Identifying with the Beautiful:
Facial attractiveness effects on unisensory and multisensory self-other distinction

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Abstract

People tend to evaluate their own traits and abilities favourably and such favourable self-perceptions extend to attractiveness. However, the exact mechanism underlying this self-enhancement bias remains unclear and one possibility could be the identification with attractive others through blurring of self-other boundaries. Across two experiments, we used the enfacement illusion to investigate the effect of the attractiveness of others in the multisensory perception of the self. In a first experiment (N=35), participants were stroked on the cheek while looking at an attractive vs. non-attractive face being stroked on the cheek in synchrony or asynchrony. In the second experiment (N=35), two new faces were used and spatial incongruency was introduced as a control condition. The results showed that increased ratings of attractiveness of an unfamiliar face lead to blurring of self-other boundaries, allowing the identification of our psychological self with another's physical self, and specifically their face, and this seems to be unrelated to perceived own attractiveness. The effect of facial attractiveness on face ownership showed dissociable mechanisms, with multisensory integration modulating the effect on similarity but not identification, an effect that may be purely based on vision. Overall, our findings suggest that others' attractiveness may lead to positive distortions of the self, identifying with the more rather than less attractive others. This research provides a psychophysical starting point for studying the impact of others' attractiveness on how we perceive the self, which can be particularly important for individuals with malleable, embodied self-other boundaries and body image disturbances.

Keywords: Facial attractiveness; Multisensory Integration; Enfacement Illusion; Deafference; Self-enhancement bias

1. Introduction

The perception of facial attractiveness, and more general physical attractiveness, has been the focus of a large body of literature. A high level of agreement across individuals, cultures and age groups has been found in terms of how facial attractiveness is perceived and judged, yet there is still a debate about whether this reflects an innate preference (e.g. Langlois, Roggman, Casey, Ritter, Riesser-Danner & Jenkins, 1987), or common learning as a result of adaptation (e.g. Hahn & Perrett, 2014). Crucially, facial attractiveness appears to be an influential factor for social exchanges, affecting people's perceptions at high-order emotional and cognitive levels (Langlois et al., 2000). According to the "what is beautiful is good" stereotype (Dion et al., 1972), which is supported by a substantial body of evidence, physically attractive individuals are considered more positively in terms of the Big Five model (Tartaglia & Rollero, 2015), and are also thought to possess a wide range of positive qualities, such as competence and friendliness (Mobius & Rosenblat, 2006), intelligence (Zebrowitz et al., 2002) and higher moral standards (e.g. Burke et al. 1990). These effects extend beyond interpersonal judgment to social behaviour, with attractiveness being associated with greater social integration and lesser social stigma (Gordon, Crosnoe & Wang, 2017), as well as attractive adults (and children) being treated in a more positive way (for a review see Langlois et al., 2000) and receiving more positive professional evaluations (Riniolo, Johnson, Sherman & Misso, 2006) as compared to less attractive individuals. Overall, evidence points to an advantage for attractive people in terms of how others perceive and judge them in social interactions and beyond, hence it comes as no surprise that attractiveness is a quality that is greatly valued among individuals. However, while we know that others' attractiveness influences how we perceive them

at a cognitive and social level, the question remains as to whether others' attractiveness may also influence how we perceive the self.

People have a tendency to perceive themselves in a positive manner, displaying attributional, memorial and evaluative biases that favour the self (e.g. Sedikides & Green, 2000). For instance, a pervasive bias in learning, thought to be arising from self-enhancing motivations, leads people to change their beliefs about the future more readily when confronted with good news rather than bad news (Sharot & Garett, 2016). People also tend to evaluate their own traits and abilities favourably, creating flattering images of themselves (Dunning, 1999) and such favourable self-perceptions extend to physical appearance. Research has shown that people consider themselves more attractive than the average person (Horton, 2003). Another study found that participants made self-enhancing judgments for their own attractiveness (Donaghue & Smith, 2008) and this was true even when they rated themselves to be more overweight than others consider them to be, indicating a dissociation between self-perception of body image and physical attractiveness. This self-serving bias seems to also extend to face recognition. In a study by Epley and Whitchurch (2008), participants' faces were made more or less attractive using a morphing procedure, and participants were found to be more likely to recognize an attractively enhanced version of their face as their own. The results suggest that the recognition of one's own face as being more attractive than it actually is, represents a distinct form of self-enhancement, produced by relatively implicit and automatic psychological mechanisms. Moreover, this self-enhancement bias was correlated with implicit measures of self-worth and it was, therefore, suggested that this may reflect a top-down effect of making positive associations to the self, ultimately leading to positive distortions of it. However, the exact mechanism underlying this self-enhancement bias for face recognition remains unclear. The study

by Horton (2003) mentioned above, did not only show that participants regarded themselves as more attractive than the average person, but also more similar on attractiveness to attractive, rather than unattractive, targets. Therefore, a possible mechanism underlying this self-enhancement bias for face recognition could be a blurring of bodily boundaries between self and other, resulting in the identification with other attractive faces.

Self-other merging has been found to occur as a result of synchronous multisensory stimulation. Multisensory integration, defined as the ability of the brain to synthesize information across modalities, is fundamental for self-perception and the bodily self, more generally (Blanke, 2012; Ehrsson, 2012). Multisensory integration paradigms allow the manipulation of the perception of one's own limb (Rubber Hand Illusion, Botvinck & Cohen, 1998) or body ("full body illusion" , Lenggenhager et al. 2007; Ehrsson, 2007), by blurring self-other boundaries. In such bodily illusions, temporal and spatial congruency between seen and felt sensory events gives rise to the sense of body ownership, i.e. the feeling that a body (part) belongs to me (Tsakiris & Haggard, 2005). The same is also true for the face, which is probably the most representative instance of personal identity (Filippetti, 2015) and the ability to recognise it is considered an index of self-awareness and a fundamental aspect of the sense of selfhood (Gallup, 1970; Rochat, 2009). Synchronous multisensory stimulation between two faces gives rise to the "enfacement illusion", with participants assimilating more of the other person's features in their own self-face representation (Tsakiris, 2008; Paladino et al., 2010; Sforza et al., 2010). The "enfacement illusion" extends beyond body perception to a more conceptual merging between self and other, by affecting social cognition processes (Paladino et al., 2010) and affective ratings for the other face, including ratings of greater attractiveness and trustworthiness after the induction of the

illusion (Tajadura et al., 2012). As such, the enfacement illusion paradigm affords us the opportunity to experimentally manipulate the effects of attractiveness in a simulated situation of social interaction. Evidence has shown that attractiveness might influence the degree to which one experiences the enfacement illusion. In a study employing the "enfacement illusion" paradigm among individuals who were familiar to each other, the strength of the illusion was found to positively correlate with physical attractiveness attributed to the partner's face (Sforza et al., 2010). In other words, the higher the perceived attractiveness of a familiar face prior to the illusion, the higher the levels of enfacement with that face. However, this study could only establish a correlation between facial attractiveness and enfacement given that facial attractiveness was not experimentally manipulated using both attractive and unattractive faces but rather merely measured on the basis of subjective ratings and then correlated with enfacement scores. Moreover, the partners of that study were familiar to each other, hence it cannot be ruled out that perceived attractiveness may have been influenced by other factors such as familiarity and social desirability. The question, therefore, remains as to whether other people's attractiveness may influence self-face recognition during multisensory integration and whether the underlying mechanism is a top-down process (e.g. such as beliefs and desirability associated with attractiveness) or a bottom-up multisensory integration effect of attractiveness. This idea is partially supported by a previous study showing that attractiveness seems to play a crucial role in the enhancement of tactile perception (i.e. visual remapping of touch, VRT; Serino, Pizzoferrato & Ladavas, 2008) on the face when observing a more or less attractive avatar (Noel, Giovagnoli, Costa & Serino, 2014). In other words, we seem to be able to transfer the attribution of physical attractiveness to our own multisensory perception system to some extent.

To this end, the literature points to a self-enhancement bias, by which people perceive their own face as more attractive than it actually is. However, the exact mechanism underlying this remains unclear and a possibility could be the identification with others' attractive faces through blurring of self-other boundaries. Accordingly, here we aim to elucidate whether being exposed to other people's faces, either attractive or unattractive, can modulate the way we perceive ourselves. In order to address this question, the current study used the enfacement illusion paradigm to examine for the first time the role of attractiveness in the multisensory modulation of face ownership over two experiments. While the term 'self-face recognition' is habitually used as the face analogue of 'body ownership', our previous research has shown a dissociation between self-report measures (enfacement questionnaire) and behavioural measures (self-recognition task) (Panagiotopoulou, Filippetti, Tsakiris & Fotopoulou, 2017). Therefore, the term 'face ownership' is used instead to describe both subjective and behavioural aspects of enfacement, with identification and similarity referring to the subjective component and self-face recognition referring to the behavioural component. In a first experiment (N=35), participants were stroked on the cheek while they were seeing an attractive or a non-attractive face being stroked on the cheek in synchrony or asynchrony. Participants were asked to complete a behavioural self-face recognition task before and after the induction of the illusion, as well as an enfacement questionnaire capturing the subjective experience of the illusion. In the second experiment (N=35), two new faces were used and spatial incongruency (cheek vs. forehead) was introduced as a control condition instead of temporal asynchrony. This choice of an alternative control condition was made given that both amodal properties (temporal and spatial congruency) have been found to be critical in promoting multisensory integration in our previous studies (Panagiotopoulou et al., 2017).

