# Social group membership does not modulate automatic imitation in a contrastive multi-agent paradigm

Laura De Souter, Senne Braem, Oliver Genschow, Marcel Brass, and Emiel Cracco

Author Note

Laura De Souter is affiliated with the Department of Developmental, Personality and Social Psychology, Ghent University. Senne Braem, Marcel Brass, and Emiel Cracco are affiliated with the Department of Experimental Psychology, Ghent University. Oliver Genschow is affiliated with the Social Cognition Center Cologne, University of Cologne.

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Correspondence concerning this article should be addressed to Emiel Cracco, Department of Experimental Psychology, Ghent University, Henri Dunantlaan 2, B-9000. E-mail: emiel.cracco@ugent.be.

## Abstract

A key prediction of motivational theories of automatic imitation is that people imitate in-group over out-group members. However, research on this topic has provided mixed results. Here, we investigate the possibility that social group modulations emerge only when people can directly compare in- and out-group. To this end, we conducted three experiments in which we measured automatic imitation of two simultaneously shown hands: one in-group and one out-group hand. Our general hypothesis was that the in-group hand would be imitated more than the out-group hand. However, even though both explicit and implicit manipulation checks showed that we succeeded in manipulating participants' feelings of group membership, we did not find support for the predicted influence of group membership on automatic imitation. In contrast to motivational theories, this suggests that group membership does not influence who we do or do not imitate, not even in a contrastive multi-agent paradigm.

In day-to-day situations, it often happens that people copy the pose of the person they are interacting with. You might, for example, find yourself sitting with your legs crossed and your hands in your lap, only to notice that the person you are talking to is sitting in the exact same way. This copying behavior has been studied using behavioral mimicry paradigms in social psychology (e.g., Chartrand & van Baaren, 2009) and automatic imitation paradigms in cognitive psychology (e.g., Cracco, Bardi, et al., 2018; Heyes, 2011), although both may not be correlated (Genschow et al., 2017). In a prototypical automatic imitation task (e.g., Brass et al., 2000), participants are instructed to respond to a symbolic cue (i.e., number 1 or number 2) by making a certain movement (i.e., by lifting their index finger or middle finger). Together with the symbolic cue, a task-irrelevant action stimulus is shown (i.e., a picture of a hand lifting index or middle finger). Responses are typically faster when the required action is congruent to the observed, task-irrelevant action than when it is incongruent (Bertenthal et al., 2006; Brass et al., 2000; Catmur & Heyes, 2011; Heyes et al., 2005). This congruency effect is known to be a reliable (Genschow et al., 2017) and valid (Cracco & Brass, 2019) measure of automatic imitation (Cracco, Bardi, et al., 2018; Heyes, 2011).

However, in most day-to-day situations, it is not efficient (nor possible) to imitate everyone. Therefore, an important research endeavor has been to try and identify which factors determine who we do and do not imitate. An important finding in this field is that imitative tendencies are modulated by socio-affective factors, such as pro- and anti-social primes (Cracco, Genschow, et al., 2018; Leighton et al., 2010; van Baaren et al., 2003). Based on evidence that being imitated increases pro-social attitudes and behaviors towards the imitator (Duffy & Chartrand, 2015), motivational theories of automatic imitation explain these socio-affective modulations in terms of social reward. For example, the social top-down response modulation account (STORM; Wang & Hamilton, 2012), a prominent motivational theory, states that people imitate more when they have a heightened motivation to affiliate, or, in other words, when they want their interaction partner to like them. An illustration of this principle can be found in the finding that automatic imitation is reduced when there is no eye contact with the interaction partner (Forbes et al., 2016; Wang et al., 2011; Wang & Hamilton, 2014), as imitating someone who isn't looking at you doesn't facilitate social interaction (Wang & Hamilton, 2012).

Another social factor that has been argued to play an important role in automatic imitation is social group membership (Genschow & Schindler, 2016; Gleibs et al., 2016; Rauchbauer et al., 2015, 2016). Belonging to a social group is an evolutionary important aspect of human life (Dunbar, 2012; Dunbar & Shultz, 2010; Machin & Dunbar, 2011), and acknowledging another person as an in-group member is thought to activate the motivation to affirm mutual group membership by affiliating with this person (Van der Schalk et al., 2011). Thus, because mutual group membership activates affiliation motives, STORM predicts that people will imitate in-group members more than out-group members (Wang & Hamilton, 2012). In line with this hypothesis, two studies found more automatic imitation of in-group than of out-group members (Genschow & Schindler, 2016; Gleibs et al., 2016), but only when there was a high motivation to affiliate with the in-group (Genschow & Schindler, 2016) and only in a cooperative as opposed to a competitive context (Gleibs et al., 2016). However, other studies also found no in-group bias (Weller et al., 2020) or more automatic imitation of out-group members, either in general (Rauchbauer et al., 2015) or only if they displayed an angry facial expression (Rauchbauer et al., 2016).

In sum, research on the influence of social group on automatic imitation has yielded mixed results. Most strikingly, not a single study so far has reported a direct increase in automatic imitation for in-group compared with out-group members. A possible explanation for this pattern is that previous research used paradigms in which each trial showed only an in-group member or only an out-group member, but never both. In contrast, social group effects may require a frame of reference. This is consistent with evidence that social judgements are often based on social comparison (e.g., Mussweiler, 2003). Applied to group membership, social comparison theories argue that the out-group is judged only when it can be compared with the in-group. This, in turn, depends on the saliency of group membership (Brewer, 1991; Brewer & Weber, 1994). For example, Brewer and Weber (1994) found that only when group membership was a distinctive feature, individuals contrasted themselves with the out-group and assimilated with the in-group. Hence, based on this research, an interesting hypothesis is that out-group members are imitated less only when in- and out-group members can be compared directly (Mussweiler, 2003), such as when they stand next to each other.

Importantly, testing this hypothesis requires an automatic imitation paradigm with multiple agents. Cracco et al. (2015) recently developed such a paradigm by showing not just one but two hands making compatible or incompatible movements on each trial. The results revealed that automatic imitation was stronger when both hands performed the same movements than when just one hand performed a movement, and that two hands performing two different movements, one congruent and one incongruent, produced concurrent facilitation and interference effects that cancelled out each other. These findings have been confirmed and extended by subsequent work (Cracco et al., 2016; Cracco, Keysers, et al., 2018; Cracco & Brass, 2018b, 2018a, 2018c; Cracco & Cooper, 2019) and suggest that in multi-agent settings, multiple observed actions are processed simultaneously in the motor system.

The current study builds on this work by using a multi-agent paradigm to test the hypothesis that social group has a direct influence on automatic imitation when in-group and out-group can be compared directly within rather than across trials (Mussweiler, 2003). Specifically, we report three experiments measuring automatic imitation of two simultaneously shown hands: one in-group and one out-group hand. In Experiment 1, one hand made a congruent movement and the other hand an incongruent movement. If in-group members are imitated more, the influence of the two hands should not cancel out each other (Cracco et al., 2015), but a congruency effect in the direction of the in-group hand should be observed. In Experiments 2 and 3, instead of two different movements, either one hand made a movement or both hands made the same movement. This allowed us to test, first, if there was an in-group bias, by comparing trials in which only the in-group hand moved with trials in which only the out-group hand moved. Second, it also allowed us test if the out-group hand was imitated at all, by comparing trials in which only the in-group hand moved with trials in which both the in- and out-group hand moved.

