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EXAMINING THE IMPACT OF CONTROL CONDITION DESIGN IN MIMICRY–LIKING LINK RESEARCH: HOW MOTOR BEHAVIOR MAY IMPACT LIKING

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Mimicry is an automatic imitation of an interacting partner's behaviors. The most frequently researched consequence of being mimicked is liking. Yet there is little research on whether specific design of control conditions (i.e., variable behavior of the confederate across conditions) may affect study results. In this study, we compared the classical mimicry group with four control conditions: (i–ii) a confederate sits still or makes random movements (common in mimicry research), (iii) confederates receive no instructions regarding their nonverbal behavior (rarely observed in mimicry studies), and a condition that we created, in which (iv) a confederate makes atypical motor movements. Participants (N = 538) were interviewed by confederates, while the confederates' behavior varied across conditions during the interviews. They mimicked the participants' nonverbal behaviors (mimicry condition), sat still (no-movement condition), made random nonverbal movements unrelated to the participants (responsiveness condition), made repetitive body and object movements (repetitive behavior condition), or participated in the interview without any further instructions (double-blind condition). The confederate's behavior influenced liking: $\chi^2(4) = 40.7$, $p < 0.001$, $\varepsilon^2 = 0.07$. Participants liked the confederates more when the latter mimicked them than when they sat still ($p < 0.001$) or made repetitive movements ($p = 0.008$), but not when the confederates made random movements, and when they only engaged in the conversation ($p > 0.5$). There

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were also differences between the no-movements condition (i) and the responsiveness condition ($p = 0.003$), (ii) and the double-blind condition ($p < 0.001$). Because the two classical control conditions are treated interchangeably in mimicry studies, more attention should be paid to the methodological aspects of mimicry research. Additionally, a mini-metaanalysis was conducted.

Keywords: mimicry; interpersonal liking; experimental conditions; methodology; systematic review; metaanalysis

This article aims to draw attention to the methodological aspects of mimicry research. In most studies, researchers utilized between-condition analysis, with mimicry and one single control condition, when verifying the impact of mimicry on interpersonal outcomes such as liking (see Table 1). There is no consensus regarding the optimal control condition (Kulesza et al., 2023), although the key differentiator is the specific confederates' body movement factor. Some researchers use a control condition with the confederate not making any motor movements (Chartrand & Bargh, 1999, Study 2), while others introduce the confederate's random movements as a control condition (e.g., Kouzakova et al., 2010a, 2010b). There is also a control condition with the confederates' body movements opposite of what the participant did (e.g., Hasler et al., 2014), and a condition with the least interference in the confederate's natural movements, where they receive no instruction regarding their body postures or gestures (Dalton et al., 2010). We argued that if the participants dislike certain confederates' body control behaviors while reacting neutrally or favorably to others, the results of mimicry on liking would be misleading. The methodological research practices can prevent difficulties in replication and may eliminate inflation of effects.

In this study, we examined whether various designs of control conditions—the confederate's specific body behavior—may have an effect on research outcomes (i.e., liking the confederates). The confederate's behaviors were introduced, followed by the participants' rating of how much they liked the confederates. We added to one single control condition others to test whether various non-mimicking (control) behaviors of the confederate could lead to different (or similar) results when compared to actual mimicry. The mimicry group (where the confederate mimics the participant's non-verbal movements, see Chartrand & Bargh, 1999, Study 2) was compared to the two classical control groups used in mimicry research (where the confederate's body is still; see Chartrand & Bargh, 1999, Study 2; and where the confederate makes random nonverbal movements; see Kouzakova et al., 2010a, 2010b). The mimicry condition was also compared to a third group, rarely observed in mimicry studies, where the confederate receives no instructions on how to behave non-

verbally (Dalton et al., 2010)—and to a group unlikely to be used in such research, which we created, where confederates exhibited atypical nonverbal and object movements (repetition and immutability; Kapp et al., 2019). The rationale underlying the importance of this topic is that most people efficiently perceive others' attitudes and intentions (*social meaning*; Anderson, 1981) by observing their motor movements (such as posture, gestures, not just mimicry behaviors). On that basis, an impression about a person may be formed (Fiske, 1993). We limited our review to behavioral mimicry (of postures, body movements, and facial expressions[1]) but did not include literature on emotional and verbal mimicry in studies on liking. Additionally, a mini-metaanalysis of reviewed studies was carried out.

Mimicry

Mimicry is often defined as an automatic imitation of various behaviors of another person (posture, gestures, facial expressions, or speech) (Chartrand & Lakin, 2013). Previous studies have used naturalistic situations in which human confederates (mimickers) are trained to mimic participants' (mimickees') movements during social tasks (such as describing photos see, e.g., Chartrand & Bargh, 1999, or interviewing, e.g., Kulesza et al., 2016). Participants usually receive limited information about the confederate; for example they may be told only the confederate's name.

Mimicry can promote social bonds, it is like "social glue" (Lakin et al., 2003; Wang & Hamilton, 2012). One of the most researched consequences of mimicry is liking (Chartrand & Bargh, 1999; Trzmielewska & Brzóska, 2022). The studies that we reviewed tested the extent to which mimicry affects the liking of the mimicker by the mimickee (e.g., Chartrand & Bargh, 1999; Study 2, but not the opposite, when the mimicker likes the mimickee), even when the two people are strangers or new acquaintances who are not seeking to establish a relationship (i.e., there is no overarching interpersonal interest of the interactants in each other). The link between mimicry and liking sometimes disappears and the mechanisms behind this inconsistency are unknown (Drury & van Swol, 2005).

