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RESEARCH ARTICLE

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The role of long-term and short-term familiarity in visual and haptic face recognition

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Abstract Recent studies have suggested that the familiarity of a face leads to more robust recognition, at least within the visual domain. The aim of our study was to investigate whether face familiarity resulted in a representation of faces that was easily shared across the sensory modalities. In Experiment 1, we tested whether haptic recognition of a highly familiar face (one's own face) was as efficient as visual recognition. Our observers were unable to recognise their own face models from tactile memory alone but were able to recognise their faces visually. However, haptic recognition improved when participants were primed by their own live face. In Experiment 2, we found that short-term familiarisation with a set of previously unfamiliar face stimuli improved crossmodal recognition relative to the recognition of unfamiliar faces. Our findings suggest that familiarisation provides a strong representation of faces but that the nature of the information encoded during learning is critical for efficient crossmodal recognition.

Keywords Face recognition · Haptics · Vision · Face familiarity

Introduction

The various facets of visual face processing and recognition are well documented (Bruce and Young 1998; Kanwisher and Moscovitch 2000; Peterson and Rhodes 2003; Rakoner and Cahlon 2003; Tarr and Cheng 2003). However, very little is known about our capability for processing and recognising faces outside the visual domain. Recently, Kilgour et al. have embarked upon a series of studies aimed at furthering our understanding of face recognition in the tactile domain (Kilgour et al. 2004; Kilgour and Lederman 2002). In their initial study, Kilgour and Lederman (2002) demonstrated that haptic input allowed for the successful tactile matching of unfamiliar faces. Furthermore, they found that participants were able to match unfamiliar faces across sensory modalities, suggesting that face information can be represented and shared across vision and touch.

The studies reported by Kilgour et al. suggest that the haptic and visual systems both have the capacity to process faces, and that face information can be shared across sensory modalities, possibly involving the same neural substrate (Kilgour et al. 2004). Given this evidence, it might be reasonable to assume that other factors affecting visual face recognition will similarly influence face recognition through touch. In this study, we investigated whether or not familiarity with a face leads to a better recognition of that face across modalities. In particular, we were interested in whether long-term familiarity, such as familiarity with one's own face, results in robust recognition in both vision and touch. Furthermore, we tested whether short-term familiarity, such as recent exposure to a face, results in better crossmodal recognition.

The degree to which a face is familiar to an observer has been found to influence the way in which that face is processed and recognised through vision. Familiarity with a face can confer recognition advantages, in terms of accuracy and response latencies. For instance, when deciding whether a face is intact or scrambled, familiarity facilitates quicker responses to intact stimuli (Bruce 1986). A large discrepancy has also been found between recognition rates for unfamiliar and familiar face images captured from video. Face matching performance was poor when face images were unfamiliar, despite unlimited time and reduced memory load (Bruce et al. 1999). However, even in poor quality CCTV images, participants were surprisingly good at recognising highly familiar targets from video footage. Performance, however, dropped to chance levels if participants were unfamiliar with the targets (Burton

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et al. 1999). Hancock et al. (2000) argued that the recognition of unfamiliar faces is not robust to changes in image-based factors such as changes in lighting (Johnston et al. 1992) and viewpoint (Hill et al. 1997; Newell et al. 1999; O'Toole et al. 1998), or facial expression (Bruce et al. 2001). Recognition of familiar faces, however, can be carried out effortlessly despite such variations (Hancock et al. 2000).

Although both long-term and short-term familiarity have been shown to lead to more robust visual recognition, it is not clear whether the effect of familiarity is specific to or independent of sensory modality. On the one hand, familiarity with a face may promote a more multisensory representation to allow for better crossmodal recognition of the face. Indeed, it has been shown that the recognition of highly familiar objects generalises across modalities (Reales and Ballesteros 1999), and if faces are considered to be a type of object class (Tarr and Gauthier 2000) then we might expect that the recognition of familiar faces also generalises across modalities. On the other hand, faces represent a set of highly similar stimuli. Studies of crossmodal object recognition using highly similar stimuli found that crossmodal recognition was impaired relative to unimodal recognition (Newell et al. 2001). The participants were familiarised with these novel objects in one modality only during the course of the experiment. Therefore, it is possible that crossmodal object recognition benefits from more long-term familiarity with objects. The aim of our study, therefore, was to investigate the role of familiarity in the recognition of faces across vision and touch.