However, our previous findings showed that temporal synchrony and tactile affectivity may have orthogonal effects on face ownership, whereas the effect of tactile affectivity was dependent on spatial congruence. Higher levels of enfacement were expected for an attractive vs. a non-attractive face, particularly in the synchronous (Experiment 1) and the spatial congruent (Experiment 2) condition. Such a finding would suggest that attractiveness has an effect on the multisensory integration process itself, rather than being a more general, top-down effect.

Experiment 1

2. Method

2.1 Participants

Thirty-five Caucasian female participants (Mean age 24.30 ± 3.13SD years) with no psychiatric or neurological history were recruited online via a University Subject Pool system and took part in a single one-hour experimental session in a laboratory setting. The sample size was determined based on prior calculations for 99% power (effect size f set at 0.34, G*Power 3.1) in accordance with the effect size obtained in the significant interaction in Panagiotopoulou et al. (2017) ($\eta^2 = .102$). Females were tested, given that the experimenter delivering the touch was female and there is evidence suggesting that the hedonic value of touch varies according to the gender of both giver and receiver (Gazzola et al., 2012). Participants were reimbursed for their time with either payment (£10) or course credits. Written, informed consent was obtained from all participants prior to their participation. The study was approved by the Ethics Committee of the Research Department of Clinical, Educational and Health Psychology, University College London.

2.2 Design

The study employed a 2 x 2 within-subjects design with two factors; 1) Synchrony (synchronous tactile stimulation vs. asynchronous tactile stimulation) and 2) Attractiveness (other attractive face vs. other non-attractive face). The dependent measures were: a) a self-recognition task as a behavioural measure of the illusion that was delivered before and after the interpersonal stimulation and b) an enfacement questionnaire capturing the subjective experience of the illusion that was delivered only after the stimulation (see Materials section for details on selection of faces etc.).

2.3 Materials

2.3.1 Facial Attractiveness Survey

In order to select the attractive and non-attractive faces for the visuo-tactile stimulation videos (described below), a survey was conducted with a separate sample of 65 Caucasian women (mean age = 28.68, SD = 11.64) (see Appendix A for more details).

2.3.2 Construction of the Visuo-tactile Stimulation Videos

For the induction of the illusion, two visuo-tactile stimulation video clips were created. The two females, the faces of whom were selected from the above survey to represent the attractive and non-attractive face respectively, were invited to the lab at UCL to create the two videos. Each of these videos displayed the (attractive or non-attractive) face being stroked on the cheek with a soft cosmetic brush. Each stroke covered a distance of 8 cm in 1 sec. Each video lasted 120 seconds; 1 second of tactile stimulation followed by 1 second of rest (60 strokes in total).

2.3.3 Construction of Morphing Movies for the Behavioural, Self-recognition Task

For the self-recognition task, morphing movies were created for each participant. A digital photograph of the participant was taken at the beginning of the experimental session. The participant's face in the photograph was mirror-transposed, converted to greyscale, and all non-facial attributes were removed (e.g. background, hair, ears) with GNU Image Manipulation Program (GIMP). A computerized morphing procedure implementing a mesh warping algorithm (Abrasoft Fantamorph) was used to merge each participant's face with the unfamiliar face (attractive and less attractive) in 1% steps resulting in 100 frames with graded blending of the facial features of the two faces. For each participant, four morphing movies were created since there were two unfamiliar faces (attractive vs. non-attractive) and two directions: from 100% self to 0% self ("*self to other"* direction) and from 0% self to 100% self (*"other to self"* direction). Each movie lasted 33 seconds and contained 100 frames (see Figure 1).

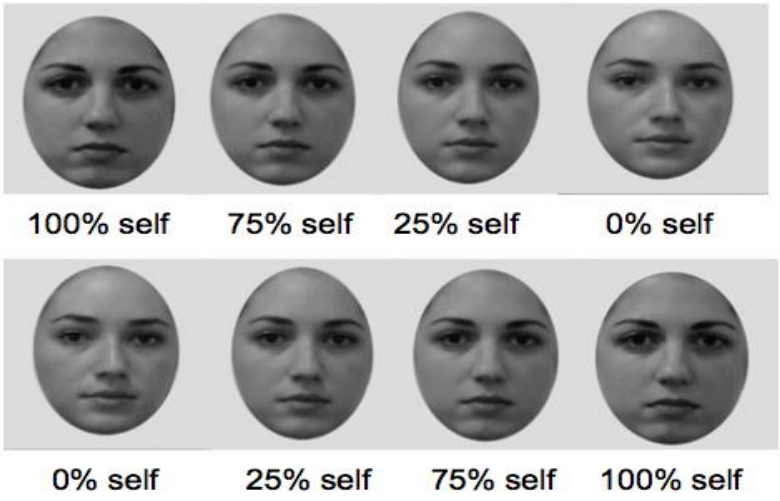

Figure 1*:* Illustrative example of self-recognition task with the selected attractive face (top right and bottom left).

2.3.4 Enfacement Questionnaire (Subjective Measure):

After the interpersonal stimulation, participants were asked to complete a previously used enfacement questionnaire (Panagiotopoulou et al., 2017) consisting of 8 questions presented in a random order (7-point Likert-type scale; −3, strongly disagree; +3, strongly agree), which reflected participants' subjective experience of the illusion (see Table 1). The questionnaire used consisted of three sub-components: *identification*, that is the extent to which participants feel that the other's face is theirs (items 1–3, 6); *similarity*, that is the extent to which participants perceive the other's face as similar to theirs (items 4, 5); and *affect*, that is the extent to which participants judge the other's face as attractive and trustworthy (items 7, 8).

2.4 Procedure

The experimental session began with a baseline self-recognition task, where participants were presented with two morphing movies showing: a) their own face morphing into one of the attractive or non-attractive faces ("self to other" direction) and b) the attractive or non-attractive face morphing into their own face ("other to self" direction). Participants were asked to press the space key, with their right index finger, as soon as they thought that the face shown began to look more like the face that it was morphing into (self or other depending on direction of movie). The number of seconds at which the movie was stopped was recorded. Following this baseline self-recognition task, participants were instructed to look at the screen placed in front of them, relax and watch the visuo-tactile stimulation video for 120 seconds. As soon as the video began, tactile stimulation was delivered by the experimenter with a cosmetic-like soft brush on a specular congruent location between both faces either synchronously or asynchronously (with 1 sec delay). Right after the task, participants completed the same

self-recognition task as in baseline, as well as the enfacement questionnaire. In total, there were four conditions: 1) *attractive* face with *synchronous* stimulation; 2) *unattractive* face with *synchronous* stimulation; 3) *attractive* face with *asynchronous* stimulation; 4) *unattractive* face with *asynchronous* stimulation. The order of these conditions was randomized. Between conditions, participants were instructed to look at their own face for 90 seconds using Photobooth application for Mac computers in order to "break" the enfacement illusion and in preparation for the next block (see Figure 2).

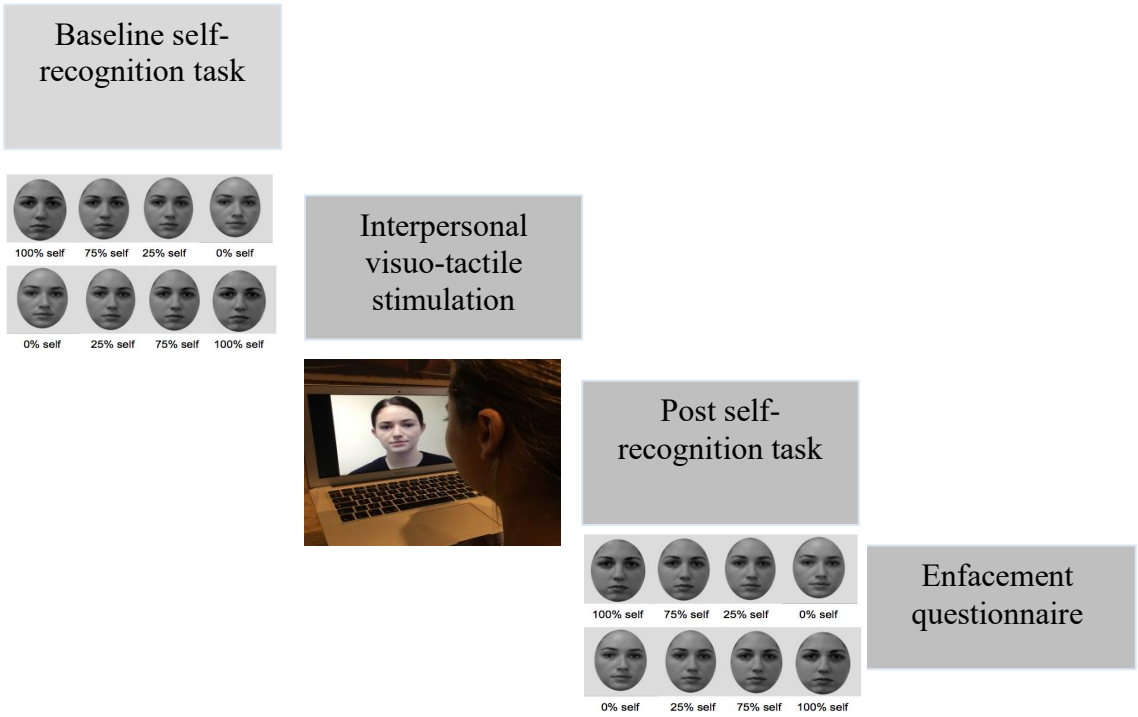

Figure 2*:* Experimental procedure per condition in Experiment 1

2.5 Data Analysis

All of the statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 23 (IBM, Chicago, IL, USA). The overall enfacement score was calculated based on the first two subcomponents (identification and similarity), and the four individual sub-components were also analysed separately, with

the last two items comprising the 'affect' subcomponent (i.e. attractiveness and trustworthiness) acting as manipulation checks. Separate, repeated-measures analysis of variance (ANOVA) were performed on the overall and the subcomponent scores with Synchrony (synchronous vs. asynchronous) and Attractiveness (attractive vs. non-attractive) as within-subject factors. Bonferroni corrected post-hoc analyses were conducted when appropriate.