[1] There is, however, inconsistency if facial mimicry is a part of behavior mimicry (Hess & Fischer, 2013).

Control Conditions in Mimicry-Liking Link Research

In mimicry-liking link research, there are typically two conditions: mimicry and one single control (also called "no-mimicry" groups; e.g., Bretter et al., 2023) in between subject design. In the *mimicry condition*, the confederates are often instructed to mimic the participants' nonverbal behaviors (the posture, gestures, and mannerisms; Chartrand & Bargh, 1999, Study 2) that people do automatically in social interactions (such as foot shaking, face or hair touching, leg crossing, and posture changing; Vinciarelli et al., 2009) with a delay of about two seconds (e.g., Kouzakova et al., 2010a). There are two commonly used control conditions: the first that we called in this paper "the no-movements condition" (cf. Chartrand & Bargh, 1999, Study 2), and the second that we called here "responsiveness condition" (e.g., Kouzakova et al., 2010a, 2010b).

The no-movements condition was presented in a classic work on the mimicry–liking link (Chartrand & Bargh, 1999, Study 2). In this condition, confederates sit in a relaxed, upright position, placing their palms flat on the desk and both flat feet on the floor (they sit relatively still). The confederates in both groups (mimicry and control) are instructed to remain physically relaxed.[2] Based on the study procedure by Chartrand and Bargh (1999, Study 2), another method was created (Kulesza et al., 2015, Study 1): a computer-based method that simulates real-life interactions with a person who is mimicking participants' facial expressions (or not). The interaction consisted of a prerecorded scenario in which a woman (confederate) copied the participant's facial expression (mimicry condition) or maintained a neutral expression—she made no facial movements (control condition).

In the responsiveness condition (e.g., Kouzakova et al., 2010a, 2010b), confederates are behaviorally responsive. The confederates are instructed to perform random, natural nonverbal movements that people usually exhibit in social interactions (postures and gestures; Kouzakova et al., 2010a, Studies 1 and 2; Kouzakova et al., 2010b), and postures, gestures and facial expressions (Stel & Harinck, 2011; Stel et al., 2011) that did not mimic the participants' movements.

There are also two other control conditions (in studies where liking is not a dependent variable, that is in studies going beyond researching only the mimicry–liking link): (1) the counter-mimicry condition (Hasler et al., 2014) and (2) the double-blind condition (Dalton et al., 2010). The counter-mimicry

[2] In this article, the term "physically relaxed" was not operationalized.

condition involves reverse pattern behaviors. For example, when the participant leans forward, the confederate leans backwards (Hasler et al., 2014). Under the double-blind condition, the confederate receives no instructions regarding their body behavior during the interaction with participants, and is engaged only a conversation (Dalton et al., 2010).

Mimicry-Liking Research Link: The Outcomes

In a classical experiment, confederates who mimicked participants (the mimicry group) were liked more than those who did not (i.e., under the no-movements condition; Chartrand & Bargh, 1999, Study 2). In other studies this experiment design was used, too (e.g., Kot & Kulesza, 2016; Kulesza, 2016; Kulesza et al., 2016; Muniak et al., 2021; Trzmielewska & Brzóska, 2022). In some other studies, a similar but computer-based method was implemented (Bocian et al., 2018, Study 4; Kulesza et al., 2015, Study 1). In all the studies described above, higher liking was observed of confederates who did mimic).

Other studies used the responsiveness condition (Kouzakova et al., 2010a, 2010b; Stel & Harinck, 2011; Stel et al., 2011). Generally, mimicry situations generated more liking of confederates by participants than in the absence of mimicry. However, some studies using the same study design did not replicate those findings (Drury & van Swol, 2005; van Swol, 2003).

A recent study tested the factors related to the design of control conditions in the mimicry–liking link (Kulesza et al., 2023). This study used a computer-based method (Kulesza et al., 2015, Study 1) and combined two control conditions with one experimental (mimicry). The first control group was similar to the classical no-movements condition (called "control condition" in the original papier by Chartrand & Bargh, 1999, Study 2), and the second was similar to the responsiveness condition (Kouzakova et al., 2010a, 2010b) with a third mimicry condition (Chartrand & Bargh, 1999, Study 2). The liking of the confederate was stronger when facial mimicry was used compared to the no-movements condition, but not when facial mimicry with random facial movements was applied (the responsiveness condition).

The Aim of the Study

We expand on a recent mimicry study that tested the effect of control condition design (the confederate's various behaviors in control conditions; Kulesza et al., 2023). In this research, there was no difference between the two common control groups (i.e., between the no-movement condition and the responsiveness condition; for the computer-based method, see Kulesza et al., 2015, Study 1) with regard to the liking of the confederate. The confederate was liked much more only when her mimicking behavior was compared with her neutral expression (neutral face), but not when she made random facial movements. However, the confederate made motor movements in both control groups (i.e., they write to create the illusion of a real-life interaction). In the original procedure by Chartrand and Bargh (1999, Study 2), in the control condition (no movements), the confederate makes no motor movements (no hands and legs activity). In our experiment, we changed the study design from a computer-based method to stationary (face-to-face interaction) and in real-time (not pre-recorded). We also implemented mimicry of postures and gestures, instead of just facial expressions.