In addition to investigating social group effects in a contrastive multi-agent paradigm, a secondary goal of this study was also to explore potential moderators. First, based on evidence that attention modulates automatic imitation (Bach et al., 2007; Cracco, Bardi, et al., 2018), Experiments 1 and 3 investigated the role of attention allocated towards the in-group, as measured by a dot-probe task (MacLeod et al., 1986). Second, based on the STORM prediction that fluctuations in people's motivation to affiliate drive social modulations of automatic imitation (Genschow & Schindler, 2016; Wang & Hamilton, 2012), Experiment 3 included self-reported motivation to affiliate with the in-group as moderator. By using a contrastive paradigm and exploring multiple moderators, the current study provides a strong test of the hypothesis that social group membership, a key social factor, modulates automatic imitation (Wang & Hamilton, 2012).

## Experiment 1

### Participants

The sampling goal of Experiment 1 was to collect 40 participants. This was based on our previous work (Cracco et al., 2015) and on the fact that such a sample provided us with adequate power to detect medium-sized effects (i.e., 80% power to detect $d = 0.45$ at $\alpha = 0.05$).

Eventually, thirty-nine students (30 female, $M_{age}$ = 18.60, $SD_{age}$ = 1.33, $range_{age}$ = 17-22) participated in the experiment in return for course credit. All participants were right-handed, had normal or corrected-to-normal vision, and signed an informed consent before the start of the experiment.

## Tasks and Procedure

The experiment consisted of a social group manipulation, in which participants were assigned to the “blue” or “green” group based on their political orientation, followed by a manipulation check and two experimental tasks: an automatic imitation task and a dot-probe task. All tasks were programmed using the Tscope5 library in C (Stevens et al., 2006).

**Group Manipulation.** Participants first answered a political orientation question. More specifically, they had to indicate their political orientation on a 6-point scale including “Far-left”, “Left”, “Centre-left”, “Centre-right”, Right”, and “Far-right” and were told that they would be assigned to the blue or green group based on their answer. It was furthermore mentioned that they would complete all remaining tasks of the experiment as a member of this group. The six options were printed on the computer screen from left to right with a number (1 to 6) linked to each option. The number was printed above each option in black in a light blue rectangle. Participants could respond by choosing the option that described them best by pressing the corresponding button on the keypad. After doing so, the rectangle of the chosen option turned red, and this option was printed at the bottom of the screen. This remained on the screen for 2250 milliseconds. Next, a feedback screen appeared, explaining the consequences of their choice to participants. Unbeknownst to participants, the feedback depended on the participant number. Participants with even numbers got the message that they were assigned to the blue group based on their political orientation, while participants with uneven numbers got the message that they were assigned to the green group based on their political orientation. For example, if a participant with an even number indicated that her political orientation was centre-left, the (translated) feedback was: “You indicated that your political preference is centre-left. Based on this political preference, you are part of the blue group. Members of the blue group have a left political preference, just like you. Members of the green group have a far-right to centre-right political preference. You will complete the remaining tasks in this experiment as a member of the blue group”. After 12 seconds, the instruction to call the experimenter was shown at the bottom of the screen. The experimenter gave participants a glove with the color of the group to which they were assigned, and participants wore this glove for the remainder of the experiment. The median response to the political orientation question was “centre-right”, with responses ranging from “left” to “right”.

**Token Task.** To test the effectiveness of the manipulation, we used a previously validated task measuring in-group favoritism (Chen & Li, 2009). More specifically, participants were asked to divide 200 tokens three times between two other anonymous participants, referred to by their participant number (e.g., “participant 36 from the blue group”). In the first round, both participants belonged to the in-group. In the second round, both participants belonged to the out-group. In the last round, one participant belonged to the in-group and the other participant to the out-group. Participants were instructed to divide their tokens according to what they felt was best. We used the results of the third composition as a measure of in-group favoritism, as previous studies consistently found that in this division participants allocate more tokens to in-group members (Chen & Li, 2009). The three compositions were repeated three times in the same order.

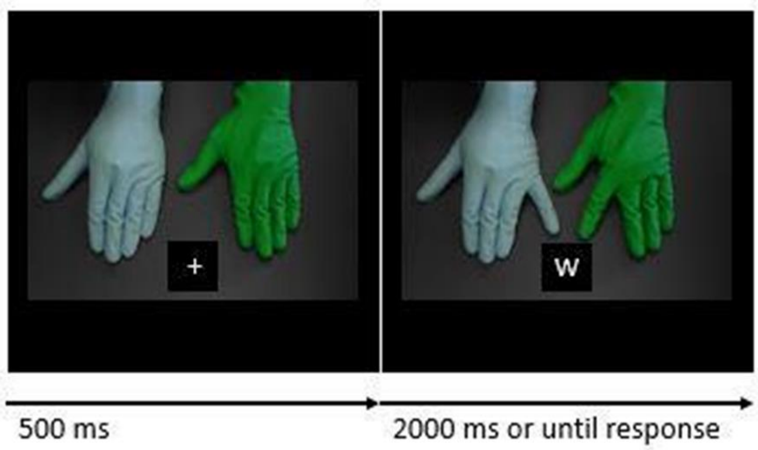
**Automatic Imitation Task.** To measure the effect of in- versus out-group on automatic imitation, we used an adapted version of the automatic imitation paradigm created by Cracco and colleagues (2015). In their paradigm, participants had to respond to a cue by moving their index or little finger while ignoring congruent or incongruent movements made by two hands simultaneously shown on the screen. We used the same paradigm but adapted it in such a way that on every trial one in-group hand and one out-group hand was shown. More specifically, we used pictures of two different mirrored male left hands wearing a blue or green glove. Pictures of the two hands were made for all possible combinations of position on the screen (i.e., left or right), glove color (i.e., blue or green), and finger movement (i.e., index finger or little finger abduction). This resulted in a total of eight sets of pictures, with each set containing a picture of the hands in neutral position and a picture of the hands performing the movement. Which hand wore which glove was counterbalanced across participants, with the location of the hands depending on the block. In blocks 1 and 3, the blue hand always appeared on the left and the green hand on the right, whereas the opposite was true in blocks 2 and 4.

The experiment started with 8 practice trials in which accuracy feedback was provided, followed by 4 blocks of 96 trials without feedback. Trials were presented at random with 48 trials per condition per block. In between the blocks, participants were given the opportunity to take a short break. The experiment only included one set of trials from Cracco et al. (2015), namely those trials in which the two hands performed two different (i.e., one congruent and one incongruent) movements (Figure 1a). Trials were presented at random and started with a picture of the two hands in neutral position. In between the two hands, at the bottom of the screen, a fixation cross was shown. This neutral image was shown for 500 ms, after which it was replaced by a picture in which one hand abducted the index finger and the other hand the little finger. At the same time, the fixation cross was replaced by the letter W or P, indicating that participants had to, respectively, abduct their index or little finger. This remained on the screen until participants responded, with a maximum duration of 2000 ms. Responses were recorded with an optical response box that registered when the index or little finger was moved from its instructed resting position. Each trial ended with an intertrial interval of 1000 ms, after which the next trial started.