For the analysis of the self-recognition task, the means of seconds at which participants stopped the videos were converted into % of frames containing the "self". Given that there is evidence that the ability for self-other discrimination is influenced independently of the direction of morphing videos (Heinisch et al., 2010; Heinisch et al. 2012; Payne & Tsakiris, 2016), the two directions of morphing ("self to other" and "other to self") were averaged. As variable baseline enfacement scores have been noted in the previous research using the same task (Panagiotopoulou et al., 2017) and also repeated measures (Level 1) were nested within individuals (Level 2)**,** multilevel modelling was implemented**.** First, a linear mixed model (LMM) was performed to explore the effects of attractiveness on 'pre' scores, with 'pre' score as the outcome variable, 'attractiveness' as a dummy-coded categorical predictor and subjects specified as random effects. Subsequently, based on the results of the above model that, as predicted, showed that baselines scores differed not only within and between individuals, but also on the basis of the attractiveness manipulation, a second LMM was performed with 'post' score as the outcome variable and 'pre' score as the continuous predictor, mean-centred in order to avoid multicollinearity (Tabachnick & Fidell, 2007). 'Synchrony' and 'attractiveness' conditions were inserted in the models as dummy-coded categorical predictors. In all of the analyses, fixed main effects for each of the categorical and continuous explanatory variables were specified, as well as

the interaction term between synchrony and attractiveness. Random intercepts for subjects were also specified (i.e. random effects).

3. Results

3.1 Subjective Enfacement

3.1.1 Overall Enfacement

A 2x2 ANOVA revealed a significant main effect of "synchrony" [F (1,34) = 47.27, $p < .001$, $\eta^2 = .582$] with synchronous stroking producing higher levels of enfacement as compared to asynchronous stroking. A significant main effect was also found for "attractiveness" [F (1,34) = 6.48, $p = .016$, $\eta^2 = .160$] with attractive face producing higher levels of enfacement as compared to non-attractive face. The interaction between "synchrony" and "attractiveness" was not significant [F (1,34) = 3.01, $p = .092$, $\eta^2 = .081$)] (Figure 3).

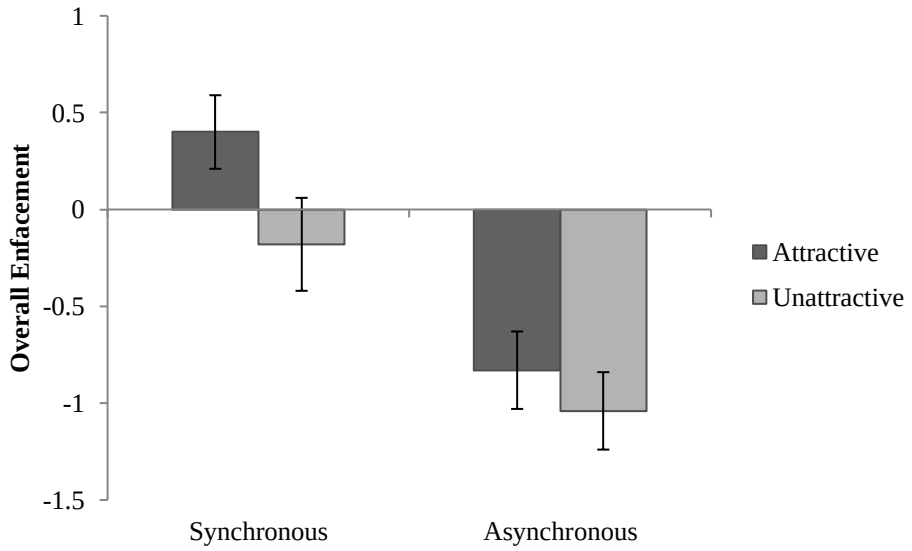

Figure 3: Means for overall subjective enfacement in Exp. 1. Higher scores indicate higher levels of enfacement. Error bars denote standard errors.

3.1.2 Sub-component analysis: Identification

A 2x2 ANOVA revealed a significant main effect of "synchrony" [F (1,34) = 49.07, $p < .001$, $\eta^2 = .591$] with synchronous stroking producing higher levels of identification as compared to asynchronous stroking. A significant main effect was also found for "attractiveness" [F (1,34) = 4.52, $p = .041$, $\eta^2 = .117$] with attractive face producing higher levels of identification as compared to non-attractive face. The interaction between "synchrony" and "attractiveness" was not significant [F (1,34) = 1.01, $p = .322$, $\eta^2 = .029$)] (Figure 4).

3.1.3 Sub-component analysis: Similarity

A 2x2 ANOVA revealed a significant main effect of "synchrony" [F (1,34) = 19.36, $p < .001$, $\eta^2 = .363$] with synchronous stroking producing higher levels of similarity as compared to asynchronous stroking. A significant main effect was also found for "attractiveness" [F (1,34) = 6.07, $p = .019$, $\eta^2 = .151$] with attractive face producing higher levels of similarity as compared to non-attractive face. The interaction between "synchrony" and "attractiveness" was also significant [F (1,34) = 4.73, $p = .037$, $\eta^2 = .122$)]. Bonferroni-corrected post hoc tests (alpha = 0.025) revealed that perceived similarity was higher for attractive vs. unattractive face when the stimulation was synchronous [t (34) = 2.88, p = .007] but not asynchronous [t (34) = .991, p = .329] (Figure 4).

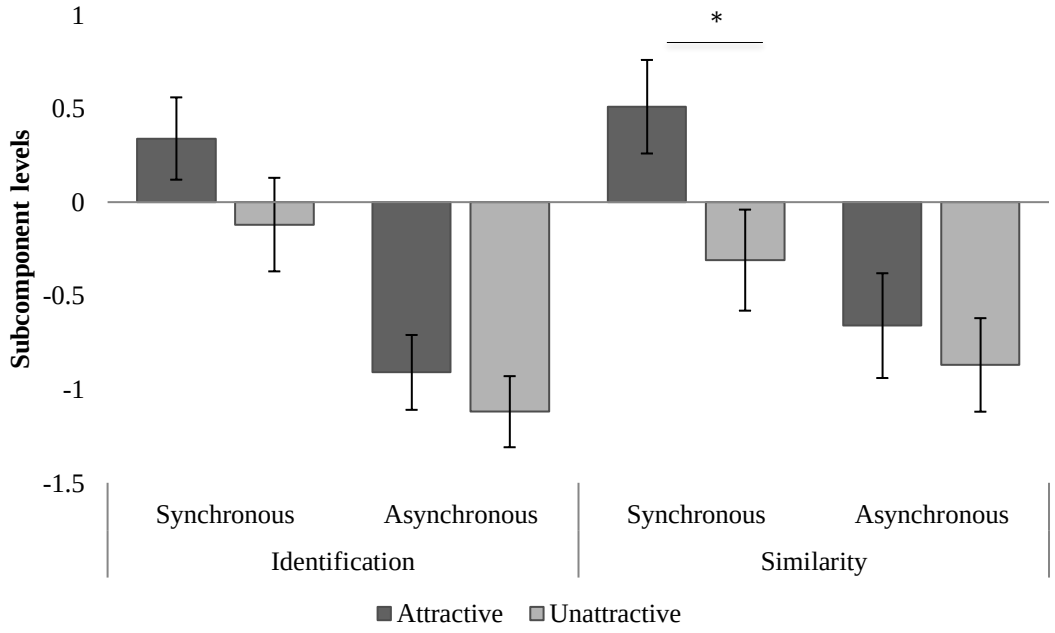

Figure 4: Means for identification and similarity in Exp. 1. Higher scores indicate higher levels of each sub-component. Error bars denote standard errors

For the manipulation checks on Trustworthiness and Attractiveness see Appendix B.

