Stereotype priming in face recognition:

Interactions between semantic and visual information in face encoding

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Abstract

The accuracy with which previously unfamiliar faces are recognised is increased by the presentation of a stereotype-congruent occupation label (Klatzky, Martin, & Kane, 1982a, b). For example, providing the label 'criminal' both during encoding and test improves recognition for previously unfamiliar faces that look like the stereotypical criminal. Experiments 1 and 2 both replicate this effect and show that the label exerts its influence during the encoding of stereotypical faces and has little influence at test. These findings indicate that semantic information that is congruent with novel stereotypical faces facilitates their encoding.

1. Introduction

Eyewitness testimony is characterised by memory for faces and events based upon relatively brief opportunity for encoding. Moreover, the faces and events are unlikely to have been encountered in the past and are therefore typically unfamiliar to the eyewitness. It is well established that the conditions under which events are encoded are directly related to the success with which they are subsequently recalled (for a review see Coin & Tiberghein, 1997). In the domain of face processing, encoding conditions have been shown to exert a greater influence on successful recognition than retrieval conditions (c.f., Bruce, 1998).

Winograd (1981) assessed face recognition after they had made one of nine judgements during the initial encoding of a face. During encoding, participants were instructed to rate faces on one attribute that could either pertain to their physical characteristics (big nose, straight hair, and heavy), or various abstract traits (intelligent, anxious and friendly), and occupations (actor, businessman, and teacher). Recognition accuracy was poorer when physical judgements were made about the faces (e.g., big nose or straight hair) than when abstract judgements were made (e.g., intelligent or teacher; see also, e.g., Light, Kayra-Stuart, & Hollander, 1979; Mueller, Carlomusto, & Goldstein, 1978).

There are several potential explanations for the different effects of making physical as opposed to abstract judgements about a novel face on the accuracy of subsequent face recognition. For example, the Levels of Processing framework (Craik & Lockhart, 1972) assumes that the more deeply an item is processed, the better it is

recalled. Within this framework, making a physical judgement about a face during encoding should result in poorer subsequent performance than making an abstract judgement. However, other research has shown that selecting the most distinctive feature in a face during encoding (a surface judgement) results in similar recognition accuracy to making an abstract judgement during encoding (Daw & Parkin, 1981; Deffenbacher, Leu, & Brown, 1981). This finding suggests that, at least for the case of faces, the influence of abstract judgements on recognition might not simply reflect the depth with which they are processed. In contrast to the depth of processing analysis, Courtois and Mueller (1979) argued that the critical factor determining face recognition accuracy was the *number* of facial features assessed during encoding. According to this view, making either a distinctive-feature judgement or an abstract judgement results in a greater number of features being processed during encoding and it is this fact that supports greater recognition accuracy. However, there is no direct evidence that making personality or occupation judgements about a face either requires or results in a greater number of features being processed than does making a gender classification (Kerr & Winograd, 1982). In fact, the evidence concerning the reaction times to make these differing judgements is inconsistent: Bloom and Mudd (1991) found that "honesty" judgements took longer than gender classification, whereas Daw and Parkin (1981) found the opposite pattern of results.

It is clear that making an abstract judgement about a face increases, in some way, the readiness with which it is subsequently recognised. This kind of influence has also been demonstrated by Shepherd, Ellis, McMurran, and Davies (1978) using a quite different method of assessment. In their study, Shepherd et al. (1978) asked participants

to create a Photofit from a picture they had seen previously. Half of their participants were told during presentation of the picture that the face belonged to a convicted murderer, whereas the other half were told that the face was that of a lifeboat captain. The constructed Photofits were then rated for traits such as intelligence, humorousness, sociability, and attractiveness by another set of participants, who were unaware of the stereotype labels that had originally been provided. The Photofit of the 'lifeboat captain' was rated as more attractive and more intelligent than the Photofit of the 'criminal'. These results can be taken to suggest that occupation labels presented during encoding altered the way a face is encoded and/or subsequently retrieved (in this instance for reconstruction).

Other research has revealed an influence of the provision of semantic information during encoding that appeared to be much more selective: it depended on whether or not the presented face was congruent with the stereotype of the occupation label that accompanied it. Thus, Klatzky et al. (1982a), using a recognition paradigm, provided evidence that occupation labels given by the experimenter influences subsequent face recognition. Klatzky et al. collected a set of faces that were reliably classified as having one of 11 occupations (e.g., accountant, hairdresser, actor, and musician; c.f., Bull & Green, 1980); there were 11 sets of 4 such pictures. The participants were presented with a subset of the 44 faces. The faces were either accompanied during encoding with an occupation label that was stereotypically congruent or incongruent with that face. Participants given the congruent occupation label recognised more faces in the subsequent recognition test than did those who had received an incongruent label. Because the occupation labels were also presented at

test, this effect was evident both in participants' propensity to say "yes" to occupation-congruent targets and to occupation-congruent distractors (false hits). An analysis of *d'* (Signal Detection Theory, SDT e.g., Swets, 1966) demonstrated that sensitivity was higher for occupation-label congruent faces, even accounting for the increase in false hits. However, in a recognition test where the ratio of targets to distractors is greater than one to one, as it was in Klatzky et al. (1982a), response bias is likely to be increased (c.f., Balakrishnan, 1998). It is, therefore, possible that the effect reported by Klatzky et al. reflects response bias rather than accuracy. Notwithstanding these problems, if one could establish that the presentation of semantic information affects the encoding of stereotype-congruent faces then it would have important theoretical implications: The existence of such a *stereotype priming effect* is not anticipated by several influential models of face recognition.

