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Where is the love? The social aspects of mimicry

Rick van Baaren[1,*], Loes Janssen[2], Tanya L. Chartrand[3] and Ap Dijksterhuis[1]

[1]*Behavioral Science Institute, Radboud University Nijmegen, The Netherlands*
[2]*Department of Communication, Twente University, The Netherlands*
[3]*Fugua Business School, Duke University, Durham, NC, USA*

One striking characteristic of human social interactions is unconscious mimicry; people have a tendency to take over each other's posture, mannerisms and behaviours without awareness. Our goal is to make the case that unconscious mimicry plays an important role in human social interaction and to show that mimicry is closely related to and moderated by our connectedness to others. First we will position human unconscious mimicry in relation to types of imitation used in cognitive psychology and cognitive neuroscience. Then we will provide support for social moderation of mimicry. Characteristics of both the mimicker and the mimickee influence the degree of mimicry in a social interaction. Next, we turn to the positive social consequences of this unconscious mimicry and we will present data showing how being imitated makes people more assimilative in general. In the final section, we discuss what these findings imply for theorizing on the mechanisms of imitation and point out several issues that need to be resolved before a start can be made to integrate this field in the broader context of research on imitation.

Keywords: imitation; social; humans

Imitation, by definition, is a truly social phenomenon: it takes two to imitate. Although at first glance this statement may seem somewhat trivial, the social nature of imitation in fact has not been fully appreciated by current theorizing on imitation. Whereas we know a lot about the mechanisms of imitation from a cognitive-, developmental- and neuropsychological perspective, the social moderators and consequences are less well understood. Do we imitate everybody or are we more selective? How does our relationship to the mimicker or mimickee moderate imitation and its consequences? What are the social consequences of imitation? The purpose of this paper is to present evidence for the social side of imitation and by doing so, hopefully inspire other disciplines to integrate these findings in their theorizing and empirical work. It is not the intention to provide a complete review of all the work done on mimicry (for a review, see Chartrand & Van Baaren 2009), instead, the paper is written to make a strong case for social processes in this type of imitation.

In the next sections we will provide evidence for social moderators and consequences of mimicry, whereafter we will discuss the fit and misfit with current theorizing. It is not our intention to integrate the present chapter in the theorizing done in other chapters in this special issue, simply because there is just too little research on this type of mimicry in cognitive psychology and cognitive neuroscience. What we do instead is point out which questions, in our view, should be addressed by studies in the near future. First, however, we will clarify what type of imitation is the focus of this paper.

1. TYPE OF IMITATION: UNCONSCIOUS HUMAN MIMICRY

The social psychological studies providing evidence for the social side of imitation have mostly focused on *human mimicry*. In this field, mimicry is defined as *unconscious* or automatic imitation of gestures, behaviours, facial expressions, speech and movements (for an extensive review see Chartrand & Van Baaren 2009). A prototypical example is when two people in a bar are involved in a conversation and are unaware of the fact that they take on the same posture, nod their heads, and make the same face rubbing or hair touching movements. This type of mimicry thus is different from the more conscious types of imitation that have been studied in the realm of learning, modelling and acculturation (e.g. Bandura 1962). This type of mimicry is also different from the types used in research in cognitive psychology and cognitive neuroscience that has focused on imitation (see other chapters in the special issue). The difference in this case centres around awareness; are you aware of the behaviour you see and are you intentionally trying to copy it? When it comes to unconscious mimicry, the answer to those questions is 'no'. In most cognitive and neuropsychological studies, at least one of these questions is answered by 'yes'.

A related key difference between the social psychological studies and most of the studies in cognitive- and cognitive neuroscience is the relative focus on ecological

* Author for correspondence (r.vanbaaren@bsi.ru.nl).

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versus internal validity. Most studies on unconscious mimicry use an observational method and one is in a sense waiting (like an amateur bird-watcher) until the behaviour to be imitated is *spontaneously* produced. This is in contrast with many tasks used in cognitive- and cognitive neuroscience where often a stimulus–response compatibility task is used (e.g. Prinz 1990; Iacoboni *et al.* 1999; Brass *et al.* 2001; Massen & Prinz 2009) and the behaviour of interest is either instructed or inherent in the task or participants are consciously observing a behaviour and their spontaneous motor or neurological responses are coded.

