seconds, with a one-second fixation delay between faces. All faces were in colour and were presented from a frontal viewpoint. Following this, participants were required to complete two distractor tasks, one of which involved identifying an object as an airplane or not (though fairly easy, this task trained participants to use the computer interface in preparation for the face recognition task which followed), and the other involved playing air hockey for three minutes. Both filler tasks served to prevent rehearsal of the faces participants had just seen in the slide show.

The final task involved recognition, requiring participants to identify faces as having appeared in the slide show (i.e. 'seen') or not (i.e. 'unseen'), using the right and left shift keys. This recognition task contained seen and unseen learned faces (which the subjects had learned the previous day), seen and unseen celebrity faces (selected from those identified in the celebrity matching task the day before) and seen and unseen unknown faces (randomly selected from a wider pool of student photographs). Faces were shown in black and white, and the form in which they appeared was manipulated. All faces were presented from a frontal or three-quarters viewpoint in one of the following forms:

normal portrait, inverted, internal features only, external features only (see Appendix D). The participant's reaction times were recorded by the computer. After completion of this final task, an explanation of the experiment appeared on the computer screen. In the debriefing, all participants were informed that the profiles were randomly paired with faces, and that all profiles were entirely fictional. The researcher was available to answer questions and provide more information if participants were interested. They were thanked for their participation and were awarded research participation credit.

RESULTS

Recognition performance was operationalised in three ways: latency (reaction time), accuracy of recognition (d'), and response bias (β). A series of repeated measures ANOVAs were conducted to examine the influence of semantic information condition (neutral, positive sensational or negative sensational), face presentation manipulation (normal portrait, inverted, inside features only or outside features only) and face type (learned, known and unknown) on these measures of recognition performance.

Latency

Each subject's reaction time was initially recorded in milliseconds. The natural log of these raw scores was taken in order to normalize the distribution of the data, and these new values were used in the analysis of variance. A significant between-groups difference was found only for the 'outside features' manipulation, where an interaction between face type and condition emerged ($F(4, 106) = 3.917$, $p < .005$). When the condition was 'neutral' or 'positive sensational', reaction time was significantly faster for the learned faces than for the known faces ($M_{(neutral)} = 7.107$ vs. $M_{(neutral)} = 7.362$, $p = 0.001$; $M_{(positive\ sensational)} = 7.097$ vs. $M_{(positive\ sensational)} = 7.461$, $p < .0001$). Furthermore, for the neutral condition, learned faces were recognised significantly faster than unknown faces (M = 7.107 vs. M = 7.307877, p = 0.020). See Figure 1.1.

A significant main effect emerged for face type for the ‘outside features’ (F (2, 106) = 23.748, $p < .0001$) and ‘inverted’ (F (2,106) = 8.098, $p < .001$) manipulations; see Figures 1.2 and 1.3. In the outside features manipulation, learned faces were recognised faster than both known faces (M = 7.154 vs. M = 7.392, $p = 0.0001$) and unknown faces (M = 7.154 vs. M = 7.289, $p = 0.0006$). Similarly, in the inverted manipulation, learned faces were recognized faster than both known faces (M = 7.188 vs. M = 7.297, $p = 0.008$) and unknown faces (M = 7.188 vs. M = 7.326, $p = 0.001$).

There were no significant main effects of ‘inside features’ presentation ($F(2, 106)$ = 0.939, $p < .394$) or ‘normal portrait’ presentation ($F(2, 106) = 0.772$, $p < .465$) on reaction time. There were no main effects for information condition (Inside features: $F(2, 53) = 0.439$, $p < .647$, Normal portrait: $F(2, 53) = 0.088$, $p < .916$, Outside features: $F(2, 53) = 0.414$, $p < .663$, Inverted: $F(2, 53) = 0.867$, $p < .426$). See Table E1 for main effects.

Accuracy

To determine each subject’s recognition accuracy, d’ was computed to separate true hits from false positives. A higher d’ translates into clearer signal detection. Across all manipulations, a significant main effect was found for face type. The inside features manipulation ($F(2, 106) = 50.613$, $p < .0001$) yielded a significantly higher d’ for known faces than for learned faces (M = 2.995 vs. M = 1.533, $p = 0.0001$), and a higher d’ for learned faces than for unknown faces (M = 1.533 vs. M = 0.418, $p = 0.0002$); See Figure 2.1.

A similar result was found for the normal portrait presentation ($F(2, 106) = 39.23$, $p < .0001$) [$M_{(known)} = 3.343$ vs. $M_{(learned)} = 2.552$, $p = 0.015$; $M_{(learned)} = 2.552$ vs. $M_{(unknown)} = 0.925$, $p = 0.0001$] and for the inverted manipulation ($F(2, 106) = 36.867$, $p < .0001$) [$M_{(known)} = 2.627$ vs. $M_{(learned)} = 1.918$, $p = 0.024$; $M_{(learned)} = 1.918$ vs. $M_{(unknown)} = 0.411$, $p = 0.0001$]. See Figures 2.2 and 2.3.

In the outside features manipulation, the difference between learned and known faces was not statistically significant ($p < 0.876$). The relationship between learned and unknown faces was similar to that seen in the other manipulations ($F(2, 106) = 22.27$, $p < .0001$)[$M_{(learned)} = 1.580$ vs. $M_{(unknown)} = 0.301$, $p = 0.0001$]. See Figure 2.4.

There were no significant main effects for information condition (Inside features: $F(2, 53) = 0.164$, $p < .849$, Normal Portrait: $F(2, 53) = 1.351$, $p < .268$, Inverted: $F(2, 53) = 1.554$, $p < .221$, Outside Features: $F(2, 53) = 2.379$, $p < .102$), nor were there any interactions between face type and information condition (Inside features: $F(4, 106) = 0.995$, $p < .413$, Normal Portrait: $F(4, 106) = 1.262$, $p < .289$, Inverted: $F(4, 106) = 1.074$, $p < .373$, Outside Features: $F(4, 106) = 2.230$, $p < .071$). See Table E2 for main effects.

Response Bias

β was computed to examine whether participants employed differential selection strategies in recognising faces. Extreme β values indicate that the participant was less likely to make a deliberate choice in recognising a face, and more likely to simply guess. A significant main effect was found for face type across the ‘inside features’ ($F(2, 106) = 4.557$, $p < .013$), ‘normal portrait’ ($F(2, 106) = 12.736$, $p < .0001$), ‘outside features’ ($F(2, 106) = 6.624$, $p < .002$) and ‘inverted’ ($F(2, 106) = 7.481$, $p < .0001$) manipulations.

For ‘inside features’, a significant difference was found between learned and known faces (M = -0.15 vs. M = 1.41, $p = 0.01$). See Figure 3.1. The result was similar for the ‘normal portrait’ manipulation ($M_{(learned)} = -0.582$ vs. $M_{(known)} = 1.959$, $p = 0.0001$), but a significant difference between learned and unknown faces was also found (M = -0.582 vs. M = 1.195, $p = 0.003$); see Figure 3.2. Significant differences were found between learned and known faces for the ‘outside features’ manipulation (M = 0.243 vs. M = 1.513, $p = 0.004$) and for the ‘inverted’ manipulation (M = -0.777 vs. M = 1.077, $p = 0.001$); see Figures 3.3 and 3.4. Furthermore, when ‘outside features’ were shown, a difference was also found between the known and unknown faces (M = 1.512 vs. M = 0.391, $p = 0.012$).

No interactions were found between information condition and face type (Inside features: $F(4, 106) = 0.437$, $p < .782$, Normal portrait: $F(4, 106) = 0.505$, $p < .732$, Outside features: $F(4, 106) = 1.201$, $p < .315$, Inverted: $F(4, 106) = 1.337$, $p < .261$). There were no significant main effects of information condition on response bias (Inside features: $F(2, 53) = 0.279$, $p < .758$, Normal portrait: $F(2, 53) = 1.343$, $p < .270$, Outside features: $F(2, 53) = 0.504$, $p < .607$, Inverted: $F(2, 53) = 3.179$, $p < .051$). See Table E3 for main effects.

DISCUSSION

The primary hypothesis of this study was that the familiarity of learned faces would be significantly elevated above that of random, unknown faces. It was also hypothesised that faces paired with sensational information would be raised to familiarity more successfully than faces paired with neutral information. The results generally support the first hypothesis, but not the second. The hypotheses were underpinned by three predictions:

1. *Face type will influence recognition performance: known faces will elicit superior recognition, followed by learned faces, followed by unknown faces; these differences will be particularly evident in the most challenging recognition conditions* – This prediction was generally supported. In line with this prediction, learned faces were recognised significantly faster than unknown faces when presented upside down or with outside features only. Surprisingly (and contrary to the prediction), learned faces were also recognised significantly faster than known faces in these manipulations. This result suggests that subjects became thoroughly familiarised with their learned faces to the point of surpassing their known faces on the measure of reaction time. No such differences emerged from the ‘inside features’ or ‘normal portrait’ manipulations. This is in accord with the second part of the prediction, as the ‘outside features’ and ‘inverted’ manipulations constitute more challenging recognition tasks (Bartlett & Searcy, 1993;

Ellis, Shepherd, & Davies, 1979; Leder & Carbon, 2006). Ability to recognise faces quickly when presented in these forms indicates true familiarity.