Current models of face recognition do not explicitly allow semantic information to influence the encoding of previously unfamiliar faces. In particular, the Interactive Activation and Competition with Learning (IAC-L) model (Burton, 1994) assumes that face recognition units (FRUs) can become linked to semantic information units (SIUs). However, this model provides no obvious or plausible grounds for anticipating the influence of semantic information on the encoding of novel faces[1]. Indeed, Valentine's (1991) alternative face-space model does not include any link to semantic information (Valentine, Chiroro, and Dixon, 1995). Given the potential theoretical implications of the results reported by Klatzky et al. (1982a) it is therefore important both to replicate

[1] It could be assumed that the IAC-L contains an infinite number of blank FRUs that are preconfigured to code for faces that are stereotypical and that these blanks are linked to appropriate SIUs. This assumption is rather implausible. In particular, it is unclear how the system could become preconfigured in this way.

them and to establish whether the effect of interest reflects a genuine effect on encoding. The experiments reported here aim to provide a demonstration of the stereotype priming effect and to examine its locus.

Two experiments employed a factorial design in which participants viewed pictures of faces that had been judged (by other participants; see below) to be stereotypical of different occupations (e.g., actor, artist, banker, criminal). These pictures could be accompanied by a congruent or an incongruent/irrelevant occupation label. During the test, the now familiar faces were presented together with other unfamiliar exemplars of the various stereotypes. The test faces were either accompanied by a congruent label or an incongruent/irrelevant label. Test performance was assessed using signal detection measures; in particular, the stereotype priming effect was measured in terms of accuracy (*d'*) and response bias (C). This form of analysis allows accuracy to be assessed independently of participants' response criterion (c.f., Klatzky et al., 1982a).

2. Phase 1: Development of Stimulus Set

2.1. Method

2.1.1. Participant

Four male and six female Cardiff University Psychology undergraduates participated as a partial fulfilment of a course requirement.

2.1.2. Materials

Two-hundred-and-fifty faces were created using Faces™ software package produced by Interquest™. This software package produces realistic pictures of faces from sets of feature pools[2]. These were presented to the participants using Microsoft™ Powerpoint™ software.

2.1.3 Design and Procedure

Faces were presented sequentially and in a random order. Participants were instructed to write down on a separate sheet of paper which of 10 stereotype labels most accurately represented each face. The labels were actor, artist, banker, criminal, hairdresser, lawyer, philosopher, and politician. These labels were taken from Bull and Green (1980). Once the participant had made their judgement, they moved the Powerpoint™ presentation on one slide. Thus, each face had ten stereotype labels attached to it, one from each participant.

2.2. Results

All faces that had less than five of the same label given to them were discarded. Moreover, those which had five of one label and five of a separate label were removed (this occurred in six cases, all of which were judged to be either lawyers or criminals).

[2] Artificial faces were used as it was difficult to find a sufficient number of real faces that were reliably given occupation labels. However, in other studies that used real faces but only one stereotype label, the results were similar to those reported here (Hills, Lewis, & Honey, 2005).

The remaining 186 faces were used in the next phase. Only four stereotype labels were used consistently: actor, artist, banker, and criminal.

3. Phase 2: Development of Stimulus Set

The second phase was conducted in order to ensure both that the faces were reliably associated with a given label and that all categories of faces were of the same distinctiveness.

3.1. Method

3.1.1. Participants and Materials

Ten more Psychology undergraduates from Cardiff University took part in this study in partial fulfilment of a course requirement. Three were male and seven were female. All 186 faces created in Phase 1 were used in Phase 2.

3.1.2. Design and Procedure

Participants received 5 blocks of presentations. In each block the 186 faces were presented in random order and the participants were instructed to give each face a rating. In the first block the participants were asked to judge how much each face looked like the stereotype of an actor (using a 1 to 9 scale, where 9 was much like the stereotypical actor and 1 was unlike the stereotype). In the subsequent 3 blocks, participants made the same form of rating, but with respect to the labels artist, banker and criminal. In the final block, participants provided a distinctiveness rating of the

form of a rating concerning how easy each face would be to spot in a crowd (on a 1 to 9 scale, where 1 is difficult to spot in a crowd (i.e., typical), and 9 is easy to spot in a crowd (distinctive); Light, et al., 1979). The order of the blocks was randomised, with the constraint that none of participants received the same order.

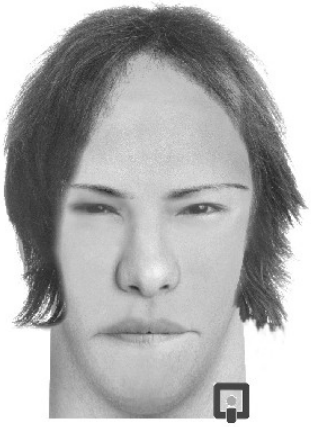
3.2. Results

All faces that had a stereotype rating of greater than 4.5 were given that stereotype label. All faces that scored 4.5 on more than one stereotypical scale were removed from further consideration. This process left an uneven number of faces in each of the four stereotype categories. Any face that scored more than 4 on distinctiveness was removed from the subsequent analysis. Finally, the 20 faces with the highest stereotype rating in each stereotype category were employed in Experiments 1 and 2.