It is important to realize that, in studies on unconscious human mimicry, mimicry is just a by-product in the interaction. The participants are focusing on something completely different (e.g. working on a picture describing task (Chartrand & Bargh 1999) or judging advertisements (Van Baaren *et al.* 2003)) and they are unaware of the behaviour, the mimicry and the fact that the researchers may in fact be interested in something else other than the irrelevant task the participant is working on…. In sum, the type of imitation we have researched most extensively is unconscious, peripheral mimicry.

A prototypical example of an experimental investigation of human unconscious mimicry is the 'Chameleon effect' (Chartrand & Bargh 1999). In this research, participants interacted with an unknown confederate in two consecutive picture-describing sessions. In one session, the confederate either rubbed her face or shook her foot while describing the pictures with the participants, while the second confederate performed the behaviour that the first confederate did not. The behaviour of the participants, 'secretly' recorded on videotape, showed that participants shook their foot more in the presence of the foot-shaking confederate, and rubbed their faces more in the presence of the face-rubbing confederate. Debriefing indicated that participants were unaware of their mimicry.

2. EVIDENCE FOR SOCIAL MODERATORS: MIMICKER CHARACTERISTICS

The Chameleon effect (Chartrand & Bargh 1999) did show that there is an automatic human tendency to mimic behaviour and mannerisms. However, subsequent research revealed we don't imitate *everyone all the time*. Our tendency to unconsciously mimic is moderated by both enduring and temporary characteristics of the mimicker and the mimickee.

First, nonconscious mimicry is increased when people are more focused on the individuals around them. Providing initial support for this contention, Chartrand & Bargh (1999, study 3) found that people high in perspective taking (i.e. who are paying more attention to those around them) mimicked the behaviour of a confederate to a greater extent than those low in perspective taking.

Additional evidence for the moderating role of concern with others comes from research by van Baaren *et al.* (2003). In three studies that either temporarily primed self-construal orientation or compared participants from different cultures, an interdependent self-construal was associated with more automatic mimicry than with an independent self-construal. In essence, self-construal refers to the extent to which people perceive themselves as unique individuals, independent of others instead of connected to, and dependent on, others (see Brewer 1991). Even though, in general, some people are enduringly more dependent than independent, self-construal can be temporarily modified. For example, priming participants by presenting them or having them read words like 'I', 'me' or 'mine' versus 'we', 'us' or 'our' temporarily shifts their self-construals on the social-personal dimension. This in turn influences the degree of unconscious mimicry in a subsequent interaction with a stranger (Van Baaren *et al.* 2003; study 2). That is, participants with either a temporary or enduringly dominant and interdependent self were more likely to nonconsciously take on the behaviours and mannerisms of a confederate. Using a stimulus–response compatibility task (a dependent variable more common to cognitive psychology compared to spontaneous mimicry), Leighton *et al.* (submitted) recently conceptually replicated this effect.

Finally, enduring or temporary attention to and concern with others have been shown to moderate the extent to which individuals mimic an interaction partner. For example, an affiliation goal is associated with more mimicry than no affiliation goal, as has been shown by Lakin & Chartrand (2003). This held regardless of whether the goal was consciously held after getting explicit instructions to get along with another person, or nonconsciously held after being subliminally primed with affiliation-related words such as affiliate, friend, team, partner, and like.

Thus, when we are more concerned with others, depend more on them, feel closer to them, or want to be liked by them, we tend to take over their behaviour to greater extent. This malleability of mimicry is beautifully captured by Brewer's (1991) optimal distinctiveness theory. The theory suggests that people try to strike a balance between a desire for distinctiveness (i.e. feeling unique and different from others) and a desire for assimilation or belonging (i.e. feeling similar to others). When people feel too distinct or too similar, they are motivated to regain the balance. Thus, they have a need to assimilate activated in situations where they feel unusual or different. In a study applying the principles of this theory to mimicry behaviour, Uldall *et al.* (submitted) had participants complete a supposed 'personality test'. They were given (bogus) feedback on the test that indicated they had a 'personality type' that was either very similar to most others at their undergrad institution or one that was extremely unusual at their university. Participants then interacted with another student (actually a confederate), and those who had earlier been told they were very different from others at their school engaged in more mimicry of the confederate than those who had been told they were similar to others at their school. This suggests that people mimic more when they are feeling too different from in-group members. Mimicry is a way that people (nonconsciously) regain their 'optimal' balance (Brewer 1991) by affiliating with others in an effort to belong. It is important to

