The Bilateral Advantage for Famous Faces: Interhemispheric Communication or Competition?

Lyndsay M. Baird & A. Mike Burton
Department of Psychology, University of Glasgow, UK

Correspondence concerning this article should be addressed to:
Mike Burton, Department of Psychology, University of Glasgow, UK, G12 8QQ.
Tel : +44 (0)141 330 4060
Fax : +44 (0) 141 330 4606
E-mail: mike@psy.gla.ac.uk

Short title: The Bilateral Advantage for Faces

Abstract

The bilateral advantage for the perception of famous faces was investigated using a redundant target procedure. In Experiment 1 we compared simultaneous presentation of stimuli (a) bilaterally and (b) one above the other in the central field. Results showed a redundancy advantage, but only when faces were presented bilaterally. This result lends support to the notion of interhemispheric communication using cross-hemisphere representations. Experiment 2 examined the nature of such communication by comparing bilateral presentation of identical face images, with bilateral presentation of different images of the same person. When asked to make a familiar/unfamiliar face judgement, participants showed evidence for a redundancy advantage under both bilateral conditions. This suggests that the nature of the information shared in interhemispheric communication is abstract, rather than being tied to superficial stimulus properties.

Communication between the cerebral hemispheres has become the focus of much recent research. For example, it has been shown for a range of stimuli, including faces, that dividing information across the hemispheres can improve performance for complex tasks compared to when processing is restricted to a single hemisphere (Compton 2002; Koivisto, 2000; Liederman, Merola & Martinez, 1985; Weissman & Banich, 2000).

One phenomenon of particular interest is the "bilateral advantage" in which simultaneous presentation of identical stimuli to both visual fields improves performance over presentation to either hemisphere alone (see Banich, 1998; Hasbrooke & Chiarello, 1998). In contrast to many tasks used to study interhemispheric communication, this bilateral redundant technique presents viewers with stimuli which do not require interhemispheric interaction, since the same information is presented in both fields. Nevertheless, an advantage in processing speed for such redundant stimuli has been demonstrated for a wide range of stimuli, including simple visual patterns (Miller, 1982), colours (Roser & Corballis, 2003), and consonant–vowel–consonant syllables (Marks & Hellige, 1999; 2003; Hellige & Adamson, 2007). Mohr, Pulvermüller, & Zaidel, (1994) asked subjects to discriminate between words and pronounceable pseudo-words, and demonstrated a robust bilateral advantage for words, but not for pseudo-words. Furthermore, this advantage was absent in a split-brain patient, in whom any cortically mediated hemispheric interaction was unlikely, suggesting that the effect is dependent on the existence of an intact corpus callosum (Mohr, Pulvermüller, Rayman & Zaidel, 1994).

These findings have more recently been extended to other complex visual stimuli. Specifically, a significant bilateral advantage has been found for the recognition of famous but not unfamiliar faces (Mohr, Landgrebe & Schweinberger, 2002; Schweinberger, Baird, Blümler, Kaufmann, & Mohr, 2003). Such findings suggest that at least for complex stimuli, bilaterally redundant information has a facilitative effect on processing. However, this appears to be restricted to stimuli that have been previously learned such as words and famous faces, and is not a general processing advantage, since it is absent for pseudo-words and unfamiliar faces. It is not clear, however, if the bilateral advantage for complex stimuli is restricted to presentation of

identical stimuli or might extend to stimuli denoting the same concept (e.g. two different photographs of the same familiar person).

One interpretation of the bilateral advantage is that it reflects a race between the processing of two competing stimuli. Specifically, if both stimuli are processed independently and in parallel, the hemisphere that is most efficient for a particular task normally completes it first. However, if the less specialised hemisphere occasionally completes the task fastest, the overall average processing speed will be faster than unilateral presentation to the specialised hemisphere. Hence a bilateral redundant advantage will be observed.   In fact, this race model of the bilateral advantage may also be applied to processing of pairs of stimuli anywhere in the visual field. If increasing the number of stimuli results in faster detection, then improved performance might be predicted for a wide range of stimuli, both crossing visual fields and lying within them (Marks & Hellige, 1999).

However, while there are several bilateral-advantage phenomena in the literature which can easily be accounted for by the race model (Corballis, 1998, Iacoboni & Zaidel, 2003), there are others for which such an account sits less comfortably (Miniussi, Girelli & Marzi, 1998). For example, the fact that bilateral advantage is observed for familiar but not unfamiliar stimuli is hard to explain in 'race' terms. In order to accommodate these results an alternative model based on hemispheric collaboration and Hebbian learning mechanisms has been proposed (Pulvermüller & Mohr, 1996). It is suggested that learned stimuli such as faces may become represented in interconnected cell assemblies (CAs) that can become distributed across hemispheres to form transcortical cell assemblies (TCAs), as concepts located in different regions of the brain become associated. TCAs may be involved with the processing of certain stimuli or represent mental concepts such as words or faces. If stimulated once through input to a single hemisphere, the CA activation will be less efficient than if both hemispheres are stimulated simultaneously. Further support for such a theory comes from the facilitative effect found when a CA is stimulated twice in the same visual field (Mohr, Pulvermüller, Mittelstädt, & Rayman, 1996).

