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Influence of Mimicry on Communal and Agentic Self-perceptions

Doctoral dissertation written under the supervision of Professor Bogdan Wojciszke

Warsaw, 2022

Abstract

Mimicry is defined as an automatic imitation of an interaction partner's behaviors in social interactions. People imitate a wide range of different behaviors. Based on a dominant view, mimicry plays an essential social function, as it binds people together in the form of a *social glue*. There is a large portion of research showing that behavioral mimicry leads to various positive social consequences. For example, mimicry facilities liking, trust, empathy. Moreover, when a person imitates another, people being mimicked often feel more other-oriented (in terms of interdependency and interpersonal closeness). Based on this reasoning, it was plausible to predict that being mimicked (facial expression, nonverbal behavior, and speech patterns) should influence individuals' perception of the self in terms of other concepts that tap into the distinction between self and others. Furthermore, it seems there is a lack of investigations on whether all types of mimicry has comparable effects on other-orientation, as well as, there is a lack of investigations on an impact on self-centered self-concepts and one's actual perspectives. To address these questions, in my doctoral research it was tested whether being mimicked by a stranger influences people's self-concepts (rated on meta-self-concepts: agency and communion) and perspectives (rated on agent and recipient perspective).

In Study 1 ($N = 160$) participants' facial expressions were either mimicked or not during video-chat settings. In Study 2 ($N = 173$) participants' nonverbal behaviors were mimicked or not by a confederate. In Study 3 ($N = 201$) participants' verbal characteristics were also mimicked or not by confederates. In Study 4 ($N = 71$), based on human/non-human interaction in a virtual reality environment, participants' non-verbal behaviors were mimicked or not by a virtual agent. Regardless of the applied mimicry manipulation, and environment, it was found that mimicry increases thinking about the self in terms of communal characteristics. In most studies, independently of whether people were mimicked or not, they defined themselves as possessing more communal self-concepts than agentic ones. Mimicry

does not, however, impact thinking about the self in terms of agentic characteristics. In Studies 1, 2, and 3 it was also shown that being mimicked induced a general perspective of the recipient, while it did not influence the agent perspective. The findings are generally internally consistent. It can be concluded that mimicry can increase people's communion self-concepts and recipient perspective (but not agent self-concepts and agentic perspective). The results provide insights for practitioners, in the sense that mimicry would cause beneficial social changes in people who have lowered social orientation. More research is needed, however, to carefully examine the social context of the effect, and characteristics of people sensitive to such impact of mimicry. I decided to conduct a pilot study ($N = 115$), as part of my desire to broaden the prior routes, and found that mimicry may influence impression formation. That is, people being mimicked may immediately rate more favorably a person when considering an ambiguous description of this target. Additionally, the findings suggest that mimicry effects may last for a longer time, but it seems that only when the activated category through mimicry (i.e., affiliative category) is applicable (fit) to the judgements. Such preliminary findings may help to understand how people form impressions in social relations when they are faced with ambiguous targets.

Acknowledgments

I thank professor Bogdan Wojciszke for his supervision during my doctoral degree process. Professor was supportive (and very patient) in supervising my research and writing process. Without his support my dissertation would be impossible to be completed. Special thanks are directed to professor Wojciech Kulesza, who has passed on a passion for mimicry to me, and who showed that the impossible became possible. I want to thank doctor Konrad Bocian for some of his advice.

I want to thank the SWPS University Institution in Warsaw for funding my doctoral education and for financial opportunities due to which I, for instance, took part in a research internship in Nijmegen, Netherlands, Radboud University. I especially want to thank doctor Barbara N. C. Müller for help during this internship period, without her help my scientific writing skills – and not only, would not have improved. I want to thank doctor Gero Lange for helping plan my doctoral study in the RIVERLAB laboratory at Radboud University. I thank Erik van den Berge for implementing my ideas during the preparation of the VR method at Radboud University.

I also want to thank professor Peter Jonason for confirming that it is worth to be brave. I thank doctor Joanna Szen-Ziemianska for an invitation to write a monograph book about scientific routes. This publication helped me to understand more broadly why it is worth, and why it is not, following the scientific path. Many thanks to the Dean of the Faculty of Psychology and Law in Poznań, professor Jarosław Michałowski for his support and the opportunity to write my dissertation at SWPS University. I want to thank my students for their work in collecting data. I could not have written this work without the support of numerous people, I want to extend thanks to everyone for supporting me. Finally, on an emotional level, I thank myself for persistence in completing this stage of my doctoral program.

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Introduction

From a functional approach to social cognition, each behavior is triggered by people's

perceptions (Fiske, 1992; Dunning, 2004). People's spontaneous self (and others) perception

can be organized into the two meta-traits of agency and communion, also called the *Big Two*

(Abele & Wojciszke, 2007, 2014; Bakan, 1966). Communal and agentic self-concepts seem

dominant in the core structure of a person's self-perception (Diehl et al., 2004). Those people

who judge self-agency high relate themselves to their own achievements (e.g., I am a

competent person"), whereas those who judge self-communion high, relate themselves to

other people (e.g., "I am a kind person"). Therefore, communion refer to a construct that

reflect a focus on other people and social relations, whereas agentic a construct that reflect the

focus on the self, and self-interest (Helgeson & Fritz, 2000). Throughout their lives, people

are confronted with two different and even potentially conflicting, challenges. On the one

hand, to be connected to others (represented by communal self-concepts) and, on the other, to

attain and demonstrate competence and status (represented by agentic self-concepts; Ybarra et

al., 2008). People may be driven to see themselves as similar, as well as, different from others

(Brewer, 2007). Through bonding with others, people may fill the needs of belonging, while,

by seeing themselves in an individual category, they may fill the needs of distinctiveness

(Crocker et al., 2009; Paulhus & John, 1998). Both challenges are not fully independent

(Abele & Wojciszke, 2014). Agency may be influenced – mitigated, by communion and

conversely. For instance, an unmitigated self-agency can repress communal feelings

(Helgeson & Fritz, 1999).

The conceptualizations of how people perceive themselves (and others) are named in

different ways, but their meanings are only slightly different (Abele & Wojciszke, 2007).

Particularly, these conceptualizations are referred to as not only dimensions of agency vs

communion, but also competence vs warmth, competence vs morality, masculinity vs

femininity, intellectually good–bad vs socially good–bad, dominance vs warmth, dominance vs nurturance, or power and intimacy (Abele & Wojciszke, 2014; Bakan, 1966; Bem, 1974; Fiske et al., 2002, 2007; Judd et al., 2005; McAdams, 1988; Peeters, 2001; Peeters & Czapinski, 1990; Rosenberg et al., 1968; Spence, 1974; Wiggins, 1979; Wiggins & Broughton, 1991; Wojciszke, 2005; Ybarra et al., 2008). These dimensions can be simply clustered into the two bigger independent conceptual groups. The concepts on the right-hand side belong to communal content and refer to concentration on the interests and motivations such as affiliation (Abele & Wojciszke, 2014). These on the left-hand side belong to agentic content and refer to focusing on one's own interests and concern motives such as dominance and control. Therefore, the self can be comprehended as both, separate from and related to other people (Kühnen & Oyserman, 2002).

Dual Perspective Model of Agency and Communion

Related to these two meta-self-concepts, each social relation involves two roles, for example, actor vs observer and leader vs follower perspective, speaker vs listener, agent vs actor (Enfield, 2011; Frimer et al., 2014; Jones & Nisbett, 1987; Magee & Galinsky, 2008; Malle, 2006). People perceive their world in a way that is functional for completing their current goals and the perceptions are in turn a function of the roles they are taking in a given social interaction (Peeters, 2001, 2008). In the dual-perspective model (DPM; Abele & Wojciszke, 2007, 2014), the agent perspective refer to a person who performs an action and exert control over one's own situation (acts), while the recipient perspective refer to a person who is mostly concentrated on experiencing of other people actions (receives).

To generate social perceptions, each party in the interaction attends to information that conforms with their role. When someone is in the role of an agent, they will monitor and place greater weight on the efficacy of their own actions in how they perceive themselves, whereas the recipient will monitor and place greater weight on the other person's actions and their

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consequences for both the recipient and others as well (Baryla et al., 2019; Bialobrzeska et al., 2019; see Table 1). Thus recipients may pay attention to other people's behavior, while agents may concentrate on their goals, on a means to an end (Abele & Wojciszke, 2014; Wojciszke, 2010; Wojciszke & Baryla, 2006a,b).

In the dual-perspective model both perspectives can be related to people's own and other people interpretations of behaviors. This is in contrast to other theoretical concepts of dual perspectives (e.g., actor-observer; Jones & Nisbett, 1987). In such, the perspective of the actor is linked to the observation and interpretation of the actor's behaviors. The observer's perspective is, however, linked to the observation and interpretation of the other's behaviors (*attributive asymmetry hypothesis*, Jones & Nisbett, 1987). Additionally, attributive actor-observer differences promote many cognitive deformations (Jones & Nisbet, 1971). That is, people may interpret, see different purposes, for behavior depending on whether they interpret their (actor's perspective) or other people's behavior (observer's perspective). Actors may tend to assign causes of their behaviors to external factors (unstable), while observers may tend to assign causes of other people's behaviors to internal factors (stable). The main goal to draw the DMP model was to extend past models to focus much broader on operations associated with social information processing.

Functional approach to self-concepts and self-perceptions

Agentic and communal self-concepts are related to various psychological characteristics and cognitive processes (Abele et al., 2016; Abele & Wojciszke, 2014; Diehl et al., 2004; Helgeson & Fritz, 2000). Given the theoretical assumptions, agentic self-concepts are, expectedly, positively correlated with *differentiating* style of thinking, whereas communal with *integrating* style of thinking (Woike, 1994). The differentiating style of thinking refers to people who perceive themselves as different and independent when processing social information. The integrating style, refers to people who often notice similarities with others

when processing socially significant information (Baker-Brown et al., 1992; Markus & Kitayama, 1991). Consistently, agentic and communal self-concepts are related to diverse types of social understanding (*social knowing*, Belenky et al., 1986). Agentic people would not only perceive themselves as different, but also distance themselves from others through critical thinking (*separate knowing*). Contrarily, communal people would empathize with others and build relationships based on similarities (*connected knowing*, Labouvie-Vief, 1994).

The relationship between agentic and communal self-concepts and personality traits is also described (e.g., with *Big Five* conceptual frameworks; Costa & McCrae, 1992). People inclined to agentic self-concepts tend to score higher in emotional stability, openness to experience, and lower in agreeableness. Those with communal self-concepts scored higher in extraversion, agreeableness, and, interestingly, neuroticism. In addition, both agentic and communal characteristics can be linked with conscientiousness (Abele et al., 2016; Diehl et al., 2008). The global self-evaluation may be better predicted by agency, whereas global evaluation of others by communion (Abele & Hauke, 2020; Abele & Wojciszke, 2014). Agency may enhance self-esteem – can be a strong predictor of self-esteem, whereas the relation between communion and self-esteem reflects the same pattern, but the effect can be smaller, or even does not exists (Baryla & Wojciszke, 2005; Whitley, 1983; Wojciszke, 2010; Wojciszke et al., 2009, 2011; Wojciszke & Sobiczewska, 2013, see Soral, 2017).

Moreover, people who define themselves as agentic may experience agentic memories as more recent than communal ones, and conversely for people who perceive themselves as communal (Gebauer et al., 2013; Woike & Bender, 2009). Such pattern is essential, because recent memories are often more influential on actual interpretations and motivational states than distant ones (Peetz & Wilson, 2008). It was, for instance, found that when conflict appears, people who define themselves high in communal self-concepts, in the process of

deciding whether or not to agree with someone else, may act in more compromising ways, while those higher in agentic, may face difficulties to act by adaptation to other people's needs (i.e., they may not give up their needs; Wojciszke & Cieslak, 2014). Communion is generally associated with positive relationship related outcomes (such as marital satisfaction, Helgeson, 1994). Agency, contrarily, is mostly related to self-control or self-expansion behaviors. Moreover, being high in agency may positively influence personal well-being, and reduce depression and anxiety feelings (Holahan & Spence, 1980). The relationships between communion and personal well-being is less clear. Sometimes such a relation is positive, but small (Jasielska & Rajchert, 2020; Whitley, 1984). In other times no such relationship is noted (Bassoff & Glass, 1982). This last pattern can be linked with other evidence: thinking about the self in positive moral terms may lead to, paradoxically, an increase in ruminations. Interestingly, people may recall their past inappropriate behaviors, not really situations when doing good (Baryła, 2005). Conversely, thinking about oneself in terms of agentic terms may lead to decrease in the frequency of rumination.

In the DPM model, agency and communion are linked to agent and recipient perspectives differently (Abele & Wojciszke, 2007, 2014). Agentic content is more relevant among agents in the self-and-other perception. This is theoretically logical, because when someone is in the agent role, personal control increase, and the attention can be directed to realization of own goals (Abele & Wojciszke, 2014). Contrarily, communal content may be more relevant among recipients, in the self-and-other perception (Abele & Brack, 2013; Abele & Bruckmüller, 2011; Abele et al., 2014; Kenworthy & Tausch, 2008; Wojciszke & Abele, 2008; Wojciszke et al., 2011). It is also theoretically logical, because when people are in the recipient's role, they may focus on the stimuli that affect them, i.e. mostly other people. For example, people with experimentally evoked recipient perspective may put community values and norms over agentic, and conversely for people with induced agent perspective

(Wojciszke, 1997). Consistently, people who scored higher in agent perspectives may be more likely to believe in agentic values, while those with higher recipient perspective in communal values (Baryla et al., 2019).

The relationship between both perspectives and other psychological characteristics was also tested (Baryla et al., 2019; Bialobrzeska et al., 2018). For example, the recipient perspective was strongly and positively correlated with empathic concern. There was, however, no such relationship to the agent perspective (Baryla et al., 2019). The recipient perspective was correlated positively with personal distress (i.e., personal anxiety in the face of others people's difficulties) but negatively to the agent perspective. The cognitive component of empathy (perspective-taking) was weakly and positively associated with both perspectives. Similarly as with agentic self-concepts, agent perspective was found to be linked with extraversion, openness to experience, conscientiousness, and negatively with neuroticism. Contrarily a positive link between the recipient perspective and neuroticism was observed. The relationship between these two perspectives was also related to indices of life achievements (Baryla et al., 2019). Agents may score higher in life satisfaction, feelings of success, power, personal control, life achievements, and self-esteem, whereas recipients may score higher in feeling harmed by others and lower in life satisfaction and self-esteem (but see Bialobrzeska et al., 2019). Interestingly, it is suggested that the propensity to take the recipient perspective can be associated with the worse life outcomes (e.g., because of the link with tendency to ruminate and worry), whereas the propensity to take the agent perspective with better life outcomes (e.g., due to the link with high life satisfaction, Baryla et al., 2019).

Having summarized, the current concise literature review can support the view of separateness of self-concepts and perspectives in terms of their primary functions (Baryla et al., 2019; Carver & Scheier, 1981; Gibbons, 1990; Storms, 1973). However, because most of the studies mentioned in this section (e.g., in the case of both recipient and agent perspectives)

are correlational in nature, the other amount of research experimental, or longitudes should be also required. Importantly, because of the aims of this thesis, the dynamic activation of the self-related cognitions may influence the way information about the self– and the other is processed (Brewer & Gardner, 1996). In very general way: when self-centered self is activated, a person may distance oneself from the other, whereas when the individual social-self becomes activated, a person may accentuate similarities to the others (Abelson et al., 1998; Aron et al., 1992). Therefore, also the dynamic changes in the self-construal, not only chronic properties, may influence how people process information about self-and-others.

Table 1

Basic characteristics of the agents and receptive modes of cognitive functioning

	Agents	Recipients
Factors that activates perspectives	• Implementation of action. • Empathizing with the agent.	• Being the recipient of someone else's action. • Reflection on one's behavior (from a time distance).
Cognitive processing	• Question: how (how to achieve the goal). • Concrete and procedural interpretation. • Assumed goals (inferenced from intention). • Goal is the prism of intention. • Domination of agentic content.	• Question: what (what does this person do). • What results from agents' actions for me? • Abstract and declarative interpretations. • Aims inferred from the effects. • Domination of communion content.
Motivational processes	• Activated agents motives: achievements, control, domination. • Dominance of the interest of agent. • Evaluation criteria: effectiveness and agency.	• Activated communal motives: affiliation, approval, intimacy. • Domination of the interest of recipient. • Evaluation criteria: communion and morality.

Note. Based on Wojciszke (2010); Wojciszke & Baryla (2006a).

Stability versus malleability of how people perceive themselves

How people perceive themselves is the result of a dynamic interaction between person and situation where there are dispositional tendencies, and circumstances demand people take on different roles (Abele et al., 2008; Abele & Wojciszke, 2014; Baryla et al., 2019; Bialobrzeska et al., 2019; Moskowitz et al., 1994; Wojciszke & Baryła, 2006a,b; Uchronski et al., 2013). Therefore, how people perceive themselves may be chronically available to them,

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but it can also be influenced and vary in cognitive accessibility depending on the current situation. Cultural differentiation can also be observed when it comes to self-formation. Collective cultures may promote independent (agentic) self-images, whereas individualistic cultures interdependent (communal) self-images (Hofstede, 1983; Markus & Kitayama, 1991; Oyserman et al., 2002). Therefore, how people perceive themselves can 1) be assessed as a chronic tendency, 2) depend on cultural origins, or 3) be situationally primed (Giacomin & Jordan, 2017).

Malleability of self-concepts

The structure of self-concepts can be, therefore, both stable and not. This distinction implicates that core self-conceptions can be insensitive to situational factors, and —contrarily—so-called working self-concepts (the active/current self-concepts) may be sensitive to external factors (Abele, 2003; Abele et al., 2008; Higgins et al., 1982; Markus, 1977; Markus & Wurf, 1987; Moskowitz et al., 1994; Tesser & Campbell, 1984; Uchronski, 2008; Uchronski et al., 2013; Wheeler et al., 2005, 2007). Some longitudinal studies prove the continuity and stability of self-concepts, and suggest that they are relatively constant (Greenwald, 1980; Markus & Kunda, 1986; Swann & Hill, 1982). Other studies imply that actual self-concepts may be also influenced by priming or social situations, although argued that this reorganization can be rather subtle (Markus, 1986; Tedeschi & Lindskold, 1976).

Agentic self-concepts may vary based on situational factors, especially in a context of performance or achievements (Abele, 2003; Abele et al., 2008; Moskowitz et al., 1994). For example, people's agentic characteristics are affected by situational circumstances, either by the experience of success and failure, or by social status differentiation (Abele, 2003; Abele et al., 2008; Leszczynski, 2009; Moskowitz et al., 1994; Wojciszke & Baryła, 2019). It is suggested that communal self-concepts are more stable than agentic because the communal self-concepts are a priori high (and higher than agency self-concepts, Abele, 2003; Abele &

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Wojciszke, 2007; Allison et al., 1989; Bialobrzeska et al., 2018; Moskowitz et al., 1994; Twenge, 1997, 2001; Uchronski, 2008; Wojciszke et al., 2011; Wrona, 2014; Van Lange & Sedikides, 1998; Ybarra et al., 2012). Indeed there is a portion of evidence for primacy of communion, for instance in language, and in information processing. It seems, however, that communal self-concepts are also malleable, but in response to other situational characteristics than agentic (Leszczynski & Strough, 2008; Uchronski et al., 2013). The communal self-concepts can be more sensitive to factors related to social contexts (than non-social contexts), for instance with affiliation, and involvement with other people. For example, people may list more communal characteristics within the family than the work context, and more agentic characteristics within the work than the family contexts (Uchronski, 2008). Consistently, when empathizing with other people, individuals may describe themselves as more communal than those who do not take the perspective of other people in actual moments (Uchronski et al., 2013).

Relation between agentic to communal concepts

Agency and communion were seen originally as opposite ends of the same continuum (Abele, 2003). More recently, they are treated as orthogonal, because both refer to the independent fields of functioning: 1) the agency is expressed by the aspiration to attain the goal, while 2) the communion with the aspiration to affiliate. Therefore, there does not need to be a change in agentic characteristics when someone adopts more communal characteristics (Abele & Wojciszke, 2014). When looking at the correlations of the self-ratings, the orthogonality of agency and communion is often expressed by null correlations between these two concepts (Abele, 2003; Wojciszke, 2005; Wojciszke et al., 1998). Furthermore, when considering a pool of various features, all dimensions denoting the essential content from the agency (e.g., individualism, or self-interest benefit) formed a single conceptual group. This first group have not merged with the second conceptual group, which denotes the essential

content from the communion (e.g., collectivism, benefit to the interests of others, or morality, Abele & Wojciszke, 2007, Study 1).

Although agency and communion are mostly defined as orthogonal, sometimes they are positively correlated (Abele & Wojciszke, 2014). For instance, most words of language are overfilled with valance – positive versus negative, and both communion and agency both may be generally rated as positive in fashion (Abele & Wojciszke, 2007). This effect can be observed in perception of other people, and may be explained in terms of the *halo effect* (Soral, 2017). Furthermore, agency and communion sometimes are negatively correlated (Wojciszke, 1994, 1997a). Such relationship can be found in perception of social groups (e.g., when apply to stereotypes in person's perception, Fiske et al., 1999). Giving an example, groups viewed as more with reference to communion can be perceived as weakly agentic (e.g., older people). This negative pattern between agency and communion can be also found in impression formation (Leary, 1996). For instance, when people want to appear *warm* (want to be liked), they may mostly agreeing with others, compliment, or do them favors. However, when they want to seem more competent (than warm), they may emphasize confidence and control over the situation (Gibson & Oberlander, 2008; Godfrey et al., 1986; Holoien & Fiske, 2013; Leary, 2010). These changes in self-concepts refer to the *compensation effect* between agency and communion (Judd et al., 2005). This effect is presented as a rather controlled (than automatic) process while which people may be aware of dissociation between agency and communion self-concept's (Abele & Wojciszke, 2014). So that, building on one image (communal, saint) may be treated as a special case of threats to the second image (agentic. effective). It is also suggested that the agency and communion can be negatively related because they are often processed in various situational contexts, and from different dynamically changed views (Abele & Wojciszke, 2014).

Malleability of taken perspectives

The perspective of either agent or recipient can be taken dynamically in response to different situational contexts, however these studies are in its infancy (Bialobrzeska et al., 2019). Still, there can be individual differences in the extent of a person take one of each perspective (Abele & Wojciszke, 2014; Baryla et al., 2019; Bialobrzeska et al., 2018).

There are a series of studies where both perspectives were situationally manipulated (Białobrzeska et al., 2019). For instance, participants were playing roles of agents (e.g., pumping up a seat with air), or recipients (e.g., sitting on a seat pumped up by someone else) during the performance. Another time they were asked to recall a certain situation when they had been acting as agents or recipients. Those in "agent's condition" stated more often they had an influence and control, and reduced interdependence on others than those in "recipient's condition". Recipients also focused more on experiencing the external factors, whereas agents focused more on their performance. In another study, the agent perspective was activated by thinking about values one should possess (Wojciszke, 1997). The recipient's perspective was activated by thinking about the values that other people should have. In another study by the same author (1994), people imagined they were an actor and they assessed their behavior from this perspective, or they imagined that they were the person whom the main character acted on and judged an actor from this perspective. The first condition activated more strongly the agent's perspective, while the latter the recipient's perspective. Furthermore, agents used agentic characteristics more strongly (than communal) in the assessments, whereas recipients exactly conversely.

A subjective interpretation may be a factor which covers up situational disposition to take a particular type of perspective. For instance, it was suggested that the sense of agency may not result from characteristics of the role (position) is taken, but rather more from a subjective interpretation (perception) of such taken role (Bialobrzeska et al., 2019). An

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example of such an explanation might be the result of our own research: contrarily to the initial hypothesis, hospitalized patients with cancer reported a higher sense of control, lower dependence on others, and lower recipient perspective than people who visited local surgeries (i.e., with no need to stay in a hospital; manuscript in preparation). This situational reinterpretation, e.g. kind of self-strengthening, is relatively common among oncological patients (Trzmielewska et al., 2019).

Interesting, according to the DMP model, both agent and recipient perspectives are complementary, that is, a person may adopt stronger one of them. That is, it cannot be the recipient in absence of the agent, and conversely (Abele & Wojciszke, 2014). Summarizing the above considerations, self-concepts and perspectives can be either sensitive or insensitive in response to situational factors. It seems that self-concepts, and possibly taken perspectives, can be influenced by the context of interactions between people (Ashton-James et al., 2007; Bialobrzeska et al., 2019). Mimicry may be one of these contextual factors of interpersonal relations. People subjected to someone mimicking their behaviors might adjust their self-concepts – and, hypothetically, self-and/or other-perspective – as a flexible response to the situation (Ashton-James et al., 2007; Stel & Harinck, 2011). This issue will be explored further as the main purpose of this thesis.

Mimicry

Mimicry is often defined as a subtle imitation of various behaviors of others (Chartrand & Bargh, 1999; Clarke, 2013; Hess & Fisher, 2014; Kulesza, 2016; Kulesza et al., 2015; Latu et al., 2019). People regularly do not pay much attention to imitation behaviors, although when examined closely its manifestations can be seen in social relations (Chartrand & Bargh, 1999). Sometimes mimicry it is also defined as a broader group of behaviors that refer to *interpersonal coordination* (Bernieri, 1988; Bernieri & Rosenhal, 1991; Forbes, 2018; Hale et al., 2019). Even though these types of imitation can be identified within the social

interactions, the latter is not equal to mimicry (Chartrand & Lakin, 2013; Hale et al., 2019;

Kulesza, 2016). Both types differ in terms of the timing of the executed movement. Whereas

the execution of mimicry is delayed (around 2–10 s) coordinated movements (as dancing,

walking) occur at the corresponding time (even with 0 ms lag, Hale et al., 2019; Kulesza,

2016; Leander et al., 2012; Néda et al., 2000; van Ulzen et al. 2008). Moreover, whereas the

coordinated movements does not need to be identical, mimicry refers to the same patterns of

mimicked behaviors (Chartrand & Lakin, 2012; Hale et al., 2019; Néda et al., 2000;

Richardson et al., 2005, 2007). Therefore, during the process of mimicry, 1) a mimicker – a

person who mimics behaviors, and 2) a mimickee – a person whose behaviors are mimicked

can be distinguished. Mimicry also usually does not raise awareness of its presence, so that

the person who mimic is often not fully aware of the mimicking, nor the person being

mimicked usually not notice the motor similarity to their own (Chartrand & Bargh, 1999).

Although mimicry is mostly automatic, it can be also used strategically (Duffy et al., 2020;

Wang & Hamilton, 2012). It will be discussed later in this thesis.

