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Another Perspective on Mimicry: Investigating the Nature and Social Consequences of Mimicry Via the Third-Party Paradigm

A dissertation submitted in partial satisfaction of the requirements for the degree of Doctor of Philosophy

in

Psychology and Cognitive Science

by

Liam Kavanagh

Committee in charge:

Professor Piotr Winkielman, Chair
Professor David Barner
Professor Benjamin Bergen
Professor Patricia Churchland
Professor Vilayanur Ramachandran

2016

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University of California, San Diego

2016

EPIGRAPH

It is better to fail in originality than to succeed in imitation.

Herman Melville

Originality is nothing but judicious imitation. The most original writers borrowed one from one another.

Voltaire

All art is but imitation of nature.

Lucius Annaeus Seneca

Nature is commonplace. Imitation is more interesting.

Gertrude Stein

The human is indissolubly linked with imitation: a human being only becomes human at all by imitating other human beings.

Theodor Adorno

He who joyfully marches to music in rank and file has already earned my contempt. He has been given a large brain by mistake, since for him the spinal cord would fully suffice. This disgrace to civilization should be done away with at once.

Einstein

Through others we become ourselves.

Lev S. Vygotsky

Another cause of dullness is imitation. You are made to imitate by tradition. The weight of the past drives you to conform, toe the line, and through conformity the mind feels safe, secure; it establishes itself in a well-oiled groove so that it can run smoothly without disturbance, without a quiver of doubt. Watch the grown-up people about you and you will see that their minds do not want to be disturbed.

Jiddu Krishnamurti

Almost all absurdity of conduct arises from the imitation of those whom we cannot resemble.

Samuel Johnson

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ABSTRACT OF THE DISSERTATION

Another Perspective on Mimicry:

Investigating the Nature and Social Consequences of Mimicry Via the Third-Party Paradigm.

by

Liam Kavanagh

Doctor of Philosophy in Psychology and Cognitive Science

University of California, San Diego, 2016

Professor Piotr Winkielman, Chair

Mimicry has become a subject of great interest because of its ability to signal affiliation and rapport, unconscious nature, and seemingly strategic application. Studies of this phenomenon have focused on dyad members and inspired several explanations, but none has gained broad acceptance. This dissertation explores a neglected line of research, that of third parties' impressions of mimics, and uses the evidence gained to reflect on mimicry's true nature.

The first chapter challenges the common assumption that mimicry necessarily signals positive characteristics, such as prosociality or trustworthiness. Rather, when mimicry is directed towards condescending models, it can reduce third party onlookers' impressions of the mimic's competence.

The second chapter shows that observers do not take an act of mimicry as an indication of a general similarity between a mimic and his model, but make contextualized interpretations, dependent on the mimic's knowledge of his model's reputation and beliefs. Third party onlookers do, however, tend to conclude that a mimic shares his model's opinion -- but only when the mimic could have known this opinion. This leads to arguments in chapter four that the empirical facts relating to mimicry can be explained parsimoniously by assuming that mimicry emerges as part of an implicit learning process.

Before this, the third chapter investigates the basis of the complicated perceptions of mimicry shown in earlier chapters. Experiments here test the involvement of the mirror system in detecting rapport and mimicry, showing that nonverbal judgments are remarkably robust to both traditional cognitive load (counting backwards) and interference methods targeting the motor system. The latter methods are shown to place general demands on attention, so that interference with non-verbal judgments cannot be claimed to due to motoric demands, specifically.

INTRODUCTION

Motivation for the Current Work

The phenomenon of human mimicry, our seemingly simple-minded tendency to adopt the mannerisms, gestures, expressions and moods of others has been remarked on for centuries (Butcher, 1961; Smith-Watt, 2012), and studied intensively in the last few decades, but without the emergence of a strong consensus as to its underlying logic. This diversity of opinions may be partly due to the fact that we generally have little explicit insight into our tendencies towards mimicry. As the researchers have begun to defy nature by assembling explicit insights into this behavior, they have increasingly been surprised by its power and complexity (Chartrand & Lakin, 2013).

We mimic those that we like, and mimicry also makes others like us (Chartrand & Bargh, 1999). Evidence suggests some kind of logic behind mimicry as well. It is well known that we imitate outgroup members less than ingroup members, but distinctions do not stop there. We mimic some expressions more than others (Hess & Fischer, 2014), and also mimic others more when it is more important to us to gain their favor (Lakin & Chartrand, 2003).

A remarkably steady stream of research on mimicry has not often looked at the implications of mimicry beyond the dyad, or settled on an account for this phenomenon. This thesis presents experiments that investigate the breadth of mimicry's social importance, and at the same time, mimicry's fundamental nature, by studying perceptions of mimicry outside the dyad. Early experiments examining perceptions of mimicry beyond the dyad yielded evidence of mimicry's influence on interpersonal rapport (Bernieri, 1988; Grahe & Bernieri, 1999). This perspective has received little emphasis during the following wave of mimicry research, which has focused on perceptions within the dyad.

Given that non-verbal behavior powerfully effects perceivers' impressions on an array of judgments (e.g. Burgoon, Guerrero, & Floyd, 2010; Tsay, 2013) it might not be surprising if mimicry has subtle influence on social judgments made outside the dyad. Extant theories disagree on the nature of this influence, however. If third party impressions indeed reveal an "intuitive expertise" in interpreting mimicry, we can take advantage of third party judgments to gain insight into mimicry's elusive nature.

The first two chapters of this thesis test the implications of mimicry for social judgments. The primary focus here is on the ways that third party observers form impressions of the trustworthiness and competence of the mimic. Trustworthiness (warmth) and competence have been shown to be the main dimensions on which humans judge one another (Yzerbyt, & Kashima, 2005), and mimicry affects both in contextually dependent ways. The results obtained show that mimicry does not communicate strictly positive qualities, but can rather communicate incompetence in the wrong situation. Also, third party judgments show sophistication in interpreting mimicry – specifically, what the mimic knows and doesn't know about his model is shown to moderate social judgments in chapter two. Further results show that observers infer shared opinions from mimicry, despite not inferring similarity on the main dimensions of social judgment. This result indicates that mimicry may signal a consequential tendency to share feelings or "implicit information", foreshadowing arguments, made in chapter four, that mimicry might be more related to learning functions than is commonly appreciated.

The experiments of chapter three attempt to shed light on the perceptual mechanism underlying the complex, but implicit, judgments that observers make based on mimicry. Specifically, the research question here is whether experimental manipulations targeting

the “mirror system” will interfere with the processing of mimicry and non-verbal behavior, generally. Past studies have hinted at a role for the mirror system in understanding gesture (Ping, Bleilock, and Goldin-Meadow, 2013) and non-verbal behavior, generally (e.g. Zaki, Hennigan, Weber, & Ochsner, 2010.) The results of the current studies, while not inconsistent with this, also show that experimental manipulations introducing constant “motor load” can place significant demands on general attention. Experimental methods targeting embodied perception provide some intriguing evidence of interference effects, but must be refined further before they can be regarded as conclusively demonstrating the role of the mirror system.

As with any evidence, the data produced in these experiments cannot be interpreted in a vacuum. Instead, they are motivated by, and interpreted with reference to, existing theory and evidence on the nature of mimicry. Therefore, the next section will provide an economical introduction to the vast literature on mimicry and imitation. One key issue arising from this review of the literature is whether mimicry signals a generally prosocial disposition or an affiliative disposition towards specific others. Another issue is whether models and other observers of mimicry perceive the true importance of mimicry or are guided by an assumption of broad similarity between mimics and models. With the relevant facts introduced, the implications that follow from the assumption that mimicry and perceptions of mimicry are adaptive or “ecologically rational” will be discussed more fully, as these inform both the research strategy taken and the conclusions drawn from following empirical studies.

Background

The observation that humans have a pronounced tendency towards imitating each others' actions, mannerisms, and inner feelings that is both very useful, and difficult to understand, is far from new. Aristotle remarked that men by nature learn through imitation and placed a high value on this, viewing imitation as having a common root with metaphor and forming the basis of art (Butcher, 1961). Franz Gall included an imitation organ among the brain regions posited in his phrenological theories (Gall, 1835, p. 201), and Charles Darwin remarked on the endearing tendency of the native peoples of Tierra del Fuego, to imitate heavily in order to cross the language barrier (Darwin, 1863). Watt-Smith reports that what we would call mimicry was a great source of fascination in the Victorian era, with scientists studying the skull shapes of actors, and penitentiary inmates for signs of imitative ability, which was often seen as a talent, but one that might make manipulative criminals out of those blessed with it (Watt-Smith, 2014.) At the same time, others saw imitation as driven by a deep stupidity (ibid.)

Most of these issues have reoccurred over the last 30 years as science has held sustained interest in the human tendency to copy each other's postures, gestures and mannerisms, nowadays called "mimicry". Mimicry is simultaneously relevant to several contemporary fascinations, including the role of imitation in cultural learning (Tomasello, 1999), the nature of "unconscious" or "automatic" behaviors (Bargh & Chartrand, 1999), and empathy and prosociality, which are thought to be important for human group living (Preston & de Waal, 2002).

Mimicry: The Core Findings

The current wave of interest in mimicry began with the study of rapport in the 1980s and 90s (Bernieri, 1988; Grahe & Bernieri, 1999). Here, it was noticed that mimicry, along with synchrony, signaled rapport to viewers, reflecting dyads' own ratings (ibid). Building on these findings in an experimental setting, Chartrand and Bargh (1999), showed that when subjects were mimicked by a confederate, they reported a greater quality of interaction. Another experiment in this same article showed that subjects were unaware of their tendency to mimic a partner that had been paired with them in video rating task, demonstrating mimicry's automaticity. These findings were replicated and extended in a mock interview setting by Stel, Blascovisch, McCall and Vonk (2010). These investigators found that, compared to participant-interviewees who had not been mimicked by a confederate-interviewer, participants who were mimicked felt more empathized with and understood by the interviewer. They also felt greater empathy towards the interviewer. Further, being mimicked seems to lead to a better disposition towards others: generally, both adults (Van Baaren, 2004) and 18-month old children (Carpenter, Uebel & Tomasello, 2013) are more likely to help to pick up pencils after an experimenter has mimicked them.

Various experiments have also shown that mimicry levels are sensitive to the ingroup status of models. For example, subjects who write positive, as opposed to negative, written reports about their models show greater facial mimicry (Likowski, Muhlberger, Seibt, Pauli and Weyers, 2008), and subjects mimic favored politicians strongly (Bourgeois & Hess, 2008). Further, these findings cannot be explained as merely the result of attention paid to a target. For example, Lanzetta and Englis (1989) showed that subjects adopted opposite facial gestures when they saw a competitor frown or smile but produced congruent

expressions while viewing teammates. This anti-mimicry of competitors, which clearly requires perception of and attention towards the competitor, can happen as quickly as mimicry of teammates (Carr, Winkielman, & Oveis, 2014), showing that attitudes can moderate responses to gestures. These findings do not necessarily imply an "unbounded rationality" behind our mimicry actions, such that any act of mimicry is perfectly optimized for the situation (see discussion of rationality below). Instead, given repeated exposures to situational cues, humans may slowly adjust imitation levels in response to the rewards that are experienced while imitating in the presence of these cues (see, e.g., Heyes, 2011, for related arguments).

The tendency for mimicry to be produced in a manner that is consistent with strategic affiliation goals was first shown by Jessica Lakin and Tanya Chartrand (2003). These investigators tested the idea that a failure to affiliate with one person would spur subjects towards increased mimicry in a second interaction with another person. First, participants were either given an explicit affiliation goal, primed with affiliation related words, or primed with neutral words. Then, they took part in an online interview session. In this interview, participants asked an experimental confederate a series of scripted questions. The answers were either friendly or unfriendly, so that the participants' "affiliation goal" was either fulfilled or frustrated after this initial contact. Finally, participants had a live interaction with a second experimental confederate, who gave neutral answers to the confederate's questions. Among those participants who did not have an affiliation goal, the success of online interactions did not affect mimicry levels. However, when participants who had an affiliation goal "failed" in their first affiliation attempts, they mimicked the second interaction partner more.

Further, it seems that individuals increase their mimicry of a person when the attainment of good rapport with that person is desirable but difficult. For example, children imitate more intensely when they have been told to persuade a person to eat unappetizing-looking cookies, than when they must convince a person to "do something" with the cookies (Thelen, Miller, Fehrenbach, Frautschi, & Fishbein, 1980.) Thus, it seems that mimicry is also deployed in a way that selectively signals our desire to affiliate and to persuade.

Imitation as a General Learning Mechanism

Social psychological findings on mimicry should not be considered in isolation, as mimicry is clearly dependent on a rich capacity for imitation, which is employed in the service of more than just affiliation. Imitation is an important skill for humans, as our conspecifics are constantly inventing new skills and artifacts that we can take advantage of (Tomasello, 1999). Thus, learning how, and whom, to imitate is an important part of human socialization (ibid.) Adult humans' imitation of utilitarian actions is different than mimicry, however, in that it is often consciously engaged in with the knowledge that it is "imitation as such", informed by a particular goal. Mimicry may be useful in the internalization habits of the model such as accents and mannerisms (Chartrand & Van Baaren, 2009; Donald, 2005) as well as affiliation. A strain of the development literature that is especially relevant to mimicry, and more specifically to arguments put forward later on (see chapter 4), deals with children's learning by "over-imitation" – that is, the high-fidelity imitation of utilitarian actions, including those elements that are causally irrelevant to the goal of the action.

In the most famous example of over-imitation, Meltzoff (1988) showed 14 month old infants a video of a model pressing button with her head, thus turning on a light. After returning a week later, these infants tended to turn on the light using their heads. However, when this paradigm was modified so that 14-month-old infants saw a model that said she was cold and wrapped her arms up in a blanket, preventing her from pressing the button by hand, children tended to use their arms to press the button (Gergely, Bekkering & Kiraly, 2002.) It seems that, because the model could have, but did not, use their hand in the original (Meltzoff, 1988) experiment, children understood that there must be a good reason for the model's use of her head.

This shows that imitation has more logic than is supposed, even at a young age. Still, an infant with only formative models of the causal relations between events can sometimes be hard-pressed to understand what parts of a sequence of actions are necessary, and which are unnecessary, in order to achieve a particular goal. Thus, infants are thought to often over-imitate, so as to "have all their bases covered" when they are trying to make an end goal become reality (Gergely, Bekkering & Kiraly, 2002).

Though the idea that action understanding leads to more emulation and less imitation seems broadly consistent with the empirical results on emulation/imitation, some studies show imitation of irrelevant details of actions (Lyons, Young, & Keil, 2007). Over and Carpenter (2011), proposed that much of the ambiguity in this literature may be due to under-appreciation of the social functions of imitation. They theorize that slight differences in experimenter behavior and methodology can affect the tendency of children to affiliate with their model, and that this may change children's motivations from being mostly geared towards acquisition of a skill, towards affiliation with the experimenter. As detailed

in the next section, they propose that the proximate mechanism of affiliation is the appearance of outward similarity, echoing sentiments of other authors (see below.) This supposition, is important to note as it motivates several experiments later on in this thesis. This general line of evidence will be revisited later on, when the relationship between mimicry's status as an affiliation signal and its role in learning is reconsidered (see chapter 4.)

Extant Accounts of Mimicry

An early explanation of mimicry, proposed by Chartrand and Bargh (1999), is that mimicry results from simple ideomotor mechanisms, whereby perception of actions primes the production of similar actions. Though appealing in its simplicity, and consistent with high profile findings on social "priming" (e.g. Bargh & Chartrand, 1999) the proposal that mimicry is purely due to an ideomotor response became less credible as empirical results accumulated, showing anti-mimicry of outgroup members, strategic mimicry, and other situationally mediated results (e.g. Lakin & Chartrand, 2003; Bourgeois & Hess, 2008; Leighton & Heyes, 2010). A consensus has now emerged that attention is not the lone moderator of mimicry (see Hess & Fisher, 2014; Heyes, 2011 for reviews of the relevant evidence). As mentioned, people placed in competitive situations respond to the smiles of outgroup members with negative reactions (Lanzetta & Englis, 1989). This shows that imitation does not inevitably follow from attention. Further, "counter-imitative" responses in such situations can happen at the same time delay as mimicry (Carr, Winkielman, & Oveis, 2014), casting serious doubt on the idea that a simple ideomotor reaction is *all* that is at work.

Another appealing idea about mimicry, which is especially important in the context of questions about mimicry's perception by third parties, is that mimicry shows a shared state of mind and is therefore connected with the understanding of others. Variants of this position were held by early researchers of mimicry in the non-verbal behavior literature (Uzgiris, Benson, Kruper, & Vasek, 1989; Bavelas, et al., 1987). Similarly, many works in the facial mimicry literature have studied the idea that mimicry can help to understand emotional states (Stel and van Knippenberg, 2008; See Niedenthal, Mermillod, Maringer, & Hess, 2010, for a review). Some studies implicate measures of mimicry with trait empathy, as well (Sonnby-Borgstrom et al. 2003; Sonnby-Borgstrom, 2008), indicating that outward displays of mimicry might be indicative of a general prosocial disposition.

A far more sophisticated decision process is posited by Wang and Hamilton (2012), who believe that experimental results showing apparently strategic production of mimicry imply that we should see mimicry as "Machiavellian" in nature. These authors take it as a given, from empirical results, that mimicry achieves affiliation and state that mimicry is a response that is automatically engaged, but in a strategic manner so as maintain social standing.

Another family of explanations attribute mimicry's effects to an outward demonstration of alikeness. In the first such example, Lakin, Jefferis, Cheng & Chartrand (2003) concluded that mimicry was originally an evolved learning mechanism that later came to be a sort of "social glue" by demonstrating similarity to others. This view that mimicry achieves affiliation by acting as an outward demonstration of alikeness, was echoed in Meltzoff's (2007) explanation of his finding that mimicry by experimental confederates yields increased liking among children aged only 18 months. Similarly, Over

and Carpenter (2012) hold that mimicry gains the favor of others due to an innate heuristic disposition to like similar others, citing evidence that adults are more attracted to confederates whose surnames appear to resemble their own and whose experimental code numbers share digits with their own birthdays (Jones, Pelham, Carvalo, & Mirenberg, 2004).

This class of theories attempts to explain human behavior as the outcome of simple hardwired heuristics that generally result in adaptive behaviors. Though there is much appeal to this perspective, there are also problematic commitments, due to the assumption that alikeness is imputed via a simple heuristic. It is impossible to deny that imitation creates some similarities in appearance and will, over time, cause us to be more like our model (because this implies learning from them) but these theories go further by claiming that we *innately* equate physical alikeness with other forms of similarity, and that it has a basic heuristic value. Since the assumption that alikeness is inferred from mimicry is crucial to several accounts, the proposition is investigated in chapter 2. Though it is not necessary that third party observers will share the putative tendency, on the part of models, to assume similarity between mimic and model, it is also not clear why third party observation should follow fundamentally different rules than those governing the perception of mimicry within the dyad.

The Rationality of Production of, Responses to, and Perceptions of Mimicry

A reoccurring consideration in the design and interpretation of the following experiments is the extent to which mimicry, and perceptions of it, are "rational." To the degree that the human mind comes to conclusions that accurately reflect the state of the world (are rational) then mimicry should be rational (i.e. "functional", i.e. "adaptive") to

produce. Similarly, it should also be rational (i.e. “functional”, i.e. “adaptive”) to respond to mimicry by affiliating with the mimic. This latter consideration presents something of a problem for the above theories -- it is not clear that those who act like a model, especially for the purpose of courting favor, actually are like their model. For this reason, all of the major accounts have difficulty in explaining how mimicry can be rational for both mimics and models. That is, there is no obvious rationale behind affiliation with a Machiavellian mimic, or assuming similarity where there may be little.

Note, however that in appealing to notions of rationality, it is not implied that the perception, or the production, of mimicry is perfect or arrived at deliberatively. Rather, the sense of “rational” used here simply implies that an organism (in this case a human) learns to enact the best response of which it is capable (see Kacelnik, 2005, discussion of B-rationality). This sense of the word can be, and has been, used to describe the foraging behavior of birds (Schuck-Paim, & Kacelnik, 2002), and invertebrates (Najera, McCullough, & Jander, 2012). It has also been used to describe primate cognition by researchers who deny that any non-human primate has “had a theory” (Penn, Holyoak, & Povinelli, 2008.)

The Current Experiments as they Relate to Theory

If human perceptions of mimicry are generally well tuned to their environment, then third party observers’ impressions of mimicry should reflect the true nature of mimicry. For example, if mimicry does not reliably communicate trustworthiness to observers, then it should be questioned whether an act of mimicry really is a strong cue to pro-sociality. This proposition is investigated in chapter 1, where it is shown that mimicry of others can communicate incompetence while failing to communicate trustworthiness,

and again in Chapter 2 where is it is shown that it can also indicate either trustworthiness, or a lack of trustworthiness depending on the situation.

Also, if observers both show rationality, and do not seem to heuristically impute similarity to pairs of similarly behaving people, then we might question whether mimicry functions by signaling "alikeness". Thus, the results of chapter 2, in which mimicry often fails to transfer the models' traits to their mimics, and sometimes appears to yield movements in the *opposite* direction, argues against the idea that we impute a broad similarity to similarly behaving others. Rather, observers' interpretations of mimicry show sensitivity to explicit information about the mimic's motivation and beliefs, as well as environmental cues. These results suggest that observers may have a nuanced ability to infer what mimicry means in different contexts, rather than simply assuming similarity.

The lone situation in which observers are demonstrated to assume similarity between a mimic and his model occurs when observers are asked about the opinions of a mimic towards a stimulus that he jointly views with his model. In this situation, also covered in chapter 2, participants assume that mimics have similar opinions, while anti-mimics are assumed to have conflicting opinions. On the basis of the accumulated evidence (combined with results from the literature,) it is argued that extant accounts of mimicry likely need revision.

The complex interplay between implicit and explicit factors in the first two chapters leads naturally to questions about the mechanism of mimicry perception. Some evidence points to a possible role for the mirror system, which is engaged automatically in response to bodily motion, in perceiving non-verbal behavior generally (Zaki, et al., 2010, Di Cesare et al., 2015) and this may extend to mimicry. If so, then the mirror and mentalizing systems

may work together to produce social judgments of mimics. Chapter three presents a series of experiments designed to test whether the mirror system is involved in mimicry perception. Though strong conclusions are not arrived at, the methodologies used do show some promise for investigating embodied social perception.

Finally, the nature of mimicry is revisited. Here, it is argued that spontaneous mimicry arises a corollary of the human need to learn and perform appropriate implicit actions, including emotional responses. It is argued that this basic learning function not only implies that mimicry should be confined to ingroup members, but that there will be costs associated with mimicking outgroup members. This is because mimicry involves the internalization of habits and, likely, implicit attitudes. It is argued that "catching" these from the outgroup will be maladaptive, and so mimicry of the outgroup is inadvisable. This in turn explains the tendency of models to respond positively to mimicry, and why mimicry works better when it is low-fidelity. It is also argued that mimicry's selective and apparently strategic use is consistent with this view. Finally, the findings from the first two chapters are briefly revisited, seen through the new account of mimicry.

A Final Note: In What Way is Mimicry "Unconscious"?

Part of what makes the above findings so fascinating to the research community is their implicit or "unconscious" nature. It is worth discussing briefly, before proceeding, what is implied by these terms. What can be said clearly is that mimics do not typically see their imitative actions as mimicry "as such". Likewise, persons who view mimicry usually do not explicitly notice these shared behaviors "as such", this is true whether mimicry is directed at us, or at someone else.

This lack of "naturally occurring" explicit rational knowledge of our actions is not particularly unusual, as far as non-verbal behavior is concerned. Many of our behaviors are not explicitly understood (Burgoon, Guerrero, & Floyd, 2010) and, importantly, this is often the case for emotional contagion. People do not typically perceive that they are happy "because others are happy" or that their own yawn is due to another person's yawn (Preston & de Waal, 2002). In fact, empathy is usually distinguished from emotional contagion by saying that empathy only occurs when we have explicit awareness of the fact that our feelings are similar to those of others (ibid; de Waal, 2008). This does not mean that we are unaware of the actual acts that, together, constitute a case of "contagion", but rather we lack an explicit awareness or "meta-awareness" (see Winkielman & Schooler, 2011, for lucid discussion of related points) of the causal relationship between one act and the other. In the same way, we can be aware of all the separate actions that make up an act of mimicry, but without a concept that is anything like the academic concept of mimicry being used to represent relations between those actions explicitly.

So, in the following experiments, one should not assume that actions themselves are not noticed. One also cannot assume that there is no consciously available correlate of mimicry. Subjects in the following experiments consistently report "feelings about" the people they view, and know that these have something to do with "body language". However, they very seldom explicitly report awareness of imitation, copying, or mimicry.

CHAPTER 1

When it's an Error to Mirror

Abstract

This chapter, originally published as a short report in Psychological Science, and supplemented here with expanded discussion, investigates whether the consequences of mimicry are necessarily positive. Participants see two targets who are being interviewed, ostensibly with the possibility of being participants' future partner in an economic game. The attitude of the interviewer is manipulated across conditions so that he is sometimes condescending, and sometimes cordial. Results show that interviewees who mimic a condescending interviewer is seen as less competent, likely because he has displayed a lack of social judgment. Experiment 2 shows that these effects are nullified when the interviewer is cropped out of the video. Experiment 3 conceptually replicates Experiment 1, but uses a cover story to manipulate the desirability of affiliating with a cold model. When the cold model is presented as socially desirable, the reputational consequences of mimicking him show a tendency towards reduction.

Introduction

Mimicry can facilitate affiliation and group cohesion (Kashima, 2008; Kitayama & Cohen, 2007; Preston & de Waal, 2002). However, the literature suggests several accounts of mimicry, and many possibilities that it might communicate, especially to those who observe it. Like children learning skills (Gergely & Csibra, 2005), people who are executing implicit, affiliative imitation in some way "select" appropriate models, but perhaps in a manner consistent with the strategic need to maintain social connections (Lakin & Chartrand, 2003) and keep in touch with a culture.

This first set of experiments seeks to expand our knowledge of what mimicry can tell onlookers, and specifically whether what is communicated *outside* the dyad is fundamentally alike what has been documented about mimicry's affects *inside* the dyad. It is possible to imagine that, like models (i.e. the person who is mimicked) third-party onlookers will like or trust mimics more than non-mimics. Mimicry has been shown to be correlated with trait measures of empathy (Sonnby-Borgstrom et al. 2003) and therefore might be seen as a sign of a prosocial disposition and trustworthiness. Further, mimicry is also thought to depend on the same capacities as empathy, which plays an important role in human sociality (Preston & de Waal, 2002.) Thus, a display of mimicry may be seen as a display of a tendency towards prosociality. Further, being mimicked seems to give us general feelings of prosociality, such that people who have been mimicked are more likely to be helpful -- even to persons outside the dyad (Carpenter, Uebel & Tomasello, 2008). On the other hand, it may be difficult to infer general dispositions from an act of mimicry. Another possibility is that mimicry is mediated by motivation and judgment, and thus

reflects a mimic's *desire for a relationship with a particular person* – e.g. as information about how a mimic "picks his friends".

