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I Feel What You Feel if I Like You: The Effect of Attractiveness on Visual Remapping of Touch

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Abstract

Observing touch being applied to another human's face enhances tactile perception for touch being applied to one's own face. This effect, termed the Visual Remapping of Touch (VRT), is maximal the greater the physical or conceptual similarity between observer and observed. An interesting possibility, however, is that even though the basic nature of the VRT is multisensory, a high cognitive level affinity from the observer toward the observed could modulate the VRT even in the face of decreased physical similarity. In the present study we manipulate the level of attractiveness of the avatars that participants observed being touched. By doing so, we either increased (attractive) or decreased (unattractive) the interpersonal judgment value toward the avatar, while always decreasing the physical semblance between the avatar shown and the original image. Results revealed that both for an avatar depicting oneself or a stranger, the VRT is present when touch is applied to an attractive, but not to an unattractive avatar. These findings suggest that basic multisensory effects, such as visuo-tactile interaction, are modulated by higher-level cognitive representations of the self and of others.

Keywords

Visual Remapping of Touch, multisensory, face representation, attractiveness, social perception

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1. Introduction

The sense of touch is often conceptualized as the most private of senses as it pertains exclusively to the individual experiencing tactile stimulation (Descartes, 1960, 1993; Ross, 1956). However, recent results in the field of multisensory integration challenge the assumption that tactile processing is inherently personal. Neuroimaging studies demonstrate that viewing touch on the body of others automatically activates one's own somatosensory system (Blakemore *et al.*, 2005; Cardini *et al.*, 2011; Ebisch *et al.*, 2008; Gallese *et al.*, 2004; Keysers *et al.*, 2004). These cortical effects have intriguing behavioural counterparts. For instance, visuo-tactile synaesthetic subjects report to perceive tactile stimulation on their own skin when observing someone else being touched (Banissy and Ward, 2007). Notably, the study of the neural correlates of visuo-tactile synaesthesia reveals that similar areas activate in synaesthetes and non-synaesthetes when they see a tactile stimulation on the body of others. The difference between synaesthetes and non-synaesthetes lies in the strength of the visually evoked somatosensory activation (Blakemore *et al.*, 2005).

These findings imply that most subjects' somatosensory system is activated as a consequence of visual information about touch, but that this somatosensory activity is not evidenced at a perceptual level as it falls below a certain threshold of conscious experience. In fact, Serino *et al.* (2008) have shown that when tactile stimuli are administered close to the threshold of tactile perception, vision of touch evokes a form of visuo-tactile interaction resembling visuo-tactile synaesthesia in non-synaesthetic subjects. In that experiment, participants viewed a face either being touched, or merely being approached, by fingers as they were concurrently presented with a near-threshold tactile confrontation task on the face (i.e., participants had to decide whether they had been touched on the right, left, or both cheeks). Findings demonstrated an enhanced accuracy for tactile detection that was specific to the case of observed touch. This effect was termed the Visual Remapping of Touch (VRT; Làdavas and Serino, 2010). The VRT is exclusive to the perception of touch on a body-part, since it does not occur when viewing an object being touched, and is expressed maximally when subjects view their own face being touched, as compared to the face of another person (Cardini *et al.*, 2011; Serino *et al.*, 2008). In addition, the VRT is stronger when participants observe touch on an individual they perceive as similar to themselves, either from a low-level physical features, or from a high-level conceptual socio-political stance (Serino *et al.*, 2009; see also Paladino *et al.*, 2010). Indeed, Serino *et al.* (2009) reported that the VRT is stronger when observers see touch on members of their same ethnic group or on someone representing their own socio-political tendency, than when they observe touch on someone representing a diverging background.

Evidence for multisensory interaction between vision and touch is massive (see, e.g., Spence and Driver, 2004; Macaluso and Maravita, 2010). However, studies on VRT suggest intriguing questions regarding possible interactions between low-level multisensory effects, such as visuo-tactile integration, and high-level social representations of the self and of the others. In the present study we raised a new question regarding the VRT effect, namely, whether we could elicit a VRT effect by increasing one's 'interpersonal judgement' (Dion *et al.*, 1972) toward the self or other, even in the face of experimentally decreasing physical resemblance between the participant and the avatar that she sees touched. Given the close relationship between social perception and perceived attractiveness — the 'what is beautiful is good' stereotype (Dion *et al.*, 1972) — physical attractiveness appears to be a good bodily candidate variable in order to manipulate the perceived value of others in social context without a confounding effect of physical semblance. An image manipulated to be perceived as attractive will poorly resemble the original image, but it will be perceived as of high social value. Conversely, an image altered to be perceived as unattractive will again poorly resemble the original image, but this time, will be attributed low social value.