Not only can such a model account for the relative hemispheric specialisations frequently observed for certain tasks but it may also explain the observed distinction

between a bilateral advantage for familiar and unfamiliar stimuli. Specifically, CAs should only exist for concepts that are known, and so bilateral presentation will produce no facilitation for previously unlearned stimuli. While this explanation also offers an account for the lack of bilateral advantage observed in a split-brain patient (Mohr et al, 1994) it should be noted that other results with acallosal patients are more variable, with some demonstrating enhanced bilateral redundancy gains for basic stimuli (e.g. Corballis, 1998).

A bilateral advantage has not been found in a task involving the recognition of facial expressions (Schweinberger, et al., 2003). Such a finding seems to suggest that it is not how meaningful a stimulus is *per se* that leads to bilateral activation of TCAs, but rather it must be the activation of concepts acquired through learning. It has been suggested that expression recognition may be an innate process (Ekman & Friesen, 1972). If this is the case then it could be assumed that this process would require no activation of acquired cortical representations. Therefore, a lack of bilateral advantage for the recognition of expression could be seen as evidence in support of a neurocognitive theory.

A route to disentangling these two competing theories, race versus TCAs, is to establish whether a similar performance advantage can be achieved when two identical stimuli are presented anywhere in the visual field. In an attempt to establish the extent performance on bilateral trials might be due to target redundancy rather than to stimulation of both hemispheres, Marks & Hellige (1999), used a paradigm in which two copies of identical nonword letter trigrams were always presented on each trial for participants to identify. On unilateral trials both copies of the stimulus were presented to the same visual field whilst on bilateral trials one copy of the stimuli was shown simultaneously to each visual field. Results revealed that the best performance occurred when stimuli were presented to the RVF, worst for stimuli to the LVF, with intermediate performance on bilateral trials. Such a finding indicates that for CVC identification, redundancy gain is not restricted to bihemispheric presentations. However, it is of interest to establish how generalisable these results may be in the case of more complex meaningful stimuli such as faces. If two (redundant) stimuli always give rise to faster performance than one, this would lend support to a race model which does not depend on differential processing across

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hemispheres. In contrast, interhemispheric cooperation accounts predict a redundancy advantage only when the stimulus is presented separately to each hemisphere. More specifically, such an advantage would only be expected to occur after the presentation of familiar stimuli for which learned TCAs already exist. In Experiment 1, we therefore present individual and paired stimuli, sometimes across visual fields, and sometimes centrally.

Experiment 1

Method

Participants

26 participants (16 females) were paid for their participation in the study. Ages ranged from 18 to 24 years (M = 20.2 years). Each participant had normal or corrected-to normal vision. All participants were strongly right-handed (mean laterality quotient = 94.78) as assessed by the Edinburgh Handedness Inventory (Oldfield, 1971) and had no left-handed first-degree relatives. Participants were recruited on the basis that they could recognise British and American celebrities. The University of Glasgow Ethics Committee approved this study and all participants gave their informed consent prior to participation.

Stimuli

Stimuli comprised 16 familiar and 16 unfamiliar faces (8 men and 8 women of each category) in greyscale. Famous faces comprised well-known politicians, actors, singers and sports stars and were obtained from the Internet. All were high-resolution photographs, showing full face views in grey scale; see Figure 1 for an example. Unknown faces were matched to famous faces with respect to gender and any distinguishing features. All faces had previously been rated for familiarity by a comparable group (i.e. students from the same source, but not those who took part in this experiment). Faces were rated 'definitely familiar', 'possibly familiar', or 'definitely unfamiliar'. Only stimuli were used which attracted 'definitely familiar' or

'definitely unfamiliar' ratings from all subjects in this exercise. On screen image size was approximately 3.5cm high x 2.5cm wide corresponding to a visual angle of 3.5 x 2.5 degrees shown at distance of 57cm. Stimuli eccentricity was 3.0cm (centre to fixation) corresponding to 3º visual angle and resulting in an inner visual angle of approximately 1.75 degrees.

Procedure

Participants were seated at a fixed distance of 57cm from the16inch monitor of an Apple Macintosh G5 Workstation, using a chin-rest with forehead restraint bar. Participants were instructed that they would be presented with faces for which they must perform a familiarity decision task. They were instructed not to move their eyes from the fixation cross, and to perform as fast an accurately as possible.