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note the difference between priming or activating a self-construal and the manipulation used in the Uldall *et al.* (2008) study. Whereas independent or interdependent self-construals are self-construals that can differ between and within people, depending on context, the Uldall *et al.* manipulation entails an extremely dependent or independent priming. This means that it is outside the 'normal' boundaries of how we relate to others and we (unconsciously) feel the need to restore the balance. In the experiments on affiliation goals and self-construal, however, the priming is not extreme and people assimilate to the prime, instead of restoring a balance. Extremity is the moderating principle here (Brewer 1991).

Social processes can extend to a basic perceptual and cognitive level, and research from cultural and social psychology indicated that the mimicker characteristics, such as self-construal, are correlated with the perceptual and cognitive mimicker characteristics (Witkin *et al.* 1979; Witkin & Goodenough 1981; Ji *et al.* 2000). Field dependence, for example, which refers to the phenomenon of perceptually integrating objects in their context, goes together with socially being more attuned to others. On the other hand, field independence, which is the tendency to perceptually isolate objects from their contexts, is related to a socially independent mindset. In three experiments by Van Baaren *et al.* (2004*a*,*b*), the cognitive styles (field dependency versus field independence) were either measured or experimentally primed and then the degree of unconscious mimicry in a subsequent interaction was measured. As expected, the more field dependent participants were on a test of cognitive style (e.g. the Hidden Figures Test, Witkin *et al.* 1971) the more they mimicked their interaction partner. This attests the idea that the mimicker characteristics influencing our unconscious mimicry are deeply rooted and fundamental.

3. EVIDENCE FOR SOCIAL MODERATORS: MIMICKEE CHARACTERISTICS

Another important social moderator of mimicry is our evaluation of the characteristics of our interaction partner. When we like a person, or his/her ethnicity, or group membership or social status, we will imitate that person to a greater extent compared to when we do not positively evaluate those characteristics. Johnston and colleagues have conducted several experiments providing evidence for this effect. First, Johnston (2002) investigated the impact of a social stigma on mimicry. In two studies, participants were ostensibly working on an icecream tasting task together with another person (a confederate), who had or had not a visible social stigma (being obese, or having a facial scar). The confederate ate a lot or a little ice cream and it was assessed whether the participant mimicked the ice cream consumption. The results revealed indeed a mimicry effect of the participant's consumption; however, no mimicry occurred when the confederate had a visible social stigma. The theory is that mimicry (unconsciously) creates a bond or connection between individuals and that humans automatically and unconsciously try to prevent mimicry in cases where they do not want to bond with another person.

Taking it more broadly than social stigma, Stel *et al.* (submitted) have explored the relationship between evaluation or liking of a target and mimicry. In a first study where participants' *a priori* liking for a target was manipulated and their mimicry of that person was then measured, they found that when a target is disliked, facial mimicry is attenuated. In another study, a reaction time measure to assess implicit associations (IAT, see Greenwald *et al.* 1998) towards Dutch and Moroccans was administered. With this measure, the relative evaluation of Dutch versus Moroccans can be quantified. In a subsequent session, participants watched videos of both a Dutch actor and a Moroccan actor performing some clerical tasks and in addition performing some subtle behaviours, such as face/hair touching and pen-playing. Hidden videocameras registered the participants' behaviours and it was found that the implicit attitudes correlated with unconscious mimicry, that is, the more negative participants were towards Moroccans relative to Dutch, the less relatively they mimicked a Moroccan compared to a Dutch actor. Similar results were previously obtained by Yabar *et al.* (2006), where instead of ethnic attitudes, implicit attitudes towards Christians (versus non-Christians) were used. Finally, several other studies found main effects of ingroup–outgroup distinction on mimicry. Heider & Skowronski (submitted) conducted a study in which African-American and Caucasian participants interacted with two confederates one after the other, one African-American and one Caucasian. They found more mimicry of ethnic ingroup members than ethnic outgroup members. Similarly, Bourgeois & Hess (2008) found more facial mimicry of ingroup members than outgroup members.