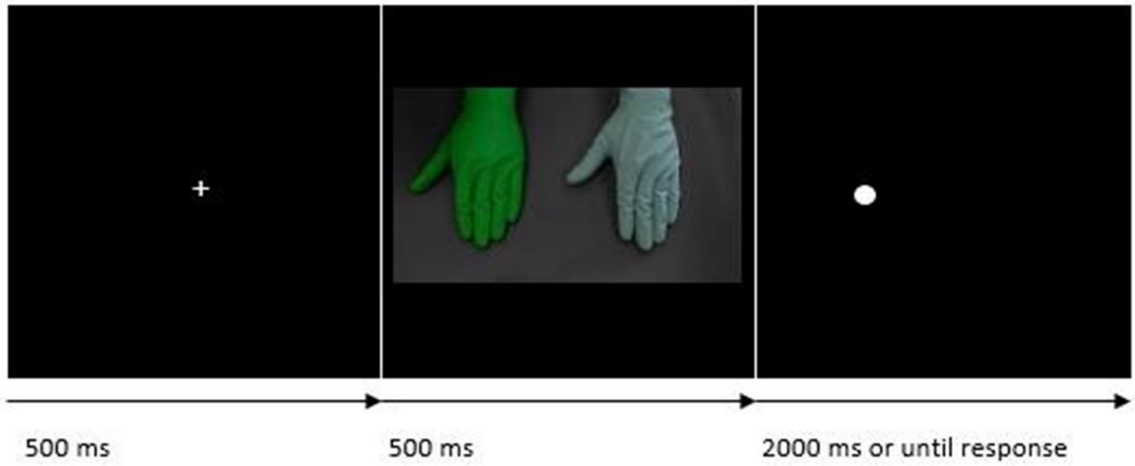
There were two trial types: (a) in-group congruent trials, in which the in-group hand performed a congruent movement and the out-group hand an incongruent movement, and (b) in-group incongruent trials, in which the in-group hand performed an incongruent movement and the out-group hand a congruent movement. By comparing both trials types, we can test if there was an in-group bias, because any difference between them is necessarily due to systematically increased imitation of one of the two hands. Indeed, previous research found that reaction times (RTs) and error rates (ERs) on trials where two hands performed two different actions, one congruent and one incongruent, were the same as on trials where neither hand performed an action, suggesting that imitative responses elicited by both hands cancelled out each other (Cracco et al., 2015). Therefore, if participants responded faster on in-group congruent than on in-group incongruent trials, this would mean that the in-group hand elicited stronger imitative responses than the out-group hand and hence that participants displayed an in-group bias.

**Dot-Probe Task.** After the automatic imitation task, participants did a dot-probe task (MacLeod et al., 1986) testing whether there was an attentional bias towards the in-group hand. In this task, participants had to respond to a white dot appearing on either the left or right side of the screen by pressing, respectively, the left or right arrow key with their right hand. Crucially, the appearance of the dot was preceded by a picture of the two hands used in the automatic imitation task (Figure 1b). Thus, the dot could appear either at the location of the in-group hand or at the location of the out-group hand. If there is an attentional in-group bias, this procedure should result in faster and more accurate responses when the dot appears on the in-group side than when it appears on the out-group side, as this would indicate that participants' attention was directed towards the in-group hand when the picture was shown (MacLeod et al., 1986).

The dot-probe task comprised 4 blocks of 96 trials, presented at random with 48 trials per condition. In between the blocks, participants were given the opportunity to take a short break. In blocks 1 and 3, the blue hand appeared left and the green hand right, whereas the opposite was true in blocks 2 and 4. Each trial started with a fixation cross in the middle of the screen for 500 milliseconds. Next, a picture of the two hands in neutral position was shown for 500 milliseconds, followed by the dot at the location of the left or right hand for 2000 milliseconds or until a response was given. Trials ended with an intertrial interval of 1000 milliseconds.




a.




b.

**Figure 1.** Timeline of (a) one trial in the automatic imitation task and (b) one trial in the dot-probe task. In Experiment 1, both hands always performed two different actions in the

automatic imitation task (as shown). In Experiments 2 and 3, either one hand performed a congruent or incongruent action or both hands performed the same congruent or incongruent action.

## Data Analysis

All analyses were performed in R and all data and analysis scripts are available on the OSF: https://osf.io/c8vfj/. RTs were used as the primary dependent variable in all experiments, because research has shown that they are more sensitive than ERs (Cracco, Bardi, et al., 2018). However, we will also report ERs as a secondary measure. For key tests, we will additionally report Bayes Factors (BF). BFs compare the likelihood of the data under the null and alternative hypothesis and as such can provide evidence not only for but also against an effect. As a rule of thumb, $BF > 3$ is often interpreted as evidence for the alternative hypothesis, whereas $BF < 0.33$ is often interpreted as evidence for the null hypothesis (Jeffreys, 1961). All Bayesian analyses were conducted using the default priors of the BayesFactor package in R (Morey & Rouder, 2018).

**Token Task.** No participants were excluded from the token task analysis. The data were analyzed with a two-sided paired *t* test comparing the average amount of tokens given to the in-group member and out-group member in the composition with one in-group and one out-group member.

**Automatic Imitation Task.** Participants were excluded from the automatic imitation analysis if their mean ER or RT exceeded the sample mean by $\geq 3$ SD. This resulted in the exclusion of one participant with a mean ER of 17.62% and another participant with a mean RT of 830 ms. Thus, the automatic imitation analysis was done on a sample of 37 participants. Trials were excluded from both the RT and the ER analysis if no response was provided (0.35%) or if the RT was < 100 ms (0.16%) and from the RT but not the ER analysis if the response was incorrect (3.52%) or if the RT exceeded the participant's mean RT by ≥ 3 SD (2.10%). The resulting data was analyzed with a two-sided paired *t* test comparing RTs and ERs on in-group congruent and in-group incongruent trials.

**Dot-Probe Task.** The same exclusion criteria were applied as for the automatic imitation task. As a result, one participant with a mean RT of 692 ms was excluded. Trials were excluded from both the RT and ER analysis if no response was provided (0.21%) or if the RT was < 100 ms (0.03%) and from the RT but not the ER analysis if the response was incorrect (1.40%) or if the RT exceeded the participant's mean RT by ≥ 3 SD (1.86%). The resulting data was analyzed with a two-sided paired *t* test comparing RTs and ERs on in-group and out-group trials.

## Results

**Token Task.** The token task analysis confirmed the presence of an in-group bias: participants gave on average more tokens to the in-group member (M = 111, SD = 29) than to the out-group member (M = 89, SD = 29), $t(38) = 2.39$, $p = .022$, $d_z = 0.38$, 95% CI = [0.06, 0.71], $BF_{10} = 2.14$.

**Automatic Imitation Task.** Neither the RT, $t(36) = -0.10$, $p = .921$, $d_z = 0.02$, 95% CI = [-0.31, 0.34], $BF_{10} = 0.18$, nor the ER, $t(36) = -0.23$, $p = .824$, $d_z = 0.04$, 95% CI = [-0.29, 0.36], $BF_{10} = 0.18$, analysis revealed a significant difference between in-group congruent and in-group incongruent trials (Figure 2). However, it is possible that only participants with a strong in-group favoritism imitated the in-group hand more. To rule out this hypothesis, we correlated the difference in RTs between in-group congruent and in-group incongruent trials with the size of the in-group bias in the token task. This revealed no correlation, $r(35) = 0.07$, $p = .696$.

**Dot-Probe Task.** We first tested whether there was an attentional bias for the in-group (Figure 2), but found no evidence for such a bias in either RTs, $t(37) = -0.46$, $p = .646$, $d_z = -0.08$, 95% CI = [-0.39, 0.24], $BF_{10} = 0.19$, or ERs, $t(37) = -0.70$, $p = .491$, $d_z = -0.11$, 95% CI = [-0.43, 0.21], $BF_{10} = 0.22$. Second, we tested whether inter-individual differences in attention towards the in-group moderated the effect of social group on automatic imitation by computing the attentional bias in RTs towards the in-group for each participant and correlating these scores with the difference in RT between in-group congruent and in-group incongruent trials in the automatic imitation task. However, the resulting correlation was not significant, $r(34) = .00$, $p = .999$.