We also added two more control conditions: (1) a double-blind condition and (2) a repetitive behavior condition, where the confederate made atypical movements (Kapp et al., 2019) to test whether various non-mimicking behaviors could lead to different (or similar results) when compared to actual mimicry (and when across control-conditions). Evidence shows that when confederates are physically responsive in a control group, the mimicry–liking link fails to replicate (Drury & van Swol, 2005; Kulesza et al., 2023; van Swol, 2003). There appear to be no such null effects when the confederate makes no hand and leg movements in the control group. We summarized that the control condition that uses random but natural movements of the confederate (responsiveness condition) is not comparable (i.e., not the same baseline) to a situation with a control condition where the confederate is relatively still (the no-movements condition). Physically responsive people are usually more liked than unresponsive people (Mottet et al., 2004). Furthermore, motor immobility over a period of time may be comparable to socially atypical behaviors characterized by repetition and immutability, prevalent among neuroatypical people with attention deficit hyperactivity disorder (ADHD), autism spectrum disorder (Charlton et al., 2021; Kapp et al., 2019), and schizophrenia (catatonic hypokinetic symptoms such as stupor, rigidity, immobility; Hirjak et al., 2018). People may perceive individuals showing these behaviors as disturbing

or threatening (Faso et al., 2015; Kapp et al., 2019), which may engender negative attitudes toward them including withdrawal, rejection, or aggression (Arora, 2012; Cook & Rapp, 2018; Humphrey & Hebron, 2014). Therefore, in our study we also introduced a control group with the confederate's atypical motor (and object) movements. Generally, we wanted to verify whether different various control confederate behaviors could influence mimicry study outcomes. A comparison of different behaviors of the confederates—those less typical and those more natural in social interactions—can indicate potential differences (or a lack thereof) in the level of liking of people manifesting given behaviors (allowing identification signals that interfere with typical rapport-building). In such a situation, it is easier to move towards standardization of the control group in search of the optimal one in mimicry–liking link field (i.e., a neutral control condition). We predicted that the liking of confederates would be significantly higher in the mimicry group compared to the remaining control groups, also classified in this study as motorically atypical (no movements condition, repetitive behavior condition), excluding the double-blind condition. We treated the double-blind condition as the most naturalistic control condition (a situation that does not eliminate natural mimicry presence). The remaining comparisons between the control conditions were treated as exploratory. For a summary of reviewed studies in this article, see Table 1; Figures 1–2 present the results of the mini meta-analysis[3] (k = 18) from these studies.

Mini Meta-Analysis

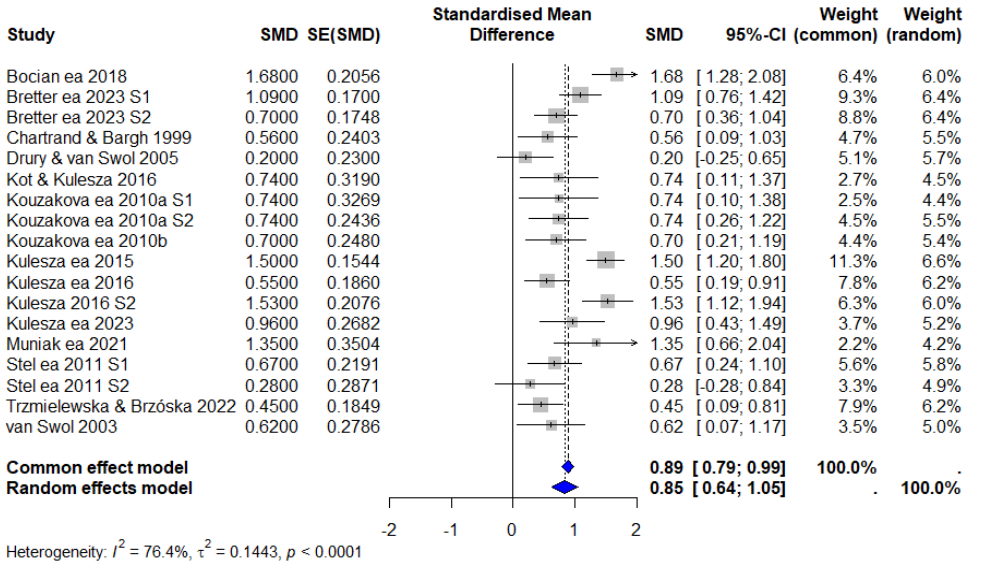
To assess the consistency of results across the reviewed studies, a meta-analysis was conducted. The conducted meta-analysis (k = 18) revealed a significant effect of moderate-to-high magnitude (d = 0.85, SE = 0.11, 95% CI [0.64, 1.05]), z = 8.00, p < .0001. A random-effects model was applied due

[3] The studies presented in Table 1 were included as they examined the effects of intergroup differences between the control group and the experimental group (mimicry condition). Various statistical analyses were employed across these studies, but only between-group effect sizes were extracted; depending on the study, effect sizes were reported as eta squared (η^2) or Cohen's d. Where necessary, these measures were converted to a standardized d index to ensure consistency. While not all studies explicitly reported statistical significance or effect sizes, those that provided means, standard deviations, and sample sizes made an effect size estimation possible. These values represent the best possible approximation based on the available data. All reported effect sizes were carefully verified and, if necessary, corrected before inclusion. Table 1 presents either the originally reported effect sizes when deemed suitable for meta-analysis or recalculated values based on the data provided in the respective publications.