The recognition accuracy findings further support this prediction. Across all manipulations, accuracy was the highest for known faces, followed by learned faces, followed by unknown faces. All differences were statistically significant, except for the ‘outside features’ manipulation: when presented with outside features only, participants were equally accurate in recognising learned and known faces. As above, this indicates that the learned faces were truly familiarised, as participants showed superior accuracy on the most challenging recognition task. It is interesting to note that although the means were statistically unequal, learned faces were more similar to known faces that they were to unknown faces in terms of accuracy, suggesting that they were indeed successfully familiarised.

Learned, known and unknown faces had different effects on response bias, but the direction of the difference is not entirely as expected, thus only providing partial support for the prediction. For all manipulations, known faces provoked more deliberate familiarity judgments than learned faces. Contrary to expectations, however, unknown faces also provoked more deliberate familiarity judgments than learned faces. The implication of this finding is that participants were more inclined to guess when the face type was learned. Though this trend was present across all manipulations, the difference between learned and unknown faces was only significant for the ‘normal portrait’ presentation.

The following explanation can be offered for the unexpected response bias trend (i.e. greater confidence for known and unknown faces than for learned faces): during the recognition task, confidence in accepting faces as ‘seen’ was high for known faces, and confidence in rejecting faces as ‘unseen’ was high for unknown faces. In other words, the ‘known’, seen faces were so familiar that they were identified as having appeared in the slideshow with certainty. The ‘unknown’, unseen faces were so unfamiliar that they were identified as having *not* appeared in the slideshow with certainty. In comparing response bias for unknown and learned faces, it makes sense that the response, 'I have never seen this person before' could be made with more confidence than the response, 'I learned this person yesterday, but did not see her in the slideshow'. Thus, known, seen faces were accepted with high confidence and unknown, unseen faces were rejected with high confidence, bolstering the response bias scores for these face types above those of learned faces.

With regard to this prediction, it can be concluded that, on the whole, face type does affect recognition performance. Given the unexpected superiority of participants on measures of latency and accuracy for learned faces, it can be concluded that the previously unknown faces were successfully raised to the threshold of familiarity, and the primary hypothesis is confirmed.

2. *Information condition will influence recognition performance: the positive and negative sensational groups will display superior recognition to the neutral information group* – This prediction was not supported. The type of information paired with the faces produced no significant results for latency, accuracy or response bias. Thus, the answer to the research question for this study is conclusive: all types of information are equally successful at raising unknown faces to the threshold of familiarity. The lack of support for this prediction disconfirms the study's second hypothesis.

3. *Recognition performance for learned faces in the sensational information conditions (positive and negative) will match recognition performance for known faces in these conditions* – This prediction was not supported. In terms of reaction time, only the results for the negative sensational information group supported this prediction. For this group, known and learned faces were recognised equally rapidly. On the other hand, participants in the positive sensational and neutral information groups reacted more quickly to the learned faces than they did to the known faces This surprising result suggests that these groups became *more* familiar with their learned faces than they were with their celebrity faces. It is not entirely clear why this is the case. Measures of accuracy and response bias did not demonstrate the same trend. In sum, only one of the

three measures of recognition performance revealed an interaction between information condition and face type. This interaction did not conform to expectations, however, thus invalidating the prediction. As above, the lack of support for this prediction contradicts the study's second hypothesis.

Limitations and Directions for Future Study

The study suffered from a minor technical glitch. For some participants, a 'none of the above' option was absent during the testing phase of the experiment. These participants were not included in the analysis, however, and could therefore not contaminate the results.

A second limitation of this study was the lack of physiological measures of arousal in participants. Though profile items in the sensational information groups were rated as highly sensational by independent judges prior to inclusion, it is possible that the information was attention-grabbing, but not arousing. In future, physiological arousal could be recorded through electrodermal responsiveness, for example, as used in previous research on arousal (Bradley et al., 1992). Incorporating physiological measures of arousal in future studies would lend more cogency to the findings that neutral and sensational information are equally successful at familiarising random unknown faces.

The study was slightly limited by the fact that there was no check ensuring that subjects were truly familiarised with their known faces. Although all subjects were able to identify at least 16 of the 30 faces, it is conceivable that the celebrities may have not been equally familiar to all the participants. This is compounded by the fact that the celebrities were all white females, while the sample of participants was racially diverse and contained both males and females. In future, the pool of celebrity pictures could be larger and demographically more diverse, and checks could be implemented to ensure that the subjects are, in fact, truly familiarised with the known faces. Furthermore, as this study employed only photographs of females, a similar study could be executed using male faces, to establish whether recognition performance trends are consistent across stimulus gender.

Checking the extent to which the semantic information was encoded and how this affected subsequent recognition was unfortunately not in the scope of this study. In future, the correlation between the number of profile questions answered correctly and recognition performance could be observed. Recall of semantic information would need to be tested following both the learning and recognition phases of the experiment. From this, one could establish whether better learning of the information can predict superior recognition, or whether simple exposure to the information (irrespective of how well it is learned) is enough to elevate a face to the level of familiarity.

Conclusion

This study aimed to establish whether semantic information can be used to elevate a random unknown face to the threshold of familiarity. It was established conclusively that random unknown faces can be made familiar through semantic information. It was found that recognition performance for learned faces not only equals, but in some capacities surpasses that of known faces, and certainly outstrips recognition performance for unknown faces.

The success of this familiarisation method presents a solution to the central problem in face recognition research: the acquisition of a 'known' face set which is truly familiar to participants, but not inherently memorable. The practices of using already familiar faces (such as family members), and celebrity faces (Bruce, Burton, & Dench, 1994; Bruce, 1982) are plagued with problems. Familiarisation through semantic information pairing offers a feasible alternative method for researchers to generate a known face set. As illustrated in this study, familiarization can be achieved through fairly brief exposure (45 minutes) to unknown faces and their accompanying profiles. As each participant's 'learned' face set is unique, no inherent memorability threatens to confound recognition performance. This method allows for the rapid creation of 'identity specific semantic codes' which facilitate recognition (Johnston & Bruce, 1994), and is both time- and cost-effective.

In addition to its research applications, this study's main finding may be relevant in a social context. Semantic information promotes familiarisation and facilitates later recognition. From this we can infer that it is socially judicious to supplement introductions with information about the people being introduced. Even the lack of support for this study's secondary hypothesis has interesting social implications: all information, even of a relatively bland and impersonal nature, can be useful in making introductions more meaningful.

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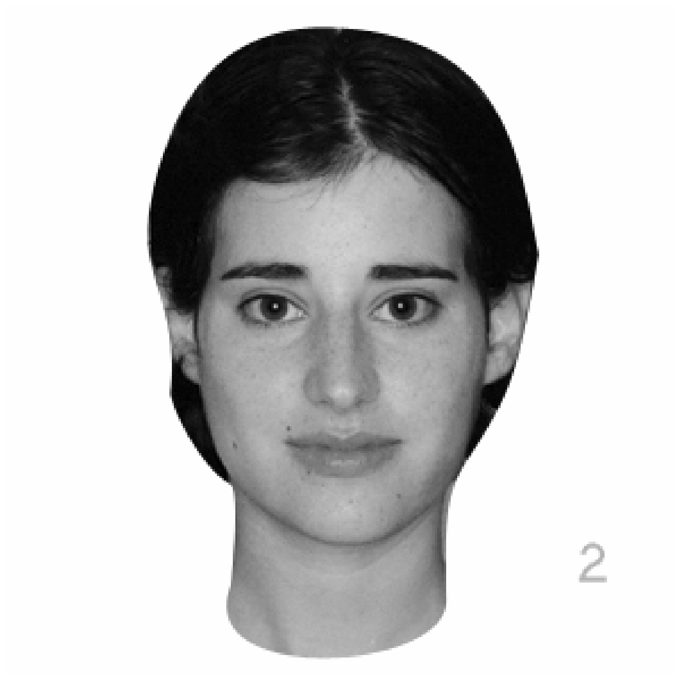
APPENDIX A: FACE STIMULI (AS VIEWED DURING THE LEARNING PHASE)