A one-way ANOVA was conducted on the strength of stereotype ratings for the 4 sets of 20 faces. This analysis revealed that strength of stereotype ratings did not differ across categories $F(3, 76) = 1.895$, MSE = 0.334, $p>.05$. The stereotype ratings were subjected to a regression to ensure that there was no co-linearity between the stereotype labels. This revealed that there were significant negative correlations between the stereotype ratings: bankers-actors, r (80) = -.21, $p<.05$; bankers-criminals, r (80) = -.365, $p<.05$; bankers-artists, r (80) = -.383, $p<.05$; criminals-artists, r (80) = -.322, $p<.05$; and a significant correlation between actors and artists, r (80) = .246, $p<.05$; and no significant correlation between actors and criminals, r (80) = -.074, $p>.05$. To ensure that one category of faces was no more distinctive than any other; the distinctiveness scores for the 4 sets of 20 faces were also subjected to a one-way ANOVA. This revealed that there

were no significant differences in distinctiveness across the stereotype categories, $F(3, 76) = 0.62$, MSE = 0.287, $p>.05$. This process of stimulus set development thus produced 20 consistently rated stereotypical actors, artists, bankers, and criminals. An example of each is presented in Figure 1. There were no distinctiveness effects across categories and the stereotypes were mutually exclusive, except for artists and actors. These 80 faces were used in Experiments 1 and 2.

a.



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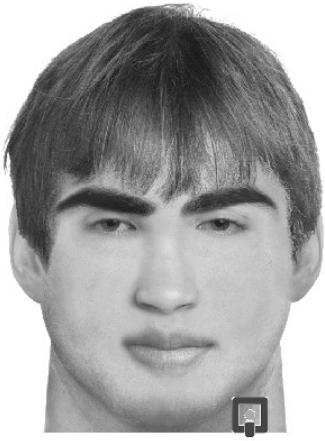

c.

d.

Figure 1. An example face from each stereotype category: a. An actor (distinctiveness score = 4.1, stereotype rating = 7); b. An artist (distinctiveness score = 4.6, stereotype rating = 6.7); c. A banker (distinctiveness score = 3.4, stereotype rating = 6); d. A criminal (distinctiveness score = 4.4, stereotype rating = 5.9).

4. Experiments 1 and 2

Experiments 1 and 2 were identical with the exception that they used different pictures of faces (Experiment 1: artists and criminals; Experiment 2: actors and bankers) and corresponding stereotype labels (Experiment 1: artist/criminal/banker; Experiment 2: actor/criminal/banker). In both experiments, participants viewed a subset of the stereotypical faces developed previously. In Experiment 1, the artist and criminal faces were used and in Experiment 2 the actor and banker faces were employed. In both experiments, the pictures were accompanied by a congruent (e.g., actor face plus label "actor") or an incongruent/irrelevant occupation label during training (e.g., actor face plus label "banker/criminal", respectively). During the old/new recognition test, the now familiar faces were presented together with other unfamiliar exemplars of the two stereotypes. The test faces were either accompanied by a congruent label (e.g., "artist" for the artist faces) or an incongruent/irrelevant label (e.g., "criminal/banker" for the artist faces).

4.1 Experiment 1

4.1.1. Method

4.1.1.1. Participants

One hundred and eighty Psychology undergraduates from Cardiff University participated in Experiments 1 and 2 as partial fulfilment of a course requirement (90 in each experiment). All had normal or corrected vision and were allocated to one of the

nine Experimental conditions randomly but in equal numbers. This left equal group sizes of 10 in each condition.

4.1.1.2. Materials

Twenty artist and 20 criminal faces created in the first stage of this study were used. These faces were presented 130 mm wide by 130 mm high, with a resolution of 72 dpi. Participants sat 50 cm away from the computer screen. They were presented using an RM PC, using SuperlabPro 2™ Research software.

4.1.1.3. Design

Participants saw both artist and criminal faces, but were randomly allocated to one of nine priming conditions depending on whether the label was congruent, incongruent or irrelevant at encoding or whether the label was congruent, incongruent or irrelevant at test. Thus, a 2 (type of face; i.e., artist/criminal) x 3 (label at encoding; i.e., artist/criminal/banker) x 3 (label at test; i.e., artist/criminal/banker) design was employed. The irrelevant label was banker. The dependent variables were recognition accuracy, as measured using *d'*, and response bias, as measured using C. Participants were randomly allocated to one of the counterbalanced conditions, with the constraint that each condition had approximately equal numbers of participants within it. There were two sets of artist faces (either designated as old or new), and these sets were divided into six subsets (accompanied by a congruent/incongruent/irrelevant label during encoding or test; ns=3/4).

4.1.1.4. Procedure

The experiment had three consecutive phases: the encoding, distracter and test phases. Prior to the encoding phase, a set of instructions were given to the participants, presented on the computer screen. The instructions were:

> *You will see a set of faces of [stereotype label; e.g., "artists"]. Please rate these faces on how easy they would be to spot in a crowd.*

The participants were provided with the scale (from 1-9) on which to rate face distinctiveness. During the encoding phase the participants saw the stereotype label for 250 ms, the label then disappeared and the face was presented for 3000 ms. Participants rated the distinctiveness of the face within during the 3000 ms. Immediately after the encoding phase participants were given 25 anagrams to complete within 3 minutes. Finally, the participants were given an old/new recognition task consisting of all 40 faces. The instructions were:

> *You will see a set of faces of [stereotype label; e.g., artists]. Some of them you have seen before and some you haven't. Please indicate whether you've seen each face before by pressing the appropriate key (z=old, m=new).*

Participants were asked to complete this task as quickly and as accurately as they could. Finally all participants were thanked and debriefed.