Beyond theoretical inferences about the nature of mimicry, the third party perspective allows us to investigate the degree to which we can use affiliation signals, even when they are not directed towards us, to navigate the social world. Real-world social behavior often occurs in the presence of other individuals, beyond the dyad. In that sense, mimicry is socially situated (Semin & Cacioppo, 2008). These observers can potentially use mimicry to form judgments about the dyad members, which will influence their future interactions.

With these considerations in mind, the experiments described in this chapter asked whether mimicry influences trait evaluations made by third-party observers. Critically, it was predicted that observers would be sensitive to the appropriateness of individuals' mimicry. It was reasoned was that, just as a competent learner will select the appropriate individuals and actions to imitate, a competent interaction participant will discriminate, often without conscious deliberation, between situations in which it is appropriate to mimic and those in which mimicry is disadvantageous. Conversely, an incompetent individual may be indiscriminate or injudicious in his or her mimicry. An individual's selection of whom to mimic therefore has the potential to serve as a valuable source of information about that individual's characteristics. In particular, observers could judge people as less competent if they mimic the wrong individual than if they do not mimic that individual. As a result, mimicry may have reputational costs that, at times, makes the choice not to mimic one's interaction partner a superior social strategy, at least in the eyes of third-party observers.

To examine this possibility, we had subjects observe interactions in which individuals either did or did not mimic cordial or unfriendly models. We predicted that even without explicit awareness of mimicry, third-party observers would evaluate individuals who mimicked an unfriendly model as less competent than individuals who mimicked a cordial model. More importantly, we predicted the counterintuitive effect that mimicry would actually be costly—specifically, that people who mimicked an unfriendly model would be viewed as less competent than those who did not mimic that model.

Experiment 1

Participants were 83 University of California, San Diego (UCSD), undergraduates (60% females, 40% males; predominantly college juniors). Each subject evaluated two interviewees (always played by the same two confederates) in videotaped interviews (Fig. 1, left panel). A given subject saw the same interviewer (also a confederate) in both videos, but the attitude of the interviewer changed between subjects. One group saw two videos featuring a cordial interviewer, and another group saw two videos featuring a condescending interviewer (these impressions were confirmed by pilot testing). Within subjects, the two interviewees differed in whether they mimicked the interviewer's mannerisms: One interviewee subtly but persistently mimicked arm mannerisms and leg-crossing behaviors, and the other did not (confederates playing the interviewee were counterbalanced across mimicry conditions).

Interviewees were simply asked a series of questions about their likes and dislikes, where they lived, and were from originally, and so on. Confederates, who were blind to the hypothesis, were told to answer honestly so as to allow them to concentrate on making their mimicry as naturalistic as possible, and questions were selected so that both confederates

could give honest, but innocuous, answers. This was important so that observers' impressions would not be strongly driven by answers to interview questions. Several takes were recorded of each interaction and the most natural-seeming were selected as stimuli.

Subjects rated the interviewees on the major dimensions of social judgment related to competence and warmth (Judd, James-Hawkins, Yzerbyt, & Kashima, 2005; Wojciszke, 2005). Specifically, using Likert-type scales ranging from 1 through 9, participants rated the interviewees' competence (no particular aspect of competence was specified), as well as their trustworthiness and likeability. To ensure careful evaluation of the videos, we told subjects that the interviewees might later be their partners in an economic game. Post-experimental debriefing revealed no awareness of the mimicry (Bargh & Chartrand, 1999).

Analysis and Results

We found the predicted two-way interaction of mimicry and model's attitude for the competence dimension only, [$F(1, 81) = 4.91$, $p < .05$]. This interaction was interpreted using simple-effects analyses. In the cordial-model condition, mimics were rated as non-significantly more competent than non-mimics [(7.05 vs. 6.91), $t(42) < 1$]. Critically, in the condescending-model condition, mimics were rated as less competent than non-mimics [($M = 6.00$ vs. 6.75), $t(39) = 2.36$, $p < .05$]. In addition, simple-effects analyses revealed that mimics were rated as significantly less competent in the condescending-model condition (M=6.00) than in the cordial-model condition [$M = 7.05$; difference of –1.05 rating points, $t(81) = 3.03$, $p < .01$]. For non-mimics, the difference in the competence ratings between the condescending-model condition (M=6.75) and the cordial-model condition (M=6.91) was non-significant [difference of –0.16, $t(81) = 0.44$]. Figure 1.1 (right panel) illustrates this result by showing differences in average competence rating

between the condescending-model and cordial-model conditions as a function of mimicry. As is evident in the figure, the mimic, but not the non-mimic, incurred interpersonal costs in the form of a lowered competence rating when interacting with a condescending, rather than cordial, interviewer.

Experiment 2

In a follow-up study, a modified version of experiment 1 was conducted to ensure that the observed reputational costs were due to the actual mimicry of an inappropriate model, rather than the display of incompetent mannerisms such as nervousness, or other artifacts. Therefore, we repeated the experiment, but prevented the detection of mimicry by cropping the interviewer out of the videos (Fig. 1, left panel), but retaining the complete sound tracks.

Participants were 147 UCSD undergraduates (75% females, 25% males; predominantly college juniors). As expected, interviewees who mimicked the interviewer received similar competence ratings in the condescending- and cordial-model conditions (6.47 vs. 6.38, respectively); the difference of 0.09 ratings points was non-significant. Similarly, non-mimicking interviewees received similar competence ratings in the condescending- and cordial-model conditions (7.14 vs. 7.33); the difference of –0.19 ratings points in this case was also non-significant. There was no interaction between model's attitude and mimicry, $F(1, 145) = 0.69$, $p = .41$. Difference scores (condescending-model condition minus cordial-model condition; see Fig. 1, right panel) illustrate that there were no costs of interacting with a condescending interviewer when mimicry was not visible. Notably, an analysis combining Experiments 1 and 2 yielded a three-way

interaction among mimicry, model's attitude, and model's visibility, $F(1, 226) = 4.55$, $p < .05$.

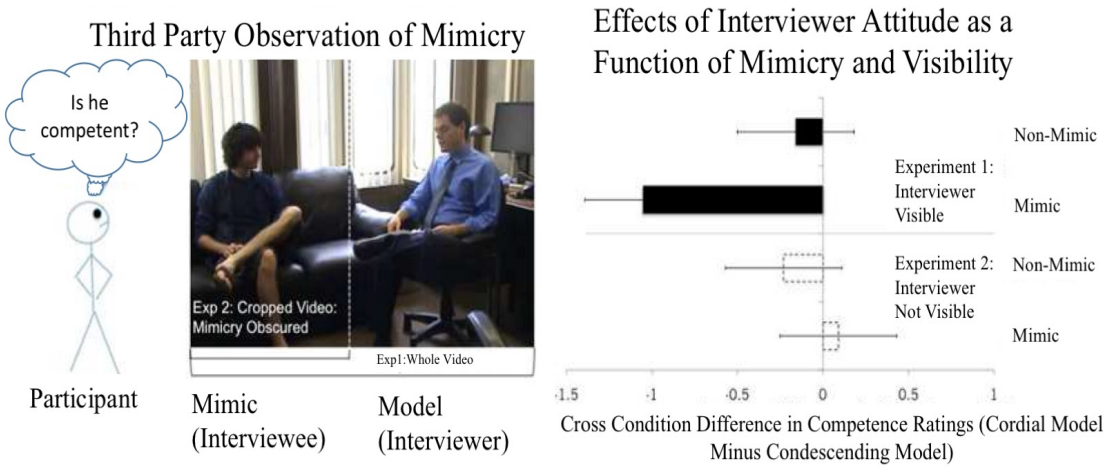


Figure 1.1: Schematic and Results for Experiments 1 (Whole Video) and 2 (Cropped Video)

Experiment 3

If mimicry of an unfriendly model signals a lack of competence, this effect could be eliminated when the observer receives favorable information about the model. This information might help to "explain away" their decision to mimic others. To test this prediction, we showed participants new videos portraying an interviewer who was merely cold and abrupt, rather than outwardly rude (impressions were confirmed by pilot testing). In one video, the interviewer conversed with a mimicking interviewee, and in the other, he conversed with a non-mimicking interviewee. Prior to observing the videos, some participants read positive information about the interviewer—that he was engaged in humanitarian work. Among 103 participants (73% females, 27% males; predominantly college juniors) who were not given this information, the finding from Experiment 1 was replicated: The mimicking interviewee was rated as less competent than the non-mimic, $t(102) = 2.40$, $p < .05$. However, this difference disappeared among the 56 participants

(66% females, 34% males) who first read about the interviewer's humanitarian work ($t < 1$). Thus, as in Experiment 1, third-party judgments about the mimic were a function not only of mimicry per se, but also of perceptions of the model. Experiments in the next chapter follow up on these suggestive results, making further use of cover stories as a means of manipulating models' reputations.

General Discussion

These results indicate that third-party observers can make judgments about individuals' competence on the basis of their decisions concerning whether and whom to mimic, and that mimicry is not taken as a signal of prosociality per se. Contrary to the notion that mimicry is uniformly beneficial to the mimic, people who mimicked an unfriendly model were rated as less competent than non-mimics. Thus, observers' subjective impressions of a person are indeed influenced by that person's mimicry, but not necessarily by their mere ability or propensity to mimic. Rather, observers' impressions seem, in this situation, most influenced by a mimic's choice of "model". In the case of experiment 1, it was concluded that the mimic showed a lack of ability to see that his affiliation was not wanted and/or a lack of ability to overcome his model's negative attitude, and thus was seen as less competent.

Given the strength of evidence that mimicry and empathy are related (see Preston & DeWaal, 2002), and given that strong arguments exist in favor of the importance of empathic behaviors in human sociality (ibid), it is worth discussing briefly how the current results, showing that mimicry does not necessarily communicate trustworthiness, can be squared with evolutionary history. This seeming contradiction may be resolved by

observing that, however important or rare an ability to mirror may have been in humanity's distant past, it is very common now.

The vast majority of humans mimic some people, some of the time (Chartrand & van Baaren, 2009.) Thus, given that one person is not mimicking a potential model, it is more reasonable to infer that they lack a positive attitude towards that person, specifically, than it is to infer that they have no tendency towards mimicry, generally. Though these results show that a single act of mimicry is not particularly indicative (at least to observers) of a trustworthy disposition today, it still may have been important as a signal for the *ability* to empathize with another human in the distant evolutionary past (see Churchland, 2011). Regardless of whether imitation and mimicry arise (as Heyes, 2011, argues) via the shaping of domain general resources into an imitation faculty by processes of cultural evolution, or our imitative tendencies result from specific genetic endowments, these behaviors were likely rare, at some point in human history. Thus, the mere ability to mimic *may* have carried information about the ability for prosocial relations. This could, even, have helped those individuals well-equipped for prosociality to identify one another, as is thought to be necessary for the propagation of prosocial dispositions (e.g. Nesse, 2010.) Results in the present studies suggest that today, however, a single instance of mimicry is more likely to signal a disposition towards a particular individual or group than a general knack for, or tendency towards sociality.

It appears, given the current results, and those of following chapters, that perception of mimicry is flexible enough to capture its ecological implications. This apparent sensitivity to ecological realities gives hope that third parties' impressions of mimics can be useful as a source of information about the nature of mimicry. However, it is possible

that the impressions of participants were driven by a simple heuristic: the imputation of similarity between the mimic and the model, based on their perceptual similarity. That is, just as several theories (see introduction) assume that mimics gain their model's allegiance by communicating similarity to the model, observers might believe that similarly behaving people are similar. Thus, the negative nature of the model may have "rubbed off" on the model producing negative impressions of the mimic in experiment one, and in experiment two, the lack of perceptual similarity may have prevented this rub-off effect. In experiment three, information about the positive nature of the model may have simply improved participants' impressions of him, thereby affecting the associations of the mimic. Experiments in the next chapter seek to discriminate between this interpretation, and the supposition that third parties make more "rational" inferences about the mimic's competence.

Whether mimicry *can* signal trustworthiness, in the right situation, is also an open question. It would be hasty to conclude that in no situation would an act of mimicry arouse the feeling, among third-party observers, that the mimic is trustworthy. As was hinted at in experiment three, and as will be seen in the next chapter, mimicry is subject to subtle, and often quite rational, interpretations.

Chapter 1 is, in part, an edited reprint of previously published material as it appears in Psychological Science. Kavanagh, Liam; Suhler, Christopher; Churchland, Patricia; Winkielman, Piotr (2011.) When it's an Error to Mirror: The Surprising Reputational Costs of Mimicry. Psychological Science, 22(10), 1274-76. The dissertation author was the primary investigator and author of this material.

CHAPTER 2

"Like Her??" – Inferences of Similarity from Mimicry Are Nuanced and Rational, Rather than Heuristic

Abstract

This chapter asks: "just how sophisticated (and how rational) are observer's inferences from mimicry?" In all experiments, participants observed a dyadic interaction in which targets mimicked or did not mimic a model. In experiment 1, prior to observation, the model's honesty was earlier defamed, or praised, in front of some, but not other, targets. Observers always knew the model's reputation, and which targets were aware of the model's reputation. Results show that observers do not simply associate the mimic's trustworthiness with that of his model, but actually see targets who *unknowingly* mimic untrustworthy models as more trustworthy. In experiment 2, potential models express opinions that reflect negatively on one of the two targets and his ingroup. Participants are privy to this opinion and also know whether interaction partners are aware of the opinion. Results suggest that targets who knowingly mimic a person who has expressed opinions unfavorable towards them, and their ingroup, are seen as less trustworthy than "unoffended" mimics. Experiment 3 shows that mimicry is interpreted as a signal of convergent opinions about a shared percept, but that similar postures that cannot be *contingent* on one another do not signal the same. Implications for accounts of mimicry are discussed.

Introduction

The results of the previous chapter showed that mimicry has the potential to negatively affect the social judgments that third-party observers (i.e. participants) make about dyad members. When the interviewer was rude to the interviewee, mimicking interviewees were rated as significantly less competent than were non-mimicking interviewees. Thus, when done in the wrong context, mimicry can negatively affect observers' judgments the mimic, rather than elicit the positive impressions that most research has found. But these results leave open two important questions, which are addressed in the present set of studies. Firstly, the previous experiments hinted at the subtlety of the judgments observers draw from mimicry, but it is unclear just how complex, and how rational (functional), judgments from mimicry are. Secondly, the only judgment dimension that was significantly affected was competence. The following experiments attempt to affect other dimensions of judgment, and to further examine the complexity of judgments made on the basis of observed mimicry.

How Complex Are Inferences from Mimicry?

The above-discussed judgments by observers can be seen as relatively "sophisticated", as they took the attitude of the model (interviewer) towards the mimic (interviewee) into account. Observers clearly did not attach a simple heuristic value, positive or negative, to the act of mimicry; rather, social inferences from mimicry were influenced by situational factors, in this case the characteristics of the person being mimicked.

This seems to show that information gleaned from mimicry is integrated with broader social information in a subtle manner. However, an alternative interpretation of

these findings is that gestural mimicry simply enhances the perceived similarity between the interacting parties. As a result, negative attributes of the model (e.g., rudeness or cordiality) "rubbed off" on the mimic but not on the non-mimic.

This can be explained as a relatively simple associationist inference that a target person who behaves like the model probably is like the model (Andersen, Moskowitz, Blair & Nosek, 2007), an effect that is highly consistent with the assumption, crucial to several prominent accounts of mimicry's logic, that mimicry is a means of enhancing perceived similarity (Lakin, Jefferis, Cheng, & Chartrand, 2003; Meltzoff, 2007; Over & Carpenter, 2012.) Thus, testing whether mimicry does in fact enhance perceived similarity to third party observers is of great theoretical interest.

In contrast to the "simple similarity" view just described, much research argues that mimicry itself is a complex, and even intelligent, process. Mimicry generation (despite its unconscious origins) depends on the context and social relationship between the mimic and the model. People reduce their mimicry or even engage in anti-mimicry when interacting with a partner who is disliked, represents an out-group, or has different goals (Bourgeois & Hess, 2008; Likowski, Muehlberger, Seibt, Pauli, & Weyers, 2008; McIntosh, 2006; Stel et al., 2010). It would thus seem maladaptive for perceivers to interpret mimicry in a context-free manner. For these reasons, it was hypothesized that inferences from mimicry would largely adaptive or "rational".

What Sorts of Judgments Can Mimicry Influence?

It is also interesting and important to understand whether third-party observers' perceptions of traits other than competence can be influenced by mimicry. Competence is one of the two main dimensions of social judgment (Judd et al., 1995). The other

dimension is trust, which is critical to group cohesion, relationships, and most social transactions. Indeed, mimicry is posited to be part of the process of developing empathy and interpersonal trust (Bavelas et al., 1987), and has been called "social glue" (Lakin & Chartrand, 2003). Thus, the connection between mimicry and trust is of obvious interest.

The link between mimicry and trust is particularly important in situations where an observer watches an interaction involving a person with a persuasive agenda. This person may use (or abuse) mimicry to gain trust of the interaction partners – a technique effective in adults (Maddux, Mullen, & Galinsky, 2008) and also employed by humans at a young age (Over, Carpenter, Spear, & Gattis, 2013). In short, it is important, and also novel, to explore how mimicry influences third-party inferences on trust.

Finally, it is also worth investigating mimicry's effects on inferences beyond these main dimensions of social judgment. One particular variable of interest is the attitudes of mimics. Evidence indicates that mimicry is modulated by similar factors as emotional contagion. This being the case, it might be thought that observed mimicry is taken by third-party observers as an indication that feelings are shared between individuals, resulting in converging opinions. If this is true, it might indicate that mimicry is, in fact, a relatively consequential social signal rather than an attempt to exploit a heuristic of similarity.

Experiment 1

The goals of the present experiment were twofold. First, it examined whether third-party judgments about mimicry result from a simple assumption of trait similarity between similarly behaving individuals (i.e., the transference or "rub off" effect described above), or whether they instead reflect more nuanced social inferences. In particular, this work tested whether observers' inferences about the target's trustworthiness were influenced by

not only the presence or absence of mimicry between the target and the model, *and* the model's past trust-relevant behavior, but also, critically, the target's epistemic state with regard to the model's past behavior. If the effects of mimicry on social judgments are indeed nuanced, observers should be sensitive to whether the mimic knows about the model's reputation-related behavior. This is not unlike sensitivity that observers, even relatively young children, show to the epistemic state of an actor in "theory-of-mind" tests (Premack & Premack, 1995).

A second goal of the present work was to show that mimicry can influence third-party observers' impressions of the trustworthiness of dyad members. It did this by directly influencing participants' impressions of the trustworthiness of one of the dyad members (the interviewer), and then testing whether mimicry (and the mimic's epistemic state) moderated the extent to which this reputation carried over to the other member (the interviewee).

The current paradigm was based on earlier work, described in the previous chapter, on third-party observation and judgment of mimicry (Kavanagh et al. 2011), but with some important changes. Participants again observed interviews and made social judgments about interviewees. Interviewees either mimicked or did not mimic their interviewer (model). Additionally, in the current study, participants also had to play an economic "trust" game (Berg, Dickhaut, & McCabe, 1995) with interviewees.

Critically, in the current study, the interviewer exhibited the same neutral behavior in all videos – that is, she was not directly cordial or directly rude to the target, as in chapter one. Rather, subjects' perceptions of the interviewer were manipulated by an experimental

confederate (also posing as a subject) who relayed a story. The interviewer was depicted as trustworthy to half of subjects, and as untrustworthy to the other half.

Participants' understanding of whether they and the interviewees had common knowledge of the interviewer was also manipulated. This was done by having some of the interviewees be present as "subjects" in the waiting room, along with the actual participant. There, both the participants, and the confederates, also heard either the praising or defamatory story about the interviewer. Other interviewees were not among the subjects in the waiting room. Thus, the observers knew that some interviewees, having heard the story, were aware of the interviewer's high/low trustworthiness, but that other interviewees, having not heard the story, were not aware of the interviewer's high/low trustworthiness.

This step was motivated by the moral psychology literature, as well as philosophical and legal perspectives on responsibility more broadly, which suggest that observers take into account an agent's mental states (e.g., intent, deliberation, knowledge) when determining culpability for right/wrong actions (Suhler & Churchland, 2009). Importantly for the current study, it seems that such considerations are relatively automatic (Young & Saxe, 2009).

The current paradigm allows for a test of the level of nuance seen in impressions of mimicry. If mimicry (similar movements) simply leads dyad members to be seen as similar, then observers should judge interviewees that mimic the trustworthy interviewer more favorably than interviewees mimicking the untrustworthy interviewer, regardless of the interviewee's state of knowledge about the interviewer's trustworthiness or

untrustworthiness. However, it was assumed that observers make more nuanced sets of predictions in the context of trust-related situations.

The most straightforward prediction is that mimicking a trustworthy interviewer should benefit interviewees who are personally knowledgeable about his or her trustworthiness. This prediction should be offered with the caveat that work within the dyad has shown that some level of mimicry is expected in a normal face-to-face interaction (Dalton, Chartrand, & Finkel, 2010) and so it may be that very strong mimicry would be required in order to "make a positive impression" on the viewer.

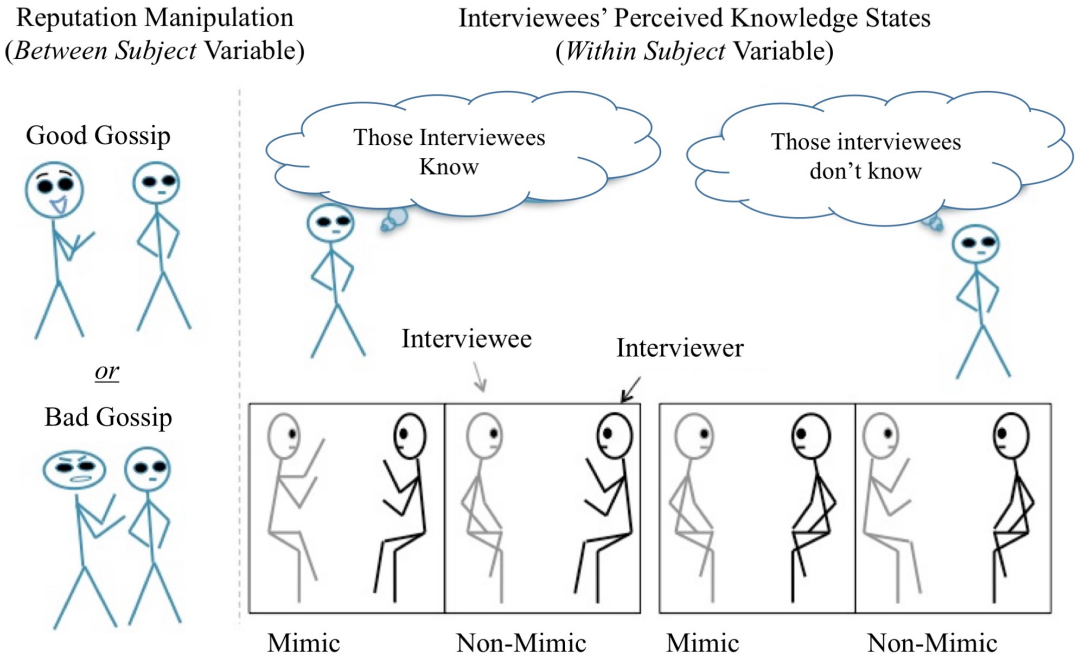


Figure 2.1: Experimental Conditions for Experiment 1

The second and perhaps more interesting prediction is that mimicking an untrustworthy interviewer may benefit interviewees who are *not* knowledgeable about his or her misdeeds. After all, for the observer, when an "innocent" mimics an undesirable

individual (i.e., shows affiliative behavior toward an undeserving party), the mimic might be seen as a particularly trusting (or naïve) and prosocial individual in contrast to his model. The combination of these factors should result in a three-way interaction between mimicry (present/absent), trustworthiness (positive/negative), and knowledge (present/absent).

Participants and Procedure

123 UCSD undergraduates participated for class credit. Upon arrival in the lab, subjects were greeted by the experimenter, who consulted a list and then told them that they would be in the rater condition and placed in a waiting room marked "rater condition." Another waiting room, clearly visible, was marked "interviewee condition" (this language was chosen to minimize ingroup effects by emphasizing situational assignment to the interviewee role). Several minutes before the supposed experimental start time, the confederate (henceforth "the gossip") who would be used to manipulate opinions about the trustworthiness of the interviewer was brought to the waiting room posing as another subject. Two other confederate "subjects" (confederate interviewees), who would eventually be transferred to the interviewee condition, entered the room one at a time right around the experimental start time. This made their entrance (i) noticeable by subjects and (ii) minimized their chances of being engaged in conversation by subjects. After the last confederate arrived, the experimenter then fetched another confederate ("the interviewer"), introduced her to the subjects, and while the interviewer stood on, told the subjects (accurately) that they would see four interviews and then would play an economic game with the interviewees which the trustworthiness of one's partner would be crucial to success. Subjects were also (deceptively) told that interviews would take place live in the interview room and that the video would be broadcast to computer screens in the rating

rooms via the local intranet. After all these instructions, the experimenter left to take the interviewer to the interview room.

While the interviewer was gone, “the gossip” loudly told a story meant to either erode or build the participants’ trust in the interviewer. In the praise condition the gossip recounted that the interviewer had driven to his home to return a lost wallet intact. In the defamation condition, participants were told that the interviewer was a friends’ roommate who avoided paying all bills, repaying loans and shunned any communication.

After sufficient time, the interviewer returned and said that the experiment was ready to start but that two “subjects” currently in the rater condition would need to be transferred to the interviewee condition because participants assigned to the condition had failed to show up. The confederate interviewees were chosen for transfer and taken to the interview room, while subjects and the gossip were escorted to small rooms equipped with a computer.

The computer portion of the experiment (see Figure 2.1, right panel) consisted of viewing and responding to 4 video interviews, each showing a different interviewee, all of whom were paired with the confederate interviewer. At the start of the computer portion, participants also viewed a detailed explanation of the Trust Game (see below). To back up the experimenter’s cover story that the videos were in fact live, a screen of variable duration saying simply “waiting for live feed” in slowly flashing text was added to each video. Each subject now saw two interviewees (knowledgeable interviewees) who had heard the same story that they did, and two that did not (non-knowledgeable interviewees). Within each of these knowledge conditions, videos were arranged so that one member mimicked the interviewer and one did not. Mimicry was implemented as is standard in the literature,

with neutral gestures (e.g., chin rubbing and leg-crossing) and no other differences between verbal or meaningful nonverbal content.