Trials began with the presentation of a central fixation cross for 1500ms followed by a face for 150ms in one of 6 presentation conditions. The fixation cross remained on screen during stimulus presentation. The inter-trial duration was 500ms in which a blank screen was shown. In single-stimulus conditions faces were presented to the left right, above or below fixation cross. In dual-stimulus conditions, stimuli were to the left and right of the fixation cross, or above and below it. Examples are given in Figure1 .

FIGURE 1 HERE PLEASE

Each identity was shown once in each of the 6 presentation conditions, comprising 4 experimental blocks with 192 trials in total. Order of trials was independently randomised for each participant. A short practice session consisting of all experimental conditions preceded the experimental session. Practice faces were not shown subsequently.

Manual responses were made by computer keyboard. All responses were made bimanually by pressing two "familiar" keys with the middle fingers of the left and right hands and two "unfamiliar" keys with the index fingers of both hands. Key assignment was counter-balanced between participants. Though bimanual responses

were required, only the fastest response on each trial was analysed, regardless of the hand used. The experiment was controlled using PsyScope version 10.

Results and Discussion

Reaction Times

FIGURES 2A & 2B HERE PLEASE

Means of median reaction times for familiar and unfamiliar faces across the 6 presentation conditions are shown in Figure 2a. A two-way within subjects ANOVA was carried out with factors familiarity (familiar / unfamiliar) and presentation condition (LVF / RVF / upper_VF / lower_VF / BVF_H / BVF_V). Results revealed a significant main effect of presentation condition, $F(5, 125) = 4.46$, $MSE = 8708$, $p < 0.05$, but not of familiarity, $F(1, 25) < 1$. The familiarity x presentation interaction was significant, $F(5, 125) = 2.58$, $MSE = 9345$, $p < 0.05$. Analysis of simple main effects revealed a significant effect of presentation condition for familiar faces only, $F(5,125) = 5.85$, $MSE = 8708$, $p < 0.05$. Comparing means using the Bonferonni adjustment indicated that responses to the BVF_H condition were significantly faster than either the LVF or the RVF ($p < 0.05$) reflecting a bilateral advantage. Importantly, reaction times to the BVF_V did not show a significant advantage over any of the unilateral conditions

Accuracy Analyses

TABLE 1 HERE PLEASE

Mean accuracy across conditions is shown in Figure 2b. A two-way within subjects ANOVA was carried out with factors as for the RTs. Analysis revealed a main effect of familiarity, $F(1, 25) = 9.9$, $MSE = 0.035$, $p < 0.01$, with unfamiliar faces being recognised more accurately than familiar faces, possibly reflecting a bias to respond

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"unfamiliar". Indeed, the Hit and False Alarm rates presented in Table 1 appear to confirm this suggestion. This bias may be occurring because of the difficult nature of the task, involving fast presentations in the periphery of vision, rather than because of a general unfamiliarity with the faces. Indeed, previous studies using brief presentation of familiar faces in the periphery of vision demonstrate similarly low overall hit rates (Compton, 2002; Mohr et al, 2002). There was also a significant main effect of presentation condition, $F(5, 125) = 3.763$, $MSE = 0.009$, $p < 0.01$, however no significant familiarity x presentation condition interaction, $F(5, 125) = 1.58$, $MSE = 0.014$. Comparisons between means for familiar faces revealed only that the BVF_H condition was significantly more accurate than the LVF condition, $F(1, 125) = 3.92$, $p < 0.05$. As with the reaction time analysis, the BVF_V condition did not show any performance advantage over any unilateral condition

These results show quite clearly that an advantage for presenting two face stimuli occurs only when they are horizontally aligned (i.e. one to each visual field), and not when they are vertically aligned (above and below fixation). Of course, in the vertically aligned condition, information was presented to both hemispheres. However, this was complementary information (the left and right halves of the faces). This was not sufficient to produce an advantage in processing, in either speed or accuracy. Instead, it was necessary to present redundant information simultaneously to both hemispheres to produce an effect. This result supports the interhemispheric communication account of the bilateral advantage for face stimuli, and suggests that race accounts (at least those depending on competition between stimulus processing which is independent of hemisphere), will not suffice for these stimuli.

A more subtle aspect of the data concerns the familiarity by condition interactions in RTs and accuracy. There appears to be some evidence for a speed accuracy trade-off here. When single familiar faces were lateralised to either the left of right visual fields they were responded to as quickly yet less accurately than unfamiliar faces. When the faces were presented to upper or lower fields, the familiar faces were responded to as accurately yet slower than unfamiliar faces. The overall bias to respond 'unfamiliar' is evident in both these patterns, though why it should be manifested differently in vertical than in horizontal presentation planes is not clear.

Experiment 2

Since Experiment 1 supports the interhemispheric account of the bilateral advantage phenomenon, it is of interest to investigate the precise nature of this communication. Initial studies investigating the phenomenon with faces have used identical copies of a stimulus presented to both hemispheres. It is therefore unclear whether findings reflect cooperation at either a pictorial or more abstractive representation of the stimulus.