Vision researchers have studied the effects of familiarity on face recognition performance by comparing responses to unfamiliar faces with responses to either newly-learned faces (short-term familiarity, see Katanoda et al. 2000), or highly familiar or famous faces (long-term-familiarity, see Bruce 1986; Bruce and Valentine 1985). Furthermore, faces varying in familiarity may undergo differential processing in terms of the facial information used, or the neural substrate involved (Clutterbuck and Johnston 2002; Leube et al. 2003). In this study, we were concerned with the role of both long-term and short-term familiarity in multisensory face recognition. We investigated these effects first by testing self-face recognition across modalities (Experiment 1), and then by testing crossmodal face recognition to a recently familiarised set of faces (Experiment 2).

In Experiment 1, we examined haptic recognition of one's own face relative to visual recognition. Given the long-term familiarity of our own faces, we should expect to have a robust representation of our face in visual memory, as was reported in previous studies using famous faces. However, we also have a lifetime's experience with our own face through touch (for example from grooming) and it may be possible that we use this haptic information along with visual information to construct a multisensory representation of our faces in memory. Currently there is no direct evidence that such a representation exists; however, the results of a recent study on reach and grasp movements suggest that a haptic representation of our own face is available in memory, at least at the featural level (Edwards et al. 2005). If familiarity with a face facilitates multisensory recognition, we hypothesised that self-face recognition performance would be similar across the visual and haptic modalities.

In Experiment 2, we investigated whether familiarity obtained due to brief exposure to previously unknown faces promotes more efficient crossmodal face matching, or whether the benefits of short-term familiarity are modality-specific. We hypothesised that if familiarity confers a more multisensory representations of faces, we should observe better crossmodal matching performance for familiar than unfamiliar faces, regardless of whether they were familiar in vision or touch.

Experiment 1

Experiment 1 examined whether or not individuals are able to recognise their own face through touch. Our own face is highly familiar to us visually and possibly through touch, suggesting that both a visual and a tactile representation of our own faces may preside in memory. Kilgour and Lederman (2002) have shown that practice with even unfamiliar faces allows for sufficient haptic recognition of faces. We predicted, therefore, that long-term familiarity would facilitate self-face recognition, with participants easily able to recognise models of their own faces through touch, at least as well as through vision.

Method

Participants

Thirty-two undergraduate and graduate students (16 males, mean age 22.88 years, SD = 4.78) from the Department of Psychology, Trinity College Dublin participated in this study for research credits. Testing procedures for this and the following experiment met with the standards delineated by the Ethics Committee of the Department of Psychology, Trinity College Dublin, and all participants gave informed consent prior to performing this experiment. All participants reported normal or corrected-to-normal vision and none reported any tactile impairment.

Apparatus and stimuli

Stimuli were comprised of 32 plaster models, one for each participant's face. To create these face models we first covered each participant's hair with a swimming-cap and applied a thin layer of petroleum jelly to their eyebrows and eyelashes. A thick layer of Accu-Cast 880, an alginate casting substance, was applied to the face