4.1.2. Results and Discussion

The *d'* scores (Macmillan & Creelman, 2005) are presented in Figure 2. In the overall ANOVA there was no effect of label congruence during the test or any interaction involving this factor (see below) and for presentational purposes Figure 2 collapses across this factor. Inspection of Figure 2 indicates that test accuracy was greater for the faces that were congruent with the label at encoding (e.g., "artist") than those that were either incongruent (e.g., "criminal") or irrelevant ("banker"). A three-way mixed-factorial ANOVA was conducted on the data summarised in Figure 2 (factors: type of face: artist or criminal; label at encoding: "artist/criminal/banker", label at test: "artist/criminal/banker"). This analysis revealed that there was the significant main effect of label at encoding, $F(2, 81) = 4.413$, MSE = 0.587, $p<.05$, but no other main effects, largest $F(2, 81) = 0.164$, $p>.84$. The label at encoding-by-face type interaction was significant, $F(2, 81) = 12.092$, MSE = 0.284, $p<.001$; but there were no other significant interactions, largest $F(4, 81) = 1.013$, $p > .40$. Subsequent analysis revealed that when artists were the targets there was an effect of label $F(2, 87) = 9.748$, $p < .05$; and Tukey *post hoc* tests confirmed that when the artist label was presented with artist faces, recognition accuracy was significantly higher than when it was presented with either the incongruent, criminal faces (mean difference = 0.541, $p < .05$), or the irrelevant, banker faces (mean difference = 0.717, $p < .05$). Similarly, when criminals were the targets the effect of label was again significant, $F(2, 87) = 4.385$, $p < .05$; and further analysis confirmed that when the criminal label accompanied criminal faces, recognition accuracy was significantly higher than when it accompanied incongruent, artist faces (mean difference = 0.392, $p < .05$) or irrelevant, banker faces (mean difference = 0.458, $p < .05$). The effect size of presenting a congruent label at encoding

was r = .38 (Cohen's d = 0.83).

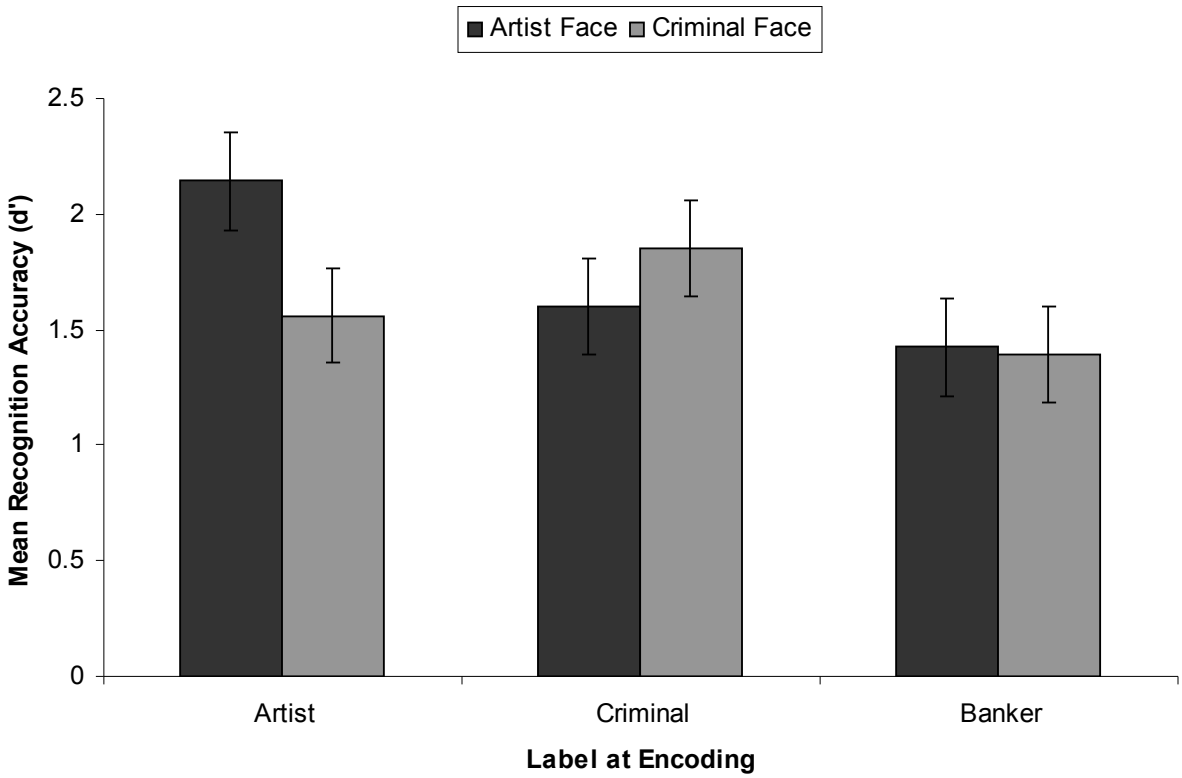

Figure 2. Mean recognition accuracy (±SEM; standard error of the means) for artist and criminal faces when the labels were artist, criminal, or banker (irrelevant) at encoding. Higher *d'* indicates greater recognition accuracy.

A parallel analysis was conducted on the response bias results summarised in Figure 3. Bias was assessed using C (Macmillan & Creelman, 2005). In the overall ANOVA there was no effect of label congruence during the test or any interaction involving this factor (see below) and for presentational purposes Figure 3 collapses across this factor. Inspection of Figure 3 indicates that response bias was more liberal for the faces that were congruent with the label at encoding (e.g., "artist") than those that were either incongruent (e.g., "criminal") or irrelevant ("banker"). A three-way mixed-factorial ANOVA was conducted on the data summarised in Figure 3 (factors: type of face: artist or criminal; label at encoding: "artist/criminal/banker", label at test: "artist/criminal/banker"). This analysis revealed that there was the significant main effect of label at encoding, $F(2, 81) = 4.525$, MSE = 0.076, $p < .05$. Further analysis showed that when criminals were targets there was an effect of label $F(2, 87) = 6.563$, $p < .05$; and Tukey *post hoc* tests confirmed that when the criminal label presented with criminal faces, response bias was significantly higher than when it accompanied incongruent, artist faces (mean difference = 0.313, $p < .05$), or irrelevant, banker faces (mean difference = 0.181, $p < .05$). However, when artists were the targets the effect of label was not significant, $F(2, 87) = 0.010$, $p > .99$. The effect size for the congruent prime at encoding was $r = .34$ (Cohen's $d = 0.72$).