APPENDIX B: NEUTRAL INFORMATION PROFILES

1. This is Ellie. She lives in Brackenfell, studies Business Science and enjoys playing pool.

2. This is Grace. She lives in Noordhoek, studies Chemical engineering and loves playing the piano.

3. This is Lucy. She lives in Constantia, studies Architecture and enjoys hiking.

4. This is Charlotte. She lives in Bellville, studies Journalism and does ballet.

5. This is Katie. She lives in Wynberg, studies Sports Science and watches TV in her free time.

6. This is Emma. She lives in Plumstead, is majoring in Religious Studies and does yoga.

7. This is Sarah. She lives in Rondebosch, studies Geology and enjoys swimming.

8. This is Megan. She lives in Muizenberg, studies Economics and likes reading.

9. This is Ashley. She lives in Tamboerskloof, studies Fine Art and enjoys cooking.

10. This is Samantha. She lives in Kommetjie, studies Actuarial Science and plays tennis.

11. This is Tarryn. She lives in Woodstock, studies Marine biology and likes surfing.

12. This is Jessica. She lives in Hout Bay, studies Drama and likes clubbing.

13. This is Emily. She lives in Newlands, studies Law and plays online games in her free time.

14. This is Sophie. She lives in Sea Point, studies Philosophy and enjoys writing poetry.

15. This is Chloë. She lives in Kenilworth, studies Occupational Therapy and loves shopping.

16. This is Olivia. She lives in Pinelands, studies Marketing and enjoys horse riding.

APPENDIX C: SENSATIONAL INFORMATION PROFILES

Positive

1. This is Ellie. She has recently been reunited with an identical twin from whom she was separated at birth.

2. This is Grace. After her cruise ship sank, she survived on a life raft for two days before being found alive.

3. This is Lucy. She has developed a radical new weight loss programme which has had only success and taken the world by storm.

4. This is Charlotte. Though the child of illiterate parents, she has won the prestigious Rhodes scholarship and is going to Oxford.

5. This is Katie. She is in remission from brain cancer and attributes her recovery to acupuncture and positive thought.

6. This is Emma. She was the winner of the most recent season of Survivor and is reputed to have played the 'cleanest' game yet seen on the show.

7. This is Sarah. She completed a climb up Mount Everest making her the youngest female yet to achieve this feat.

8. This is Megan. She inherited a vast sum of money unexpectedly from a reclusive neighbour who had no family of his own.

9. This is Ashley. She became a local hero after rescuing a child who fell onto the roller coaster tracks at an amusement park.

10. This is Samantha. After a string of dysfunctional relationships, she has found her soul-mate online and is now happily married.

11. This is Tarryn. She has given up a career as a chartered accountant to live as a nun, and has found an inner peace and happiness that her high-powered job never gave her.

12. This is Jessica. A first-time author, she published a novel last year, which soared to the top of the Best Seller lists and won the Pulitzer Prize.

13. This is Emily. She climbed the corporate ladder in record time, and is now the CEO of the publishing firm where she began as a secretary four years ago.

14. This is Sophie. After desperately wanting a child for 5 years, she has become unexpectedly pregnant after trying umpteen different approaches and finally giving up.

15. This is Chloë. She has recently 'come out' to her family and friends, who have been unexpectedly accepting and supportive.

16. This is Olivia. After living in a tree for 6 months in protest against carbon-emissions, she has finally got the attention of prominent member of parliament who has pledged support to her cause.

Negative

1. This is Ellie. She was discovered to be the notorious stalker who sent 127 items of hate mail to Prince Charles over 6 years.

2. This is Grace. She fatally stabbed her husband when she suspected he was having an affair.

3. This is Lucy. She embezzled R110 000 from the disabled children's organization for which she was a spokeswoman.

4. This is Charlotte. She attempted a dramatic suicide by driving her car off a bridge.

5. This is Katie. She was arrested for arson after torching her ex-boyfriend's house.

6. This is Emma. She lost her job as a radio personality after making an offensive racial slur about Oprah Winfrey on air.

7. This is Sarah. She secretly subscribes to Nazi ideology and has a vast collection of Nazi paraphernalia.

8. This is Megan. She earns extra money through prostitution, catering to upmarket clientele in Constantia.

9. This is Ashley. She is addicted to gambling and recently gambled away her mother's car.

10. This is Samantha. She has been having an affair with her sister's husband for five years.

11. This is Tarryn. She was selected to represent her country on the Olympic Gymnastic team, but was expelled when she was found to be taking performance enhancing drugs.

12. This is Jessica. She was found in possession of cocaine after her third stint in rehab, and her wealthy father has publicly withdrawn his support.

13. This is Emily. She has shoplifted approximately R7 000 of merchandise in the past year; she prefers upmarket boutiques and lingerie stores.

14. This is Sophie. She has been married and divorced three times in four years and has children from two of the husbands.

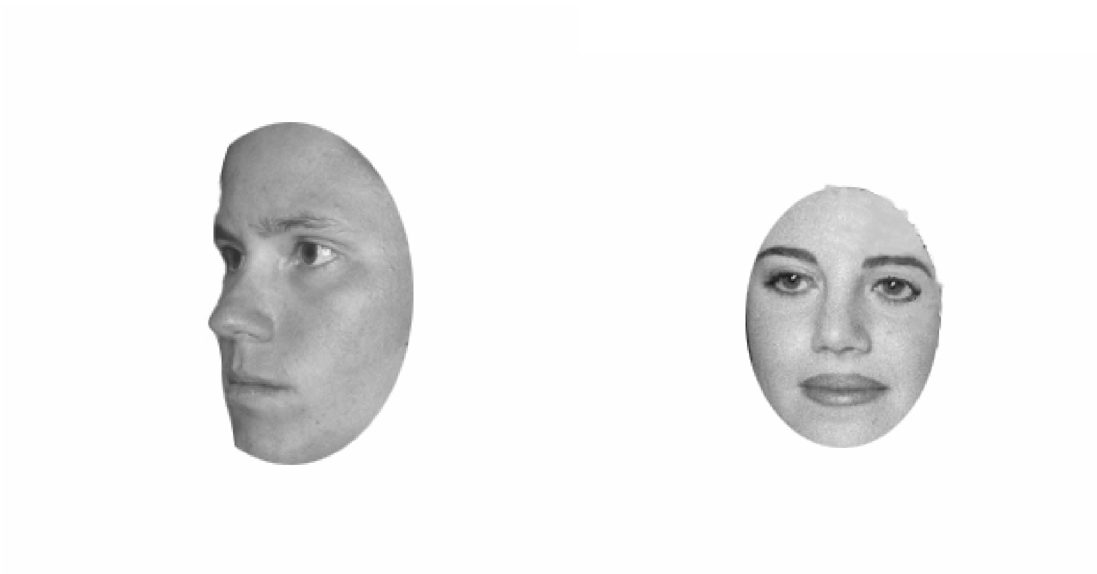
15. This is Chloë. She has been committed to a mental institution, after claiming an alter-ego was responsible for her sadistic behaviour towards her pets.

16. This is Olivia. She kidnapped a toddler out of a pram at the supermarket and kept him inside her flat for 6 months before she was discovered.

APPENDIX D: FACE PRESENTATION MANIPULATIONS (AS VIEWED DURING THE RECOGNITION PHASE)

Normal Portrait Presentation

Inverted Presentation Manipulation



Inside Features Presentation Manipulation

Outside Features Presentation Manipulation

APPENDIX E: TABLES

***Table E1.* Summary of latency effects (in milliseconds). Significant effects (*p* < 0.05) are italicised.**

	Learned Faces Mean RT	**Known Faces Mean RT**	**Unknown Faces Mean RT**	**F**	**p**
Inside Features	1326.103	1192.730	1261.428	0.94	0.394
Normal Portrait	1152.167	1166.776	1208.337	0.77	0.465
Outside Features	*1279.213*	*1622.949*	*1464.106*	*23.75*	*0.0001*
Inverted	*1323.454*	*1475.866*	*1519.292*	*8.10*	*0.001*

Table E2. **Summary of Accuracy Effects. All effects are significant (*p* < 0.05).**

	Learned Faces Mean d'	**Known Faces Mean d'**	**Unknown Faces Mean d'**	**F**	**p**
Inside Features	*1.533*	*2.995*	*0.418*	*50.613*	*0.0001*
Normal Portrait	*2.552*	*3.343*	*0.925*	*39.23*	*0.0001*
Inverted	*1.918*	*2.627*	*0.411*	*36.867*	*0.0001*
Outside Features	*1.580*	*1.696*	*0.301*	*22.27*	*0.0001*

***Table E3.* Summary of Response Bias Effects. All effects are significant (*p* < 0.05)**

	Learned Faces Mean β	**Known Faces Mean β**	**Unknown Faces Mean β**	**F**	**p**
Inside Features	*-0.151*	*1.416*	*0.604*	*4.557*	*0.013*
Normal Portrait	*-0.582*	*1.959*	*1.195*	*12.736*	*0.0001*
Inverted	*-0.777*	*1.077*	*0.283*	*7.481*	*0.0001*
Outside Features	*0.243*	*1.513*	*0.391*	*6.624*	*0.002*