In the present study, therefore, we manipulate the perceived attractiveness of the face used to induce the VRT effect by increasing/decreasing (attractive/unattractive) eye and lip size and height, factors that have been shown to correlate with perceived physical attractiveness (Costa and Corazza, 2006; Cunningham, 1986; Cunningham *et al.*, 1990, 1995). In addition, as in previous studies (Cardini *et al.*, 2011, 2013) we also manipulated the identity of the shown face, by presenting participants with pictures of either their own face (Self condition) or of another person (Other condition). Contrasting the effect of attractiveness for the Self and Other conditions would allow us to control indirectly for a confounding effect of similarity in the VRT effect. According to the so-called 'facial recognition enhancement effect', people show a bias toward recognizing their own face as more attractive than it actually is (Epley and Whitchurch, 2008). That is, participants are faster and more accurate at recognizing an attractively enhanced version of their own face than they are at identifying an unadulterated version. This bias does not exist toward unknown individuals.

Therefore, in line with previous studies (Cardini *et al.*, 2011; Serino *et al.*, 2008, 2009), we predict that participants' accuracy at detecting bilateral tactile stimuli administered close to perceptual threshold will be enhanced when subjects view fingers touching (touch condition), as opposed to merely approaching (no-touch condition), a shown face. Additionally, we predict that the VRT effect will be modulated by the level of attractiveness of the presented avatar. If attractiveness plays an independent role in modulating the VRT with respect to similarity, the VRT should be enhanced for attractive faces irrespectively of the identity of the avatar (i.e., both for the Self and Other conditions). In contrast, if a modulation by part of attractiveness is shown only under the Self condition, and not under the Other condition, then that effect could be attributed to similarity alone, as it would depend on the facial recognition enhancement effect, which is specific for self-faces.

2. Methods

2.1. Participants

Fifteen healthy subjects (12 females, 21–24 years old, 14–18 years of education) participated in this study after providing informed consent, which was approved by the local ethics committee of the Department of Psychology from the University of Bologna. All participants had normal or corrected-to-normal vision and reported normal touch.

2.2. Stimuli and Apparatus

Tactile stimuli were delivered via a pair of constant current electrical stimulators (DS7A, Digitimer) by two couples of surface electrodes (Neuroline, AMBU) placed on the subject's right and left cheeks. In order to administer tactile stimuli close to participants' perceptual thresholds bilateral tactile confrontation was elicited. For half the subjects an intense tactile stimulus was placed on the right cheek, while weak stimulation was given to the left cheek and this setup was reversed for the other half of the participants. Bilateral tactile stimulation (see below) was always a combination of a weak and a strong stimulation, and the side to which each of these was applied was counterbalanced between participants. Prior to the experiment, the intensity of the electrical stimuli was titrated for each subject in the absence of visual information. Using a staircase procedure detection thresholds were set to 90% for the strong stimulus and 60% for the weaker stimulus. In this way, in the bilateral simulation condition, competition between the two tactile stimuli was elicited, thus resulting in uncertainty about the number and side of received tactile stimuli. Thresholds were recalibrated before each experimental block.

Visual stimuli were a set of eight videos (resulting from the combination of four factors with two levels each: touch/no-touch, unilateral/bilateral, attractive/unattractive, and self/other) presented on a 17″ computer screen and placed approximately 60 cm in front of the subject. The faces presented on the screen covered an area of about 10×20 cm. In the movies, two fingers presented on the lower part of the screen, one on the right side and one on the left side, moved first toward the centrally presented face and then backwards to their starting position. The target of the moving finger was manipulated by two different variables. In the Touch condition the fingers actually touched the cheeks of the shown face, while in the No-touch condition the fingers approached the shown face and then stopped, resulting in pointing to the face from a distance of 5 cm. Similarly, in the unilateral visual stimulation condition, either the left or the right index finger approached or touched the visually presented face. In the bilateral visual presentation condition both fingers approached or touched the presented avatar, and then receded back to their initial position.