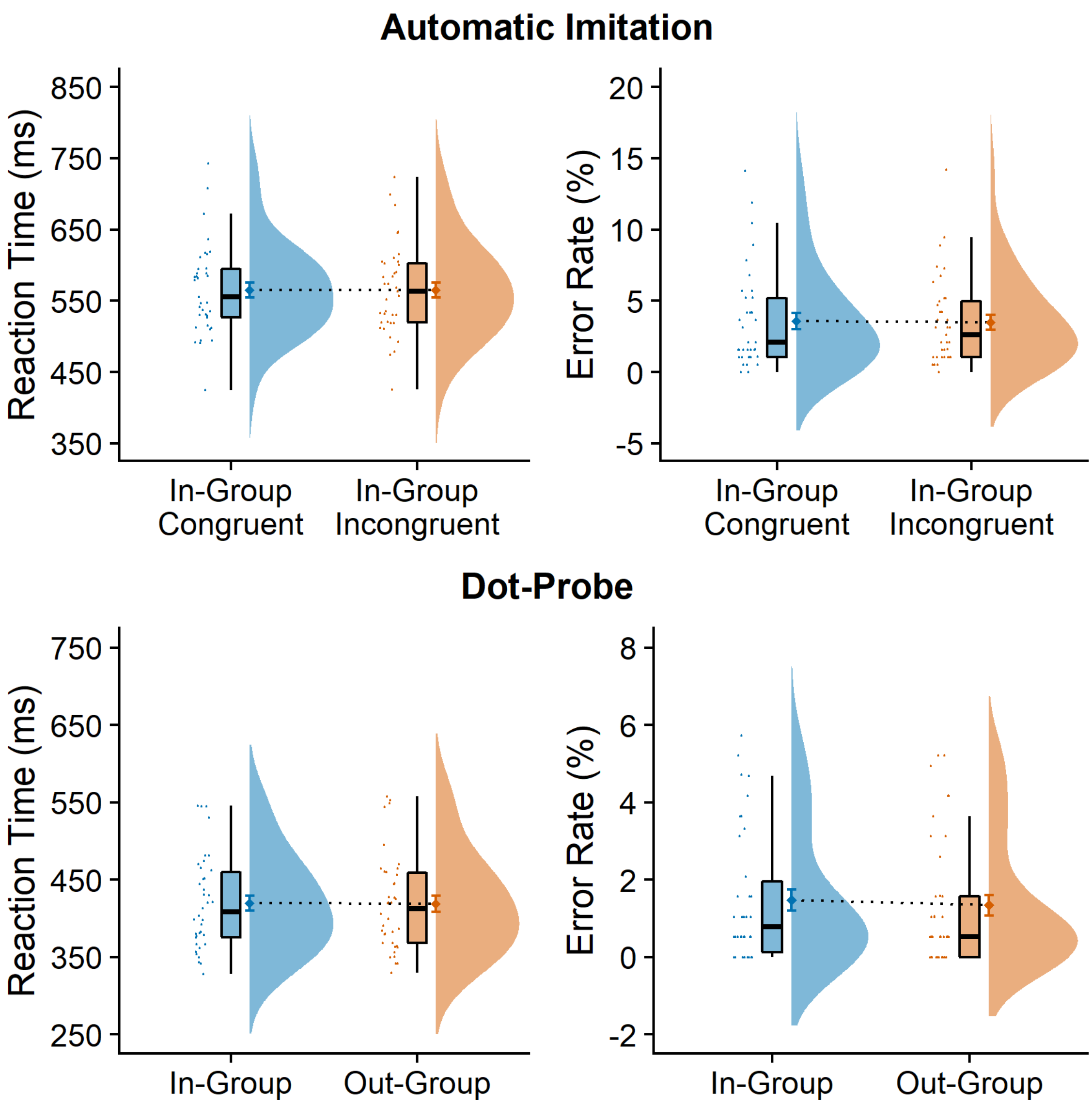


**Figure 2.** Raincloud plots (Allen et al., 2019) showing reaction times and error rates in the automatic imitation and dot-probe tasks of Experiment 1. In the automatic imitation task, the two hands always performed different actions. On in-group congruent trials, the in-group hand performed a congruent action and the out-group hand performed an incongruent action. On in-group incongruent trials, the in-group performed an incongruent action and the out-group hand performed a congruent action. Each plot shows the data individually for each participant and summarized using boxplots, means ± standard errors, and probability distributions.

**Discussion**

In Experiment 1, we found no evidence for an effect of social group membership on automatic imitation, despite using a contrastive multi-agent paradigm in which both the in- and out-group member were simultaneously visible and despite the fact that the token test revealed significant in-group favoritism. This speaks against the hypothesis that automatic imitation is modulated by social group. Yet, one could also argue that Experiment 1 was unsuccessful in eliciting automatic imitation altogether. In Experiment 1, one hand performed a congruent action and the other hand an incongruent action. Therefore, the influence of the two hands is expected to cancel out each other when there is no in-group bias (Cracco et al., 2015). According to our initial hypothesis, this explains the absence of a difference between in-group congruent and in-group incongruent trials. However, the same result would also be observed if the hands were not imitated at all. Although this seems unlikely in light of previous evidence showing that it is possible to represent two different observed actions at the same time in the motor system (Cracco, Keysers, et al., 2018; Cracco & Brass, 2018b), it remains a theoretical possibility.

Therefore, to further investigate whether automatic imitation is sensitive to social group, Experiment 2 used a different paradigm, in which either just one hand made a movement or both hands made the same movement (Cracco et al., 2015; Cracco & Brass, 2018c, 2018a). Using this paradigm, we can test (a) if there is an in-group bias, by comparing trials where only the in-group hand made a movement with trials where only the out-group hand made a movement, and (b) if the out-group hand is imitated at all when both hands move, by comparing trials where only the in-group hand made a movement with trials where both hands made a movement. If the out-group hand is imitated in addition to the in-group hand on these trials, then automatic imitation should be stronger on trials where both hands move. Moreover, because we expect a congruency effect, this paradigm makes it possible, in contrast to Experiment 1, to disentangle the absence of an in-group bias from the absence of automatic imitation altogether.

Finally, in addition to using a different paradigm, we also replaced the token task (Chen & Li, 2009) with the implicit association test (IAT; Greenwald et al., 1998; Nosek, et al., 2005) as a manipulation check of our social group manipulation in Experiment 2. That is, a potential concern with the token task used in Experiment 1 could be that it was too transparent, causing participants to respond in the way that they believed was expected from them, instead of following their actual feelings when allocating tokens (Weber & Cook, 1972). The IAT addresses this concern by providing an implicit measure of in-group favoritism (e.g. Rudman et al., 2002).

## Experiment 2

### Participants

A new sample of 39 students (29 female, $M_{\text{age}}$ = 18.85, $SD_{\text{age}}$ = 1.81, range$_{\text{age}}$ = 17-27) participated in the experiment in return for a course credit. The sample size of Experiment 2 was based on Experiment 1. All participants were right-handed, had normal or corrected-to-normal vision, and signed an informed consent before the start of the experiment.

**Tasks and Procedure**

The group manipulation of Experiment 2 was identical to Experiment 1. That is, participants were given a blue or green glove, allegedly based on their political orientation, and were asked to wear this glove throughout the rest of the experiment. They then did an automatic imitation task, followed by an IAT as manipulation check (Greenwald et al., 1998; Nosek et al., 2005). The median response to the political orientation question was “centre-left”, with responses ranging from “left” to “right”.