Participants provided Likert scale (7-point) ratings for each interviewee on trustworthiness. As a behavioral measure, subjects also indicated how much money (from $0 to 10) they would entrust with the target in the investor game (Berg et al., 1995). In this game, the participant is endowed with $10 and can transfer some amount of this endowment to the target. This money is then tripled, and a partner could (if scrupulous) then return some money back to the participant. Participants also rated targets on control dimensions of competence, likability, and friendliness. Finally, as a manipulation check, participants also rated the interviewer herself on the same measures. Post-experimental funneled debriefing was also performed to check for conscious awareness of mimicry, belief that videos were live, and skepticism towards the waiting room manipulation (gossip).

Manipulation-Checks

Analysis of debriefing questionnaires revealed that 20 participants were suspicious of the waiting room manipulation. A further 6 participants were excluded because they personally knew one of the confederates, and 1 participant was excluded because they noticed mimicry. The final sample thus consisted of 96 participants (59 females and 37 males) who were, on average, 20.23 years old (*SD*=1.58).

We tested how participants perceived the interviewer as a function of the reputational manipulation (praise/defamation) and as a function of interacting with a mimicking or non-mimicking interviewee. Across all dependent measures, a 2 x 2 MANOVA revealed only a main effect of reputation, with no ME or interactions with

mimicry on any measures. Specifically, in the Trust Game probe, participants were willing to give the interviewer more money in the praise condition [*M=4.8 vs.* 3.17, $F(1,94)=10.30$, $p=.002$]. They also rated the interviewer as more trustworthy [M = 5.05 vs. 3.67, $F(1,94)=21.5$, $p<.001$]. In the praise condition, the interviewer was also rated as significantly more likeable ($F=15$), competent ($F=5.1$), and marginally more friendly ($F=3.8$), (all $p's < .05$). However, of the 4 ratings, the trust rating was particularly strongly influenced, as reflected in the 2-way interaction of reputation by rating type, [$F(3,94) = 5.9$, $p=.01$]. In short, our manipulation was very successful in changing the perception of the interviewer (model), with the effects particularly pronounced on the trust-related dimensions.

Results

As described above, the "alikeness" hypothesis of mimicry predicts similarity in personality scores between mimics and models regardless of position. On the other hand, a more "situated interpretation" hypothesis predicts that evaluations made by third-party observers should vary as a function of the reputation of the model, presence or absence of mimicry by the target (interviewee), and the observer's knowledge about whether the target is aware of the reputation of the model (interviewer). The central prediction relating to this experiment was that if any rub-off effect occurred, it would occur when mimics knew about their model's poor reputation. This should lead to the inferences that are more than simply a function of the goodness/badness of the model, as predicted by a rub-off account.

Because the reputational manipulation (praising vs. defamatory story) targeted the model's trustworthiness, the trustworthiness ratings, and monetary investment were chosen as the critical DVs. We analyzed these variables as a function of reputation

(praise/defamation), knowledge (informed/ignorant), and mimicry (presence/absence), using a 3-way, mixed-models MANOVA.

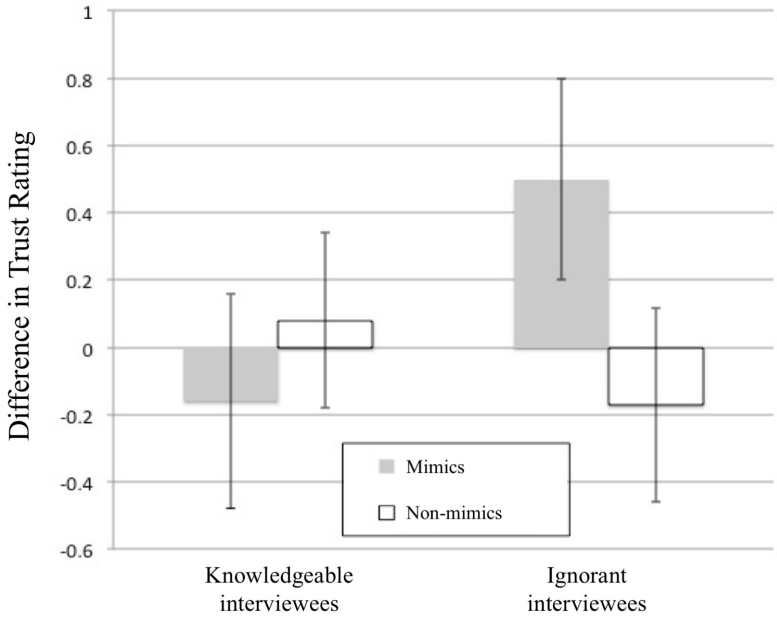


Figure 2.2: Changes in Trust Ratings as a Function of Reputation, Mimicry, and Knowledge (Difference in Ratings in the Defamation Minus the Praise Condition)

We first focused on the trustworthiness rating (Figure 2.2). There were no significant main effects or interactions in the knowledgeable condition (all *Fs* < 1). Critically, in the ignorant condition, a 2-way interaction of reputation and mimicry was found, $F(1,93)=5.87$, $p=.02$. Simple effects (two-tailed) showed that ignorant participants who mimicked bad (untrustworthy) models were perceived as more trustworthy than participants who did not mimic bad models ($p < .06$), and as more trustworthy than ignorant participants who mimicked good (trustworthy) models ($p < .10$). Overall, this pattern resulted in a significant 3-way interaction [$F(1,93)=4.58$, $p=.03$]. A main effect of knowledge was also found, such that targets who witnessed the reputational manipulation were rated as more trustworthy than targets who did not [$F(1,93)=11$, $p <.01$]. This effect

(also seen on other ratings, as discussed below) presumably reflects that participants were personally familiar with targets in the knowledge, but not the ignorant, condition.

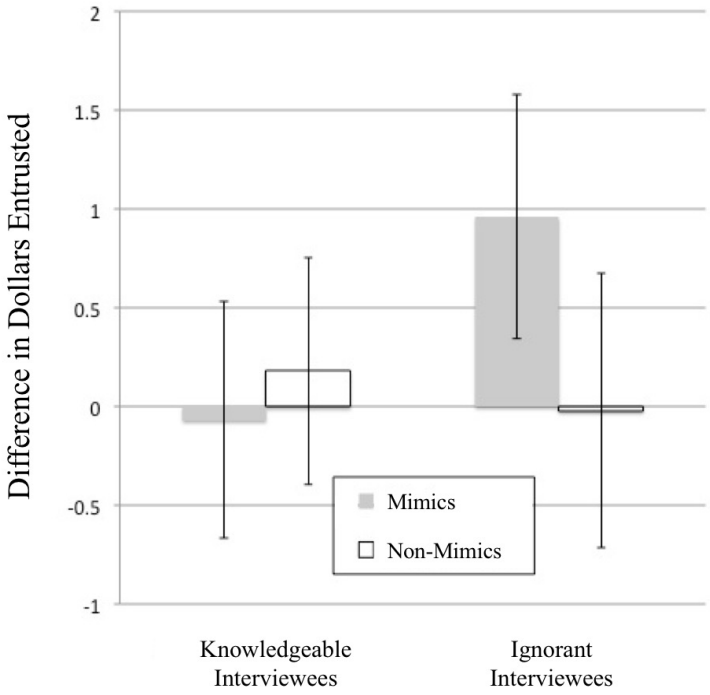


Figure 2.3: Changes in Investment as a Function of Reputation, Mimicry, and Knowledge (Difference in Dollars Invested in the Defamation Minus the Praise Condition)

On the investment measure of trust, evidence was found of a 2-way interaction of reputation and mimicry [$F(1,94)=5.41$, $p=.02$]. Simple effects (two-tailed) showed that when ignorant participants mimicked bad models, they were perceived as marginally more trustworthy than participants who did not mimic bad models ($p<.12$), and as more trustworthy than ignorant participants who mimicked good models ($p<.01$). There were no significant effects in the "knowledgeable" condition (all $Fs < 1$). Overall, this pattern resulted in a 3-way interaction [$F(1,94)=3.42$, $p=.07$]. No other main effects or interactions were reliable.

Other ratings. Similar analyses were conducted on other ratings that were not directly related to trust. Analyses revealed a main effect of knowledge, such that "knowledgeable" targets were rated as overall friendlier ($p < .01$) and more competent than "ignorant" targets ($p < .05$). As mentioned above, this effect may be due to participants' personal familiarity with targets in the knowledge condition (due to having spent time with them in the waiting room). Critically, none of the other ratings showed the 3-way interaction involving mimicry, reputation and knowledge ($Fs < 1$). This suggests that observers' inferences were concentrated on the relevant trust-related dimensions that were relevant to our praising/defaming story manipulation.

Discussion

The central question addressed in this study was whether third-party observers' inferences from mimicry are simple or nuanced – that is, whether such inferences take into account not only the presence or absence of mimicry, but also the reputation of the model *and* the target's knowledge about the model. These third-party inferences from mimicry were examined in the context of morality-related judgments of trust.

Overall, the results support the idea that inferences made about third-party dyad members on the basis of observed mimicry are nuanced. Specifically, participants' judgments of trustworthiness reflected whether the target mimicked, the reputation of the person they mimicked, and also whether the target was aware of their model's reputation. As such, the results speak against the hypothesis that third party judgments of mimics reflect simple "rub-off", where the mimic is seen, based on similar behavior, to have a global similarity to the model. More generally, these results point towards the integration of subjectively experienced information about rapport with higher-level moral judgments

that, the literature shows, reflect not only the value of the act (good/bad), but also the actor's mental state (e.g., knowledge, intentions).

Results also contain some secondary findings in need of exploration. One question is why knowledgeable targets were not seen as more trustworthy after mimicking a trustworthy model. Targets were also not "blamed" for mimicking a model they knew to be bad. One possibility, consistent with the trust literature, is that people do not give moral credit or blame for social courtesy when a proper behavior is expected (Wojciszke, 2005). Past work (Dalton et al., 2003) has provided evidence that some level of mimicry is expected in a normal social interaction, so that mimicry of a likeable person is simply expected at baseline. Certainly, some mimicry of a person who was known to be nice might simply be expected. It may be that participants made more situational inferences about those people with whom they were acquainted, and person attributions about those with whom they were not familiar. Thus persons who were in the waiting room may have been viewed from a more situational standpoint. As mentioned above, this personal familiarity non-specifically enhanced several judgments, including trust, friendliness, and competence. It may be, then, that the participants felt that they had learned enough about these others any intuition that their mimicry really reflected personal affiliation was discounted. Thus, familiarity may also have caused these targets actions' to be judged in a more "charitable" manner.

Also noteworthy is that, as expected, there was no decrement in competence ratings when targets mimicked a "defamed" interviewer. This is likely because, unlike in chapter one, interviewers were never directly condescending to by the interviewee in this study. This contextualizes previous work in which interviewees, who mimicked interviewers that

had condescended directly to them, were seen as less competent. This provides further evidence that inferences from mimicry are subtle and situated. Though the full extent and nature of such inferences is not entirely clear, the results are the first to point towards the integration of unconsciously processed embodied signals with epistemic (e.g., "theory of mind") knowledge.

Experiment 2

The results of the previous study strongly argue against a "rub-off" effect whereby the negative traits of the model are transferred to the mimic. To the extent that mimicry had effects on participants' impressions of interviewees, these effects were in the opposite direction as would be expected, given a rub-off effect. This, in turn, casts doubt on the idea that the effects seen in chapter one were driven by the perceived "alikeness" of models and mimics. The results obtained above also suggest that onlookers' beliefs about the epistemic state of dyad members may moderate their interpretation of mimicry.

If the rub-off effect is ruled out, then it seems the negative effects of mimicry seen in chapter one were due to poor social judgment. For example, a person's decision to affiliate with persons who have a negative disposition towards him may, suggest that this person is incompetent. This further suggests that a cover story that is not focused on the knowledge of the general bad character of a potential model, but, rather, on knowledge of attitudes that reflect on the mimic, would have more potential to affect participants' ratings. Thus, the present study seeks to confirm the predictions that onlookers see an interviewee as less trustworthy and competent when that onlooker *knowingly* mimics a person who holds negative attitudes towards them *and their ingroup*, compared to when when they mimic in ignorance of those attitudes.

This hypothesis was examined by having experimental participants read comments of the interviewer that express negative attitudes towards Southern California, where one interviewee came from, as well as its people (his presumptive ingroup), and his favorite food. On the other hand, the same statements did not reflect badly on the other interviewee, who hailed originally from Northern California (but as a UCSD student, lived in Southern California). Rather the interviewer compared Northern California favorably with Southern California. Critically, knowledgeability was manipulated between subjects so that participants were told that either the interviewees had a chance to read the interviewer's statement, or did not have a chance to read it. It was predicted that mimicry will more negatively influence the reputation of the effected target (the Southern Californian) than it would the ratings of the Northern Californian mimic. As in experiment 1 above, the main variables of interest were ratings of trust, competence, and the trust game investment measure.

Participants and Procedure

87 UCSD undergraduates (58.8% Female, predominantly college juniors) participated for class credit. Subjects completed the experiment on a computer in a private experimental cubicle. Each subject was asked to give their impressions of two interviewees (always played by the same two confederates) in videotaped interviews. A given subject saw the same interviewer (model) in both videos (drawn from the cordial condition of experiment 1.1), who was introduced as a visiting scholar who was interviewing the targets, as well as a copy of the interviewer's answers to questions about his impressions of Southern California. In these answers the interviewer repeated a nasty quip about Southern California, that "the location is good, its just cast and crew that are a problem", specifically,

the "cast and crew" (i.e. the people of Southern California) were regarded as shallow by the interviewer. This indirect social slight was chosen because it was simply believed to be more plausible than a direct written insult. The interviewer also expressed a dislike for the local Mexican food. One interviewee hailed from Southern California and stated that he could eat Mexican food every day. The other interviewee hailed from Northern California and enjoyed Italian food.

The apparent knowledge state of the interviewee regarding these statements was manipulated between subjects. Additionally, one experimental group read the visiting scholar's comments but was told that the targets had never seen them, while the other group was told that both interviewees had seen the comments[1]. One of the two interviewees mimicked, and the other did not. Videos were about 3 minutes in length. Also as before, subjects rated the interviewees on the major dimensions of social judgment related to competence and warmth (Judd, et al., 2005) and indicated how much they would invest when playing the trust game with both targets. To ensure careful evaluation of the cover story, subjects' knowledge of the interviewer's statement was tested with four comprehension questions. Subjects were looped back through the interviewer's written statement until all four comprehension question were answered correctly. As before, participants were debriefed with questions probing their awareness of non-verbal behavior and best guess at the purpose of the experiment. Four participants were excluded because they indicated knowledge of the experimental hypothesis on a debriefing questionnaire, leaving 83 observations. No awareness of mimicry was indicated.

[1] Due to an issue with the relevant experimental program, no subjects were run in the ignorant condition on the first day of the experiment, the remaining subjects in the knowledgeable condition and all subjects in the ignorant condition were run on two consecutive days one week later.

Analysis & Results

The opinions of the visiting scholar reflected negatively on one targets' identity and home, while the other was complemented. The targets also showed different non-verbal behavior towards the interviewer -- one mimicked, and one did not. Such an act of affiliation would seem to signal a lack of loyalty or social judgment for the former, but affiliation with the visiting scholar might be considered understandable or even astute, for the latter. However, the degree to which such inferences were drawn was thought to be moderated by targets' knowledge of the interviewer's attitudes. Specifically, the mimic was expected to be viewed less favorably vis-à-vis the non-mimic when that mimic was Southern Californian, and knew about the visiting scholars' opinion.

One relevant measure for evaluation of the experimental hypothesis is the difference between mimics and non-mimics on the dimensions of trust and competence. It was predicted that this difference would change depending on the identity and knowledge state of the mimic, such that knowledgeable Southern Californian mimics would be seen as less trustworthy and competent. This prediction was tested via MANOVA analysis, with the differences between the model and mimic on the measured dimensions of social judgment serving as the main DVs. The predicted two-way interaction between the mimic and the model on the dimensions of trust and competence was observed (marginally) on the dimension of trust [$t(82)=1.73$, $p=.09$], and on competence [$t(82)=1.65$, $p=.10$], while economic trust did not approach significance [$t(82)=.69$, $p=.49$] (see below for discussion of the reasons for these differences).

Planned contrasts provide an alternative means of testing the hypothesis that knowledge should affect ratings of Northern Californian and Southern Californian mimics

differently. The experimental hypothesis implies that, when they possess knowledge of the interviewer's opinions, the mean trust and competence ratings of Southern Californian mimics should go down, while mean ratings of Northern Californian mimics should be unaffected or go up when they have such knowledge. This relationship is expressed in terms of a planned contrast:

$$Mean(Knowledgable_Socal_Mimics) - Mean(Ignorant_Socal_Mimics) > Mean(Knowledgable_Norcal_Mimic) - Mean(Ignorant_Norcal_Mimic)$$

Or, rearranging terms, we get:

$$Knowledgable_Socal_Mimics - Ignorant_Socal_Mimics - Knowledgable_Norcal_Mimic + Ignorant_Norcal_Mimic > 0$$

Results of a planned contrast analysis based on the above inequality again show marginal significance in the predicted direction [$F(81) = 3.24$, $p=.08$, two-tailed] for trust (see figure 2.4), but differences in the predicted direction for competence which did not reach significance [$p>.20$] (see figure 2.5). As such, the experiment provided suggestive evidence for the idea that viewers' understanding of dyad members' epistemic states interacts with participants' perceptions of mimic's trust but less of an effect was seen for competence.

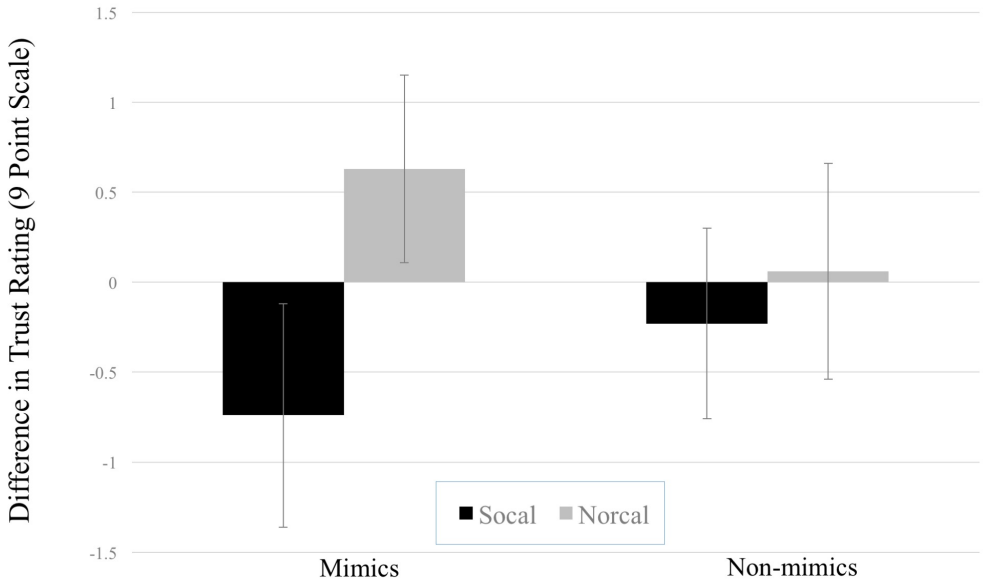


Figure 2.4: Effects of Knowledgeability on Trust
(Difference in Trust in *Knowledgeable Minus Ignorant* Condition)

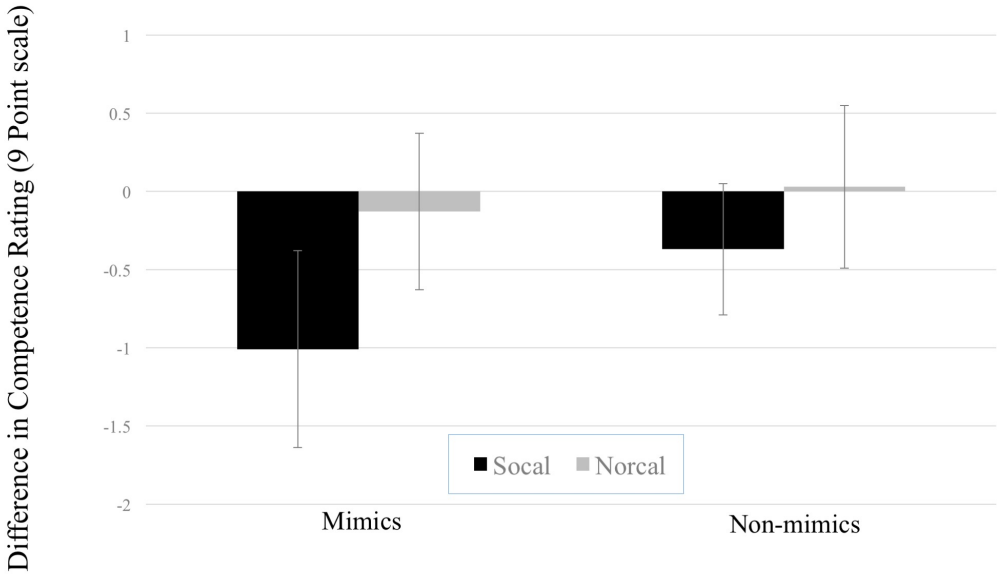


Figure 2.5: Effects of Knowledgeability on Competence
(Difference in Measures of Competence in *Knowledgeable Minus Ignorant* Condition)

Follow-up analysis using simple effects analyses showed that the difference between ignorant and knowledgeable Southern Californian mimics was in the predicted direction, but fell short of statistical significance on the dimension of trust [M = 5.31 v. 4.57, t(42) = -1.33, p=.19, two-tailed]. Similar effects were found on measures of competence [M = 5.84 v. 4.83, t(42) = -1.41, p=.17, two-tailed] and investment [M = 5.16 v. 4.21, t(42) = -1.41, p=.19, two-tailed.] Ratings of of non-mimicking Southern Californians were also lower when targets were portrayed as knowledgeable, but these differences did not approach significance (all p's > .38).

Ratings of Northern Californian showed different patterns. Surprisingly, participants' ratings of investment and trust, usually thought of as similar constructs (e.g. Fehr, 2009), showed significant divergence among Northern Californian targets. The Northern Californian mimic was seen as (non-significantly) more trustworthy when he was aware of the interviewer's attitudes towards Southern California (trust rating = 6.41) than when he was ignorant (trust rating = 5.78) [t(43) = 1.17, p=.24.] On the other hand, participants were willing to invest more money with a Northern Californian mimic when he was unaware (Investment = 6.32) of disparaging remarks about Southern California, than when he had read these remarks (Investment = 5.45).

These results suggest that economic trust may dissociate from estimates of trait trust, at least in the situation created. It may be that mimicry did not negatively affect viewers' impressions of mimics who were not personally defamed, but in economic terms, participants showed some hints of an unwillingness to risk investing money with a Northern Californian who had shows signs of affiliating with a detractor. Ignorant and

knowledgeable Northern Californian mimics showed very little difference on competence (M = 6.63 v. 6.50, t(38) = -.26, p=.78.)

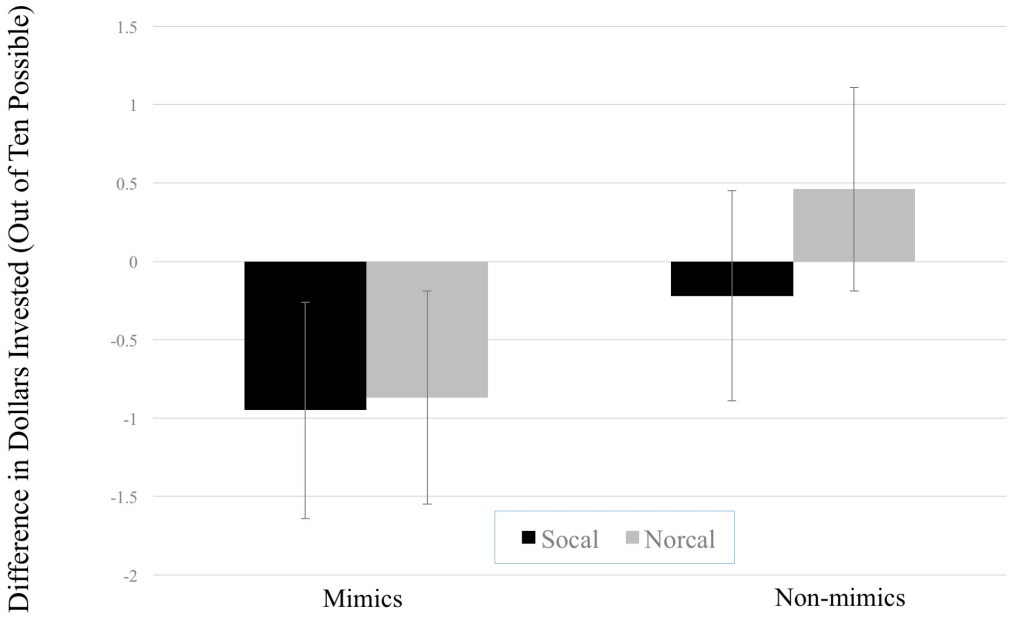


Figure 2.6: Effects of Knowledgeability on Investment
(Difference in Measures of Trust in *Knowledgeable Minus Ignorant* Condition)

Discussion

Results were generally in line with earlier findings that mimicry can reflect negatively on a person when their model has expressed attitudes that reflect negatively on them, specifically, and suggest that this effect may be mediated by knowledge. Overall results suggest that when not only a mimic himself, but his ingroup, is defamed, his mimicry reflects at least as poorly on trustworthiness as it does on his competence. A target that attempts to affiliate with persons holding opinions offensive to his friends and family may show a lack of pro-sociality, or abnormal bonding (see Churchland, 2011, for related discussion). The current results are a long way from proving this distinction, but are suggestive of opportunities for fruitful future research.

Though the current results support the notion that epistemic states are taken into account in participants' inferences from mimicry, a more definitive demonstration of the sensitivity of inferences from mimicry to mimics' knowledge states is desirable. In order to more cleanly demonstrate participants' ability to incorporate knowledge into their interpretations of mimicry, it will be useful to construct more tightly controlled stimuli and measure highly robust consequences of mimicry (see experiment 3, below.)

A pattern of results that may merit future investigation is the dissociation between investment and trust ratings among participants who saw a Northern Californian mimic. This result may hint that these two ratings do not have as similar a basis as is usually supposed. It might be that mimicry behavior among Northern Californians was not seen as a signal of an untrustworthy disposition, as their affiliation behavior was not disloyal to an ingroup that can be presumed to have "placed its trust" in these mimics. However, the opposite pattern of decreased economic trust of a knowledgeable Northern Californian mimic may suggest that residents of Southern California felt hesitation in investing with this person, specifically.