In addition, another two types of imitation are specified in the literature, such as

modeling and *automatic imitation* (Bandura, 1962, 2015; Genschow et al., 2017; Heyes,

2011). The modeling is described as an intentional, goal-directed process of copying the

modeled actions to achieve the observed results. Automatic imitation also refers to relatively

conscious, but laboratory-measured imitative response. The method is often used to

investigate the time of imitative responses on certain stimuli (Brass et al., 2009, 2010). A

participant may 1) imitate stimuli movements (e.g., finger tap) or *anti-imitate* (may show

incongruent movements compared to those observed), and/or 2) observe whether the imitated

movements are secondarily copied in a congruent (or incongruent) way. Contrary to automatic

imitation, mimicry is examined with a greater ecological validity, mostly in naturalistic

settings (Genschow et al., 2017). Although, the automatic imitation and mimicry may be not

correlated, they may share some similarities (Forbes, 2018; Genschow et al., 2017). For instance they both may involve an activation of mirror neuron system (Genschow et al., 2017). However, the detailed pattern of this relationship is still unknown. The validity of automatic imitations as a measure of mimicry is also a subject of debate (Forbes, 2018; Ramsey, 2018). In this thesis, in accordance with this issue, and its primary aims, the review of literature is focused on mimicry, not automatic imitation.

Types of mimicry

According to the classic view, behavioral mimicry occurs when someone automatically "parrots" a various range of partner's behaviors (Ashton-James et al., 2007; Ashton-James & Chartrand, 2009; Chartrand & Bargh, 1999, Chartrand & Lakin, 2013; Cheng & Chartrand, 2003; Dalton et al., 2010; Dijksterhuis, 2005; Guéguen, 2011; Guéguen et al., 2011, 2012; Karremans & Verwijmeren, 2008; Kot & Kulesza, 2016; Kouzakova et al., 2010a,b; Kulesza et al., 2016; Leander et al., 2011, 2012; Preston & de Waal, 2001). Early investigations focused on people who knew each other, and examined the correlation between mimicry and interpersonal rapport (Allport, 1937; Bernieri & Rosenthal 1991; Charny, 1966; Köhler, 1927; Maurer & Tindall, 1983; Scheflen, 1964). These classical studies usually involved interpersonal coordination, not just mimicry per se. Recently, behavioral mimicry is often investigated between strangers (Chartrand & Bargh, 1999; Chartrand & Lakin, 2013). Importantly, even when 1) the people did not know each other, 2) affiliative behaviors were not performed by interaction partners (despite mimicry), 3) participants were not aware of the existence of mimicry, it still can cause many social phenomena.

People also mimic each other's facial expressions (Chartrand & Bargh, 1999; Dimberg, 1982; Frijda, 1986; Lakin et al., 2003; Meltzoff, 2007a,b; Meltzoff & Moore, 1977, 1999; O'Toole & Dubin, 1968; Vaughan & Lanzetta, 1980; Zajonc et al., 1987). Observers may automatically use the specific facial muscles to adjust it to the certain emotional display

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(Hatfield et al., 1994). Evidence for the unconscious nature of facial mimicry comes from the studies where mimicry occurs rapidly, after a given subliminal stimulus, and despite some cases of brain damage (Dimberg, 1982; Dimberg & Thunberg, 1998; Dimberg et al., 2000; Dimberg et al., 2002; Ohme et al., 2001; Tamietto et al., 2009). This is consistent with the proposition of evolutionary roots of facial mimicry controlled by biological mechanisms (Darwin, 1872; Ekman, 1973; Tomkins, 1962). Such mimicry may also occur in a more conscious manner, especially when the affiliation goal is present (Hess & Fischer, 2013; Kulesza et al., 2015; Wróbel, 2016). However, it is difficult to fully control facial mimicry in real life, as mimicry is in general a subconscious process (Condon & Ogston, 1967).

Facial mimicry usually applies to expressions of happiness and anger, although also include sadness, disgust, surprise (Hess & Blairy, 2001; Hess & Fischer, 2013; Lundqvist, 1995; Moody et al., 2007). However, the results can be mixed, especially in a latter expression (Wróbel, 2016). There is some inconsistency whether the facial mimicry can be considered as a part of behavioral mimicry, or cannot (Chartrand et al., 2005; Gump & Kulik, 1997; Hatfield et al., 1994; Hess & Fischer, 2013; Lakin & Chartrand, 2003; Stel & Vonk, 2010). According to the latter proposition, facial mimicry can be more intrinsically meaningful than behavioral (Hess & Fischer, 2013). Nonetheless, facial mimicry is also studied in the context of emotional contagion, and in such cases as the first step to sharing (catching) emotional states of others (McIntosh, 1996; Soussignan, 2002; Wróbel, 2016). Similar to behavioral mimicry, facial mimicry promote various positive social effects (such as liking, Stel & Vonk, 2010; Kulesza et al., 2015).[1]

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[1] These results are mixed. In the study by Kulesza et al. mimickees liked the mimickers more compared to a person who did not mimic them. Contrary, however, to Stel and Vonk findings more liking does not occur for the mimickee by mimicker when people intentionally mimic other person's facial expression.

People may also automatically mimic several aspects of language. During conversation they may adopt other people's words, accents, speech rate, tone of voice, pauses, or phrase length (Cappella & Planalp, 1981; Giles & Powesland, 1975; Goode & Robinson, 2013; Kulesza et al., 2013; Neumann & Strack, 2000; Webb, 1969; van Baaren et al., 2003a, 2004a). According to an interactive alignment model verbal mimicry is spontaneous (automatic, Goldinger, 1998; Pickering & Garrod, 2004). During dialogue verbal mimicry by one person may leads to a cognitive representation of that imitative aspect in conversation partners, correspond with a theory of mirror neuron systems (MNS, Case et al., 2015; Chan & Han, 2020). Additionally, a communication accommodation theory (CAT; see Giles, 1973; Giles & Ogay, 2007) differentiates four conversational strategies that can be adopted during a dialogue 1) *accommodation*, 2) *convergence*, 3) *divergence*, and 4) *maintenance*. The convergence strategy shares some similarities with mimicry, as such when communicating people may make their language patterns similar to their interaction partners. According to CAT assumptions, the similarities within a spoken language may diminish the distance between interlocutors, which may, in turn, lead to the improvement of interpersonal contact (it may reduce the distance between them). It is suggested that people may modify their communication style within certain situational settings (Giles, 1973; Williams, 1999). In that propositions some features of speech can be less cognitively activated than others. For instance, in a typical conversational situation it may be easier to control for topic shifts (which can be use with a large portion of the awareness) than for other various characteristics of mimicry in the language (which can be used usually with a smaller portion of the awareness). Importantly, there is evidence of positive social effects of verbal mimicry (van Baaren et al., 2003a, 2004a).

It seems that there is a lack of systematic examination of whether these three types of mimicry are equal in terms of their consequences. There are at least two reasons for such

investigations to be so limited. First, central research focus refers to the importance of mimicking paradigms, not being mimicked paradigms. Second, it seems that researchers tend to narrowly focus on using non-verbal mimicry conditions, not facial or verbal. Therefore, it is difficult, or even impossible, to make reliable comparisons. For example, in a broad literature review, half of the reported studies referred to social, and non-social consequences of behavioral mimicry (Kulesza, 2016). Others studies referred to facial mimicry outcomes, or to a combination of both facial and non-verbal behaviors. Only a few studies focused on consequences of verbal mimicry, or combination of mimicry's types. Similar pattern was presented in other reviews (Chartrand & Dalton, 2009; Chartrand & van Baaren, 2009). It is likely, however, that three types of mimicry share at least some consequences. This issue is extended further in this thesis.

Virtual Reality

Mimicry outcomes, regardless of its subtypes, are typically examined experimentally in natural settings (Hale & Hamilton, 2016). Such studies may face substantial challenges because, for instance, various measures of mimicry are not fully controlled. Participants in such studies are typically instructed to perform a social task with another unknown human as confederate (Wang, 2012). Although such tasks are usually simple, their nature is often socially interactive (as interviewing) – it may, unfortunately, disturb mimicry's influence (Chartrand & Bargh, 1999; Kulesza et al., 2016). This thesis used the virtual reality method, designed in a cooperation with the research team from Radboud University, in order to overcome some of aforementioned methodological issues.

Virtual Reality as a tool to investigate social relations characteristics

Virtual Reality (VR) technology is increasingly used to investigate social effects that occur in the real world in laboratory environments (Blascovich et al., 2002; Georgiev et al., 2021; Hale & Hamilton, 2016a,b; Lee et al., 2020; Pan & Hamilton, 2018). When engaged in

VR tasks, participants must do their best to ignore external stimuli and focus only on those provided by the VR system. Virtual reality experiences may create 1) a sense of presence in the virtual word, despite knowledge of not being there (*a place illusion/presence*); 2) a sense of interacting with others (*co-presence/social presence*), and 3) a sense that events happening in the VR world are real, despite knowledge they are not (*plausibility illusion*; Casanueva & Blake, 2001; Diemer et al., 2015; Garau et al., 2003; Hargrove et al., 2020; Pan et al., 2012; Sanchez-Vives & Slater, 2005; Slater, 2009, Slater et al., 1994, 2010; Usoh et al., 2000).

People do seem to interact with virtual agents and even with simple moving objects in line with rules dictating how they interact with people (Epley et al., 2008; Heider & Simmel, 1944; Langer, 1989; Lester et al., 1997; Michotte, 1963; Nass et al., 1994, 1997; Nass & Moon, 2000; Ohnishi et al., 2004; Reeves & Nass, 1996). Despite the fact that people interacting with virtual agents and computerized non-humans operate in ways reminiscent of their interactions with people, they still might be less interested in creating bonds with artificial partners (Bhatt et al., 2004; Shechtman & Horowitz, 2003). Especially when the partners are not controlled by a person in the physical world, but instead by a computer program (Bhatt et al., 2004; Pan & Hamilton, 2018; Shechtman & Horowitz, 2003).

It seems that increasing the extent to which virtual characters can mimics human capabilities and idiosyncrasies should enhance the social influence of the virtual agents. For instance, programming computerized non-human agents to have a wider behavioral repertoire (behavioral realism)[2] while looking more like an actual person and not a digital representation of one (photographic /visual realism)[3] can make these experiences more believable, and

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[2] "Behavioral realism refers to the extent to which virtual humans and other objects behave like their counterparts in the physical world …" (Blascovich et al., 2002, p. 112).
[3] "Photographic realism refers merely to the photographically realistic appearance of virtual humans and objects … " (Blascovich et al., 2002, p. 112).

authentic. There is growing evidence that people do often respond towards virtual agents as if they were real people, as well as that virtual characters may induce many social psychological consequences (Bente et al., 2007; Bickmore et al., 2010; Blascovich et al., 2002; Dehn & Van Mulken, 2000; Forbes, 2018; Garau et al., 2003, 2005; Gong, 2008; Hale & Hamilton, 2016a,b; Lombard & Ditton, 1997; Kopp et al., 2005; Matsui & Koike, 2021; Pan et al., 2012; Pan & Hamilton, 2018; Sanchez-Vives & Slater, 2005; Slater, 2009; Slater et al., 1994, 2010). For example, people allocate attention to virtual agents and may also produce non-verbal expressions during interaction with the latter (Appel et al., 2012; Tolins et al., 2016). Virtual agents seem to induce approach/avoidance, but also promote prosocial behaviors (Bailenson et al. 2003; Montero-López et al., 2016; Shriram et al., 2017; Vrijsen et al., 2010a,b). The positive interpersonal effect of mimicry is also observed between humans and virtual agents (Bailenson & Yee, 2005; Hale & Hamilton, 2016a,b; Hasler et al., 2014; Krämer et al., 2013; Likowski et al., 2008; Müller et al., 2020; Numata et al., 2020; Raffard et al., 2018; Weyers et al., 2006; Verberne et al., 2015).

Virtual reality and mimicry

People appear to similarly mimic virtual agents as they would human agents and when the virtual characters mimic the people, the people respond to that mimicry how people respond to another person mimicking them (Bailenson & Yee, 2005; Krämer et al., 2013; Hale & Hamilton, 2016a; Hasler et al., 2014; Pan & Hamilton, 2015; Vrijsen et al., 2010a). However, only a few experiments induced mimicry in participants using VR technologies. This appears more an artifact of the newness of the technology rather than an inability to find such mimicry effects. For instance, when a virtual agent gave a speech and moved his head, participants spontaneously mimicked the agents' movements shortly after (Vrijsen et al.,

2010a)[4]. Alternatively, participants seem to also mimic facial expressions of VR agents or pitch of voice not just behaviors like nodding (Bevacqua et al., 2010; Krämer et al., 2013; Mattheij et al., 2015). While intriguing, this research is in its infancy so any strong conclusions must wait for more rigorous investigations with complex behaviors, but it seems that at basic human-like mimicry occurs when people interact with virtual agents.

The neural base of production and recognition of mimicry

Work in social neuroscience provides information that may be informative for social psychological work. In this section, a brief review of 1) primary neural base of mimicry production and its recognition, and 2) the activation of certain brain regions under mimicry is presented. The neuroscience research allows to conclude that under mimicry, the self and the others differentiations may be partially blurred. Such findings are consistent with social psychology works and with main assumptions from this thesis.

Shared representation of the self-and-other: Mirror neuron system and mimicry

Neurological structures, associated with the mirror neuron system (MNS; Case et al., 2015; Chan & Han, 2020; human mirror system, HMS; Hogeveen et al., 2014), are involved in the production and observation of action, and may act as the foundation of mimicry, especially motor mimicry (Decety & Jackson, 2006; Gallese, 1998; Iacoboni et al., 1999; Kraskov et al., 2009; Oh et al., 2019; Uithol et al., 2011). In a broader view, mirror structures may be activated when a subconsciously detected action is imitated due to creation by the mirroring system of a motor representation of the observed actions. Mimicry occurs because the observation and the execution of an action is neuro-physiological similar. In other words, mimicry is due to an overlap between self and others representations. Even the observation of

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[4] In this study individuals with high self-reported social anxiety (HA) mimicked VR agents less than those with low self-reported HA.

partial motor movements of targets appears to create similar motor-related responses and neural activations in observers (Fadiga et al., 1995; Keysers & Gazzola, 2006; Umiltà et al., 2001). This perspective has its roots in the concept of an ideomotor action implying that even merely thinking about an action makes it more likely to physically occur (Carpenter, 1874; James, 1890, Genschow & Brass, 2015). However, this increase in behavioral tendencies it is likely not restricted to motor acts or mimicry, but may spread and apply for more conscious activities that are equivalent in meaning (Aarts et al., 2004; Dijksterhuis & Bargh, 2001).

Therefore, the tendency to mimic others is understood as a result of the way the behavior is represented mentally and how these mental representations are tied to motor systems. In other words: a shared motor representation between the perception of others' actions and a self-action (Dijksterhuis & Bargh, 2001). There is also some empirical support of the existence of "auditory" mirror neurons, responsive during perception of other speech and mouth gestures (Iacoboni & Dapretto, 2006; Levy, 2012; Meister, 2003; Spunt, 2013). Also in a large amount of literature, the facial mimicry is linked with MNS system activity, meaning that in facial mimicry occurrence these systems may also play an important role (Iacoboni & Dapretto, 2006). Importantly the disturbance of MNS activity may inhibit the mimicry effects and that evidence seem supported the claim that MNS may be the of the primary neural mechanism of mimicry effects (Catmur et al., 2008). This so-called perception-behavior link, triggered by shared neural activations, may probably help people to understand others' intentions, actions and emotions (Preston & de Waal, 2001; Prinz, 1990; Rizzolatti & Sinigaglia, 2010, but see critic in the end of this subsection).

Mirror systems' response to being mimicked

Most neurocognitive researchers interested in mimicry have focused on what happens in people's brains when they mimic others, not when they are being mimicked (Hale, 2016; Hale & Hamilton, 2016a). One study that did consider the effect of being mimicked on mirror

system activation, captured pre-/post-test electroencephalographic (EEG) recordings of the a EEG marker of mirror systems function (Hogeveen et al., 2014). In this study, participants listened to and evaluated several pieces of music (based on van Baaren et al., 2003c) when the experimenter 1) mimicked participants' non-verbal movements, 2) did the opposite as the participants did (*anti-mimicked*), or 3) was not present, and instead, participants completed the task on a computer, as a control. The MNS activity increased only when participants were mimicked, it was stable when they were anti-mimicked, and decreased after participants completed the computerized-control task. Therefore, being mimicked may drive to increased activity in the human mirror neuron system. The authors drew attention to the fact that being mimicked is also likely associated with the activation of other brain regions closely involved with distinguishing between self and other representations (Hogeveen et al., 2014).

Self-other differentiating after being mimicked

The idea that mimicry is part of complex self-other processes has received support in the neurocognitive literature (Brass et al., 2001, 2005, 2009; Decety et al., 2002; Hale, 2016; Hale & Hamilton, 2016a; Wang et al., 2011). Studies investigated the extent to which being mimicked and mimicking others is based on similar or distinct underlying mechanisms. In the study by Brass et al. (2009), participants experienced stronger activation in the rTPJ in response to being mimicked based on functional MRI (fMRI) data, than when they intentionally imitated finger movements. Other research suggested that individuals whose actions are mimicked display greater activation in the right inferior parietal lobule (rIPL) than those who mimic the experimenter's actions (Decety & Chaminade, 2003; Decety et al., 2002). Therefore, it seems that the experience of being mimicked and mimicking others may activate similar regions of the brain that are responsible for self-and-other distinctions processes, but that activation of these regions might be stronger when being mimicked as opposed to mimicking others.

Even though both brain regions (rTPJ and rIPL) are not synonymous in all their functions[5], they are involved in people's ability to distinguish between self and other perspectives and actions (Brass et al., 2009; Duffy et al., 2019; Farrer & Frith, 2002; Farrer et al., 2003, Jackson et at., 2006; Ramachandran & Rogers-Ramachandran, 1996; Ruby & Decety, 2001, 2003; Santiesteban et al., 2012; Spengler et al., 2009, 2010; Quesque & Brass, 2019; van Overwalle, 2009). For example, rTPJ activity appears linked to distinguishing one's own goals and actions from those of others, and seems to be responsible for the control of shared representations, especially motor ones (Quesque & Brass, 2019; van Overwalle, 2009). Other results suggested that this brain region may be also involved in processing other's mental states (van Overwalle & Baetens, 2009, but see Quesque & Brass, 2019).

The rIPL might play a role in self-other discrimination, and may be activated when experiencing another person's actions, or when people are asked to imagine someone else acting (Decety et al., 2002; Farrer & Frith, 2002; Ruby & Decety, 2001, 2003; Uddin et al., 2006). The rIPL might be also involved in subconscious detection that action performed by the interaction partner is similar to that initiated by themselves (Decety & Chaminade, 2003). During being mimicked, but not when mimicking others, also the homologue of the lateral intraparietal (LIP) area might be also activated – this brain region is involved when monitoring of other actor motor movements (Chaminade & Decety, 2002; Sereno, 2001). In that sense activation of these few mentioned brain region through mimicry may lay a key function for self-other discrimination, as well as identification with others.

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[5] TPJ is a small brain region that overlaps the IPL (Igelström & Graziano, 2017).

Blurred self-other distinction after being mimicked

When considering the entire systems for imitation, it is suggested that being mimicked may lessen connectivity within brain regions involved in self-other control and the MNS, blurring the self-other distinction (Hogeveen et al., 2014). In the context of everyday social interactions, however, there should not be a complete overlap for self and other representations (Decety & Grèzes, 2006; Decety & Sommerville, 2003; Hogeveen et al., 2014). Impairment of such systems might lead to egocentrism or abnormalities in self-awareness causing limitations in the imitative control systems[6], leading to atypical imitation and creating confusion during social interactions (Decety & Grèzes, 2006; Duffy et al., 2019; Georgieff & Jeannerod, 1998; Hogeveen et al., 2014). Such dysregulation of self-other processing and atypical imitation may occur with people suffering from some types of schizophrenia, autism, and borderline personality disorder (Ilankovic et al., 2011; Matthews et al., 2013, 2014; Matzke et al., 2014; Spengler et al., 2010; Walther et al., 2013).

Therefore, when mimicry occurs, even at the subconscious level of awareness, there can be a partial blurring of self and other (Brass et al., 2009; Decety et al., 2002; Decety & Grèzes, 2006; Duffy et al., 2019; Georgieff & Jeannerod, 1998; Jeannerod, 1999)[7]. For instance, in mechanistic self-other overlap model, Hale and Hamilton (2016a) proposed that people mimicked might simultaneously see themselves in the others (through activation of MNS systems), while importantly still maintaining their sense of self (through activation of TPJ brain area, Brass et al., 2009; Decety et al., 2002). This feeling may increase their

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[6] There is also concern that inhibiting imitation requires differentiating of the self and other representations via rTPJ activation, the rTPJ might play a regulatory role in imitation control instead (Darda & Ramsey, 2019).

[7] Interestingly, it was found that people may even have some preference for motor gestures similar to their own (pre-recorded movements of participants) displayed later by another person (virtual agent) simultaneously with unawareness about own ownership (Luo et al., 2013).

affiliative tendencies because they feel a greater sense of closeness through the activation of the MNS, which may be underpinned by reward systems in the brain (e.g., ventral striatum, insula, Guionnet et al., 2012; Hsu et al., 2018; Kühn et al., 2010; Neufeld & Chakrabarti, 2016)[8]. However, the mechanism by which this similarity comparison between people occurs and is transferred to a feeling of social affiliation is still unknown (Hale & Hamilton, 2016a).

Unfortunately, part of the assumptions and research on mimicry by neurocognitive researchers is speculative by nature of the methods used and the data relied on (Hale & Hamilton, 2016a). For example, the hypothesis to account for mirror systems is not without limitations and critics. It is suggested that there is no one-to-one mapping of perceived moments and motor performance, as the term "mirror" suggests (Lamm & Majdandžić, 2015; Steinhorst & Funke, 2014). However, still, the motor representation production and action perception overlap with the same neural systems (Wang, 2021). Furthermore, research in this area may suffer from the directionality problem. Meaning that mirror neurons might for instance reflect understanding rather than contribute to action understanding (Csibra, 2007; Pomiechowska & Csibra, 2017; Steinhorst & Funke, 2014). Last, neural systems associated with understanding others' actions and emotions are not solely found in the mirror neuron system, they are found in a variety of other brain regions as well (Lamm & Majdandžić, 2015; see Molenbergh et al., 2009). Moreover, most studies relying on neuroimaging and EEG techniques cannot incorporate (at least presently) the social and dynamic processes of in vivo mimicry because of restrictions placed on researchers to capture the data (e.g., participants need to remain still, Hale & Hamilton, 2016a). This means that most researchers can study extremely isolated micro motor movements that are likely weak proxies for studying mimicry

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[8] Activation of brain reward regions might be activated through observing being mimicked; or after directly being mimicked.

in people's lives (Brass et al., 2009; Decety et al., 2002). Despite its sensational nature, neuroimaging techniques of any kind are indirect measures of averaged heterogeneous neural activity of a focal region that often serve multiple functions simultaneously (Bukowski & Lamm, 2017; Lamm & Majdandžić, 2015). These works, however, provide valuable information for social psychological work to study the effects of mimicry with greater ecological validity.

The social function of mimicry

Mimicry may play an important social function in creating harmonious interactions, and sharing emotional states of others and communicating those understanding among others (Bavelas et al., 1986; Chartrand & Bargh, 1999; Lakin et al., 2003). According to the first proposition, mimicry may create bonds between humans (Farmer et al., 2018). In a dyadic interaction one person may interchangeably take any action (usually unconsciously) and the other who mimics may "send" the message of affiliation (may take the role of a sender), whereas a person being mimicked may subconsciously detect the affiliation message (may take the role of the receiver; Farmer et al., 2018). Overall, mimicry may act as a *social glue* because reciprocal mimicking may fulfill an important social function as it bonds people together by creating generally prosocial orientation (Chartrand & Bargh, 1999; Chartrand & Lakin, 2003; Lakin et al., 2003).

It is also assumed that people may recreate states of others in their reactions, and communicate that shared state to other people (Hess & Fischer, 2013; Niedenthal et al., 2010). In other words: people who mimic others (e.g., their facial expressions) may better understand (and recognize, see Kulesza et al., 2015) their nonverbal signals than those who do not mimic (Allport, 1924). Some studies that examine the activation of mirror neuron systems under mimicry also show the evidence for these claims. Mimicry would activate the MNS systems which stimulates the limbic system and results in the better understanding of others'

emotions (Iacoboni, 2008). However, again, the level of using the MNS systems to understand others is still a subject of speculation. Furthermore, mimicry allows people to communicate their emotional states to others. Even early in development people are sensitive to the mimicry presence (Carpenter et al., 2013; Gopnik & Meltzoff, 1994; Legerstee & Varghese, 2001; Meltzoff, 2007a,b; Meltzoff & Moore, 1999; Nadel-Brulfert & Baudonniere, 1982). Mimicked newborns tend to look and smile more toward their imitators, and this increase in social awareness is thought of as an implicit form of mimicry detection (Bigelow, 1998; Bigelow & Walden, 2009; Bloom et al., 1987; Nadel, 2002, 2004; Sauciuc et al., 2020; Striano & Rochat, 1999). Infants may also repeat or diversify actions while observing if a mimicry companion is mimicking them (Agnetta & Rochat, 2004; Meltzoff, 1995; Nielsen, 2006; Sauciuc et al., 2020), those "testing behavior" are described as a more complex form of mimicry recognition. Adults are also sensitive to mimicry, they gaze and smile more at people who mimic them (Knapp & Hall, 2018; Kulesza et al., 2015; Neufeld & Chakrabarti, 2016; Over, 2020; Over & Carpenter, 2012, 2013).

Unconsciousness of mimicry recognition

When someone is in a role of being mimicked, they may experience several subconscious states (Decety et al., 2002). For example, being mimicked results in activation of brain structures responsible for monitoring other external actions (when based on PET methods, Decety et al., 2002; Nadel, 2004). Therefore, even though people may not be fully aware they are being mimicked, they can still detect that something is going on (Genschow et al., 2017). Mimicry might fill the pre-reflective sphere of consciousness, and therefore, it may not in a conscious way disturb people's thoughts, ideas, or perceptions (Gallagher, 2000, 2005, 2007; Howard et al., 2016 as cited in Kljajevic, 2021). In other words, people need not to be aware of being mimicked or that they are even engaged in that action to derive the benefits from being mimicked or from mimicking others (Castiello et al., 1991; Chartrand &

Bargh, 1999; Decety & Grèzes, 2006; Georgieff & Jeannerod, 1998; Graybiel, 2008; Jakobson & Goodale, 1989).