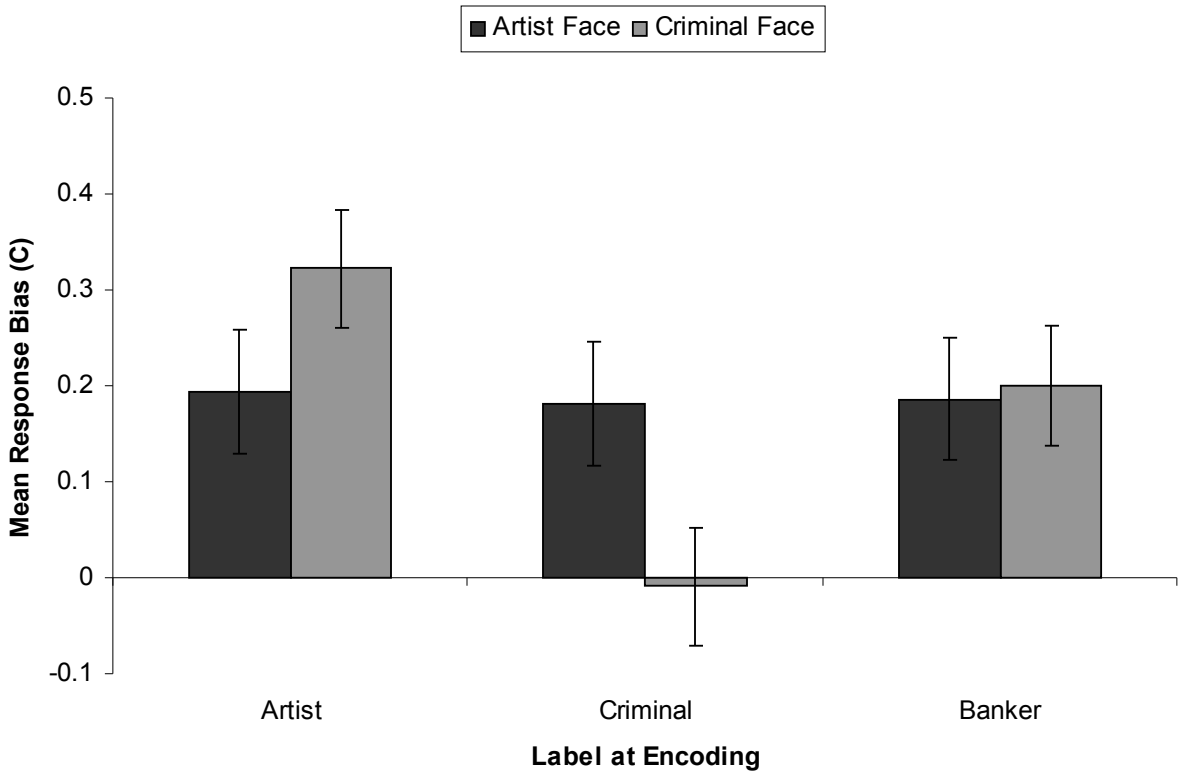

Figure 3. Mean response bias (± SEM) for artist and criminal faces when the labels were artist, criminal, or banker (irrelevant) at encoding. Lower C represents a more liberal response bias (i.e., a tendency to respond with a hit or false alarm).

The results of Experiment 1 are theoretically interesting and, as foreshadowed in the Introduction, they pose a problem for extant models of face processing (e.g., Burton, 1994). Before proceeding to provide a theoretical analysis for this interaction between semantic and visual information during encoding it seemed important to replicate the results using a different stimulus set. To this end, Experiment 2 was conducted using actor and banker faces. All other aspects of the method were identical to Experiment 1 except for the labels, where actor and banker were used as the two relevant labels and criminal was used as the irrelevant label.

4.2. Experiment 2

4.2.1. Results

The *d'* recognition accuracy scores are presented in Figure 4. This figure collapses across the congruence of the label at test because, as in Experiment 1, the ANOVA revealed that this manipulation was again without influence (see below). Inspection of Figure 4 indicates that test accuracy was greater for the faces that were congruent with the label at encoding (e.g., "actor") than those that were either incongruent (e.g., "banker") or irrelevant ("criminal"). A three-way mixed-factorial ANOVA was conducted on the results summarised in Figure 4 (factors: type of face: actor or banker; label at encoding: "actor/banker/criminal", label at test: "actor/banker/criminal"). This analysis revealed that there was the significant label at encoding-by-face type interaction, $F(2, 81) = 8.04$, MSE = 0.347, $p < .001$; but there were no other significant main effects or interactions, largest $F(4, 81) = 1.073$, $p > .37$. Further analysis showed that when artists were targets there was an effect of label at encoding, $F(2, 87) = 3.531$, $p < .05$; and Tukey *post hoc* tests confirmed that when the stereotype label presented was congruent with the face, recognition accuracy was significantly higher than when it was incongruent (mean difference = 0.401, $p < .05$) or irrelevant (mean difference = 0.335, $p < .05$). Similarly, when bankers were targets there was a significant effect of label at encoding, $F(2, 87) = 3.648$, $p < .05$; and *post hoc* tests revealed that when the stereotype label presented was congruent with the face, recognition accuracy was significantly

higher than when it was incongruent (mean difference = 0.317, $p < .05$) or irrelevant (mean difference = 0.317, $p < .05$). The effect size of presenting a congruent label at

encoding was r = .28 (Cohen's d = 0.59).