It has been suggested that the cortical representations responsible for the bilateral advantage are neurobiological equivalents of face recognition units (FRUs) (Bruce & Young, 1986; Burton,et al 1999, 2005). Such FRUs are said to be structural codes that allow for the identification of a face independently of variations in image. In order to ascertain whether these abstract structures might underlie the bilateral advantage, Experiment 2 presents two different images of the same identity simultaneously to both hemispheres. If such a manipulation leads to a bilateral advantage, this would suggest co-operation at an FRU-like level. Alternatively, a reduction in the bilateral advantage in such circumstances may imply that co-operative representations are image-based.

Method

Participants

28 participants (16 females) were paid to take part in this study. Ages ranged from 18 to 25 years (M = 20.3 years). Each participant had normal or corrected-to normal vision, and all were strongly right-handed (mean laterality quotient = 96.5) as assessed by the Edinburgh Handedness Inventory (Oldfield, 1971) with no left-handed first-degree relatives. Participants were recruited on the basis they be able to recognise British and American celebrities. The University of Glasgow Ethics Committee approved this study and all participants gave their informed consent prior to participation.

Stimuli

Stimuli comprised two different images of 16 familiar and 16 unfamiliar identities (8 men and 8 women) in greyscale. Familiar stimuli were again well-known politicians, actors, singers and sports stars, but different from those used in Experiment 1. Face images were obtained from the Internet. Again, unknown faces were matched to famous faces with respect to gender and any distinguishing features. All faces had previously been rated for familiarity. Differences between pictures of each identity were obtained by selecting images that had been taken using different cameras or at different time periods. On screen image size was approximately 3.5cm high x 2.5cm wide, corresponding to a visual angle of 3.5 x 2.5 degrees shown at distance of 57cm. Stimuli eccentricity was 3.0cm (centre to fixation) corresponding to 3° visual angle and resulting in an inner visual angle of approximately 1.75 degrees.

Procedure

The experimental procedure was the same as for Experiment 1. Presentation conditions were as follows:

1. Left visual field only (LVF)
2. Right visual field only (RVF)
3. Identical images to both visual fields (BVF_same)
4. Different images of the same identity to both visual fields (BVF_diff)

Each identity was shown once in each of the four presentation conditions, giving 16 pictures per category and 128 trails in total. Breaks were allowed every 32 trials. As before, a short practice session preceded the experiment proper, but practice faces were not shown subsequently.

Results and Discussion

Reaction Times

FIGURES 3A &3B HERE PLEASE

Means of median reaction times for familiar and unfamiliar faces across the 4 presentation conditions are shown below in Figure 3a. A two-way within subjects ANOVA was carried out with factors familiarity (familiar / unfamiliar) and presentation condition (LVF/ RVR / BVF_same / BVF_diff). Results revealed a significant main effect of presentation condition, $F(3, 81) = 5.572$, $MSE = 4335$, $p < 0.01$, but not of familiarity, $F(1, 27) = 1.596$, $MSE = 16367$. The familiarity x presentation condition interaction was also a significant, $F(3, 81) = 3.604$, $MSE = 6617.626$, $p < 0.05$.

Simple main effects revealed that familiar faces were responded to significantly faster than unfamiliar faces however only at the BVF_same condition, $F(1,27) = 5.870$, $MSE = 16367$, $p < 0.05$. More importantly, there was a significant effect of presentation condition for both familiar, ($F(3,87) = 8.121$, $MSE = 4335$, $p < 0.01$) and unfamiliar faces ($F(3,87) = 2.952$, $MSE = 4335$, $p < 0.01$). Comparison of means for familiar faces, using the Bonferroni correction, revealed a bilateral advantage for the BVF_same condition, (BVF_same v LVF, BVF_same v RVF, $p < 0.01$). The BVF_diff condition produced significantly faster responses than the LVF presentation condition, $p < 0.01$, and a ns trend for an advantage over the RVF condition, $t(81)=1.591$, $p = 0.11$. There was no significant difference between the two bilateral conditions.

For the unfamiliar faces, further analysis revealed no systematic pattern of results, with significant differences occurring between the LVF and BVF_diff conditions, $p < 0.01$, RVF and BVF_same conditions, $p < 0.01$ and between the BVF_same and BVF_diff conditions, $p < 0.01$.

Accuracy

TABLE 2 HERE PLEASE

Mean correct response rates for familiar and unfamiliar faces in the four presentation conditions are shown in Figure 3b. A two-way within subjects ANOVA was carried out with factors as in the RT analysis. This revealed a significant main effect of presentation condition, $F(3, 81) = 3.02$, $MSE = 0.006$, $p < 0.05$, but no main effect of familiarity, $F(1, 27)$, $= 3.69$, $MSE = 0.047$. There was, however, a significant familiarity x presentation condition interaction, $F(3, 81) = 4.15$, $MSE = 0.01$, $p < 0.01$.