Strategical or automatic use of mimicry

Whereas there is a consistent evidence that mimicry may exists for social purposes, there are inconsistencies about the strategic use of mimicry (Chartrand & Bargh, 1999; Hale, 2016a; Wang & Hamilton, 2012). Some authors argue that mimicry is socially adaptive and mostly uncontrolled (Arena et al., 2010; Meltzoff, 2007a,b), and that the ability to mimic, might become automated from conscious to unconscious over time (Baumeister & Leary, 1995; Palagi et al., 2020). Other researchers suggest that mimicry is socially adaptive because people may use it strategically, particularly when they want to affiliate. In such motivational theories (the social top-town response modulation theory, STORM, Wang & Hamilton, 2012), mimicry is to some extent controlled. Previous research found that mimicry behaviors depends on a context, which implies "the top-down" control of mimicry (Lakin & Chartrand, 2003; Likowski et al., 2008). However, there is also evidence that mimicry can be found without affiliative goals present, which suggests "the bottom-up processes" (Ashton-James et al., 2007; Chartrand & Bargh, 1999). The latter processes can be underpinned by activation of the MNS systems. As already mentioned, activation of MNS systems may blur the boundary between action and perception, as well as differentiation between self and others (Hale, 2016). However, because the activation of the MNS systems does not always lead to mimicry, the top-down modulation of bottom-up processes of mimicry is proposed (Duffy et al., 2019). In this thesis, it is indicated that being mimicked, will result in positive social effects, even when is not associated with a consciously present goals of affiliation. Nevertheless, it may not exclude an option to use mimicry strategically.

Psychological consequences of mimicry

In social psychological works there is a belief, underpinned by empirical results, that mimicry bonds people together (Chartrand & Bargh, 1999; Lakin et al., 2003). Motivational theories of imitation (Chartrand & Dalton, 2009; Wang & Hamilton, 2012) explain mimicry with the notion that individuals imitate others either consciously or unconsciously because they expect social benefits from mimicking others as mi a social bond and a pro-social orientation between interaction partners (Lakin et al., 2003, Majka et al., 2020; van Baaren et al., 2004). Evidence for this claim comes from research investigating the social consequences of mimicking others as well as being mimicked. Because of the main aims of this thesis review is mostly limited to the results of how mimickees perceive and respond to being mimicked.

Positive response to mimicry

One of the most-often researched consequences of mimicry is liking (Chartrand & Bargh, 1999; Guéguen et al., 2012; Kot & Kulesza, 2016; Kouzakova et al., 2010a,b). Starting from the original finding indicating that individuals report higher liking for others who mimicked them (Chartand & Bargh, 1999). Several researchers across the globe were able to replicate this result using a broad range of different paradigms. Although research relying on this mimicry paradigm also failed to replicate the mimicry-liking link (Drury & van Swol, 2005; Maddux et al., 2008; Stel et al., 2011; van Swol, 2003). Alternatively, mimicking facial expressions, regardless of the valence of the expression, and a combination of speech and gestures and posture, may generate greater liking for the mimicker (Bocian et al., 2018; Jacob et al., 2011; Kulesza et al., 2015). Beyond liking, mimicry may lead to several other interpersonal benefits. Mimicry may serve as an embodied cue of social competence (e.g., mimicker can be judged as more competent or persuasive, Jacob et al., 2011; Guéguen et al., 2013; van Swol, 2003). However, mimickers might also be perceived by mimickees as less

assertive and mimicry in this study failed to influence ratings of mimicker competence

(Bocian et al., 2018, see also Kulesza et al., 2017). Being mimicked may lead to more trust,

warmth, and empathy for mimicker (Bocian et al., 2018; Guéguen et al., 2011; Maddux et al.,

2008[9]; Maurer & Tindall, 1983; Swaab et al., 2011). Mimicry may also fosters prosocial acts

(Carpenter et al., 2013; Guéguen et al., 2011; Kulesza et al., 2014a; Müller et al., 2012; van

Baaren et al., 2003a, 2004a) which may spread beyond mimicker themselves (Fischer-Lokou

et al., 2011; van Baaren et al., 2004a, Studies 2 and 3). Mimicry may be influential in creating

rapport between mimicker and mimickee in VR environments (Bailenson & Yee, 2005; Hale

& Hamilton, 2016a,b; Raffard et al., 2018). People respond more favorably to virtual agents

who are mimicking them than those who are not (Bailenson & Yee, 2005; Müller et al.,

2020). When a virtual agent mimicked participants' head movements, participants rated the

virtual agent more favorably and more persuasive compared to agent who showed pre-

recorded natural movements (Bailenson & Yee, 2005)[10]. Using the same mimicry paradigm,

VR agents who engaged in mimicry were rated as more trustworthy based on questionnaire

(Jian et al., 2000) and indirect measures; and were also rated as more likable[11] but less

intelligent (Verberne et al., 2013). However, they were not rated as more competent or

trustworthy in terms of relational trust. These results were not replicated with another male

agent. Inconsistent effects of mimicry on liking and trust were replicated in later experiments

(Clerke & Heerey, 2021; Hale & Hamilton, 2016b; Müller et al., 2020; Verberne et al., 2015).

Therefore, virtual agents may reap more favorable interpersonal perceptions by those they

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[9] Trust towards mimicker can mediate a positive outcome of mimicry on the likelihood of successfully closing a deal in negotiation.
[10] Index of favorably, within the communal and agentic traits were included (Guadagno & Cialdini, 2002).
[11] Within the liking index the communal and agentic traits were included, e.g., confident, likable, friendly, sincere, warm, competent, informed, credible.

mimicked, but there are some undesirable interpersonal perceptions that may also arise

(Verberne et al., 2013)[12].

Changes in self-concepts

Mimicry has the power to influence how people think about themselves. Previous

research repeatedly demonstrated that individuals imitate others more strongly when they

focus on others than when they focus on the self (e.g., Stel et al., 2011; for a meta-analysis,

see Genschow et al., 2019). Likewise, other research indicates that being mimicked increases

a focus on others, in the sense that mimicked people feel more strongly other-orientation

(Ashton-James et al., 2007). So that, responses to being mimicked may be linked not only

with changes of how people being mimicked perceive others around them, but also with how

the mimicked sees themselves in relation to others after detecting an imitative act. Mimicked

person might perceive oneself as someone who focuses more on others (in the sense of more

interdependence / interconnectedness to others) than when they are not imitated (Ashton-

James et al., 2007; Stel & Vonk, 2010; van Baaren et al., 2003b).

Being mimicked might enhance interpersonal closeness (the degree to which people

see themselves as independent, for instance in terms of identity, perspective, and resources

from others, Aron et al., 2013), tested on one-item pictorial scale (Inclusion of Other-in-the-

Self-Scale, IOS; Aron et al., 1992), which depicts increasingly overlapping circles

representing self and other. For instance, when facial expressions were mimicked individuals

felt closer to the mimicker, compared to experiencing no facial mimicry in the interaction

(Stel & Vonk, 2010). Additionally, observing mimicry from the first-person perspective of the

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[12] This may be the result of limited ecological validity in the experiments. For instance, if the mimicker copies every action – something natural mimicry may not be characterized by – people may perceive the mimicker as less intelligent (Kavanagh et al., 2011; Kouzakova et al., 2010b).

actor being behaviorally mimicked (e.g., arms moves) was also associated with greater feelings of closeness to the mimicker, compared to being in the role of an anti-mimicked (Kühn et al., 2010). Mimicry may spread beyond mimickee's perceptions of her/his interconnectedness with the mimicker. For example, people who are mimicked (e.g., gestures, postures) may feel more interpersonally close to others in general than when not mimicked (Ashton-James et al., 2007; Study 2; van Baaren et al., 2003b). Furthermore people being mimicked sit closer to someone, as a behavioral measure of one's sense of closeness to others (Ashton-James et al., 2007, Study 3). However, sometimes such results are inconsistent, and being mimicked also does not lead to increased self-other overlap (Hogeveen et al., 2014).

Mimicry, within the context of virtual reality, may also influence interpersonal closeness although results are also mixed (Hale & Hamilton, 2016b; Hasler et al., 2014). For example, mimicry of the head and torso does not affect participants' sense of interpersonal closeness with VR agents (and other people) by itself (Hale & Hamilton, 2016b; Verbene, 2013). First, mimicking of this kind by a virtual agent did not affect the participant's sense of closeness with others (either with virtual or real persons, Hale & Hamilton, 2016b, Study 1). Second, when only head movements of participants were mimicked it did not affect their ratings of self-other overlap (Verberne et al., 2013). Contrary however, when participants interacted with virtual agents from an outgroup, mimicry of the positions of an arm and leg by the VR agent led to a greater sense of interpersonal closeness towards the VR agent compared to anti-mimicked behaviors (Hasler et al., 2014).

Moreover, under behavioral mimicry (i.e., gestures, postures) people perceive oneself as more focused on others compared to situations without mimicry when measured by other methods than the self-other overlap (Ashton-James et al., 2007, Study 2; Stel & Harinck, 2011). To measure self-construal, researchers asked participants to complete 20 statements that started with the first person singular pronoun I) in free response format (The Twenty

Statements Test; Kuhn & McPartland, 1954); in which people may define themselves by relationships with other people (interdependently) or without reference to others (independently). In these both studies participants mimicked were more likely to perceive themselves as more interdependent with others (Ashton-James et al., 2007; Stel & Harinck, 2011).

Interestingly, there is no previously proved and reported the impact of mimicry on self-centered construal's (independent-self). For example, some studies measured independent self-concepts although did not report these findings: " ... self-construal's were subsequently coded by two raters as independent if they described a personal attitude […], and as interdependent if they described a social role or relationship" (Ashton-James et al., 2007, p. 530). Others only calculated interdependent self-concepts, but not independent ones: „ … we calculated the proportion of interdependent statements out of participants' total amount of statements" (Stel & Harinck, 2011, p. 81). Furthermore, it seems that there is a lack of findings which would test the relationship between interdependent vs. independent feelings after being mimicked (see Table 2 and 3). Researchers often predicted changes in other-oriented self-concepts through mimicry, referring to other social psychological works (Ashton-James et al., 2007; Stel & Harinck, 2011; Stel & Vonk, 2010). For instance, they predicted enhancement in other-focus (interdependent self), basing on previous findings of positive e social consequences of being mimicked (cognitive and behavioral). These predictions included the enhancement of context-dependent processing as well as prosocial-orientation as a result of being mimicked (e.g., Müller et al., 2012; van Baaren et al., 2003a, 2004a).

Table 2

Studies measuring the effect of being mimicked on self-construal in natural settings

Study	Study design	Mimicry character	Control condition	Task	Measure	Participants	Effect size	Significance
Ashton-James et al. (2007)	Between-subjects	Confederate mimic non-verbal postures and gestures of participants.	Confederate refrain from mimicking participants' non-verbal behaviors.	5 minutes of interview.	Study 1. The Twenty Statements Test (Kuhn & McPartland, 1954). Free format responses. Study 2. IOS Scale (Aron et al., 1992). Study 3. Distance between the self and other measured by seating distance (how far / close participants sat to the other person, i.e., occupied chair). Study 4. The Twenty Statements Test (Kuhn & McPartland).	Study 1 $N = 41$ Study 2 $N = 26$ Study 3 $N = 58$ Study 4 $N = 51$	Study 1. Interdependence: Not reported values, but calculated [13]by the author by means and standard deviation: d Cohen's = 0.9; CI [0.26, 1.54]. Study 2, 3, 4. Not reported values of standard deviations (only means). In all of the studies the lack of report of independence results.	Study 1. $p < .01$ Study 2. $p < .02$. Study 3. $p < .05$. Study 4. $p = .09$.
Stel & Vonk (2010)	Between subjects	Half of participants intentionally mimicked other people's non-verbal behaviors (also facial expressions), and other participants were mimicked.	Participants refrain from mimicking participants non-verbal behaviors and facial expressions.	Interaction.	IOS Scale (Aron et al., 1992).	$N = 164$	Interpersonal closeness: Not reported, but I calculated. Targets (person being mimicked): d Cohen's = 0.7; CI [0.21, 1.13]; Observers (mimickers): d Cohen's = 0.5; CI [0.10, 0.90].	$p < .001$
Stel & Harinck (2011)	Between Subjects	Confederate mimic non-verbal behavior of participants (postures, gestures of participants; also facial expressions).	The Confederate showed behaviors unrelated to the mimicry movements (not precise).	Interaction (masking information: testing the communication skills).	The Twenty Statements Test (Kuhn & McPartland, 1954). Free format responses.	$N = 86$	Interdependence: $\eta_P^2 = .06$ The lack of a report of independence results.	$p = .03$

[13] https://www.psychometrica.de/effect_size.html

Study	Study design	Mimicry character	Control condition	Task	Measure	Participants		Significance
van Baaren et al., (2003b, not published manuscript).	Between Subjects	The confederate mimic participants (see van Baaren et al., 2004).	The Confederate showed behaviors unrelated to the mimicry movements (see van Baaren et al., 2004).	Not described	Not described	Not reported	Not reported, but described that being mimicked made people more interpersonal closer to others compared to situations when not mimicked.	Not described, but significant
Kühn et al. (2009).	Between Subjects	Participants took first-person perspective of an actor being behaviorally mimicked.	Participants took first-person perspective of an actor being anti-mimicked.	Interview.	IOS Scale (Aron et al., 1992).	$N = 15$	Not reported, but described as being mimicked (i.e., took that first-person perspective) made people more interpersonal closer to others compared to situations when anti-mimicked (i.e., took that first-person perspective).	Not reported, but significant
Hogeveen et al. (2014).	Between subjects	The confederate mimics participants' motor behaviors.	Confederate refrain from mimicking participants' non-verbal behaviors.	"Music-rating" task (van Baaren et al. 2003c).	IOS Scale (Aron et al., 1992).	$N = 13$	Not reported.	$p = .12$, ns.

Table 3

Studies measuring the effect of being mimicked on self-construal in VR

Study	Study design	Mimicry character	Control condition	Task	Measure	Participants	Effect size	Significance
Hale & Hamilton (2016b)	Between Subjects	Virtual character mimicked head and torso movements, automated,	Virtual characters displayed pre-recorded movements.	Photo description task	Modified IOS Scale (Aron et al., 1992). 1. Overlap: specific agent 2. Overlap: agent in general 3. Overlap: best friend 4. Overlap: others in general	$N = 63$	$\eta_P^2 = 0.01$ $\eta_P^2 = 0.002$ $\eta_P^2 = 0.002$ $\eta_P^2 = 0.001$	$p = .58$ $p = .73$ $p = .77$ $p = .82$
Verberne et al., (2013) Trail 1&2	Between Subjects	Virtual characters mimicked head and torso movements, automated.	Virtual characters displayed pre-recorded movements.	Decision making-tasks	Modified IOS Scale (Aron et al., 1992). 1. Overlap: specific agent 2. Overlap – participants could choose which pair depicted their relationship with the agent best.	$N = 40$	Not reported	Not reported, but ns
Hasler et al., (2014)	Between Subjects	Virtual character mimicked 4 arm positions (in lap), and 7 leg positions (legs parallel with both feet on the floor).	Virtual characters displayed opposite movements performed by participants.	Pseudo-natural conversation.	Modified IOS Scale (Aron et al., 1992). 1. Overlap: specific agent (outgroup).	$N = 60$	Not reported	Not reported, but significant

Table 4

Examples of studies measuring the effect of being mimicked on liking when liking serve as

manipulation check

Study	Study design	Mimicry character	Control condition	Task	Measure	Participants	Effect size	Significance
Kot & Kulesza (2016)	Between Subjects	Confederate mimicked nonverbal behaviors' of participants	Confederate maintained still.	Photo description	7-point Likert scale	$N = 42$	Cohen's $d = 0.74$	$p = .002$
Kouakova, Karremans et al. (2010)	Between Subjects	Confederate mimicked nonverbal behaviors' of participants	Confederate moved naturally (avoided behaviors used by participants)	Photo description	7-point Likert scale	Study 1 $N = 69$, Study 2 $N = 40$.	Study 1 $\eta^2 = .11$ Study 2 $\eta^2 = .12$	$p = .003$ (both studies)
Kouzakova, van Baaren et al. (2010)	Between Subjects	Confederate mimicked nonverbal behaviors' of participants	Confederate moved naturally (avoided behaviors used by participants)	Photo description	7-point Likert scale	$N = 72$	$\eta^2 = .12$	$p = .004$
Kulesza et al. (2016)	Between Subject	Confederate mimicked nonverbal behaviors of participants	Confederate maintained still.	Interview	7-point Likert scale	$N = 120$	$\eta^2 = .07$	$p < .001$

Thesis overview

Having evidence that agentic and communal self-concepts and agent and recipient perspectives can influence people's feelings, and behaviors, this doctoral studies, highlighted the importance on finding possible factors that have an impact on them. Based on the theoretical framework, it was plausible to predict that one of these factors is mimicry. A series of experiments were conducted using various types of mimicry. Four experiments had similar procedures. All started with mimicry manipulation either in natural settings, or virtual reality environments (Study 4). Mimicry manipulation was followed by the assessments of dependent variables. Overall, it was predicted that under the influence of mimicry people will like their mimicker more, compared to people not being mimicked. Furthermore, it was predicted that communal self-construal is positively correlated with the recipient perspective, whereas agentic self-construal with the agentic perspective. The main prediction was associated with the assumption that people should ascribe more communal and recipient scores under influence of mimicry, compared to situations without it. It was also predicted that people should feel more communal than agentic regardless of the mimicry influence, however, mimicry should enhance this effect. In the case of mimicry impact on agentic self-concepts and agent perspective, and the relationship between recipient and agent perspectives, predictions were more tentative.

First, it was hypothesized that being mimicked increases liking for the mimicker. In experimental, but also correlational research paradigms, it is repeatedly shown that manipulated nonverbal (or facial) mimicry produces a higher evaluation for mimicker (including liking, Bocian et al., 2018; Chartrand & Bargh, 1999; Kot & Kulesza, 2016). This result is often explained by the fact that mimicry serves the adaptive function of fostering sympathy between people and creates bonding (Chartrand & Bargh, 1999; Lakin et al., 2003). There is (probably) a lack of investigations on this link in regard to verbal mimicry, but this

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thesis result filled this gap. Moreover, liking usually works as a mimicry manipulation check (see Table 4), and it was also implemented in all doctoral experiments.

Second, it was hypothesized that, regardless of mimicry effects, people with more communal self-concepts would take the recipient perspective to a higher degree (Abele & Wojciszke, 2014). It was also assumed that people with more agentic self-concepts would take the agent perspective to a higher degree. These connections are the core assumptions from the DPM model (Abele & Wojciszke, 2014). If the agent's perspective is taken, activation of agentic content should appear, because this content is related to the execution of the action. When, however, the recipient's perspective is taken, activation of communal content should appear, because this content is related to obtaining outcomes of other people's actions, and with the monitoring other people's behaviors. These effects are proved in previous research (the correlation between communion and recipient perspectives usually range from $r = .30$ to .45, whereas, those between agency and agent perspectives is often stronger, $r = .60$ to even .80; Abele & Wojciszke, 2014; Baryla et al., 2019; Bialobrzeska et al., 2019; Wojciszke, 2010; Wojciszke & Baryla, 2006a,b).

Third, it was hypothesized that people mimicked will define themselves as more communal compared to non-mimicked ones. It was predicted building on research where an individual's self-perception can be sensitive to information about their connection with others, and such connectedness can be as subtle as someone mimicking their behaviors (see Tables 2 and 3). In such studies mimicry (either nonverbal or facial) enhanced interdependent-self and one's interconnected feelings with others. These effects are often explained by the fact that mimicry leads to more context-dependent information processing (Giacomin & Jordan, 2017; Kühnen & Oyserman, 2002; Kühnen et al., 2001). There is also evidence from neurocognitive research which supported the link of the positive influence of mimicry on communion. Therefore in this thesis, it was tested if communal self-concepts are susceptible to mimicry

effects. Such research is required due to a lack of systematic examination of the malleability of communal self-concepts. Moreover, there is a lack of detailed observations on whether different types of mimicry differ in the impact of the other-oriented self.

Fourth, it was assumed that people should feel more communal than agentic regardless of mimicry influence, although mimicry should enhance this effect. In prior mimicry research the relation between interdependent and independent self was not tested. Thus such results will extend prior findings. Generally, people may value more agentic characteristics in their self-view, additionally, self-esteem is usually closely related to the agency (Abele & Wojciszke, 2007). However, paradoxically, people regularly ascribe to themselves more communion than agency (Abele & Wojciszke, 2014). It can be explained, for example, by evolutionary adaptability of communal dimension; a person more communal would have engendered more kindness from others, and in turn would create more harmonious relationships (Baumeister & Leary, 1995; Palagi et al., 2020). It seems that both communal and agentic self-concepts can be flexible but to different situational contexts, respectively: by the social context and by the self-enhance one (Baryla & Wojciszke, 2019; Uchronski, 2008). Additionally, some more support comes from studies, where highly accessible self-construal (culturally-rooted) and situational manipulations (e.g., priming) influence changes in self-concepts (i.e., interdependent/independent self) independently of each other (Liu et al., 2015; Trafimow et al., 1991, 1997).

Fifth, it was a challenge to predict of the possible influence of mimicry on agentic self-concepts. Prior research did not report, or measure, or even discuss the influence of mimicry on self-centered self-construal. It can be that mimicry does have not an impact on agentic self-concepts, because 1) agentic-self construal is rather not influenced by social contexts, 2) the relation between agency and communion is often defined as orthogonal (Abele, 2003; Abele & Wojciszke, 2014; Uchronski, 2008; Uchronski et al., 2013). That is,

the upwards regulation of a communal self-perception in response to mimicry would not be accompanied by changes in agentic traits. It also would be that mimicry has an impact on agentic self-concepts, as mimicry would decrease agency because 1) people would be motivated to present themselves as more communal, and as less agentic (Judd et al., 2005), 2) it is found that mimicry can decrease self-esteem and self-liking of mimickee, and these both (self-esteem and liking) can be closely linked to agency (Kot & Kulesza, 2016). Therefore, even mimicry would cause people to gain socially, people would still experience unwanted intrapersonal costs. Additionally, it would be that mimicry could increase agency. So that under the influence of mimicry people would want to present themselves as both highly competent, as well as, highly warm. There is some supporting portion of empirical data from third-party observers. That is, mimickers can be perceived as more submissive, whereas mimickee's as more dominant and confident. Intuitively, the agency would be inhibited under the influence of mimicry, but due to problems with the lack of supporting empirical data, and given the possibility of alternative hypotheses, predictions are more tentative. An exploratory analysis will be conducted.

Sixth, it was hypothesized that mimicry may influence the recipient's perspective. It seems there is a lack of such empirical investigations, but the prediction was supported by the fact that mimicry influences other people's focus, and that the recipient perspective is related to the observation of others. Moreover, a person being mimicked is sometimes defined as being in the role of the receiver of the affiliation message, while this who mimics as a sender that brings such a message among mimickee (Forbes, 2018). Furthermore, there is evidence that when someone behavior is mimicked people pay more attention to mimicker's behaviors than without mimicry (Decety et al., 2002; Carpenter et al., 2013; Gopnik & Meltzoff, 1994; Legerstee & Varghese, 2001; Meltzoff, 2007a,b; Meltzoff & Moore, 1999; Nadel, 2004; Nadel-Brulfert & Baudonniere, 1982). Furthermore, the recipient's perspective scores are

connected with empathy, and also mimicry is positively connected with the latter. Therefore, it may be that being mimicked naturally leads to a recipient perspective. In the sense that the person mimicked receives and monitors the behavior of another person (mimicker). These predictions are essential because it seems they are novel in the mimicry field.

Seventh, it was a challenge to predicting of possible influence of mimicry on agent perspective and the relation between agent and recipient perspective. It seems that there is a lack of studies which test such predictions: that is to which extent a person being mimicked takes the role of agent and which of these two 1) recipient, or 2) agent roles is dominated in such cases. Interestingly, a person who mimics behaviors may be rated as less dominant, and more submissive, as well as, weak and unconfident when compared to a person who initiated the movement (mimickee, Genschow & Alves, 2020). Therefore, people who are being mimicked would be seen as more in power than those who are mimicking. There is, however, a lack of findings in which a subjective perspective of a persons in such situations. On the other hand, it is assumed that mimicry makes people more oriented toward others, and that mimicry arouses the affiliation and intimacy motives in person being mimicked (Ashton-James et al., 2007; Chartrand & Bargh, 1999). Moreover, a person who mimics can be perceived as the one who sends the message of affiliation (actor), and a person whose behaviors are mimicked more as in the role of the receiver (receiver, Farmer et al., 2018). Furthermore, being mimicked leads to activation of brain structures responsible for monitoring other's actions (more than one's own, Decety et al., 2002). Consistently, people being mimicked may pay attention among mimickers (Knapp & Hall, 2018; Neufeld & Chakrabarti, 2016; Over, 2020; Over & Carpenter, 2012, 2013). Also, the activation of MNS systems, through mimicry, may blur differentiation between the self-and-other perspectives (Hale, 2016). Importantly, in the DMP model it is assumed that there should be an 1) agent, or 2) recipient in any dyadic interaction (Abele & Wojciszke, 2014). Given such inconsistent assumptions, in the case of agent perspective, and

relation between agent and recipient perspectives, predictions of mimicry influence are more tentative. The exploratory analysis will be conducted.

Lastly, given the positive correlation between communion and liking, in all studies, communal self-concept was treated as a mediator in the relationship between mimicry and liking the mimicker. It is known that sympathy for other people, is often influenced by the communal qualities of these judged people (Wojciszke et al., 2009; Oleszkiewicz & Lachowicz-Tabaczek, 2016). The reverse also seems true: liking of the people can be influenced by self-ascribed communal qualities of the persons who judged others, as communal self-concepts are an important factor of satisfying interpersonal relationships (Abele & Wojciszke, 2014; Le et al., 2018). To summarize, based on the presented theorizing and the review of existing research, it was predicted that:

- Hypothesis 1. Mimicry by a confederate leads to more liking for him, compared to situation without mimicry.

- Hypothesis 2. a) Agentic self-concept is positively correlated with taking the agent perspective, b) Communal self-concept is positively correlated with taking the recipient perspective.

- Hypothesis 3. People mimicked perceive themselves as more communal compared to those not mimicked.

- Hypothesis 4. Regardless of mimicry, people perceive themselves as more communal than agentic, and mimicry enhances this effect.

- Hypothesis 5. People mimicked will define themselves as more in recipient scores compared to those not mimicked.

Additionally, exploratory analyses are planned in the areas where directive hypotheses are impossible to formulate unequivocally:

- RQ1. Does mimicry have an impact on agentic self-construal?

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- RQ2. Does mimicry have an impact on the agent perspective?

- RQ3. Does mimicry have an impact on relation between taking the agent and recipient perspective?