3.2 Self-recognition task

The figure below illustrates the levels of behavioural enfacement per condition:

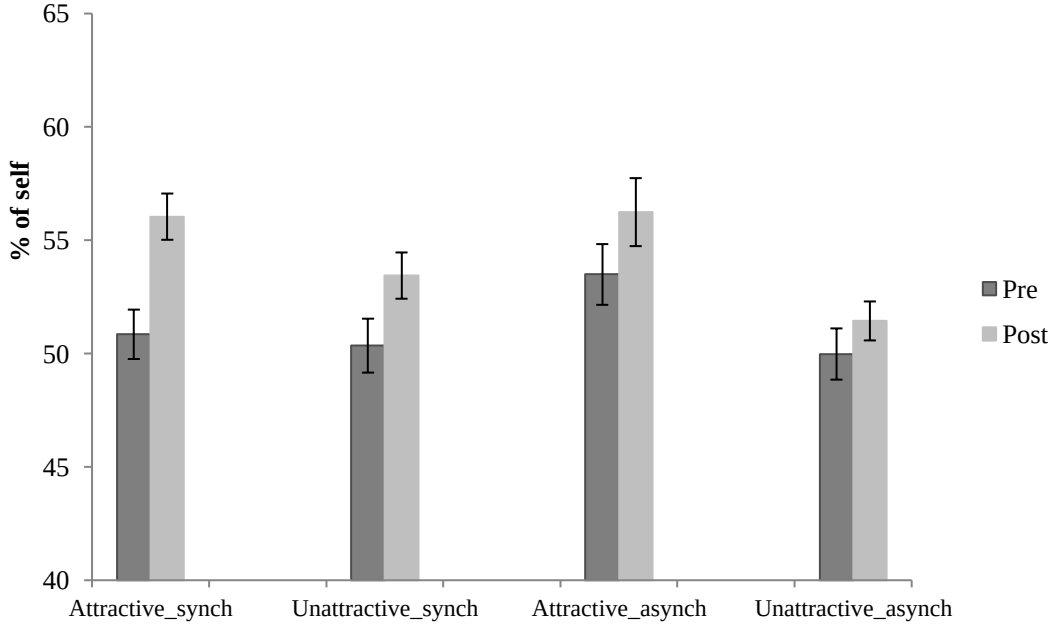

Figure 5: Means for percentage of frames containing 'self' in the different conditions. Error bars denote standard errors.

The first LMM revealed a significant effect of attractiveness on 'pre' score (b = -4.71, SE = .808, p < .001), with attractive face (M = 52.17, SD = 6.15) leading to higher levels of behavioural enfacement, as compared to unattractive face (M = 50.16, SD = 6.81).

The results for the second LMM with 'post' score as the outcome variable are presented in the table below:

Table 1: Multilevel modelling results for outcome variable 'post' scores. Significant main effects and interactions are highligh bold.

				95% Confidence Interval	
Effect	b	SE	p-value	Lower Bound	Upper Bound
Synchrony	**3.459247**	**1.247233**	**.009**	**.930959**	**5.987536**
Attractiveness	.132677	1.006735	.896	-1.913567	2.178921
Synchrony x Attractiveness	-.206752	1.693915	.904	-3.651071	3.237566
Pre	**.516553**	**.074970**	**.000**	**.367739**	**.665367**

As reported in Table 1, there was a significant main effect of synchrony with synchronous stimulation (M = 54.046, SD = .845) leading to higher levels of behavioural enfacement as compared to asynchronous stimulation (M = 51.11, SD = .716). The main effect of attractiveness and the interaction between attractiveness and synchrony were non-significant.

4. Discussion

In this first experiment, the enfacement illusion paradigm was used to explore for the first time the role of facial attractiveness in the modulation of face ownership during multisensory integration. The findings showed that synchronous stimulation led to higher levels of enfacement, measured both at a behavioural (self-recognition task) and a subjective level (questionnaire), thus replicating the "enfacement illusion" and confirming the important role of multisensory integration in face ownership (Tsakiris, 2008; Sforza et al., 2010, Paladino et al. 2010). The main hypothesis regarding the role of facial attractiveness in face onwership was, however, only partly confirmed, in the sense that attractiveness had dissociable effects on unisensory and multisensory perception during the enfacement illusion. These findings are discussed in detail below.

In terms of behavioural face ownership as captured by the self-face recognition task, no main effect of attractiveness or interaction between synchrony and attractiveness was found. Yet, attractiveness was found to enhance behavioural enfacement at baseline, prior to any interpersonal visuo-tactile stimulation. In other words, participants enfaced more the attractive, as compared to the non-attractive face, just by looking at it, independently of any multisensory visuo-tactile process. Previous research on other bodily illusions has shown that congruent visuo-proprioceptive cues may be sufficient to induce subjective embodiment of a fake body (part), in the absence of visuo-tactile integration, a phenomenon known as 'visual capture of ownership' (VOC) (e.g. Carey, Crucianelli, Preston & Fotopoulou, 2018; Ponzo, Kirsch, Fotopoulou & Jenkinson, 2018; Martinaud, Besharati, Jenkison & Fotopoulou, 2017; Crucianelli, Krahé, Jenkinson & Fotopoulou, 2018). The finding of the current experiment suggests that attractiveness may have a first effect on enfacement purely based on vision and irrespective of multisensory integration.

With regards to subjective enfacement, a main effect of attractiveness was found for overall subjective enfacement, as well as the individual sub-components of identification and similarity. After interpersonal multisensory stimulation, the levels of overall enfacement, as well as identification (i.e. first sub-component) were significantly higher for an attractive face as compared to a non-attractive face, but no interaction between synchrony and attractiveness was found, in line with the behavioural findings. In fact, during synchronous stimulation, watching an attractive face led to an increase in the ratings for overall enfacement and identification. On the other hand, the ratings for overall enfacement and identification were negative when the stimulation was asynchronous, indicating the absence of enfacement, yet watching an attractive face, reduced the degree of non-enfacement. This pattern of results is similar to our previous research, where pleasant, affective touch was found to increase feelings of enfacement during synchronous stimulation and decrease feelings of non-enfacement during asynchronous stimulation (Panagiotopoulou et al., 2017). One possible explanation is that an affective, social stimulus – previously affective touch and, in this case, an attractive face - may not only increase identification during optimal conditions of synchronous sensory stimulation but may also have the potential to reduce "deafference", which is described as a phenomenon of unpleasant and numb feelings about the body caused by the temporal mismatch between seen and felt tactile stimulation (Longo et al. 2008). On the other hand, the present study found an interaction between synchrony and attractiveness for subjective similarity ratings (i.e. second sub-component), indicating that attractiveness led to higher levels of similarity in the synchronous condition rather than the asynchronous. Dissociable effects on identification and similarity have been previously reported (Panagiotopoulou et al.,

2017), hence suggesting that identification and similarity are possibly mediated by different mechanisms (discussed in General Discussion in more detail).

More generally, previous research has found a different effect of affective touch on face ownership under temporal mismatch as compared to spatial mismatch (Panagiotopoulou et al., 2017). More specifically, the effect of affective touch during spatial mismatch (i.e. spatially incongruent stroking) was found to be dependent on spatial congruency. Synchrony and spatial congruency during multisensory stimulation lead to a perceptual binding between seen and felt events, while the effects of multimodal asynchronous stimulation may be dependent on various other mechanisms (Rhode et al., 2011; Abdulkarim & Ehrsson, 2016), one such being "deafference" (Longo et al., 2008).

To this end, we decided to conduct a second experiment to explore whether the effect of facial attractiveness on face ownership is also dependent on spatial congruency. Moreover, given the lack of baseline ratings for the subjective measure of this first experiment, another aim of the second experiment was to investigate whether the effect of attractiveness at baseline does apply for subjective enfacement too. To achieve these aims, spatial incongruency (cheek vs. forehead) was introduced as an alternative to temporal asynchrony in order to control for the phenomenon of "deafference" found predominantly during asynchronous stimulation. Thus, based on the results of our previous research, it was expected that facial attractiveness would lead to higher levels of enfacement during spatially congruent but not incongruent stimulation. Moreover, the enfacement questionnaire was administered both at baseline and post-stimulation and, in line with the hypothesis that the effect of attractiveness is purely based on vision, it was hypothesised that attractiveness would enhance

subjective enfacement even at baseline, prior to any interpersonal visuo-tactile stimulation.

Experiment 2

5. Method

5.1 Participants

Thirty-five Caucasian female participants (Mean age 20.89 ± 2.74SD years) with no psychiatric or neurological history were recruited online via a University Subject Pool system and took part in a single 30-minute experimental session in a laboratory setting. The sample size was determined based on prior calculations for 99% power (effect size f set at 0.37, G*Power 3.1) in accordance with the effect size obtained in the significant interaction between synchrony and attractiveness in Experiment 1 (η^2 = .102). Participants were reimbursed for their time with either payment (£5) or course credits. Written informed consent was obtained from all participants prior to their participation. The study was approved by the Ethics Committee of the Research Department of Clinical, Educational and Health Psychology, University College London.

5.2 Design, Materials and Procedure

Design, materials and procedures were identical to Study 1, except for the following four differences:

1) In order to ensure that the results of the first experiment were not down to some characteristic of the selected faces, two new faces were used in the visuo-tactile stimulation videos, once again selected on the basis of the results of an independent

survey with a separate sample of 25 Caucasian women (mean age = 25.42, SD = 9.43). For more details see Appendix C.

2) Spatial incongruence was used as a control instead of asynchrony. In half of the trials participants were touched on a congruent location (i.e. cheek) with attractive vs. less attractive face, and in the other half they were touched on an incongruent location (i.e. forehead) with attractive vs. non-attractive face.