to high heterogeneity ($I^2 = 74.60\%$, $H^2 = 3.94$). The Q test indicated a significant variability across studies, $Q(17) = 71.99$, $p < .0001$, suggesting the presence of potential moderators based on differences in research procedures (see Figure 1). The estimated between-study variance was $\tau^2 = 0.14$ ($SE = 0.07$), indicating variability in effect sizes depending on the study context. A regression test for funnel plot asymmetry was conducted to assess potential publication bias. The test did not reveal a significant asymmetry, $z = -0.78$, $p = .435$, suggesting no strong evidence of small-study effects. The estimated effect size at the limit (as standard error approaches zero) was $b = 1.20$, 95% CI (0.28, 2.12), indicating that the true effect may be slightly larger in studies with lower standard errors (see Figure 2). However, given the nonsignificant asymmetry test, the observed effect size distribution is unlikely to be substantially influenced by publication bias.

Figure 1

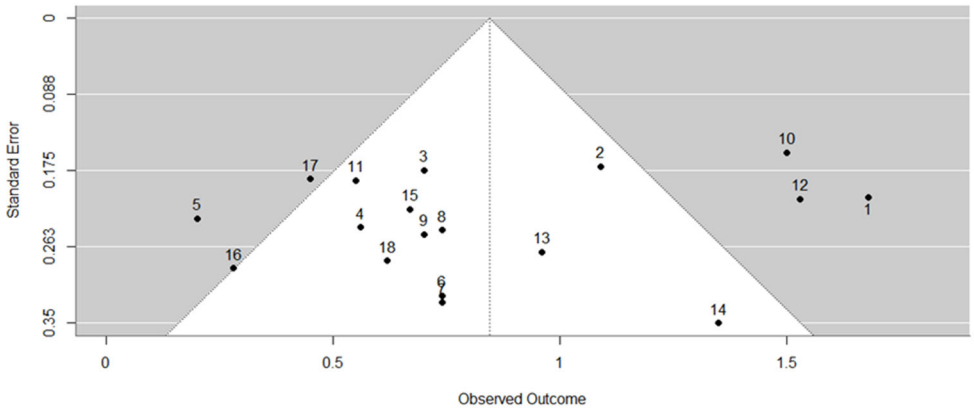
Forest Plot Displaying Individual Study Effect Sizes Along With 95% Confidence Intervals



Note. Each horizontal line represents the confidence interval for a single study, with the center marker indicating the estimated effect size (Cohen's *d)*. Longer confidence intervals reflect greater uncertainty, while shorter intervals indicate more precise estimates. The vertical reference line represents the null effect ($d = 0$), and the diamond at the bottom denotes the overall pooled effect size with its confidence interval.

Figure 2

*Funnel Plot Showing the Relationship Between Effect Sizes and Their Standard Errors (*k *= 18)*



Note. Each dot represents an individual study. The larger studies appear toward the top and smaller studies toward the bottom. The numbers corresponding to specific studies: 1 = Bocian et al. (2018), 2 = Bretter et al. (2023, S1), 3 = Bretter et al. (2023 S2), 4 = Chartrand & Bargh (1999), 5 = Drury & van Swol (2005), 6 = Kot & Kulesza (2016), 7 = Kouzakova et al. (2010a, S1), 8 = Kouzakova et al. (2010a, S2), 9) = Kouzakova et al. (2010b), 10 = Kulesza et al. (2015), 11 = Kulesza et al. (2016), 12 = Kulesza (2016, S2), 13 = Kulesza et al. (2023), 14 = Muniak et al. (2021), 15 = Stel et al. (2011, S1), 16 = Stel et al. (2011, S2), 17 = Trzmielewska & Brzóska (2022), 18 = van Swol (2003).

Table 1

Comparison of Studies in the Mimicry-Liking Link

Study	Study design			Confederate	Sample	Results	
	Recording	Baseline liking	Conditions	Training no. of confederates	Participants	*p*	Effect size (ES) *d* / η^2
Bocian et al. (2018, Study 4)	Yes, but mimicry presence was not counted	No	Mimicry condition (*n* = NM) & control condition 1 [a], computer-based method (*n* = NM)	Video-recorded actress	Students (*N* = 128)	< .001	1.68 [c] / .41
Bretter et al. (2023)	Yes, but mimicry presence was not counted	No	Study 1: Mimicry condition (*n* = 80) & control condition 1 (*n* = 79) Study 2: Mimicry condition 1 (*n* = 72) & control condition (*n* = 72)	NM Confederates: NM	Study 1 (*N* = 159) Study 2 (*N* = 139)	Study 1: *p* < .001 Study 2: *p* < .001	Study 1: 1.09 /.23 [c] Study 2: 0.70 / .11 [c]
Chartrand & Bargh (1999, Study 2)	Yes, but mimicry presence was not counted	No	Mimicry condition (*n* = 37) & control condition 1 (*n* = 35)	Yes (duration undetermined) Confederates: 4 females	Psychology students (*N* = 72)	.020	0.56 / .07
Drury & van Swol (2005)	Yes, but mimicry presence was not counted	No	Mimicry condition (*n* = 38) & control condition 2 [b] (*n* = 38)	Yes (0.5 hour) Confederates: NM	Undergraduate students (*N* = 76)	.900 (ns)	0.20 / .01 [c]
Kot & Kulesza (2016)	NM	No	Mimicry condition (*n* = NM) & control condition 1 (*n* = NM)	NM Confederates: NM	Students (*N* = 42)	.022	0.74 [c] / .12