In sum, there is ample evidence for social moderation of mimicry, namely, the human nonconscious tendency to imitate. We do not just imitate *everybody all the time*. We imitate more when: we feel connected to others, others are important, we want to affiliate with others, we are socially oriented or have an assimilative cognitive style. Furthermore, in addition to these more general mimicker characteristics, the characteristics of the mimickee also moderate mimicry. *A priori* evaluations of those targets predict our subsequent mimicry.

In the next section we discuss another line of evidence lending strong support for a view that mimicry is closely related to influences and is influenced by social processes in human interactions. Then, we move on to an attempt to integrate these social moderators and consequences in current theorizing on imitation.

4. SOCIAL CONSEQUENCES OF UNCONSCIOUS MIMICRY: ON THE DYAD

In many commercial books on influence and making friends, imitation is offered as one of the means to create a good impression and have a positive relation or rapport with others (e.g. Lieberman 2000). There is now experimental evidence that this indeed occurs. Positive social consequences have been observed for

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mimicry of body movements and speech variables. In a typical experiment, a participant and a confederate work on an irrelevant task. During that task, the confederate mimics (or not) the posture, mannerisms, and behaviours of the participant after a short delay. These can be gestures or movements such as face-rubbing, foot-shaking, playing with a pen, orientation of the body (avoiding movements that indicate power or status), or speech variables such as using the same phrases of speech. This subtle mimicking almost always is completely unnoticed by the participant. After this imitation manipulation, the dependent variable is assessed, which is often an evaluation of or behaviour towards the confederate.

Chartrand & Bargh (1999) found that participants who were subtly mimicked by a confederate liked that confederate more and had smoother interactions with that confederate. The developmental psychology literature documents evidence that infants react more favourably towards adults who imitate them than adults who do not (Meltzoff 1990; Asendorpf *et al.* 1996). Interestingly, similar consequences have been observed in human–computer interactions. Bailenson & Yee (2005) had a realistic interface agent (i.e. an avatar using virtual reality technology) either imitating the participant's head movements or performing different head movements. The imitating interface agents were rated as more likeable and more persuasive than the non-mimicking avatars. Similarly, Suzuki *et al.* (2003) found that mimicry of certain (prosodic) properties of a participant's voice by a computer agent led to more favourable evaluations of the computer agent. Thus, the evaluative consequences of imitation are not unique to human–human interactions.

Van Baaren *et al.* (2004*a*,*b*; experiment 1) found that being imitated not only influences evaluations such as liking or rapport, but also makes people behave in a more pro-social manner. In this study, a mimicking or non-mimicking experimenter 'accidentally' dropped several pens on the floor. The dependent variable was whether participants got off their chairs and started to help (a measure developed by Macrae & Johnston 1998). The results revealed that imitated participants were considerably more helpful than non-imitated participants. This effect was recently replicated with eighteen-month old children (Carpenter *et al.* submitted).

What was confounded in the studies, on the consequences of imitation, is that the effects of imitation were measured vis-a-vis the imitator. This is important to note, because it could theoretically be possible that the effects of imitation are not restricted to the dyad and the imitator. Perhaps the effects extend beyond the relation between the imitator and the imitated. Accordingly, it affects the imitated person in a more fundamental way. It is possible that imitation makes one more pro-socially oriented in general.