3) Due to time and practical constraints, there was no behavioural measure of enfacement (i.e. self-face recognition test). Instead, the enfacement questionnaire was administered both before (baseline) and after the interpersonal stimulation (post), unlike Experiment 1 where it was only administered post-stimulation. Specifically, participants were presented for 5 seconds with still images of the attractive and the non-attractive face in order to obtain a measure of enfacement prior to any interpersonal stimulation. This was repeated twice for each face to match the number of post-stimulation enfacement scores.

4) Experiment 1 did not involve any measure of participants' self-attractiveness, yet this may have influenced the degree of perceived similarity between themselves and the attractive versus the unattractive face. Therefore, here at the end of the experimental task, participants were asked to complete a short demographic questionnaire, as well as the physical attractiveness item (item number 4) from the Body Image States Scale (BISS; Cash, Fleming, Alindogan, Steadman, & Whitehead, 2002).

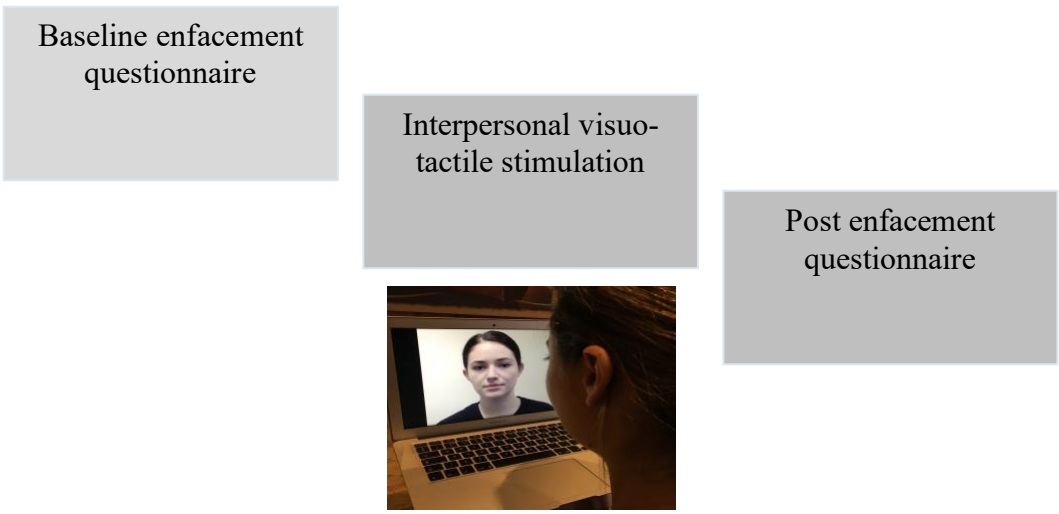

Figure 6*:* Experimental procedure per block in Experiment 2

5.3 Data analysis

All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) version 23 (IBM, Chicago, IL, USA). Given that repeated measures (Level 1) were nested within individuals (Level 2)**,** multilevel modelling was implemented in exactly the same way as Experiment 1.

6. Results

6.1 Overall Enfacement

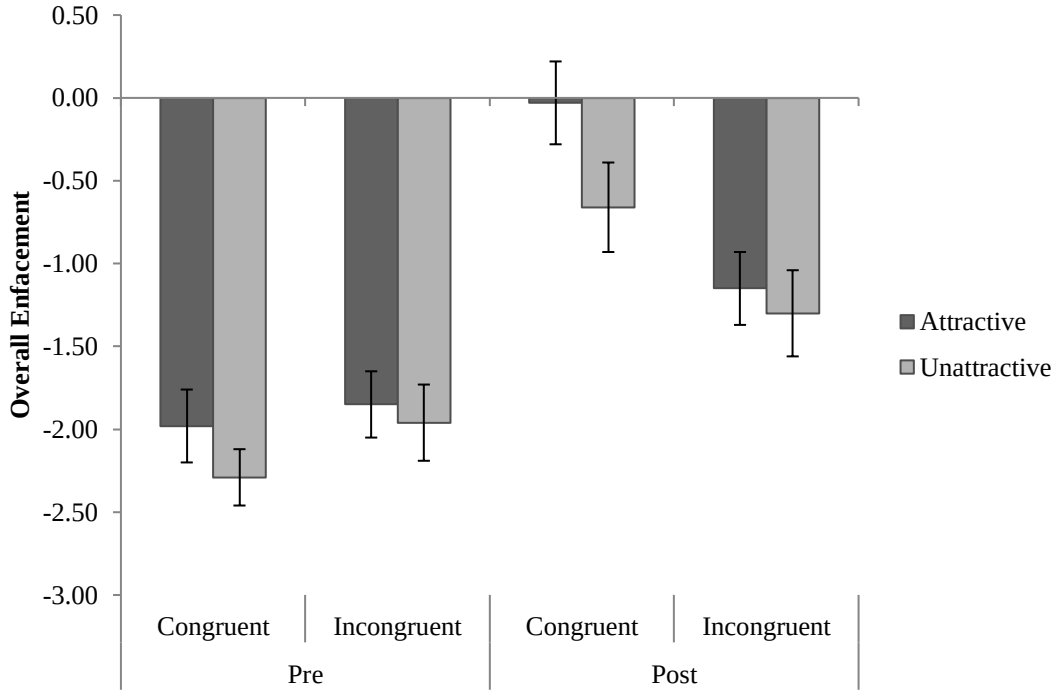

Figure 7*:* Means for overall enfacement in Exp. 2. Higher scores indicate greater enfacement. Error bars denote standard errors.

The first LMM showed a significant effect of attractiveness on 'pre' scores (b = .311 SE = .129, p = .021), with attractive face (M = -1.92, SD = 1.26) leading to higher levels of enfacement, as compared to unattractive face (M = -2.13, SD = 1.16).

The results of the second LMM with 'post' score as the outcome variable are presented in the table below:

Table 2: Multilevel modelling results for outcome variable 'post' scores. Significant main effects and interactions are highlighted in bold.

				95% Confidence Interval	
Effect	b	SE	p-value	Lower Bound	Upper Bound
Attractiveness	.153089	.185730	.416	-.224444	.530622
Congruency	**.640733**	**.205812**	**.004**	**.222641**	**1.058825**
Congruency x Attractiveness	.482143	.295539	.112	-.119504	1.083789
Pre	**.675441**	**.083201**	**.000**	**.510442**	**.840440**

Self_attractiveness	-.023515	.066805	.727	-.159620	.112591

As reported on Table 2, there was a significant main effect of congruency, with congruent stimulation (M = -.346, SD = 1.55) leading to higher levels of overall enfacement as compared to incongruent stimulation (M = -1.22, SD = 1.42). The main effect of attractiveness and the interaction between attractiveness and congruency were non-significant.

6.2 Sub-component analysis: Identification

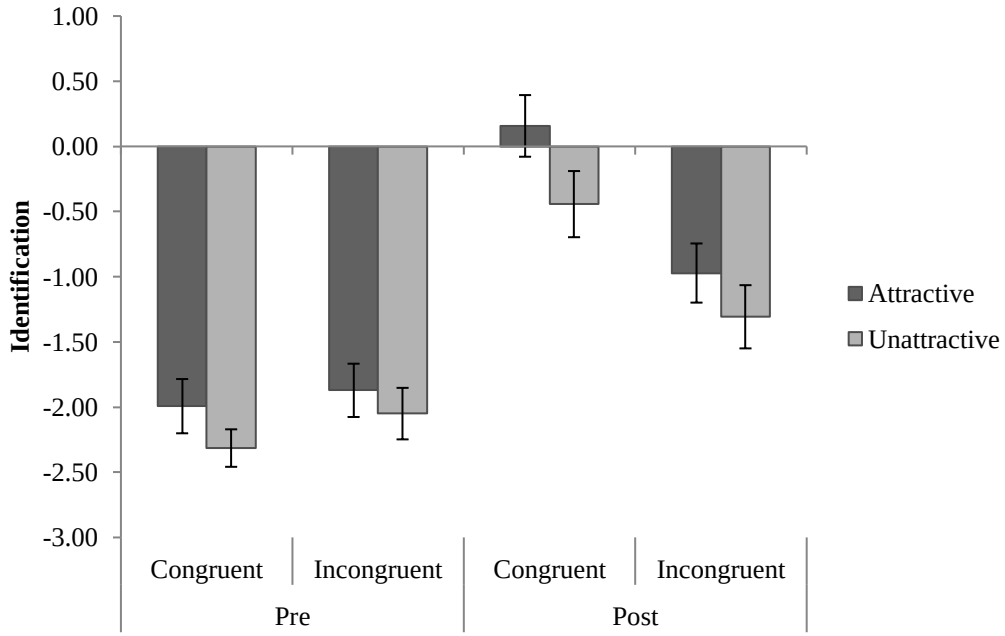

Figure 8*:* Means for identification in Exp. 2. Higher scores indicate greater identification. Error bars denote standard errors.

The first LMM showed a significant effect of attractiveness on 'pre' scores (*b* = .250 *SE* = .119, *p* = .038), with attractive face (M = -1.93, SD = 1.21) leading to higher levels of identification, as compared to unattractive face (M = -2.18, SD = 1.02).

The results of the second LMM with 'post' score as the outcome variable are presented in the table below:

Table 3: Multilevel modelling results for outcome variable 'post' scores. Significant main effects and

interactions are highlighted in bold.