Study	Study design			Confederate	Sample	Results	
	Recording	Baseline liking	Conditions	Training no. of confederates	Participants	*p*	Effect size (ES) *d* / η^2
Kouzakova et al. (2010a)	NM	No	Study 1: Mimicry condition (*n* = NM) & control condition 2 (*n* = NM) Study 2: Mimicry condition (*n* = NM) & control condition 2 (*n* = NM)	Yes (duration undetermined). Study 1 & Study 2: (Confederates: 1 male)	Study 1 (*N* = 69), Undergraduate students Study 2 (*N* = 40) Undergraduate students	Study 1: .028 Study 2: .028	Study 1: 0.70 / .11 [c] Study 2: 0.74 / .12 [c]
Kouzakova et al. (2010b)	NM	No	Mimicry condition (*n* = 39) & control condition 2 (*n* = 33)	Yes, same as in Kouzakova et al., (2010a) Confede-rates: 2 females	Students (*N* = 72)	.004	0.74 / .12 [c]
Kulesza (2016, Study 2)	NM	No	Mimicry condition (*n* = NM) & control condition 1 (*n* = NM)	NM Confederates: 1 female	Students (*N* = 120)	< .001	1.53 / .37
Kulesza et al. (2015, Study 1)	Yes, but degree to which facial mimicry matches was not counted.	No	Mimicry condition (*n* = NM), & control condition 1, computer-based method (*n* = NM)	Video-recorded actress	Students (*N* = 215)	.001	1.50 / .36
Kulesza et al. (2016)	NM	No	Mimicry condition (*n* = NM) & control condition 1 (*n* = NM)	NM Confederates: 1 female	Students (*N* = 120)	.001	0.55 / .07 [c]
Kulesza et al. (2023)	Yes, but mimicry presence not counted	No	Mimicry condition (*n* = 21) & control condition 1, computer-based method (*n* = 21), and control condition 2, computer-based method (*n* = 20)	Video-recorded actress	Students (*N* = 62)	.008	0.96 [c] / .19

Study	Study design			Confederate	Sample	Results	
	Recording	Baseline liking	Conditions	Training no. of confederates	Participants	*p*	Effect size (ES) *d* / η^2
Muniak et al. (2021)	NM	No	Mimicry condition (*n* = 20) & control condition 1 (*n* = 20)	NM Confederates: NM	Students (*N* = 40)	< .001	1.35 [c] / .31
Stel & Harinck (2011)	NM	No	Mimicry condition (*n* = 43) & control condition 2 (*n* = 43)	Yes (duration undetermined) Confederates: NM	Students (*N* = 86)	NM	NM
Stel et al. (2011)	NM	No	Study 1 and Study 2: Mimicry condition (*n* = NM) & control condition 2 (*n* = NM)	Yes (duration undetermined) Confederates: NM	Study 1 (*N* = 88), Students Study 2 (*N* = 49), Pedestrians	Study 1: .010 Study 2: .129 (NM)	Study 1: 0.67 / .10 [c] Study 2: 0.28 / .02 [c]
Trzmielewska & Brzóska (2022)	NM	No	Mimicry condition (*n* = 57) & control condition 1 (*n* = 58)	Yes (duration undetermined) Confederates: NM	Students (*n* = 40) employees (*n* = 80), *N* = 120	.041	0.45 / .05 [d]
van Swol (2003, Study 1)	Yes, but mimicry presence was not counted	No	Mimicry condition (*n* = NM) & control condition 2 (*n* = NM)	Yes (1 hour) Confederates: 2 males and 4 females	Undergraduate, graduate students (*N* = 54)	.640 (ns)	0.62 [c] / .09

Note. NM = not mentioned, ns = not significant. [a] Reflects the no-movements condition. [b] Reflects the responsiveness condition. [c] ES value reported in the original article. [d] In the original article the rank biserial coefficient was used.

METHOD

The study received ethical approval involving human participants from the SWPS University's ethics committee (ref. no. 2024-269).

Participants

A sensitivity analysis conducted using G*Power (ver. 3.1.9, by Faul et al., 2009) indicated that, given the total sample size ($N = 538$), $\alpha = 0.05$, and desired power level of 0.95, the minimal detectable effect size for a one-way ANOVA with 5 groups was $f = 0.19$ (or, for the *Kruskal-Wallis* test, $\varepsilon^2 = 0.03$). This suggests that the study was sufficiently powered to detect even small-to-moderate effects.

The participants included 555 Polish students and undergraduates. We excluded data from 17 participants who correctly guessed the purpose of the study. The final sample covered 538 participants aged between 18 and 72 years ($M = 19.01$, $SD = 11.60$), 55.9% being female ($M = 25.98$, $SD = 8.87$), 43.1% being male ($M = 24.83$, $SD = 6.70$), and 0.9% not identifying with either gender ($M = 21.60$, $SD = 3.84$). For details of all participants see Table 2.