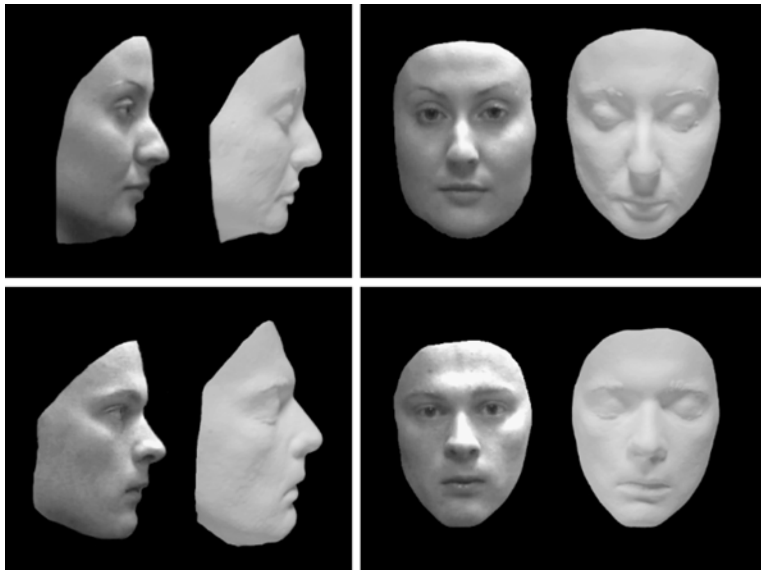

Fig. 1 A sample of the haptic face stimuli used in Experiments 1 and 2. On the *top row*, a female face is compared with its plaster model in both profile and portrait views. The *bottom row* shows the same detail for a male face. The haptic models provide faithful representations of the live faces

leaving an opening for the nostrils, and this was allowed to set for 8 min. A layer of gypsona (plaster-of-paris) bandages was then applied over the alginate and allowed to harden for 10 min before it was removed from the participant's face. A thin layer of casting plaster was poured into each face mould and allowed to stand for 20 min. A wooden mount was inserted into the base of the mould, consisting of a square pole attached to a base. Each face model was positioned approximately 11 cm above the base of the mount. The face models were left to dry in the mould for 24 h, and when removed they were allowed to dry for a further 24–48 h. Small imperfections were corrected using very fine-grain sandpaper. An example of a male and female face model along with their live counterparts is illustrated in Fig. 1. A trial consisted of a "line-up" of face models including the target face and seven non-target face models, all of which were positioned side-by-side on a workbench.

Design

The experiment was based on a one-way repeated measures design with recognition modality as the factor. This factor comprised three levels; two haptic and one visual. The two haptic conditions were haptic recognition from memory (haptic memory) and haptic recognition after priming (haptic prime). The visual condition was recognition from memory (visual memory). There were two trials in the haptic memory condition (namely forward-facing and away-facing, based on the direction of the face model with respect to the participant) [1] and one trial each in the haptic prime and visual memory conditions. In each trial, the target face had to be recognised from among seven distractors in a "line-up" scenario. For each participant, the same distractor faces were used in all four line-ups. Distractor faces were randomised across participants. For all participants, the forward-facing and backward-facing face stimuli were counterbalanced across trials in the haptic memory condition and the position of the target face stimulus in the line-up was randomised across trials. The trials always followed the same sequential order: haptic memory, haptic prime, and visual memory. This was necessary in order to avoid learning effects or effects of visual imagery on performance in the haptic memory task. Performance was measured in terms of recognition accuracy.

Procedure

Approximately one week after the casting process, participants were recalled to complete our face recognition task. The task for each participant was to select his or her own face from a line-up comprising eight faces, which always included the target face and seven distractor faces. In the haptic trials, participants could feel each stimulus for an unrestricted period of time, but were not permitted to return to any previously explored face once they had moved on, in order to promote a recognition-from-memory strategy rather than a strategy involving feature comparisons. Participants were blindfolded for the first two haptic memory trials. In the haptic prime trial the blindfold was removed but the face model was positioned such that it faced away from the participant and was thus obscured from view. In this trial participants were instructed to first feel their own face for 10 s before feeling each face model. Ten seconds were necessary so that the participant had enough time to feel all of their face and not just one or two features. In the visual memory trial, participants were presented with the line-up of face

[1]We included both the forward- and away-facing orientations of our face models relative to the observer in order to avoid any advantages or disadvantages of orientation presentation (see Newell et al. 2001)