**Implicit Association Test.** The IAT consisted of five blocks (Figure 3). Depending on the block, participants had to do a target concept discrimination of blue and green, with two pictures for each color, or an attribute discrimination of pleasant and unpleasant, with two words for each dimension (Nosek et al., 2005). In the first block, the target concept discrimination was introduced. On every trial in this block, participants saw either a blue or a green hand in the middle of the screen. They were instructed to respond to the color of the hand by pressing the left arrow key if the glove was blue and the right arrow key if the glove was green. In the second block, the attribute dimension was introduced. On every trial in this block, participants saw either a pleasant (“liefde” or “vrede”, the Dutch words for “love” and “peace”) or an unpleasant word (“moord” or “haat”, the Dutch words for “murder” and “hatred”). They were instructed to respond to the attribute dimension of the word by pressing the left arrow key when the word was pleasant and the right arrow key when the word was unpleasant or vice versa (counterbalanced).

In the third block, the stimuli used in the previous two blocks were randomly intermixed. Thus, participants saw either a picture of a blue or green hand or a pleasant or unpleasant word. They were instructed to respond to the color of the hand and to the valence of the word. They did this by responding to the pictures and words using the same responses as in the previous two blocks. In the fourth block, the response assignments for the target concept discrimination were reversed. In this block, participants again saw either a picture of a blue hand or a picture of a green hand, and they were instructed to respond to the color of the hand. However, the buttons participants used to respond to the color were reversed with respect to the first block. Finally, in the fifth block, the attribute dimension and target-concept discrimination were again combined but now with the target concept discrimination mapping established in the fourth block.

Blocks 1, 2, and 4 all contained 64 practice and 64 experimental trials, whereas blocks 3 and 5 contained 64 practice trials and 192 experimental trials. Participants received accuracy feedback on practice trials but not on experimental trials. The third and fifth block were the blocks of interest. In these blocks, we expected participants to respond faster when pleasant words and in-group hands were matched to the same response (congruent) than when they were mapped to different responses (incongruent). Whether this was the case in block 3 or in block 5 was counterbalanced across participants within each group. Each trial started with a fixation cross for 200 ms, followed by the target until participants responded or until the maximum response time of 2000 ms had passed. After an inter trial interval of 400 ms, the next trial started.

**Automatic Imitation Task.** Instead of two hands making two different movements, participants now saw two hands of which either one hand made a movement or both hands made the same movement. Thus, in Experiment 2, either the in-group hand made a congruent or incongruent movement (in-group trials), the out-group hand made a congruent or incongruent movement (out-group trials), or both hands made the same congruent or incongruent movement (in+out-group trials). Everything else was identical to Experiment 1. The imitation task consisted of 4 blocks of 96 trials each. Trials were presented at random with 16 trials per condition per block.


**Figure 3.** Structure of the Implicit-Association Test (from left to right: Block 1 to Block 5).

## Data Analysis

**IAT.** There were no participants with a mean RT or ER exceeding the sample mean with > 3SD. The IAT data was analyzed by calculating a D1 score according to the guidelines laid out in Greenwald et al. (2003). This involves excluding trials in which no response was recorded before the 2000 ms response deadline (0.60%) and then dividing the difference in RTs between congruent and incongruent blocks by the standard deviation across all trials in those blocks. Importantly, the D1 score also includes error trials and is calculated using both the experimental and practice trials (Greenwald et al., 2003). To test whether participants established an association between the in-group hand and positive words and the out-group hand and negative words, we conducted a two-sided one sample *t* test comparing the D1 score to zero.

**Automatic Imitation Task.** The same exclusion criteria were applied as in Experiment 1. There were no participants with a mean RT or mean ER exceeding the sample mean with > 3SD. Trials were excluded from both the RT and ER analysis if no response was provided (1.41%) or if the RT was < 100 ms (0.29%) and from the RT but not the ER analysis if the response was incorrect (3.78%) or if the RT exceeded the participant's mean RT by more than 3 SD (2.11%). The resulting data was analyzed with a 3 (group: in-group, out-group, or in+out-group) x 2 (congruency: congruent or incongruent) repeated measures MANOVA.

**Results**

**IAT.** The IAT results revealed that the D1 ($M$ = 0.12, $SD$ = 0.29) score was significantly larger than zero, $t(38) = 2.63$, $p = .012$, $d_z = 0.42$, 95% CI = [0.09, 0.75], $BF_{10} = 3.46$, confirming the presence of an in-group bias.

**Automatic Imitation Task.** The RT results (Figure 4) revealed a main effect of congruency, $F(1, 38) = 71.19$, $p < .001$, $\eta^2_p = 0.65$, 95% CI = [0.48, 0.74], with faster RTs on congruent than on incongruent trials, but no main effect of group, $F(2, 37) = 1.46$, $p = .246$, $\eta^2_p = 0.07$, 95% CI = [0.00, 0.20]. Importantly, there was also a significant group x congruency interaction, $F(2, 37) = 3.54$, $p = .039$, $\eta^2_p = 0.16$, 95% CI = [0.01, 0.31]. To test whether there was an in-group bias, we followed up on this interaction with three analyses. First, we tested whether participants preferentially imitated the in-group hand by comparing the congruency effect on in-group trials with the congruency effect on out-group trials. However, there was no significant difference between both types of trials, $t(38) = 1.56$, $p = .126$, $d_z = 0.25$, 95% CI = [-0.07, 0.57], $BF_{10} = 0.53$. Second, we tested whether the out-group hand was imitated at all when both hands made a movement by comparing the congruency effects on both in-group trials and out-group trials with the congruency effect on in+out-group trials. This revealed that there was no significant difference between in-group trials and in+out-group trials, $t(38) = 1.05$, $p = .302$, $d_z = 0.17$, 95% CI = [-0.15, 0.48], $BF_{10} = 0.29$, but a smaller congruency effect on out-group trials than on in+out-group trials, $t(38) = 2.69$, $p = .011$, $d_z = 0.43$, 95% CI = [0.10, 0.76], $BF_{10} = 3.95$. Finally, similar to Experiment 1, we tested whether the group x congruency interaction depended on the size of the in-group bias in the IAT by adding the IAT D1 scores as a covariate to the ANOVA. Confirming the results of Experiment 1, this showed no evidence for a group x congruency x IAT interaction, $F(2, 36) = 0.51$, $p = .608$, $\eta^2_p = 0.03$, 95% CI = [0.00, 0.12].