Effect	b	SE	p-value	95% Confidence Interval	
				Lower Bound	Upper Bound
Congruency	**.861212**	**.223246**	**.000**	**.407413**	**1.315011**
Attractiveness	.332641	.195536	.098	-.065073	.730354
Congruency x Attractiveness	.285863	.310368	.364	-.345910	.917637
Pre	**.602448**	**.094414**	**.000**	**.415088**	**.789809**
Self-Attractiveness	-.034759	.070257	.624	-.177863	.108346

As reported on Table 3, there was a significant main effect of congruency with congruent stimulation (M = -.143, SD = 1.49.) leading to higher levels of identification as compared to incongruent stimulation (M = -1.14, SD = 1.41.). The main effect of attractiveness and the interaction between attractiveness and congruency were non-significant.

6.3 Sub-component analysis: Similarity

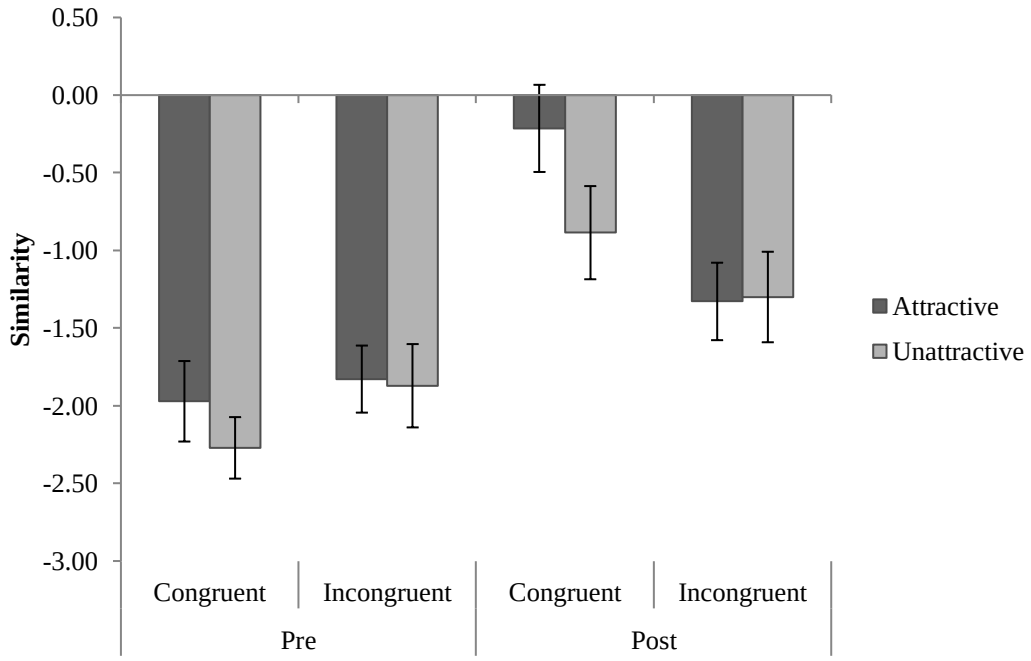

Figure 9*:* Means for similarity in Exp. 2. Higher scores indicate greater similarity. Error bars denote standard errors.

The first LMM found no main effect of attractiveness on 'pre' scores (*b* = .171 *SE* = .162, *p* = .293, see Figure 9).

The results of the second LMM with 'post' score as the outcome variable are presented in the table below:

Table 4: Multilevel modelling results for outcome variable 'post' scores. Significant main effects and interactions are highligh

				95% Confidence Interval	
Effect	b	SE	p-value	Lower Bound	Upper Bound
Congruency	.414286	.213760	.061	-.019772	.848343
Attractiveness	-.028842	.245289	.907	-.527052	.469367
Congruency x Attractiveness	**.700271**	**.334618**	**.044**	**.019141**	**1.381401**
Pre	**.632506**	**.082976**	**.000**	**.467971**	**.797042**
Self-Attractiveness	-.018887	.073598	.799	-.169009	.131235

As reported on Table 4, there was a significant interaction between congruency and attractiveness. Bonferroni-corrected post hoc tests (alpha = 0.025) revealed that perceived similarity was higher for attractive vs. unattractive face when the stimulation was congruent [t (34) = 2.21, p = .034] but not incongruent [t (34) = -.101, p = .920].

For the manipulation checks on Trustworthiness and Attractiveness see Appendix D.

7. General Discussion

Over two experiments, we investigated for the first time the role of facial attractiveness in the multisensory modulation of face ownership using the enfacement illusion paradigm. First, the important role of multisensory integration in face ownership recognition was confirmed (Tsakiris, 2008; Sforza et al., 2010, Paladino et al., 2010), showing that temporally and spatially congruent visuo-tactile stimulation leads to higher levels of enfacement, measured both at a subjective and a behavioural level. Most importantly, this study provides the first direct evidence that facial attractiveness has an effect on some facets of face ownership, and this effect seems to be partly independent of multisensory integration processes.

To begin with, the results of both experiments suggest that subjective, as well as behavioural face ownership appear to be higher for an attractive vs. a non-attractive face, even when participants were visually exposed to the face for only five seconds, in the absence of any visuo-tactile stimulation. Moreover, attractiveness was found to lead to increased levels of overall subjective enfacement and perceived identification (first, subjective sub-component) during synchronous stimulation and decreased levels of non-enfacement/identification during asynchronous stimulation, also indicating that attractiveness enhances subjective enfacement and identification independently of multisensory effects. Nevertheless, the same was not true for perceived similarity (second, subjective sub-component). For similarity ratings, and in line with our main hypothesis, an interaction was found between attractiveness and synchrony, as well as between attractiveness and spatial congruency, indicating that attractiveness enhanced perceived similarity between one's face and another face when visuo-tactile stimulation was temporally and spatially congruent but not when it was incongruent. The discrepancy in the effect of attractiveness on perceived identification and similarity was also demonstrated by the effect of attractiveness on identification at baseline, purely

based on vision, which was not found for similarity. This discrepancy between the two sub-components, which is in line with previous research (Panagiotopoulou et al., 2017), indicates that identification and similarity are possibly mediated by independent mechanisms. In fact, self-identification is considered to be one of the key processes involved in the formation of a mental representation of our physical appearance (Tajadura et al., 2012). This process matches to the identification component of the enfacement questionnaire, referring to a more general matching between felt and seen sensorimotor signals (Tajadura et al., 2012), which, in turn, leads to the formation of a mental representation of one's physical appearance. However, the sub-component of similarity refers to a more specific experience of physical resemblance with the other person and, hence, it may be considered a distinct process. It, therefore, appears to be important to study identification and similarity separately rather than merely obtaining an overall score of enfacement.

Despite the effects of attractiveness being dissociable for different components of face ownership, attractiveness appears to overall enhance face ownership and the possible interpretations regarding the underpinning reasons are multiple. To begin with, one plausible hypothesis of why attractiveness leads to higher levels of identification with another face, over and above any multisensory effects, could be offered from a social psychology perspective. Research has shown that attractiveness leads to imitation, which is a fundamental aspect of the process of identification (Tajadura-Jimenez et al., 2012). For instance, Muller et al. (2013) found that empathy predicts imitation but only for attractive others and not for unattractive. Similarly, Babel (2014) found social selectivity in spontaneous phonetic imitation, with the degree to which vowels were imitated being affected by attractiveness ratings. This imitation is thought to stem from the idea that "what is beautiful is good" and the need to affiliate with and

take on characteristics and behaviours of people who are beautiful, hence nice (van Leeuwen, Veling, van Baaren & Dijksterhuis, 2009; Lakin & Chartand, 2003). As an extension of what social identity theory posits, that is people having a tendency to classify themselves into social categories and favour their in-groups in order to enhance their self-esteem (Tajfel & Turner, 1979), it is possible that the identification with a more as opposed to less attractive individual serves the adaptive purpose of classifying the self within a category which is already favoured, therefore, enhancing one's self-esteem.

Alternatively, another plausible interpretation of why people are inclined to identify more with an attractive face as compared to a non-attractive face after brief visual exposure could be provided by salience-driven attention. Previous research has shown that attractive faces capture greater spatial attention as compared to non-attractive faces, even if the task is unrelated to the judgment of attractiveness (e.g. Sui & Liu, 2009; Liu & Chen, 2012). More recently, attractiveness has also been found to temporally modulate visual attention (Nakamura & Kawabata, 2014) and the attention to the attractiveness of a face has been shown to be rapid and automatic (Palermo & Rhodes, 2007; Sui & Liu, 2009). Therefore, the orthogonal effects of attractiveness and multisensory integration on identification could possibly be explained by the fact that processing fluency underlies preference for attractive faces (e.g. Trujillo, Jankowitsch & Langlois, 2014; Reber, Schwarz & Winkielman, 2004) and, hence, this may be driving visual effects by causing less 'prediction' errors in the visual domain. By contrast, perceived similarity with an attractive face may be dependent on temporal and spatial congruency in multisensory integration in that any visual differences between own and other face need to be attenuated for the visuo-tactile input to dominate over proprioceptive information. Of course, these are all exploratory hypotheses so further

research is required to disentangle the different mechanisms driving the effects of attractiveness.