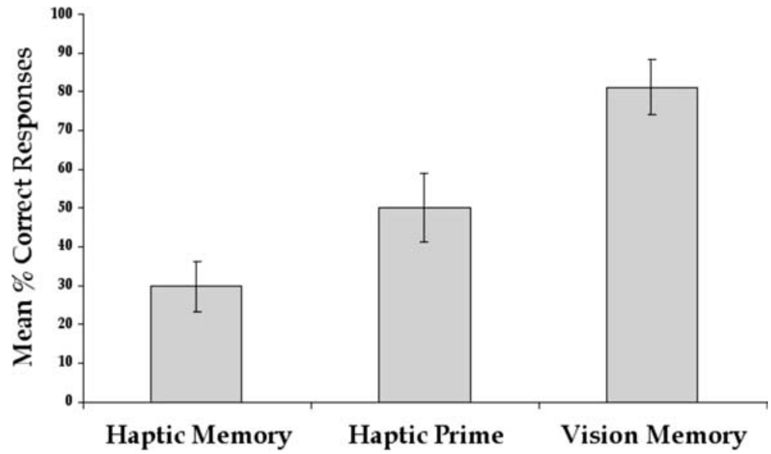

Fig. 2 Mean percentages of correct recognition of one's own face across the haptic and visual conditions. *Error bars* represent ±1 standard error of the mean

models and required to visually identify their own face from among the distractor face models by indicating its position in the line-up.

Results

We first analysed the data across the trials within the haptic memory condition only in order to determine if there was any benefit to one particular orientation of the face model over the other with respect to the observer. We used a Wilcoxon Matched-pairs test, which found no effect of face orientation ($T(32)=11$, n.s.). For subsequent analyses we took each participant's average performance for the haptic memory condition.

The mean percentages of correct recognition responses for the different conditions are shown in Fig. 2. We performed a Friedman's ANOVA on recognition accuracy performance across the haptic memory, haptic prime, and visual memory conditions. A main effect of condition was found ($\chi^2=21.92$, d.f. = 2, $p<0.001$). Post hoc analyses were conducted using Wilcoxon Matched-pairs tests and we found that recognition performance was significantly better in the visual memory condition than in either the haptic memory condition ($T(32)=11$, $p<0.001$) or the haptic prime condition ($T(32)=11.0$, $p<0.01$). Furthermore, performance in the haptic prime condition was significantly better than performance in the haptic memory condition ($T(32)=36.5$, $p<0.03$). Priming of the participant's own face facilitated the subsequent haptic recognition of his or her own face model. Indeed, using a Sign test we found that performance in the haptic memory condition was not significantly greater than performance due to chance ($z=0.5303$, n.s.).

The haptic prime trial was, however, always preceded by two haptic memory trials, raising the concern that better performance in the haptic prime trial was simply a practice effect. To rule out this possibility, trials in the haptic memory condition were divided into their sequential trial order and analysed using a Wilcoxon Matched-pairs test. We found no difference in performance between the first and second trials in the experiment ($T(32)=27.5$, n.s.) suggesting that the improved performance in the haptic prime condition was not simply due to practice.

Discussion

In this experiment we found that participants were unable to recognise their own faces through touch alone. However, haptic recognition of their own face improved when participants were allowed to feel their own live face prior to feeling a model of their face. Nevertheless, haptic recognition was not as good as visual recognition of their own face.

Poor haptic self-face recognition relative to visual recognition of the same face model might suggest that haptic familiarity with the face is insufficient for a tactile representation in memory. However, there may be other reasons why haptic performance was poor relative to visual performance. For example, although we have a lifetime of experience with touching our own faces, the tactile experience may be incidental to the task at hand (such as washing, make-up application, and so on) and therefore the conditions for encoding the shape of the face in tactile memory may not be optimal. It may be necessary to attend to the shape characteristics of the face during encoding in order to form a representation of that face. For vision, attending to the shape of one's face is necessary when we view images of ourselves in photographs, film and in the mirror. However, there are few, if any, real-world tasks that require us to attend to the entire shape of our face through touch. In the Kilgour and Lederman (2002) study, good haptic recognition performance was achieved because participants were familiarised with faces through touch. Here we have shown that, despite tactile familiarity, there does not appear to be a representation of the shape of one's own face in tactile memory.