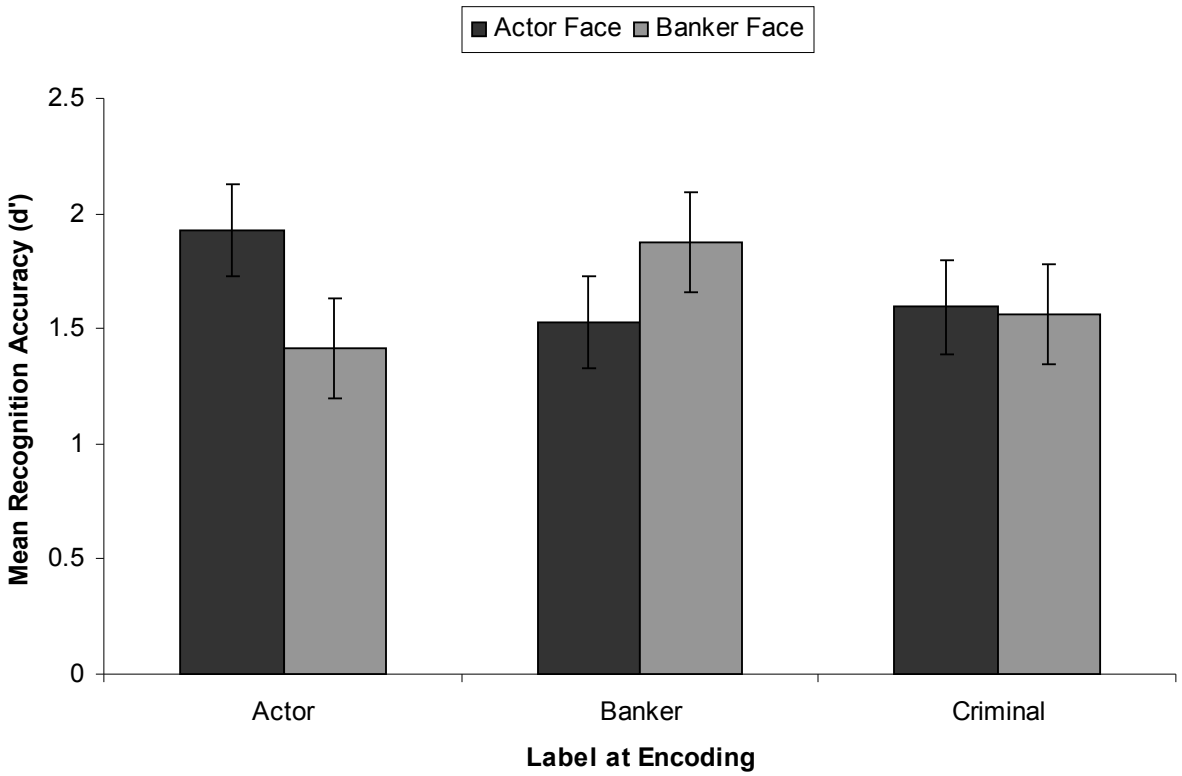

Figure 4. Mean recognition accuracy (±SEM) for actor and banker faces when the labels were actor, banker, or criminal (irrelevant) at encoding. Higher *d'* indicates greater recognition accuracy.

The C scores are presented in Figure 5. This figure collapses across the congruence of the label at test because, as in Experiment 1, the ANOVA revealed that this manipulation was again without influence (see below). Inspection of Figure 5 indicates that response bias was more liberal for the faces that were congruent with the label at encoding (e.g., "actor") both than those that were incongruent (e.g., "banker") or irrelevant ("criminal") with respect to the face. A three-way mixed-factorial ANOVA was conducted on the results summarised in Figure 5 (factors: type of face: actor or banker; label at encoding: "actor/banker/criminal", label at test: "actor/banker/criminal "). This analysis revealed that there was the significant label at encoding-by-face type interaction, $F(2, 81) = 15.915$, MSE = 0.106, $p < .05$; but no other main effects or interactions were significant, largest $F(4, 81) = 0.613$ $p > .65$. Further analyses revealed that when artists were targets there was an effect of label at encoding, $F(2, 87) = 5.863$, $p < .05$; and *post hoc* tests confirmed that when the stereotype label presented was congruent with the face, response bias was significantly higher than when it was incongruent (mean difference = 0.330, $p < .05$) but not higher than when it was irrelevant (mean difference = 0.182, $p > .05$). Similarly, when bankers were targets there was a significant effect of label at encoding, $F(2, 87) = 5.505$, $p < .05$; and *post hoc* tests revealed that when the stereotype label presented was congruent with the face, response bias was significantly higher than when it was incongruent (mean difference =

0.337, $p < .05$) but not higher than when it was irrelevant (mean difference = 0.137, $p > .05$). The effect size for the congruent prime at encoding was r = .31 (Cohen's d = 0.66).