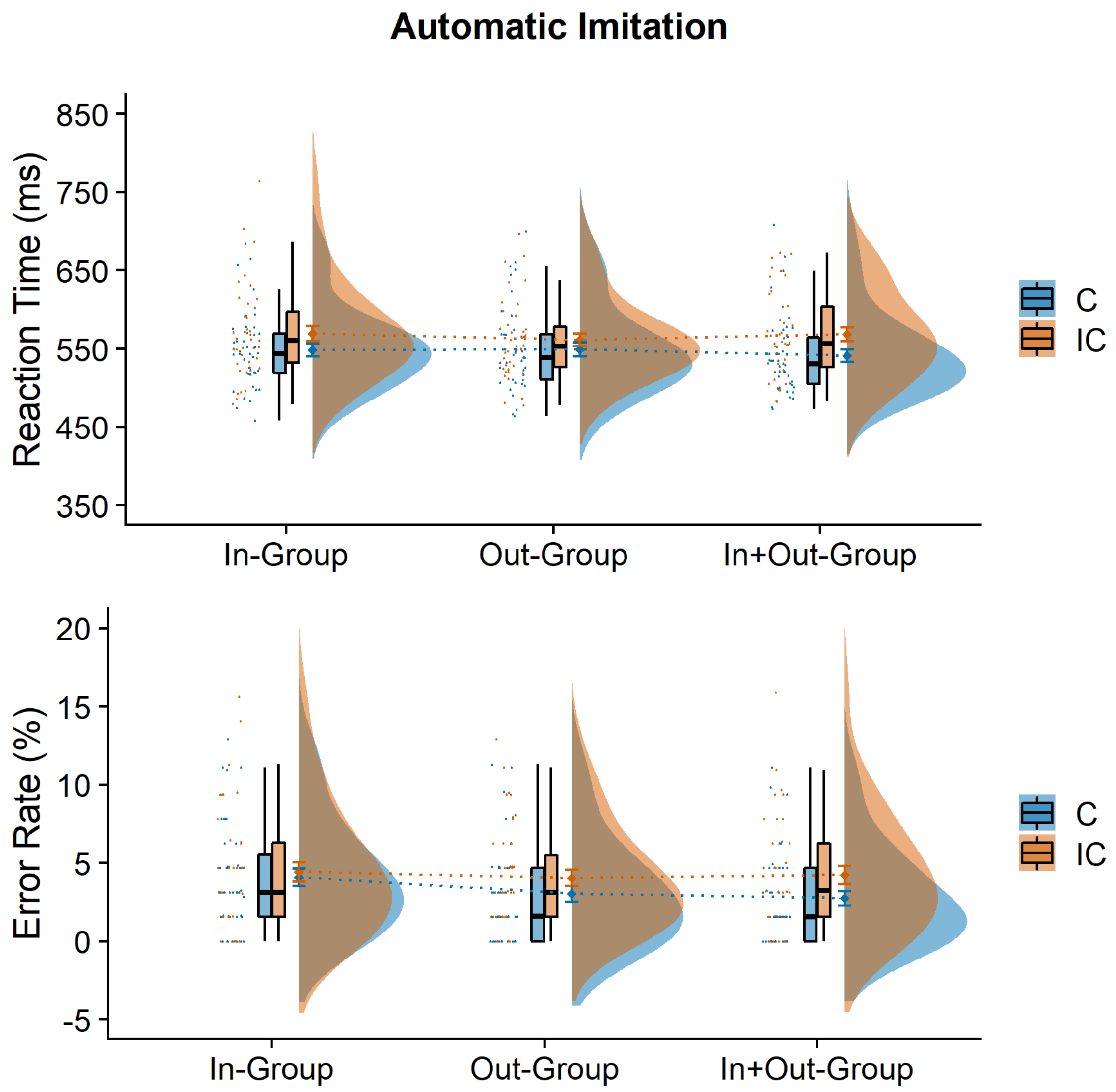



**Figure 4.** Raincloud plots (Allen et al., 2019) showing reaction times and error rates in the automatic imitation task of Experiment 2. Each plot shows the data individually for each participant and summarized using boxplots, means ± standard errors, and probability distributions.

The ER results (Figure 4) revealed a significant main effect of congruency, $F(1, 38) = 12.81$, $p < .001$, $\eta^2_p = 0.25$, 95% CI = [0.07, 0.42], with fewer errors on congruent than on incongruent trials, and a marginally significant main effect of group, $F(2, 37) = 3.21$, $p = .052$, $\eta^2_p = 0.15$, 95% CI = [0.00, 0.29], with more errors on in-group trials than on both out-group trials and on in+out-group trials. The interaction between group and congruency was not significant, $F(2, 37) = 1.02$, $p = .371$, $\eta^2_p = 0.05$, 95% CI = [0.00, 0.17].

## Discussion

Experiment 2 tested for an influence of social group on automatic imitation by investigating (a) whether in-group members are imitated more than out-group members and (b) whether out-group members are imitated at all when both the in- and out-group member make a movement. The results were mixed. On the one hand, there was no evidence that the in-group hand was imitated more than the out-group hand. On the other hand, the data also suggested that the out-group hand did not influence imitation when the in-group hand made a movement as well.

Therefore, to obtain a clearer answer to the question if social group modulates automatic imitation, we decided to replicate Experiment 2 with a larger sample. In addition, we also measured two potential moderators. First, in line with Experiment 1, we added a dot-probe task to investigate whether the in-group bias, if present, is modulated by differences in attention towards in- and out-group members. Second, we added a questionnaire measuring participants' motivation to affiliate with, respectively, the in- and out-group, in line with previous research showing that only people who have a high motivation to affiliate with the in-group show an in-group bias in a cross-contextual imitation paradigm (Genschow & Schindler, 2016).

# Experiment 3

## Participants

A new sample of 65 students (57 female, $M_{age} = 19.15$, $SD_{age} = 4.48$, $range_{age} = 17\text{-}54$) participated in the experiment in return for a course credit. This provided us with 80% power to detect even relatively small effect sizes ($d_z = 0.35$). All participants were right-handed, had normal or corrected-to-normal vision, and signed an informed consent before the start of the experiment.

## Tasks and Procedures

In Experiment 3, we again manipulated social group using the same political orientation question. The median response to this question was “centre-left”, with responses ranging from “extreme-left” to “right”. Participants then did the same automatic imitation task as in Experiment 2, followed by a dot-probe task and a questionnaire measuring their motivation to affiliate with the in-group. The automatic imitation task was identical to Experiment 2 and the dot-probe task to Experiment 1. The motivation to affiliate questionnaire was an adapted version of the six-item identification scale from Castano et al. (2002), based on the version used by Genschow and Schindler (2016). The six questions used here were: “To which degree do you feel like a part of this group?”; “How strongly do you identify yourself with the group sharing the same political attitude?”; “How strongly does this political attitude shape your daily life?”; “How strongly do you feel associated with the group sharing the same political attitude?”; “Would you buy an item (e.g., a t-shirt, a poster, a pen… ) of this group?”; “Would you indicate on a social media platform (e.g., Facebook) that you are part of this group?”. Participants indicated their responses to these six questions on a seven-point Likert scale, with 1 meaning “Not at all” and 7 meaning “Very much”.

## Data Analysis

**Automatic Imitation Task.** One participant with a mean ER of 85.76% was excluded. Next, the same exclusion criteria were applied as in Experiments 1-2. This resulted in the exclusion of one additional participant with a mean RT of 801 ms. As before, trials were excluded from both the RT and ER analysis if no response was provided (0.22%) or if the RT was < 100 ms (0.17%) and from the RT but not the ER analysis if the response was incorrect (3.64%) or if the RT exceeded the participant's mean RT by more than 3 SD (2.13%). The resulting data was analyzed in the same way as in Experiment 2, namely with a 3 (group: in-group, out-group, or in+out-group) x 2 (congruency: congruent or incongruent) repeated measures MANOVA.

**Dot-Probe Task.** The same exclusion criteria were applied as in Experiment 1. Four participants were excluded from the dot-probe analysis: three participants with mean ERs of 5.91%, 5.77%, and 6.07% and one participant with a mean RT of 731 ms. Trials were excluded from both the RT and ER analysis if no response was provided (0.18%) or if the RT was < 100 ms (0.04%) and from the RT but not the ER analysis if the response was incorrect (1.03%) or if the RT exceeded the participant's mean RT by more than 3 SD (1.76%). The resulting data was analyzed with a two-sided paired *t* test comparing RTs and ERs on in-group and out-group trials.