5. SOCIAL CONSEQUENCES OF UNCONSCIOUS MIMICRY: BEYOND THE DYAD

Initial support for this idea was obtained in studies looking at the effects of being mimicked on behaviour towards people other than the mimicker (Van Baaren *et al.* 2004*a*,*b*). Similar to the previously described experiment, participants were mimicked or not by an experimenter and the effects on prosocial behaviour were assessed. This time, however, the experimenter who mimicked the participant said he was finished, and that a new experimenter would come in and left the room. After a while, the new experimenter entered the room and dropped the pens on the floor. Were mimicked participants more prosocial after being mimicked, even though the person was somebody else rather than the mimicker? The results revealed indeed that also this new person benefited form the increased pro-sociality of a mimicked participant. It could be the case that these results can be explained by a transfer of the pro-social orientation towards the mimicking experimenter onto the new experimenter, because they have similar roles and operate in the same setting. To control this, the next study looked at prosocial behaviour towards an abstract, non-human entity: donation to a charity. After the imitation manipulation, participants were left alone in a room, with the money they received for participating and they were asked to fill out a questionnaire on the 'CliniClowns' a Dutch charity trying to alleviate the stay in hospital for seriously ill children. There was a sealed collection box in the corner of the room and participants were in the position to anonymously donate or not. Whereas non-mimicked participants on average donated a little under 40 eurocents to the CliniClowns, the donation increased upto almost 80 eurocents for those whose behaviour had been mimicked.

6. SOCIAL CONSEQUENCES OF UNCONSCIOUS MIMICRY: SELF-CONSTRUAL

How can these general consequences be explained? As was described in the section on moderators of mimicry, self-construals are intimately linked to unconscious imitation. A interdependent (or social) self-construal goes hand in hand with mimicry and prosocial behaviour, whereas an independent (or personal) self-construal is associated with less mimicry. A bi-directional link between this mindset and mimicry could explain the general social consequences described in the previous paragraph. Ashton-James *et al.* (2007) tested the idea that self-construal may mediate the effect of mimicry on prosocial behaviour. In one of the experiments, participants were mimicked during an initial interaction. After this mimicry manipulation, their self-construal was assessed using the 'Twenty Statements Test' (TST, Kuhn & McPartland 1954), in which participants had to give twenty answers to the question 'Who am I?'. The answers to this test are then coded for interdependence (social roles, connections to others, e.g. I am Tom's brother) and independence (unique attributes, personal characteristics, e.g. I am tall). After the TST, the measure of prosocial behaviour (in general) took place. The participant was asked to help another researcher, who was unable to pay them, with another experiment. Ashton-James *et al.* (2007) indeed found an effect of mimicry on both self-construal and prosocial behaviour and, in line with the hypotheses, self-construal mediated the mimicry-prosocial effect.

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Thus, being imitated makes people feel more attuned to and connected with others.

As was previously mentioned, there is an intimate link between self-construal and cognitive style. Assimilation on a behavioral level goes hand in hand with an assimilative information processing style, implying that if being mimicked leads to a social self-construal then it should also lead to an interdependent (field-dependent) cognitive style. Van Baaren *et al.* (2004*a*,*b*; experiment 3) found evidence for this hypothesis. After a mimicry manipulation, participants whose behaviour had been unobtrusively copied scored better on a memory task sensitive to contextualized memory (Chalfonte & Johnson 1996). In this measure, the relative position of an object in relation to other objects is the focus of interest and an example of an interdependent processing style.

(a) *Present study*

However, the question remains whether being mimicked really leads to an assimilative mindset. Instead, it could be the case that, through mimicry, we tend to relate people and objects to their context and see them in relation to other people and objects, but we do not necessarily have to *assimilate* object and context. Contrast could also be an outcome of such a comparative process. Here, we will present a study designed to test whether mimicry indeed truly leads to an assimilative tendency. Do people actually see more similarities between objects or people after being mimicked? To test this, a measure developed by Mussweiler (2003) will be used (see appendix A). In this task, participants see two different pictures and are asked to rate how similar they find them. There are no right or wrong answers and because there is no context or comparison to other pictures, there are no anchors to perform the task. Hence, the similarity judgement is based on a general tendency to assimilate or contrast. In this experiment we will test the hypothesis that being mimicked indeed moves people to be more assimilative in general and we expect mimicked participants to perceive more similarity between the two pictures.

7. METHOD

(a) *Participants and design*

Twenty-one students from Radboud University Nijmegen were randomly assigned to one or two between-subjects conditions, Mimicry (yes versus no), and received 1 euro for participation in this brief experiment.