- RQ4. Is communal self-construal a possible mediator of the relationship between mimicry and liking?

Study 1: Role of facial mimicry in communion and agency

In previous studies it was found that a combination of non-verbal mimicry with facial mimicry makes people being mimicked more other-focused compared to situation when they were not mimicked (Stel & Harinck, 2011; Stel & Vonk, 2010). In these prior studies, self-concepts were examined by 1) interpersonal closeness concept measured by the "Inclusion of Other-in-the-Self-Scale" (IOS; Aron et al., 1992, 2013), and 2) interdependent self-concepts measured by "The Twenty Statements Test (Kuhn & McPartland, 1954). Researchers did not examine the possible relationships between interdependent and independent concepts, nor changes in self-centered concepts under mimicry. Going one step further, impact of facial mimicry on novel 1) agentic and 2) communal self-concepts, were examined in the present study. The novelty was also an examination of an impact of mimicry on perspective taking: the agent and recipient perspective.

Method

Participants

Data for this study was collected at SWPS University of Social Science and Humanities in exchange for course credit. During the experiment 12 participants were excluded because they indicated suspicion that the procedure was not an actual online interaction, comparable with other studies (Kulesza et al., 2015). The final sample consisted of 160 participants (101 women aged from 19 to 46, $M_{age} = 23.03$, $SD = 3.82$ and 59 men aged from 19 to 31, $M_{age} = 22.66$, $SD = 2.55$) randomly assigned to the mimicry ($N = 81$), or non-mimicry condition ($N = 79$). Ethical approval for this study was obtained at the SWPS University of Social Sciences and Humanities (SWPS) from the Ethics Committee for Scientific Research, Faculty of Psychology (2018-08-01).

Measures and materials[14, 15]

Liking the mimicker

To measure if the mimicry manipulation increased liking of the mimicker (actress), participants indicated the veracity (1 = *definitely not*; 7 = *definitely yes*) of seven items ("This person triggers a positive feeling in me", "I'd like to meet this person in future", "I think me and the other person got along pretty fast", "I feel a lot of sympathy towards this person", "I suppose this person would understand my feelings very well", "This person awakens positive feelings in me", "I think this person is nice") which were averaged to create an index. A method previously adopted to study liking ratings (Bocian et al., 2018), where items formed an internally consistent scale with Cronbach's α = .95 (Kulesza et al., 2015) and as in previous studies, liking ratings serve as a manipulation check (Kot & Kulesza, 2016; Kouzakova et al., 2010a,b). In the current study Cronbach's α was = .83.

Agentic and communal characteristics

To measure the degree to which participants perceived themselves as agentic and communal, the Agency and Communion questionnaire was used (Wojciszke & Szlendak, 2010). The measure was modified to measure participants' feelings in the current moment ("Please indicate how far each of these items describe you or not at this moment"). The two-dimensional measure consisted of 30 items; 15 concerned agency characteristics (e.g., [I am] "Self-confident", "Active", "Persistent", "Persuasive", "Competent") and 15 concerned communal ones (e.g., [I am] "Friendly", "Carrying", "Kind", "Compassionate"). Participants indicated the veracity (1 = *definitely not*; 7 = *definitely yes*) of each item. For analysis an

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[14] Additional questionnaires were completed for answering research questions unrelated to thesis. They were not included in the analyses of this thesis.
[15] All materials were used in polish.

average was calculated for each. In the current study Cronbach's for agency characteristics was α = .89 and for communal ones Cronbach's α = .85.

Agent and recipient perspective

To explore individual differences in people's willingness to take the perspective of the agent and the recipient, the Polish version of the perspective questionnaire was used (Baryla et al., 2019). The measure was modified to measure participants' feelings in the current moment ("please indicate how far each of these items describe you or not at this moment"). The questionnaire consisted of 20 items; 10 concerned the perspective of the agent (e.g., "When I make up my mind, nothing can stop me", "I like to make decisions") and 10 concerned the perspective of the recipient (e.g., "I really care about what other people are doing", "I experience strong emotions in my interactions with other people"). Participants indicated the veracity (1 = *definitely not*; 7 = *definitely yes*) of each item. For proper measurement of these two aspects, an average was calculated for each. In the current study Cronbach's for agent perspective was α = .83 and for recipient was Cronbach's α = .84.

Mimicry manipulation

The mimicry manipulation used in this study was a computer-based method, applied in previous experiments (Bocian et al., 2018; Kulesza et al., 2015). This method is top-notch as for example can make research easy to replicate. In the task, individuals see a person on the computer monitor and are led to believe they are engaging in a live interaction with this person (emotion recognition via video conference), who is ostensibly copying their facial expression or not. It is, however, pre-recorded material presenting a woman with fair skin in her thirties (i.e., face and body-torso of a professional actress) seated at the other desk, facing a computer monitor. Participants, therefore, had the illusion they interacted with another person over a video chat. The laboratory was set up for emotion recognition via video conference task with one computer with a built-in camera (Dell, 24 inches), professional

headphones connected to the computer, and one small table for participants to complete questionnaires. The Media Player Classic program, version 1.7.9.190, was used to show the video to participants, but they were restricted from seeing playback interface options to maintain the illusion that this was a genuine interaction. The window on the computer screen was maximized, and the movie was set to play by pressing the spacebar. After the movie was finished (in both conditions took 8:23 s), the option in Media Player Classic program, was set up to automatically turn off the computer, again to maintain the deception that this was a bona fide interaction. It was applied so that participants would not see the end of the movie and viewing options in the MPC program.

Procedure

Participants were individually invited to the lab and were seated at a table with a computer monitor. They were told that the experiment was testing a new cross-cultural research method to study the universality of emotional recognition (basic emotions such as anger, disgust, fear, happiness, sadness, surprise; Ekman, 1973; see Kulesza et al., 2015). Participants were told they would engage in a video conference where they would not talk to another person, but instead display various emotions, as instructed, and while their ostensible conversation partner would try to guess the emotions displayed. However, they were not told about the mimicry manipulation. Further, they were told that upon completing this task, they would complete the paper-and-pencil questionnaires afterwards at the table provided. After information about the aims of the study (emotion recognition via video conference), and their rights as participants was provided, consent was obtained in writing.

All participants sat about 30 centimeters from the computer screen, and were provided with headphones. They were instructed to express about 50 facial expressions that will be indicated via headphones. Pre-recorded content was created with a single male speaker using a monotone voice announcing the expressions to be displayed with a 10 second time lag in-

between. The announcements consisted of a pre-randomized assortment of mixed negatively (anger, disgust, fear, and sadness) and positively (happiness, and surprise) words which directly referred to emotional expressions, and that were presented with a time lag respectively. All participants heard the same order of the words. Participants in both conditions were asked to immediately make emotional expressions with their face that reflected the one they heard so that their ostensible interaction partner could try to guess which one they heard the participant displayed. In the mimicry conditions (see Figure 1), when participants were asked to show certain facial expressions after hearing the command, the pre-recorded actress made the same emotion as was heard by the speaker within a two second lag, meaning that the mimicry appeared with a delay of about two seconds. In the no-mimicry condition (see Figure 2), the actress maintained a neutral expression. In both conditions, participants could observe that the actress wrote down her judgments, but they could not see what she wrote. Once done with the emotion recognition task, participants completed all questionnaires in writing and provided demographic data. Upon completion, participants were thanked, debriefed, and those who needed received course credit. Before leaving, participants were casually asked what they thought the study was about; none guessed the purpose of the study.

Figure 1

The actress when displaying the happiness as seen by the participants in the mimicry condition

Figure 2

The actress displayed a neutral affective expression as seen by the participants in the no-mimicry condition

Analyses

Data analysis was done in several steps in SPSS Statistics version 26. To understand the relationships between the variables, and verified hypotheses a Pearson's *r* was used. Mixed model ANOVA (repeated measures with between-subjects factors specified in SPSS)[16] were conducted to determine the main and interaction effects of the mimicry conditions (i.e., between-subjects: mimicry vs. no-mimicry) and the dependent variables (a) within-subjects: agency vs. communion and, b) within-subjects: agent perspective vs. recipient perspective).

Results

Descriptive statistics, correlations and manipulation check[17]

Randomization was successful for age $t(157)$[18] $= -0.58$, $p = .562$, respectively in mimicry condition ($M_{age} = 22.85$, $SD = 2.96$) and non-mimicry condition ($M_{age} = 23.20$, $SD = 4.53$) and sex $\chi^2(1, N = 160) = 0.02$, $p = .966$. Table 5 contains the descriptive statistics for the study variables, and, also, correlations between the study variables. Mimicking the participant had an impact on how much they liked for the actress: Participants who were mimicked ($Mdn = 5.71$) liked the actress more than those who were not mimicked ($Mdn = 4.57$), $U(N = 160) = 1514.00$, $z = -5.76$, $p < .001$, this was consistent with predictions. The rank biserial correlation coefficient, $r = .53$, 95% CI $= [0.39, 0.64]$. This effect is considered as large (LeBlanca & Cox, 2017). Furthermore, the degree to which participants perceived themselves as agentic was positively correlated with how much they took the agent's perspective. Also, the degree to which participants took the agent's perspective was negatively associated with how much they took the recipient's perspective. Further, the degree to which participants took the

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[16] Alike other researchers testing differences between self-concepts and perspectives (Abele et al., 2014).

[17] Sample size for this study was based on the power analysis which indicate that at least 156 participants were necessary to detect a moderate effect ($F = 0.32$) with adequate power ($\alpha = .05$, $1 - \beta = .80$; Hale, Hamilton, 2016).

[18] One missing value.

recipient's perspective was positively correlated with the degree to which they perceived themselves as communal and liked the confederate (the actress), and negatively correlated with how much participants perceived themselves as agentic. The degree to which participants perceived themselves as communal was also positively correlated with the amount of liking for the actress.

Table 5

Descriptive statistics and correlations for all relevant study variables

Measure	1	2	3	4	5
1. Agent Perspective	—				
2. Recipient Perspective	-.23**	—			
3. Agency	.73**	-.21**	—		
4. Communion	-.07	.41**	.02	—	
5. Liking	-.32	.24**	.05	.39**	—
Total sample ($N = 160$) M (SD)	5.32 (0.75)	4.95 (0.97)	5.05 (0.87)	5.41 (0.67)	5.02 (1.21)
No-mimicry ($N = 81$) M (SD)	5.33 (0.67)	4.70 (0.99)	5.07 (0.81)	5.31 (0.69)	4.46 (1.26)
Mimicry ($N = 79$) M (SD)	5.31 (0.83)	5.20 (0.90)	5.03 (0.93)	5.52 (0.64)	5.56 (0.87)
F-test	0.03	11.39**	0.01	4.05*	18.75**
η_p^2	.00	.07	.00	.03	.21

Note. * $p < .01$, ** $p < .001$

Main effects

A 2 (mimicry vs no-mimicry) × 2 (self-concepts: agency vs communion) mixed model ANOVA with agentic and communal self-concepts as the within-subject variable was conducted (see Table 5 for descriptive statistics). There was a main effect of self-concepts, $F(1, 158) = 17.89$, $p < .001$, $\eta_p^2 = .10$, such that independently of the condition participants' evaluation of communal characteristics were higher ($M = 5.41$, $SE = 0.05$) than agentic ($M = 5.05$, $SE = 0.07$). There was no main effect for the mimicry condition, $F(1, 158) = 0.88$, $p = .349$, $\eta_p^2 = .01$, nor was there an interaction, $F(1, 158) = 2.28$, $p = .133$, $\eta_p^2 = .01$ (see Figure 3). Subsequent post-hoc analyses revealed that when facial expressions were mimicked by the actress, participants reported higher communal scores, compared to the situation when they were not mimicked, $F(1, 158) = 4.05$, $p = .046$, $\eta_p^2 = .03$. Agency scores did not differ based

on the mimicry condition, $F(1, 158) = 0.12$, $p = .873$, $\eta_p^2 = .001$. The differences between communion and agency self-concepts scores within conditions were analyzed, suggesting that in a mimicry communion was higher than agency, $F(1, 158) = 16.68$, $p < .001$, $\eta_p^2 = .10$, but with no difference in the no-mimicry condition, $F(1, 158) = 3.66$, $p = .058$, $\eta_p^2 = .02$.

Figure 3

Interaction between the condition and agency and communion self-concepts
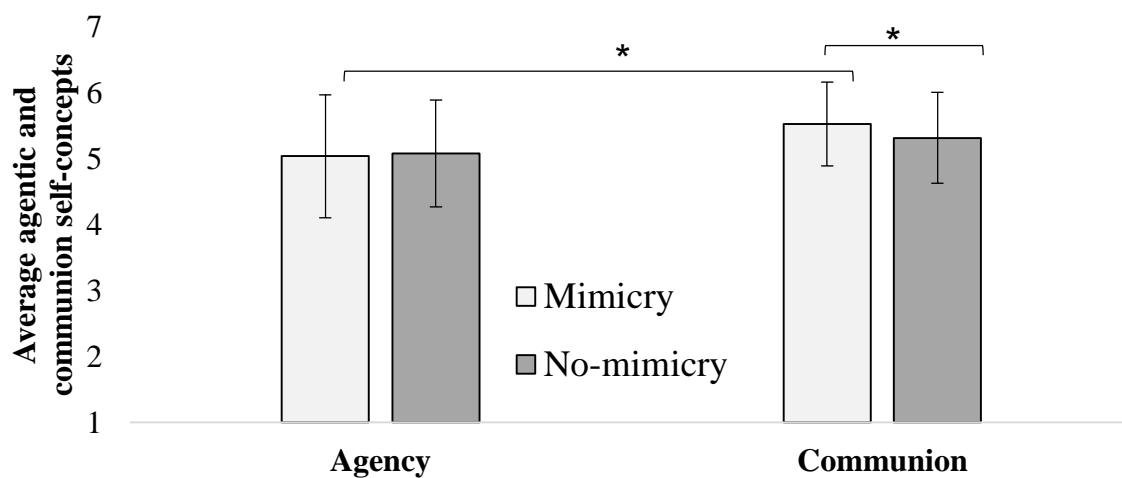
Note. Error bars correspond to standard deviations.

In mimicry condition ($M = 5.25$, $SE = 0.06$) the level of agent and recipient scores were higher, $F(1, 158) = 8.22$, $p = .005$, $\eta_p^2 = .05$, than in no-mimicry ($M = 5.01$, $SE = .06$) condition, according to main effect of condition. Participants, independent of mimicry, reported higher, $F(1, 158) = 12.70$, $p < .001$, $\eta_p^2 = .07$, scores in the agent perspective ($M = 5.32$, $SE = .06$) than recipient one ($M = 4.94$, $SE = .08$) according to main effect of self-perceptions. An interaction emerged between the condition and participant's ratings of agent and recipient perspectives scores, $F(1, 158) = 6.15$, $p = .014$, $\eta_p^2 = .04$ (see Figure 4). Subsequent post-hoc analyses revealed that when facial expressions were mimicked by the actress, participants reported higher recipient perspective scores, compared to the situation

when they were not mimicked, $F(1, 158) = 11.39$, $p = < .001$, $\eta_p^2 = .07$. Agent perspective

scores did not differ based on the mimicry condition, $F(1, 158) = 0.03$, $p = .856$, $\eta_p^2 < .01$.

The differences between agent and recipient perspective scores within conditions were

analyzed, suggesting that agent perspective scores were higher than recipient perspective

scores in the no-mimicry condition, $F(1, 158) = 18.04$, $p < .001$, $\eta_p^2 = .10$, but with no

difference in the mimicry condition, $F(1, 158) = 0.60$, $p = .442$, $\eta_p^2 = .004$.

Figure 4

Interaction between the condition and perspective scores
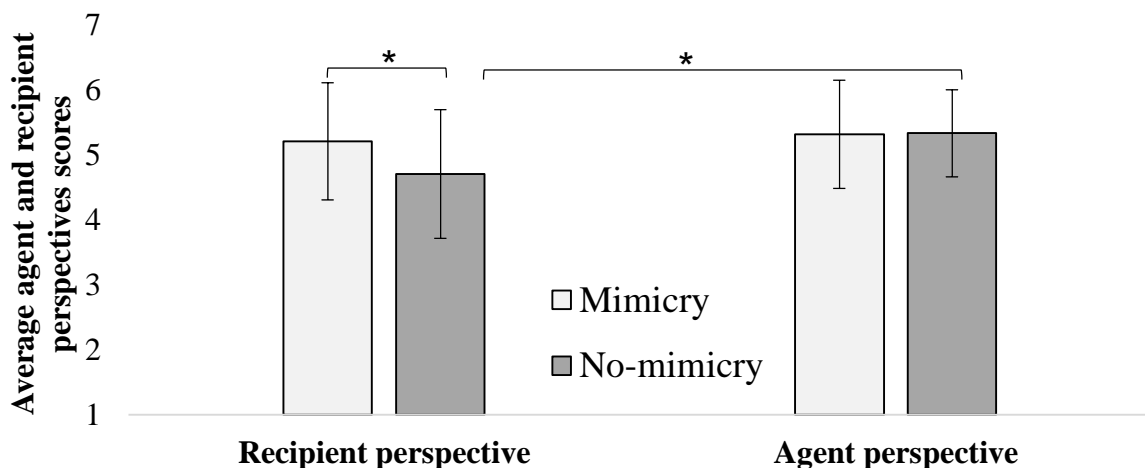
Note. Error bars correspond to standard deviations.

Exploratory analyses

Communion as a mediator of the relationship between mimicry and liking

To test for communion as a possible mediator in the relationship between mimicry and

liking, mediation analyses were computed in the JAMOVI program. The overall significance

of the indirect effect was tested by devising a 95% confidence intervals (bootstrap percentiles,

$N = 1000$, see Preacher & Hayes, 2004). The indirect effect $B = 0.12$, $SE = 0.07$, $\beta = 0.05$, $p =$

.062, 95% CI = [-0.01, 0.27], failed to become significant.

Figure 5

Standardized regression coefficients for relationship between facial mimicry and liking with communion as mediator
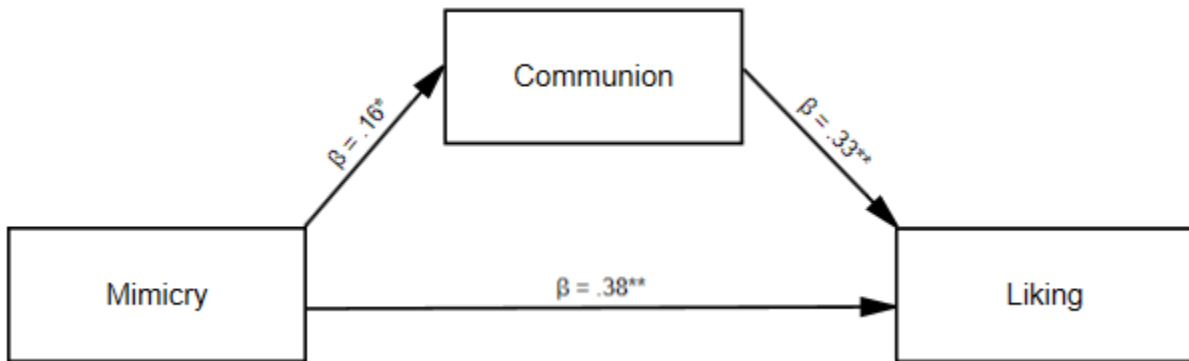
Bayesian analysis for quantify evidence in favor of null hypothesis

In the analyses presented in this study, facial mimicry was found to be non-influential to agency self-concepts. Given that findings, frequentist analyses were supplemented with Bayesian analysis which allows for quantify evidence in favor of null hypothesis (Wagenmakers et al., 2018). Bayesian independent sample t test was conducted with JAMOVI software using default effect size priors (Cauchy = 0.707). Regarding the current data there is 3.73 times more evidence in favor of the null-hypothesis than the alternative-hypothesis (BF_{01} = 3.73). According to Jeffreys, (1961) guide to interpreting the strength of evidence this is moderate evidence. For the second null-hypothesis analysis (facial mimicry was found to be non-influential to agentic perspective) was also conducted with JAMOVI software using default effect size priors (Cauchy = 0.707). Regarding the current data there is 5.70 times more evidence in favor of the null-hypothesis than the alternative-hypothesis (BF_{01} = 5.70). This is moderate evidence (Jeffreys, 1961).

Discussion

In this study mimicry increased liking, consistent with previous works using a similar method of mimicry manipulation (Bocian et al., 2018; Kulesza et al., 2015). Obtained effects

of mimicry on liking, considered as large, were comparable with other empirical results. Therefore, the experimental manipulation of mimicry was rather effective, and brings consistent outcomes (Bocian et al., 2018; Kulesza et al., 2015). In line with assumptions, a positive correlation between agency and the agent perspective scores was found. Also a positive correlation between recipient perspective and communion was noted. The recipient score was positively correlated with liking, and negative with agency. Agent perspective were negatively correlated with the recipient perspectives scores. Furthermore, communion was positively correlated with liking. Moreover, consistent with predictions, participants who were mimicked felt more communal (this effect was considered as small, Cohen, 1988) than those not mimicked. Also in line participants being mimicked felt more as recipients than participants not mimicked (this effect is considered as medium, Cohen, 1988). There were no significant differences between mimicry and no-mimicry conditions in participant's agentic self-concepts, nor in agent perspective scores.

In this experiment, people whose facial expressions were mimicked perceived themselves as more communal than those not mimicked. Such findings are essential because they proved that mimicry is a factor that temporarily increases prominence of the communal self-concept. This is in line with theoretical assumptions, and evidence that changes in communal self-concepts can be sensitive when people are exposed to a social affiliative context (Uchronski, 2008; Uchronski et al., 2013). The result is also consistent with previous research showing that a combination of nonverbal and facial mimicry may arise other-orientation in people (Stel & Harinck, 2011; Stel & Vonk, 2010), and in general context-dependent processing (van Baaren et al., 2003). However, the result obtained in this study was smaller than those in earlier works. Maybe the nature of the implemented task is the reason behind such differences. Contrary to the prior studies, task-oriented settings were used, which in general may weaken people's affiliative responses (Leander et al., 2012).

The more communal self-concept after being mimicked can be explained with social glue hypothesis and with assumptions from self-other overlap models (Chartrand & Bargh, 1999; Greenwald, 1970; Lakin & Chartrand, 2003; Hale & Hamilton, 2016; Prinz, 1997). When based on a latter models, it would be that the facial mimicry increased activity in mirror neuron systems, as well as, brain regions responsible for differentiating the self-and-the other, which in turn, would drive the partial blur between self-and-other representations (Hale & Hamilton, 2016a). It is also suggested that the activation of MNS through mimicry, which results in greater feelings of closeness to others, may be underpinned by a reward system in the brain (Guionnet et al., 2012; Hsu et al., 2018; Kühn et al., 2010; Neufeld & Chakrabarti, 2016). Interestingly in this study, when based on exploratory analyses, communion was correlated positively with happiness. However, the emotional states of participants were measured on a one-item-author's scale, so that this measure was not validated and reliable. In future studies should investigate whether the participant's mood fluctuation would be a mediator in the relationship between mimicry and communal feelings. In addition, there is still debate if the simple activation of mirror neuron systems can fully explain facial mimicry processes (Carr et al, 2003). Facial mimicry can be a more complex process (than non-behavioral one) that involves others than MNS brain regions. In other words, MNS systems are probably related to mimicry and its outcomes, but they're still might be many more mechanisms responsible for such links. Moreover, in this experiment, people perceived themselves as more communal than agentic, but there was no difference in the no-mimicry group, inconsistent with predictions.

In this study, mimicry did not impact the agentic self-concepts. The underlying mechanism is still unknown. Current data provide, however, the information that there was around four times more evidence in favor of the null hypothesis, than the alternative one. It means that there are some evidence that agentic self-concepts might be insensitive to mimicry

impact. These results would be consistent with assumptions that 1) agency and communion are orthogonal as opposed to opposite ends of the same continuum of attitudes (Abele, 2003). Therefore, there does not need to be a change in agentic self-concepts when a person adopts more communal self-concepts.

Furthermore, people being mimicked describe themselves as more from the recipient perspective than those not mimicked. This result is a valuable novelty in a field of mimicry research, because it seems that there is a lack of investigations into whether and how mimicry impacts a person's self-perspectives. Increased level of recipient perspective may be explained by assumptions described above (claims from social glue hypothesis, or the self-and-other overlap models, Lakin & Chartrand, 2003; Hale & Hamilton, 2016a). Meaning that people being mimicked, would feel closer to others, and focused (monitor) more on them and their actions, which would in turn arise their recipient perspective.

Moreover, no significant effects of mimicry on agent perspective was found. Current data, however, provide information that there was more evidence in favor of null-hypothesis compared to alternatives. Collected data also helped to answer other questions. That is, although people who experience a lack of mimicry felt more like agents than recipients, the experience of mimicry might disturbed that pattern. Put simply, in the mimicry condition there was no diversity in the amount of 1) role of the agent, 2) role of the recipient. People mimicked described themselves with a similar degree as recipients and agents. These results are supported by neurocognitive evidence, as such, for instance it is suggested that activation of MNS systems under mimicry, may blur the boundary between action and perception, as well as differentiation between self and the other (Hale, 2016). So that in the actual moment people being mimicked, would face difficulties to precisely assume their role in interaction. Finally, given positive correlation between communion and liking, communal self-concepts

were treated as mediator in the relationship between mimicry and liking. Communion, however, failed to become a mediator in such a model.

Limitations and future directions

The first limitation of this study is related to sampling. Relying on a student sample, even though it is a common practice in psychological studies, may narrow generalizability and replicability (Hanel & Vione, 2016, Richmond et al., 2015). For instance, students may be more psychologically homogeneous than non-students (Peterson, 2001). This experiment was also slightly predominant in females. Gender differences in self-concepts may get blurred, but this reduced difference can occur within the self-centered self-concepts (e.g., agency), but not within other-focused self-concepts (e.g., communion, Abele, 2000; Spence & Buckner, 2000, Twenge, 1997; Wojciszke & Szlendak, 2010). The latter self-concepts still tend to be higher for women. Future studies should consider examinations with more diverse samples. Moreover, in the present study, there were no used baseline scores for dependent variables. That makes it impossible to analyze the changes from baseline, either by looking at absolute variations or a percentage change from baseline. It is a large limitation of this study. The condition without mimicry would diminish the communal and recipient scores (and liking), rather than mimicry would be beneficial by making people more communal, and more in recipient perspectives, and share more liking for unknown others. Future studies should utilize baseline measures of self-concepts and perspectives scores to resolve these issues.