Finally, it is worth mentioning that no main effect of knowledge state was observed on social judgments or investment levels, but rather the effect of knowledgeability was variable, depending on origins and non-verbal behaviors. This suggests that the main effect of knowledgeability observed in experiment one was due to participants meeting with knowledgeable participants. This confound might be thought to explain the previously observed effects of knowledge – for example, it might be thought that the knowledgeable interviewees in experiment 1 were somehow "insulated" from judgment by their ingroup status. However, the current results suggest that mimicry is indeed interpreted in a

situationally nuanced manner. Furthermore, the results of the current study are consistent with results in chapter one, and easily interpretable in terms of existing theory.

Experiment 3

Though previous experiments provided suggestive hints that mimicry can influence a variety of social judgments and that knowledge states can mediate inferences from mimicry, a more definitive demonstration is desirable. In the current experiment, such a demonstration is achieved by a few means. Firstly, a more controlled experimental method is used: "green screen" technology, which allow the superimposition of actors over a background, allows clips of non-verbal behavior to be mixed and matched so that mimicry or anti-mimicry can be created using the same video clips. Secondly, this experiment studies a type of similarity that is predicted by views of mimicry that do not rely on the assumption of a heuristic perception of similarity. Specifically, the following experiment studies whether mimicry is indicative of similarity in opinions.

Mimicry is like emotional contagion in that it is mediated by ingroup membership and involves automatic reproduction of bodily actions, suggesting the possibility of similar underlying dynamics (DeWaal, 2008; Hess & Fischer, 2014.) If mimicry indicates that, generally, the mimic is contagious for bodily activity of his model, including the "catching" of affective states, then seeing similar non-verbal behavior may signal similar opinions, as opinions are thought to be informed by feelings (Schwarz, 2011) including contagious ones (Ramanathan & Gill, 2007). However, if two persons' behaviors are not contingent on one another (i.e. one cannot have "caused" the other), then rationally, similar actions should not indicate similar opinions. Of course, a "simple similarity" account predicts this sharing of opinions as well -- however, it also predicts kinds of similarity that experimental results

have so far not supported. Thus, the current experiment tests whether a perspective that emphasizes mimicry's connection to contagion can produce more reliable results.

Ramanathan and Gill (2007) showed that the degree of convergence between two persons' opinions when jointly evaluating stimuli was mediated by mimicry, showing that similarity in opinions may be rational to infer. From a broader theoretical perspective, the sharing of implicit and emotional information is important for ingroup members, as it will help with coordination of values, attitudes, and opinions (see chapter 4 for in-depth discussion.) In the current experiment, it is asked whether third party judgments support this perspective. This is done by placing participants in the role of a third party observer of a dyad that is watching a video. Participants again observe a dyad, but are told that both members of the dyad must make a judgment about a singing performance. Only one member expresses an opinion verbally. Participants were asked to guess the opinion of the other judge, who either mimics or "counter-mimics" the speaking judge.

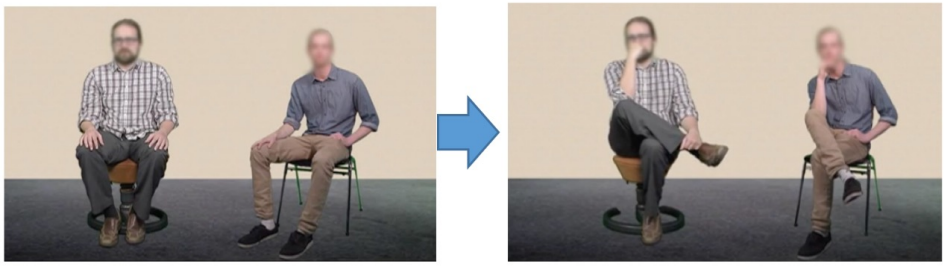
The current study also makes use of a new experimental paradigm, meant to isolate the effects of mimicry with greater precision. The stimuli used were created with "green screen" technology that allows the isolation of behavioral segments from individuals, so that they can be mixed and matched. Thus, the very same action of one "dyadic member" can be seen as either mimicry or anti-mimicry depending on whether his "dyadic partner" shares the same action. This methodology allows for near certainty that observed effects are not due to any artifacts. This methodology also makes it possible to manipulate whether similar behaviors can be contingent upon one another – this done by placing characters in either the same room, or different rooms. In the latter situation, similar actions cannot possibly be due to mimicry, because it they cannot be contingent on another (see Hess &

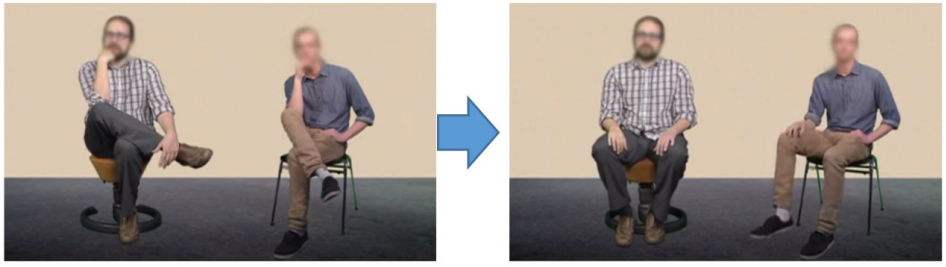
Fischer, 2014, for discussion.) It was thus predicted that when they are presented as occupying two rooms, actors would be seen as influencing each other less strongly.

Video Stimuli

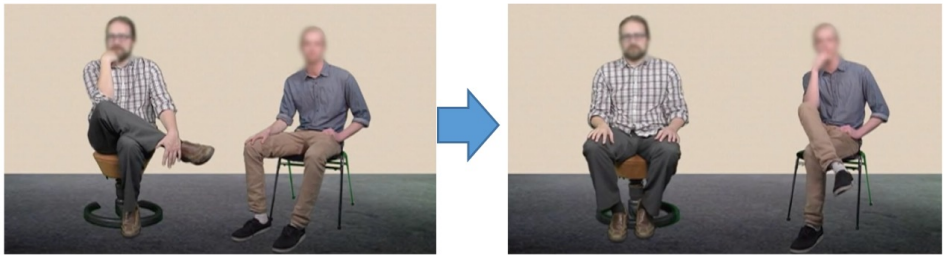
Raw video material making up the stimuli were recorded at Humboldt University, Berlin, using an HD camera. High definition recordings were taken of two actors at separate times. One actor recorded a silent video against a solid green backdrop and simply switched back and forth between two positions at approximately 15 second intervals. The first posture involved sitting up straight with the hands comfortably resting at the waist, from this posture, actors moved to cross their legs and with an elbow rested at the knee (see figure 2.7), and then back to the original posture. The other actor performed the same movements against the same backdrop, but at the same time expressed an opinion, either positive or negative, about the musical performance, such that he changed posture in the middle of voicing the opinion. It should be noted that the opinions voiced were not strong. The speaking judge spoke in a tone of voice connoting indecisiveness, and gave ambiguous descriptions of the singer (she had a "great personality" and a voice that was either "pretty good, too" or "not that good.") This mild response was selected to keep the opinion of the speaker from driving judgments either to floor or to ceiling. Each actor performed 15 "takes" of each crossing and uncrossing action and the results were rated for naturalness of movement by undergraduate assistants, with the highest scoring versions being used as elements of experimental videos. 4 videos were selected for the dyad member who expressed an opinion (selected to allow a 2x2 counterbalancing of posture change and opinion expressed), and 2 were selected for the silent judge (one of each type of posture change).

Mimicry





Anti-Mimicry



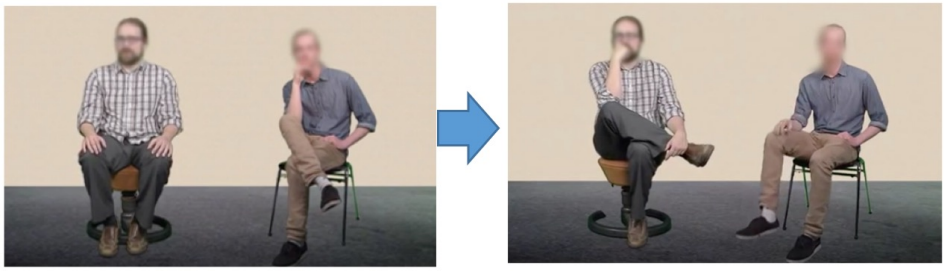


Figure 2.7: Green Screen Stimuli for Experiment 3

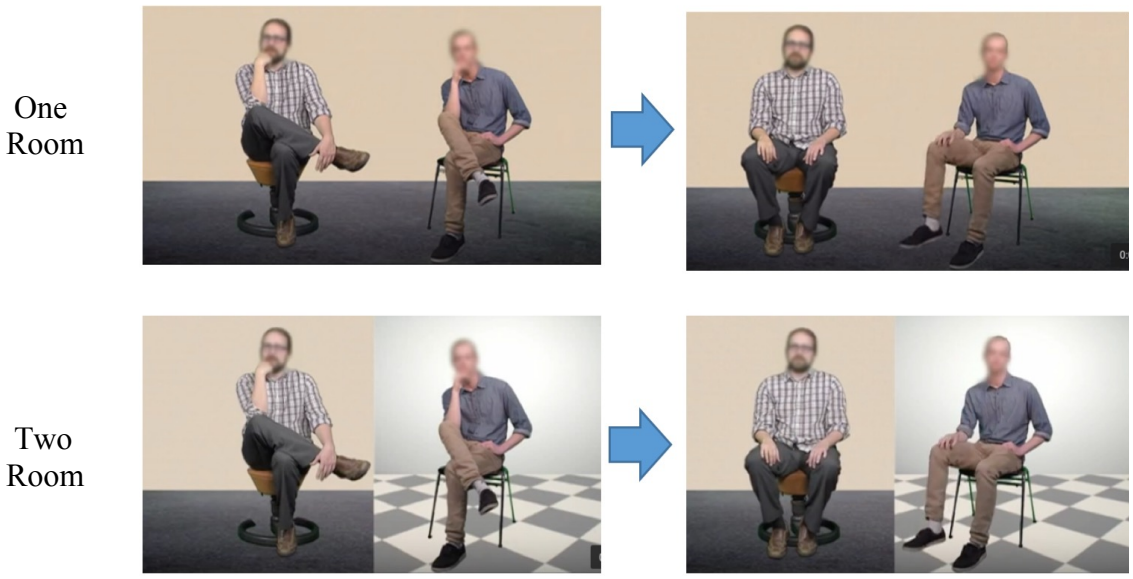


Figure 2.8: Stimuli for "One Room" and "Two-Room" Conditions (Experiment 3)

elements of experimental videos. 4 videos were selected for the dyad member who expressed an opinion (selected to allow a 2x2 counterbalancing of posture change and opinion expressed), and 2 were selected for the silent judge (one of each type of posture change).

The green background was filtered out of the selected videos using Adobe After Effects (version 12.0) and videos were combined in Final Cut version 8. The green background was replaced by two different backgrounds, pictured above. One of these backgrounds made it appear as though both actors were in the same room, and one made it appear as though they were in different rooms (see figure 2.8 above.) In one condition, both characters were placed in a room with a wooden floor and off-white walls, and in the other, one character was placed in a room a checkered floor. In the second room, the room's wall also appeared to be set farther back from the camera (see figure 2.8.) This gave the

impression that the two partners were in either in the same room (i.e. “one room condition”, or different rooms (“two room” condition) while watching the singing performance. Further, participants in the two room condition were informed that the two judges were in different rooms. Since this should imply that the two dyad members’ behaviors could not be due to one another, it was hypothesized that participants would be less likely to see mimicry as a cue to agreement.

16 videos were made by superimposing one of eight different combinations of actions on these two backgrounds. The eight combinations of actions were created out of the possible permutations of the four speaking and two silent videos so that a positive and a negative opinion was paired with each of the four possible pairings of observed motions (see figure 2.7.) In other words, videos were counter-balanced for number of rooms, the speaking judge’s opinion (yes/no), speaking judge’s posture change (crossing/uncrossing) and silent judge’s posture change (crossing/uncrossing), to make a counterbalanced (2 x 2 x 2 x 2) set of stimuli. The timing of the clips was arranged so that that the speaking partner started his posture change 2-3 seconds before the non-speaking partner started his change, an average delay for mimicry of postures (Chartrand & Bargh, 1999). This ensured that the non-speaking partner’s action was always interpretable as a response to the speaking partner’s action. Finally, to decrease participants’ reliance on facial expressions, the faces of actors were blurred using the Gaussian blur tool in Adobe Photoshop CS6 (see image).

Participants and Procedures

160 workers participated on Mechanical Turk in exchange for compensation and were routed randomly to one of the 16 experimental videos. On-line participants were chosen because the nature of the stimuli composed called for a very short presentation

(approximately 10 seconds). Simply put, the synchronizing of long segments of behavior, such that various combinations both look natural and look like mimicry, is experimentally difficult. Using only short behavioral segments affords greater apparent naturalness of interaction, and also the ability to showing the power of a single act of mimicry. Because of this short video length, the entire experiment typically took less than 3 minutes, allowing a large number of participants on a small budget.

Online participants saw one video only, which was framed as the reaction of two people, who had been asked to be judges. Participants were simply asked to guess whether the second, non-speaking judge favored the singer's advancement to the next round (i.e. a binary yes/no response), and also to provide the same judgment, but on a continuous scale (-5 to +5). The latter response was asked to allow greater sensitivity in checking for any factors, besides mimicry, that might affect participants' responses. In order to check for awareness of mimicry, participants were also asked to explain how they made their judgments, and whether non-verbal behavior played a role. To judge whether participants as a whole were paying attention, they were also asked what the opinion of the speaking judge was (all but eight responded correctly to this, demonstrating good attention by the participants as a whole). Eight participants (four in the one room condition and four in the two room condition) indicated explicit awareness of imitation.

Table 2.1: Experimental Hypotheses for Experiment 3
Experimental hypotheses predict that mimicry will indicate agreement while anti-mimicry will indicate disagreement. Note that these hypotheses were thought to hold more strongly in the one-room condition.

Speaking Judge Opinion	Postural Change, Speaking Judge	Postural Change, Non-Speaking Judge	Hypothesized Opinion of Non-Speaking Judge
approve singer	cross legs	cross legs	approve singer
approve singer	cross legs	uncross legs	disapprove singer
approve singer	uncross legs	cross legs	disapprove singer
approve singer	uncross legs	uncross legs	approve singer
disapprove singer	cross legs	cross legs	disapprove singer
disapprove singer	cross legs	uncross legs	approve singer
disapprove singer	uncross legs	cross legs	approve singer
disapprove singer	uncross legs	uncross legs	disapprove singer

Analysis and Results

The experimental hypothesis predicts that mimicry would push participants to believe that the second, silent judge would share the opinion of the speaking judge, while anti-mimicry would give the impression of disagreement. This leads to straightforward predictions for participants' guesses at the opinion of the non-speaking dyad member. Namely, in the half of videos in which there was mimicry, it was predicted that the silent judge would agree with the speaking judge, and in the remaining videos there was predicted to be disagreement. Thus, experimental hypotheses lead to expectations of approval in fifty percent of subjects and disapproval in the other fifty percent. Likewise, agreement and disagreement with the silent judge were each expected in fifty percent of cases. Thus, if participants' judgments are, in fact, not influenced by the similarity or dissimilarity in the judges' postures, fifty percent agreement with experimental hypotheses would be expected. This is true regardless of any overall response biases by participants (65% believed the silent judge was not in favor of the singer's advancement – 69% in the one room condition

and 62% in the two room condition), conventional conformity effects (see below), or a tendency to see a particular posture as indicative of a positive or negative opinion (which was not found to be case).

Binary Responses

First, participants' responses were recoded to indicate whether they were in line with the predictions of the "simple similarity" interpretation. After the exclusion of eight participants who explicitly noticed mimicry, the rate of agreement with these hypotheses (as laid out in table 2.1) was 67.1% (51 of 76 participants) for participants in the one-room condition, and 46.1% in the two-room condition (37 of 76). This meant that participants in the one-room condition were significantly above chance in their rate of agreement with experimental hypotheses [chi-square = 8.1, p=.0012], while those in the two-room condition agreed with the experimental hypotheses at (non-significantly) below chance levels [chi-square = .45, p>.43.] Z tests for difference in proportion showed that differences between conditions were significant (z=2.62, p <.025.)

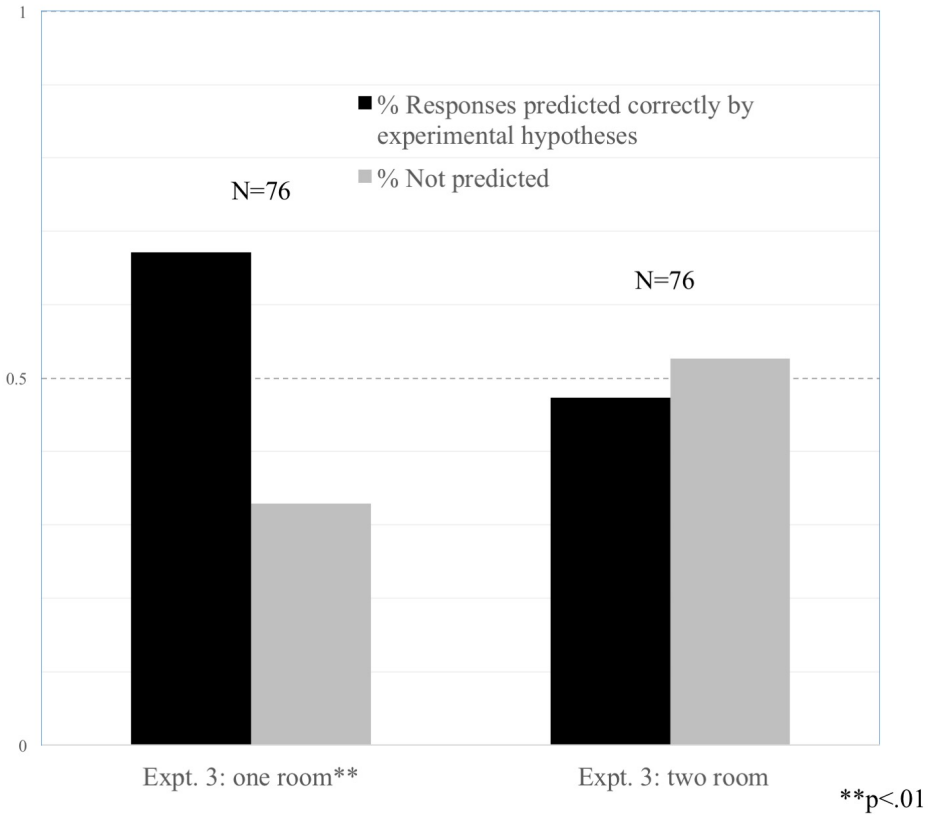


Figure 2.9: Percentage of Participants Responding as Predicted by Experimental Hypotheses

Continuous Responses

Analyses of the scaled responses (on a -5 to 5 scale) was first performed separately for participants in the one-room and two room condition, using predicted response as a between-subjects factor. In the one-room condition, a significant difference was observed between those respondents for whom the experimental hypotheses predicted a negative response (scale average = -1.49), and those for whom a positive response was expected (scale average = .15) [$t(75) = -2.91$, $p=.005$]. The same analysis revealed no significant effects for participants in the two room condition [$t(75) = -.35$, $p>.72$] between conditions where hypotheses predicted a negative response (Average Response = -.83) and those

conditions in which a positive response was predicted (scale average = -.62.) As predicted, a two-way ANOVA with number of rooms and predicted response as between subjects factors showed a significant interaction between these factors [t(151) = -2.23, p=.027].

Table 2.2: Parameter Estimates from a 3-Way ANOVA, With All Interactions Between Judges' Postures and the Expressed Opinion (Experiment 3)
Mimicry is captured here by the three-way interaction of between both judges' postures, as well as the speaking judge's opinion. Surprisingly, this is the only significant factor involving posture, despite the fact that isolated postures were mentioned by participants more frequently when explaining their judgments.

N=76

Term	Estimate	Std. Error	t-Ratio	P-value
Intercept	-0.63	0.29	-2.15	0.035
3-way interaction [Posture*Posture*Opinion]	**0.86**	**0.29**	**2.94**	**0.005**
Silent judge opinion [Approve]	**0.54**	**0.29**	**1.83**	**0.072**
Speaking judge post [Cross]	-0.15	0.29	-0.52	0.605
Silent judge posture [Cross]*silent judge opinion [Approve]	-0.10	0.29	-0.34	0.734
Silent judge posture [Cross]	0.06	0.29	0.21	0.833
Speaking judge post [Cross]*silent judge opinion [Approve]	0.06	0.29	0.20	0.841
Speaking judge post [Cross]*silent judge posture [Cross]	-0.01	0.29	-0.05	0.962

Table 2.2 and 2.3 below show results from an ANOVA within the one room condition expanded to include all factors, fully interacted (that is: posture of speaking judge, posture of the silent judge, and opinion of the speaking judge). This allows the effects of postures to be studied independently from their status as mimicry or non-mimicry, and also allows more precise estimation of mimicry's effects vis-à-vis standard conformity (agreement with the speaker) or independent effects of either judges' posture. Within this analysis, the hypothesized effect of mimicry is simply captured by the three-way interaction between both judges' postures and the speaking judges' opinion, which is

highly significant (p=.002, see table 2.2). Perhaps surprisingly, given that more participants remarked on whether postures were open or closed than remarked on mimicry, neither these posture of the silent judge nor that of the speaking judge was significant alone (both p's>.63.) The speaking judges' opinion was the only other factor, besides mimicry, that explained a significant amount of variance (p=.07, see table) and had the expected effect -- a speaking judge who disapproved of the singer made participants believe that the silent judge was less favorable to the singer's advancement. Table 2.3 shows the cell means of the various levels of interaction between the posture of the speaking judge, the posture of the silent judge, and the speaking judges' opinion. These levels are in line with experimental predictions that mimicry signals agreement, while anti-mimicry signals disagreement.

Table 2.3: Least Squares Mean Estimates of Silent Judge Attitude by Level of 3-Way Interaction

Predictions of the experimental hypotheses largely describe the data. Estimates of the silent judge's favorability towards the singer are higher in every condition where approval was predicted than they are in any condition in which disapproval was expected. An effect of the speaking judge's opinion is also visible. Within each prediction category, the two conditions in which the speaking judge expressed a negative opinion scored lowest.

(Responses on -5 to 5 scale, 5 = Strong Belief that Silent Judge Approves Contestant)

Experimental Prediction:	Approve				Disapprove			
Speaking judge opinion:	Approve		Disapprove		Approve		Disapprove	
Silent Judge Mimicry:	Mimic		Anti-Mimic		Anti-Mimic		Mimic	
Silent Judge Posture :	Uncross	Cross	Uncross	Cross	Uncross	Cross	Uncross	Cross
Least Sq. Mean:	0.63	0.89	-0.67	0.08	-1.00	-0.89	-2.00	-2.11
Std. Error:	0.89	0.84	0.73	0.73	0.84	0.82	0.96	0.82

Discussion

Similarity in posture and gesture does not lead participants to infer similarity on major personality dimensions between individuals, according to the current results, or the previously introduced studies, but it does, situationally, indicate to participants that two people are likely to share opinions. This is only true, however, when participants have a good reason to believe that the mimicking person's actions in some way resulted from their model. This last result is not necessarily in conflict with those of previous studies. Rather, it may imply that third-party observers' inferences are not based on a similarity heuristic but are arrived at by a process meeting the criteria of "ecological rationality". If taken as evidence on the true nature of mimicry, results support the notion that mimicry may be indicative of the sharing of feelings and attitudes (Ramanathan & Gill, 2007), in this case, feelings towards a singing contestant. As shared feelings can be expected to lead to a sharing of attitudes and preferences, which is common among ingroup members (McPherson, Smith-Lovin, & Cook, 2001), mimicry may signal more consequential characteristics than has often been supposed. This line of reasoning is further developed in chapter 4.

One concern with the paradigm used in experiment 3 is that conscious noticing of mimicry was high in these stimuli compared to those used in most previous studies. This may have been due to the fact that there was very little other information in the stimuli, especially, the target, besides non-verbal information. Future research should attempt to reduce spontaneous noticing of mimicry in similar stimuli to a lower level, such that several can be shown to the same participant without mimicry ever rising to awareness. Such stimuli would allow for very precise study of the significance of mimicry, and could be

used effectively with fMRI or TMS. Despite these concerns, it is worth noting that more participants in the one-room condition cited some other specific aspect of postural *movement* as informing their decision (9), than noted mimicry (4.)[2] In contrast, there was a lack of any measurable effect of specific postures on judgment in the results shown in table 2.2. Many participants took the time to write down explanations that referenced "body language", generally. Thus, though the current paradigm seems to result in more conscious awareness of mimicry, results overall support the notion that participants are typically not explicitly aware of the true influence of mimicry as such, and have more conscious awareness of less powerful cues.[3]

General Discussion of Chapter 2

Do the Data Fit with Accounts of Mimicry?

The results obtained are difficult to fit neatly into any extant account of mimicry, though they do imply the existence of a rich ability for interpretation of mimicry by observers. The lack of unconditional transfer of traits from models to mimics speaks against the idea that mimics are automatically perceived to be similar to their models. The evidence here, coupled with that from chapter 1, does seem to show that inferences from mimicry that are consistent with the idea that mimicry is seen as evidence of an implicit "choice" to affiliate. What participants believe about a mimic's character and dispositions is variable, however, and seemingly rational. As mentioned, the ability of the human

[2] It is also true that more participants in the two-room condition noted some other aspect of posture (10) than noted mimicry (4), but this cannot be claimed to bear directly on the implicitness or non-implicitness of mimicry. The similarity in posture sometimes seen in these conditions is not properly seen as mimicry, so the relative self-report of the weight of mimicry in opinions, and the actual weight cannot be meaningfully compared.

cognitive system to understand the implications of mimicry (demonstrated most effectively in experiment 3 above) is at odds with the idea that mimicry is produced *solely* in order to gain others' favor. That is, in order to explain mimicry as Machiavellian, one must explain why "rational" observers are able to be manipulated.

These discrepancies between accounts of mimicry and the results obtained recommends one of two courses of action. Firstly, it might be concluded that the extant accounts of mimicry are simply in need of revision or extension, or, secondly, it might be assumed that third parties' perceptions of mimicry follow fundamentally different rules than do models' perceptions within the dyad. That is, perhaps models are driven by heuristic imputation of alikeness, even if observers are not. Which of these two routes is preferable depends on the strength of one's prior beliefs that human information processing is rational (adaptive), and, relatedly, one's degree of certainty in extant accounts of mimicry. Both of these considerations, it is argued, point towards a reexamination of the nature of mimicry.