Simple main effects showed a significant effect of presentation condition for both familiar, $F(3, 81) = 7.47$, $MSE = 0.006$, $p < 0.01$, and unfamiliar faces, $F(3, 81) = 2.83$, $MSE = 0.006$, $p < 0.01$. Comparison of means using the Bonferroni adjustment revealed that for familiar faces there was no difference between the two unilateral conditions, and no difference between the two bilateral conditions. However, both bilateral conditions produced significantly higher accuracy than either unilateral condition ($p < 0.01$ in all cases). Analysis of the unfamiliar stimuli revealed only that LVF was significantly more accurate than either of the bilateral presentation conditions, $p < 0.05$. Table 2 shows a breakdown of the accuracy scores into hits and false positives. Unlike the previous experiment, there is no evidence this time for a bias towards 'unfamiliar' responses, and no evidence of a speed-accuracy trade-off.

Experiment 2 replicates the standard bilateral advantage previously observed for pictures of identical familiar faces, and this pattern is observed in both RT and accuracy. However, there is also evidence for collaboration at a more abstract level. There is a clear bilateral advantage for different images of the same familiar face in the accuracy data, where performance is indistinguishable from the standard effect using identical images. The RT data is more equivocal, showing only a trend in the direction of an advantage across different images. Taken together, the experiment shows that interhemispheric collaboration effects can operate at an abstract level, such as that corresponding to an FRU in theories of face recognition. However, there appears to be an extra advantage for co-operation at the image level. Such a pattern

has many precedents in face recognition, for example repetition priming for identities survives a change of image between prime and test, though priming is largest when identical images are used (e.g., Ellis et al, 1996).

General Discussion

The present experiments were designed to determine whether interhemispheric communication can provide a suitable explanation for the bilateral advantage observed for famous faces (Experiment 1). In addition, the nature of such hemispheric interaction was explored in an attempt to establish whether such communication occurs at a low sensory or more abstract level of information transfer (Experiment 2).

Results from Experiment 1 revealed the established bilateral advantage for famous faces (Mohr, et al, 2002; Schweinberger, et al, 2003). However, no similar performance advantage was observed when both faces were presented centrally. This makes clear that the bilateral advantage for famous faces relies on the positioning of faces within the visual system and not merely on the presence of additional stimulus information on bilateral presentations. Such a finding is at odds with Marks & Hellige (1999), who found no advantage for stimuli being presented to both visual fields when compared with performance achieved when redundant stimuli were presented to the dominant RVF/Left hemisphere. Whilst there are several methodological differences between these studies the major difference is that the stimuli used in our experiments are considerably more complex than those of Marks and Hellige. It is quite possible that interhemispheric processing confers an advantage only for complex stimuli, such as those used here.

A model of interhemispheric interaction based on Hebbian learning mechanisms appears more useful than a race model in explaining these findings. Specifically, if acquired memory representations for familiar faces are stored in TCAs, performance on bilateral trials is improved due to a greater number of neurons within such a TCA becoming activated when both hemispheres are stimulated simultaneously. A range of neuroimaging and neuropsychological results appear to support the notion of

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underling bilateral distributed networks at least in the domain of lexical processing (Pulvermuller, 2005; Mohr, Endrasss, Hauk & Pulvermuller, 2007).

Experiment 2 revealed the bilateral advantage is not an image-specific effect, suggesting that hemispheric communication may be occurring at a more abstract level of processing, perhaps related to identity. These findings are consistent with several other studies in the field examining the nature of information collaborated during the bilateral advantage (e.g. Marks & Hellige, 2003 & Patel & Hellige, 2007). Marks & Hellige (2003) presented participants with three-digit numbers as either digit trigrams or as dot-pattern trigrams. These stimulus formats were combined on bilateral redundant trials to produce bilateral consistent and inconsistent conditions in which trigrams would either be in the same format or represent the same numeric quantity in different formats respectively. Consistent with our findings in Experiment 2, results revealed a bilateral gain even when the numeric formats of the stimuli differed. This again indicates that the bilateral advantage is not confined to instances in which physically identical stimuli are used. Of particular interest was the additional finding that the greatest bilateral gain was found when stimuli were presented in the same numeric format. This again mirrors our finding in Experiment 2 in which the greatest bilateral advantage was found when identical famous faces were presented to both hemispheres. In addition, it should be highlighted that the bilateral advantage observed in Experiment 2 only occurred for famous but not unfamiliar faces. This once again lends support to a model of hemispheric communication dependent upon TCAs acquired for learned stimuli only. Given that no CAs should exist for unknown concepts, bilateral presentation should produce no facilitation for such previously unlearned face stimuli.Together, these findings indicate that both superficial and conceptual aspects of the stimulus contribute to the bilateral advantage. This is perhaps not surprising given that most callosal fibres connect homologous regions of the two hemispheres (e.g Vercelli & Innocenti, 1993). In relation to the neurocognitive explanation of the bilateral advantage, discussed above, it could be that different identity formats activate areas of the cortex and hence cell assemblies that are similar yet not completely identical. As a result, provided that both formats activate sufficiently homologous areas then activation will be enough to produce a bilateral advantage although perhaps one that is less robust than would be produced for identical stimuli. This idea that different stimulus formats access related yet