The third variable manipulated in the visual stimuli was the level of attractiveness of the model presented on the screen. Face pictures were digitally manipulated using WinMorph software (www.debugmode.com/winmorph/). In order to increase attractiveness eye height, eye width and lip height and width were increased by 7% in comparison to original sizes. In order to decrease attractiveness the same parameters were decreased by 7%. The background of the faces was set to black. Facial expression was neutral and gaze was directed toward the observer (Ewing *et al.*, 2010). Participants' post-experiment rating of the presented stimuli (Likert scale, 1 being very unattractive and 5 being very attractive) confirmed that Attractive stimuli ($M = 2.96$, S.E.M. = 0.32) were perceived as better looking than Unattractive stimuli ($M = 1.92$, S.E.M. = 0.19), $z = -2.48$, $p < 0.05$ (Wilcoxon Signed Ranks Test). Lastly, the faces shown on the screen were altered versions (attractive or unattractive) of either the participant himself or herself (Self condition) or of a same-sex stranger to the subject (Other condition). Example stimuli are depicted in Fig. 1.

A PC running C.I.R.O. software was used to control the presentation of the stimuli and the recording of experimental responses.

2.3. Procedure and Design

Experimental procedure followed largely the procedure taken in Serino *et al.* (2009). In different randomised trials either the finger on the right, the finger on the left, or both fingers, moved toward the centre of the screen where a face was shown (see above). A tactile stimulus (bilateral or unilateral) was delivered to the participant precisely when the fingers reached their visual target (this target being either on the cheek of the shown face — in the Touch condition — or being 5 cm away from the face of the depicted on the screen — in the case of the No-Touch condition). Subjects were instructed to press a button with the hand corresponding to the side where they felt the tactile stimulus on their face while ignoring the visual stimulus. Participants were to press both buttons (on the left and on the right) in the case of a double stimulation.

The experiment comprised four counterbalanced experimental blocks (two that were Self condition blocks, and two that were Other condition bocks) of the tactile confrontation task. Each block presented four repetitions of 16

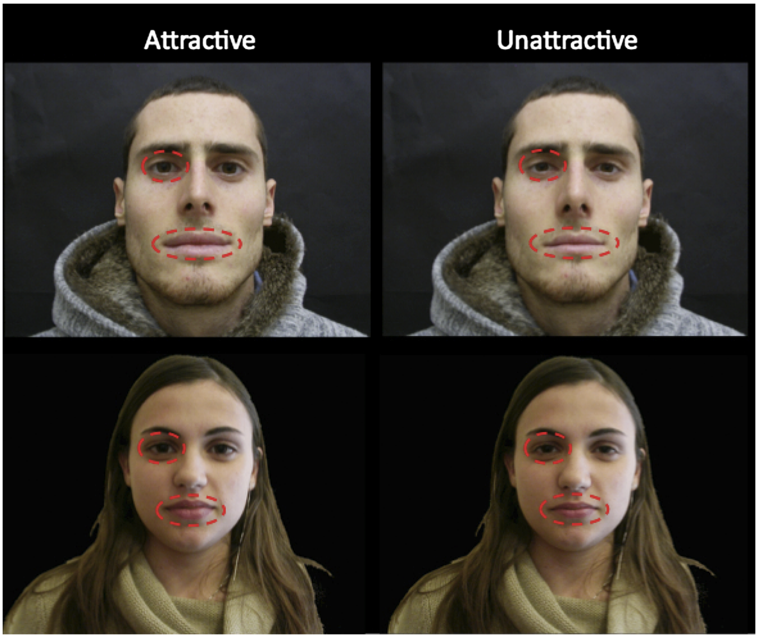

Figure 1. Example stimuli. The pictures utilised during visual presentation of fingers either touching or approaching an individuals' face were altered by either increasing or decreasing (attractive and unattractive, respectively) eye and lip size, two variables that play a key role in perceived attractiveness. Additionally, subjects were presented either with a modified picture of themselves or of a same-sex stranger. For purpose of illustration here we show a male and a female model. This figure is published in colour in the online version.

unique stimuli representing all combinations of side of tactile stimulation (left or right unilateral, and bilateral), side of visual stimulation (left or right unilateral, and bilateral), finger-movement trajectory (touch and no-touch), and finally level of attractiveness (attractive and unattractive). In this manner, each block consisted of 64 randomised trials (across tactile and visual stimulation, finger trajectory, and the avatar's attractiveness) for a total of 256 trials over the course of the experiment. Each trial lasted about 3 s.