Though human cognition is certainly limited, and in some cases systematically inaccurate, past studies do show that humans are able to infer rapport and differences in power from mimicry quite effectively (Grahe & Bernieri, 1998; Over and Carpenter, 2014). Also, when they can be compared, data from third parties and dyads are largely compatible with the idea that third parties are intuitive experts, drawing inferences that are ecologically valid. For example, mimicry has been shown to mediate convergence of opinions in the dyad (Ramanathan & Gill, 2007), but persons "mimicking" *neutral* gestures while in separate rooms (as in experiment 3) cannot possibly be "catching" attitudes of their apparent "model". Experiment 3 is therefore completely consistent with that notion that

humans possess an ecologically valid sense of the implications of mimicry. Similarly, findings that third parties associate mimicry with good rapport (Grahe & Bernieri, 1999) and infer power differentials from mimicry (Over & Carpenter, 2014) show sensitivity to the behavior's true meaning. Thus, insofar as we have evidence within the dyad to check them against, third parties' impressions can be said to reflect the true nature of mimicry.

This evidence regarding humans' adept inferences from mimicry is consistent with a rich and influential recent literature showing the many ways in which human cognition is well-attuned to its environment (e.g. Oaksford & Chater, 2007; Jussim, 2005; Griffiths & Tenenbaum, 2006). In general, the idea that systematic inaccuracies in well-practiced tasks are the exception, rather than the rule, has much theory and evidence to recommend it. Thus, we should only conclude that models, who have the greatest incentive to understand their mimics, lack third-party observers' ability for nuanced interpretation of mimicry if there is great evidence for this. In general, however, reviews of mimicry have concluded that no explanation is widely accepted (Chartrand & Van Baaren, 2009; Chatrand and Lakin, 2013). Thus, in chapter four, a perspective on mimicry is proposed that aims to reconcile mimicry's status as an affiliation signal with humans' expertise in understanding mimicry. This is done by assuming the functionality of all parties' perceptions and responses, and exploring whether mimicry's status as an affiliation signal can be explained by the idea that mimicry is, at base, connected to social learning and the gathering of implicit information, as implied by experiment 3 above.

Mimicry as an Implicit Determinant of Theory of Mind Judgments

The results of this chapter are also an interesting addition to the literature on social judgments, because they show that trait assessments and even assessments of others' beliefs, normally discussed under the heading of "theory of mind", can be mediated by observation of mimicry. Certainly, the assessment of others' opinions, and even judgments of character could reasonably be called inferences about mind, and here explicit ideas are partially informed by a kind of knowledge that is implicit (For related discussion see Perner, 1996; Apperly and Butterfill, 2009).

Clearly, the information that implicitly internalized by observation of mimicry is eventually used to inform attitudes (i.e. theories) about the mimic, the model, and the situation. Participants' "theories" also seem to be influenced by verbal information, such as experimental cover stories used here. Thus, implicit information resulting from observations of mimicry and explicit thoughts about the observed social actor are *interdependent*, even if they are *distinct* phenomenon. However, we do not know how the relevant implicit information arises, and cannot say much about the precise nature of the division of cognitive labor between implicit and explicit processes.

One class of theories that has attempted to integrate implicit and explicit sources of information about others' beliefs are "mixed simulation-theory theories" of mind such as advanced by Josef Perner (1996). Perner assumes that our propositional attitudes about others (i.e. "Theory Theories") are largely influenced by, and attempt to accommodate and make use of, implicit feelings, which result from various avenues. Even this perspective, though, helps us to form additional questions more than it provides clear answers.

Perner (ibid), using the example of a suspicious character encountered in an alleyway, argues that our feelings about others are not necessarily empathic, even if we

assume that they are driven by implicit "simulations". In this case, feelings of fear reflect, according to Perner, the potential implications of others' actions for the feeler. Additional sources of implicit "feelings about" others include our response when we see an attractive mate, empathic feelings of sadness when we see a grieving family, or non-empathic feelings of suspicion that frequently precede our judgments that others are lying to us. Which of these examples (if any) most closely resembles whatever feelings are aroused by observed mimicry, and lead to social judgments, is an open scientific question.

How Does Subjective Experience Inform Judgments?

There is good reason to assume that mimicry affects explicit thought via some intermediate, consciously available processes. Subjects' responses to questions about how they made decisions show awareness of body language, especially when there is a lack of verbal information. Responses such as "I just went with my gut" or "his body language just told me (that he didn't like the singer)" and "It's just what I felt" are common. But at the same time subjects cannot quite explain what their feelings depended on, explicitly. Experimental results indicate, however, that this lack of explicit knowledge about their decision process does not prevent participants from arriving at valid conclusions.

There are various plausible scenarios regarding the relative contributions of implicit and explicit processes to the interpretation of mimicry. It could be that, in experiment 2 of this chapter, participants who saw a Southern Californian who had been knowingly defamed, received similar information (probably in the form of "feelings") from their implicit processes as did those who saw ignorant interviewees. Participants in the former condition may simply have concluded that a disloyal disposition was needed in order to explain the presence of this information, while for those in the ignorant condition, this was

normal and "expected" in light of explicit knowledge about the situation. It could also well be that participants in various conditions had quite different feelings that informed their decisions in different ways. In short, there is much work to be done before a deep understanding of these suggestive results can be achieved.

An account of the basic mechanisms underlying mimicry's perceptions would be helpful for an understanding nature of observers' feelings about mimics. It could be, for example, that similarity in purely spatial configurations of two bodies is used as a cue to the social relatedness and rapport of individuals. It could also be that the Action Observation Network or "Mirror Neuron System" (Van Overwalle and Baetens, 2009) detects "resonance" between two successive patterns of activation in mirror system, which occur as eye gaze and attention move first from one individual, and then to another. Building on recent experiments that suggests a role of the mirror/motor system in gesture understanding, the next chapter represents an attempt to make progress towards a fuller account of third parties' understanding of mimicry, by investigating the possibility that the human mirror system is involved in the interpretation of mimicry.

Chapter 2 is, in part, being prepared for submission for publication of the material. Kavanagh, Liam; Bakhtiari, Giti; Hess, Ursula; Suhler, Christopher; Churchland, Patricia; Holland, Robert; Winkielman, Piotr. The dissertation author was the primary investigator and author of this material.

CHAPTER 3

Is the Motor System Involved in the Perception of Non-Verbal Behavior and Mimicry? Evidence from the Third Party Perspective

Abstract

Three experiments investigated whether two interference tasks, constant arm motion, and counting backwards by threes, interfere with perception/interpretation of non-verbal behavior and mimicry. In experiment 1, participants in both interference conditions score non-significantly lower than control subjects on a rapport rating task, but only counting interfered with utilization of non-verbal cues. This includes cues related to the arms, which are targeted by the embodied manipulation. Experiment 2 introduces control tasks that require attention and working memory, and requires participants to rate rapport of dyads who do, or do not, display arm-based mimicry. Results of Experiment 2 show separation between experimental conditions on control tasks but again, insensitivity of rapport ratings to either type of load. Finally, in Experiment 3, several measures are taken to produce more sensitive stimuli. Stronger instances of naturalistic mimicry are taken from a larger library of footage, with as many non-verbal cues removed, besides arm mimicry, as possible. Also, a forced choice paradigm is adopted. The results of Experiment 3 suggest that interference with non-verbal judgments can be obtained, experimental conditions perform equally well on control tasks. Results recommend more thorough consideration of the demands placed on general attention by tasks meant to occupy "embodied" resources.

Introduction

Background

Research presented in the previous chapters shows that mimicry influences our impressions of others in subtle ways, but the mechanisms underlying this fascinating process are poorly understood. The current experiments test the notion that interpretation of mimicry involves mental processes in the perceiver that are involved in action execution. In the literature, the general term for these underlying substrates is the Mirror Neuron System (MNS), although many writers prefer the more neutral term of Action Observation Network (AON), which includes the MNS in a wider network underlying action perception. Though the MNS' existence is increasingly accepted (e.g. Hickok, 2014), its role is controversial (ibid; Keysers, 2015; Kemmerer, 2015). The MNS' possible role in understanding implicit non-verbal behavior (e.g. mannerism, gesture, mimicry, etc.) has received little attention compared to the understanding of explicit, often intentional actions (Gallese, Fadiga, Fogassi, & Rizzolatti, 1996), simulations supporting theory of mind (Gallese & Goldman, 1998) and even language (Rizzolatti & Arbib, 1998). However, recent results do suggest a role of the MNS in processing of subtle nonverbal signals.

For example, Kuzmanovic et al, asked participants to make social judgments about job applicants (2012) based on either verbal or non-verbal information, and found activation in the AON-MNS while non-verbal behavior was viewed. Further, the strength of social judgments made in these two conditions correlated with different brain areas, leading the authors to conclude that "qualitatively different cognitive operations underlie person evaluation depending upon the stimulus domain". Di Cesare and colleagues (2015) had subjects watch dyads who made gestures that were similar in their overall motion and

verbal description, but different in their emotional character (e.g. a pushing motion that was either "excited" or "relaxed") and had subjects identify the correct emotional character of stimuli. Results showed that activation in areas associated with the AON-MNS accompanied the viewing of these stimuli, and that change in the strength of judgment was correlated with activity in the insula, also a somatotopic area (ibid).

Of course, the presence of MNS activation, or any other form of correlated embodiment, during action observation does not prove that embodied activity is causally involved in judgments. For this, one needs some evidence that interfering with embodied activity interferes with judgment. For example, observation and mimicry of facial expressions involves activity in MNS regions (Likowski et al., 2012). However, while some evidence shows that such mirroring causally contributes to understanding facial expressions (Oberman, Winkielman & Ramachandran, 2007), other studies find no such effects (Blairy & Hess, 1999). More recent reviews, written by authors on both sides of this debate (Niedenthal, Mermillod, Maringer, and Hess, 2011), have proposed complementary roles for embodied simulation and non-embodied routes, with both being important for understanding different aspects of facial expressions (ibid).

Importantly, however, there are reasons to believe that processing of nonverbal gestures, other than faces, may be more reliant on the "embodied route". Specifically, explicit knowledge is associated with the ability to recognize and reproduce stereotyped and conventionalized patterns of non-verbal behavior, such as posed facial expressions (Gazzaniga & Smylie, 1990; Gainotti, 2012). But, body language, including gestural mimicry, is typically implicitly perceived and more reliant on implicit cognition than facial expressions (Burgoon et al., 2010). Thus, there is some reason to believe that perceiving

nonverbal signals from the body will rely more on implicit embodied simulation than on explicit pattern matching. The current study seeks to shed light on the above issues by interfering selectively with motor resources during the viewing of implicit non-verbal information.

The Current Studies

Motivated by mirror/simulation theories, the current work investigates whether task-irrelevant physical motions *selectively* impair perception of judgments based on arm expressions generally, and mimicry, specifically. This class of methods has a long history in the embodiment literature, where experimental manipulations that induce physical actions have been shown to affect the recognition of facial expressions (Niedenthal, Brauer, Halberstadt, & Innes-Ker, 2001), emotional words (Niedenthal, Winkielman, Mondillon, and Vermuelen, 2009), and language relating to physical action (Glenberg and Kaschak, 2002).

The reasons for supposing that these manipulations could affect perception of mimicry and other rapport signals are straightforward – mimicry is a bodily event[4] and these often result in activity in the mirror system of the viewer (Calvo-Merino, Glaser, Grezes, Passingham, & Haggard, 2005; Filimon, Rieth, Sereno and Cottrell, 2014). Further as mentioned, several recent studies have suggested a role for this system in the understanding of non-verbal behavior (di Cesare et al., 2013; Kuzmanovic et al. 2012; Zaki, et al, 2010). Critically, the activation of the AON-MNS is automatic and implicit, just as judgments about non-verbal behavior are. So, if the AON underlies detection of mimicry

[4] The term "action' is avoided because of its implications of intention.

and rapport then interfering with the particular bodily area by which mimicry/rapport was expressed should interfere with perception of observed motions, and therefore, perception of mimicry, and judgments of rapport.

An important contribution of the current experiments is the investigation of a widely accessible method that can potentially test the motor system's role in the implicit understanding of non-verbal behavior. This method is provided by Ping, Bleilock, and Goldin-Meadow (2013). These investigators had subjects hear action sentences (e.g., "The woman hammered the nail into the wood"). In half of trials, sentences were accompanied by hand gestures that complemented the meaning of the sentence (e.g., hammering gesture). During all sentences, subjects engaged in either continuous arm movement, continuous leg movement or no movement at all. After each sentence, subjects stopped any motion and verified whether the sentence mentioned a specific item (e.g., "nail"). Subjects that were asked to make arm movements took more time taken to respond correctly, while leg movement had no such effect. Though it is possible that these results were obtained because leg movements create less cognitive load than arm movements, these findings are certainly consistent with the hypothesis that the motor system is involved in the understanding of nonverbal behavior. This work also suggests a method to test whether the motor system contributes to the understanding of mimicry and non-verbal signs of rapport.

In contrast to TMS, the experimental method of placing load on the motor system via bodily motion is widely available. These methods are only useful, however, if manipulations demanding motor movements can be decisively shown to produce specific impairment in participants' understanding of others' movements, rather by than producing

general strains on attention. Thus, the current experiments adopt not only control manipulations that are well known to place general demands on cognitive performance (counting backwards by threes), but also control tasks that measure more general cognitive performance. Specifically, control tasks are included that are sensitive to attentional demands (identification of masked letters) and working memory (memory for three letter sequences).

Experiment 1

In the first experiment, participants rated rapport levels in naturalistic dyads while either moving their arms or counting backwards, or while under no demands. The focus of this work was on the ability of "motor load" and more domain general interference conditions to interfere with rapport judgments based on non-verbal behavior, generally, rather than mimicry, specifically. As interference with rapport judgments has not been studied, generally, this question is of interest of its own right. Also, because rapport is a well-studied consequence of mimicry, a demonstration of interference with rapport judgments is one possible way in which the interference of mimicry can be shown. Thus, the current study provides valuable insights into the methodology required for, and the feasibility of, a demonstration that perception of mimicry is interfered with by demands for physical motion. Further a broadening of research focus, to general non-verbal behavior allowed the current experiment to make better use of preexisting stimuli.

The videos of these interactions came from a pioneering investigation of "thin slices" rapport judgments by Bernieri and colleagues (Bernieri, Gillis, Davis, & Grahe, 1996). This study was part of a classic line of research showing that observers are reasonably good (correlations ranging from .2 to .3) at determining the actual rapport level of the dyad from

short (15-50) second randomly sampled segments of video interactions (ibid, Grahe & Bernieri, 1999.) Critically, the interactions used in the current study (see figure 3.1) had been previously rated in terms of rapport by both members of the original dyad, providing a benchmark against which to assess participants' accuracy. They were also rated by independent raters for the presence of a variety of non-verbal cues, which could be used to assess the bases of participants' rapport judgments and whether these changed across experimental conditions. This is only true, however, if representative segments of the previously rated segments are shown. This provided another reason to study interference with a wider set of non-verbal cues, rather than selecting short segments intense in (arm-based) mimicry.



Figure 3.1: A Sample Dyad

As such, these interactions provide promising material to investigate whether observers' ability to interpret physical cues depends on somatosensory resources. Specifically, we were concerned with whether the arm motion task selectively interfered with participants' ability to assess the rapport within dyads that exhibited a high degree of

general arm expressiveness. The videos (which contained sound) showed two participants, one male and one female, who were discussing a social or political issue on which they disagreed. 37 videos samples for the current study were obtained from the original investigators, which had been reduced to 30 seconds each (randomly selected by the original investigators). A subset of 26 videos was selected out of concern for making participants excessively tired (less than 15 minutes of arm motion were required, and the paradigm afforded subjects the chance to rest). 5 Videos were eliminated on the basis of inferior sound and video quality, and the 26 videos were randomly selected from the remaining 32 videos. The videos had relatively low resolution, due to their age, a trait that was viewed as acceptable because it deemphasized facial information, a powerful cue to rapport.

A challenge of the present study was to provide information about the robustness of estimates of rapport to load, including both "motor load" and counting backwards. As established by research into "thin-slices" of non-verbal behavior, subjects converge on estimates of rapport based on pieces of non-verbal footage as little as 15 seconds in length (Grahe & Bernieri, 1999; Gifford, 1996). This is thought to occur because various channels of non-verbal information move observers towards the same overall impression of the dyad (Gifford, 1996; see figure 3.2). On the other hand, the ability of participants to judge rapport under load has never been studied before, so that robustness of rapport estimates to load is unknown.

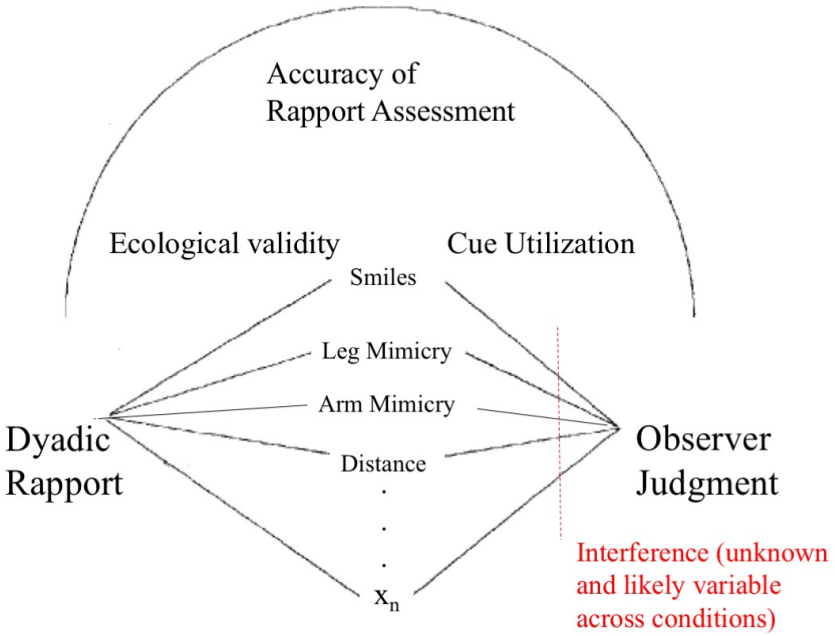


Figure 3.2: The Brunswikian Lens Model
True "dyadic rapport" (left) results in the production of cues (middle), which reach the observer by various channels, resulting in rapport judgments (right.) Research on the AON-MNS implies that some cues and not others are interfered with by tasks placing physical demands on participants.

The types of load induced by the counting and arm motion manipulations were viewed as having the potential to interfere with the utilization of different sets of cues (as represented in the dashed red lines in figure 3.2), and thus affect the accuracy of raters' judgments (represented by the wide arc), differently. Note that cue utilization is defined as the dependence of participants' judgments on cues (i.e. correlation), and can be studied independently of accuracy, the correlation of participants' judgments with actual rapport ratings (Bernieri, et al., 1996.) The counting task demanded that participants occupy their working memory and attention with internal recitation of numbers. This general demand on attention was thought to be likely to interfere with both non-verbal and verbal information and therefore to reduce accuracy.

An embodied perception perspective implies that the arm motion manipulation would also interfere with non-verbal information. Specifically, the results of Ping et al. (2013), if valid and generalizable to other forms of non-verbal behavior, would imply that the motor load task specifically interferes with information communicated *via the arms*. Recall, a control task in this study was leg motion, with the difference observed across conditions implying that demands for motion in one effector do not interfere with embodied information, generally. As mentioned, it is also possible that the effects seen in previous research were due to simple demands on attention. If the latter were the case, then another prediction follows — arm motions should reduce *overall* accuracy and cue utilization, but they should not *differentially* affect accuracy of videos that were high in arm motion.

For the counting task, subjects counted backwards by 3 (rather than a higher number), so that sensitivity of stimuli to interference could be measured against considerable, but not maximal, demands on attention. That is, it is a priori certain that some level of general interference would interfere with non-verbal judgments. So, rather than aiming to prove that interference was possible, the current study used a relatively mild level of interference in order to better judge whether the stimuli chosen were sufficiently sensitive to allow a test of the main experimental hypothesis.

Methods

107 undergraduate participants (62% Females, predominantly college juniors) from the University of California, San Diego (UCSD) participated for extra course credit. Participants were divided among three conditions: the control condition (n=35) in which participants had no distraction, the counting task (n=37), and the arm motion manipulation (n=35) drawn from Ping et al. (2013). Participants were run in one condition in each

experimental time slot, in order to prevent participants in the arm condition from feeling that the demands of their condition were unfair, vis-à-vis the control condition. Participants were met by the experimenter and given an explanation of the meaning of the word "rapport", to avoid any possibility that they would be confused by the main DV.

In the arm-motion condition, participants were given detailed verbal instructions on how to move their arms prior to the experiment, along with a physical demonstration. Participants were told that they could go home at any time (with credit), if they felt unable to perform the task, and were instructed that arm motions should be continuously performed from the time of a cue (a tone). As in Ping et al. (2013), participants were told that they could make any movements that they wanted, as long as these movements were not repetitive or cyclical in any way. This requirement is thought to place consistent demands on motor resources that are important for understanding others' movements, both intentional and unintentional (Reed & Farah, 1995, and Reed & McGoldrick, 2007). These instructions were also repeated on the computer screen prior to the start of the experiment.

After reading the instructions and seeing a sample video, participants watched the video stimuli. Three seconds before each video, the participants were told to start moving their arms, to start counting backwards from a provided number, or simply to wait for the video (depending on their condition). Immediately after each video, subjects were cued (with another tone) to stop waving their arms, to stop counting, or, to press the spacebar (depending on their condition). Next, they provided their rapport ratings for each video. They then spaced any key to advance to the next video (giving them time to rest.) Additionally, subjects in the arm-motion condition were reminded to move their arms if they were not doing so at any point during the experiment.

Analysis and Results

All subjects' data was imported to JMP for analysis. To measure the accuracy of participants' rapport estimates, these were correlated with original dyad members' rapport estimates, and then subject to a Fisher's *z* transformation to allow for comparison across experimental conditions. For each participant, separate Fisher's *z* statistics and were created for the two halves of the stimulus set -- videos split according to coders' ratings of the amount of arm expressiveness contained. Further, another split was performed by overall gesture as assessed by Bernieri and colleagues' original raters. This variable included only non-verbal acts that "have a verbal equivalent", and thus tracked actions that were similar in kind to those seen in Ping's original study. Original dyad members had a 17-question Likert-type scale questionnaire on feelings of rapport, and the rapport index was created as an average of these responses over both dyad members (see Bernieri et al., 1996).

The average of the Fisher-transformed correlations between original dyad's rapport ratings and the estimates of rapport given by individual participants in the current study was .18, almost equal to the participants in Bernieri's et al. (1996), original study, who scored .19. When individual participants' estimates of rapport were first averaged over individual videos (creating *consensual judgments)*, and then these averages rapport estimates were correlated with original dyads' reports of rapport, a correlation of .30 was achieved, the same score as was achieved in the earlier study (ibid.) This indicates a "wisdom of the crowd" effect whereby group estimates outperform individuals' estimates, which was also seen in previous studies.

Table 3.1: Correlation Coefficients Between Mean Rapport Estimates and Cues in Current Study and in Bernieri, et al. 1996

Cue	Pearson r – Bernieri, et al. 1996	Pearson r -- Current Study (Across All Three Conditions)
Attractiveness (mean)	.23	.23**
Expressivity	.61**	.56***
Eye Contact	.22	.26**
Forward Lean	.10	.09
Gesture[2] (Female)	.16	.14*
Gesture[2] (Male)	.16	-.04
Laughter (Female)	N.A.	.25**
Laughter (Male)	N.A.	.19*
Mutual Silence	-.14	-.03
Nervous Behavior	-.31*	-.07
Proximity	.48***	.33***
Regulators[1]	.48**	.42***
Racial Similarity	-.28*	-.43***
Smiling[γ]	.51***	.10*
Synchrony/mimicry	.35*	.39***

*Significant at .05 level **Significant at .01 level level *** Significant at .001

[γ] Significantly different across experiments at the .05 level

1 Refers to "uh hmms." and similar auditory signals, as well as head nods.

2 Refers specifically to arm motions “with word equivalents”

Further, following Bernieri and colleagues, consensual judgments (i.e. average impressions of rapport) were correlated the strength of individual non-verbal cues, as arrived at by Bernieri and colleagues' original raters. These, again, were broadly similar to the scores reported by Bernieri and colleagues (see table above). Only smiling showed a significant difference across experiments, an effect that may have been due to the age of the videos (reducing their acuity.) As mentioned, this was not seen as a negative trait.

Accuracy Across Conditions

Critically, there was no overall significant effect of experimental condition on the correlation between participants' rapport ratings and the original dyads' ratings. Fisher's z scores were slightly lower in the arm motion condition (*z'* = .17) than in the control condition (*z'* = .21). Participants in the counting condition scored lowest (*z'* = .15). Pairwise t-tests did not reveal a significant difference in accuracy between the control condition and either participants assigned to the counting condition [t(106) = -1.53, p = .18, two-tailed] or the arm-motion condition [t(106) = -.90, p = .37, two-tailed].

Table 3.2: Comparison of Accuracy -- High v. Low Arm Expressiveness Videos

	Average Accuracy in Judging Rapport (Fisher's z)		**Differences in Accuracy Across Video Types**			**Contrasts: Differences in Accuracy Across Conditions**	
	Low Arm Expression	High Arm Expression	Difference	Stand. Error	p-value, diff from other conditions		p-value, difference in contrasts
Arm Motion	.05	.32	.27	.068	.27	Arms - Controls	.55
Counting	-.05	.35	.40	.068	.89	Counting - Control	.41
Controls	.07	.39	.32	.066	.41	Counting – Arms	.16

Next, participants' accuracy in rating two separate halves of videos, split by levels of arm expressiveness, was assessed. Comparing across video categories, there was a highly significant effect of arm expressiveness, such that participants' rapport estimates were more accurate for highly expressive videos [$t(104) = 8.98$), $p<.0001$]. Average Fisher's *z* for low arm expressiveness videos were not significantly greater than zero (*z'* = .02), while the highly expressive pairs showed an average *z'* of .35[5]. As predicted, among high gesture videos, participants in the arm-motion condition were less successful than control participants in judging rapport [*z'* = .32 vs. .39, $t(106) = 1.12$, $p = .23$] but not significantly so. Participants in the counting condition also scored non-significantly worse than controls [*z'* = .35 vs. .39, $t(106) = .66$, $p = .51$]. Among the low-expressiveness videos, results showed that participants who counted backwards displayed a marginally significant difference from controls ($p=.06$, see table 4.2), and accuracy was highest among participants in the control condition.

Finally, a MANOVA analysis was conducted, contrasting the differences in accuracy between video types. As implied by experimental hypotheses, the arm motion condition was compared to the other two conditions, combined. Results showed that "arm movers", compared to other conditions, showed non-significantly less improvement in accuracy when they saw videos that were higher in arm motion ($p = .27$.) Thus, though the relative levels of accuracy across conditions were consistent with the idea that arm motion interferes more with the judgment of videos containing high arm expressiveness, the magnitude of differences seen could easily be produced by chance.