(b) *Procedure*

Upon arrival at the laboratory, the participant was brought to a room by the experimenter and was asked to take a seat at a table with two chairs. The experimenter seated herself on the other chair and explained they will discuss some recent advertisements. During this discussion, she unobtrusively mimicked (or not) the spontaneous behaviour of the participant (e.g. facial expressions, face/hair touching, movements by feet or arms) with a 4-second delay. The interaction lasted between 5.5 and 6 min. After this mimicry manipulation, the experimenter handed the similarity measure to the participant and left the room.

(c) *Results and discussion*

To test the effect of mimicry on assimilation, a *t*-test was performed. As predicted, mimicked participants perceived more similarity between the two random pictures ($M = 6.91$, s.d. $= 1.14$) compared to non-mimicked participants ($M = 5.6$, s.d. $= 1.51$), $t(21) = 2.26, p < 0.05$.

These results demonstrate that being imitated changes the way we perceive and interact with other people on a fundamental level. After being imitated, we perceive more similarity between objects, feel more similar to others and behave in a more prosocial manner. What remains a great challenge for future research is finding out how these effects occur chronologically. What exactly activates this assimilative mindset and the related self-construal? What ingredient in mimicry triggers these assimilative and social processes? In our view, at this stage of research on the social aspects of mimicry, now is the time to focus on the neural correlates of being imitated. Until we have found sound ways to measure being imitated in the brain, the magic of mimicry remains a mystery.

In all the experiments on the consequences of being mimicked that have been described so far, the interaction is always between two strangers. In all these cases, the consequences have been positive. What happens when we *a priori* do not like a person? Does that yield the same results or can mimicry actually backfire?

(d) *Social consequences of unconscious mimicry: when it backfires*

Likowski *et al.* (submitted) examined the boundary conditions of the positive consequences of being mimicked. Specifically, they found that being mimicked by a member of an outgroup makes an individual like the outgroup member *less*, not more. Thus, outgroup members who mimic are *less* liked than outgroup members who do not mimic. In a second study, they examined walking synchrony. A synchronized ingroup member was liked more than a non-synchronized ingroup member, but the opposite was found for outgroup members (a synchronized outgroup member was liked less than a non-synchronized outgroup member). Interestingly, the authors also found that the effect extends to liking of the ingroup or outgroup as a whole; being mimicked by an ingroup member leads to more liking of the ingroup, whereas being mimicked by an outgroup member leads to less liking of the outgroup.

Wigboldus *et al.* (in preparation) showed that the consequences of being imitated by an outgroup member are moderated by implicit prejudice. The head movements of white Dutch participants were unobtrusively mimicked or not by an avatar in an immersive virtual environment. For half the participants, the avatar was Dutch looking, and for the others he was Moroccan looking. The results showed that for low-prejudiced people, the 'normal' effect of being mimicked occurred: a mimicking avatar was

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evaluated more positively than a non-mimicking avatar. Importantly, this effect was reversed for high-prejudiced participants who were mimicked by an avatar with typical Moroccan features; they evaluated the mimicking avatar less favourably compared to the non-mimicking one.

A final interesting phenomenon where mimicry is not the default is complementarity, or the tendency to automatically react opposite to the observed behaviour. When behaviour is related to status, power or hierarchy, humans seem not to imitate. Instead, dominance automatically triggers submissiveness and vice versa (Wiggins 1982; Tiedens & Fragale 2003). Tiedens & Fragale (2003) for example manipulated the dominance or submissiveness of a confederate's posture (e.g. wide versus narrow) and observed how the participant's posture changes over time in response to the confederate. They found evidence for automatic complementarity; when participants were faced with a dominant confederate, their own body gradually and unconsciously took up less space, whereas they tended to extend their bodies in space when interacting with a submissive confederate.

(e) *Implications for theorizing on imitation*

How do these social moderators and consequences fit within the broader theories on the mechanisms of imitation presented elsewhere in this issue? At the present time, this question cannot be answered by empirical data and any theorizing is at best speculative. The field of unconscious mimicry has worked in isolation too long. What can be done, however, is to focus on the research described in this chapter and to distill and highlight those aspects of the data that need an explanation or may be of interest to theories on imitation in a broader sense.