distinct cortical access routes receives support from Patel & Hellige (2007), who demonstrated, in a task difficulty paradigm, that mixing stimulus formats within a hemisphere can increase the processing capacity of that hemisphere.

The stimuli used in bilateral inconsistent trials by Marks & Hellige (2003) were even more distinct than the different images used in our Experiment 2, raising the possibility of rather high level representations being the locus of this effect. The precise nature of such communication might be explored further by examining the effect of semantic judgements of personal identity on the bilateral advantage. Although different identities sharing a common concept may not activate completely homologous cortical areas, it is possible that some shared representations of a given CA will be activated. Indeed, as has been suggested by Marks & Hellige, the size of the bilateral advantage obtained may be determined by the extent to which stimuli on bilateral trials activate homologous areas in both hemispheres. It has however been argued that there may be a capacity limit to our ability to process multiple faces (Bindemann, Burton & Jenkins, 2005) and so it is possible that no such bilateral advantage would be found. Further investigation is, of course, necessary to understand the processing implications of presenting more than one stimulus at a time: a commonplace event in everyday life, but one little studied the psychology laboratory.

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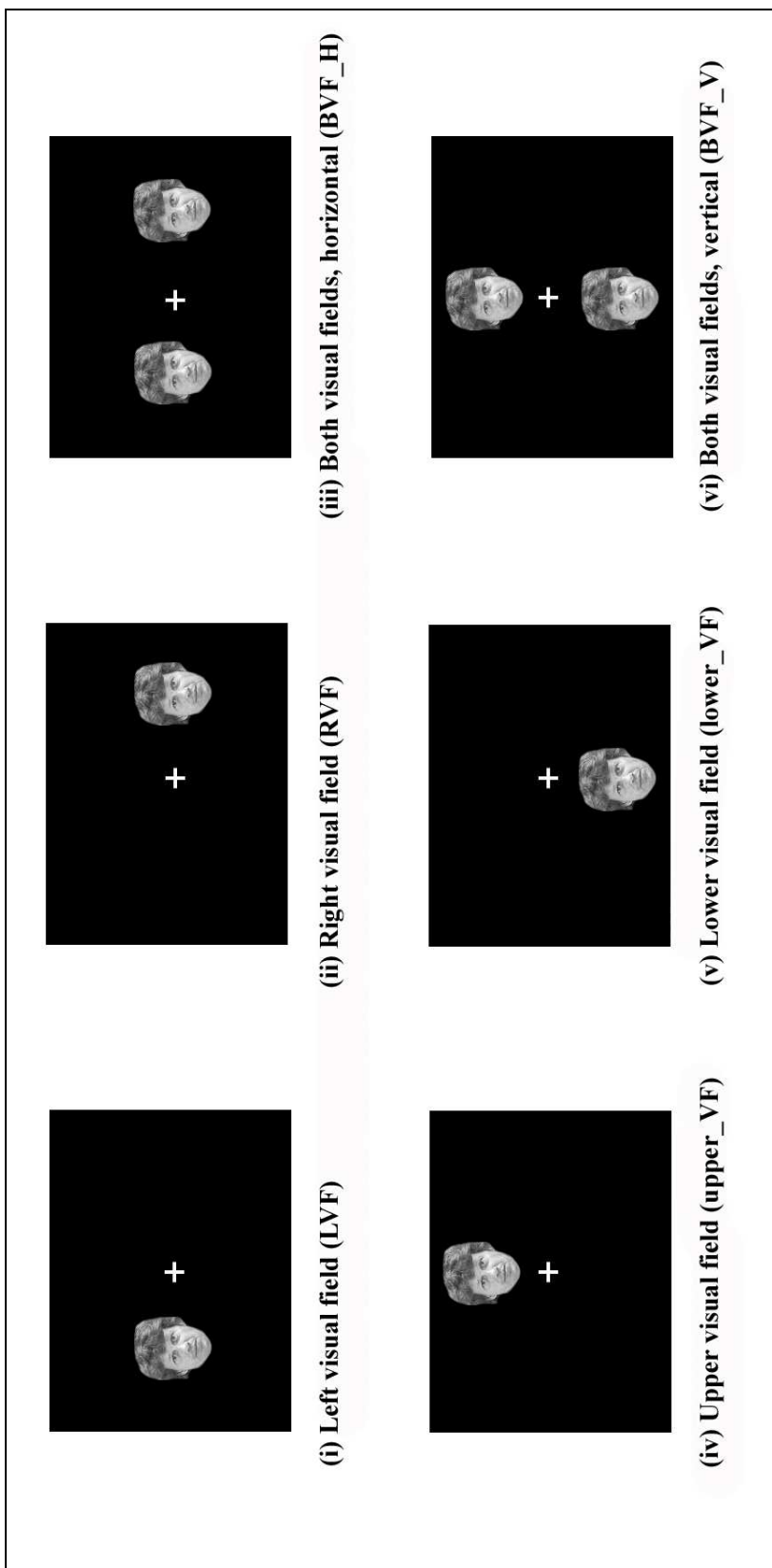
(i) Left visual field (LVF)　　　(ii) Right visual field (RVF)　　　(iii) Both visual fields, horizontal (BVF_H)