## Results

**Automatic Imitation Task.** The RT results (Figure 5) revealed a main effect of congruency, $F(1, 62) = 46.62$, $p < .001$, $\eta^2_p = 0.43$, 95% CI = [0.27, 0.54], with faster RTs on congruent than on incongruent trials, but no main effect of group, $F(2, 61) = 0.52$, $p = .596$, $\eta^2_p = 0.02$, 95% CI = [0.00, 0.08]. The group x congruency interaction was again significant, $F(2, 61) = 12.88$, $p < .001$, $\eta^2_p = 0.30$, 95% CI = [0.13, 0.42]. Follow-up tests comparing the congruency effect on in-group trials with the congruency effect on out-group trials and the congruency effects on both in-group and out-group trials with the congruency effect on in+out-group trials revealed no significant difference between in-group trials and out-group trials, $t(62) = -0.06$, $p = .953$, $d_z = 0.01$, 95% CI = [-0.24, 0.25], $BF_{10} = 0.14$, but a smaller congruency effect on both in-group trials, $t(62) = 4.53$, $p < .001$, $d_z = 0.57$, 95% CI = [0.30, 0.84], $BF_{10}$ = 699, and out-group trials, $t(62) = 4.34$, $p < .001$, $d_z = 0.55$, 95% CI = [0.28, 0.81], $BF_{10}$ = 375, than on in+out-group trials.

The ER results (Figure 5) revealed a significant main effect of congruency, $F(1, 62) = 35.14$, $p < .001$, $\eta^2_p = 0.36$, 95% CI = [0.20, 0.49], with fewer errors on congruent than on incongruent trials, and a significant main effect of group, $F(2, 61) = 7.00$, $p = .002$, $\eta^2_p = 0.19$, 95% CI = [0.05, 0.31], with more errors on in+out-group trials than on out-group trials and more errors on out-group trials than on in-group trials. The interaction between group and congruency was significant as well, $F(2, 61) = 4.10$, $p = .021$, $\eta^2_p = 0.12$, 95% CI = [0.01, 0.23]. Follow-up tests showed that the congruency effect did not differ between in-group and out-group trials, $t(62) = 1.28$, $p = .207$, $d_z = 0.16$, 95% CI = [-0.09, 0.41], $BF_{10} = 0.30$, nor between in-group and in+out-group trials, $t(62) = 1.44$, $p = .156$, $d_z = 0.18$, 95% CI = [-0.07, 0.43], $BF_{10} = 0.37$, but was larger on in+out-group trials than on out-group trials, $t(62) = 2.87$, $p = .006$, $d_z = 0.36$, 95% CI = [0.11, 0.62], $BF_{10} = 5.73$.

**Dot-Probe Task.** We first tested whether there was an attentional bias for the in-group (Figure 5), but found no evidence for such a bias in either RTs, $t(60) = 0.70$, $p = .488$, $d_z = 0.09$, 95% CI = [-0.16, 0.34], $BF_{10} = 0.18$, or ERs, $t(60) = -1.30$, $p = .199$, $d_z = -0.17$, 95% CI = [-0.42, 0.09], $BF_{10} = 0.31$. Second, we tested whether inter-individual differences in attention towards the in-group moderated the effect of social group on automatic imitation. To this end, we computed the RT attentional bias towards the in-group for each participant and added the resulting scores as a covariate to the automatic imitation RT analysis. This revealed a non-significant group x congruency x attentional bias interaction, $F(2, 56) = 2.82$, $p = .068$, $\eta^2_p = 0.09$, 95% CI = [0.00, 0.20].

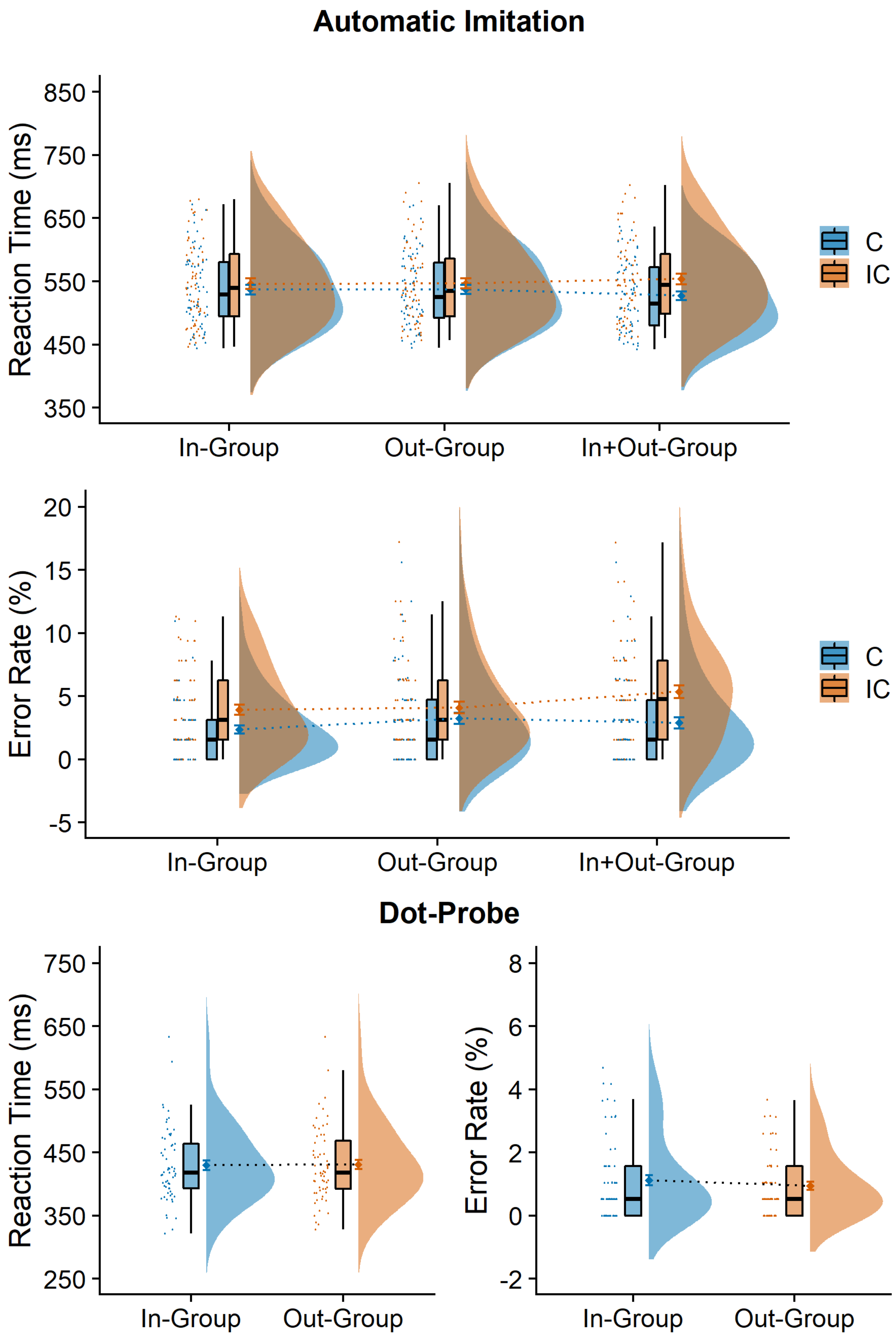

Automatic Imitation
Reaction Time (ms)
850
750
650
550
450
350
In-Group
Out-Group
In+Out-Group
C
IC
Error Rate (%)
20
15
10
5
0
-5
In-Group
Out-Group
In+Out-Group
C
IC
Dot-Probe
Reaction Time (ms)
750
650
550
450
350
250
In-Group
Out-Group
Error Rate (%)
8
6
4
2
0
-2
In-Group
Out-Group

**Figure 5.** Raincloud plots (Allen et al., 2019) showing reaction times and error rates in the automatic imitation and dot-probe tasks of Experiment 3. Each plot shows the data individually for each participant and summarized using boxplots, means ± standard errors, and probability distributions.