The design of no-mimicry condition also has its limitations. During the computer task, the actress kept a neutral face that is not very natural for interpersonal interactions. This could have biased the ratings of 1) the actress's emotional state, or/and 2) initial interaction, or/and 3) participant's self-perception. In social cognition, even neutral faces can cause impressions because of their ambiguous features (Bambaeeroo & Shokrpour, 2017; Gilbert et al., 1999). The source of this bias can be either 1) the self-reference processes or/and 2) the situational

context (Lee et al., 2008; Wieser & Brosch, 2012). The control and mimicry groups showed the difference in perception of the actress's emotions that was uncovered during the debriefing. Under mimicry people rather recognized the actress' smiles (without mimicry detection), whereas those in control perceived her rather as dissatisfied, sad, or even angry. The not instinctive nature of the task would cause stress because people often mask emotions in public, as well as online interaction usually produces more stress in them (Jacobsen & Kristiansen, 2015; Murphy, 2001; Tibbetts et al., 2021). If it would be true, interpreting neutral face negatively occurred because of cognitive accessibility of that content (see *negativity bias*, Vaish et al., 2008). When based on exploratory analysis (Table S1), not mimicked individuals felt more guilty, less happy, excited, and interested than those mimicked. Two conditions do not differ when considering feelings of anger and contempt. Perhaps this also causes the ratings of liking and a person's self-perception.

Additionally, in a no-mimicry condition, the actress's facial expressions remained stable, while participants expressed many emotions facially. These atypical behavior of actress would provide an alternative explanation for given outcomes from this experiment. That is, differences between conditions would arise not because the actress mimicked participants but rather because she was perceived as more cheerful and responsive than in a no-mimicry condition. For example, the actress's unresponsive manner would influence liking, because expressive (and responsive) individuals are usually more liked than those unresponsive (Gorham, 1988; Mottet et al., 2004). That alternative explanation is not a simple critique, researchers should draw attention to the challenge of designing good no-mimicry conditions in mimicry studies, and potential misinterpretation of the obtained results.

Some more limitations may be related to the ecological validity of the mimicry method. Despite the fact the actress occasionally moved during the computer-video task, there was no possibility to establish verbal contact with her, something again which did not occur

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naturally in social interactions (Gorham, 1988). The last limitation is related to the degree of experimental control. During an examination, the experimenter was not present, and recording was not used. These made it impossible to check whether persons followed the instructions in completing the computer-video task. In debriefing, however, participants reported adequate completion.

Study 2: Extension: Role of non-verbal mimicry in communion and agency

In Study 2, the extension of Study 1 was conducted. First, in this experiment instead of facial mimicry, the method of nonverbal mimicry was applied. In previous studies, non-verbal mimicry resulted in more other-focus (Ashton-James et al., 2007; Kühn et al., 2009; van Baaren et al., 2003b) or not (Hogeveen et al., 2014). In these prior research, self-construal's were investigated by interpersonal closeness measured on the IOS scale (Aron et al., 1992) or by interdependent/independent-self concepts measured on The Twenty Statements Test (Kuhn & McPartland, 1954). Researchers, as was already discussed, did not examine potential changes in self-centered concepts (independent self) following mimicry. In the present study, agency and communal self-concepts, as well as, agent and recipient perspectives were examined, like in Study 1. Second, the human confederates were invited instead of utilizing video-recorded material. Third, the task used during the mimicry manipulation was changed. Interacting with an unknown person in a task-oriented context may diminish mimicry tendencies, inferring that usual such a setting is unnatural/atypical in social interactions (Leander et al., 2012). So that, instead of applying task-oriented surroundings, a more conversational condition was designed (Kulesza et al., 2016). The formulated hypothesis and exploratory questions were the same as in Study 1.

Method

Participants

Data for this study was collected at SWPS University of Social Science and Humanities in exchange for course credit. The sample consisted of 173 participants (132 women, aged from 19 to 46, $M_{age} = 23.95$, $SD = 6.40$, and 41 men, aged from 19 to 42, $M_{age} = 23.68$, $SD = 4.93$), randomly assigned to the mimicry ($N = 86$) or no-mimicry condition ($N = 87$). Ethical approval for this study was obtained at the SWPS University of Social Sciences

and Humanities (SWPS) from the Ethics Committee for Scientific Research, Faculty of

Psychology (2018-08-01).

Mimicry manipulation

A widely used confederate behavioral mimicry method was applied (Chartrand, &

Bargh, 1999). A confederate either mimicked or did not mimic the participant's non-verbal

behaviors during an interaction task. The task involved an interview, where participants

assessed the quality of teaching at the home university (Kulesza et al., 2016). Participants

were randomly assigned to one of the two conditions differentiated by the confederate's style

of interaction with the participants. In the mimicry condition, the confederate was instructed

to sit in a relaxed position and to copy the posture, and movements displayed by the

participant (e.g., nodding, rubbing neck or leg, wiping nose, feet tapping, crossing and

uncrossing the legs) with a delay of about 2–3 seconds. The confederate tried to be natural

and repeated behaviors used by participants around every second presence – not in every, to

avoid the unnaturalness of the conversation or the orientation of the participants that they

were being copied (Kavanagh et al., 2011; Kouzakova et al., 2010b). In the no-mimicry

condition the confederate was instructed to sit in a neutral relaxed position, and refrain from

mimicking participants' non-verbal behaviors (Ashton-James et al., 2007; Chartrand & Bargh,

1999). To make sure that confederates will not automatically mimic participants, they were

instructed to sit relatively still (put palms flat on a desk, and both flat feet on the floor,

Chartrand & Bargh, 1999; Kot & Kulesza, 2016).

Measures and materials[19]

Liking the mimicker.

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[19] Additional questionnaires were completed for answering research questions unrelated to the thesis. They were
not included in the analyses of this thesis.

To measure if the mimicry manipulation increased liking of the mimicker (i.e., confederate), participants indicated the veracity (1 = *definitely not*; 7 = *definitely yes*) of seven items, which were averaged to create an index (Cronbach's α = .93), as in Study 1, Cronbach's α in the current study was = .83.

Agency and communion self-concepts.

To measure the degree to which participants perceived themselves as agentic and communal, the Agency and Communion questionnaire (Wojciszke & Szlendak, 2010) was used as in Study 1. The agency (α = .87) and communal (α = .89) items had good internal consistency and, therefore, averaged.

Agent and recipient perspective.

To explore individual differences in the perspective of the agent and the recipient scores, the Polish version of the perspective questionnaire was used (Baryla et al., 2019) like in Study 1. The items for the perspective of the agent (α = .82) and the perspective of the recipient (α = .83) had good internal consistency and were therefore averaged.

Procedure

Participations were tested individually in a laboratory at a university with one confederate present. The confederate was unaware of the exact hypotheses. They both were seated facing each other, with approximately four feet between them. All participants provided written consent after they had been informed about their rights and the general aims of study. Participants were told they were involved in a study to assess and improve quality of teaching at the university. Upon commencement of the study, the confederate introduced herself as a local university student in market research who was conducting a study to fulfill

course requirements. The cover story provided was justification for administering a post-interview questionnaire. Each interview took approximately 7–10 minutes and was composed of 12 questions asked in the same order. The participants were free to briefly respond to each of those questions; responses were not recorded, but in both conditions the confederate pretends to be taking notes from time to time during the interview. During the interview, the confederate mimicked or did not mimic the participant's non-verbal behaviors. Once the interview was completed, the participants started with the self-report surveys, then provided demographic questions, and were at the end asked if they had guessed the purpose of the experiment or noticed that the confederate was copying them. Lastly, the participants were thanked, debriefed, and, for those who needed it, were awarded course credit.

Analyses

Data analysis was done in the same way as Study 1.

<div align="center">

Results

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Descriptive statistics, correlations and manipulation check[20]

Randomization was successful for age $t(171) = 1.88$, $p = .062$, respectively in mimicry condition ($M_{age} = 23.02$, $SD = 5.50$) and no-mimicry condition ($M_{age} = 24.75$, $SD = 6.50$) and sex $\chi^2(1, N = 173) = 0.24$, $p = .621$). Table 6 contains the descriptive statistics for the study variables, and, also, correlations between the study variables. Mimicking the participant had an impact on how much they liked for the confederate: Participants who were mimicked ($Mdn = 5.71$) liked the confederate more than those who were not mimicked ($Mdn = 4.57$), $U(N = 160) = 1514.00$, $z = -5.76$, $p < .001$. The rank biserial correlation coefficient, $r = .53$, 95% CI $= [0.39, 0.64]$. This effect is considered as large (LeBlanca & Cox, 2017). The degree to

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[20] Sample size for this study was based on the power analysis which indicate that at least 156 participants were necessary to detect a moderate effect ($F = 0.32$) with adequate power ($\alpha = .05$, $1 - \beta = .80$; Hale, Hamilton, 2016).

which participants perceived themselves as agentic was positively correlated with how much they took the agent's perspective, and with the amount of liking for the confederate. Further, the degree to which participants took the recipient's perspective was positively correlated with the degree to which they perceived themselves as communal, and liked the confederate. The degree to which participants perceived themselves as communal was also positively correlated with the amount of liking for the confederate.

Table 6

Descriptive statistics and correlations for all relevant study variables

Measure	1	2	3	4	5
1. Agent Perspective	—				
2. Recipient Perspective	-.08	—			
3. Agency	.62**	-.14	—		
4. Communion	-.10	.40**	.19	—	
5. Liking [a]	-.00	.15	.10	.30**	—
Total sample ($N = 173$) M (SD)	5.33 (0.74)	5.07 (0.88)	5.02 (0.77)	5.58 (0.71)	5.62 (0.96)
No-mimicry ($N = 87$) M (SD)	5.43 (0.71)	4.88 (0.88)	5.04 (0.72)	5.34 (0.69)	5.25 (1.02)
Mimicry ($N = 86$) M (SD)	5.24 (0.76)	5.26 (0.85)	5.01 (0.83)	5.84 (0.64)	6.00 (0.73)
F-test	3.01	8.01**	0.50	24.24**	30.75**
η_p^2	.02	.05	.00	.12	.15

Main effects

A 2 (mimicry vs. no-mimicry) × 2 (self-concepts: agency vs. communion) mixed model ANOVA with agentic and communal traits as the within-subject variable was conducted (see Table 6). Regardless of the type of self-concepts, scores were higher, $F(1, 171) = 7.67$, $p = .006$, $\eta_p^2 = .04$, in the mimicry condition ($M = 5.42$, $SE = 0.61$) than in the no-mimicry condition ($M = 5.19$, $SE = 0.61$). And last, participants, independent of mimicry, reported higher, $F(1, 171) = 65.34$, $p < .001$, $\eta_p^2 = .28$, scores in the communion ($M = 5.59$, $SE = .059$) than agency ($M = 5.03$, $SE = .051$). An interaction emerged between the condition and participant's ratings of agentic and communal scores, $F(1, 171) = 14.33$, $p < .001$, $\eta_p^2 = .07$ (see Figure 6). Subsequent post-hoc analyses revealed that when participant's non-verbal

were mimicked by the confederate, they reported higher communal scores, compared to the situation when they were not mimicked, $F(1, 171) = 24.24$, $p < .001$, $\eta_p^2 = .12$. Agency characteristics scores did not differ between both conditions, $F(1, 171) = 0.05$, $p = .821$, $\eta_p^2 < .001$. The differences between communal and agentic characteristics within conditions were analyzed and the results showed that participants' evaluation of communal scores were higher than agentic scores in both the mimicry condition, $F(1, 171) = 70.03$, $p < .001$, $\eta_p^2 = .29$, and the no-mimicry condition, $F(1, 171) = 9.29$, $p = .003$, $\eta_p^2 = .05$. The difference between agency and communion was, however, substantially larger when the participants were mimicked by the confederate, $\Delta F = 60.74$, $\Delta\eta_p^2 = .24$.

Figure 6

Interaction between the condition and agency and communion self-concepts
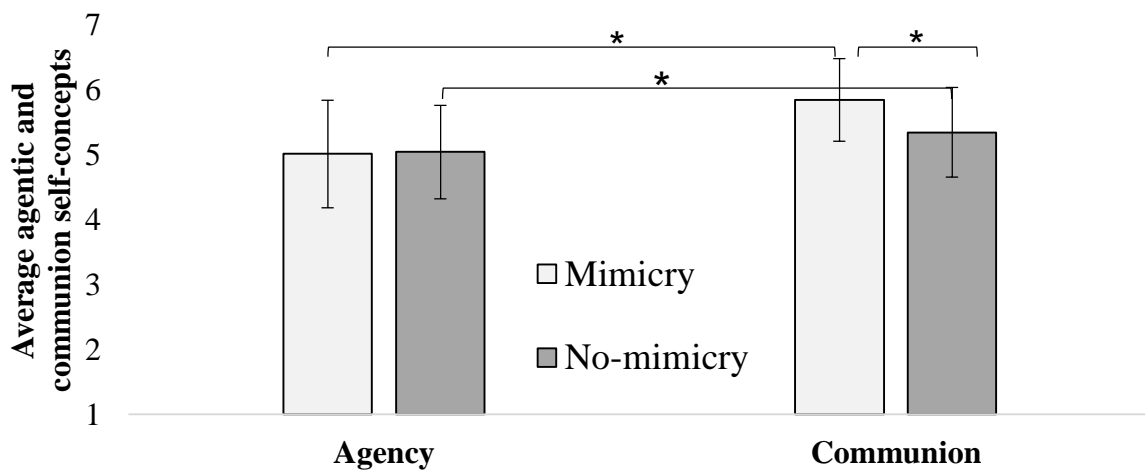
Note. Error bars correspond to standard deviations.

The main effect of the condition was not significant, $F(1, 171) = 1.15$, $p = .285$, $\eta_p^2 = .01$. Participants, independent of mimicry, reported higher, $F(1, 171) = 9.11$, $p = .003$, $\eta_p^2 = .05$, scores in the agent perspective ($M = 5.34$, $SE = .056$ than recipient one ($M = 5.07$, $SE = $

.066). An interaction emerged between the condition and participant's ratings of agent and recipient perspectives, $F(1, 171) = 10.37$, $p = .002$, $\eta_p^2 = .06$ (see Figure 7). When non-verbal behaviors were mimicked by the confederate, participants reported higher recipient perspective scores, compared to the situation when they were not mimicked, $F(1, 171) = 8.10$, $p = .005$, $\eta_p^2 = .05$. Agent perspective scores did not differ based on the mimicry condition, $F(1, 171) = 3.09$, $p = .080$, $\eta_p^2 = .02$. However this result may be also considered as marginally significant. The differences between agent and recipient perspective scores within conditions were analyzed, suggesting that agent perspective scores were higher than recipient perspective scores in the no-mimicry condition, $F(1, 171) = 19.57$, $p < .001$, $\eta_p^2 = .10$, with no difference in the mimicry condition, $F(1, 171) = 0.02$, $p = .887$, $\eta_p^2 = .00$.

Figure 7

Interaction between the condition and taking perspectives of agent and recipient
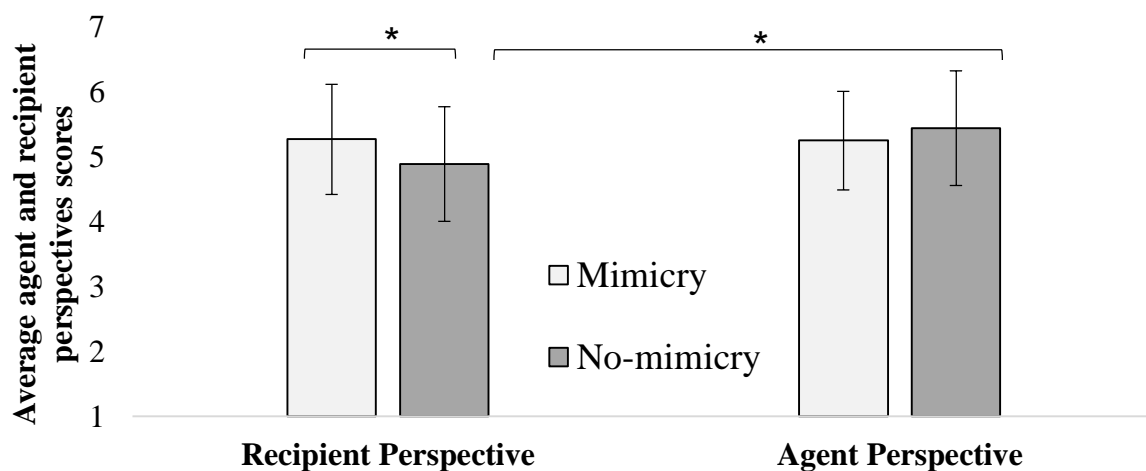
Note. Error bars correspond to standard deviations.

Exploratory analyses

Communion as a mediator of the relationship between mimicry and liking

In Study 1 there were no evidence for communion as mediator in the relation between mimicry and liking. To test this relation in this study, mediation analyses was computed in

JAMOVI program. The overall significance of the indirect effect was tested by devising a 95% confidence intervals (bootstrap percentiles, $N = 1000$, see Preacher & Hayes, 2004). The indirect effect $B = 0.12$, $SE = 0.06$, $\beta = .06$, $p = .035$, 95% CI = [0.02, 0.26], $z = 2.11$, was significant.

Figure 8

Standardized regression coefficients for relationship between nonverbal mimicry and liking with communion as mediator
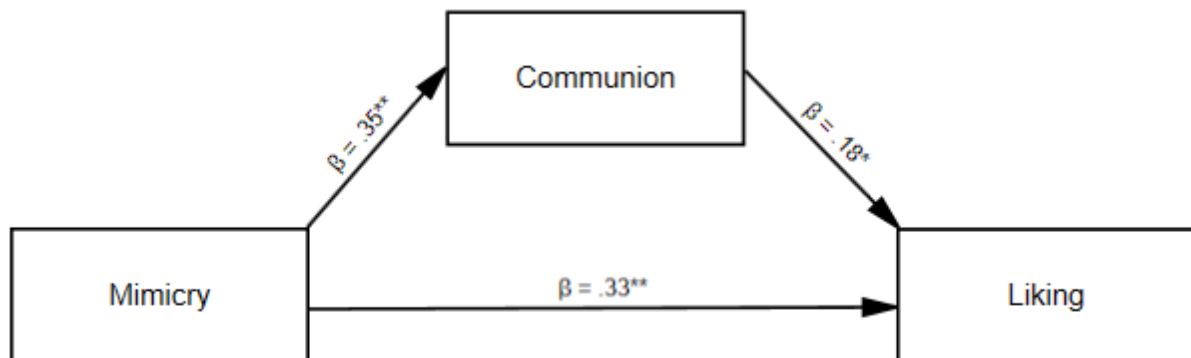
Bayesian analysis for quantify evidence in favor of null hypothesis

In this study, non-verbal mimicry was again found to be non-influential to agency. Given that findings, Bayesian independent sample t test was conducted. JAMOVI software was used with default effect size priors (Cauchy = 0.707). Regarding the current data there is 5.08 times more evidence in favor of the null-hypothesis than the alternative-hypothesis (BF_{01} = 5.08). According to Jeffreys (1961) guide to interpreting the strength of evidence this is moderate evidence. As effect of mimicry on agent perspective was at the margin of significance, Bayesian independent sample t test analysis was conducted. JAMOVI software using default effect size priors (Cauchy = 0.707) have been used. In regard to current data

there is no evidence (Jeffreys, 1961) in favor of either null-hypothesis nor the alternative-hypothesis ($BF_{01} = 0.76$).

Discussion

In this study, it was examined whether nonverbal mimicry by a confederate influences people's actual agentic and communal self-concepts and their agent's or recipient perspectives. First, mimicry increased liking, consistent with previous Study1, and with other works used the same or similar mimicry manipulation (Kot & Kulesza; Kozakova, Karremans et al., 2010, Kozakova, van Baaren et al., 2010). Obtained effect was also comparable with research using a confederate method of mimicry. Second, in line with predictions, mimicked participants felt more communal than those not mimicked. Third, participants under mimicry were more in a role of recipients than those without mimicry experience. There were no significant differences in both conditions on participant's tendency to view themselves as agentic well as there was no significant effect of mimicry in terms of changes in agent perspective.

In general, there were positive correlations between agency self-concepts and agent perspective, with participants who described themselves as more agentic and assuming the agent perspective to a higher degree. Additionally, there were also positive correlations between communion self-concepts and recipient perspective, with participants who reported more communal self-concepts having higher recipient perspective. This is consistent with the theoretical assumption from the DPM model (Abele & Wojciszke, 2014), which states that in the recipient perspective communion is more relevant than agency, and contrarily that in the agent perspective, agency is more relevant than communion. Results from this experiment also showed positive correlations between communion self-concepts and liking. That is, more communal self-concepts, facilities more liking for confederate. These results, similarly like in

Study 1, strengthened the need of testing the communal feeling, through mimicry, as a possible mediator for the relationship between mimicry and liking. It was further tested in exploratory analysis.

Furthermore, it was found, like in Study 1, that communal self-concept can be sensitive to mimicry – in particular – to nonverbal mimicry. Consistently with previous research showing that people whose gestures or postures are mimicked may feel in general more other-oriented (Ashton-James et al., 2007; Kühn et al., 2009; van Baaren et al., 2003b, obtained effects are similar). It is essential, as it is more evidences that mimicry is the factor that may temporarily impact communal self-concepts. Again, the results might be interpreted with work on social glue theories, and the self-other overlap models (Chartrand & Bargh, 1999; Lakin & Chartrand, 2003; Hale & Hamilton, 2016). Moreover, in this experiment, regardless of whether people were mimicked or were not, they perceive themselves as more communal than agentic. This effect is compatible with theoretical assumptions, as such people may have a tendency to describe themselves as more communal than agentic in their self-image (Abele & Wojciszke, 2014). However, the experience of being mimicked may probably make people more communal than agentic than without mimicry experience.

In this study mimicry did not impact agentic self-concept. Similar null effects have been detected in previous Study 1. The underlying mechanism is unknown. Current data provide, however, the information that there is 5 times more evidence in favor of the null hypothesis, than the alternative one. It means that agentic self-concepts might be insensitive to mimicry impact. Received null results are also consistent with assumptions that agentic and communal self-concepts may vary depending on context.

Furthermore, consistent with predictions, and with results from Study 1, people being mimicked felt more like recipients, compared to a situation when they are not mimicked. These conclusions are especially relevant because it seems there is a lack of investigations

into what perspective do people take, depending on whether they are in the role of mimickers or mimickees. Importantly, using more interactive task during the experiment, opposed to being more task-oriented in Study 1, did not change these patterns.

Moreover, no significant effects of mimicry on agent perspective was found (i.e., but the direction of results follow in decrease of agent perspective). Current data provide information that there is no evidence in favor of either null-hypothesis or the alternative one. Although, again like in Study 1 people who were not mimicked felt more like agents than recipients, but the experience of mimicry disturbed that pattern. In mimicry conditions, the degree of agent and recipient scores did not differ. Future studies should increase the clarity of the roles that participants engage in when completing the task. It might be best to assign people to particular roles they may be familiar with from their social and professional lives or embed more contextual cues to alert participants to the need to shift roles.

Finally, given positive correlation between communion and liking, communal self-concepts were treated as mediator in the relationship between mimicry and liking for mimicker. Communion, indeed, played a role of mediator in such a model, however, this result was inconsistent with previous outcomes in Study 1 (where communion failed to be mediator in the relationship between facial mimicry and liking). Findings obtained in this study are theoretically consistent, as 1) liking for others may be influenced by the others communal characteristics, 2) communal self-concept is an important factor in predicting satisfying interpersonal relationships, and 3) previous studies showed that feeling of interdependence is a mediator in relationship between nonverbal mimicry and prosocial behavior (Ashton-James et al., 2007). Therefore, results from this study, going one step further prior ones in mimicry field. That is, being behaviorally mimicked during social interactions, may increase the other-focus, which mediates the influence of mimicry – not only on prosocial behaviors, but also social evaluations (liking for mimicker). Future studies

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should investigate the possible reasons for such differentiations between facial and behavioral mimicry in this model.

Limitations and future directions

First limitation of this study is related to the nature of the sample. The study relied on a student sample with participants predominating in females, just like the previous experiment. Future studies should include more diverse samples. Second limitation is associated with the type of mimicry manipulation. In the present study the popular confederate paradigm was used (Chartrand & Bargh, 1999; Kot & Kulesza, 2016). While this method has brought many consistent results in social psychology works – just like in this study – it may also bring some disadvantages (Hale & Hamilton, 2016b). For instance, 1) it is hard —perhaps impossible—for confederates to be blind to the research hypotheses. Although in the present study confederates were unaware of research hypotheses, they knew the study was about mimicry (and liking). That would lead to experimenter bias. Moreover, in the confederate paradigms 2) it is hard to control many external variables. During the experiment, confederates may present behaviors not strictly related to mimicry (e.g., the presence of a warm voice tone or/and smiling) which can influence the study results (Hale & Hamilton, 2016b; Wang, 2012; Wang et al., 2011). In this experiment, no control was provided for these potential external variables. In further studies, video recording should be used to code behaviors presented by confederates.

Third limitation – large one, similar to the previous doctoral study, was related to the lack of the baseline scores of dependent variables, making it impossible to analyze the occurred changes from baseline. Future research should include baseline measures of critical variables. Fourth limitation of this experiment is related to challenges with good-design no-mimicry conditions. In this study confederates in no mimicry group remained behaviorally inactive (i.e., they keep palms flat on a desk, and both flat feet on the ground, Chartrand &

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Bargh, 2016; Kulesza & Kot, 2016). This behavior would be perceived as unnatural, as such during real-life interactions there is often compatibility between verbal and nonverbal language (Morcinek-Abramczyk, 2019). Additionally, Polish people use – regarding frequency – nonverbal communication that falls somewhere in the middle of the axis, when compared to other countries. If participants perceived behaviors of the confederate as atypical this would lead to less liking for him/her. Moreover, apart from those described above, it also may be that the lack of responsiveness of the partner of interaction might lead to less liking. Nonverbal cues may demonstrate liking for one person, who in turn may reciprocate that liking (Gorham, 1988; Mottet et al., 2004). However, these issues can be tempered by other research findings (e.g., Kouzakova et al., 2010a,b). That is, when confederates in the no-mimicry group moved independently from the participants (but not anti-mimic), the results of liking were relatively comparable to those found in this study. Interestingly, when based on exploratory analysis, not mimicked individuals felt less happy, interested, and marginally less excited than those mimicked. Two conditions do not differ when considering feelings of anger, guilt, and contempt (see Table S1). Perhaps this causes the ratings of liking and a person's self-perception. The last limitation is related to the degree of experimental control. During the examination, there was again no recording. These made it impossible to check whether confederates adequately followed the instructions of mimicry and no-mimicry manipulation. In future studies, video should be provided.