Edwards et al. (2005) found that over-estimations of the grasp size necessary to grasp an object are significantly smaller for facial features such as the nose or mouth compared to similar sized neutral objects or other body parts (wrist or thumb). These authors discounted the notion that the familiarity of the action of grasping face-parts might contribute to this finding, instead proposing that familiarity of a feature underpinned a more accurate grasp size. Given the poor haptic performance in our task, however, it is possible that even a feature recognition strategy is insufficient for facilitating haptic face recognition from memory, at least without a relevant prime.

Haptic recognition performance improved after a brief priming event. This improved performance was not simply due to a practice effect with the face stimuli since no effect of practice was found across the first two trials (in other words, in the haptic memory condition). Thus, when participants could attend to the particular shape of their own faces through touch, they were then able to identify their own face model through touch. This result suggests that it may be possible for the haptic system to build a representation of a face (even if it is a short-term representation) for subsequent recognition purposes (see also Kilgour and Lederman 2002).

In the visual memory condition, we found that participants' recognition performance was not perfect, as might be expected: approximately 20% of our participants made an error in this condition. We speculate that these errors were due to recognising non-normal versions of their own face. For example, the face models lacked any pigmentation cues, which might normally contribute to the recognition of faces (Yip and Sinha 2002). Indeed, some studies have demonstrated that the addition of colour texture to facial surfaces greatly improves performance in tasks involving the recognition of faces from a novel viewpoint (Troje and Bülthoff 1996) and the categorisation of faces according to their sex (Bülthoff and Newell 2004).

Although visual recognition of the participant's own face model was good, the representation of their face in visual memory was clearly discrete and could not be shared across modalities: haptic self-face recognition did not seem to benefit from a visual representation of that face. This finding suggests that although familiarity may promote good visual recognition, it does not promote multisensory recognition. In Experiment 2, we explicitly tested whether or not familiarity promotes better recognition across the sensory modalities by familiarising participants with previously unfamiliar tactile and visual faces.

Experiment 2

It is argued that familiar faces are processed more efficiently in the visual system than unfamiliar faces (Young et al. 1985), leading to more robust face perception (Schwaninger et al. 2002). It is not known, however, whether familiar faces are more easily recognised across the sensory modalities or whether familiarity benefits a sensory-modality-specific representation of that face. The results from our previous study suggest that long-term familiarity affects modality-specific representations, although it may be that visual face recognition was the result of a lifetime's experience of processing information in that modality. Consequently, face representations may be "captured" by vision when they are highly familiar in that modality, because vision may be the more appropriate modality for face recognition (Welch and Warren 1980). Thus, if familiarity promotes robust recognition across the senses, then we would expect that familiar faces would be matched more efficiently across modalities than unfamiliar faces. On the other hand, if familiarity affects the representation of a face in a modality-specific manner, then there should be no benefit for matching familiar over unfamiliar faces across modalities.

Method

Participants

Thirty-nine psychology undergraduates (28 females, mean age 20.3 years, SD = 3.3) participated in this experiment to fulfil research credit requirements. Informed consent was obtained from all participants prior to the experiment, and none had participated in the previous experiment. All participants reported normal or corrected-to-normal vision, and none reported any tactile impairment.

Apparatus and stimuli

Twenty-six plaster models of faces were randomly chosen from the stimulus set in Experiment 1 and used as haptic stimuli in this experiment. Digital colour images of the live faces of the individuals from whom the models were cast were used as visual stimuli. All of the individuals used as models in our experiment were unfamiliar to the participants, who had just commenced their first year of study in the Psychology Department. This was confirmed verbally after the experiment was conducted. During the familiarisation stage of the experiment the visual images were presented as a set of laminated photographs, and during the experiment they were presented as digital images using Microsoft PowerPoint on a Macintosh PowerBook G3. The images presented on the computer screen subtended a visual angle of approximately 10° vertically and 7.5° horizontally. Participants were required to learn a fictitious name and occupation for each face during familiarisation. We chose familiar, simple names (such as Sue, Mike, Jill, and so on) and familiar occupations (including builder, teacher, and so on) for the participants to learn in order to reduce any memory demands on the task. The haptic stimuli were presented facing towards the participant whilst the visual stimuli were presented in a 3/4 view.