APPENDIX F: FIGURES

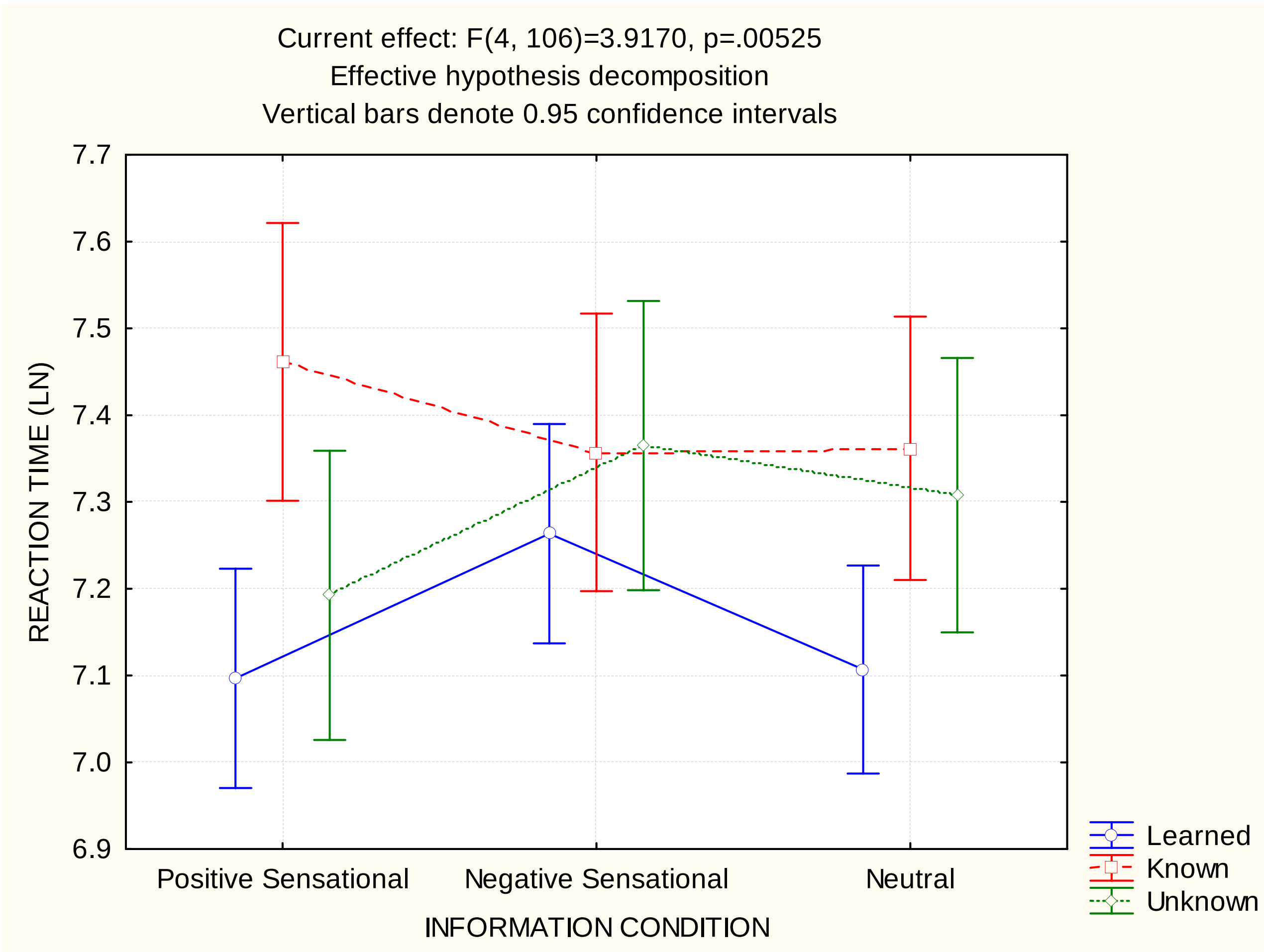


Figure 1.1. **Latency: interaction between face type and condition (lnRT)**

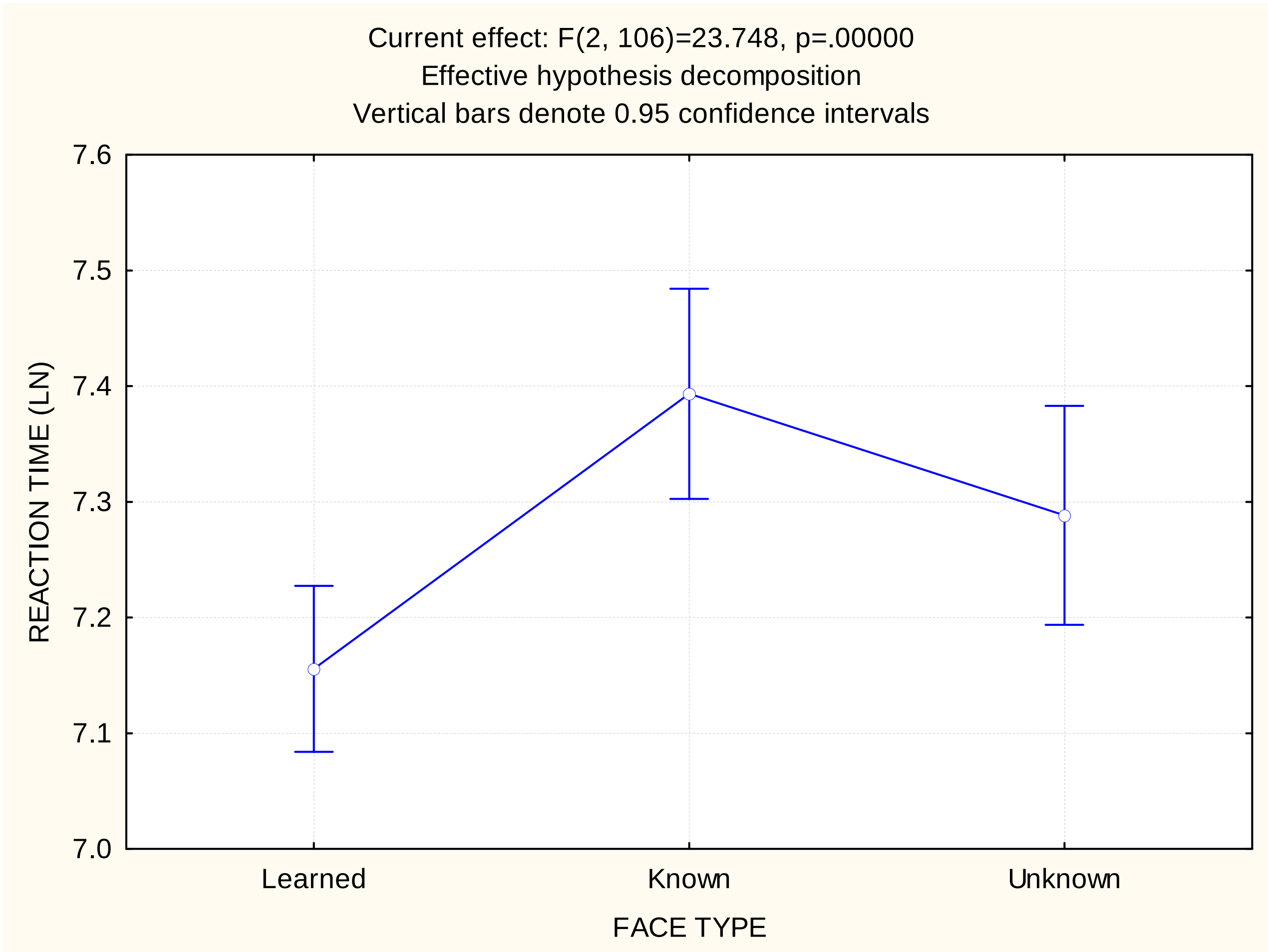


Figure 1.2. **Latency: main effect for face type in the 'outside features' presentation manipulation (lnRT)**