(iv) Upper visual field (upper_VF)　　　(v) Lower visual field (lower_VF)　　　(vi) Both visual fields, vertical (BVF_V)

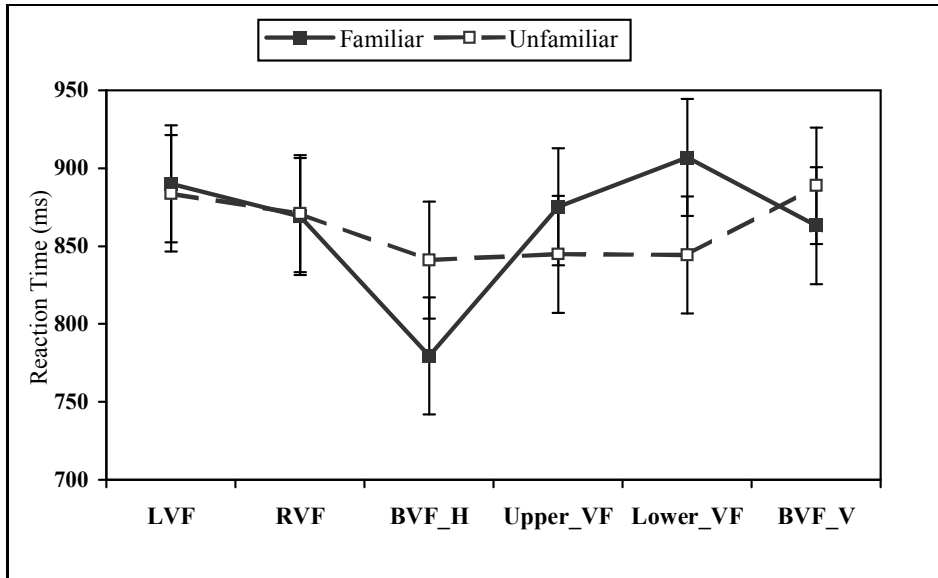Figure 1: Presentation Conditions of stimuli in Experiment

Figure 2a. Means of median RTs across each of the 6 presentation conditions for familiar and unfamiliar faces.
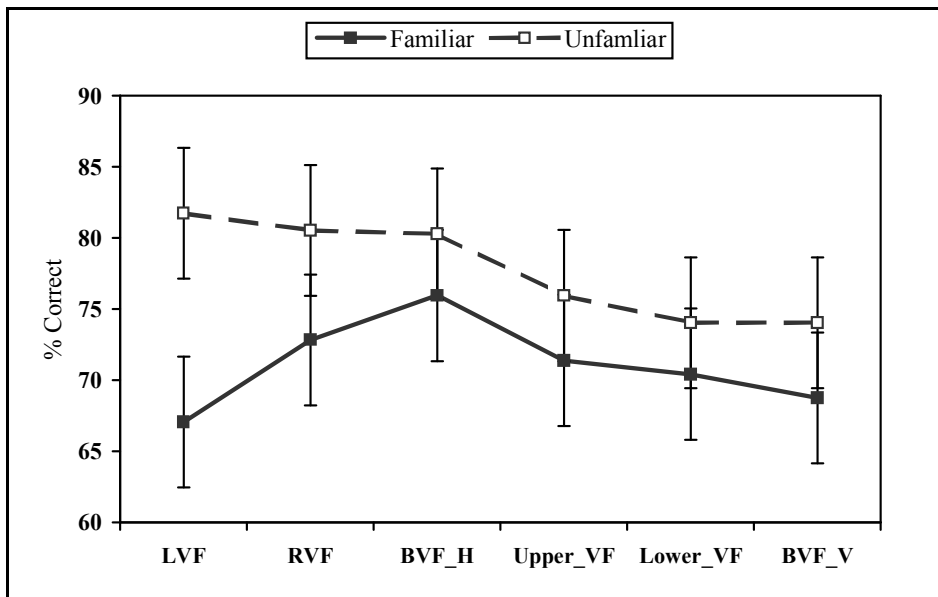
Figure 2b. Correct responses across each of the 6 presentation conditions for familiar and unfamiliar faces.