Table 2

Sociodemographic Characteristics of Participants

Baseline characteristics	Mimicry ($n = 235$)		No movements ($n = 76$)		Responsiveness ($n = 81$)		Repetitive behavior ($n = 72$)		Double-blind ($n = 74$)		Collectively ($n = 538$)	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Gender												
Female	138	58.7	40	52.6	31	38.3	46	63.9	46	62.2	301	55.9
Male	96	40,9	36	47.4	50	61.7	25	34.7	25	33.8	232	43.1
Other	1	0.4	–	–	–	–	1	1.4	3	4.1	5	0.9
Field of study												
Psychology	31	13.2	13	17.1	17	21.0	10	13.9	5	6.8	76	14.1
Other	204	86.8	63	82.9	64	79.0	62	86.1	69	93.2	462	85.9

Psychology students (confederates) collected data mostly for a university course (An Empirical Research Project). One experimental condition (mimicry) and three control conditions (no-movements, responsiveness, and repet-

itive behavior) were created. Every student from the university course acted as a confederate. The participants were recruited by advertising online (on platforms like Facebook and Instagram). Each confederate examined ten participants, five under the mimicry condition, and another five participants under one of three control conditions to which they were assigned. The confederates were split into groups, where the experimental (mimicry) condition was combined with one from the three randomly selected control conditions.[4] The participants were randomly assigned to the mimicry condition (n = 235) and each of three control conditions: the no-movements condition (n = 76), the responsiveness condition (n = 81), and the repetitive behavior condition (n = 72). The data measurement for the double-blind condition (n = 74) took place outside the university course and was collected and conducted by the two psychology students (confederates) on research internships. Importantly, the strategy for recruiting participants for the double-blind condition was the same as in all other conditions. The external conditions of the study (room characteristics, seating arrangements, completed surveys, etc.) were also the same (see the Procedure section).

Measures

Liking of Confederate

To investigate the level of post-interview liking of the confederates, the participants indicated the veracity (1 = *definitely not* to 7 = *definitely yes*) of seven items (e.g., "This person triggers a positive feeling in me"). The results were averaged to create a composite measure of liking (Cronbach's $\alpha = 0.94$). This method has been used previously on Polish-speaking samples (e.g., Kulesza et al., 2023, $\alpha = 0.86$).

Demographics

At the end of the study, the participants reported their gender and age.

[4] The criteria within the university course was that students were divided into groups, within which research assumptions were to be differentiated, and they were to present their results in these separated groups. Given this study's hypotheses, a mimicry condition was always included for each group to be able to compare the mimicry condition with a particular (a single standardized) control condition. This was why group sample sizes were uneven (see the Results section).

Procedure

Dyadic interaction

In all conditions, the confederates were instructed to sit in a neutral and relaxed posture, maintain a neutral (1) facial expression and (2) tone of voice, the same length of the conversation and the same level of word complexity, as well as the frequency of nodding. We tried to reduce the number of variables (facial expressions, tone of voice, etc.) that could influence the interaction quality between a participant and the confederate, regardless of those variables that were intentionally introduced. All confederates had to familiarize themselves with the study protocol and instructions regarding their behavior in a given condition (see the research materials available on the OSF portal). The instructions were standardized for each group. The confederates underwent a half-hour training session with the head experimenter, in which they practiced mirroring behavior, and the other behaviors in regards to the control condition they had been assigned. Before conducting the research the confederates underwent a half-hour up to one-hour online consultations with the head experimenter, and in case of any doubts they could meet for an additional meeting.

The confederate's behavior in the mimicry condition and the three control conditions (no-movements, responsiveness, and the double-blind condition) was as described here in section "Control Conditions in Mimicry-Liking Link Research". In the mimicry condition, the confederates did not mimic every behavior of the participants because a strong temporal contiguity between movements might bring the mimicry into a participant's conscious awareness and give an impression of unnaturalness (Kavanagh et al., 2011). Accordingly, the confederates only mimicked every second behavior. Importantly, in three control conditions confederates were told to refrain from counter-mimicry (reverse pattern behaviors). In the repetitive behavior condition, the confederates made repetitive (1) body movements (finger snapping), and (2) object movements (rotating a pen;[5] see, e.g., Kapp et al., 2019; Nwaordu & Charlton, 2024) alternatively for about 30% of the total duration of the conversation (approximately two minutes; Jacques et al., 2018). For the remaining time, the confederates were instructed to show natural nonverbal behavior, but refrain from mimicry and counter-mimicry. If a participant verbally referred to the

[5] Both repetitive behaviors were visible on video recordings (see our research materials) which the experimenters had to familiarize before conducting the study.

confederate's repetitive movements, the confederate was instructed to say that such behavior was natural.

Study Procedure

Each participant was examined individually with a confederate in a university classroom or other closed, quiet and well-lit room. The participants were given full information relevant to their participation in the study, signed informed consent (on a standard one-page information consent form) and were asked to describe prior or current academic experience (see materials, for details see also Kulesza et al., 2016). The cover story provided justification for administering a post-interview likeability questionnaire.

The interview room was set up with two chairs facing each other. The participants had ample room to move regardless of the confederate's movements. Each interview lasted seven minutes and consisted of eight questions presented in the same order to which the participants could provide a brief response (see the materials on the OSF). The confederates were specifically requested to use different motor behaviors across the study conditions. For example, in mimicry condition, the confederates performed movements similar to the participants' nonverbal movements and delayed those movements by two seconds. Only in double-blind condition were the confederates asked to conduct a conversation without any instructions regarding their nonverbal behavior. After the interview, the participants completed a self-report on the likeability of the confederate, answered demographic questions, and were asked what they thought the study was about. Lastly, the participants were thanked and debriefed (they did not receive compensation for participating).