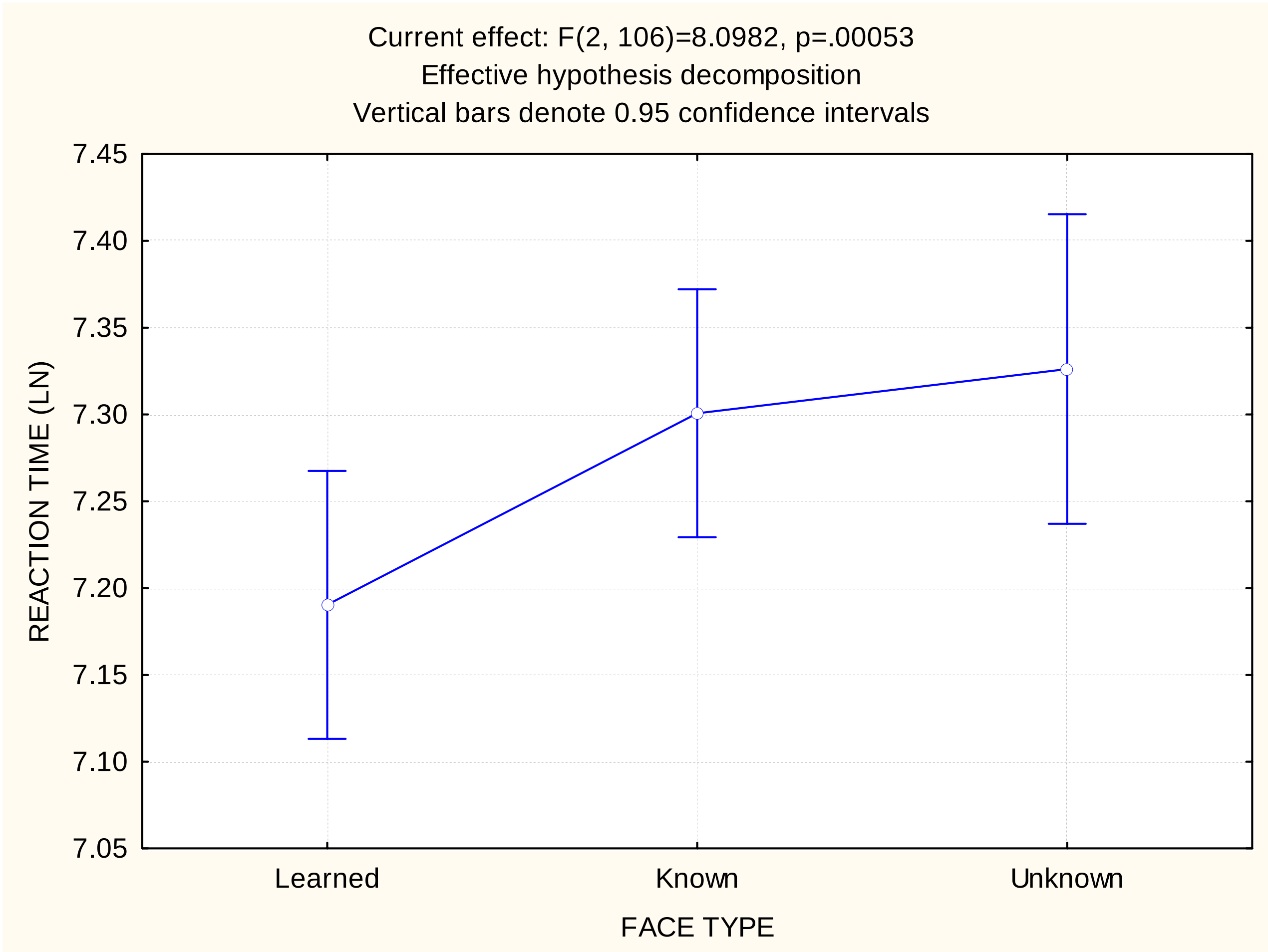


Figure 1.3. **Latency: main effect for face type in the 'inverted' presentation manipulation (lnRT)**

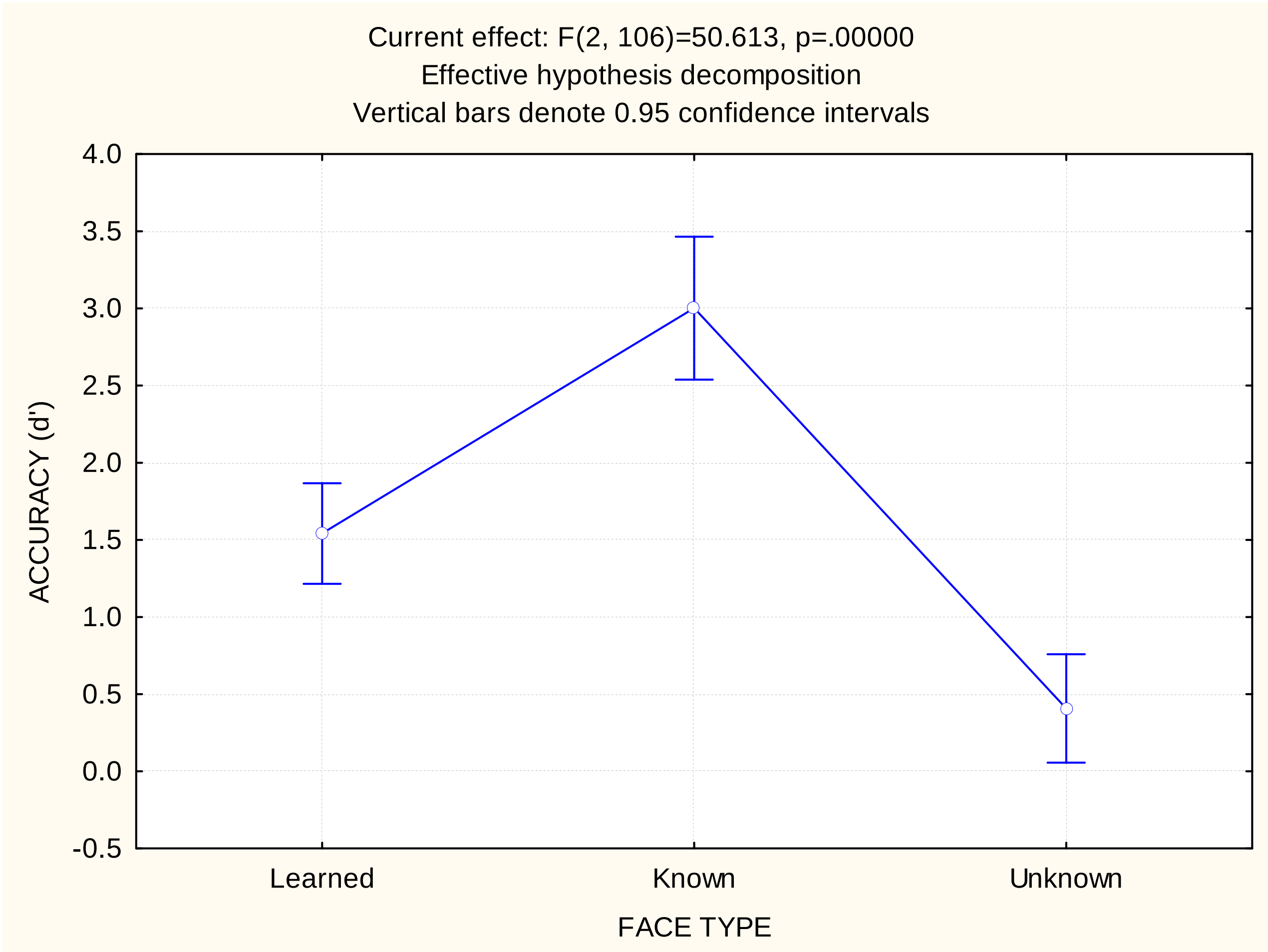


Figure 2.1. **Accuracy: main effect for face type in the 'inside features' presentation manipulation (d')**