First of all, unconscious mimicry is surprisingly flexible, in some cases it occurs more than in others and there are even circumstances where a tendency to act in a complementary instead of assimilative way is revealed. Second, given that the studies reported here on the consequences of imitation concern effects of which the mimickee is *unaware*, we need to be able to explain how our brains unconsciously code or 'recognize' we are being imitated or not and how that affects our brains in such a way that we become more prosocial (or less in cases of not liked targets).

In our view, these aspects are currently not well understood and thus any suggestion on possible integration is inherently speculative. However, regarding the flexibility of mimicry, there are two theories that provide an architecture (theoretically or neurologically) in which flexibility of sensory-motor couplings may occur: Heyes' Associative Sequence Learning theory on sensorimotor associations (e.g. Heyes & Bird 2007) and Keysers & Perrett's Hebbian Perspective on the mirror system (Keysers & Perrett 2004). In both these theories, the mirror system acquires its properties by learned associations between sensory input and associated actions. When there is consistent co-activation between sensory and motor neurons, in time, these neurons become capable of mutual activation. When you wave your hand and you always see your hand wave, a direct link between the perception of a waving hand and waving it occurs. This in turn, due to sensitivity of both endogenous and exogenous stimuli in the mirror system, can lead to (pre)motor activity when we see somebody else move a hand. Importantly, this can also explain why we sometimes respond in a complementary way. If we learn in life that it is healthier to respond submissively to dominant people, and vice versa, the same mechanisms of associated sensory-motor couplings can explain these automatic complementary movements. Recent work by Catmur and colleagues (Catmur *et al.* 2007, 2008) provides evidence for this flexibility of the mirror system (Catmur *et al.* 2009). In their study, a training paradigm was introduced where different types of sensory-motor couplings were trained; compatible combinations (e.g. responding with a hand movement when observing a hand movement) and incompatible combinations (e.g. responding with a foot movement when observing a hand movement or vice versa). When participants were trained in incompatible combinations, a reversal of the typical compatibility effects were found on a reaction times measure; participants were actually faster on compatible compared to incompatible trials. In addition, using fMRI, the corresponding effect also occurred in the mirror system. After incompatible training, the activation of the action observation parts of the mirror system were modulated by training. Conceptually similar effects were observed on a muscular level using TMS and a hand opening–hand closing task.

Relating this to the work on human unconscious mimicry and the finding that mimicry is moderated by *a priori* liking of the target (or his/her group), it would suggest that this system is also sensitive to context. Training or task demands are one type of context, but the characteristic of the person whom we are about to mimic is another important context. On a sensory level, the behaviour we observe is integrated in a more complex array of stimuli: time, place, race, prior experience, expectations and the like. If the mirror system is flexible in the sensory–action couplings, then these peripheral aspects of the sensory input could be capable of influencing the type or direction of sensory–action coupling.

A possible mechanism that may help to explain how liking of a target moderates mimicry is provided by Brass *et al.* (2009). They describe the function of a brain circuit, comprised mainly of anterior frontomedian cortex (aFMC) and temporoparietal junction (TPJ), that plays a crucial role in distinguishing self from other. It is possible that such a system plays an important role both in mimicry and in the consequences of being mimicked. The more self–other overlap we 'feel', the more we will mimic the other and the more positive the consequences of being mimicked by that other will be. Future studies will be needed to test this idea and find evidence for connections between this 'different-from-me' mechanism and the brain mechanisms responsible for unconscious mimicry and its consequences.

Finally, regarding the consequences of being imitated, the first question that needs to be addressed is how our brain detects we are being imitated, even

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though we do not consciously realize it. Theoretically, the difference between being and not being imitated can be conceptualized as the presence or absence of compatible sensory and motor concepts. When we are imitated it means our sensory and motor activation resemble each other more compared to cases where we are not imitated. How the brain detects this and how that subsequently affects our prosocial orientation is still a mystery, although the suggested link between the neural bases of imitation and empathy (Preston & de Waal 2002; Decety & Jackson 2004) may be a starting point (also see Bastiaansen *et al.* 2009). Both (automatic) imitation and empathy seem to share at least for a large part the same neural mechanism. In addition, De Vignemont & Singer (2006) describe the contextual malleability of empathy, where our empathic response to others is modulated by, among others, individual characteristics and relational factors. Whereas an empathic response to a specific person is something else than a general assimilative mindset, the consequences of being imitated and empathy may show considerable overlap.