**Motivation to Affiliate.** To investigate whether motivation to affiliate with the in-group moderated the effect of social group on automatic imitation, we computed for each participant an average score from the questionnaire and added these scores as a covariate to the automatic imitation RT analysis. This revealed a non-significant group x congruency x affiliation motivation interaction, $F(2, 59) = 0.19$, $p = .830$, $\eta^2_p = 0.01$, 95% CI = [0.00, 0.04].

## Discussion

The aim of Experiment 3 was to replicate Experiment 2 with a larger sample and to test two potential moderators, namely attention towards the ingroup and motivation to affiliate. While Experiment 2 had mixed results, Experiment 3 provided clear evidence against an influence of social group on automatic imitation. More specifically, we found that automatic imitation was stronger on trials where not one hand but both hands made a movement (e.g., Cracco et al., 2015) but did not depend on whether the moving hand belonged to the in- or out-group. Furthermore, in contrast to earlier work (Genschow & Schindler, 2016), this was true regardless of participants' motivation to affiliate with the in-group. In the same vein, differences in attention towards the in-group did not modulate the effect of social group on automatic imitation either, although it should be noted that this effect approached significance. Nevertheless, considering that a similar analysis in Experiment 1 yielded no results and considering that we did not find any evidence for an attentional bias towards the in-group as such in either Experiment 1 or Experiment 3, this finding should be interpreted with care. Still, further testing whether attention towards the in- and out-group modulates social group effects in automatic imitation could be an interesting avenue for future research.

Finally, even though Experiment 3 was powered to detect relatively small effects, a criticism could still be that the true effect of social group on automatic imitation is even smaller and hence was unnoticed. Therefore, in a final analysis, we also combined the samples of Experiment 2 and Experiment 3 (N = 102). This provided us with 80% power to detect effect sizes of $d_z = 0.28$ at $\alpha = .05$. However, even with this increased statistical power, we did not find any difference between the RT congruency effects on in- and out-group trials, $t(101) = 1.06$, $p = 0.293$, $d_z = 0.11$, 95% CI = [-0.14, 0.35], $BF_{10} = 0.19$ (see Supplementary Material for the full analysis).

## General Discussion

A key prediction of motivational theories of automatic imitation is that we imitate in-group members more than out-group members (Wang & Hamilton, 2012). However, research manipulating group membership has obtained mixed results, with some studies finding no effect (Weller et al., 2020) and other studies finding both stronger (Genschow & Schindler, 2016; Gleibs et al., 2016) and weaker in-group imitation (Rauchbauer et al., 2015, 2016), often modulated by other variables. In the current study, we tested the hypothesis that clear evidence is lacking because previous research always showed the in- and out-group separately, instead of together. In other words, we tested the hypothesis that social group effects require a frame of reference (Mussweiler, 2003). According to this idea, out-group members are only imitated less when group membership is made salient by comparing out-group to in-group members (Brewer, 1991; Brewer & Weber, 1994).

To test this hypothesis, we measured automatic imitation in response to two simultaneously presented hands, one of which was an in-group hand and the other an out-group hand. In Experiment 1, the two hands always performed two different movements, so that on each trial one hand made a congruent movement and the other hand made an incongruent movement. In Experiments 2-3, only one movement was presented per trial, and this movement was executed either by the in-group hand, the out-group hand, or both hands. In contrast to our hypothesis, we could not find support for an in-group bias in any of the three experiments, and this was confirmed in a pooled analysis of Experiments 2 and 3 with a combined sample of N = 102. Thus, our results indicate that social group does not modulate automatic imitation, not even in a contrastive multi-agent paradigm. However, there are also at least three alternative explanations. First, it is possible that our social group manipulation was unsuccessful. Yet, this seems unlikely, considering that manipulation checks revealed a significant in-group bias in both explicit (i.e., the token allocation task) and implicit measures (i.e., the IAT) of in-group favoritism.

Second, it is possible that social group effects are only present under certain conditions – that is, they are moderated by affective, motivational, or other factors. However, we found no influence of attention towards the in-group, nor of motivation to affiliate, on imitative behavior, therefore ruling out these two variables as moderators. Interestingly, the latter finding goes against a recent study by Genschow and Schindler (2016), who found an in-group bias for people of the same nationality in a cross-contextual imitation paradigm only for participants who had a high motivation to affiliate with the in-group. This could mean that the findings of Genschow and Schindler (2016) were a false positive, but also that there is a stronger motivation to affiliate with people of the same nationality than with people sharing the same political orientation. In other words, more research with different paradigms (e.g., automatic imitation and cross-contextual imitation) and different moderators (e.g., affiliation motives and attention) will be needed before clear conclusions can be drawn on which factors, if any, modulate the influence of social group membership on imitation and for which measures of imitation this holds. In any case, we found little evidence for the hypothesis that social group effects in the current task depend on attention towards or motivation to affiliate with the in-group.

Finally, a third possibility is that our social group manipulation was too artificial to influence imitative behavior. That is, it could be that participants felt that they were part of the in-group but that this feeling was not strong enough to exert any influence over automatic imitation. In addition, not only the group manipulation, but also the task as such might have been too artificial. That is, perhaps social group only influences automatic imitation in more ecologically valid contexts. In line with this view, social psychological research in more natural settings has consistently found that in-group members are mimicked more than out-group members (Bourgeois & Hess, 2008; Chen & Chartrand, 2003; Lakin et al., 2008; Mondillon et al., 2007; Yabar et al., 2006). For example, in one of these studies, Lakin et al. (2008) measured imitation while participants interacted with an in- or out-group confederate who repeatedly performed a natural movement, such as shaking the foot. In such studies, both the setting and the imitated movement are less artificial than in tasks used in cognitive psychological research, where participants see isolated body parts performing movements on a computer screen. Based on this research, an interesting hypothesis is that social group effects only emerge in natural contexts. Importantly, however, assignment to the in- or out-group is not necessarily less artificial in social psychological experiments. For example, Yabar and colleagues (2006) recruited non-Christian participants and created a Christian out-group by letting a confederate wear a large crucifix around their neck and a bracelet that said “GOT GOD”. Similarly, Bourgeois and Hess (2008) assigned groups based on whether or not participants liked basketball. This, together with the fact that our manipulation check was positive, might indicate that the absence of an in-group bias in our studies, if related to ecological validity, was presumably caused by the artificial context and/or movement rather than by the artificial nature of the manipulation.

However, an important caveat is that automatic imitation and motor mimicry do not correlate (Genschow et al., 2017) and may therefore measure (partially) different processes. In addition, it should also be noted that much of the social psychological research on this topic has used relatively small samples and, therefore, requires replication before strong conclusions can be drawn regarding ecological validity. Thus, based on our results, it will be important in future research to directly to test the degree to which ecological validity is a condition for social group biases and whether such biases depend on other moderators not tested here such as cooperation vs. competition (Gleibs et al., 2016) or emotional valence (Rauchbauer et al., 2015, 2016).

In conclusion, we find no evidence for the hypothesis that social group influences automatic imitation in a multi-agent contrastive paradigm. While further research is needed to stipulate whether such effects are limited to specific conditions or simply do not exist, these findings might have important implications for motivational theories of automatic imitation (Wang & Hamilton, 2012).

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