Data Analysis

Statistical analyses were conducted using jamovi 2.4 (2023; R Core Team, 2022).

RESULTS

Analyses for descriptive statistics were performed (see Table 3).

Table 3

Descriptive Statistics by Conditions Along With Shapiro–Wilk Test Concerning Liking of the Confederate

	R	*Mdn*	*Q1–Q3*	*Mrang*	Skew.	Kurt.	*W*	*p*
Mimicry	2.86–7.00	5.86	5.14–6.71	305.78	–0.52	–0.50	0.93	0.001
No movements	1.57–7.00	4.79	3.46–5.96	181.87	–0.25	–0.90	0.96	0.01
Responsiveness	3.14–7.00	5.71	5.00–6.29	265.48	–0.61	–0.24	0.95	0.003
Repetitive behavior	2.57–7.00	5.43	4.61–6.25	236.93	–0.38	–0.47	0.97	0.046
Double-blind	3.71–7.00	5.71	5.14–6.21	280.37	–0.48	–0.19	0.96	0.01

A Kruskal–Wallis test with Dwass–Steel–Critchlow–Fligner pairwise comparisons was performed to reveal differences between conditions. A non-parametric test was chosen due to the distribution of the dependent variable (*DV*; liking for confederates, which significantly deviated from the normal distribution, see Table 3), heteroscedasticity of the data, and unequal sample sizes (overrepresentation of participants in the mimicry condition; χ^2 (4) = 188.97; $p < 0.001$).

Our analysis revealed statistically significant differences between conditions, with a medium effect size, χ^2 (4) = 40.7, $p < 0.001$, $\varepsilon^2 = 0.07$. To examine whether participants experienced a stronger liking of a confederate, we used post hoc tests. These tests indicated differences between the mimicry condition (*Mdn* = 6.86, *IQR* = 1.57) and the no-movements condition (*Mdn* = 4.79, *IQR* = 2.36, *W* = –8.12, $p < 0.001$, *r* = 0.44) and the repetitive behaviors condition (*Mdn* = 5.43, *IQR* = 1.50, *W* = –4.68, *p* = 0.008, *r* = 0.50). An exploratory analysis found that the no-movements condition significantly differed from the responsiveness condition (*Mdn* = 5.71, *IQR* = 1.29, *W* = 5.08, *p* = 0.003, *r* = 0.33) and the double-blind condition (*Mdn* = 5.71, *IQR* = 0.96, *W* = 5.79, $p < 0.001$, *r* = 0.39). For detailed results, see Table 4.

Table 4
Post Hoc Tests: DSCF (Dwass–Steel–Critchlow–Fligner)

	Condition	*Mdn*	*Mrang*	*Q1–Q3*	H (4)	*p*	Post hoc
	Liking						
A.I	Mimicry	5.86	305.78	5.14–6.71	40.69	<.001	A.II < A.I**
A.II	No movements	4.79	181.87	3.46–5.96			A.II < A.III**
A.III	Responsiveness	5.71	265.48	5.00–6.29			A.II < A.V**
A.IV	Repetitive behavior	5.43	236.93	4.61–6.25			A.IV < A.I*
A.V	Double-blind	5.71	280.37	5.14–6.21			

Note. *$p < 0.001$, ** $p < 0.01$.

DISCUSSION

In our study, we exposed participants to research confederates who made various motor movements in control conditions. We examined whether a particular physical behavior of confederates would affect participants' impressions of them (i.e., liking) in a different way compared to situations where confederates mimicked participants. Overall, our findings were inconclusive. However, we believe this methodological approach calls for further verification and replication, and makes an important contribution to experimental studies of effects of mimicry. Furthermore, due to high heterogeneity and the lack of evidence for asymmetry in our meta-analysis, further analyses of differences in the procedure for measuring differences across studies seemed to be particularly important to identify factors influencing the strength of the obtained effects in mimicry–study link.

In this study, the participants generally expressed a stronger liking for confederates who mimicked them only in situations where the confederates (1) made no motor movements and (2) made repetitive movements, which only partially aligns with our hypothesis. There were no other significant differences when mimicry was included as a factor in between-group comparisons.

The comparison between mimicry by confederates and no motor movements by confederates replicated previous studies (e.g., Chartrand & Bargh, 1999; Kot & Kulesza, 2016; Muniak et al., 2021; Trzmielewska & Brzóska, 2022), and the result was similar to what could be predicted from the literature (e.g., Lakin et al., 2003) and to what we hypothesized. The confederates who mimicked the participants were liked more than the confederates who did not

make body movements (did not mimic). In the literature on social psychology, mimicry is usually presented as an important social function in creating harmonious interactions ("social glue"; Lakin et al., 2003). The mimickee's liking of the mimicker could be explained by reciprocal liking (Sprecher & Felmlee, 2008), when a person likes others who have expressed a liking for them. A mimicker can act as the *sender* of affiliative intentions toward the mimickee, whereas the mimickee may serve as *the receiver* of such social cues (may subconsciously detect the affiliation message; Farmer et al., 2018).