During the experiment, the participant sat in front of a table and the haptic stimuli were presented on the table behind an occluder (a curtain mounted on a wooden frame). Participants were required to place their hands underneath the curtain to touch each face model. We positioned a Macintosh PowerBook on the table to the right of the participant in order to display the visual images.

Design

This experiment was based on a mixed design with sensory-modality matching conditions (vision to touch or touch to vision) as a between-subjects factor and face familiarity (familiar or unfamiliar) as a within-subjects factor. Participants were randomly assigned to either the visual or the tactile learning modality.

The experiment began with a familiarisation session where participants learned to identify a set of faces either through touch or vision alone. All participants were familiarised with 13 faces, one of which was used in a subsequent practice trial, and the other 12 in the experiment. Within each visual or haptic learning group in the experiment, half of the participants were familiarised with 12 of the 24 face stimuli and half were familiarised with the other 12 stimuli. The presentation order of the face stimuli was randomised across participants.

The experiment was based on a delayed match-to-sample paradigm where participants had to match faces across sensory modalities. Each face stimulus appeared twice during the matching task, once in a "same" or matching trial, and once in a "different" or non-matching trial. Half of the total number of trials included unfamiliar stimuli and half included familiar stimuli. The presentation order of the trials was randomised across participants. In order to avoid a response bias, there were equal numbers of same and different trials, although our dependent variable was the number of hits only: the accuracy to the same trials [2]. Familiarity was counterbalanced across the same and different trials.

Procedure

Participants were required to perform a familiarisation task prior to the experiment. Familiarisation consisted of learning the name and occupation (for example, "Sue the accountant") of each face stimulus and subsequently identifying each face by both its name and occupation. We set a learning criterion of 90% accuracy in both the visual and haptic familiarisation tests before the participant could proceed to the experiment. The familiarisation process was repeated until this criterion was achieved. On average, the familiarisation of the haptic stimuli took about 75 min to complete, whereas familiarisation with the visual task took about 5 min to complete.

During the experiment, a haptic stimulus was always presented for 60 s, whereas a visual stimulus was presented for 1 s. The participant pressed the space bar on the computer to begin each trial. In the vision to touch (V-T) matching condition, a 1 s fixation cross preceded the visual stimulus. In the touch to vision (T-V) matching condition, the experimental procedure was identical to the V-T condition except that the haptic stimulus was presented before the visual stimulus. In any trial, the presentation of the second stimulus immediately followed the first stimulus. At the end of each trial, participants were required to make a same/different response by circling the appropriate answer on a response sheet.

Results

Figure 3 depicts the mean percentages of hit responses for familiar and unfamiliar faces in the crossmodal matching task. We analysed the data using a 2×2 mixed design ANOVA with matching condition as a between-subjects factor (V-T or T-V) and face familiarity (familiar or unfamiliar) as a within-subjects factor. A main effect of learning modality was found ($F_{(1,37)} = 13.80$, $p < 0.001$), with better performance in the V-T condition than in the T-V condition. We also found a main effect of familiarity ($F_{(1,37)} = 4.65$, $p < 0.04$), with better crossmodal matching performance for familiar faces than unfamiliar faces. There was no significant interaction between the factors, ($F_{(1,37)} = 0.016$, n.s.).

Discussion

In this experiment we found that crossmodal matching for newly familiar faces was better than for unfamiliar faces, regardless of whether face stimuli were matched from vision to touch or touch to vision. These results suggest that short-term familiarity promotes better recognition across sensory modalities.