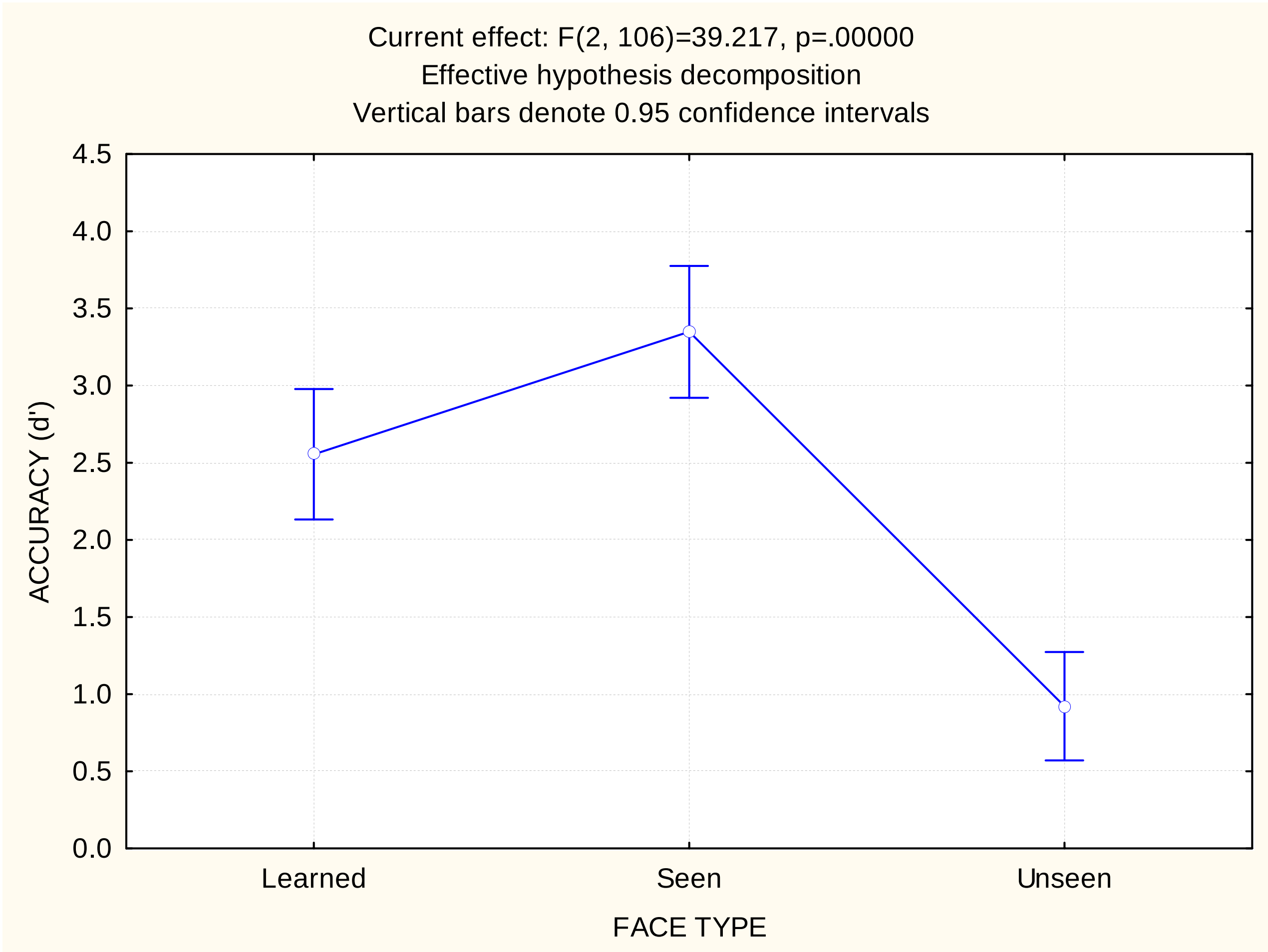


Figure 2.2. **Accuracy: main effect for face type in the 'normal portrait' presentation manipulation (d')**

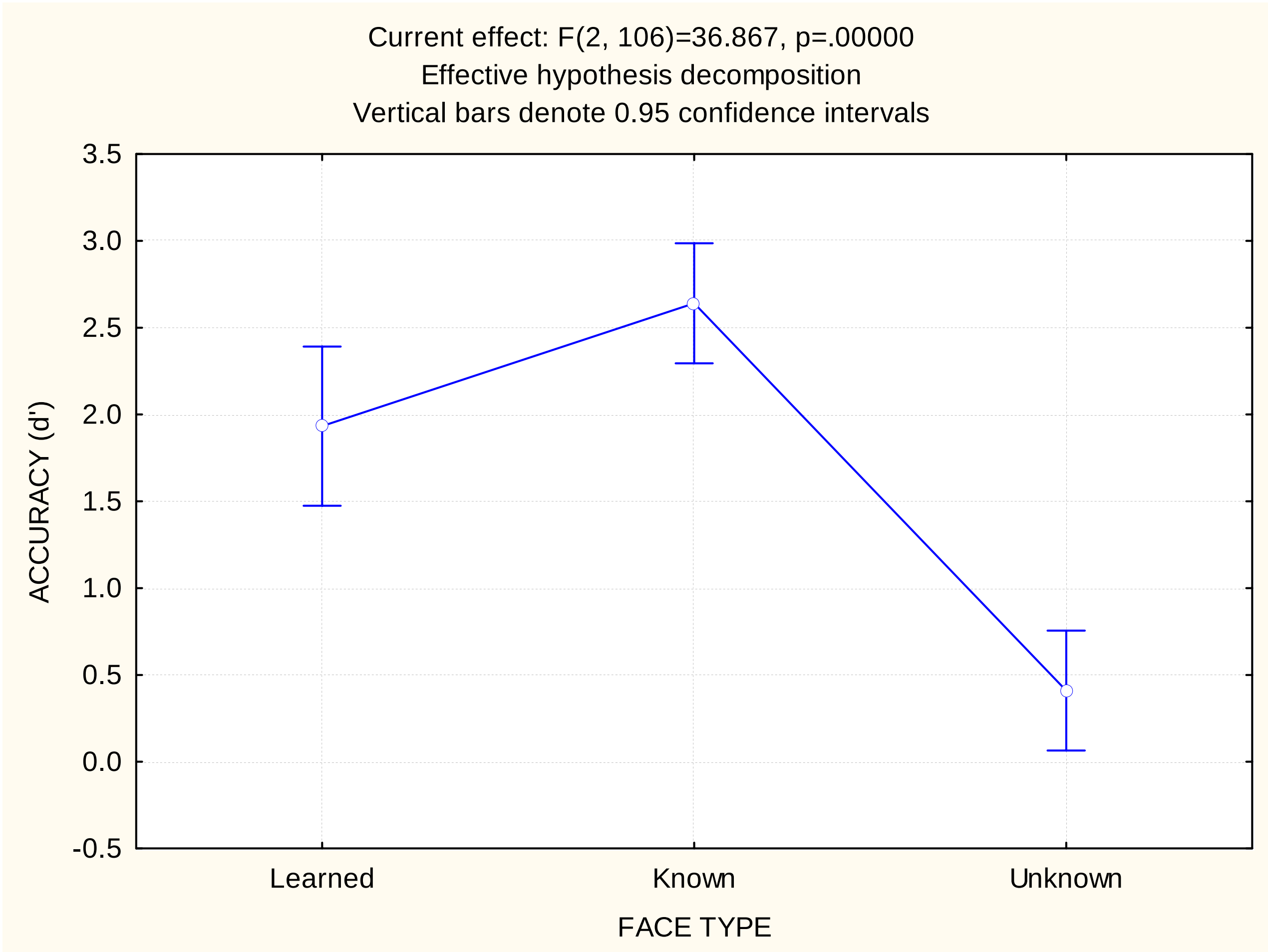


Figure 2.3. **Accuracy: main effect for face type in the 'inverted' presentation manipulation (d')**