Study 3: Extension: Role of verbal mimicry in communion and agency

In Study 3, the extension of previous doctoral studies was performed (Studies 1 and 2). In this experiment instead of facial and non-verbal mimicry manipulation verbal mimicry was applied. It seems there is a lack of the studies testing the changes in self-concepts under this type of mimicry. In the present study, like in previous ones, agency and communal self-concepts, as well as, agent and recipient perspectives were tested. Again – like in Study 2, the human confederate method was used. The formulated hypothesis and exploratory questions were exactly the same as in Study 1 and in Study 2.

Method

Participants

Data for this study was collected at SWPS University of Social Science and Humanities in exchange for course credit. The sample consisted of 201 participants (140 women, aged 18 to 46 years of age, M_{age} = 23.78, SD = 5.44, and 61 men from 19 to 52, M_{age} = 24.41, SD = 6.54) who were randomly assigned to the mimicry (N = 101) or non-mimicry condition (N = 100). Ethical approval for this study was obtained at the SWPS University of Social Sciences and Humanities (SWPS) from the Ethics Committee for Scientific Research, Faculty of Psychology (2018-08-01).

Mimicry manipulation

The effective paraphrase verbal mimicry method was used (Kulesza et al., 2014a), meaning that the confederate changed the order of the words used by the participant, however, used the same words, for example if the participant's answered: " … I liked the social psychology faculty", the confederate used the paraphrase of words as: " … aha, that is you liked the faculty of social psychology". The task involved an interview, where participants assessed the quality of teaching at the home university, like in Study 2 (Kulesza et al., 2016). Participants were randomly assigned to one of the two conditions (mimicry vs no-mimicry)

differentiated by the confederate's style of interaction with the participants. The confederate in both conditions maintained a neutral facial expression, and retrained from mimicking non-behaviors of the participants. The confederate tried to be natural and repeated sentences used by participants around every second / third sentence (not in every, to avoid the unnaturalness of the conversation or the orientation of the participants that they were being copied; Kavanagh et al., 2011; Kouzakova et al., 2010b) with 2–3 sec. delay. In the no-mimicry condition, the confederate, instead, used different words as the participant, and used short answers (e.g., yes, ok), or just nodding.

Measures and materials[21]

Liking the mimicker.

To measure if the mimicry manipulation increased liking of the mimicker (i.e., confederate), participants indicated the veracity (1 = *definitely not*; 7 = *definitely yes*) of seven items which were averaged to create an index (Cronbach's α = .92); a method used in Studies 1 and 2.

Agency and communion characteristics.

To measure the degree to which participants perceived themselves as agentic and communal, the Agency and Communion questionnaire (Wojciszke & Szlendak, 2010) was used like in Study 1 and 2. The agency (α = .86) and communal (α = .88) items had good internal consistency and, therefore, averaged.

Agent and recipient perspective.

To explore individual differences in people's willingness to take the perspective of the agent and the recipient, the Polish version of the perspective questionnaire was used (Baryla

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[21] Additional questionnaires were completed for answering research questions unrelated to the thesis. They were not included in the analyses of this thesis.

et al., 2019) as in Studies 1 and 2. The items for the perspective of the agent ($\alpha = .81$) and the perspective of the recipient ($\alpha = .79$) had good internal consistency and were therefore averaged.

Procedure

Participation took place individually, in a room at a university with only a confederate present. They were seated facing each other, with nearly four feet between them. The confederate was unaware of the exact hypotheses. All participants provided written consent after they had been informed about their rights and the general aims of the study. Participants were told they were involved in a study to assess and enhance the quality of teaching at the university. Upon commencement of the study, the confederate introduced herself as a local university student in market research who was conducting a study to fulfill course requirements. Each interview took approximately 7–10 minutes and was composed of 12 questions asked in the same order. The participants were free to briefly respond to each of those questions; responses were not recorded. During the interview, the confederate mimicked or did not mimic the participant's verbal answers. Once the interview was complete, the participants completed self-report surveys, provided demographic questions, and were asked if they had guessed the purpose of the experiment or noticed that the confederate was copying them. Lastly, the participants were thanked, debriefed, and, for those who needed it, were awarded course credit.

Analyses

Data analysis was done in the same way as Studies 1 and 2.

Results

Descriptive statistics, correlations and manipulation check[22]

Those in the mimicry condition (M_{age} = 24.72, SD = 6.34), and no-mimicry condition (M_{age} = 23.21, SD = 5.10) did not differ in their ages $t(199)$ = 1.86, p = .064) but there were more women than men in the mimicry condition, $\chi^2(1, N = 201)$ = 5.51, p = .019 suggesting the randomization was not fully successful. Table 7 contains the descriptive statistics for the study variables, and, also correlations between the study variables. The confederate who mimicked was liked more (Mdn = 6.14) by participants than the confederate who did not mimic, (Mdn = 5.57), $U(N = 173)$ = 2050.00, z = -5.14, p < .001. The rank biserial correlation coefficient, r = .28, 95% CI = [0.12, 0.42]. This effect is considered as small (LeBlanca & Cox, 2017). The degree to which participants perceived themselves as agentic was positively correlated with how much they took the agent's perspective, and with the amount of liking for the confederate. Further, the degree to which participants took the recipient's perspective was positively correlated with the degree to which they perceived themselves as communal, and liked the confederate. The degree to which participants perceived themselves as communal was also positively correlated with the amount of liking for the confederate.

Table 7

Descriptive statistics and correlations for all relevant study variables

Measure	1	2	3	4	5
1. Agent Perspective	—				
2. Recipient Perspective	-.02	—			
3. Agency	.64**	-.05	—		
4. Communion	-.13	.34**	.12	—	
5. Liking [a]	-.13	.15*	.18*	.19*	—
Total sample (N = 201) M (SD)	5.31 (0.76)	4.95 (0.89)	4.98 (0.81)	5.46 (0.73)	5.80 (0.90)

[22] Sample size for this study was based on the power analysis which indicate that at least 156 participants were necessary to detect a moderate effect (F = 0.32) with adequate power (α = .05, 1 – β = .80; Hale & Hamilton, 2016).

|						
Non-mimicry ($n = 81$) M (SD)		5.33 (0.73)	4.82 (1.01)	4.96 (0.82)	5.24 (0.72)	5.58 (1.00)
Mimicry ($n = 79$) M (SD)		5.29 (0.80)	5.09 (0.75)	4.99 (0.79)	5.67 (0.67)	6.03 (0.73)
	F-test	0.22	4.58*	0.07	19.34**	13.31**
	η_p^2	.00	.02	.00	.08	.06

Note. * $p < .05$, ** $p < .01$, [a] in the case of the liking variable the Spearman's rho correlation showed comparable

effects.

Main effects

A 2 (mimicry vs. no-mimicry) × 2 (self-concepts: agency vs. communion) mixed

model ANOVA with agentic and communal self-concepts as the within-subject variable was

conducted for all participants (see Table 7). Participants – independently of the mimicry

influence – perceived themselves as more, $F(1, 199) = 46.38$, $p < .001$, $\eta_p^2 = .19$, communal

($M = 5.46$, $SE = 0.49$) than agentic ($M = 4.98$, $SE = 0.57$), when considered main effect of

self-concepts. Scores were higher, $F(1, 199) = 8.39$, $p = .004$, $\eta_p^2 = .04$, in the mimicry ($M = 5.33$, $SE = 0.6$) than in the non-mimicry ($M = 5.10$, $SE = 0.6$) condition, regardless of their

agentic or communal content, when considered main effect of condition. An interaction

emerged between the condition and participant's ratings of agentic and communal scores, $F(1, 199) = 8.16$, $p = .005$, $\eta_p^2 = .04$ (see Figure 9). Subsequent post-hoc analyses revealed that

when participant's speeches were mimicked by the confederate, they reported higher

communal scores, compared to the situation when they were not mimicked, $F(1, 199) = 19.34$, $p < .001$, $\eta_p^2 = .08$. Agentic self-concepts did not differ between both conditions, $F(1, 199) = 0.65$, $p = .799$, $\eta_p^2 < .001$. The differences between communal and agentic scores

within conditions were analyzed and the results showed that participants' evaluation of

communal scores were higher than agentic scores in both the mimicry condition, $F(1, 199) = 46.96$, $p < .001$, $\eta_p^2 = .19$, and the no-mimicry condition, $F(1, 199) = 7.78$, $p = .006$, $\eta_p^2 = .04$.

The difference between agency and communion was, however, substantially larger when the

participants were mimicked by the confederate, $\Delta F = 39.18$, $\Delta \eta_p^2 = .15$.

Figure 9

Interaction between the condition and agency and communion self-concepts
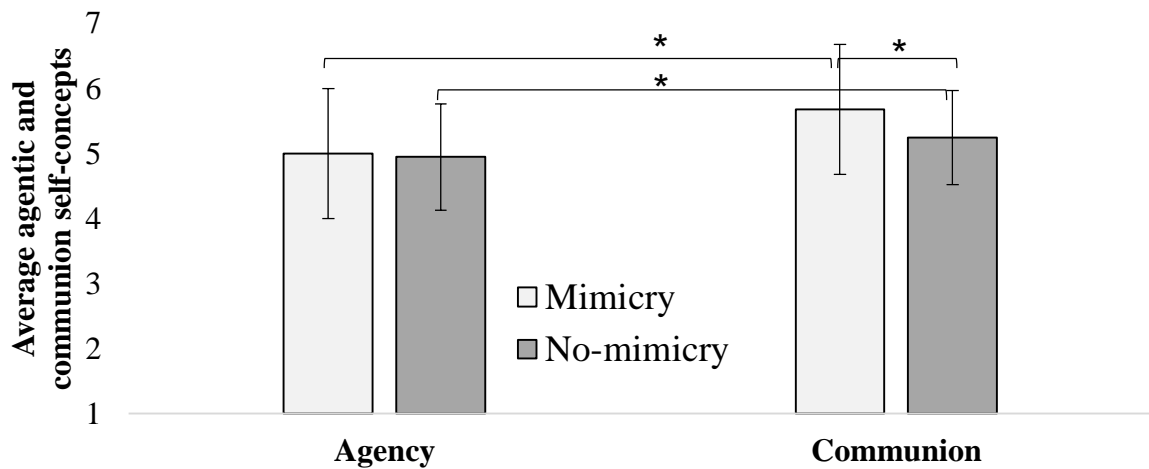
Note. Error bars correspond to standard deviations.

In a further mixed model ANOVA, the effects of mimicry were tested on all participants' scores in taking the agent or recipient perspectives. Independently of the condition, participants took the agent's perspective ($M = 5.31$, $SE = 0.54$) more, $F(1, 199) = 18.61$, $p < .001$, $\eta_p^2 = .09$, than the recipient's perspective ($M = 4.95$, $SE = 0.63$). Regardless of the type of perspective, scores were higher, $F(1, 199) = 3.82$, $p = .052$, $\eta_p^2 = .02$, in the mimicry condition ($M = 5.21$, $SE = 0.58$) than in the no-mimicry condition ($M = 5.05$, $SE = 0.59$). There was no interaction, $F(1, 199) = 1.70$, $p = .194$, $\eta_p^2 = .01$. Subsequent post-hoc analyses revealed that when participant's speeches were mimicked by the confederate, they reported higher recipient scores, compared to the situation when they were not mimicked, $F(1, 199) = 4.58$, $p = .034$, $\eta_p^2 = .02$,. There were no differences between both groups in a case of agent perspectives scores, $F(1, 199) = .22$, $p = .637$, $\eta_p^2 = .001$, (see Figure 10). The differences between recipient and agent perspective within conditions were analyzed and the results showed that participants' evaluation of agent scores were higher than recipient scores in both the mimicry condition, $F(1, 199) = 4.56$, $p = .034$, $\eta_p^2 = .02$, and the no-mimicry

condition, $F(1, 199) = 15.69$, $p < .001$, $\eta_p^2 = .07$. The difference between agent and recipient was, however, lower when the participants were mimicked by the confederate, $\Delta F = 39.18$, $\Delta \eta_p^2 = .05$.

Figure 10

Interaction between the condition and taking perspectives of agent and recipient
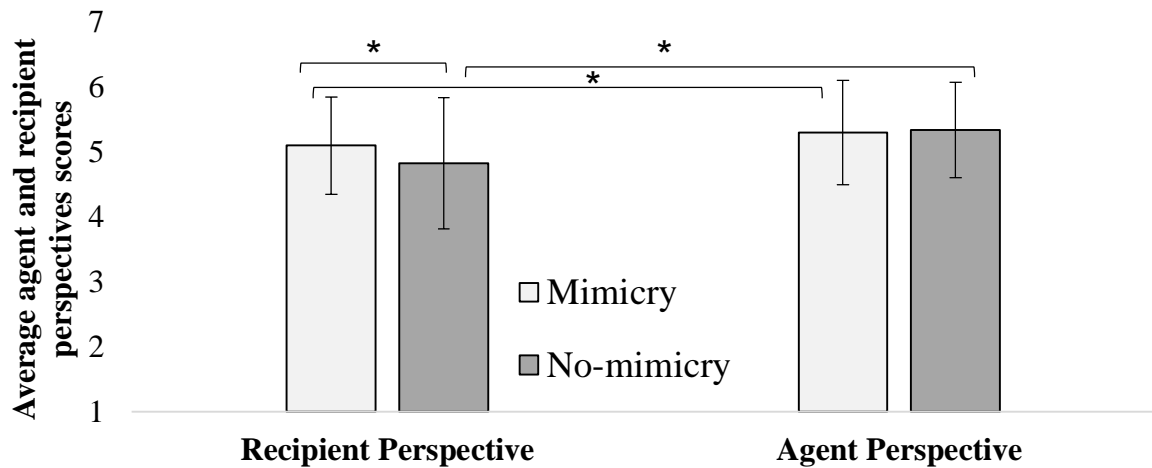
Note. Error bars correspond to standard deviations.

Exploratory analysis

Communion as a mediator in the relationship between mimicry and liking

Previous studies (Study 1 and 2) bring mixed results. Communion did not play a role of a mediator in the link between facial mimicry and liking, whereas did in the link between non-behavioral mimicry and liking. To test for communion as possible mediator of the mimicry on liking, mediation analyses was computed in JAMOVI program. The overall significance of the indirect effect was tested by devising a 95% confidence intervals (bootstrap percentiles, $N = 1000$, see Preacher & Hayes, 2004). The indirect effect $B = 0.07$, $SE = 0.04$, $\beta = .04$, $p = .10$, 95% CI = [-0.01, 0.15], failed to become significant.

Figure 11

Standardized regression coefficients for relationship between verbal mimicry and liking with communion as mediator
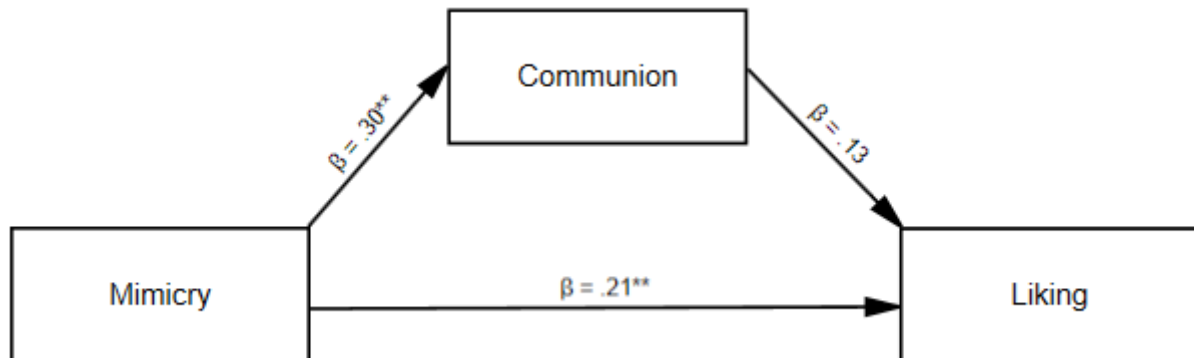
Bayesian analysis for quantify evidence in favor of null hypothesis

In this study, verbal mimicry was again found to be no influential to agency. Bayesian independent sample t test was conducted. JAMOVI software was used with default effect size priors (Cauchy = 0.707). Regarding the current data there is 7.85 times more evidence in favor of the null-hypothesis than the alternative-hypothesis ($BF_{01} = 7.85$). According to Jeffreys, (1961) guide to interpreting the strength of evidence this is moderate evidence. Another Bayesian analysis was conducted for null hypothesis (i.e., verbal mimicry was found to be non-influential to agentic perspective). Bayesian independent sample t test was conducted with JAMOVI software using default effect size priors (Cauchy = 0.707). Regarding the current data there is 9.06 times more evidence in favor of the null-hypothesis than the alternative-hypothesis ($BF_{01} = 9.06$). According to Jeffreys (1961) guide to interpreting the strength of evidence this is moderate evidence.

Discussion

In this study, it was tested whether verbal mimicry has an impact on people's agentic/communal self-concepts, and their agent's/recipient' perspectives. First, mimicry increased liking for confederates, consistently with previous doctoral studies (Study 1 and 2), and with other research, which used confederate methods of mimicry (e.g., Kulesza et al., 2016). Obtained effect (i.e., small to medium) was comparable with prior studies (e.g., Kulesza et al., 2016). However, this effect was lower when compared to other types of mimicry manipulation used in this thesis. A positive correlation between agency and agent perspective was noted. There was also a positive relationship between communion and recipient perspective found, consistent with prior doctoral studies, and theoretical assumptions (Abele & Wojciszke, 2014). Liking for the confederate was weakly associated with communion, recipient perspective and agency.

Importantly, comparable with Study 1 and Study 2, the communal self-concept appeared sensitive to mimicry impact. This finding provides novel insights, because it is likely that communal self-concepts are responsive – not only to facial and nonverbal – but also to verbal mimicry. Results obtained in this study can be supported with Communication Accommodation Theory assumptions (Giles, 1973). In CAT theory it is proposed that verbal mimicry may in general reduce the psychological distance between people. Consistent assumptions are presented in the social glue theories and self-other overlap model (Lakin et al., 2003; Hale & Hamilton, 2016a). However, in these three propositions, it is not specified whether a varied type of mimicry may produce such similar consequences. Moreover, only in the self-other overlap models, the mechanism underlying such outcomes are given. Like was already mentioned, in one of this models it is stated that MNS systems (through mimicry) would blur distinctions between self-and-other (Hale & Hamilton, 2016a). Interestingly, when considered verbal mimicry, there is some portion of the evidence of auditory mirror neuron

systems (Lewis et al., 2018; Rizzolatti & Craighero, 2004) – called "echo-neuron systems" (ENS). The ENS may be probably involved in 1) verbal mimicry production, and 2) speech perception (Liberman & Whalen 2000). Furthermore, ENS networks are considered to function as providing a sense of meaning or intention behind sound sources produced by the other (Buccino et al., 2001). Speculating, the verbal mimicry subconscious detection would activate the ENS systems in person being mimicked, which in turn would blur differentiations within self-and-other images in him/her. More investigations are required to determine those issues, especially because of a lack of systematic research on auditory mirror systems, and its functions. Furthermore, in the present study, mimicry did not impact agentic self-concepts, in line with Study 1 and Study 2. Current data provide some information that there would be at least eight times more evidence in favor of the null hypothesis. It suggests that there is at least moderate evidence of insensitivities of agency self-concepts to mimicry impact. This pattern is consistent with prior doctoral research, however, the reason behind its mechanisms is still unknown.

Moreover, in line with a hypothesis and with the results from Study 1 and Study 2, people being mimicked felt more like recipients, than those not mimicked. As already discussed, these findings are especially valuable because of the lack (likely) of studies investigating such relationships. The possible mechanisms behind the impact of verbal mimicry on recipient perspective would be similar to those behind facial and nonverbal mimicry. If mimicry blur differentiation between the self-and-the other representations and perspectives, maybe people being mimicked focused more on others and their actions, including monitoring of imitative behaviors – external actions (on a subconscious level, Decety et al., 2002; Farrer & Frith, 2002; Ruby & Decety, 2001, 2003). It is also important, that when using the same interactive task, during mimicry manipulation (like in Study 2), a pattern of results remains the same. However, in future research it is worth including different

types of tasks to investigate whether (and how) task type would influence mimicry impact on recipient perspective.

Furthermore, mimicry has no impact on agent perspective, this is in line with Study 1 and Study 2. Current data, however, provide information that there is nine times more evidence in favor of the null hypothesis. It suggests that, there is at least moderate evidence of insensitivities of agency to verbal mimicry. Interestingly, contrary to the two other studies from this thesis participants in both conditions felt more like agents than recipients, meaning that verbal mimicry, as opposed to facial, and nonverbal, did not disturbed such a pattern. Lasty, communal changes under mimicry, was tested as a possible mediator in the relationship between mimicry and liking. This model failed to become significant, consistently with Study 1, where facial mimicry manipulation was implemented. As was already discussed, future research should investigate the possible reasons of such differentiations between facial and behavioral mimicry in proposed mediation models.

Limitations and future directions

First limitation of the present study is that it relied on student samples, with female participants dominated, similar to the previous two doctoral studies. That may limit the generalizability of the results on non-student samples. Second limitation is related to human confederate-paradigms (Chartrand & Bargh, 1999). Disadvantages of this method were already discussed. Similarly, like in Study 2, confederates were aware of mimicry presence (and its association with liking). It would lead to an experimenter bias. Third, there was no control for the external behaviors presented by the confederate, which would influence study results (Hale & Hamilton, 2016b; Wang, 2012; Wang et al., 2011). In future studies, video recording should be provided to code these possible behaviors.

Fourth, in this study, there was no control concerning the baseline for the critical dependent variables. It again makes it uncontrollable to examine the occurred variations from

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a baseline. Fifth limitation was associated with challenges with good designing of no-mimicry condition. Although, in no mimicry group, there were instructions for confederates to 1) use different words as the participants, 2) use short answers, or 3) just nodding, there was no control for the amount of each of those behaviors used by confederates. In the other words: confederate – while interviewing – would once just nod, in another time use short answers. This critique is necessary, because behaviors like nodding, or short answers, can have incomparable social effects when opposed to dialogue or verbal mimicry (Kulesza et al., 2014). This potential discriminates of confederate behaviors, would have an impact on 1) participants' amount of liking for confederate, 2) fluency of initial interaction 3) self-perception of participants. Hypothetically, when only nodded, confederates would be perceived by participants as unresponsive, and in turn less liked (Mottet et al., 2004; Gorham, 1988). Interestingly, when based on exploratory analysis (see Table S1), not mimicked participants felt less happy, interested, and interestingly they felt more anger. The two conditions did not differ when analyzing feelings of excitement, guilt, and contempt. Perhaps, the variation of experienced emotion also influenced the ratings of liking (and /or) a person's self-perception. The last limitation is associated with the degree of experimental control. When interviewing – there was no camera recording, it made it impossible to verify whether confederates appropriately followed the instructions of mimicry manipulations. In future research, such control should be provided.

Study 4: Extension: Role of nonverbal mimicry in communion and agency in VR[23, 24]

In this study, the extension of previous doctoral studies was performed. First, given

challenges related to the confederate-paradigms a Virtual Reality method was designed with

the advantage of a more rigorous experimental control. That is, mimicry is typically

manipulated (and was also in the case of Study 2 and 3) in such a way that a confederate in

the mimicry condition responds with the same actions to the actions of a participant whereas

the confederate in the no-mimicry condition does not respond with any particular action.

However, such a paradigm leaves open whether it is the imitation of the exact same actions

that triggers these effects or whether merely responding to another person with any kind of

actions is sufficient to produce the effects. To shed light onto the processes underlying the

effects of being mimicked, manipulating mimicry within an Virtual Reality (VR) environment

was applied. A virtual agent was programmed to either mimic (or not) the non-verbal

behaviors of the partners of interaction. As the behaviors of VR agents resemble human

behaviors, the influence of mimicry on actual self-concepts-and-perspectives processing

should be equivalent to these occurring in humans (Garau et al., 2005). To enhance ecological

validity, a VR agent was programmed to perform 1) a few behaviors that typically occur

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[24] The results of this study were published as conference proceedings:
Trzmielewska, W., Müller, B. C. N., Kulesza, W., & Lange, W. G. (2020). Chameleons make us more oriented. A virtual reality study. Conference proceedings presented at the 103rd Association for Education in Journalism and Mass Communication (AEJMC) conference, San Francisco, United States.
Müller*, B. C. N., Trzmielewska, W., Lange, W. G., & Bosse, T. (2020). Mimicry
decreases resistance towards a VR interaction partner – a pilot study. Conference proceedings presented at the 103rd Association for Education in Journalism and Mass Communication (AEJMC) conference, San Francisco, United States.

during social interactions (gazing, speaking) in both conditions (mimicry/no-mimicry); 2) several body movements unrelated to the participant's, only in no-mimicry condition.

Second, this study was conducted to complement and broaden understanding of the role of mimicry in predicting a person's self-concepts-and-perspectives changes in VR environments. Previous works (Hasler et al., 2014) are limited by narrow conceptualizations of self-concepts and the reliance on a single item to measure a person's sense of interpersonal closeness (Inclusion-of-other-in-the-Self scale; Aron et al., 1992). Third, the present research aims to confirm that virtual agents with relatively wide programmed behavioral repertoire would work efficiently. Those VR agents would provide findings comparable to those obtained in natural settings. The formulated hypothesis were the same as in all previous studies.

Method

Participants

Eighty undergraduate students (54 women)[25] of a Dutch university, aged 18 and older, not susceptible to motion sickness, were invited to participate, and were rewarded with a course credit or a €5 gift card (IRIS cheques). Thirty participants were recruited via Radboud SONA research participant system whereas fifty students unknown to the researcher – via direct recruitment by a personal approach. Five participants were excluded before the analysis because they ascertained the purpose of the experiment, whereas four were removed due to technical problems. The final sample consisted of 71 participants (46 women, aged 18 to 41, $M_{age} = 22.71$, $SD = 4.14$ and 25 men, aged from 18 to 29, $M_{age} = 23.32$, $SD = 3.22$), who were randomly assigned to the mimicry condition ($N = 34$) or no-mimicry condition ($N = 37$).

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[25] Sample size for this study was based on an a priori power analysis which indicated that at least 58 participants were necessary to detect a moderate effect $\alpha = .05$, $1 - \beta = .80$, Cohen's $d = 0.76$ (Vrijsen et al., 2010a).

Ethical approval for the experiment was obtained at the Radboud University Nijmegen by the Ethics Committee Faculty of Social Sciences (ECSW-2019-077).