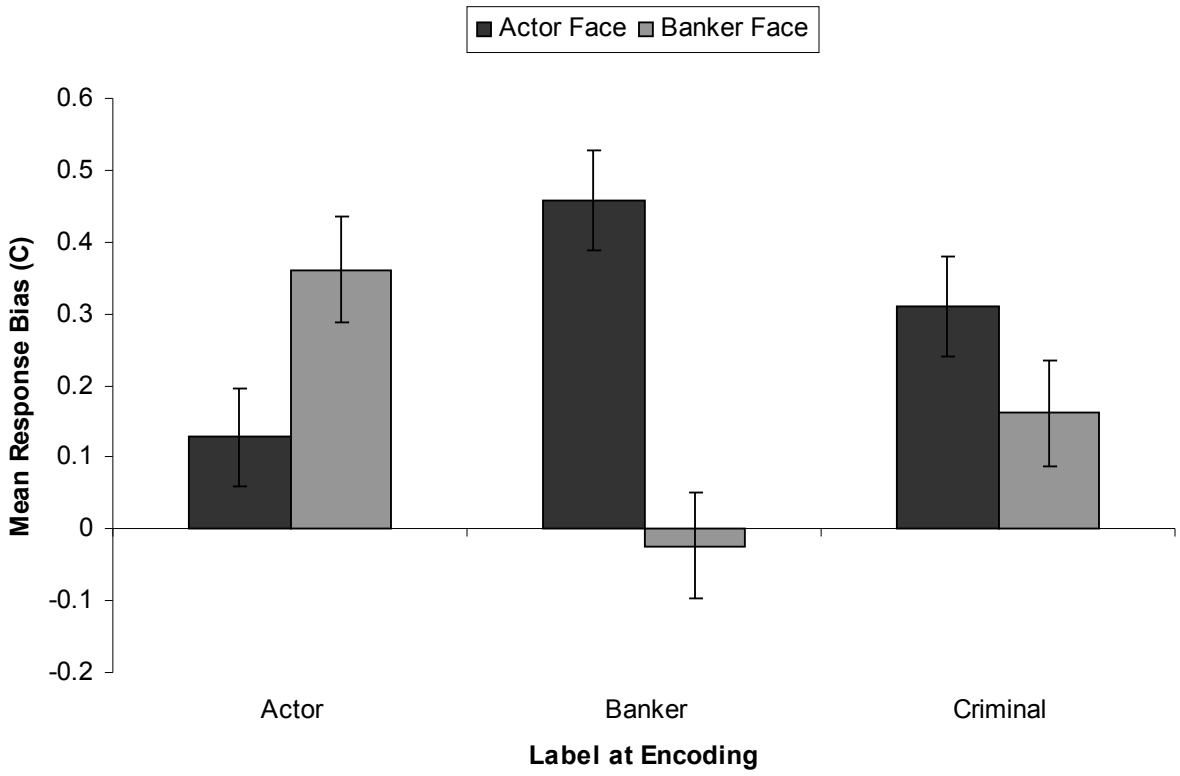

Figure 5. Mean response bias (± SEM) for actor and banker faces when the labels were actor, banker, or criminal (irrelevant) at encoding. Lower C represents a more liberal response bias (i.e., a tendency to respond with a hit or false alarm).

5. General Discussion

The results from this study clearly show a reliable stereotype priming effect, whereby faces that are presented with a congruent stereotype label are better recognised subsequently. This effect, apparent in an analysis of d' scores, was solely a consequence

of the presentation of the stereotype congruent label during encoding. This priming effect, however, is also associated with a more liberal response bias for faces congruent with the label, as evident in more false hits for stereotype congruent distractors (c.f., Klatzky et al., 1982a). The fact that the presentation of a label at encoding is on previously unfamiliar faces indicates that the effect observed in Experiments 1 and 2 is not one of category priming. Instead, the effect of the label on face encoding represents an interaction between the nature of the label and the visual properties of the face. How this interaction can be accommodated within currently popular models of face recognition now needs to be considered.

The IAC-L model (Burton, 1994) is a neural network model of face recognition. The IAC-L contains Face Recognition Units (FRUs) that can come to be activated by specific faces as the result of experience with those faces. Each FRU is connected through Personal Identity Nodes (PINs) to Voice Recognition Units (VRUs), Semantic Information Units (SIUs), and Name Recognition Units (NRUs). Within this architecture, activation from the semantic nodes can propagate to the FRUs through reciprocal excitatory links between the SIU, PIN and FRU. Thus, presentation of an occupation label will activate semantic nodes, PINs to which they are linked, and thereby to extant FRUs (i.e., those corresponding to familiar faces). In its present form, the IAC architecture is incapable of providing an account of the stereotype priming effects evident in Experiments 1 and 2. In order for semantic information to affect the processing of a given face then a PIN for that face needs to mediate the spread of activation from an SIU to an FRU. When a face is novel it will neither have an FRU nor a PIN. Even if one supposes that an FRU and PIN were acquired during a single

encoding experience, there remains the problem of how stereotypicality is represented within the FRU pool. In order to provide an analysis of the results of Experiments 1 and 2 a more sophisticated characterisation of face processing is required.

Valentine et al. (1995) suggested that the FRU pool could be represented by a face-space that codes faces along dimensions (between 15 and 22, according to Lewis, 2004) that correspond to visual characteristics of faces (e.g., distance between the eyes). According to this scheme, proximity in multi-dimensional face-space indicates that two faces provide similar activation of the various dimensions. For example, two faces that have similar distances between the eyes and similar hairlines will be closer together in face space than two faces that only have similar distances between the eyes. The fact that people can reliably categorise faces as belonging to a particular occupation indicates that some values on some dimensions are linked or associated with particular occupations (i.e., SIUs). For example, to recognise hairdressers, the hairline and style is likely to be more important than to recognise bankers, and the narrowness of the eyes is likely to characterise a stereotypical criminal but not the stereotypical actor (see Bull & Green, 1980). With this set of assumptions in mind, the results of Experiments 1 and 2 are readily interpreted.