A similar split halves analysis was performed by splitting the video files according to ratings of gesture obtained from the codings of Bernieri and colleagues' (1996) original trained raters. It should be remarked that this measure of gesture targeted only hand and arm motions "that had word equivalents", and as such, is different from arm expressiveness, generally (r=.40). Thus, a median split by this variable can be seen as studying similar effects as did Ping et al.'s original work (2013.) When split by this measure, participants did not show significant differences across conditions by video type (p = .59). However, within video types, there were marginally significant effects. When rating videos low in gesture, participants in the counting condition scored marginally lower than controls (p = .06). On the other hand, when rating videos high in gesture, participants in the arm motion condition scored lower than controls (p=.11). When levels of accuracy in rating high v. low gesture videos were differenced within participants, an overall difference between experimental conditions was observed (see table below.)

Table 3.3: Comparison of Accuracy -- High v. Low Gesture Videos

	Average accuracy in judging rapport (Fisher's z)		**Differences in Accuracy Across Video Types**			**Contrasts: Differences in Accuracy Across Conditions**	
	Low Gesture	High Gesture	Difference	Stand. Error	P-value, diff from other conditions	Between Condition Contrasts	p-value
Arm Motion	.19	.08	-.11	.068	.05	Arms - Control	.36
Counting	.09	.18	.09	.068	.03	Counting-Control	.21
Controls	.20	.17	-.03	.066	.92	Counting – Arms	.03*

Though this analysis, comparing performance across halves split by gesture, did give results consistent Ping and colleagues (2013) original findings, several concerns arise

in the interpretation of these effects. Firstly, since neither experimental condition was significantly different from controls, the difference between experimental conditions cannot be attributed to one or the other manipulation. Secondly, the significance of the contrasts depends on the low accuracy of participants in the counting condition on the low-gesture videos. This is in contrast to the control condition, which showed approximately equal accuracy on both video categories. It is possible that the improvement in accuracy across conditions takes place because higher levels of gesture were especially helpful to counting participants in assessing accuracy, vis-à-vis other cues that are interfered with. However, utilization scores in the next section show lower, rather than higher, use of gesture by participants in the counting condition in construction of rapport judgments. Still, this finding is consistent with previous results, and may indicate that more tightly controlled stimuli, or more advanced data analysis in a similar paradigm, could uncover evidence of an effect of arm motion on judgments of rapport.

Overall, results among highly expressive videos spoke to the robustness of assessments of rapport, such that participants were able to utilize the cues that were available to arrive at relatively similar rapport assessments, despite any interference introduced by experimental manipulations. Naturalistic stimuli provide subjects with a variety of cues, however, so that the importance of any one cue to final judgments is low. As such, participants may have been able to compensate for real interference with the ability to process expressive arm motions (or any other cue) by the use of other cues. Thus, a follow up analysis was performed to investigate the roles that specific cues played in rapport judgments, and whether these roles changed across experimental conditions.

Cue Utilization

Another common measure from the non-verbal literature is cue utilization – the Fisher-transformed correlation between trained raters' assessments of cues and individual participants' rapport ratings (Bernieri et al., 1996, Gifford, 1996). These statistics can be used to show what cues participants in different conditions actually use to make their judgments. These measures are distinct from the ability to arrive at accurate judgments, which is measured by the correlation between participants' rapport estimates and actual dyadic rapport levels. Subjects' rapport assessments are more highly correlated with several cues to rapport than with original dyad's actual rapport levels, affording greater opportunity to show interference with utilization measures by an interference task.

In order to compare the effects of the two kinds of load on cue utilization, correlations were computed between each participant's series of rapport estimates for the set of videos and the preexisting ratings of cue strengths (from trained coders) for the set of video stimuli. These individual correlations measures were converted to Fisher's z scores, to create measures of each participant's utilization of a particular cue. Next utilization measures were compared across conditions.

Table 3.4: Differences in Cue Utilization Across Experimental Conditions
The average correlation (Fisher transformed) between an individual participant's estimates of rapport and various non-verbal cues, broken down by experimental conditions.

	Attractiveness		Arm Expressivity		Expressivity (Avg.)		Expressivity (Female)	
	Fisher z	p-values	Fisher z	p-values	Fisher z	p-values	Fisher z	p-values
Arm Motion	.11		.13		.37		.33	
Controls	.15		.10		.34		.36	
Counting	.15		.05		.28		.26	
Arms-Counting	-.032	.42	.080	.10	.083	.15	.071	.14
Count-Control	-.004	.91	-.055	.25	-.055	.33	**-.100**	***.04***
Control-Arms	.036	.36	-.025	.59	-.026	.64	.028	.56

	Expressivity (Male)		Gesture (Average)		Gesture (Female)		Laughter (Female)	
	Fisher z	p-values	Fisher z	p-values	Fisher z	p-values	Fisher z	p-values
Arm Motion	.10		.02		.12		.10	
Controls	.09		-.02		.08		.19	
Counting	.12		.00		-.02		.11	
Arms-Counting	.027	.49	.019	.70	.143	***<.01***	.010	.86
Count-Control	.028	.47	.017	.65	-.095	***.01***	.075	.14
Control-Arms	-.001	.98	-.036	.40	-.047	.20	.085	.10

	Laughter (Male)		Mutual gaze		Proximity		Racial Similarity	
	Fisher z	p-values	Fisher z	p-values	Fisher z	p-values	Fisher z	p-values
Arm Motion	.10		.11		.19		-.23	
Controls	.08		.10		.26		-.30	
Counting	.13		.08		.15		-.22	
Arms-Counting	-.035	.36	.029	.49	.048	.27	-.016	.68
Count-Control	.049	.21	-.026	.52	**-.111**	***.01***	.079	***.04***
Control-Arms	.013	.73	-.003	.95	.062	.15	-.062	.11

	Regulators (Male)		Regulators (Female)		Synchrony/ Mirroring		Smiling	
	Fisher z	p-values	Fisher z	p-values	Fisher z	p-values	Fisher z	p-values
Arm Motion	.17		.24		.26		.04	
Controls	.24		.28		.25		.05	
Counting	.19		.18		.19		.08	
Arms-Counting	.015	0.69	.055	.19	.073	.09	-.044	.35
Count-Control	-.048	0.19	-.102	***.01***	-.065	.13	.029	.53
Control-Arms	.063	0.09	.047	.26	-.008	.85	.015	.75

Consistent with their task's demands on general attention, participants in the counting condition showed significantly reduced utilization of several cues (See table 3.4). Results show that counting condition scored lowest on utilization of 9 out of 16 cues measured. These differences from controls reached significant levels on measures of female expressivity, female gesture, proximity, racial similarity, and female non-verbal "regulators" (primarily "mmm-hmms").

Notably, the arm-moving participants did not show significant reduction in utilization on any cue, as opposed to controls (see table.) If the arm motion manipulation were generally distracting, it would be expected to produce broad decreases in utilization scores, this was clearly not the case. It is worth noting that levels of utilization of gesture and arm expression, which would in theory be most affected by demands for arm motion, were low across all conditions. This could imply that either these cues were not the focus of participants' attention or that they did not have a linear relationship with participants' rapport ratings (see discussion below.)

Discussion

Results show that, though the counting task interfered with perception of some cues, the overall accuracy of rapport impressions based on those cues was not significantly affected. Apparently Information presented in 30-second clips was great enough that even significant interference with attention, as shown by some utilization measures, was insufficient to affect accuracy. This result extends findings from thin-slice research, suggesting that viewers of non-verbal interactions form impressions very quickly using a

variety of redundant cues (Gifford, 1996). With reference to the goals of this chapter, this result argues for greater control of cue availability in experimental stimuli.

Results from the utilization analysis certainly suggest that counting could have interfered with rapport judgments by impairing the utilization of several cues. Utilizations measures did not point to any obvious means by which arm motion might have interfered with rapport judgments in the current experiment, however. Of course, this does not prove that demands for physical motion cannot affect judgments based on non-verbal behavior. Arm expressiveness and gesture, the cues targeted by the embodied manipulation, explained a low percentage of the variation in participants' overall rapport ratings. It is possible that these cues were not attended to strongly and represented too small a share of total information absorbed to significantly affect accuracy results, or have a non-linear relationship with rapport measurements that is not well measured by utilization scores.

Though differences in accuracy were not large enough to draw strong conclusions, relative levels of accuracy across conditions were consistent with experimental hypotheses. These results *could* hint that arm motion interfered with rapport ratings in the hypothesized manner. It should be noted that, unlike utilization analysis, the above comparison of accuracy across video categories does not imply a linear relationship between cues and rapport estimates. It is possible that analytical methods taken from the probabilistic modeling and information theory literature could be used to more efficiently study non-linear relationships between cues and rapport ratings of naturalistic dyads. Such analytical methods might have greater power to uncover whether accuracy is increased in the presence of particular cues, and whether this relationship is mediated by interference tasks. That is, cue strengths can be seen as an indication of the amount of information, good or

bad, that is available, such that accuracy should increase in their presence. This may be the case even if there is not a reliable linear relationship between the strength of a given cue (e.g. amount of gesture or expressive arm motion) and participants' rapport ratings. However, given the desirability of tightly controlled experimental paradigms that can translate to neuroscientific research (i.e. fMRI or TMS), and the state of controversy regarding embodied perception, the following studies focused on assembling a paradigm that had the potential to give results with simple analytical methods.

In sum, results above cannot be seen as conclusive evidence, either way, for the importance of embodied processing in assessment of non-verbal stimuli. Rather, it may argue for the use of more controlled stimuli, which would force participants to rely on arm activity when making critical judgments. Thus, in following studies, greater control over stimuli was exercised, so that arm motion would represent a greater share of the total nonverbal information present. Further, instead of utilization analysis, control tasks were used to provide measures of the general interference induced by the two experimental conditions.

Experiment 2

In preparation for experiment three, another experiment was conducted to investigate the degree to which the two experimental conditions impaired attention and working memory. This was important because, the previous utilization results not withstanding, intense arm motion can reasonably be suspected to place load on the resources underlying non-embodied routes of processing. Thus, even if “motor load” manipulations, were to interfere with the perception of newer, more sensitive non-verbal stimuli, this interference cannot necessarily be attributed to demands on the motor system.

Rather, arm motion could interfere with the utilization of both embodied and non-embodied cues.

The most obvious means by which arm motion could reduce ability to utilize cues to rapport is by placing demands on attention. In other words, moving one's arms constantly may simply demand attention, thereby reducing the amount of resources that can be devoted to evaluating video stimuli. To address this possibility, a letter identification task, in which participants had to identify whether a briefly flashed letter was an "A" or "E" was included in the experiment. Another possibility is that constantly moving one's arms places a strain on working memory (especially if one grows tired), thereby making it more difficult to retain memory of impressions, or to deliberate, while rapport is being assessed. If this were the case, participants in the arm-motion condition should show impaired performance on memory tasks. Therefore, a task in which participants attempted to correctly recall strings of three letters was introduced.

Modified versions of the stimuli used in experiment 1 were also included. In order to keep the total length of the experiment similar to experiment 3, which was under preparation, 10 second video clips were selected. Also, in order to eliminate a cue that could be utilized even if perception of gestural cues was impaired, videos were presented without sound. This also allowed the isolation of video segments containing the strongest acts of arm mimicry exhibited in the library of videos. In contrast to the arm motions measured by the expressiveness index used in the previous study, which were not assumed to impact rapport positively or negatively, the literature predicts positive effects of mimicry on rapport judgments (e.g. Grahe & Bernieri, 1999). Ten candidate video segments of varying intensity of mimicry were identified from the same set of videos used in

experiment 1. Ten video clips (each of which were eight to ten seconds long) were constructed to contain these acts of mimicry, with as little other strong expressiveness as possible. The acts of mimicry in the videos were subtle (e.g., several showed both parties quickly running their hand through their hair, or subtly playing with their clothes), however, it was thought that, in shortened videos, these acts of mimicry could still represent a significant portion of the non-verbal information. Ten control video clips, that contained very little arm motion, were also used. Thus, participants saw 20 videos that were trimmed down to ten seconds each.

It should be noted that, by choosing segments of stimuli in a non-random fashion, the ability to use original rapport measures as an accuracy benchmark was jeopardized. On the other hand, if the valence of non-verbal expressions is known, then predictions can be made about the effects that will follow from interfering with the perception of these expressions. As mentioned, mimicry is widely seen as a signal of rapport — thus arm based interference should produce lower assessments of rapport on these measures. However, arm interference should interfere selectively with ratings of videos showing arm expressiveness.

Methods

The most important goal for Experiment 2 was to identify control tasks that aid in the determination of whether the arm motion and counting tasks place different demands on domain general resources. All tasks of a particular type were presented together in a single block, with the order of blocks randomized across participants. The first control task was a memory paradigm: On each trial, subjects were first presented, for 2000 msec, with a string of 3 letters. The 3 letters seen formed, with equal probability, either words,

pronounceable non-words, or unpronounceable non-words. Stimuli were drawn from list of stimuli based on Peterson & Peterson (1959) and subjects saw 96 words overall. After seeing the word string, participants were cued with instructions, for 1500 msec, to begin either counting backwards (starting from a random number), to begin moving their arms as instructed, or to simply wait for the presentation of the letters (in the control condition). Next, after a variable delay, ranging from 1000 to 16000 msec in 3000 msec increments (again, following Peterson & Peterson, 1959), participants were cued with a tone. This tone signaled that participants should discontinue their respective load-inducing task (if any) and wait for the opportunity to enter in a response to the recall task. After a 500 msec delay, subjects were presented with an opportunity to respond. This last delay was introduced in order to control for potential differences between load conditions in the amount of time that participants might take to cease performance of their load inducing task.

The second control task was based on Santee & Egerth (1982). Subjects identified which of two masked letters (always either an "A" or "E") was presented. Prior to starting each trial, subjects saw a 3000 msec instruction to begin either counting or arm-motion (depending on their assigned load task.) Next, a fixation cross was presented, and remained for a variable length of time.

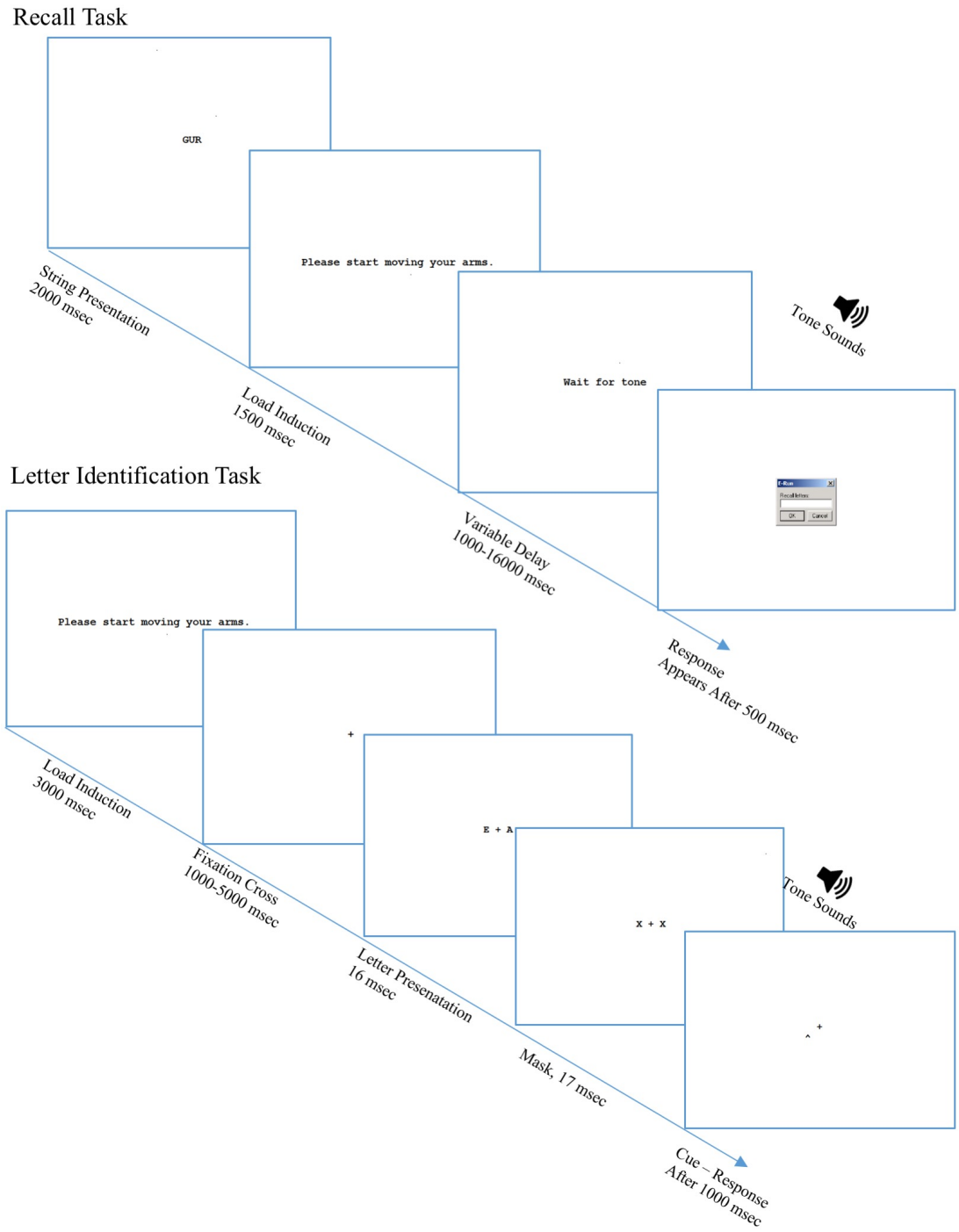


Figure 3.3: Trial Procedure for the Recall and Letter Identification Tasks
Above, the motor load condition is pictured. For subjects in other conditions, text in the load induction slide read either "Please start counting backwards from ***x***", where ***x*** was a random 3-digit number between 100 and 1000, or simply "please wait"

Potential durations of the fixation cross were 500 msec apart, ranging from 1000 to 5000 msec. Each of these extremes, and each of the intervening times was equally likely to be selected as a duration for the fixation cross. After the fixation cross, two letters were briefly presented — one in either of two potential locations on either side of fixation cross. These letters always included at least one A or one E. These lasted for 16 msec, and were followed, for 17 msec., by a mask (i.e. the original letters were immediately replaced by an "X"). Immediately after the mask, a tone sounded and simultaneously, a cue appeared underneath one of the locations were letters had previously appeared for 1000 msec. The cue always appeared under a location where an A or an E had appeared. This was accompanied by a tone signaling subjects to stop performing their distractor task and prepare to respond (or in the control condition, simply to wait). Finally, after a 2000 msec. delay, subjects were given the opportunity to respond with either an "A" or an "E", indicating what letter had appeared in the cued space.

As before, participants also rated videos on the level of exhibited rapport. Three seconds before each video, participants were told to start moving their arms, to start counting backwards from a provided number (between 100 and 999), or simply to wait for the video. Immediately after each video, subjects were cued to stop counting, or to stop waving their arms, and press the spacebar. Next, they provided their rapport ratings for each video.

Analysis

Control Tasks

Responses from all participants (83 UCSD undergraduates, 74.3% Female) were converted to accuracy scores, and overall accuracy rates were computed for each of subject on the two control tasks. The obtained scores were analyzed in JMP. As expected, participants in the counting condition showed significant differences from controls on both the memory and letter identification tasks. Participants in the control condition (n=23) identified 79% of letters correctly, while participants in counting condition (n=33) identified only 71% correctly [t(81) = -2.46, p = .013, one-tailed].

Table 3.5: Performance on Memory and Letter Identification Tasks (Experiment 2)

Memory Task

Means	Mean % Correct	Std. Error	**t-tests**	Difference	t-Ratio	p-value
Arm Motion	0.923	0.029	Controls - Arms	0.005	0.11	0.93
Controls	0.928	0.026	Controls - Counting	0.160	5.32	<.001
Counting	0.767	0.032	Arms - Counting	0.156	5.53	<.001

Letter Identification Task

Means	Mean % Correct	Std. Error	**t-tests**	Difference	t-Ratio	p-value
Arm Motion	77.9	0.023	Controls - Arms	1.3	.42	0.67
Controls	79.2	0.020	Controls - Counting	8.2	2.56	0.012
Counting	71.0	0.024	Arms - Counting	6.9	2.06	0.042

On the memory task, participants in the control condition identified 93% of words correctly, while participants in the counting condition identified only 77% correctly [t(81) =-4.77, p<.0001, one-tailed].[6] Participants in the arm-motion condition (n=27) identified

[6] This was after the exclusion of three subjects in the control condition whose data had been lost in the memory task, apparently due to an unresolved programming glitch.

92.3% of words correctly and 78% of masked letters correctly, such that performance on neither the memory [t(81) = -.08, p = .46, one-tailed], nor the letter identification task [t(81) = -.42, p = .34, one-tailed] was different from control. Thus, we observed no evidence that arm motion significantly interfered with attention or working memory.

Finally, and most critically, this lack of interference also meant that the performance of participants in the arm-motion was significantly better than those in counting condition on both the memory [t(81) = -4.43, p <.001, two-tailed] and letter identification tasks [t(81) = -2.04, p < .05, two-tailed]. Given these results, it was concluded that the selected control tasks could show differences in demands on cognitive resources between experimental conditions.

Non-Verbal Behavior

As before, data was imported into JMP for analysis. First we looked at whether the experimental manipulations affected rapport ratings differently, depending on the presence of mimicry. MANOVA analysis was conducted contrasting the average of rapport ratings across mimicry videos and the average of ratings across the unexpressive videos. If mimicry videos powerfully signaled positive rapport, and mimicry perception was interfered with selectively by arm motion, then rapport ratings of mimicry videos should be reduced by the arm motion manipulation, while rapport ratings of other videos which contained little arm expressiveness motion of any kind should be unaffected. MANOVA scores revealed no evidence for a difference in participant ratings by video type and experimental condition (all p's > .46). indicating that the perception of positive rapport, typically signaled by mimicry was not interfered with.

Also, by the same methods as explained in experiment 1, Fisher's *z*' was calculated as a measure of the average correlation between rapport estimates for all videos. The average of Fisher's *z*' was slightly negative (-.03) but only marginally so ($t(83) = -1.83$, $p=.07$), and was not significantly different across experimental conditions (all p's > .65). When mimicry videos were considered alone, correlations of participants' estimates with original dyad estimates overall was only slightly greater than chance [$M=.09$, $t(83) = 2.49$, $p=.015$], and likewise did not show significant differences across conditions(all p's >.49). Tellingly, participants' estimates of rapport in the unexpressive videos were negatively correlated with those of original dyads. These results indicate that the non-random selection of segments of video had indeed created segments that were unrepresentative of the true levels of dyadic rapport. As such, the accuracy of participants' guesses cannot be said to reflect on the experimental hypotheses, one way or another. See table below for full results on this measure.

Table 3.6 Accuracy Across Video Conditions, Experiment 2

	Average Accuracy Level (Fisher's z)			**Differences in Accuracy Across Video Types**		
	All	Low Arm Expressiveness	High Arm Expressiveness	Difference	St. Error	P-value, diff from control
Arm Motion	-.04	-.11	.06	.17	.068	.55
Control	-.08	-.10	.09	.19	.068	---
Counting	.-05	-.15	.12	.27	.066	.41

Discussion

The main goal of the current experiment, to establish that arm motion and counting backwards differentially affect measures on control tasks seemed to have been

accomplished. Measures on both the memory and letter identification tasks showed that arm motion did not affect general executive function or attention, while as, heavily suspected, counting backwards did. Given these results, it was concluded that the selected control tasks had the power to show the specificity of arm motions' interference with non-verbal information, should such interference exist.

Because neither experimental condition affected ratings of mimicry videos significantly, these results cannot be seen as evidence for or against the experimental hypothesis. There was very little evidence that interference of any kind reduced the rapport ratings on mimicry videos, which was puzzling, given the great amount of experimental evidence in favor of mimicry as a rapport signal. For example, the results in chapter 2 experiment 3 showed that a single act of mimicry can be a powerful signal of agreement. One potential explanation was that, given the experimental demand that dyad members disagree, several the instances of mimicry may come in the context of responses to dips in rapport during disagreement. Since dyads were forced into disagreement, this behavior may have occurred relatively often in this sample. This effect can be thought of as analogous to experimental results showing that mimicry increases after failed affiliation attempts (Lakin and Chartrand, 2003), or social exclusion (Lakin, Chartrand, & Arkin, 2008). It may be that such mimicry sends "mixed signals" to participants. The video contents were not representative of non-verbal interactions as a whole, but were recorded between strangers who placed under experimental demand for disagreement. Thus, the likelihood of this behavior may have increased considerably, compared to its prevalence under normal ecological conditions. Therefore, experiment three drew stronger examples of mimicry

from dyads who were engaging in a more ecologically valid task – simply meeting one another. Further, forced choice methods were adopted to increase sensitivity of stimuli.

Experiment 3

This final experiment was motivated by the concern that the stimuli used previously were simply not sufficiently sensitive to show interference of arm movements with perception of non-verbal expression via the arms, and in particular, mimicry. As mentioned, acts of strong arm mimicry were isolated, were few, and were subtle. Also, they were typically present along with many other cues such as sitting distance, body lean, and facial information that might dilute the importance of mimicry acts, alone, to participants' impressions of rapport. Further, as an experimental measure, psychometric ratings such as rapport measures themselves can be thought to be less sensitive (Anderson, 2001) than forced-choice tasks usually employed with interference paradigms (Ping et al, 2013, Borgomaneri, Gazzola, & Avenanti, 2014).

Thus, in the current experiment, the same control tasks were employed, combined with experimental stimuli that involved stronger arm mimicry, but less non-verbal information from other sources. Early studies showed that mimicry (along with synchrony) is a cue to the authenticity of (mother infant) interactions (Bernieri, Reznick, & Rosenthal, 1988.) Thus, participants were asked to make forced choice judgments of the authenticity of interactions, with the hypothesis that mimicry would be helpful in identifying natural interactions. In each trial of the experimental task, participants were presented with two dyads, and asked to decide which of these was a real dyad. In each pair, one video showed truly contemporaneous non-verbal behavior that involved arm-based mimicry, and the other video showed a pair whose actions were not made contemporaneously and did not

constitute mimicry. If embodied manipulations impede participants' ability to judge the naturalness of interactions more than they impede performance on control tasks, this would support the view that understanding of non-verbal behavior generally, and mimicry specifically, is mediated by the motor system. The fact that performance on control tasks were not affected by demands for arm motion in experiment 2 gave reason to expect that the present methods have the potential to show such a dissociation.