Although we tried to ensure that the encoding of the face stimuli was equivalent across modalities by allowing 1 min for haptic encoding and 1 s for visual encoding, we found better V-T performance than T-V performance. This difference in performance may have been due to the qualitative differences in information processing across the modalities, which, in a matching task, may benefit V-T performance over T-V performance. For example, faces are encoded holistically in vision; however, the haptic encoding of a face is not holistic but involves a feature-by-feature analysis. Previous studies have found that it is difficult to identify a feature of a face when the feature is presented in isolation or outside the context of the whole face (see Tanaka and Farah 1993; Tanaka and Sengco 1997). If haptics encodes faces

[2] The second stimulus in a "different" trial was always presented in the non-familiarised modality. For this reason we used performance to the "same" trials only as our measure.

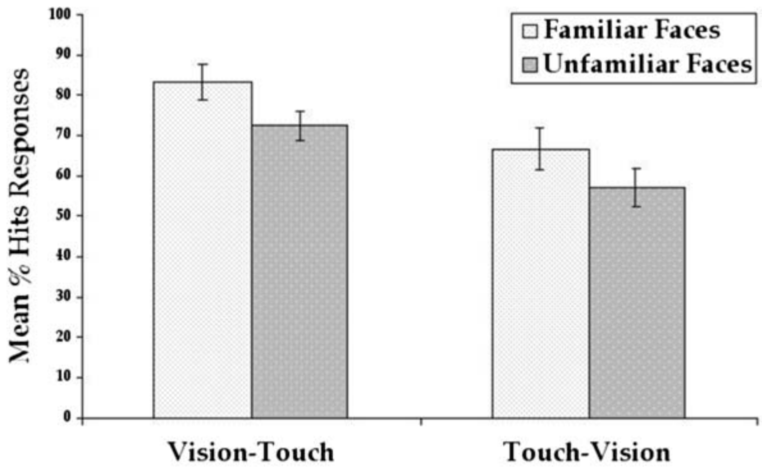

Fig. 3 Mean percentages of correct "hit" responses in the cross-modal matching task. *Error bars* represent ±1 standard error of the mean

on the basis of features, then the visual recognition of a face from its feature-based haptic representation may have been less efficient than the haptic recognition of a face from its holistic, visual representation.

General discussion

In summary, our findings support previous studies on haptic face recognition in that the results from both of our experiments suggest that faces can be represented and recognised through touch (Kilgour and Lederman 2002; Kilgour et al. 2004). In our study, we were particularly interested in the role of long-term and short-term familiarity in crossmodal face recognition. Despite a lifetime of experience with touching one's own face, in Experiment 1 we found no evidence that a representation of that face was built in tactile memory. Instead, the recognition of one's own face model through touch seemed to rely on a brief exposure to the shape of the actual face prior to recognising the face model. Furthermore, the results from Experiment 1 suggest that the representations of faces are discrete and are not easily shared across the sensory modalities. Visual familiarity with one's own face did not appear to facilitate cross-modal recognition, since information from the visual representation could not be used by the haptic system. In Experiment 2, however, we found that faces can be matched across the modalities, and despite only a relatively brief familiarisation period, this matching process is better for familiar faces than unfamiliar faces.

Our results raise two related questions: why isn't a representation of one's own face built in tactile memory, and why isn't a visual representation of one's own face shared across modalities, whereas the representations of other recently familiar faces do seem to be shared across modalities? The results from Experiment 1 suggest that, although highly familiar, the representation of one's own face is modality-specific, and therefore cannot be shared across the modalities. Yet, the results from Experiment 2 clearly suggest that even short-term familiarity can produce a more multisensory representation of the face, at least one that can be shared across modalities. If familiarity promotes a more multisensory representation, then long-term familiarity should result in efficient sharing of the face representation across modalities. Thus, there seems to be a large discrepancy in our findings.