Virtual Reality Lab and Virtual Agent

The study was administered in the virtual reality (VR) research laboratory – the RIVERlab of the Behavioural Science Institute at Radboud University Nijmegen. The VR environment was set up in Unity software (version 2017.4.3f1) based on a Unity3D platform. To immerse the participants in the virtual environment a head-mounted display (HMD) from an HTC company was used. A HMD help participant to not see real word visual inputs (Forbes, 2018; Sanchez-Vives & Slater, 2005), the displays are positioned near to the eyes and head tracking assures that the left and right images are updated according to the head moves of the participant considering the underlying VR word (Slater, 2009). Therefore, participants may initiate and intervene in virtual events (Sanchez-Vives & Slater, 2005). All animations and movements of the VR agent were pre-recorded in a form of captures of typical human movements (i.e., undergraduate female student movements) using a Qualisys motion capture system and edited using MotionBuilder 2018 from Autodesk. One female VR agent was used in both study conditions (see Figure 12).

Figure 12

Female VR agent – initial posture – from the participants point of view

Verbal introduction of the VR agent, explanation of the picture task, and picture descriptions were pre-recorded and later played when the agent presented herself, and when it was the agent's task to describe a picture. Agent's facial expressions were matched to the amplitude of the audio recording, making her lips appear more natural and human-like. The agent was designed and created in a Morph 3D software. Mouth synchronization was made with the LipSync Pro plugin for Unity from Rogo Digital. During the picture task, whenever a participant in the mimicry condition showed a typical body movement available from the behavioral repertoire of the VR agent, the experimenter was able to control – using the appropriate keys on a keyboard (see Figure 13) – the movements displayed by the agent, and triggered the respective movements. The movements – including nodding, rubbing neck or leg, wiping nose, tapping, crossing and uncrossing the legs – were subsequently displayed by the VR agent with a few (around 2–3) seconds delay, and then VR agent returned to her pre-programmed initial posture (see Figure 12, 13). In the no-mimicry condition, the agent showed pre-programmed body movements, unrelated to the participant's ones. Each movement displayed by the VR agent was carefully selected by the author of this thesis and

set up by a Dutch lab's programmer particularly to carry out this study. One of the movements was excluded in the test measurement due to its unnaturalness frequently mentioned by the participants in pilot measurement (the explain hand movement was perceived as waving and disturbed participant's concentration of the picture task). The final procedure of mimicry is confirmed to be effective and will be further used.

Figure 13

Experimenter's monitor displays in the mimicry condition as seen by the participants. The participants, however, did not see the controls on the left and right in their HMDs

Measures and materials

Liking of the Virtual Reality agent

To measure whether the mimicry manipulation increases liking of the agent, the forward translated – from Polish to English – version of the liking measure was used (scale used in Studies 1, 2, and 3). Also, in this study the effect of mimicry on liking served as a manipulation check. The measure consisted of seven items which were modified and – instead of using the form of "this person" – the name of the VR agent was used.[26] Participants indicated the veracity (1 = *definitely not*; 7 = *definitely yes*) of each item. To calculate an index of liking, average scores on the items were taken (Cronbach's α = .92).

Agency and communion characteristics

To measure the degree to which the participants perceive themselves with respect to agency and communal characteristics, the forward translated – from Polish to English – version of the Agency and Communion questionnaire (Wojciszke & Szlendak, 2010) was used as in the case of Studies 1, 2, and 3. The two-dimensional measure consisted of 30 items: 15 concerned agency characteristics and 15 concerned communal ones. Participants indicated the veracity (1 = *definitely not*; 7 = *definitely yes*). For proper measurement of these two aspects, an average of the scores was calculated. The agency (α = .89) and communal (α = .83) items had good internal consistency.

Agent and recipient perspective

To explore participants' scores regarding the perspective of the agent and recipient in their self-perception, the English version of the perspective questionnaire was used (Baryla et al., 2019). The questionnaire consisted of 20 items: 10 concerned the perspective of the agent

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[26] The name of a real person (student) from Radboud University.

and 10 concerned the perspective of the recipient. Participants indicated the veracity (1 = *definitely not*; 7 = *definitely yes*) of each item. For proper measurement of these two aspects, an average of the scores was calculated. The recipient and agent perspective items had good internal consistency ($\alpha = .83$).

Demographics

The participants' gender (i.e., "female", "male", "other") and age in years were collected. Additionally, three debriefing questions were asked (1. "Did you recognize anything special according to x (agent name) behavior?; 2. "If your answer above (x) was 'yes' please describe in 1–2 sentences which x (agent name) behavior you recognize as special?"; 3. "What do you think the goal of the experiment was?").

Procedure

After arrival at the research virtual reality laboratory, participants underwent the experiment independently. Consents of all participants were obtained in writing once they were informed about their rights and the aims of the study, and those who had agreed to participate were equipped with the virtual reality gear (HMD). Participants were told that the purpose of the study was to investigate verbal and virtual processing of information and that the experiment examined the data processing mechanisms in the VR context. Participants were not told, however, about the agent's specific body mannerisms and – specifically – mimicry. The room had low-intensity natural light. To facilitate immersion, the laboratory settings were set up to match the VR scenario with two monitors connected to one computer on a small table and two chairs facing the monitors and each other, equally spaced. The participant met a VR agent in virtual settings and the experimenter started the photograph description task in the VR setting. First, the participant saw the agent seated on the other chair. The agent briefly introduced herself and asked the participant to introduce her/himself. Subsequently, the virtual agent explained the setup of the task, namely that the agent and the

participant would take turns in describing to each other a total of 12 photographs (6 per each) (compare: Chartrand & Bargh, 1999). Each explanation was supposed to take roughly one minute. Participants were free to choose how to describe each of the six pictures.

The pictures were borrowed from National Geographic magazine (see Figure 14) and, for example, presented various buildings in the Netherlands. In both conditions, the experimenter sat opposite the participant and in front of the computer setup (where the manual program was installed). Once done with the task, participants completed all questionnaires online (Qualtrics, version 1.17) on a lab-computer, provided demographic data and answered funneled debriefing questions. Lastly, participants were thanked, debriefed, and received course credit or a gift card.

Figure 14

The photo stimuli used when participants performed the photograph description task

Analyses

In order to check effectiveness of manipulation, it was investigated whether mimicry (vs. no-mimicry) influenced liking of the VR agent using a one-way ANOVA. Mix model

ANOVAs (i.e., repeated measures with between-subjects factors specified in SPSS) were conducted to determine main and interaction effects of the mimicry conditions (between-subjects: mimicry vs. no-mimicry) and of two dependent variables (within-subjects: agency vs. communion and agent perspective vs. recipient perspective).

Results

Descriptive statistics, correlations and manipulation check

Randomization was successful for age[27] $t(68) = 0.52$, $p = .937$, respectively in mimicry condition ($M_{age} = 23.18$, $SD = 3.46$) and no-mimicry condition ($M_{age} = 22.69$, $SD = 4.17$) and sex $\chi^2(1, N = 71) = 2.27$, $p = .132$. Table 8 presents the descriptive statistics and correlations between the study variables. Further, mimicry influenced the ratings of liking of the VR agent – that is, participants who were mimicked ($M = 5.61$, $SD = 0.77$), as opposed to those who were not mimicked ($M = 4.79$, $SD = 0.83$), reported that they liked the VR agent more, $t(69) = -4.33$, $p < .001$, Cohen's $d = 1.02$. The degree to which participants perceived themselves as agentic was positively correlated with how much they took the agent's perspective. Furthermore, the degree to which participants took the recipient's perspective was positively correlated with the degree to which they perceived themselves as communal and liked the VR agent. There were also positive correlations between the degree to which participants perceived themselves as communal with the amount of liking for the VR agent.

Table 8

Descriptive statistics and correlations for all relevant study variables

Measure	1	2	3	4	5
1. Agent Perspective	—				

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[27] One missing value in mimicry condition.

|					
2. Recipient Perspective	-.11	—			
3. Agency	.63**	-.03	—		
4. Communion	.06	.42**	.07	—	
5. Liking	.21	.22	.17	.50**	—
Total sample ($N = 71$) M (SD)	5.04 (0.76)	4.71 (0.87)	4.73 (0.77)	5.48 (0.56)	5.22 (0.89)
No-mimicry ($n = 34$) M (SD)	5.11 (0.92)	4.63 (0.90)	4.84 (0.80)	5.28 (0.56)	4.79 (0.83)
Mimicry ($n = 37$) M (SD)	4.98 (0.59)	4.79 (0.84)	4.63 (0.74)	5.66 (0.50)	5.61 (0.77)
F-test	0.46	0.58	1.21	9.55**	18.75**
η_p^2	.01	.01	.02	.09	.21

Note. ** $p < .01$.

Main effects

A 2 (mimicry vs. no-mimicry) x2 (self-concept: agentic vs. communal) mix model ANOVA with agentic and communal scores as the within-subject variable was conducted (see Table 8 for descriptive statistics). The main effect of the self-concepts was significant, $F(1.69) = 49.90$, $p < .001$, $\eta_p^2 = .42$. Participants – independently of the mimicry influence – perceived themselves as more communal ($M = 5.47$, $SE = 0.63$) than agentic ($M = 4.74$, $SE = 0.91$). The main effect of the condition, however, was not significant, $F(1, 69) = 0.64$, $p = .426$, $\eta_p^2 = .01$. A significant interaction emerged between the condition and participant's ratings of agentic and communal scores, $F(1, 69) = 8.01$, $p < .006$, $\eta_p^2 = .10$ (see Figure 15). Subsequent post-hoc analyses revealed that when behavioral movements were mimicked by the VR agent, participants reported higher communal scores, compared to the situation when they were not mimicked, $F(1, 69) = 9.55$, $p = .003$, $\eta_p^2 = .09$. Agency scores did not differ between both conditions, $F(1, 69) = 1.21$, $p = .275$, $\eta_p^2 = .02$. The differences between communal and agentic scores within conditions were analyzed and the results showed that participants' evaluation of communal scores were higher than agentic scores in both – the mimicry condition, $F(1, 69) = 51.10$, $p < .001$, $\eta_p^2 = .43$, and the no-mimicry condition, $F(1, 69) = 8.60$, $p = .005$, $\eta_p^2 = .11$. The difference between agency and communion was, however, substantially larger when the participants were mimicked by the VR agent.

Figure 15

Interaction between the condition and agency and communion self-concepts
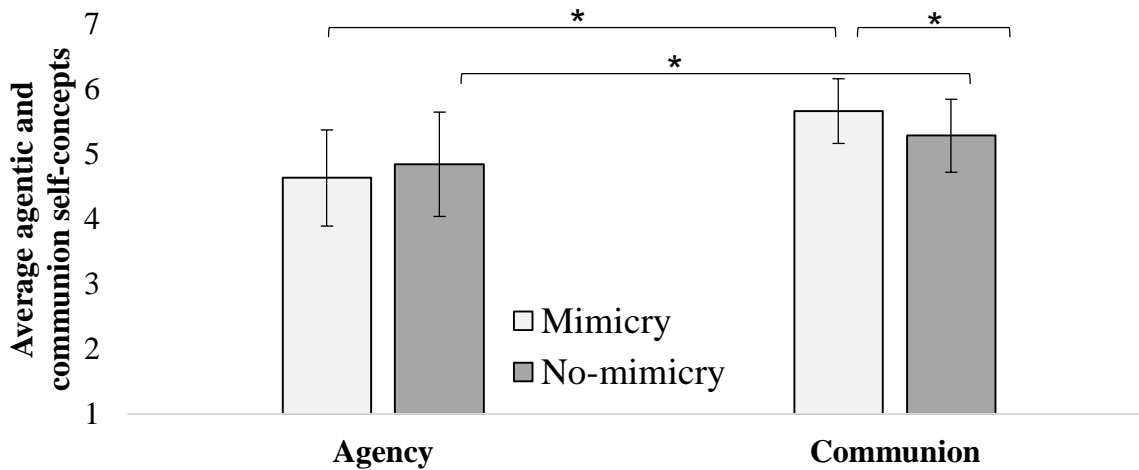
Note. Error bars correspond to standard deviations.

By the means of ANOVA mixed model the effect of mimicry on perspective scores was analyzed. There was only a main effect of perspective, $F(1, 69) = 5.32$, $p = .024$, $\eta_p^2 = .07$, such that independently of the condition participants took the agent's perspective stronger ($M = 5.04$, $SE = 0.09$) than the recipient's perspective ($M = 4.71$, $SE = 0.10$). There was no main effect for the mimicry condition, $F(1, 69) = 0.01$, $p = .899$, $\eta_p^2 < .001$, nor was there an interaction, $F(1, 69) = 0.94$, $p = .335$, $\eta_p^2 = .01$ (see Figure 16). Subsequent post-hoc analyses revealed that participants reported no difference in a case of recipient perspective between both conditions, $F(1, 69) = 0.58$, $p = .451$, $\eta_p^2 = .01$. Also agent perspective scores did not differ between both conditions, $F(1, 69) = 0.46$, $p = .499$, $\eta_p^2 = .01$. In addition, the differences between agent and recipient scores within conditions were analyzed and the results showed that participants' evaluation of agent perspective scores were higher than recipient perspective only in the no-mimicry condition, $F(1, 69) = 5.15$, $p = .026$, $\eta_p^2 = .07$, but not in mimicry one, $F(1, 69) = 0.93$, $p = .338$, $\eta_p^2 = .01$.

Figure 16

Interaction between the condition and taking perspectives of agent and recipient
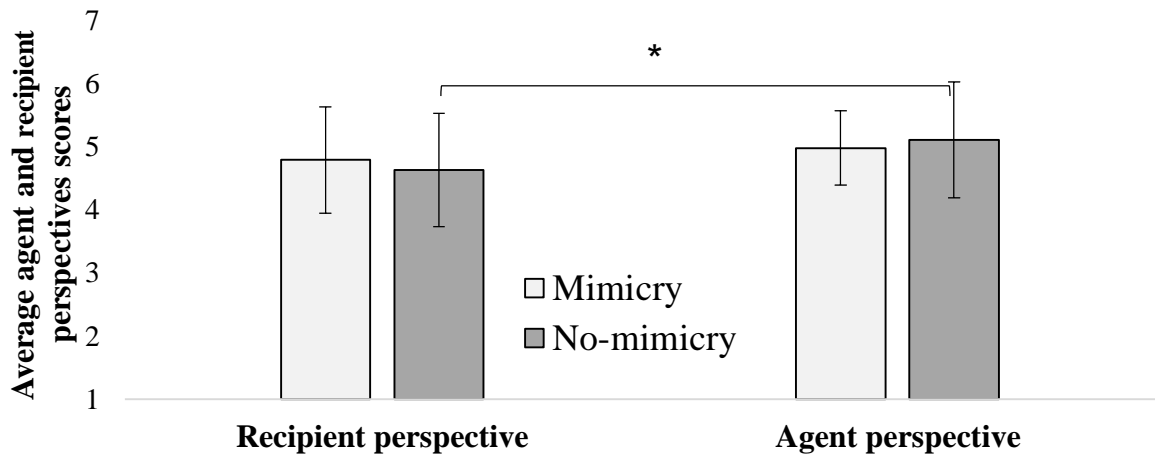
Note. Error bars correspond to standard deviations.

Exploratory analyses

Communion as a mediator in the relationship between mimicry and liking

Previous studies (Study 1, 2 and 3) bring mixed results. Communion did not play a role as mediator in the link between facial, and speech mimicry and liking, whereas did in the link between non-behavioral mimicry and liking. To test for communion as possible mediator of the mimicry on liking, mediation analyses was computed in JAMOVI program. The overall significance of the indirect effect was tested by devising a 95% confidence intervals (bootstrap percentiles, $N = 1000$, see Preacher & Hayes, 2004). The indirect effect $B = 0.20$, $SE = 0.09$, $\beta = .13$, $p = .007$, 95% CI = [0.08, 0.43], was significant.

Figure 17

Standardized regression coefficients for relationship between nonverbal mimicry by VR agent and liking with communion as mediator
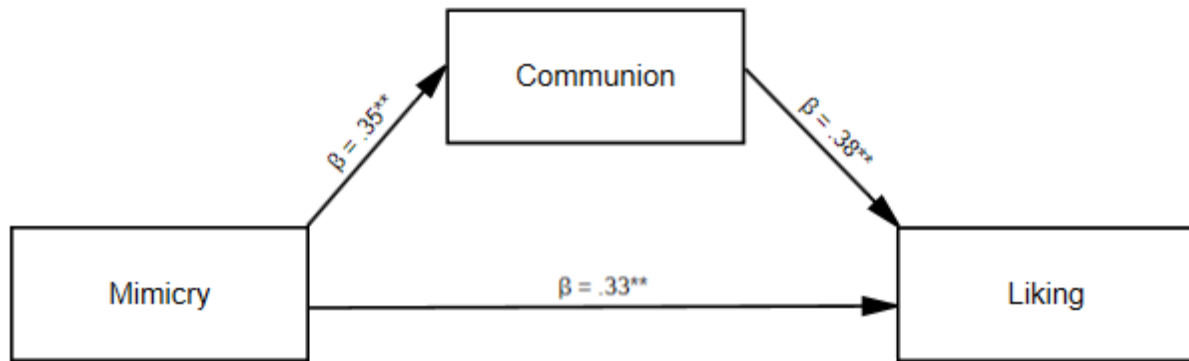
Bayesian analysis for quantify evidence in favor of null hypothesis

In this study, behavioral mimicry was found to be non-influential to agency self-concepts. Bayesian independent sample t test was conducted. JAMOVI software was used with default effect size priors (Cauchy = 0.707). Regarding the current data there is 1.44 times more evidence in favor of the null-hypothesis than the alternative-hypothesis ($BF_{01} = 1.44$). According to Jeffreys (1961) guide to interpreting the strength of evidence this is anecdotical evidence. Another Bayesian independent sample t test was conducted because mimicry was found to have no effect on recipient perspective. Analysis was conducted in JAMOVI software with default effect size priors (Cauchy = 0.707). Regarding the current data there is no evidence (Jeffreys, 1961) in favor of either null-hypothesis nor the alternative-hypothesis. Last Bayesian independent sample t test was conducted because mimicry was found to be non-influential to agentic perspective. Analysis was conducted in JAMOVI software with default effect size priors (Cauchy = 0.707). Regarding the current data there is no evidence (Jeffreys, 1961) in favor of either null-hypothesis nor the alternative-hypothesis ($BF_{01} = 0.44$).

Discussion

Consistently with previous findings of this thesis and other research on human/agent interactions present study confirmed that mimicry increased liking (Bailenson & Yee, 2005; Verberne et al., 2013). This suggested that mimicry manipulation was successful. There was a positive correlation between agency self-concepts and agent perspective. A positive

relationship between communal self-concepts and recipient perspective was found, compatible with prior findings from this thesis, other outcomes, and theoretical assumptions (Abele & Wojciszke, 2014; Baryla et al., 2019). Like in previous doctoral studies, there was also a positive correlation between communal self-concepts and liking for mimickers.

Findings from this study suggest that communal self-concepts are particularly sensitive to mimicry behaviors, also when the behavior is performed by a virtual agent. Overall, in previous studies in VR settings, mimicry of participants' head and torso movements alone by a VR agent does not increase a person's feelings of closeness with others (Hale & Hamilton, 2016). However (probably) when adding other behaviors (e.g., arm- or leg movements) participants showed greater closeness towards a mimicking VR agent than to a no-mimicking one (Hasler et al., 2014). In this study, people mimicked felt more communal than those not mimicked. Therefore, it may be that when a non-human partner engages in more complex mimicry, a person who interacts with such a partner may find it easier to identify with him/her. The agent is likely to be seen not only as more "human" but also more like the viewer him-/herself, consistent with assumptions from the self-other overlap model (Hale & Hamilton, 2016). Moreover, in this experiment – similarly like in prior doctoral studies, regardless of whether people were mimicked or not, they perceived themselves as more communal than agentic. This is in line with theoretical assumptions (Abele & Wojciszke, 2014). In general, the discussed result is essential because it may provide more evidence in favor that mimicry presented by human-like agents and humans activate the same neurological systems (Hale & Hamilton, 2016b; Kühn et al., 2010). Given shreds of evidence from neurocognitive works – mimicry by human and non-human would, therefore, activate MNS systems, as well as brain regions responsible for self-other differentiation (e.g., rTPJ or rIPL; Decety et al., 2002; Farrer & Frith, 2002; Ruby & Decety, 2001, 2003). Speculating –

the brain simply may not be sensitive enough to make the real-unreal distinction. Future studies should address this topic.

There were no significant differences between agentic self-concepts in both conditions, similar no-effects of mimicry have been detected in three doctoral studies. In this study, it was however, only over 1 times more evidence in favor of the null hypothesis than the alternative one (see Jeffreys). More research on agency, using a bigger sample needs to be performed to better understand these findings. It might be that the effects of agency in VR environments are possibly just weaker and thus, that a larger study sample is needed to find any significant differences.

Moreover, in this study mimicry did not significantly impact participants' recipient perspective, contrary to the assumption that being mimicked would naturally lead to a recipient perspective. This result is inconsistent with prior doctoral findings, where being mimicked enhanced that perspective. However, current data provide information, that there is no evidence in favor of either null-hypothesis or the alternative one. Meaning that it is more probable that there is still unknown whether an agent perspective would be influenced by mimicry in VR. The context of face-to-face interactions virtually, would not contain sufficient cues for the roles people should adopt as would be the case between, for example, a lecturer (i.e., agent) and student (i.e., recipient). Furthermore, perhaps participants couldn't correctly attribute an action (of the self and the other) in VR, because the self-ownership may be diminished in such environments. Experience of VR may confuse the distinction between the self and other (Sanchez-Vives & Slater, 2005; Slater, 2009).

Compatible with findings from previous doctoral studies, mimicry by VR agent did not impact participant's agent perspective. However, current data provide some information, that there would be no evidence in favor of either null-hypothesis or the alternative one. More studies are needed to investigate if agent perspective can be influenced by mimicry in VR.

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Again, however, like in Study 1 and Study 2, people who were not mimicked felt more like agents than recipients, but the experience of mimicry disturbed that pattern. In mimicry conditions, the degree of agent and recipient scores did not differ. Lastly, and importantly, communion played a role of mediator in the relationship between mimicry and liking for VR mimicker. That is: being behaviorally mimicked increased the communal self-concepts in people, and these feelings would mediate the impact on their evaluation of mimicker. Interestingly, that model of mediation was only achieved in Study 2, where also nonverbal mimicry manipulation was used. Future studies should investigate the reasons for such differentiation between facial, verbal, and non-verbal mimicry.

Limitations and Future Directions

The first limitation of this study, is the fact that it relied on student-samples from the Netherlands undermining generalizability with respect to cultural differences. Future research should consider cross-cultural research on how mimicry affects individuals in countries that have stronger communal (collective, e.g., Japan) as opposed to stronger agentic (individualistic, e.g., USA) cultural systems (Carducci, 2012). Such concerns, however, are tempered because prior doctoral studies were conducted in Poland, a country with an intermediate communal level, which is higher than a West-European country such as the Netherlands and found similar results (Kuźmińska-Haberla, 2017). In this study sample women also predominated, again, it would be useful to replicate these findings in more diverse samples.

The study's second limitation was that it was carried out with the experimenter present next to the participants. That would lead to socially desirable responding, or could have evoked social fears. The participants may be fully aware that the experimenter can hear and see every behavior and utterance, while they are blind to the "real life" surroundings. In future studies, mimicry should be automated by the computer or from a different room. Although, to

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resolve any doubts emerging from this issue it is worth replicating these findings with other experimenters or mimicry automated.

The third limitation was related to the self-embodiment issue. In a VR environment presented through an HMD, it was impossible for participants to see their own VR bodies (when participants moved their legs, they could not see movements of the virtual legs), this can be shocking for participants (Sanchez-Vives & Slater, 2005; Slater, 2009). In debriefing, however, none of the participants stated that they experienced issues with body ownership, nor found it disturbing. Importantly, the VR settings may alter body schema (self-embodiment) also without the possibility to perceive his/her own body representation (Balsamo, 1993; Harth et al., 2020; Murray & Sixsmith, 1999; Steed et al., 2016). In future studies, however, the participants' body representation is worth adding, or a control of a person's feeling of self-embodiment, and also co-presence.

Fourth limitation, and important, is related to challenges of the no-mimicry condition. In debriefing, participants from the no-mimicry condition stated more negative ratings of VR agent (inadequacy, unnaturalness, being nervous, unresponsive, etc.) compared to those in the mimicry condition (see for descriptive statistics Table S2 in supplementary materials). Maybe absolutely no mimicry would be experienced as unnatural (Kouzakova et al., 2010b) and provide less liking. People in the real-life environment may have found the person who does not mimic their behaviors as just strange or not sympathetic (e.g., Chartrand & Bargh, 1999). Interestingly, based on results from exploratory analysis, it was found that VR agent moved more in no-mimicry condition than in the mimicry one (see Table S2). The experimenter in the mimicry group repeated behaviors used by participants around every second of presence to avoid the unnaturalness of behaviors (Kavanagh et al., 2011; Kouzakova et al., 2010b). Importantly, the nonverbal behaviors in no-mimicry condition were recorded from a real human (student) who was instructed to not over exaggerate movements. She would, however,

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move more than a typical person, though it was not controlled in the pilot study. In the present experiment more movement by virtual agent was correlated with less liking and more negative rating for her (see Table S3). Less liking, therefore, would be caused by frequency of nonverbal movements, no by the lack of mimicry itself. That is, the movability of the VR agent would be considered as negative, maybe because it was more than usual. Future studies would investigate this issue in a more rigorous empirical manner. Lastly, in the no-mimicry condition the agent with whom the no mimicry group will interact was programmed to exhibit specific body movements at predefined points. This means that potentially, there would be an overlap between the participant and the agent behaviors (Bailenson & Yee, 2005; Verberne et al., 2013). In future experiments, video recording should be provided to test the empirical validity of this initial assumption.

Results Integration: Mini Meta-analysis

The results of the conducted experiments (Study 1, 2, 3, and 4) were integrated by conducting a mini meta-analysis, followed the more common practice to conduct meta-analyses on own studies (see Baryła & Wojciszke, 2018; Bialobrzeska et al., 2019; Goh et al., 2016). Comprehensive Meta-Analysis software (Borenstein et al., 2005) was used to estimate the overall effect size (Cohens' d with confidence level) of influence of mimicry on each dependent variable separately, weighted by the sample size.

First independent samples t-test was conducted (mimicry vs. no-mimicry) on four dependent variables: agency, agent perspective, communion, and recipient perspective (see Table 9 for descriptive statistics). The overall effect size (see Table 9) showed null findings for the impact of mimicry on agency and agent perspective, that is, self-ascribed agency did not differ between both conditions, Cohen's $d = 0.02$, 95% CI [-0.14, 0.18], $p = .815$, as well as agent perspective scores, $d = -0.04$, 95% CI [-0.20, 0.12], $p = .602$. Furthermore, there were significant differences between the mimicry and no mimicry condition when considered self-ascribed communal characteristics and recipient perspective. Consistent with hypothesis, and with prior studies (i.e., comparable effects sizes of related self-concepts were found between humans, see Table 2 and 3) self-ascribed communion was higher when individuals were mimicked, compared to situations when they were not mimicked, the effect was, $d = 0.56$, 95% CI [0.42, 0.74], $p < .001$, this effect is considered medium (Cohen, 1988). In a case of the overall effect of the influence of mimicry on recipient perspective, there was also significant difference, meaning that mimicry made people to took higher the recipient perspective, $d = 0.39$, 95% CI [0.23, 0.54], $p < .001$, compared to the situation when they were not mimicked, this effect is considered as small to medium (Cohen, 1988).