Construction of Stimuli

In order to isolate better examples of mimicry, recordings of much longer interactions were sought out. Strong mimicry of arm movements, like any other specific non-verbal behavior occurs only infrequently, so in order to isolate specific instances of non-verbal behavior, such that mimicry of arm movements would be the dominant non-verbal element in the stimuli, source material of greater length would be required. Stimuli were thus created using a set of computer generated three-dimensional representations of real interactions between individuals who had just met one another (Bente, Roth, Dratsch, & Kaspar, forthcoming.) These 30 interactions were between 6 and 15 minutes in length, rather than the 30 seconds of footage per interaction that were available from the previous set of videos.

The 3D data that comprise a record of these interactions is stored as an abstract representation of the spatial coordinates of a particular actor's joints and effectors (i.e. a "simplified skeleton"), and the angles at a particular joint at a particular time (Bente, Senokozlieva, Pennig, Al-Issa, & Fischer, 2008.) One issue with the recordings, however, is that attaching the exterior texture to a virtual character, giving it the appearance of a real human, rather than a virtual mannequin, is extremely intensive in terms of both time and

the computational power required. Further, this depends on specialized expertise and software not available at UCSD. Since the attaching of skins must be redone for each interaction pair, it was necessary to derive stimuli from a few interactions. An offsetting favorable characteristic of these stimuli, however, is that their computer-generated nature allows several instances of mimicry from the same dyad to be plausibly believed to originate from distinct "flesh and blood" dyads. That is, once a lifelike exterior texture was attached, this could be used for several interactions. This affordance was useful because strong mimicry tended, in the set of interactions, to be concentrated in relatively few dyads.



Figure 3.4: A Sample Computer Generated Dyad

The 3D recordings of naturalistic interactions were reviewed for instances of mimicry involving relatively transient but expressive movements of the arms. The two interactions with the greatest number of strong instances of arm-based mimicry were selected, and specific times at which particular acts of mimicry occurred were marked,

resulting in a pool of 20 candidates for clips of real interactions. Three different exteriors were attached to the characters in each interaction, and videos were then rendered from five different angles, so as to allow full views of the character's motions at different points in the video (similar to Bente et al. in preparation., see also Roth, 2016.)

Individual mimicry videos were created by identifying ten second segments from videos clips and combining *two separate* 2-D video renderings of that segment, each from a different camera angle. As the interactions were documented in the form of 3-D renderings, in principle, any camera angle was possible. In contrast to the attaching of computer generated exteriors, rendering to different angles is easily accomplished. To allow the portrayal of mimicry acts, participants saw each character from a viewpoint that allowed the view of their front. The two members of the dyad were presented in split screen format against a black background. A blue line was inserted to act as a divider between the actors (See figure 3.4).

There are several reasons for showing the two halves of the interactions from different camera angles in a split screen fashion, as in Bernieri, et al (1988). Firstly, this method of presentation prevents participants from focusing on cues such as distance and eye contact, which are informative of social closeness themselves. Secondly, as the mirror system is a means of resolving other people's actions onto one, common space, namely one's own bodily space, it must be capable of near instantaneous "rotation" of others motions onto our own, egocentric space. That is, if mimicry is truly perceived in a multimodal manner, via one's own bodily space, then this implies, as has been shown in the mirror literature, an immediate activation of congruent somatotopic areas corresponding to one's own bodily representation (Filimon, et al., 2014). Thus, in theory,

mirror processing should not be impeded by changing angles. On the other hand, viewing pairs of people across from each other gives a more symmetrical scene, the relationship between the two characters in space might be supposed to be more facilitated by this standard presentation. Finally, the most important confounding channel of information is the face. The original recordings do not capture facial data, eliminating facial input.

In order to create clips of false interactions, one half of each clip was preserved but was matched with every other selected clip which contained transitive arm movements. Thus, a total of 380 potential interactions (i.e. one half of each of 20 clips each paired with another half of the other 19 clips) interactions were created, and were rated for degree of mimicry on a positive-seven (high mimicry) to negative seven (low-mimicry) by three coders. Pairs of "fake" interactions were then selected by using a sorting algorithm to identify the combinations of segments that allowed for the highest differential in mimicry scores between real videos and constructed videos. This was thought necessary, given the extreme insensitivity of previous stimuli to relatively distracting tasks.

Sets of real and fake pairs were posted on Amazon Mechanical Turk as a rating task for twenty-five raters, who were simply asked to identify the real pair in each interaction. Overall, the stimuli set scored significantly above chance with 57.8 percent of correct pairs being identified [$t(25) = 2.74$]. To increase the power of stimuli, four pairings that had low differences between the ratings given to the mimicry and non-mimicry segments by in-lab coders, and had not been identified at greater than fifty percent chance by 25 raters, were removed from the set of final stimuli. This resulted in 16 interactions being selected as final stimuli for the experiment, which had been correctly identified at a rate of 61.7% in online norming. When asked about the purpose of this experiment, and the basis by which they

identified stimuli, no m-Turk participants spontaneously offered any statements related to mimicry. The same was true of participants in the main experiment.

Experimental Procedure

115 UCSD (39 Control, 38 counting, 38 arm motion) undergraduates participated for course credit (32.4% male, 67.6% Female, Avg. age 20.7 yrs.). The experimental procedure was the same as in experiment 2, but with a few exceptions. Firstly, participants engaged in forced choice identification of genuine pairs of interactants, rather than giving rapport estimates of videos. Here, sets of videos were presented in random order, with the order of the "real" and "fake" videos also randomized within pairs. Secondly, a few experimental modifications were made with the goal of increasing compliance with experimental instructions regarding both the counting and arm motion load tasks.

Because a minority of subjects in the previous experiment proved to be difficult to induce into consistent, vigorous, arm movement, and because previous results suggested that an increase in manipulation strength would be helpful, two experimental modifications were undertaken. Firstly, all subjects were informed of the demands of their experimental condition, before being handed a consent form, and the fact that the experiment was optional was emphasized. This was done in all conditions, so that subjects in the counting condition also implicitly promised to fulfill their duties before the experiment, no matter how much difficulty the counting task was causing them in answering questions.

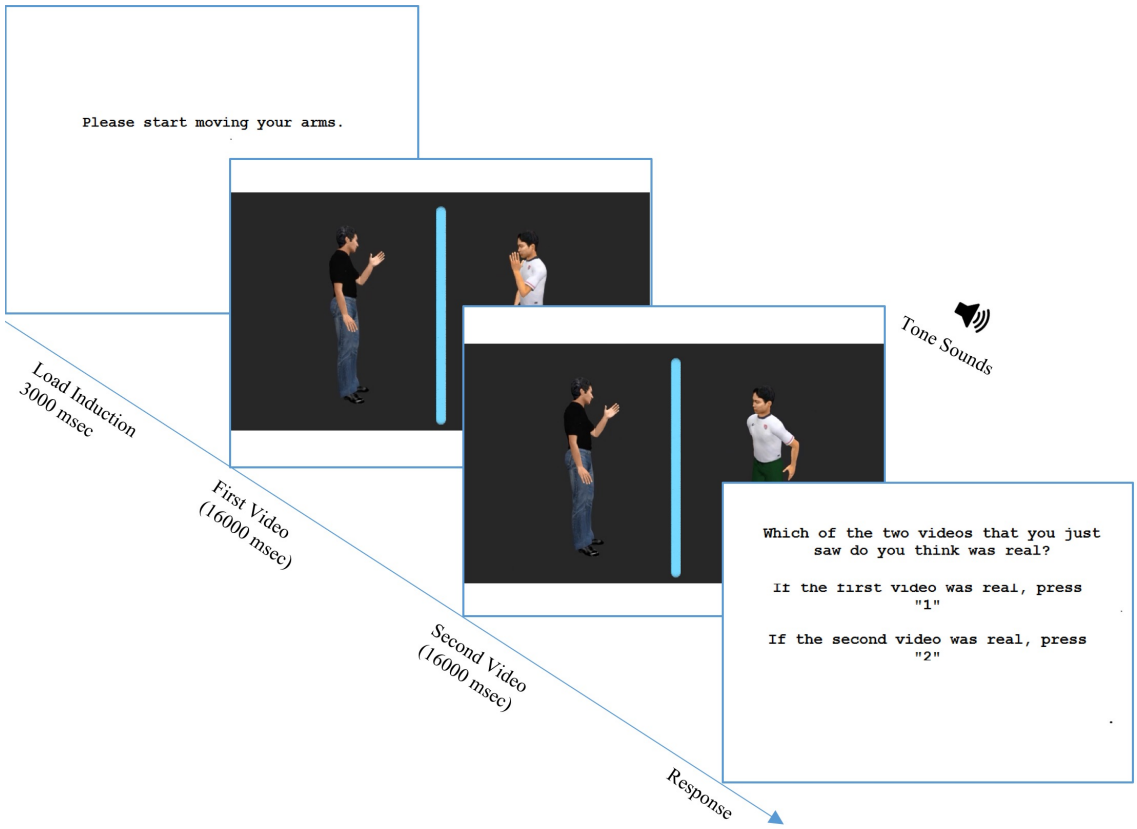


Figure 3.5: Trial Procedure for Dyad Identification
Above the motor load condition is pictured. For subjects in other conditions, text in the load induction slide read either "please start counting backwards from *x*," where *x* was a random 3-digit number between 100 and 1000, or simply "please wait."

Secondly, the experiment was constructed to allow the experimenter to give feedback on participants' arm movements. This was done by adding a fourth section to the experiment, which was always the first block of trials, and which consisted only of five trials. After these five trials experimenters gave feedback on the non-rhythmicity, randomness, and vigor of participants' arm movements. This section consisted of a series of presented word lists, each followed by a word that either was or was not on the list, which participants were to identify as being either from the original list, or not from the original list. Because the only point of this section was to allow experimental feedback and

it had a low number trials, and because its order was not counterbalanced, ensuring that all participants were "fresh" during this section, responses were from this section were not analyzed. This same set of trials was included in all conditions. Subjects in the counting condition were reminded to count backwards during the feedback portion. In the control condition, the subjects were also told to get the experimenter, but then were simply told to continue when ready.

Though, unfortunately, no ratings of arm movements were collected from experimenters during experiment 2 which would allow comparison between experiments, undergraduate assistants reported that subjects' compliance was noticeably higher in experiment 3 than it was in experiment 2. Subjectively, it was reported that fewer reminders were necessary, such that few people needed detailed "corrections" of their movements during the introduced feedback phase. Thus, it seems that the change to the introduction procedure was most effective. This observation was born out by the fact that in this experiment, significant interference is seen on the letter identification task.

Analysis

All data was imported into JMP for analysis as before. Mean identification rates, letter identification, and recall rates were computed for each participant and compared across subjects. Subjects in the control condition identified 55.7% of natural pairings correctly. Thus, the hint did not result in increased identification rates over the rates obtained during norming. Though these identification rates were greater than chance [$t(112)= 4.54$, $p=.0001$], they were not high enough to realistically allow the detection of a

difference between the control and experimental conditions.[*1] As such, analysis based on identification of all videos had very little ability to show interference between conditions (all p's > .48). This identification rate could indicate that the additional information added to the cover story was actually unhelpful.

A second unexpected result was that participants in the arm motion condition showed significant impairment in the letter identification task, scoring 7.5 percentage points lower than controls [$t(112) = -2.67$, $p<.01$]. In contrast, performance on the memory task was very similar to what was seen in experiment two, this indicates that the increased arm motion did not impair working memory enough to prevent recall of words, but did place demands on attention sufficient to prevent the recognition of very briefly presented stimuli. The most obvious cause of this change from the results seen in experiment 2 is the increased compliance with the task demands, due to changes in the experimental introduction, and the possibly the addition of a "feedback" phase to the experiment. However, it must be remarked that these results were surprising as a majority of subjects in experiment 2 were moving their arms vigorously, so that at least a trend towards difference on attention. Possibly, average levels of arm motion passed a threshold past which significant general attentional interference is induced.

[1] An experimental manipulation driving identification down so that it was only half as far above chance as controls would have a p-value of approximately .25.

Table 3.7: Performance on Memory, Letter Identification, and Natural Dyad Identification Task (Experiment 3)

Memory Task

Means	Mean % Correct	Std. Error	**t-tests**	Difference	t-Ratio	p-value
Arm Motion	0.944	0.009	Controls - Arms	-0.005	-0.25	0.806
Controls	0.93	0.018	Controls - Counting	0.119	5.32	<.0001
Counting	0.819	0.018	Arms - Counting	0.124	5.53	<.0001

Letter Identification Task

Means	Mean % Correct	Std. Error	**t-tests**	Difference	t-Ratio	p-value
Arm Motion	0.715	0.016	Controls - Arms	0.075	-2.67	0.009
Controls	0.79	0.017	Controls - Counting	0.061	-2.18	0.03
Counting	0.729	0.025	Arms - Counting	-0.014	-0.49	0.63

Natural Pair Identification –
Only Stimuli Identified at Above Mean Rate

Means	Mean % Correct	Std. Error	**t-tests**	Difference	t-Ratio	p-value
Arm Motion	60.5	0.026	Controls - Arms	0.057	1.47	0.14
Controls	66.3	0.027	Controls - Counting	0.046	1.18	0.23
Counting	61.6	0.029	Arms - Counting	-0.011	-.28	0.77

The reduced performance on the non-verbal discrimination task was surprising, given that this was contrary to the widely accepted beliefs that ingroup members and social close individuals (i.e. mothers and babies) mimic more. This belief had led to the expectation that the stimuli would be more easily identified when information about positive rapport had been provided. On the other hand, it may be that levels of mimicry seen were unusual for well-established adult ingroup members. As noted in the

introduction, experiments on purportedly strategic mimicry show elevated levels of mimicry when we have the strongest need to affiliate with others.

It is worth mentioning that the non-contemporaneous pairings might also differ in other aspects, most notably synchrony of actions. However, synchrony also has been connected to rapport and group membership by numerous studies, so that, if asynchrony was produced in non-contemporaneous pairings, this should also have aided participants in identifying interactions.

Secondary Analysis

In order to see if results provided any evidence that arm motion interfered with the ability of participants to detect the naturalness of interaction, a secondary analysis was conducted. Only videos that were successfully identified (across all conditions) at above the mean rate identification rate were included. These six videos had an average successful identification of 66.3% in the control condition, so that, as a group, they were well above chance. Thus, these videos offered a more realistic chance of showing whether arm motions could interfere with the ability to detect naturalness of interaction. In contrast, participants in the arm motion condition identified only 60.5 % [$t(112) = 1.47$, $p=.15$, two-tailed] of videos correctly, while participants in the counting condition identified 61.8 % [$t(112) = 1.19$, $p=.24$, two-tailed] of natural pairs correctly.

These results show some suggestive evidence that demands to produce motor movements may indeed impair the ability of subjects to identify mimicry. Performance on the letter identification task also leave open the possibility that any appearance of an interference effect may have a mundane explanation. These may simply be due to general demands on attention due to constant vigorous arm motion. On the other hand, it should

also be mentioned that the control tasks were quite sensitive to demands on attention, measuring subjects' ability to see letters that were presented for a fraction of a second. It could, for example, be possible that vigorous physical motion simply prevented the level of intense visual focus (i.e. by making the head unstable) required to see very briefly presented letters, but did not interfere much with the perception of physical motions, which took place over a longer time period.

In either case, the results show the necessity of active control conditions and control stimuli. It may be that different control stimuli, requiring a higher threshold of interference with visual attention, would have allowed the current experiment to show evidence of a dissociation of between the arm motion and counting conditions on measures of visual attention. However, with the current control tasks, general demands on visual attention could not be ruled as the means by which arm motion interferes with non-verbal judgments. This would remain true even with a significantly more sensitive version of the natural pairs task. Future work should endeavor to test whether other control tasks, more similar in character to the mimicry stimuli, can allow us to show differences in demands on visual attention between the arm-motion and counting manipulations. Also, the use of emerging technologies such as motion sensors would be useful in order to ensure that results are comparable across experiments and laboratories.

General Discussion

The current studies add to the literature on the evaluation of non-verbal behavior, and embodied manipulations that seek to interfere with it. Experiment 1 highlights the overall robustness of non-verbal judgments to the imposition of either general load or "motor" load. Though overall correlations were low, the half of stimuli that were high in

arm expressiveness had an average z' above .3, showing that there was some "signal" to interfere with. Despite this, neither the counting nor the arm motion manipulation significantly affected results, here. Results in experiments two and three suggest that the imposition of continuous motor load is prone to give inconsistent results, but also suggest a method for increasing compliance. The practice of having subjects agree to do the manipulation to the best of their abilities before signing their name to the experimental consent form seems to have resulted in far greater adherence to the motor load task, as evidenced by reduced performance in the letter recognition task vis-à-vis controls. This practice should be adopted in the future to ensure more consistent results and greater motor interference.

Results in experiment three point to better ways of measuring non-verbal mimicry perception, given that both the arm-motions and counting conditions came close to showing significant interference effects with relatively few stimuli. Results here also suggest, however, the difficulty of identifying natural, as opposed to unnatural interactions based on mimicry. Further, quite strong, and rarely occurring acts of mimicry were required in order to achieve an above chance success rate of this task, indicating that mimicry's ability to cue naturalness of interactions may not be powerful outside of mother child interactions. Perhaps the most interesting result here is that the hint provided to participants, that the dyads were socially close, did not appear to aid identification of natural pairs, selected for high levels of mimicry. This hint was specifically meant to recreate the expectations of social closeness as far as possible, that would be expected from Bernieri and colleagues' early (1988) study. If indeed this hint is not helpful, or even detrimental, then this is in contrast to a wide literature suggesting that mimicry is a powerful signal of social

closeness. This result may indicate a need to study levels of mimicry in established, versus unestablished, relationships.

Finally, it was also shown that arm movements can place significant demands on visual attention -- at least significant enough demands to interfere with the detection of very briefly presented stimuli. This does not, of course, prove that the effects observed by Ping and colleagues (2013), or the marginal effects observed in experiment 3 were due to demands on visual attention. The mimicry stimuli used in the current study are longer in duration than 16 milliseconds. Future studies would do well to study the effects of embodied manipulations on attention on visual identification in a broader battery of tests, so as to assure that effects shown are truly evidence of the inference with "modal" cognition. A formative suggestion here is to have participants execute single arm motions at crucial times in the experiment. The stimuli created in experiment 3, chapter 2, offer a tentative demonstration of the potential sensitivity of well constructed stimuli. Further, the addition of control stimuli, showing leg-based motion would be useful. On the other hand, the concerns over eliciting a high rate conscious identification would increase with a large number of such stimuli. A large number of such stimuli would be expected, eventually, to lead to higher rates of conscious awareness of mimicry, invalidating results. Thus great care would have to taken to build the proper stimuli set.

Another concern worth mentioning is that the manipulations used could affect comprehension of gesture more than it affects comprehension of implicit non-verbal behavior. Though the Action Observation Network is activated in response to many physical actions, the patterns of activation within this network differ, depending on the nature of the actions seen (Filimon, et, al., 2014.) As mentioned, different parts of the brain

are activated in response to intentional and implicit actions (ibid). Thus, it *could* be the case that the experimental motion task, which was intentional in nature, occupied circuits that play little role in the perception of non-verbal behavior, but play a stronger role in the perception of gesture in Ping and colleagues' original results (2011.) The combination of various physical tasks, with improved stimuli, could resolve such questions.

If the brain's mysterious mirror activity, and our striking ability to make nuanced decisions about others' non-verbal behavior, are two sides of the same coin, this would have great consequences for our understanding of sociality. Light would be shed on the nature of interpersonal relationships, and possibly, given the results seen in the first two chapters, our social judgments and judgments regarding others' opinions. It would also help to answer one of psychology's great outstanding questions – "what does reliably observed 'mirror activation' actually do?" However, future scientific investigation of this proposition will require stimuli that can reliably isolate particular aspects of non-verbal behavior, and experimental methods that can be demonstrated to interfere selectively with the underlying substrates. The final study suggests that computer rendered stimuli in combination with interference methods may have promise, here. Discrepancies between the apparent lack of demands on attention in experiments 1 (i.e. the lack of effects on utilization) and 2 (unimpaired performance on control tasks), and those seen in experiment 3 must be resolved, however. Results coming from several labs, can only be usefully combined into an account of motor interference effects after rigorous testing of the potential effects of motor interference paradigms across cognitive domains. This requires experimental protocols that elicit reliable levels of interference, perhaps aided by the use of reliable technologies, such as motion sensing.

Chapter 3 is, in part, being prepared for submission for publication of the material. Kavanagh, Liam; Roth, Daniel; Bente, Gary; Bernieri, Frank; Winkielman, Piotr. The dissertation author was the primary investigator and author of this material.

CHAPTER 4

Why Does Mimicry Signal Affiliation? -- A "Symmetrically Rational" Approach

Abstract

The previously introduced results do not fall neatly into any of the proposed accounts of mimicry. This despite their consistency with established facts about dyadic mimicry, such as its ability to act as an affiliation signal. This indicates that a satisfying functional explanation of mimicry may require some departure from previous thinking. Part 1 of this chapter is a reprint of a paper co-authored with Piotr Winkielman, forthcoming in Frontiers in Psychology, which introduces such an account. It argues that spontaneous mimicry may primarily serve to execute useful implicit actions and acquire implicit knowledge that will lead to future beneficial implicit actions. Here, actions are broadly construed, so as to include emotional responses, and implicit bodily events. The assumption that mimicry arises as a part of a basic learning function, like other forms of imitation, is actually consistent with several puzzling features of spontaneous mimicry. These include its implicit nature, its moderation by group membership and liking, ability to elicit affiliation, selective and "strategic" use, and more. In Part 2, heretofore unpublished, the dissertation author addresses potential objections and relations to other phenomenon.

Part 4.1: The Functionality of Spontaneous Mimicry and its Influence on Affiliation: An Implicit Socialization Account

Introduction

Science has discovered many facts about spontaneous mimicry -- the unintentional reproduction of model's behaviors, including gestures, postures, facial expressions, accents, and mannerisms. Yet, a satisfying functional (i.e. adaptive) explanation of this fascinating phenomenon is still elusive. Here, it is argued that, just like other forms of imitation, spontaneous mimicry primarily serves to acquire appropriate actions and reactions, including emotional responses, but in an implicit fashion. We argue that several puzzling features of spontaneous mimicry derive from this learning function, including mimicry's unconscious nature, its moderation by group membership and liking, the tendency of models to respond positively to mimicry, mimicry's low-fidelity, and its seemingly "strategic" use. Before fully discussing the current account, the core empirical findings and extant theories are briefly revisited.

Human Mimicry: Six Core Empirical Findings

Evidence shows several interesting features of mimicry. First, it is *implicitly* produced and perceived. That is, individuals do not notice when they mimic others and when others mimic them. Moreover, its *conscious control is limited* -- even economic incentives don't increase our ability to control imitation (Belot, Crawford, & Heyes, 2013). Second, *we like people who mimic us* (Chartrand & Bargh, 1999). Third, *humans mimic people they like,* as when subjects imitate friends more than strangers (Chartrand & Lakin, 2013; McIntosh, 2006). Fourth, *humans mimic outgroup members less, not at all, or even rapidly do the opposite*. For example, in a competitive situation participants scowl to a

competitor's smile just as quickly as they smile to a teammate's smile (Carr, Winkielman, & Oveis, 2014; Lanzetta & Englis, 1989).

There are also aspects of spontaneous mimicry that are rather puzzling. One is that despite its implicit nature, spontaneous mimicry can be seemingly *strategic.* For example, an earlier failure to affiliate with one person spurs subjects towards increased mimicry in a subsequent interaction with another person, especially when subjects had an initial goal to affiliate (Lakin & Chartrand, 2003; see also Thelen, Miller, Fehrenbach, Frautschi, & Fishbein, 1980; Wang & Hamilton, 2012). Additionally, spontaneous mimicry is *subtle, approximate (low-fidelity)*, and *timing-dependent*. For example, *blatant, exact (high-fidelity), or ill-timed mimicry* typically backfires (e.g. Parrill, & Kimbara, 2006; Ashton-James, Van Baaren, Chartrand, Decety, & Karremans, 2007). Finally, mimicry can be triggered by relatively simple features of gestures and expressions, and thus elicited even by artificial agents (Bailenson & Yee, 2005; Hofree et al., 2014).

Interestingly, several aspects of mimicry share characteristics with other nonverbal behaviors. Similar patterns of automaticity and moderation according to liking and ingroup status are found in emotional contagion (DeWaal, 2008; Cikara, Bruneau, & Saxe, 2011), suggesting that these phenomena share similar psychological dynamics. Further, other non-verbal behaviors, like spontaneous bodily and facial expressions, share similar patterns of subtlety, timing-dependence and coarseness (low-fidelity).

Extant Accounts of Spontaneous Mimicry: What is the Primary Function?

As mentioned earlier, several functional accounts of spontaneous mimicry have been proposed. All offer useful insights in terms of possible adaptive functions, but struggle to accommodate at least some of the empirical facts discussed earlier.

One class of accounts highlights mimicry's function for facilitating coordination and synchrony, facilitated by ideomotor mechanisms linking perception and action (e.g., Chartrand & Bargh, 1999; Heyes, 2011; Preston & DeWaal, 2002). These accounts are elegantly simple, yet they do not easily accommodate findings showing modulation by liking, strategic mimicry, and anti-mimicry of outgroup members. Another group of accounts posit that mimicry is an outward demonstration of similarity. Lakin, Jefferis, Cheng & Chartrand (2003) propose that mimicry was originally an evolved learning mechanism that later came to be a sort of "social glue" because it demonstrated similarity to others. This view of mimicry as an outward demonstration of similarity or "alikeness" is shared by Over and Carpenter (2012), who hold that the ability for mimicry to gain the favor of others is due to a biological disposition towards liking others who are like us. Supporting this view is evidence, for example, that participants are more attracted to others whose experimental code numbers share digits with their own birthdays (Jones, Pelham, Carvalo, & Mirenberg, 2004). Note, however, that many cases of spontaneous mimicry cannot be explained as attempts to elicit the impression of similarity. For example, less powerful individuals mimic the more powerful individuals, but such mimicry actually signals differences in power, rather than similarity (Over & Carpenter, in press). Also, as mentioned, mimicry tends to be subtle and imprecise, but the similarity account would suggest that overt and high-fidelity mimicry would be more effective.

A sophisticated process is posited by the Machiavellian mimicry theory of Wang and Hamilton (2012). These authors suggest that people strategically exploit mimicry to achieve their affiliation goals and advance social standing with a model. One trouble with this argument is the largely unconscious nature of mimicry. More problematically, it

implies asymmetric levels of rationality between the mimic (who is smart) and the model (who is fooled). That is, if mimicry is purely Machiavellian, then why should models respond positively to it in the long run? The same concern applies to the idea that mimicry exploits an innate attraction to similar others. If mimicry only indicates "surface similarity", then the wisdom of automatically affiliating with mimics is questionable.