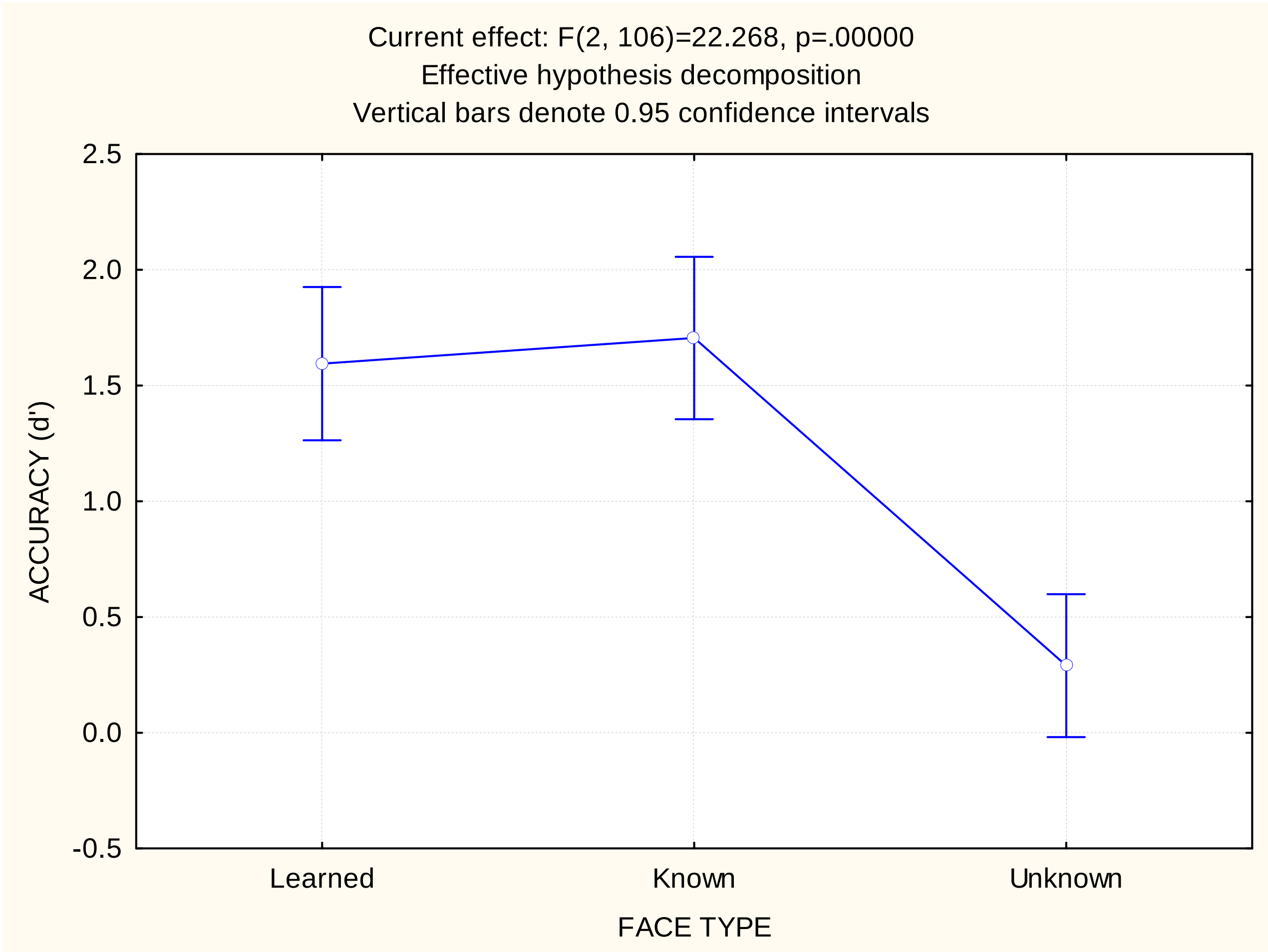


Figure 2.4. **Accuracy: main effect for face type in the 'outside features' presentation manipulation (d')**

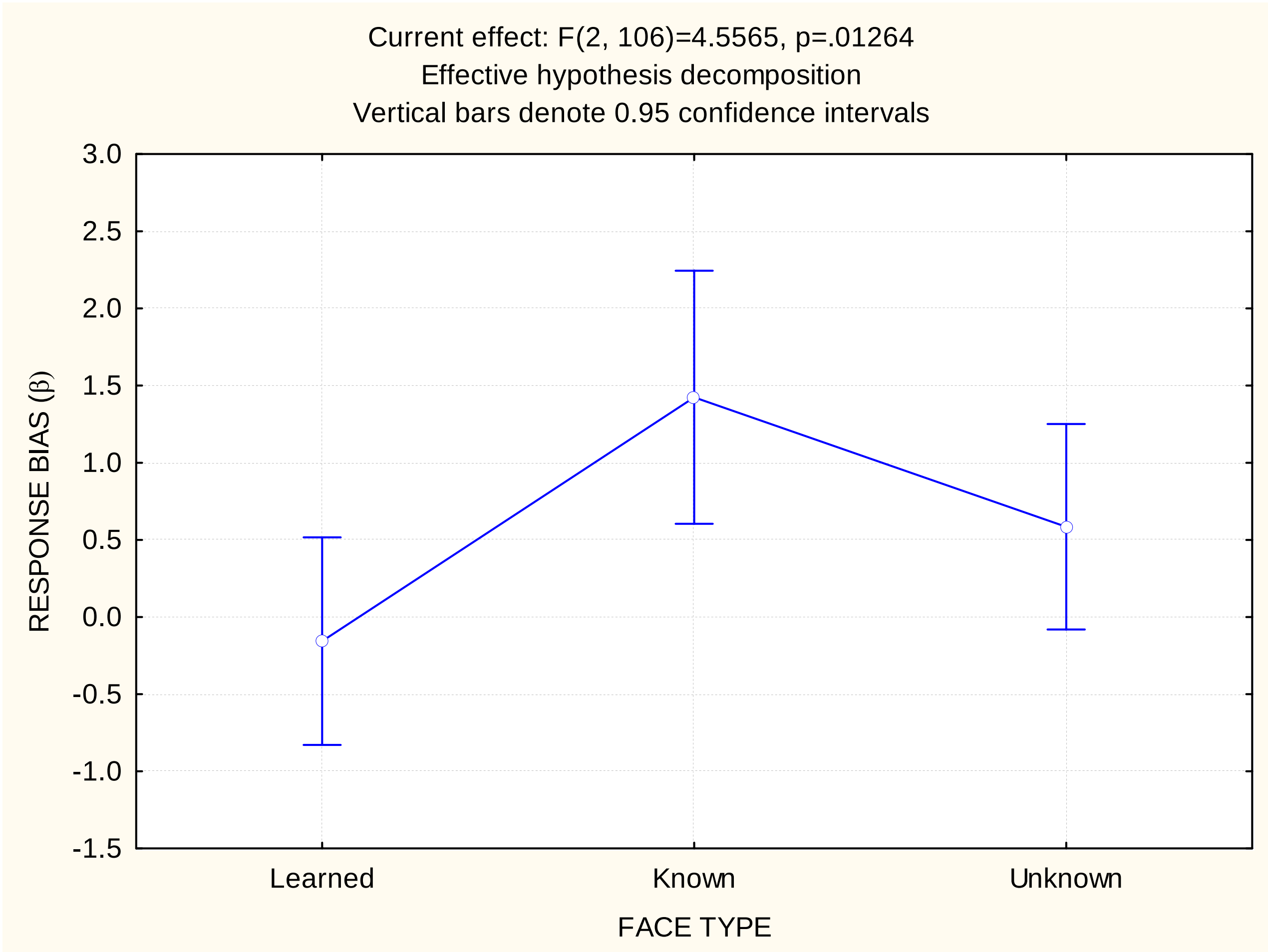


Figure 3.1. **Response bias: main effect for face type in the 'inside features' presentation manipulation (β)**

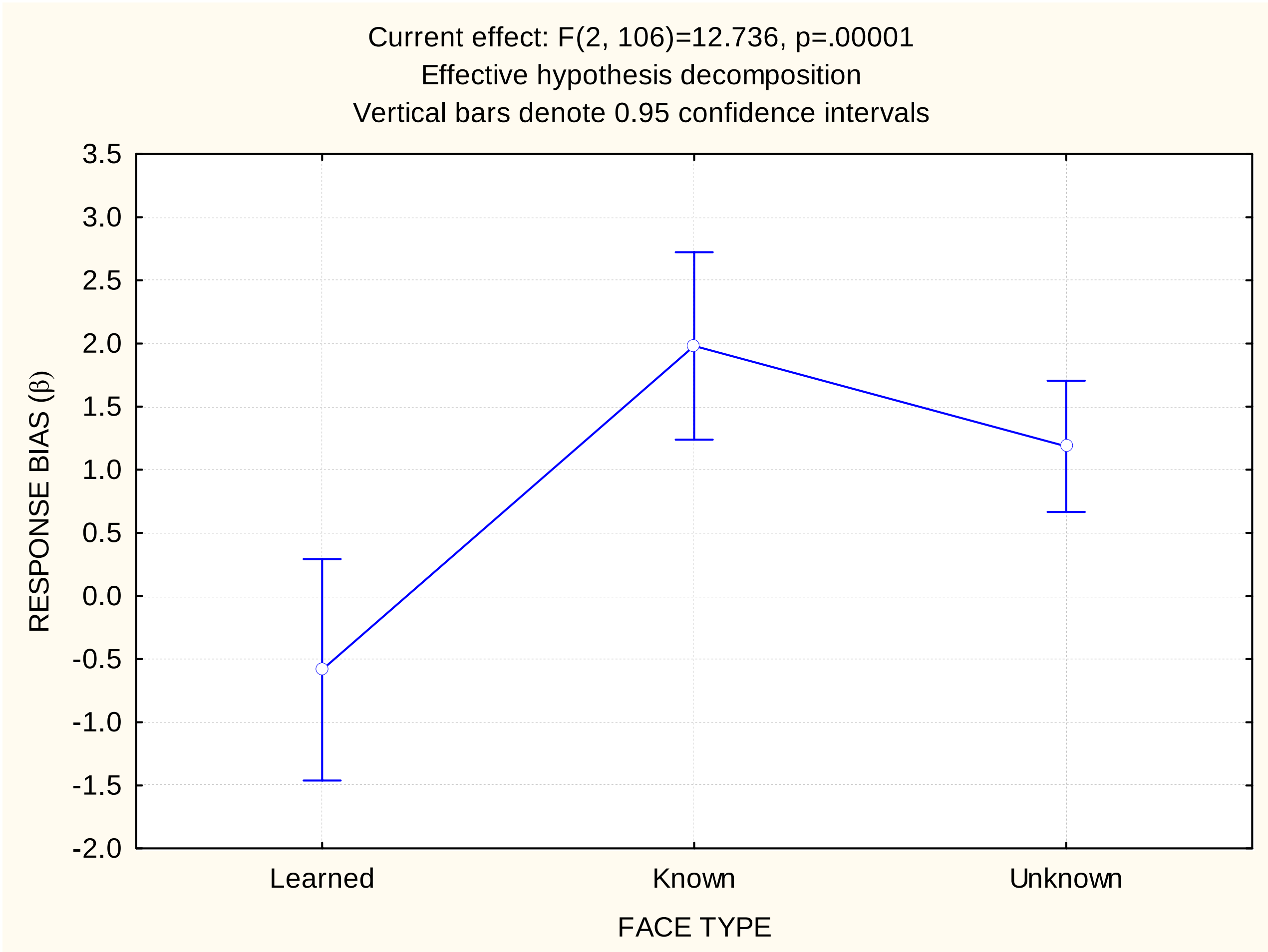


Figure 3.2. **Response bias: main effect for face type in the 'normal portrait' presentation manipulation (β)**