Parametric statistical tests were utilised throughout the analyses as all data in all conditions passed the Shapiro–Wilk normality test ($p > 0.05$).

3. Results

To study the effect of attractiveness on VRT we compared subjects' tactile accuracy at detecting bilateral tactile stimulation delivered on their face while either viewing an attractive or unattractive version of themselves or another individual, either being touched or just approached by two fingers. In line with previous studies, the remaining conditions with unilateral tactile and visual stimulation were used as catch trials and therefore were not included in statistical analysis (as in Cardini *et al.*, 2011, 2013; Serino *et al.*, 2009). The dependent variable, namely, the percentage of correct responses, therefore reflects the correct identification of bilateral touch (hits) and does not include the correct rejection of unilateral trials.

A 2 (Identity: Self *vs.* Other) × 2 (Attractiveness: Attractive *vs.* Unattractive faces) × 2 (Seeing Tactile Target: Touch *vs.* No-Touch) within-subjects analysis of variance was carried out in order to determine the effect of attractiveness on the capacity to remap seeing touch. The results revealed a significant main effect for Touch *vs.* No-Touch, $F(1,14) = 8.23$, $p = 0.012$, $\eta^2 = 0.37$, showing that participants were more accurate at detecting bilateral tactile stimulation when they observed fingers touching the shown face ($M = 57.20$, S.E.M. = 4.5) than when the fingers did not touch the presented face ($M = 51.45$, S.E.M. = 5.6). Contrarily, no significant main effect of identity [$F(1,14) = 0.73$, $p = 0.40$; Self: $M = 54.09$, S.E.M. = 4.9; Other: $M = 56.31$, S.E.M. = 5.3] nor a significant main effect for Attractiveness [$F(1,14) = 1.64$, $p = 0.22$; Attractive faces: $M = 56.59$, S.E.M. = 4.9; Unattractive faces: $M = 53.81$, S.E.M. = 5.3] were found. This pattern of results is testament to the fact that the present methodology was able to elicit a VRT effect (difference between Touch and No-touch), but that nonetheless the mere identity or the mere level of physical attractiveness of the seen models was not sufficient to enhance bilateral tactile discrimination. Notably for the hypotheses of the present study, as shown in Fig. 2, there was a significant Attractiveness $*$ Seen Tactile Target interaction [$F(1,14) = 5.76$, $p = 0.031$, $\eta^2 = 0.29$].

In order to understand the origin of the significant interaction data were collapsed across the Identity variable and Bonferroni-corrected multiple comparisons were performed. Under the Attractive Touch condition ($M = 62.63$, S.E.M. = 3.4) participants performed significantly better [$t(14) = 3.38$, $p < 0.05$, corrected] than under the Attractive No-touch condition ($M = 50.56$, S.E.M. = 5.3). Contrarily the Unattractive Touch ($M = 55.2$, S.E.M. = 4.6) and the Unattractive No-touch ($M = 52.3$, S.E.M. = 5.2) did not differ significantly [$t(14) = 1.01$, $p > 0.05$, corrected]. Lastly, the Attractive No-touch and the Unattractive No-Touch conditions did not differ from one another [$t(14) = 0.79$, $p > 0.05$], while tactile perception in the Attractive Touch condition was significantly higher than in the Unattractive condition [$t(14) = 2.17$, $p < 0.05$]. These results elucidate that the interaction observed between the level of attraction of the model presented and the target of the approaching fingers (touch or no-touch) is due to the fact that participants were more accurate at detecting bilateral tactile stimulation on their face when they observed touch on an attractive than an unattractive model, and that this finding did not hold for the case of just approaching fingers (no-touch condition).