Recently, Filippetti, Kirsch, Crucianelli & Fotopoulou (2018) investigated the role of affective, top-down aspects of sensory congruency between visual and tactile modalities in the sense of body ownership using the rubber-hand illusion (RHI). They found that incongruency between felt and vicariously perceived sensory events led to lower levels of subjective embodiment, irrespective of any valence effect. To test the effect of such an incongruency, in the second experiment of the current research a measure of participants' own perceived attractiveness was obtained, in order to explore the role of perceived attractiveness congruency in enfacement with an attractive vs. non-attractive face. Ratings of self-attractiveness were found to have no effect, suggesting that the top-down aspect of attractiveness congruency does not influence subjective enfacement of an attractive vs. non-attractive face. In other words, participants identified more with the attractive face regardless of how attractive they perceived themselves to be.

Instead, actual physical resemblance could mediate this effect, but one limitation of this study is that the actual physical similarity between participants and the attractive and non-attractive faces was not controlled for. However, this factor is unlikely to have an influence as the findings for the similarity sub-component suggest multisensory effects over and above initial baseline effects. Furthermore, although every effort was made to ensure that the models in the visuo-tactile stimulation videos were maintaining a neutral expression, it was not possible to systematically control for micro-expressions. Another limitation of this study was the sample diversity. Participants were recruited through a university subject pool, hence the sample

consisted of Caucasian female students from a Western university. Therefore, future studies could explore whether the effects are replicated in a more diverse sample and extend to males too, for whom dominance could potentially have a more pronounced effect as compared to attractiveness, given previous research suggesting that testosterone increases perceived dominance but not attractiveness of male faces (Swaddle & Reierson, 2002). Despite the limitations of this study, we sought to maximize the power, not only by conducting a priori power analyses to determine the sample size, but also by using both a subjective and an implicit measure of enfacement (Experiment 1). In addition, although we used limited faces – one attractive and one non-attractive per experiment – a survey was conducted prior to the experiment with a separate sample of women in order to identify faces that were significantly different in terms of attractiveness but were matched for all other dimensions. Last but not least, in the second experiment, a new set of attractive and non-attractive faces was used in order to ensure that any effects were not specific to the faces of the first experiment.

To conclude, research has revealed a self-enhancement bias with regards to attractiveness, with people having a tendency to perceive themselves as more attractive than others consider them to be. The findings of the current study suggest that this self-enhancement bias may be mediated by others' facial attractiveness, through blurring of self-other boundaries. More specifically, the results showed that others' attractiveness can influence the relatively automatic and perceptual process of face ownership. Increased ratings of attractiveness of a new, unfamiliar face lead to identification of our psychological self with another's physical self, and more specifically their face. While higher levels of identification with another face seem to be driven by vision, the effect of attractiveness on similarity appears to be dependent on multisensory integration. The exact mechanism behind these effects remains unknown, yet future research could try

to disentangle whether people are more inclined to acquire ownership of more attractive faces due to bottom-up salience-driven attention or top-down processes, guided by higher level knowledge and expectations. In a society where we are deluged with images of beautiful people through the media, our findings suggest that others' attractiveness may actually lead to positive distortions of the self, identifying with the more rather than the less attractive others. Yet, the question remains as to how such distortions of the self affect one's psychological well-being. This research may provide a psychophysical starting point for studying the impact of others' attractiveness in self-perception, which can be particularly important for individuals with malleable, embodied self-other boundaries and body image disturbances.

Conflict of interest

None declared.

Acknowledgements

We are indebted to Alkistis Saramandi and Emma Koprena for their invaluable help with data collection. This work was funded by the European Research Council (ERC) Starting Grant ERC-2012-STG GA313755 [to A.F.], as well as a scholarship from the Economic and Social Research Council (ESRC) and the Neuropsychoanalysis Fund (NPSA) [to E.P.].

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Appendices

Appendix A: Facial Attractiveness Survey in Exp. 1

The 65 participants of this survey (mean age = 28.68, SD = 11.64; all females) were presented with 25 Caucasian female faces and were asked to rate on a scale from 0 (not at all) to 100 (extremely) how "attractive", "trustworthy", "dominant" and "distinctive" each face was. Those 25 faces were from an unselected, consecutive sample of women who had previously taken part in another experiment, were unknown to current participants and had given their written permission for their faces to be used in this new experiment. These attributes were chosen as they have been found to be distinct properties that influence attractiveness ratings. Specifically, trustworthiness and dominance were selected given that they are thought to be primary dimensions of face evaluation influencing social judgments (Oosterhof & Todorov, 2008). Distinctiveness, defined as deviation from an average face, was also controlled for, given previous research showing that there is a complex relationship with attractiveness, with unattractive faces being distinctive, and attractive faces being rated at all levels of distinctiveness (Wickham & Morris, 2003). For the current sample of 25 faces, the mean rating for attractiveness was 37.66 (SD = 11.46), trustworthiness 42.44 (SD = 7.93), dominance 38.36 (SD = 5.70) and distinctiveness 41.76 (SD = 4.61). The two faces selected to represent attractive and non-attractive faces were the ones that were best matched for trustworthiness, dominance and distinctiveness, however they differed in perceived attractiveness (see table below for details).

Table A.1: Means (and standard deviations) from 65 raters for selected faces in Experiment 1

	Attractiveness	*Trustworthiness*	*Dominance*	*Distinctiveness*
Attractive	63.29 (22.29)	46.26 (22.87)	40.22 (21.84)	43.22 (21.10)
Non-attractive	24.91 (19.98)	38.61 (22.97)	36.21 (19.83)	39.14 (22.64)

Appendix B: Manipulation checks for trustworthiness and attractiveness in Exp. 1

Trustworthiness

A 2x2 ANOVA revealed a significant main effect of "attractiveness" [$F(1,34) = 18.23$, $p < .001$, $\eta^2 = .349$] with attractive face producing higher levels of trustworthiness as compared to non-attractive face. A trend was found for "synchrony" [$F(1,34) = 4.01$, $p = .053$, $\eta^2 = .105$] with synchronous stroking producing higher levels of trustworthiness as compared to asynchronous stroking. The interaction between "synchrony" and "attractiveness" was not significant [$F(1,34) = 1.200$, $p = .324$, $\eta^2 = .029$] (Figure B.1).

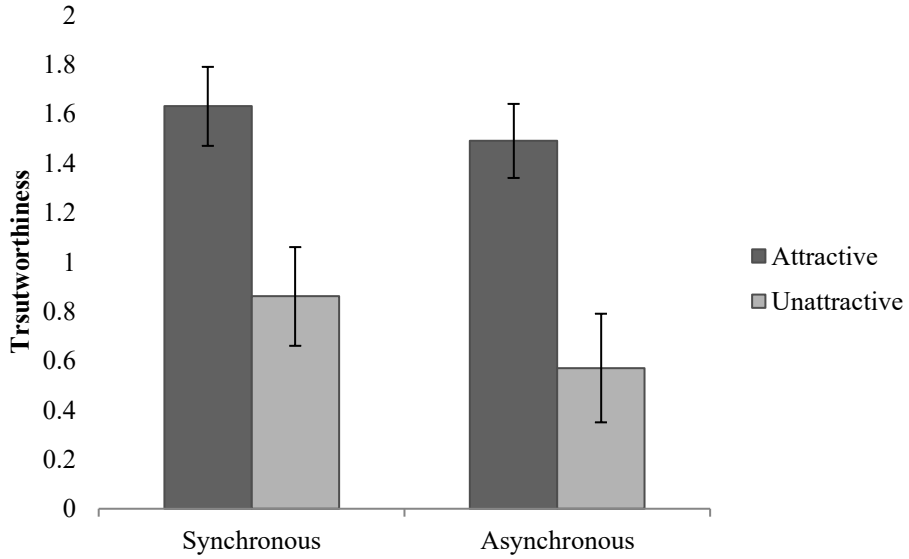

Figure B.1: Means for trustworthiness in Exp. 1. Higher scores indicate greater trustworthiness. Error bars denote standard errors

Attractiveness

A 2x2 ANOVA revealed a significant main effect of "attractiveness" [F (1,34) = 26.34, $p < .001$, $\eta^2 = .459$] with attractive face being rated as more attractive than the non-attractive face. A trend was found for "synchrony" [F (1,34) = 3.21, $p = .083$, $\eta^2 = .094$] with synchronous stroking producing higher levels of attractiveness as compared to asynchronous stroking. The interaction between "synchrony" and "attractiveness" was not significant [F (1,34) = .897, $p = .351$, $\eta^2 = .028$)] (Figure B.2).