Condition	Hits	False Alarms
LVF	67.1	18.3%
RVF	72.8%	19.6%
BVF_H	76.0%	19.8%
upper_VF	71.4%	24.0%
lower_VF	66.6%	26.0%
BVF_V	68.78	26.0%

Table 1. Percentage of Hits and False Alarms across each of the 6 presentation conditions in experiment 1
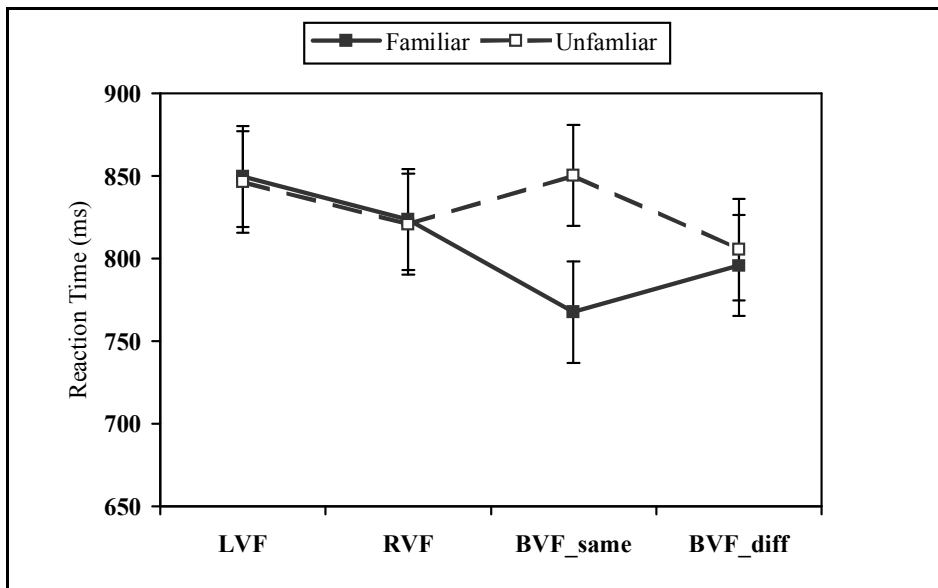
Figure 3a. Means of median RTs across each of the 4 presentation conditions for familiar and unfamiliar faces.
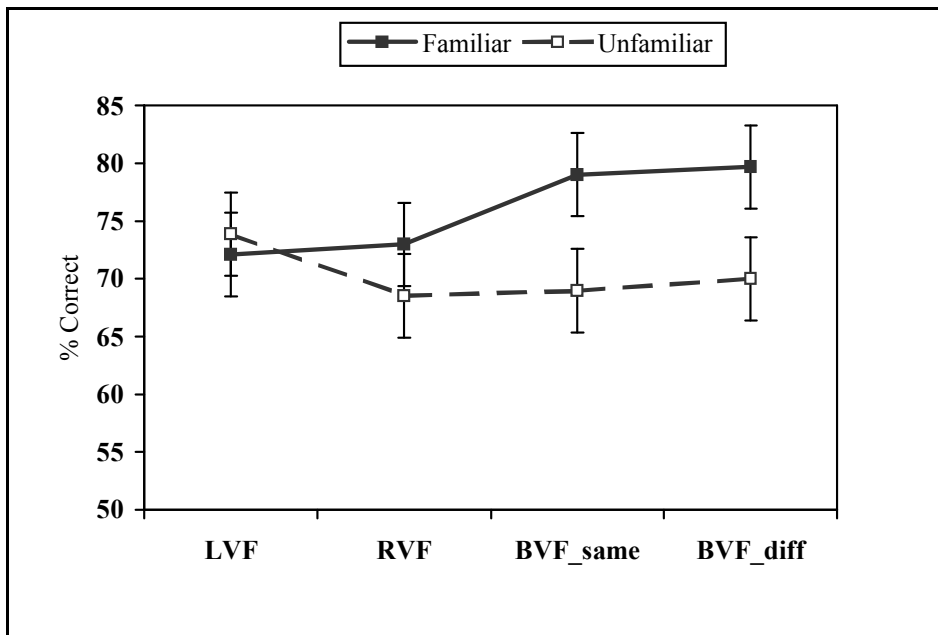
*Figure 3b. Percentage of correct responses across each of the 4 presentation
conditions for familiar and unfamiliar faces.*

Condition	Hits	False Alarms
LVF	*72.1%*	*26.1%*
RVF	*73.0%*	*31.5%*
BVF_same	*79.0%*	*31.0%*
BVF_diff	*79.7%*	*29.9%*

Table 2. Percentage of Hits and False Alarms across each of the 6 presentation conditions in experiment 2