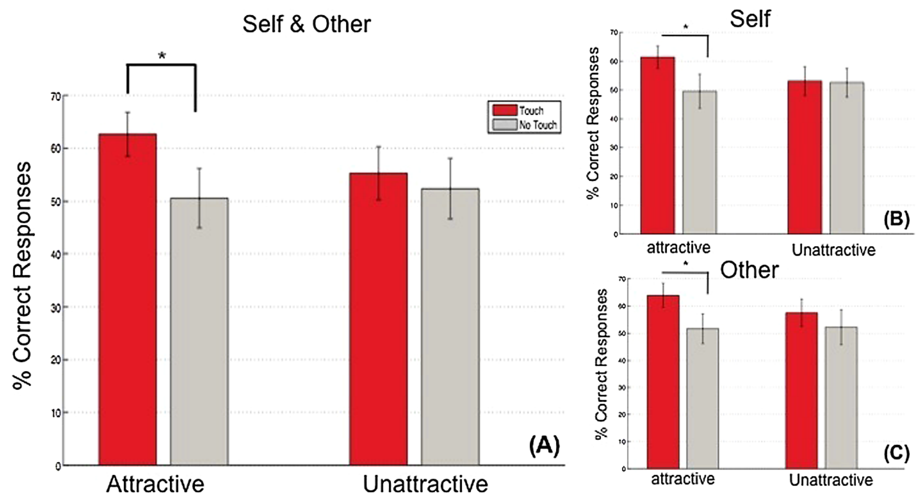

Figure 2. VRT effect. (A) Accuracy (in percentage) at detecting bilateral tactile stimulation is plotted as a function of whether participants saw the shown face being touched (touch) or merely being approached (No-touch) and whether the modified picture was an attractive or an unattractive version of the original self or other (this last variable being collapsed). (B) and (C) are respectively the accuracy (in percentage) at detecting bilateral tactile stimulation as a function of Touch/No-Touch and Attractiveness for Self (B) and Other (C). Error bars represent S.E.M. and * indicates $p < 0.05$. This figure is published in colour in the online version.

The two-way interactions, Identity ∗ Attractiveness [$F(1, 14) = 0.008$, $p = 0.93$], and Identity ∗ Seen Tactile Target [$F(1, 14) = 0.275$, $p = 0.60$], as well as the three-way interaction Identity ∗ Attractiveness ∗ Seen Tactile Target [$F(1, 14) = 0.544$, $p = 0.47$] were not significant.

4. Discussion

Previous studies have demonstrated that viewing touch being applied to another individual's face facilitates tactile discrimination on one's own face. This effect, the Visual Remapping of Touch, has also been shown to be expressed maximally when the model on which participants see touch being applied is physically (Serino *et al.*, 2008) or conceptually (Serino *et al.*, 2009) similar to the subject himself or herself. In the present study we asked the question whether other variables could come into play bringing about the VRT. In this case we tested the perceived attractiveness of the model.

Our results replicated the VRT effect showing enhanced tactile detection accuracy when subjects viewed fingers touching, as opposed to merely approaching, someone else's or their own face. In addition, findings revealed that the benefit of seeing touch being applied is only present when the observed models are considered to be attractive. That is, there seems to be no remapping of touch when the touch participants observe is applied to an unattractive individual, this last one either being an unattractive version of oneself, or of someone else. The speculations on the putative underpinning reasons for this effect can be many. For instance, what is attractive and beautiful is most prominently also considered, plainly, good (Dion *et al.*, 1972; Eagly *et al.*, 1991; Hatfield and Sprecher, 1986). What is attractive is also vastly perceived as healthier (Rhodes *et al.*, 2007; Weeden and Sabini, 2005). It is easy to imagine how both of these attributes, goodness, and especially, physical health, rank high on the evolutionary list, and therefore we can posit that organisms strive toward appropriating these traits for themselves. The veritable challenge, however, lies not in explaining why, but how such a high level cognitive ability as ascribing physical beauty and arguably a positive social value, becomes coded and kept track of in one's (multi)sensory system. Initial evidence has started to show that the likelihood of imitation behaviour (social mirroring or 'Chameleon Effect') can only be predicted for imitation of attractive others (Müller *et al.*, 2013). Indeed, research demonstrates that participants' level of empathy predicts the speed with which subjects will imitate hand-related motor behaviours of an attractive, but not an unattractive, other (Müller *et al.*, 2013). Stel *et al.* (2010) have demonstrated that the more we dislike people the less we imitate them. Similarly, Van Leeuwen *et al.* (2009) have shown that an art piece purportedly created by an attractive person was imitated significantly more often than an art piece purportedly created by an unattractive person. The mediating role of attractiveness in imitation was also found in the vocal domain by Babel (2012). In this study spontaneous phonetic imitation was enhanced when participants were confronted with an attractive talker.