There may be several reasons for this discrepancy. First, it might be that the encoding of over-familiarised faces, such as our own face, is based on task-specific requirements. For example, visual encoding may result in a holistic representation of our face for the purpose of self-recognition when we view photographs, film images or mirror reflections of ourselves. Tactile encoding, on the other hand, may be less concerned with the overall shape of one's own face, and tasks involving touching one's own face may rely more feature specific information (such as judging the length of a beard before shaving or the texture of the skin before applying moisturiser). It is conceivable, therefore, that the haptic encoding of our own face is optimised for specific tasks, but that the visual encoding and representation is more optimal for recognition purposes. Shape information can, however, be used by the haptic system, as shown in the haptic prime condition from Experiment 1 and the results from Experiment 2, but this information may require attention during encoding. A natural extension of our study would be to investigate of the influence of attention during encoding on crossmodal face recognition memory, and how such attention might modulate analytical or holistic encoding.

Another reason why the haptic recognition of one's own face model was less efficient than visual recognition may be because the face models lack information necessary for tactile recognition. For example, the plaster face models lack material properties present in a live face such as information about skin texture, tightness, and muscle tone, which may have led to poor haptic recognition. Indeed, the lack of colour information, or pigmentation, may have resulted in poor visual recognition of one's own face. Therefore, it may be important that information available in a real face is made available in the face stimuli. In Experiment 2, on the other hand, the material properties of the haptic stimuli were the same at both study and test, so matching accuracy was not influenced by differences in these properties.

Finally, the representation of one's own face may be qualitatively different from the representation of the faces of other familiar persons (Keenan et al. 2001; Kircher et al. 2000; Platek et al. 2004; Turk et al. 2002). Brady et al. (2004) found a significant preference for mirror-symmetric right-right own-face chimeras compared to a bias for composite faces of close, familiar friends comprising mirror-symmetric images of the left face. Brady et al. argued that the preference for the right side of one's own face is because of experience with mirror images of our faces. The unique way in which one's own face may be represented in visual memory may promote a more modality-specific representation of one's own face, or at least one that is not easily shared across modalities (such as due to mirror reversal). It is therefore conceivable that self-face recognition is subject to a visual capture effect (Rock and Harris 1967) which hinders successful haptic identification. This effect would not be apparent with the short-term representations of the familiar stimuli in Experiment 2, as in this instance the information provided by the visual and haptic modalities is not conflicted.

In our study, therefore, differences in performance between the haptic recognition of one's own face relative to the recognition of other familiar faces may reflect qualitative differences between the underlying visual representations. Perhaps an examination of the crossmodal capacity for recognising other highly familiar faces such as famous faces might produce effects reflecting those obtained with the briefly learned faces of Experiment 2.

It is currently a topic of debate within visual face recognition research as to whether face recognition involves specific mechanisms, distinct from the mechanisms subserving the recognition of all other classes of objects. On the one hand, a variety of data provide evidence that face recognition is a unique process (see Kanwisher 2000 for an overview). However, data also exist to show that face recognition is not "special" but is rather a function of processing expertise, and that similar results can be obtained for non-face objects with which an individual is expertly familiar (Gauthier et al. 2000; Tarr and Gauthier 2000). Whether or not our results reflect an ability to generate haptic representations of faces that differ from the representation of other objects is beyond the scope of the current paper. It will be interesting for future research to examine whether the benefit arising from familiarity is different for the crossmodal recognition of faces to that for other objects. Haptic face recognition research may have much to contribute towards this specificity debate and to crossmodal research in general, in terms of the mechanisms underpinning the integration of visual and haptic information.

Conclusion

Our findings support recent evidence that touch, like vision, can encode and represent faces for the purpose of recognition. Moreover, the results of our experiments suggest that short-term familiarity results in a representation of a face that is more easily shared across the sensory modalities. Familiarity with a face is, however, insufficient for recognition, unless those facial characteristics specific to recognition are encoded and represented by touch. The representation of one's own face in memory may be qualitatively different in comparison to other long-term and short-term familiar faces, in that it is modality-specific and not easily shared across modalities.

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