Before closing, however, the mere fact that unconscious mimicry is so pervasive and omnipresent in humans is in itself relevant to several chapters in this special issue. First of all, Ferrari *et al.* (2009) describe two possible mechanisms by which mirror neurons can influence behaviour; a 'direct' and 'indirect' way. According to these authors, direct imitation, of which unconscious mimicry seems to be an example, is only present early in human development. Coming with age, this direct translation of perception into action is less and mirror neurons influence behaviour less directly. However, this seems to be at odds with the review of studies on unconscious mimicry in this current chapter. One possible explanation is that unconscious mimicry occurs completely outside of awareness and when it does become conscious, people tend to stop or control it immediately. The type of imitation used by Ferrari *et al.* and the vast majority of studies on imitation in cognitive psychology and cognitive neuroscience is not unaware and is not tested in a truly ecological valid social context. In young children, this disliking of conscious imitation seems not to be apparent, although this needs more research.

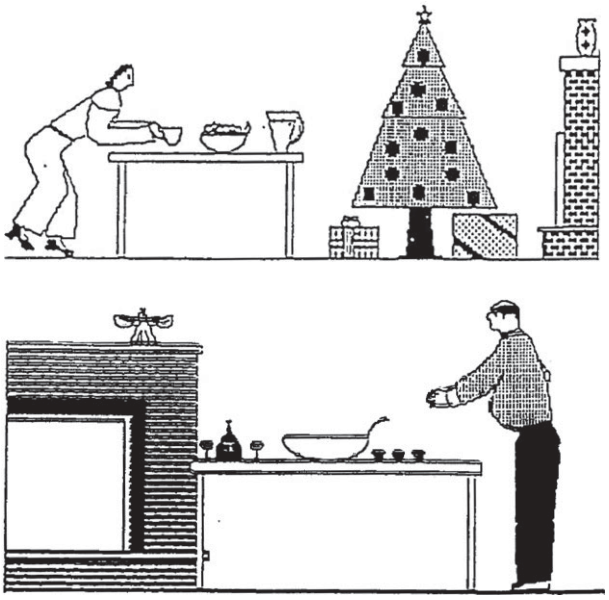
In addition, Whiten *et al.* (2009) theorize about the mechanisms that facilitate cumulative cultural learning in humans and chimpanzees and describe how automatic imitation plays a fundamental role in this process. Whereas chimpanzees are capable of imitation, they seem to use/apply it more conservatively, while human children (and adults) seem to be 'enthusiastic' imitators. Our chapter corroborates this view, at least from the human perspective in showing the omnipresence of mimicry.

A final point of concern is whether unconscious mimicry is a high level or low level automatic mechanism. In this chapter, we have repeatedly stressed its unconscious, and hence automatic nature. Conversely, we have presented moderators that seem to be more high-level, such as self-construal and liking. We think it will be a major challenge to explain how such seemingly high level psychological constructs interact with this low level motoric phenomenon. One speculative possibility is that we automatically imitate (or complement) and we need inhibitory control to stop this phenomenon (see Van Leeuwen *et al.* in press). The higher level moderators then may work as triggers for inhibition. Alternatively, high level moderators operate before the to-be-mimicked action is perceived and exert their moderating influence at the beginning of the process.

In sum, social processes play a crucial role in mimicry and most probably in most types of imitation. It is now the time to start to integrate this view in theories explaining the mechanisms of imitation. More emphasis on the ecological circumstances and context of imitation will undoubtedly inspire other disciplines and ultimately tell us more about the architecture of social interactions, of which imitation is a prime example. In the end, mimicry is a truly social phenomenon where multiple individuals are needed and influence each other. If we only focus on the micro-level or intra-individual aspects of mimicry, we may lose sight of the affective and emotional factors related to it, hence the title of this chapter: where is the love?

APPENDIX A

Dependent variable assimilation.



how similar are these two pictures?

(not at all)1 2 3 4 5 6 7 8 9(very much)

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