The Current Proposal

The current proposal, like the above accounts, assumes that mimicry functions as the "solution" to a "problem" facing humans, and that there are mechanistic constraints on possible strategies to solve that problem. However, unlike previous accounts, we emphasize the functionality (i.e. "ecological rationality") of *both* mimicry *and* model's affiliation with mimics – that is, we seek to satisfy criteria of "symmetric functionality" of mimicry and affiliative responses to it. Further, we aim to make the account as parsimonious as possible. In fact, we do not posit any special genetic adaptations beyond an imitation capacity that might have either genetic or cultural origins (Heyes, 2011). We believe that the problem that spontaneous mimicry primarily solves is, like other forms of imitation, a need to learn. However, in this case the knowledge acquired is of the implicit kind and is under limited conscious control. We further propose that it is rational to "honestly" and "spontaneously" internalize the implicit, non-causal knowledge of people who face similar environmental action-response contingencies. We also note that these criteria are approximated by ingroup membership. Further, we propose that mimicry is an ecologically valid signal of desire for affiliation. Strategic use of mimicry, we propose, follows straightforwardly from these assumptions. We elaborate on these points next.

Spontaneous Mimicry is for Learning

It is now widely accepted that deliberate, intentional imitation is an important tool for cultural learning, including learning of instrumental actions and skills (Gergely & Csibra, 2005; Tomasello & Kruger, 1993; Whiten, McGuigan, Marshall-Pescini, & Hopper, 2009). However, it is typically neglected that similar imitative learning mechanism are also involved in acquisition of implicit *bodily activities and "skills"* (not intentional "actions") associated with nonverbal mannerisms and emotion. One classic example of this is the acquisition of accents. Another is emotional contagion – "catching" of the others' somatic and feeling states. When such contagion occurs repeatedly, it leads to permanent retention of others' reactions. Importantly, note that perceiver's reactions caused by contagion processes are not typically recognized as being "caused" by the model, but are perceived as one's own response to the environment.

This is important because, given our ignorance of their external origin, mimicked behaviors and feelings become internalized and privatized in the same way as any sensations (e.g., arousal, mood) do, when subject to (mis)attribution (Schwarz, 2011). For example, in the presence of others, individuals may laugh at a joke even though they missed the punch line (Provine, 2001). When it is not obvious to individuals that others "caused" their mirth, contagious laughter may lead them to decide the joke is genuinely funnier (Bush, Barr, McHugo, & Lanzetta, 1989). Similarly, evaluations of a video program converge more when subjects can see their partner, an effect mediated by levels of mimicry (Ramanathan & McGill, 2007).

Critically, humans not only "adopt" others' emotional displays, but also postures, which can in turn influence perception, cognition and motivation (for a review, see Winkielman et al., 2015). In an example relevant to intentional behavior, Riskind and

Gotay (1982) found that telling participants to adopt an upright, as opposed to slumped, posture leads to greater persistence on an impossible task. Harmon-Jones and Peterson (2009) showed that telling participants to lean forward while looking at a stimulus influences neural responses, suggesting an increased desire. In short, postures, even those deriving from others, shape beliefs and desires. It is important to note here that we are not claiming that adopted feelings or postures of others are always "mis-attributions" (i.e. maladaptive errors). We are claiming, however, that individuals are often not aware that others are the proximate source of their feelings. Consequently, individuals focus on what "caught" feelings mean to them, causing internalization of others' feelings – an essential aspect of socialization. Thus, this lack of awareness is in some sense "rational", as it produces adaptive social behavior without burdening scarce executive resources, or even before such resources develop in children.

Selectivity of Mimicry for Learning from Ingroups

But why is spontaneous mimicry preferentially employed within ingroups? We propose that mimicry entails a potential cost in terms of acquiring maladaptive behaviors and habits. Specifically, whereas the habits of ingroup members have survived in a social environment similar to one's own (or in the environment one desires to inhabit), the habits of outgroup members have not (Donald, 2005). As this transfer of knowledge from one individual to another is implicit, there is a risk of "polluting" the receiving individuals with bad information that they are not aware of incorporating. Thus, mimicry should be engaged more in the presence of prior cues or beliefs that attendant "feelings" constitute "desirable information". However, this process should be disengaged when prior beliefs indicate that it will introduce "undesirable information" into the cognitive system. In other words, one

can argue that mimicry operates as an implicit "System 1" process (Evans & Stanovich, 2013) that is moderated in an ecologically rational fashion (Gigerenzer, Hertwig, & Pachur, 2011).

What factors should "rationally" (adaptively) modify individuals' tendency towards mimicry? Humans form groups around similarities in values, beliefs, and priorities (e.g. McPherson, Smith-Lovin, & Cook, 2001), showing that "shared feelings" on a variety of subjects are essential to social function. Humans need to have shared valuations during collective actions of any kind, from deciding where to eat to deciding how to punish a crime. Thus, the characteristics that mark someone as a member of an "ingroup" are much the same as the conditions under which it is adaptive to share feelings. Ingroup members' feelings are highly informative of what our own feelings should be or would be if we had more experience. An obvious example is a child's tendency to become afraid in response to a parent's expression of fear. Thus, greater mimicry should rationally occur when the model is regarded as a good source of information about proper non-verbal (including emotional) reactions, and ingroup membership serves as a good proxy. Of course, as individuals gain experience with a complex social environment, they will learn that some characteristics of others correlate with the rewards of spontaneous mimicry. Such cues will include likeability of others, outward markers of ingroup membership, and their status within the ingroup (e.g. "boss"). High status individuals, as "opinion leaders" will likely be more profitably mimicked by social actors seeking to coordinate feelings with their group. Sometimes individuals will also implicitly learn that certain social situations call for complementary, or counter-mimicry behaviors, such as, for example, smiling when a high status individual is frowning (Carr et al., 2014). The ability to use context to

determine whom to mimic and how is crucial, and reflects on our social competence (Kavanagh et al, 2011).

Lastly, it is important here to note that on our account mere (high fidelity) reproduction should be limited to certain contexts. A recent review of the facial mimicry literature (Hess & Fischer, 2014) is consistent with this view, arguing that much of what researchers assumed was high fidelity mimicry of facial expressions is really about responding to valenced stimuli. For example, smiles are positive stimuli, and like all positive stimuli (e.g., candy) individuals smile in response to them, but we often do not reproduce the detailed features of the observed expressions beyond their affective elements. On our account, high fidelity, detailed mimicry of emotional expressions should be most likely in situations where there is joint attention between the interactants, which makes sense if mimicry is part of learning how to exactly feel from others (Bourgeois & Hess, 2008). Thus, while repetition of other people' action and expressions sometimes appears undiscerning, the implicit mimicry process is likely tuned to learning a deeper structure of values.

Affiliation as a Secondary Outcome of Mimicry: Why Mimics are Liked, but Only if Subtle and Approximate.

If mimicry is advantageous to the mimic because it facilitates cognitive and affective convergence with the model, then, *as an observable action*, mimicry is a valid, "honest" cue to the model that the mimic sees the model as a good source from which to learn bodily actions and emotional responses, and a true signal of convergence in attitudes, choices, and values. In other words, not only do individuals benefit from learning adaptive non-verbal behaviors from ingroup members, but ingroup members also benefit from

individuals honestly learning their non-verbal behaviors. Thus, if *socio-cultural learning* is the major reason for mimicry, then models should respond positively to mimicry, as it signals the likelihood of useful, predictable, high-quality interactions. Thus, mimicry may be the proximate means by which affiliation is achieved, even though we may not be aware of mimicry. Nevertheless, the overall dynamic may be mediated by the contextual variables discussed earlier (e.g. likeability, or ingroup and social status). It is also plausible that broad contextual cues similarly drive strategic or at least goal-dependent mimicry (see Heyes, 2011 for discussion of how contextual variables could moderate spontaneous imitation).

However, if models respond to mimicry positively by affiliating with the mimic, then the anticipation of this response creates further incentive to mimic others *in order to gain their affiliation* (potentially for Machiavellian purposes) rather than for the socio-cultural learning purposes. Therefore, models are faced with the problem of discriminating true vs. false signals of affiliation. One way this discrimination can be achieved is by forming an expectation of the "proper" degree of mimicry. So, if the prior knowledge about a new individual generates an expectation of low levels of mimicry, then suspicion may be aroused when the individual exhibits high levels of mimicry. A related set of cues comes from fidelity, subtlety, and timing. Mimicry that is too precise, blatant, or unusually timed will arouse suspicion and potential distrust. Here it is worth noting that many non-verbal behaviors (e.g., smiles) can be faked but can also function as genuine signals of internal states when produced spontaneously (e.g., Duchenne smile). In general, faked signals, are costly because they are produced via separate neural circuits than are genuine signals and thus have different appearance, making them susceptible to detection (Bryant

& Aktipis, 2014). Just like spontaneous laughter (ibid), spontaneous mimicry is more indicative of a true cooperative disposition than is its deliberate twin. Mimicry behaviors are especially informative because they are easily observable and frequently emerge in the course of typical social interaction, as a corollary of activity that is otherwise adaptive (van Leeuwen et al., 2009). Also, just like a spontaneous smile, spontaneous mimicry, may be imprecise (low fidelity) but this actually enhances its validity as a genuine reflection of learning motives.

Mimicry of Inconsequential Actions

Finally, some readers might wonder how our account explains why affiliation is produced even by mimicry of seemingly inconsequential gestures (e.g., leg crossing), or actions produced by artificial agents. First, the consequentiality of non-verbal behaviors is generally hard for individuals to assess, partly because they lack explicit insight into these behaviors (Burgoon et al., 2010). Second, arbitrariness of a behavior is sometimes key to its role as a group marker (Legare et al., 2015). Third, as stated, individuals rely on heuristic, global evaluation of the usefulness of engaging in mimicry in general, rather than a comprehensive evaluation of the costs or benefits of a specific mimicry behavior. Consistently, evidence suggests that imitative tendencies as a whole are moderated by global goal states, but that imitation of specific behaviors is not (Heyes, 2011). Finally, mimicry of even inconsequential behaviors will still signal to models that the mimic considers them as good source of implicit information (which, again, implies the possibility for beneficial interaction).

Conclusion

It is clear that humans are skillful at implicit imitation, and that the imitated behaviors (gestures, postures, facial expressions, accents, mannerisms) are gradually acquired, so that they will be repeated by mimics in the future, even in the absence of the model. Though the importance of some specific mimicked behaviors is hard to establish, we argue that overall this process has symmetrically positive consequences for both individual socialization and group function. This is because mimicry entails coordinated affect, actions or reactions – thus signaling to the model that the mimic is likely to have, or to develop, the shared values necessary for shared action, feelings, and sociality. Because mimicry is a valid signal that the mimic is likely to have beneficial social interactions with the model and its group, affiliation with the mimic is also adaptive for the group. The use of this cue is, just like a smile, complicated by incentives to exploit its positive responses for Machiavellian means. However, the risk of such exploitation is reduced by the benefits of selectively incorporating ingroup values as one's own, the costs of internalizing maladaptive behaviors and feelings of the outgroup, and by the presence of "spontaneity" cues in timing and fidelity.

4.2: Objections, Limitations, Relations to Other Phenomena

How Do We Mimic Strategically?

Though faking of mimicry is addressed above, it might be argued that the current account neglects strategic mimicry as discussed by Wang and Hamilton, and in what ways (if any) this differs from mimicry as described above. One possibility is that much of mimicry undertaken "strategically" is mechanistically similar to mimicry that is undertaken

for purposes of socialization. If "true" mimicry is the result of a commitment to an imitative response, which entails implicit learning that is not easily monitored, then by what means is it used strategically? One simple answer starts with the adoption of positive attitudes towards a model such as regarding the model as an ingroup member, or colloquially simply "warming up" towards the model. If done, this will result in mimicry, and thereby increase the success of social affiliation attempts. All that is required in order for this "strategic" orientation towards another to be implemented is that a mimic understands the link between positive regard towards others and affiliation. Consider the simple finding that intentionally available information such as prosocial words unscrambled by participants (Leighton & Heyes, 2010) can increase imitation. This being the case, it seems likely that internal generation of prosocial thoughts towards another can, in turn, generate mimicry.

If social actors are able to learn the correlation between adopting good attitudes towards others, and subsequent success in affiliation, then they should simply adopt those good attitudes. This will lead to unconscious mimicry that may be (implicitly) noticed by the model, and be the proximate means by which affiliation is achieved. Mimics will also still lack explicit awareness of their imitation, but, nevertheless, this dynamic may be a straightforward consequence of intentional states. This explanation has the attractive feature of relying solely on already established mechanisms, requiring no "multiplication of entities" to explain strategic behavior. Attitudes can be adopted strategically, and mimicry has been shown to follow from attitudes towards others.

It is worth noting that this explanation has much in common with Trivers' (2011) explanation of successful deception. Trivers asks why people so often deceive themselves. His answer, interestingly, is that outwardly expressing beliefs that one does not hold

inevitably results in tell-tale signs of lying, such as a rising tone of voice. These, Trivers argues, result from inner conflict between expressed beliefs and other, inconsistent, knowledge (ibid). In contrast, when one believes one's own lies, one sounds just like a truth-teller. Thus, argues Trivers, we often simply change our inner beliefs to be consistent with our expressed beliefs. In the same way, fast, fluid and convincing production of the outward signs of mimicry might be best accomplished by simply convincing oneself that one truly likes the model. If this is so, then the interesting empirical prediction that strategic mimicry entails acquisition of others information follows.

How is Mimicry Related to Empathy?

Sometimes we do become aware that we are feeling a certain way *because* others feel the same way – as Preston and DeWaal (2002) also point out, our shared feelings then become "empathy" where they are attributed to others. This is more likely to happen when one is responding imitatively to a conspecific, but cannot plausibly attribute resulting the sensations to oneself. In other words, when what is felt internally because of contagion/imitation is not explicable in terms of one's own situation (i.e. "it violates priors", or is "prediction error"), attention is drawn, and the explanation that this information is "about" others is then demanded. Such emotions may help us to be aware of and to understand another's situation (ibid) and recognize emotional states (Oberman, Winkielman & Ramachandran, 2007). To the degree that such sensations are rewarding (Hess & Fischer, 2014) or informative, this provides further incentive for automatic imitation responses. Of course, we can also intentionally empathize with others, but this is a goal directed activity, which will result at imitation at a great time delay (Hess & Fischer, 2014) and should not be considered mimicry.

Why Don't Other Animals Mimic?

A natural objection to the current perspective is that other animals have the need to learn from conspecifics as well, and so it must be explained why mimicry is not widespread among species. This can be addressed by simply echoing arguments from the literature on explicit action imitation. Though there are sharp disagreements about the basis of imitation, both sides would claim that humans have a special ability for imitation, so that animals simply cannot mimic as easily as can humans. Some authors seem imitation as a skill learned through associative learning (Heyes, 2011) that is actively taught by enculturated humans, others see it as a based on an innate capacity (Meltzoff 2007). The current account is largely considered from the functional level, and tries to separate functional claims from mechanistic claims as much as possible. Given a unique human capacity for imitation, acquired either culturally or innately, it is argued, the patterns of mimicry observed in the literature can plausibly emerge from its use in learning implicit knowledge.

Why Don't Infants Mimic?

The question of why infants mimic similarly also requires engagement with the question of mechanism. Meltzoff has long argued (e.g. Meltzoff, 1988, 2007) that imitation is innate, based on evidence from early childhood, but recently it has been argued such evidence is unconvincing and that infants cannot properly be said to imitate (Heyes, 2009) showing that imitation is a learned skill. However, it should be remarked that infants do not do many things well, such as a speak, walk or eat. The lack of these behaviors does not mean that these are not desirable and that humans have no special talent for them, but that abilities, even those that organisms have a talent for, often develop slowly. Either way,

once the ability to imitate develops, the arguments of the present account regarding its optimal use in internalizing implicit information hold.

Is there a Clean Distinction Between Over-Imitation and Mimicry?

As mentioned, when young children do not understand the goal of an action, they tend to imitate all actions that they see when watching a model do something that is desirable. This phenomenon has been somewhat pejoratively dubbed "over-imitation", and has been considered paradoxical vis-à-vis primate imitation (Whiten, et al., 2009). Though it is tempting to declare that over-imitation is fundamentally different than mimicry, given the obvious utilitarian consequences that adult scientists can identify, it might also be questioned whether any distinction exists, in the minds of young imitators, between mysterious actions and implicit bodily events such as emotional reactions, gestures, and mannerisms.

Despite obvious similarities, researchers might still distinguish mimicry from forms of imitation involved in ritual learning and imitation because it is neither a) guided by well-understood causal relationships between an action and the events that follow from it, nor *b) even accompanied by the notion that there is a causal explanation or other reason for imitation waiting to be found*. Clegg & Legare (2015) for example, extend the logic of over imitation to the learning of rituals, as rituals are often, by their nature, "causally opaque" however imitation undertaken during ritual learning may still be perceived as "about" something, in the mind of the learner (ibid). Thus current proposal extends a very similar logic as has been applied to over imitation of not-yet-understood actions to implicit knowledge generally. Implicit knowledge is largely actions that are *never causally understood*. As the function of such actions cannot be "spoken about clearly" by implicit

knowledge structures concerned with causal explanations, they may simply be "passed over in silence" by humans' explicit thoughts, leaving the learner unaware of this imitation as being for any purpose.

What Determines the Implicitness of Mimicked Actions?

It might be objected that the consequences of some mimicked actions (a smile) can be understood, in principle; so, though it may be descriptively true that mimicked actions are not accompanied by notions of a goal, it is not clear *why* this is the case. Three reasons stand out a) following the over-imitation literature, these actions are difficult to understand in principle and, also b) in practice many actions must be taken too quickly to be deliberated over thoroughly (Preston & de Waal, 2002.) The classic example of the latter is a fear response (ibid) – when a conspecific shows signs of being imperiled, deliberative assessment of the relevance of this fear is not desirable. Rather, a swift copying of their response is optimal. In general, deliberation comes at an *opportunity cost* – the time spent deliberating could be used otherwise. Further, c) mimicked actions may take place in circuits that do not cleanly interface with those controlling deliberate knowledge.

The previously mentioned traits of potential models (group members), and the situation (e.g. analogous situations) are likely useful as substitutes for costly deliberation over potential consequences of actions telling us when it is best to just do as others do. Also, actions that are deliberate for the model may be seen, and imitated, differently than those that are not. This is because similar concerns will inform both the mimic and the models' incentives to use explicit or implicit actions – that is, if others deliberate over an action then, obviously, this shows they find it possible, and useful, to deliberate over that action. Evidence shows that humans can often differentiate between intentional and non-

goal driven actions at a young age (Clegg & Legare, 2015) and different neural areas activate to implicit and non-implicit actions rapidly (Gainotti, 2012) indicating that we may be able to make such distinctions readily. This is perhaps done on the basis of low level motion cues (see e.g., Georgescu, et al. 2014, for a related result) and moderated by the possession of explicit action concepts relating to some motions (but not others).

How is Mimicry Mediated, Mechanistically?

The most crucial point regarding the functionality of mimicry is that a) others who occupy a similar relationship towards their environment as we do to ours will be good models and b) the nature of implicit knowledge will make mimicry the best way of acquiring that knowledge. This can be seen as an ultimate motivation for mimicry. The question of how, proximately (mechanistically) this motivation translates into mediation of imitation is a dissociable, though important, consideration. For example, "group membership" could actually be assessed by low-level perceptual cues such as another's accent or the even activation of explicit concepts like "Californian." These particulars have not been emphasized in this reconsideration of mimicry for a few reasons. The first is because this hypothesis regarding the ultimate cause of mimicry can be tested independently of specific moderating mechanisms. The second is that, because various mechanisms are conceivable, a detailed consideration of these may be a distraction from the main point. However, for the sake of exposition, a few broad considerations are worth a brief mention.

Above, heuristic cues to group membership, and shared attention have been mentioned as a *feasible* means by which the tendency towards imitation might be mediated in the required way. Because such cues are in principle informative of the rewards to

imitation, they can be used modulate imitative responses up or down, according to the situation. There may be *other conceivable* means of moderation, however. It might also be that the ability to moderate mimicry is still more flexible, perhaps akin the ability to implicitly assess whether a metaphorical frame is appropriate to a particular situation (Lakoff, 2012). In other words, if a person's metaphorical/analogical cognition identifies another's relationship to the situation as being "like his own" then mimicry might be useful. Metaphors are often invoked without our awareness (ibid) making such a means of moderation also compatible with facts about mimicry's unconscious nature. Deciding on the particular mechanisms behind mediation is difficult on a priori grounds, and will require further experimentation. Tests of the current account in the near future should focus on proving patterns of mimicry that are consistent with either possibility.

Doesn't this Show that We Mimic when We are "Like Others"?

The above considerations certainly do show that mimicry is sign of similarity in many ways. We will become more like others by learning from them, and probably mimic others who are more like us because more useful implicit information can be gleaned from them. Further, we more easily mimic actions that we know, so mimicry will indeed signal a shared cultural history. Thus, it can certainly be said that mimicry does signal alikeness of a sort. However, the foregoing arguments do not recommend the assumption of innate heuristics that govern our impressions of mimics. Further, the current account predicts different patterns of mimicry (lower fidelity, situated mimicry) than accounts based on heuristic imputation of alikeness, and does not imply as great a potential for manipulation. Thus, the intuitive appeal of the idea that mimicry signals alikeness is not misplaced, it is simply not a grounds for assuming an innate alikeness heuristic. The current account

implies that this intuition itself arises from the just-discussed ecological realities, which in turn arise from the need of humans to internalize each others' vast stores of implicit knowledge, acquired in various cultural environments. This knowledge is of a type that is not profitably understood via causal learning and thus is not easily communicated by explicit means, leaving automatic imitation to fill the gap.

Chapter 4 is, in part, being prepared for submission for publication of the material. Kavanagh, Liam; Winkielman, Piotr. The dissertation author was the primary investigator and author of this material.

CONCLUSIONS

The results of this thesis show that, at the least, inferences from mimicry are highly nuanced, and show evidence of being ecologically rational. Third party evidence was used to evaluate existing claims about mimicry, and results here motivated a new perspective that attempts to show how the various empirical facts that have been established in the literature on human mimicry might emerge within rational dyads. In addition to explaining why mimicry signals rapport to observers, the theory advanced in chapter four is quite compatible with results obtained in this thesis. If mimicry is for implicit learning and affiliation (which, it is held, are highly related), and implies costs, a person who has clearly displayed that he is not a willing ingroup member is probably not a good target. Recognition of outgroup status is a type of judgment, and so attempts by the disrespected party to affiliate with outgroup members can signal that a good judgment has not been made. The same lack of judgment is, of course, not displayed when the mimic had no opportunity to know about his model's beliefs, and third parties indeed show some ability to adjust inferences in accordance with others' knowledge states. Thus, results relating to the reduced perceptions of competence among participants who perceive disrespected mimics are well addressed by the current theory.

Further evidence for this perspective was provided by results showing that mimicry signals converging opinions, as was also shown in chapter two. This perception of similarity is actually predicted by the perspective advocated in chapter 4, which claims that mimicry is a signal of general openness to other's implicit information. Accordingly, mimicry signals a "coupling of implicit states" across both viewers of the singing performance.

Though the revised account accommodates existing data well, its usefulness will depend largely on its ability to make new predictions. In this regard, the sharing of attitudes towards shared percepts, especially of ambiguous meaning is a territory ripe for the study of mimicry's role, and the role of "intersubjectivity" in general, in social cognition. In these situations, group members' feelings about the stimulus are information for the other members, and can be shared more straightforwardly than feelings towards one another can, because the mimic and his model are in strongly analogous situations. Thus mimicry should be stronger in the case of shared perception. In other words, we are more likely to mimic a friend's anger or contempt about a current event, than to mimic his anger or contempt at what we, ourselves, said (see Churchland, 2011; Hess & Fischer, 2014, for related discussion). These situations can be studied both from the third-party and first-party perspectives.

Further predictions from the current account are also possible. Obviously, mimicry happens within dyads who are focused on each other, but the current theory would imply that there will be greater mimicry when they have a shared topic of conversation that is outside the dyad, so that feelings about shared subjects of conversation can easily become congruent. Mimicry should also be likely when opinions on that topic are not ingrained, or are ingrained but congruent, because, it is posited, mimicry is not merely a surface feature, but reflective of both past congruent (or incongruent) experience and the need to learn. It should be noted, here, that mimicry is defined here as strictly an implicit process, rather than polite copying of smiles. The account of strategic mimicry offered implies that implicit mimicry, even in situations where strategic factors are at play, may still indicate liking and the adoption of the other's implicit information. It is not out of the question that

skin deep mimicry is used, in fact popular books on Neuro-Linguistic Programming advocate its use (O'Connor & Seymour, 2002), but this an effortful and explicit process, in contrast to the kind of mimicry that has occupied so much attention recently. For this kind of mimicry, its ease of production ensures its signal value.

As mentioned, the results in chapter three do little to resolve the question of just how mimicry is perceived. Development of this research program would be helpful for understanding the mechanisms of third-party perception and addressing the limitations in mechanistic details of how mimicry is perceived, specifically. In order to understand how we interpret mimicry, information about specific mechanisms involved in perceiving mimicry would be helpful. At the abstracted "problem" level of analysis, the ability of participants to interpret mimicry can simply be explained through ecological rationality. Subjects have lived in rich environments, filled with affiliation, attitudes and mimicry, and have ample opportunity to understand "what mimicry means" by whatever means available. It is clear that the actual mechanism by which these inferences are made involves implicit information being integrated with explicit information, such as given by cover stories, but this leaves much to the imagination. On this point, the current work intersects with concerns in the literature on the interplay between the Mentalizing and Action Observation networks.

Though the results in chapter three underline the difficulty of constructing stimuli appropriate to investigate the perception of mimicry, the results of experiment 3 (computer generated stimuli) give some hope that these difficulties can be overcome, with sufficient persistence. Particularly promising is the possibility of constructing greater numbers of stimuli similar to those seen in study 2.3 (i.e. the one-room two-room study.) These might

have the power to shed light on the nature of mimicry detection. They also could be interfered with by single motions at the appropriate time, rather than the more distracting demands for continuous motion used in chapter 3.

The studies covered herein demonstrate that the interplay between mimicry and and propositional attitudes is complex. Subjects seem to combine implicit intuitions and explicit information, in a way that is typically hard to express. How these intuitions are created is unclear, however. *If* they are ultimately dependent on mirror activity, it will take a great deal of effort to determine whether heterogeneous bodily "feelings about" others are produced in response to the same episode of mimicry, depending on a context partly provided via language, or if explicit knowledge causes similar bodily feelings to be interpreted differently. As it stands, the degree to which our "rational" inferences from mimicry are due to implicit processes is unknown, but the types of studies covered here provide a great chance to study this interplay.

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