Table 9

Simple effects for the four studies

Agency						
					95% CI for Cohen's *d*	
Experiment	*t*	df	*p*	Cohen's *d*	LL	UL
Study 1 (Facial mimicry)	-0.34	158	.732	-0.05	-0.36	0.26
Study 2 (Behavioral mimicry)	-0.22	171	.824	-0.03	-0.33	0.26
Study 3 (Speech mimicry)	0.26	199	.799	0.04	-0.24	0.31
Study 4 (Behavioral mimicry, VR)	1.10	69	.275	0.26	-0.21	0.73
Total effect			.815	0.02	-0.14	0.18
agent perspective						
					95% CI for Cohen's *d*	
Experiment	*t*	df	*p*	Cohen's *d*	LL	UL
Study 1 (Facial mimicry)	-0.18	158	.856	-0.03	-0.34	0.28
Study 2 (Behavioral mimicry)	-1.76	171	.080[a]	-0.27	-0.57	0.03
Study 3 (Speech mimicry)	0.47	199	.637	0.07	-0.21	0.34
Study 4 (Behavioral mimicry, VR)	0.68	69	.499	0.16	-0.31	0.63
Total effect			.602	-0.04	-0.20	0.11
recipient perspective						
					95% CI for Cohen's *d*	
Experiment	*t*	df	*p*	Cohen's *d*	LL	UL
Study 1 (Facial mimicry)	3.38	158	< .001	0.53	0.22	0.85
Study 2 (Behavioral mimicry)	2.85	171	0.005	0.43	0.13	0.73
Study 3 (Speech mimicry)	2.14	199	0.034	0.30	0.02	0.58
Study 4 (Behavioral mimicry, VR)	0.76	69	0.451	0.18	-0.29	0.65
Total effect			< . 001	0.39	0.23	0.54
communion						
					95% CI for Cohen's *d*	
Experiment	*t*	df	*p*	Cohen's *d*	LL	UL
Study 1 (Facial mimicry)	2.01	158	.046	0.32	0.01	0.63
Study 2 (Behavioral mimicry)	4.92	171	< .001	0.74	0.44	1.06
Study 3 (Speech mimicry)	4.40	199	< .001	0.59	0.34	0.90
Study 4 (Behavioral mimicry, VR)	3.09	69	.003	0.65	0.26	1.21
Total effect			< .001	0.56	0.42	0.74

[a] *Note.* Only one effect of the agent perspective was marginally significant.

General Discussion

Four experimental studies were conducted to verify the link between mimicry and self-perception on two basic dimensions of social cognition: agency and communion, and also two perspectives: agent and recipient perspectives. In general when using various mimicry manipulations (i.e., mimicry of emotional expressions, of nonverbal behaviors, and of speech), the studies showed systematically that mimicry increases thinking about the self in terms of communal characteristics, though it does not impact thinking about the self in agentic terms. Moreover, being mimicked induces in three studies the perspective of the recipient, but it does not influence the perspective of the agent. These findings are internally consistent and shed a new light on the links between mimicry, communal self-perceptions and taking the recipient perspective.

Therefore, it was found the influence of mimicry on communal (but not agentic) self-concept, and this result adds important information to existing knowledge. Up until now, it was proved that being mimicked, in a case of nonverbal and facial mimicry, may induce greater orientation on other people, measured by interdependent self-concept, and interpersonal closeness (Ashton-James et al., 2007; Stel & Harinck, 2011). This thesis results have gone one step further, and showed that communal self-concept may also be sensitive to mimicry influence, regardless of type of mimicry used. This is consistent with theoretical assumptions that communal self-concepts can be sensitive to factors related to social contexts (Uchronski, 2008; Uchronski et al., 2013). Moreover, in three doctoral studies (Study 2, 3 and 4) regardless of whether people were mimicked or not mimicked, they perceived themselves as possessing more communal characteristics than agentic. This is consistent with findings proved by other researchers (Abele, 2003; Abele & Wojciszke, 2007; Moskowitz et al.,1994; Uchronski, 2008; Twenge, 1997, 2001; Wojciszke et al., 2011; Wrona, 2014; Ybarra et al., 2012). Mimicry, however, enhances this effect in these three studies.

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Taken together, communal self-concepts seem to be responsible for the behaviors related to the formation and maintenance of social connections as mimicry. Importantly, it was argued that the experience of being mimicked leads to more communal self-descriptions, however, an alternative explanation of the collected data may be that the situation of being not mimicked rather led to decrease in participant's communal characteristics. Future studies should include the baseline of critical variables to answer that question in a more empirically rigorous manner. In future studies, it would be worth testing if the effect will be replicable in other contexts. For instance, it would be worth it to check if communion is also responsive in settings related with less interpersonal experiences. Importantly it should be checked for how long this effect of mimicry on self-ascribed communion lasts. That is, it is needed to test if it is short-term influence, or longer (and if so for how long exactly lasting).

In this thesis results also show that virtual reality technology may be a valuable tool to investigate social interactions in highly controlled lab environments. In conclusion, it was assert that virtual agents who mimicked participants increased participants' communion self-concepts (and liking of this virtual agent). It demonstrates that the bonding effect of mimicry and its effect on people's self-perception may be not restricted to interactions between humans (Ashton-James et al., 2007). Eventually, behavioral mimicry may increase identification with others, leading to a more social approach by increasing one's communion. Regardless of the above mentioned theoretical implications, these findings may help understanding and improving virtual agents' human-like behaviors. This could eventually lead to advanced virtual agent-human interactions improving human confidence in online services, training, or even treatments.

Furthermore, there was no effect of mimicry on agentic self-concept in all studies. Moreover, the Bayesian analysis showed consistently (in the case of Study 1, 2, and 3) that there may be more evidence in favor of the null hypothesis than the alternatives. Only in

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regard to study conducted in virtual reality settings, such evidence was not proved. Therefore in this thesis it was shown that people's agentic self-concepts may be insensitive to mimicry influence. It means that people may feel more communal, but not less-or-more agentic under being mimicked. This fits with the theoretical notion that agency and communion can be interpreted as orthogonal as they refer to separate features of behaviors (Abele & Wojciszke, 2014): agency is demonstrated by goal-attainment, whereas communion by intimacy and affiliation. Moreover, looking at the correlation of the self-ratings, the orthogonality of agency and communion is usually manifested by null correlations between these two primary concepts (Abele, 2003). This was also found in the presented studies; the communion did not correlate with agentic self-concepts. This result can also be explained by category accessibility assumptions. Speculating, it could be that the exposure to mimicry behavior automatically raises affiliative goals in people, and lead to such goal-directedness cognitions and motivational processes (Dijksterhuis & Aarts, 2010), but may not arises goal related to self-enhanced goals (and therefore, does not lead to such goal-directedness cognitions and motivational processes).

Moreover, and importantly, the agency concept can be defined differently. For example, it can be described as the sense that the person is that one who is causing (or producing) an action (Gallagher, 2000). Moreover, in this definition by Gallagher, a person with a sense of agency can recognize either 1) actions that are self-produced from those 2) produced by other people. Interestingly, a sense of agency can be also defined in terms of one's own personal control, but not for actions of others. In other definitions agency is equal to the feeling of choice. Importantly, when considering a paradigm of being mimicked – it is true that mimickees behavior is followed. "The decision", however, if it will be mimicked, it is not made by mimickee, but by mimicker. Scholars in the field of mimicry should more carefully focus on such differentiation of definitions of agency. An open question remains

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whether the other researchers could have obtained similar null results (in a case of self-centered concepts), but did not report it. Hypothetically, at a given moment such findings could be uninteresting, and/or perceived as incompletely related to the subject of mimicry, and/or considered as having minor importance for mimicry research (see file-drawer effect, Fanelli, 2010). This may influence the bias of the meta-analyzes and evaluation of the occurrence of the particular phenomena. As professor Jerzy Brzezinski mentioned " … the editors, "beating in the breast", but still doing the old way … [they may did not accept null findings to publish, WT]" (Szen-Ziemiańska & Trzmielewska, 2022).

Moreover, in this thesis, it was predicted that people being mimicked may feel on a greater level as recipients than those not being mimicked. The results showed that it seems to be true (Study 1, 2, and 3, but not 4). This is consistent with assumptions that, in a dyadic interaction, a person being mimicked may take the role of the receiver of the imitative act which was sent by the mimickers (Farmer et al., 2018). Therefore, being mimicked in the actual moment would lead in natural settings to enhance the recipient's perspective. In general, the obtained result is consistent with findings that people feel more oriented after mimicry, monitor other people's actions, feel more empathy for others (Ashton-James et al., 2007; Decety et al., 2002; Nadel, 2004).

Furthermore, mimicry did not impact agent perspective in any of the doctoral studies (however, in a case of Study 2 there were the marginal differences between two groups suggesting that it is likely that agent perspectives would be decreased by mimicry). However, when considering the Bayesian analysis there was not consistent if there is (or is not) more evidence in favor of the null-or-alternative hypothesis. There was more probability of null evidence when considered mimicry of facial expressions and speech mimicry (the effect was moderate). Although, in the case of nonverbal mimicry manipulation, there was no evidence regarding null or alternative hypotheses. Future studies should address this issue.

Interestingly, the collected data adds some novel information. Under being mimicked one of the perspectives (agent vs recipient) may not be dominant. It can be carefully proposed that people in such situations, can literally be in a state between being in recipient and an agent role. It may be in line with the theoretical assumptions that mimicry may blur distinctions between self-and-other and perspectives (Hale, 2016; Hale & Hamilton, 2016a; Wang, 2011; Wang et al., 2012), but this pattern is not really in line with assumptions from DPM model, which state that in a dyad interaction, there should be either a person in agent or recipient role. When analyzing the differences within conditions, it was generally found that people who were not mimicked felt more like agents than recipients, which can be explained in literature (Abele & Wojciszke, 2014), but under being mimicked (Study 1, 2, and 3) the degree of agent and recipient perspective did not differ significantly. These results are not very intuitive. Individuals who are being mimicked may be perceived by third party observers as more dominant, confident, and stronger than those people who mimicked them (Genschow & Alves, 2020). Therefore, although the movements of mimickees are followed, mimickees may not feel more like agents, even though they may be judged by a third-party observer as more dominant than their followers. It seems that the importance of which perspective is more relevant in self-perception may lay in a subjective interpretation of the situation one takes (Bialobrzeska et al., 2019). Future research should check more directly whether the person being mimicked, feels in control over the situation. Moreover, in this thesis, it was also found that communion can be a mediator of the relationship between mimicry and liking. However, that mediation model appeared significant only in the case of behavioral (i.e., nonverbal mimicry). Further studies should investigate the mechanisms behind possible differences of mimicry types in such models.

Future directions

The thesis aims to test the influence of mimicry on a person being mimicked (paradigm of being mimicked not mimicking one). However, there is evidence that people in social interactions may switch between taking the role of the person of being mimicked and being mimicker (Hale, 2016; Nadel-Brulfert, 1982). Previous works, most often address the experiments where participants are in a role either 1) of mimicker, or 2) mimickee. There is a lack of systematic studies that have attempted to measure the reciprocal patterns of mimicry behaviors in dyads. More studies are needed to examine mimicry in more natural patterns of social exchange. Furthermore, this doctoral research involved systematic investigations of the role of each type of mimicry on a person's self-perception. However, again, in natural real-life settings it rarely happens that people imitate others in terms of one, isolated, type of mimicry (nonverbal, or verbal one). Instead, they may simply combine different types of mimicry. Such studies are too rare.

There are more potential challenges. That is, the behaviors, and verbal characteristics were mimicked in Study 2, and 3 by a trained human confederate. Given the high likelihood of considerable individual variation in nonverbal, and other behaviors, type and frequency, it would be good to be more clear with decisions / determinants which behaviors to mimic (and whether there may be some a selection bias), and how the timing of act and mimicry will be organized. The more focus should be addressed to how the confederate should be trained, and her/his performance evaluated. Incorporating an ecologically valid approach to investigating mimicry is important for understanding and generalizing outcomes. Spontaneous mimicry may communicate a genuine disposition. That is, if this were the case, then people may be attuned to cues relevant to spontaneity such as appropriate timing and selectivity (Kavanagh & Winkielman, 2016). Future studies should address these methodological issues.

There is one direction which it would be worth investigating. These thesis findings were often discussed in reference to the models of the self-other overlap/shared representations (e.g., Hale & Hamilton, 2016). Although, it is suggested that positive social effects of mimicry may come directly from the brain reward activation, future studies should address these possible mechanisms. It is especially worth testing because in this doctoral research (and not only), it was found that people being mimicked, may in general feel more happier when compared to people not being mimicked (see Table S1). Moreover, in predicting the results in this thesis the importance was grounded on both: behavioral, as well as, on neurocognitive findings. It would be worth testing / replicating outcomes from these studies, considering both of these methods. It would add more to understanding of such findings.

Results found in this thesis can be essential for practitioners because mimicry would cause beneficial social changes in people who have lowered social orientation. This conclusion is worth broadening due to the two facts. First, in this thesis there was no baseline – so it is impossible to verify if people with lowered communal self-concepts (and recipient perspective) experience its enhancement, or rather people who were already relatively high in such dimensions experience subtle changes. Future studies should carefully address this issue. Second, mimicry is indeed a phenomenon that is an integral part of everyday life, but not everyone is sensitive to its effects – not everyone paying attention to mimicry and producing it. Future researchers should pay more attention on influence of mimicry on changes in self-concepts among some disorders that show dysregulation of self-other processing (such as antisocial personality disorder, narcissism, schizophrenia) because these disorders may be related in atypical production of mimicry and reaction to mimicry. Importantly, when processes of differentiation of self-and-others are activated (e.g., when an independent self-concept is primed or is chronically dominant) the inhibitory effects of a person's information

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processing on mimicry is shown (e.g., van Baaren, 2003). Therefore, the findings from this thesis do give further insight into the role of mimicry on self-perception, but these effects were tested without attention on exceptional cases, far from the norm. It must be very careful to implement mimicry, for example, in the processes of certain therapeutic sessions. There is a need for interdisciplinary research teams to develop and complement knowledge in this area (medical experts, psychologists, psychiatrists, etc.).

Study 5: Pilot study. Role of nonverbal mimicry in
impression formation

Future directions

In the doctoral research mimicry leads to more other-orientation. People who were mimicked also liked their imitators more. Communal accessibility through nonverbal mimicry probably leads to more liking for others. When looking from above, it was decided to conduct a pilot study, as part of my desire to broaden the prior routes. The study aimed to examine whether in a situation of ambiguity in the presentation of the other person (a target/stranger), people under influence of mimicry, evaluate this person more favorably. Additionally, it was checked whether – under mimicry – a stranger's traits would be assessed by participants as more agentic and communal.

Previous studies indicate that readily accessible categories can influence impression formation of ambiguous targets, but this relationship is not completely understood. Several research involved verbal (traits) priming performed in artificial settings (Higgins et al., 1997, for critics see Galinsky & Glucksberg, 2000). There are also investigations of impression formation through more naturalistic nonverbal priming, which uses mimicry. However, most of them tested the impact of mimicry on impression formation with relatively unambiguous presentation – or only a few basic information, about the target (Chartrand & Bargh, 1999). Moreover, judgments usually refer to the mimicker, not to other people in general. A few studies involved judges toward mimicker, other people or even products, but with a priori negative attitudes (Hasler et al., 2014; Kulesza et al., 2017). Thus, the study aimed to explore whether mimicry influences an impression formation of ambiguous targets (i.e., behaviors can be interpreted as positive, or negative).

In this pilot study, participants – either student and employees from a local corporations ($N = 115$) engaged in open-ended and closed-ended response tasks where, in

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both cases, they were presented with an ambiguous description of a target who was described using a person-perception paradigm (Higgins et al., 1997, see supplementary Material S1). In the open-ended portion, participants were asked to list the three most important adjectives to describe the target. These adjectives were scored (and averaged) as (1) positive/negative, (2) agentic (3) communal based on prior research (Abele & Wojciszke, 2007). In the closed-ended portion (which came second), participants rated the veracity (1 = definitely not; 7 = definitely yes) of four bipolar adjective pairs (i.e., independent/aloof; reckless/adventurous; self-confident/conceited; persistent/stubborn, Higgins et al., 1997) to describe the target. The measure to which participants feel closeness (interpersonal interconnectedness) toward other people was also implemented (IOS, Aron et al., 1992). There were also controls for liking mimicker ratings. The mimicry manipulation method was similar as used in Study 2.

First, not in line with predictions, no differentiation, when considering interpersonal closeness in both mimicry and no-mimicry groups, was found. Second, people being mimicked liked their mimicker more than people not mimicked. Third, in the open-ended task, people described the target more favorably (on overall positive, and additionally agentic and communal valence), but this effect occurred only in the first trait offered by participants. Third, in the close-ended tasks, there was the partial effect of mimicry on negative valence traits, and, unlike expected, no significant group differences on ratings of positive valence traits.

Beyond the limitation of this study (related to the popular confederate paradigm was again used, there were no measures for communal and recipient concepts) the findings are valuable, and worth reporting, even in such a concise form. In the open-ended task, people being mimicked produced more favorable (positively valence) traits of the target compared to those not being mimicked. It is consistent with theories of impression formation, where the processing of information, especially in ambiguous contexts, may evoke cognitively available

categories that people use in later judgments (Bruner, 1957). It is also suggested that exposure to a certain category can evoke corresponding feelings in people and that could have an effect on future evaluations (Higgins et al., 1977). Therefore, it would be that the inferences and judgments about others could be guided by a *good* feeling, as mimicry seems to induce in people affiliation feelings. That is, such positive affiliative feelings would be generalized on the unknown target. Additionally, under influence of mimicry, the first traits offered by participants were rated higher on its communal and agentic valence. Therefore, in response to mimicry, the target traits were immediately perceived as more positive, as well as more communal and agentic in valence. Such results can be in part related with phenomena of *halo effect*, an observer tendency to assign unobserved positive characteristics to objects based on one positive previously anticipated (Anderson, 1981). So that mimicry would bring an associative nature of immediate impression formation when faced with ambiguously presented targets. Findings from this study may have shed some light on prior research, because mimicry did not influence the second and third traits offered by participants. Given a lack of systematic studies that test how effects of mimicry are distributed with the time passage, a reliable meta-analysis of the mimicry research should be conducted to improve the understanding of obtained patterns in this study.

Furthermore, when looking at the results from the close-ended ratings, mimicry had an effect only on the two negative valence traits of the target. Interestingly, mimicry had an effect on traits with stronger negative values (reckless and conceited). This pattern can be supported by other findings, which showed that mimicry can work as a tool to *repair* social relations (Hasler et al., 2014). Mimicry in such study, improved ratings (liking and feeling of closeness) toward outgroup members (mimicker), only when people declared high a prior liking of that outgroup.

Mimicry had no impact on the target ratings on his positive valence traits in the close-ended task. Such results seem as inconsistent with results from mimicry research, in which mimicry spread beyond mimicker and do enhance judgements towards people unrelated to mimicker (Zglincka & Kulesza, 2014). However, such study considered judgments related to potential a priori negative attitudes toward the targets. Obtained results can be also considered as related with prior study using traits prime techniques (Higgins et al., 1977). It was found that the later (delayed) judgements can be effective when activated categories are applicable to objects. Additional analysis in this study showed that means of negative traits used in the close-ended tasks, was close to zero in a case of its agentic valence. However, was below zero when considered means of its communal valence. So that the mimicry effects would work longer in a case of more applicable (communal) category arises from nonverbal priming (mimicry arises affiliative feelings). It could share some similarities with prior research, where mimicry improved ratings, towards outgroup members, but this effect exists only on warmth, not competence and personality dimension (Zglinicka & Kulesza, 2014). More research on such issues using a bigger sample needs to be performed to better understand these findings. It might be that the effects of positive traits in the close-ended tasks are possibly just weaker and thus, that a larger study sample is needed to find any significant differences.

Having summarized, several studies show that when people perceive others in social relations they may form impressions automatically and effortlessly. It was noted that exposure to social behavior, even like behavioral mimicry, might influence how people perceive those around them. Such studies usually investigated impression formation processes with relatively unambiguity presentation – or lack of complex information about a target, or with a priori negative attitudes toward a stimulus person. Because social relations are generally characterized by ambiguity, in the present experiment the effects of mimicry on how people

form impressions when they are exposed to the ambiguity presentation of the target (i.e., his behaviors were described with possible bipolar interpretations) was tested. A popular behavioral mimicry method was used to better understand the processes of person-perception in such contexts. This study shows that when people are under influence of mimicry, and faced with ambiguous targets (unrelated to mimicked interaction partners), the impression formation processes may suffer from first impression bias especially in immediate judgments. It is essential because such judgments may influence a broad range of psychological consequences (e.g., decision making processes).

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Supplementary materials

Table S1

Descriptive statistic for emotional state ratings

				Study 1			
Emotion	Condition	*M (SD)*	W	p	r	95% CI for Cohen's	
						LL	UL
Happiness	Mimicry	5.20 (1.37)	4066.50	< .001	.59	0.46	0.70
	No-mimicry	3.33 (1.79)					
Interest	Mimicry	5.33 (1.34)	3156.00	< .001	.52	0.36	0.65
	No-mimicry	3.75 (1.78)					
Excitement	Mimicry	4.23 (1.74)	2923.50	< .001	.41	0.22	0.56
	No-mimicry	3.18 (1.57)					
Anger	Mimicry	0.91 (1.50)	2520.50	.888	-.01	-0.20	0.18
	No-mimicry	0.81 (1.15)					
Guilt	Mimicry	0.59 (1.49)	1541.00	.004	.25	-0.14	0.32
	No-mimicry	1.15 (1.64)					
Contempt	Mimicry	0.44 (1.37)	1859.00	.133	-.11	-0.30	0.09
	No-mimicry	0.56 (1.07)					
				Study 2			
Emotion	Condition	*M (SD)*	W	p	r	95% CI for Cohen's	
						LL	UL
Happiness	Mimicry	4.55 (1.45)	5321.00	< .001	.44	0.29	0.57
	No-mimicry	3.49 (1.47)					
Interest	Mimicry	5.63 (1.04)	4740.00	< .001	.28	0.12	0.43
	No-mimicry	4.95 (1.35)					
Excitement	Mimicry	4.44 (1.40)	4259.00	.080	.15	-0.02	0.32
	No-mimicry	3.98 (1.65)					
Anger	Mimicry	0.61 (0.77)	3644.00	.860	-.02	-0.19	0.16
	No-mimicry	0.69 (1.07)					
Guilt	Mimicry	0.79 (1.21)	3705.00	.982	.00	-0.17	0.17
	No-mimicry	0.71 (1.03)					
Contempt	Mimicry	0.51 (0.70)	3556.00	.622	-.04	-0.21	0.13
	No-mimicry	0.61 (0.89)					
				Study 3			
Emotion	Condition	*M (SD)*	W	p	r	95% CI for Cohen's	
						LL	UL
Happiness	Mimicry		5822.00	.056	.15	-0.01	0.30

	No-mimicry	4.10 (1.60)					
Interest	Mimicry	3.66 (1.64) 5.24 (1.25)	5829.50	.051	.15	-0.00	0.31
	No-mimicry	4.90 (1.34)					
Excitement	Mimicry	4.33 (1.66)	5622.50	.157	.11	-0.05	0.27
	No-mimicry	4.01 (1.63)					
Anger	Mimicry	0.85 (1.06)	4426.00	.09	-.12	-0.27	0.36
	No-mimicry	1.09 (1.26)					
Guilt	Mimicry	0.84 (0.95)	5052.00	.997	.00	-0.16	0.16
	No-mimicry	0.88 (1.07)					
Contempt	Mimicry	0.72 (0.83)	4473.00	.122	-.11	-0.27	0.05
	No-mimicry	0.92 (1.02)					

Note. For the Mann-Whitney test, effect size is given by the rank biserial correlation.

Note. Mann-Whitney U test.

Table S2

Descriptive statistic for impression ratings (0-1), and of the movements of the VR agent

						95% CI for Cohen's	
Emotion	Condition	*M (SD)*	*W*	*p*	*r*	LL	UL
Study 4							
Neutral Ratings[28] (*N*=10)	Mimicry No-mimicry	0.47 (0.51) 0.05 (0.23)	256.50	.004	.42	0.08	0.68
Negative Ratings[29] (*N*=19)	Mimicry No-mimicry	0.26 (1.34) 0.74 (1.78)	266.00	.003	.47	0.14	0.71
Movement of agent[30] (*N*=71)	Mimicry No-mimicry	140 (9.39) 115(20.51)	1077.50	< .001	.71	0.55	0.82

Note. For the Mann-Whitney test, effect size is given by the rank biserial correlation.

Note. Mann-Whitney U test.

[28] E.g., "She nodded while I was talking"; "She changed her hands and feet"; She was moving head from side to side when thinking and touching upper leg".

[29] E.g., "She was rather elaborate about describing her own photos and didn't seem to care much for my descriptions"; "She manifested some nonverbal behavioral expressing her nervousness and her embarrassment"; "I felt like she seemed a bit uncomfortable. She was nervous (…)".

[30] Mean of the frequency of movements.

Table S3

Correlations for impression ratings (0-1), liking and of the movements of the VR agent

Measure	Study 4			
	1	2	3	4
1. Neutral impression	—			
2. Negative impression	-.60**	—		
3. Liking	.37*	-.32*	—	
4. Frequency of movements of the VR agent	-.28^x	.35*	-.26*	—

Note. $^x p = .091$

Material S1

Description of target (Pilot study)

" …. Konrad spent a great amount of his time in search of what he liked to call excitement. He had already climbed, shot the Colorado rapids in a kayak, and piloted a jet-powered boat – without knowing very much about boats. He had risked injury, and even death. Now he was in search of new excitement. He was thinking, perhaps, he would do some skydiving or maybe cross the Atlantic in a sailboat. By the way he acted one could readily guess that Konrad was well aware of his ability to do many things well. Konrad's contact with people were rather limited. He felt he didn't need to rely on anyone. Once Konrad made up his mind to do something it was as good as done no matter how long it might take or how difficult the going might be. Only rarely did he change his mind even when it might well have been better if he had".