Perhaps the finding we report in the present study is a building block of the more abstract interaction between attractiveness and imitation reported by social psychology studies. The VRT effect might be understood as a type of implicit imitation behaviour performed by the body, which could then give rise to effects such as the one reported by Müller *et al.* (2013).

Two alternative explanations for the modulation by part of attractiveness on the VRT effect could be proposed. Firstly, it could be considered that the perception of attractive (as opposed to unattractive) avatars may increase arousal and/or attention, or similarly, that morphing in one direction (toward attractiveness or away from attractiveness) might result in an augmented salience of said morph resulting in increased attention or arousal, which might in turn mediate changes in lower-level perceptual processes such as the VRT. This putative explanation, however, is not supported by the lack of an overall increase in performance in the attractive (or unattractive) condition (main effect was not significant). Secondly, accordingly to the facial recognition enhancement effect (Epley and Whitchurch, 2008), people are better suited at recognising an attractive version of themselves than they are at recognising an accurate depiction of their physical semblance. Therefore, since the VRT effect is stronger for viewing one' own face (Cardini *et al.*, 2011; Serino *et al.*, 2008), an enhanced VRT effect for attractive Self images might in principle depend on stronger self recognition under the attractive condition. However, such explanation applies only if the enhanced VRT were observed solely for the attractive version of Self, but not of Other. This was not the case, and hence it appears that the driving force behind the increased VRT for attractive models is not similarity, but arguably, positive social attribution toward the viewed face. In addition, in the present study the VRT effect was not significantly stronger for viewing the Self as compared to the Other's face. This null effect could be considered a failure to replicating previous findings (Serino *et al.*, 2008) and in contradiction with the conclusions from Cardini *et al.* (2011), who stated that the VRT is most likely rooted in the neuronal mechanisms of representing the embodied self. Nonetheless, we believe that this is not necessarily the case.

Although people might explicitly better recognise their face when it is more attractive, in the present experiment we did not present participants with their own veridical attractive face, but always with a digitally modified version of either their own or of another person's face. Thus, it might be the case that such modified versions of the Self faces did not induce a preferential activation in the neural system representing the embodied self sufficient to trigger differential VRT effects for Self and Other faces. In addition, it is worth noting that previous data are compatible with important dissociation between implicit VRT effects and participants' explicit reports. First, previous modulation of the VRT effect for ethnical or political dimensions of the viewed faces always occurred when participants were completely unaware of such effects. In Serino *et al.* (2009) when explicitly asked to rate the viewed faces for pleasantness, participants did not report significant difference in their judgments for ethnically in-group and out-group faces, whereas they evaluated as more pleasant politically in-group members than their counterpart out-group members. Rather, implicitly, the degree of VRT effect was higher for in-group member in both cases.

In conclusion, results from the present study might be of interest for researchers working in the field of multisensory integration, as well as for a broader readership, because they show, on the one hand, that visuo-tactile interactions occur for stimuli 'shared' between one's own body and the body of others. On the other hand, such implicit multisensory effects are modulated by high-level perceptual and social factors such as the perceived attractiveness of others. Interestingly, perceived attractiveness for a face appears to be a process that does not end at the somatosensory cortices (Kühn and Gallinat, 2012), or multisensory areas, whereas the VRT effect occurs in primary and secondary somatosensory cortices as well as in multisensory areas in the premotor and posterior parietal cortex (Blakemore *et al.*, 2005; Cardini *et al.*, 2011; Ebish *et* *al.*, 2008). The challenge now, therefore, lies in identifying how higher levels of cognition (such as judging attractiveness) come to modulate multisensory processes (as is the VRT). We believe that research in the field of multisensory perception is ready to investigate not only basic mechanisms of interaction between simple stimuli across the senses, but also how such mechanisms might be modulated by and concur with high-level cognitive processes.

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