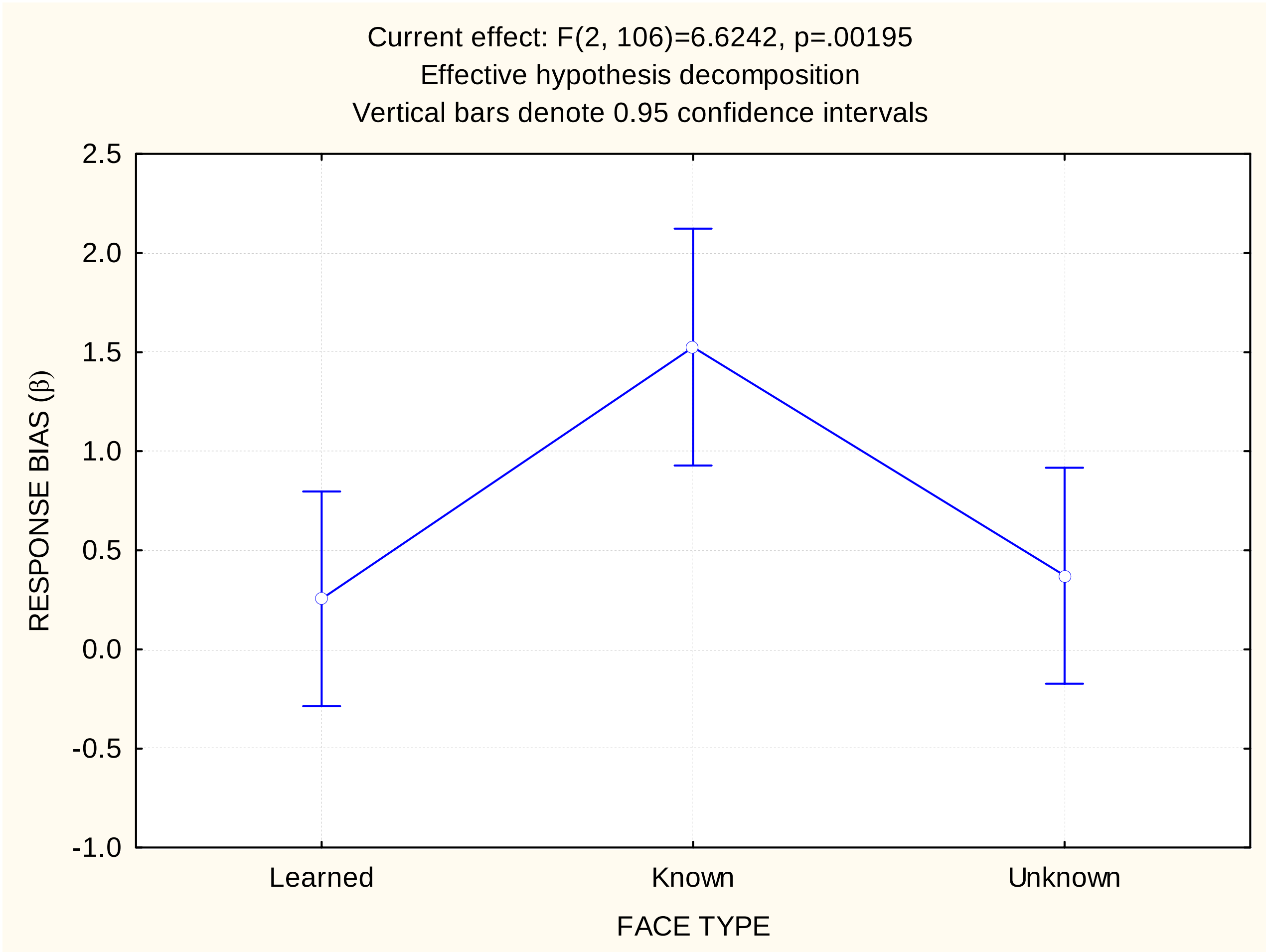


Figure 3.3. **Response bias: main effect for face type in the ‘outside features’ presentation manipulation (β)**

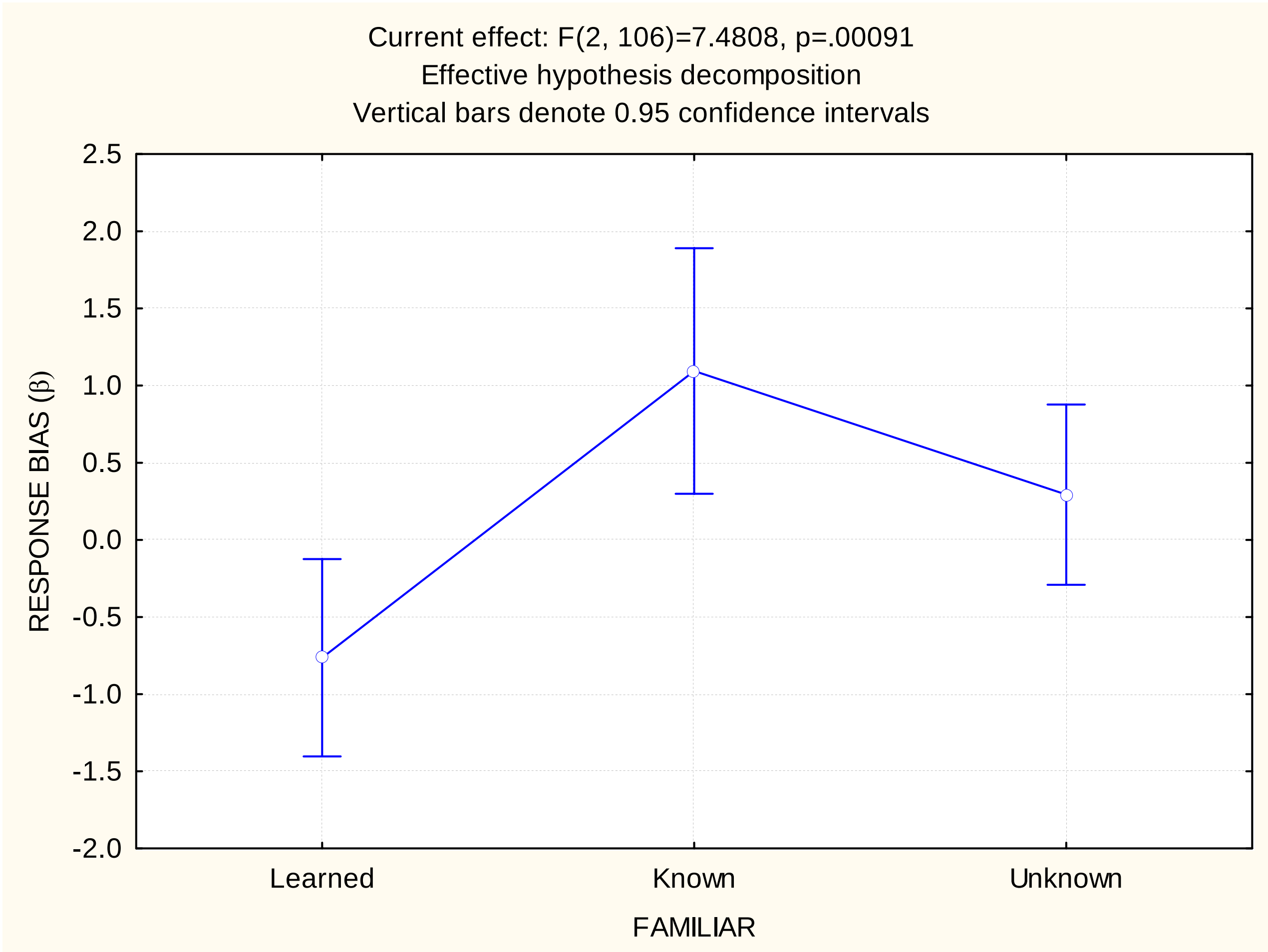


Figure 3.4. **Response bias: main effect for face type in the 'inverted' presentation manipulation (β)**