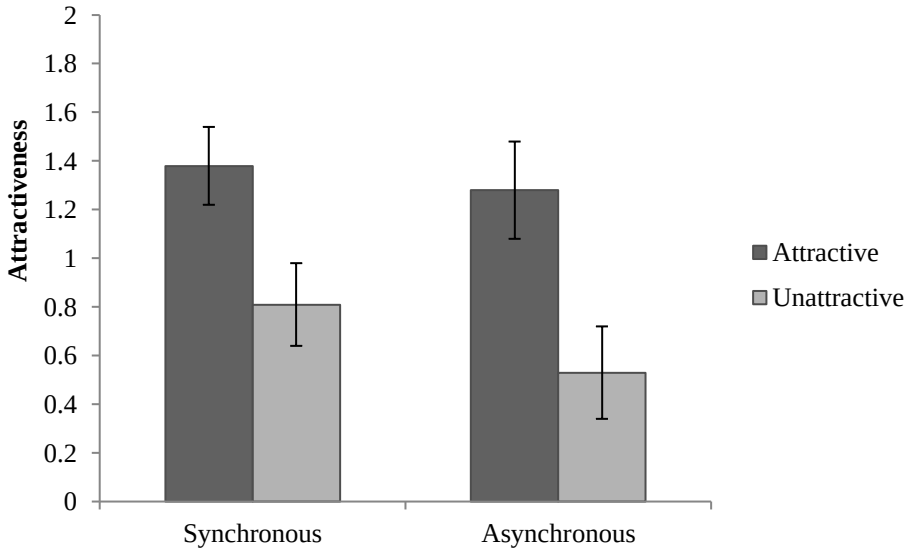

Figure B.2: Means for attractiveness in Exp. 1. Higher scores indicate greater attractiveness. Error bars denote standard errors.

Appendix C: Facial Attractiveness Survey in Exp. 2

The 25 participants of this survey (mean age = 25.42, SD = 9.43; all females) were presented with 11 Caucasian female faces and were asked to rate on a scale from 0 (not at all) to 100 (extremely) how "attractive", "trustworthy", "dominant" and "distinctive" each face was. Those 11 faces were from an unselected, consecutive sample of women who had previously taken part in Experiment 1, were unknown to current participants and had given their written permission for their faces to be used in this new experiment. For the current sample of 11 faces, the mean rating for attractiveness was 43.99 (SD = 13.81), trustworthiness 49.74 (SD = 5.66), dominance 50.38 (SD = 8.25) and distinctiveness 56.67 (SD = 9.60). The two faces selected to represent attractive and non-attractive faces were the ones that were best matched for trustworthiness, dominance and distinctiveness, however they differed in perceived attractiveness (see Table C.1 for details). Moreover, they were matched for eye and hair colour (blond hair, blue eyes).

Table C.1: Means (and standard deviations) for attribute scores for selected faces for Experiment 2

	Attractiveness	*Trustworthiness*	*Dominance*	*Distinctiveness*
Attractive	60.00 (15.63)	50.00 (15.49)	49.17 (13.57)	46.67 (12.11)
Non-attractive	30.00 (6.32)	45.00 (10.00)	47.50 (15.41)	60.00 (16.73)

Appendix D: Manipulation checks for trustworthiness and attractiveness in Exp. 2

Trustworthiness

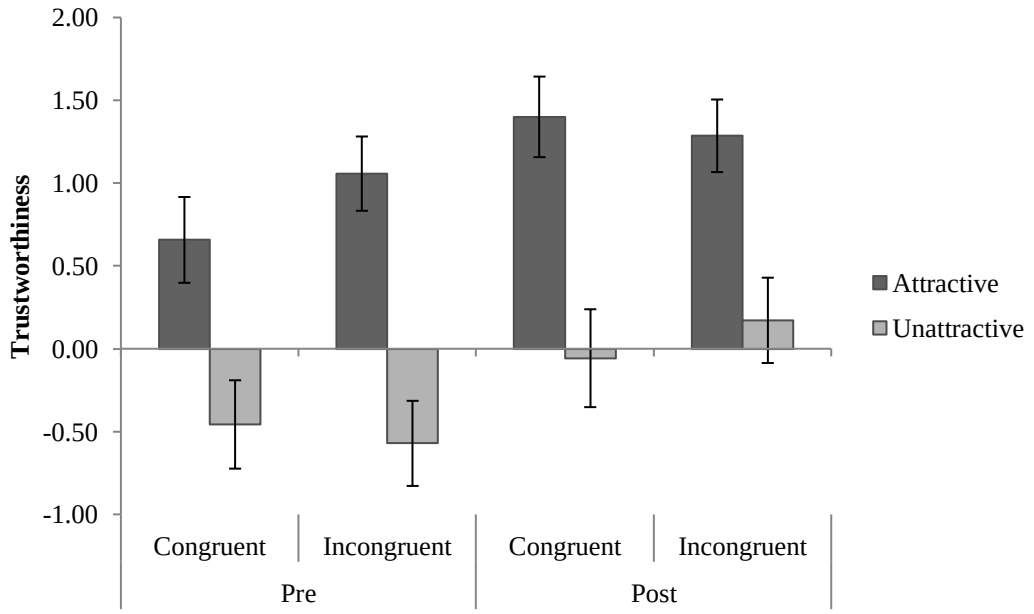

Figure D.1*:* Means for similarity in Exp. 2. Higher scores indicate greater trustworthiness. Error bars denote standard errors.

The first LMM found a significant main effect of attractiveness on 'pre' score (b = 1.37 SE = .205, p < .001), with attractive face (M = .857, SD = 1.44) leading to higher levels

of trustworthiness, as compared to unattractive face (M = -.514, SD = 1.54, see Figure D.1).

The results of the second LMM with 'post' score as the outcome variable are presented in the table below:

Table D.1: Multilevel modelling results for outcome variable 'post' scores. Significant main effects and interactions are highlighted in bold.

				95% Confidence Interval	
Effect	b	SE	p-value	Lower Bound	Upper Bound
Congruency	-.228571	.315744	.474	-.870570	.413428
Attractiveness	**1.114286**	**.257329**	**.000**	**.591545**	**1.637027**
Congruency x Attractiveness	.342857	.289842	.246	-.249029	.934743
Pre	**.530370**	**.062000**	**.000**	**.407283**	**.653457**
Self-Attractiveness	-.038794	.058993	.515	-.158777	.081190

As reported on Table D.1, there was a significant main effect of attractiveness with attractive face (M = .1.34, SD = 1.36.) leading to higher levels of trustworthiness as compared to non-attractive face (M = .057, SD = 1.63.). The main effect of congruency and the interaction between attractiveness and congruency were non-significant.

Attractiveness

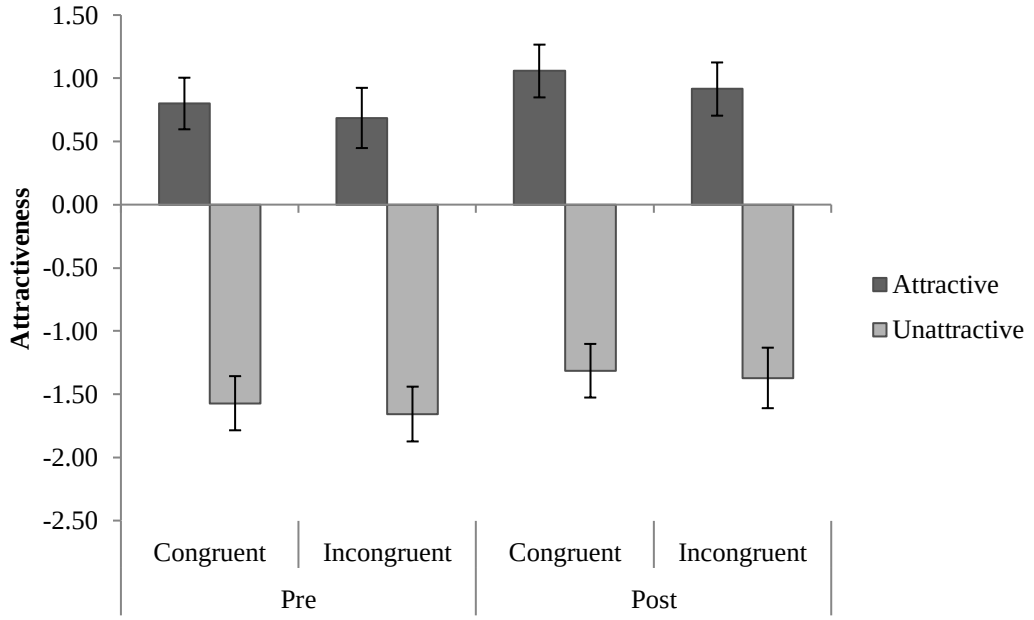

Figure D.2*:* Means for similarity in Exp. 2. Higher scores indicate greater attractiveness. Error bars denote standard errors.

The first LMM found a significant main effect of attractiveness on 'pre' score (*b* = 2.36 *SE* = .168, $p < .001$), with attractive face (M = .743, SD = 1.30) leading to higher levels of attractiveness, as compared to unattractive face (M = -1.61, SD = 1.27, see Figure D.2).

The results of the second LMM with 'post' scores as the outcome variable are presented in the table below

Table D.2: Multilevel modelling results for outcome variable 'post' scores. Significant main effects and interactions are highlighted in bold.

				95% Confidence Interval	
Effect	b	SE	p-value	Lower Bound	Upper Bound
Congruency	.057143	.168203	.736	-.282873	.397159
Attractiveness	**2.285714**	**.178182**	**.000**	**1.926651**	**2.644778**

Congruency x Attractiveness	.085714	.208995	.685	-.340415	.511843
Pre	**.661801**	**.055862**	**.000**	**.551026**	**.772575**
Self-Attractiveness	-.026214	.043821	.556	-.117219	.064792

As reported on Table D.2, there was a significant main effect of attractiveness with attractive face (M = .986, SD = 1.23.) leading to higher levels of attractiveness as compared to non-attractive face (M = -1.343, SD = 1.33.). The main effect of congruency and the interaction between attractiveness and congruency were non-significant.