The presentation of an occupation congruent label will result in activation of the value on the dimensions that are associated with the occupation-stereotype face and critically a specific region of face-space. This will allow the stereotypical dimensions to be encoded more effectively, because of the convergence between activation by the label and activation by the face itself. In effect, attentional weighting (c.f., Nosofsky, 1988) during encoding is increased to stereotypically congruent dimensions (c.f., Valentine &

Endo, 1992). By itself this effect might only appear to predict that there will be a bias towards responding old to all stereotypically congruent faces during the test. However, once it is recognised that there is spreading activation within face-space and that a given region of face-space is activate by many dimensions, then the provision of a stereotype congruent label will also result in other dimensions of the face (that are not stereotypically congruent) being encoded more effectively. It is this additional consequence that, somewhat counter-intuitively, results in superior accuracy for faces that were given a stereotype congruent label. This form of analysis also predicts that there might be some interference produced by the provision of a stereotype incongruent/irrelevant label. Briefly, under such circumstances the region of face-space that is activated by the label will differ from that activated by the face and the face will not be encoded as effectively. This analysis is illustrated in Figure 6.

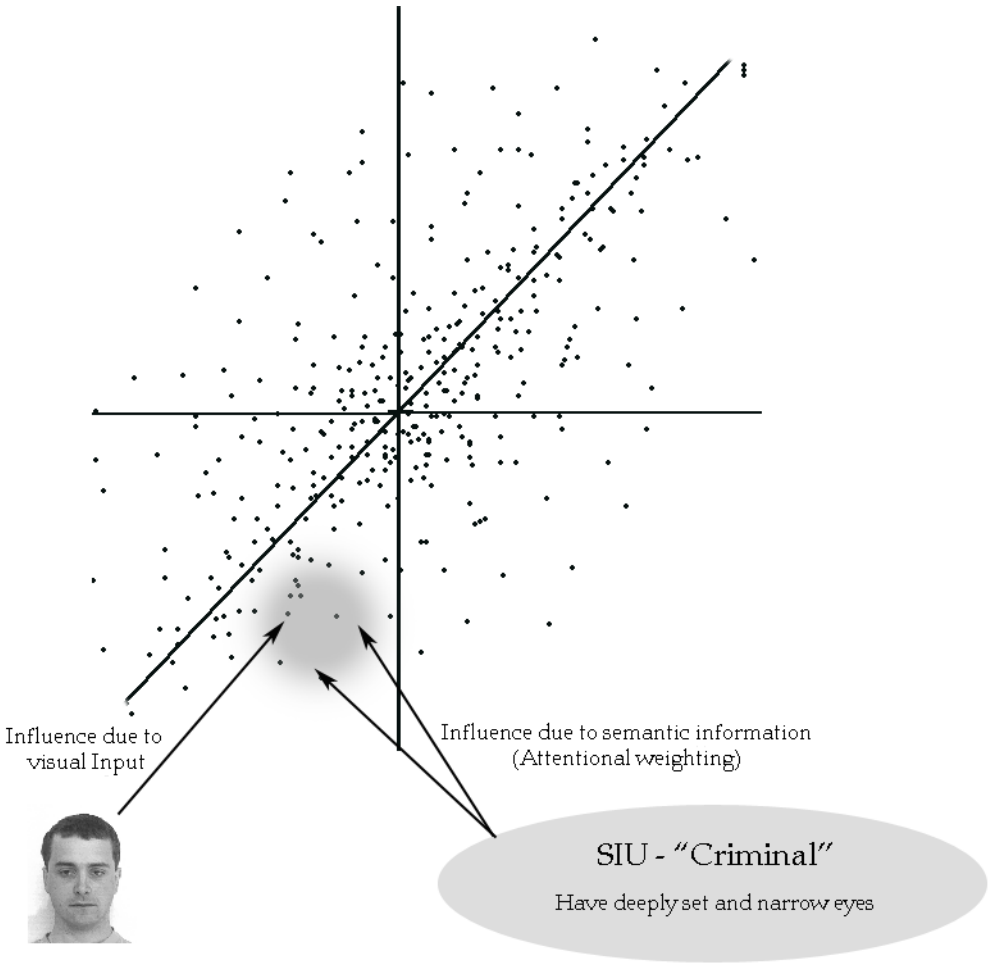

Figure 6. A representation of the proposed interaction between semantic and visual information in face-space. The SIU "criminal" acts on the same region of face-space as a face that has visual features that are stereotypically criminal (e.g., narrow and deeply set eyes). In this example, the Y axis represents distances between the eyes and the Z axis represents how deeply set the eyes are and the X represents, for example, hairline. The highlighted region is that activated by visual and semantic information that is stereotypically criminal.

The stereotype priming effect reported here is one based on the encoding of the face and we suppose that the label primes a region of face-space thereby allowing unfamiliar faces to be encoded more readily. This influence is evident after a single opportunity to encode a face and has implications for other circumstances under which the encoding conditions are similarly limited or impoverished. It is often the case that eyewitness testimony is based upon a relatively brief opportunity for encoding: The faces and events are typically unfamiliar to the eyewitness. The results of Experiments 1 and 2 indicate that the way an eyewitness encodes an event will affect their recognition accuracy. On the one hand, if an eyewitness sees a person who looks like the prototypical criminal committing a criminal act and the eyewitness (implicitly) labels them as a criminal, then they might be more likely to subsequently identify that criminal in a line up than some other equally prototypical criminal. On the other hand, if for some reason the perpetrator was not labelled but was nevertheless stereotypically criminal, then in a subsequent line up the eyewitness might be less likely to identify that criminal and more likely to identify another prototypical criminal. If the way in which an event was encoded could be established, then this might be one of the sources of information (c.f., Penrod, Fulero, & Cutler, 1995) used to assess the reliability of eyewitness testimony

The results of Experiments 1 and 2 establish that the presentation of semantic information affects the encoding of stereotype-congruent novel faces. This finding has important theoretical implications, not least because it is inconsistent with several influential models of face recognition. However, the interaction between semantic and visual information can be accommodated within models that suppose that a novel,

stereotypical face is encoded in a region in face-space (e.g., Valentine, 1991) that is linked to the semantic information associated with that stereotype.

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