Some research in social neuroscience suggests that being mimicked lessens connectivity within brain regions involved in self–other control and mirror neuron systems (MNS) (Chan & Han, 2020), partially blurring the self–other distinction. That is, mimickees might see themselves in others while maintaining a sense of self (Hale & Hamilton, 2016). This blurred self–other distinction would induce liking of mimickers because people who are mimicked might feel a greater sense of closeness with mimickers due to activation of MNS systems (Hogeveen et al., 2014).

The result of the comparison between the mimicry condition and the repetitive behavior condition groups was also in line with our predictions. Confederates who mimicked were liked much more than confederates who made repetitive motor movements. We cannot compare the result with prior works because we were unable to find a similar study design; however, we can compare it to the abovementioned theories in which mimicry induces positive feelings toward mimickers (the social glue hypothesis; Lakin et al., 2003) or arouses a greater sense of closeness with mimickers (Hale & Hamilton, 2016). Nevertheless, there is evidence that repetitive movements are perceived as incomprehensible and may arouse feelings of embarrassment or antipathy in observers (e.g., Faso et al., 2015; Freitag et al., 2007; Sheppard et al., 2016). We could therefore lead to increased differences in liking toward confederates between the mimicry condition and the repetitive condition due to the confederates' motor atypicality.

In our study, confederates who mimicked behaviors were not significantly more liked relative to confederates who moved randomly and out of sync with the participants (the responsiveness condition; Kouzakova et al., 2010a, 2010b). That null result contradicts our hypothesis and past research in this study design (Kouzakova et al., 2010a, 2010b; Stel & Harinck, 2011; Stel et al., 2011), but it is consistent with others (Drury & van Swol, 2005; van Swol, 2003). Also, in recently published research that we extended (Kulesza et al., 2023), facial mimicry was only found to impact confederate liking when compared to a lack of facial movements, but not to the random presence of facial

expressions. Mimicry–liking link studies that use the responsiveness condition as a control group may sometimes fail to replicate the standard mimicry–liking effect because responsive individuals generally induce liking in interaction partners (compared to those who are unresponsive; Mottet et al., 2004). Thus, random but natural movements by confederates (responsive confederates) could raise their likeability and, in turn, flatten the impact of mimicry. Studies are needed to investigate this hypothesis.

In our exploratory analysis, when comparing the responsiveness condition with the no-movements condition, we found that the confederates who made no motor movements were less liked than those who moved randomly, in contrast to the findings of past research (Kulesza et al., 2023). Kulesza et al. found that the confederate likeability level was similar (the difference was not significant) between these two control groups. Although the study's condition design was similar to the classical control conditions in mimicry research (Chartrand & Bargh, 1999; Kouzakova et al., 2010a, 2010b), in Kulesza et al.'s (2023) study, the confederate made movements in both control groups, and the only differentiator was facial behavior. Because the no-movements condition (Chartrand & Bargh, 1999, Study 2) and the responsiveness condition (Kouzakova et al., 2010a, 2010b) are used interchangeably for intergroup comparisons in mimicry studies, we assumed that the confederate's motor behavior in these conditions should not cause the participant to have significantly different feelings about them. When differences exist, the confederate's behavior may influence the study results. More studies are needed to replicate and explain such results more clearly.

In our study, the control condition with the confederate not making motor movements differed from all control conditions used in previous mimicry studies (the responsiveness condition and the double-blind condition). Only one nonsignificant effect of liking the confederate was found when we compared the no-movements condition with the repetitive behavior condition. This finding would suggest that not only the lack of mimicry in confederates but also the other behaviors of the confederates in control conditions might affect the results in mimicry–liking link studies.

Both the lack of movement and repetitive movements in confederates (if we consider both these types as atypical behaviors and likely to occur in conditions such as schizophrenia, autism spectrum disorder; Hirjak et al., 2018; Kapp et al., 2019) can possibly induce misunderstanding, confusion and negative feelings in the recipients (Kapp et al., 2019) as opposed to confederates

who present more natural behaviors (e.g., random but natural non-verbal behaviors).

However, we also found that there was no difference in the liking of confederates when comparing those who expressed repetitive behaviors (the repetitive behaviors condition) with those who (1) moved randomly (the responsive condition) and with those who (2) received no instructions regarding their motor behavior (double-blind condition). We note that in our repetitive behavior condition, only a few motor behaviors typical of neuroatypical people were selected, and we excluded more complex behaviors such as deficits in postural control (Bojanek et al., 2020; Nwaordu & Charlton, 2024). Also, when confederates did not make atypical movements, they presented motor behaviors that are typical in social relationships. Therefore, the repetitive control condition cannot be treated as fully reflecting the behavior of neuroatypical people in interactions. More studies must be conducted with a more rigorous (or natural) research design.

The last between-group comparison that included a double-blind condition did not differ from the responsiveness condition and the repetitive behaviors control condition. As the confederates did not receive instructions about their motor behaviors, we cannot rule out whether they used mimicry, were responsive without imitation, or expressed some atypical body behaviors. Experimental control in the form of video recording should be used in future studies, and it should be verified in advance whether the confederates' motor behaviors are typical (or not).

Among all the group comparisons, the confederates who were physically still (the no-movements condition) were liked the least. This result appears logical because nonverbal cues usually send a "social message", for example about aggressiveness or sympathy (Anderson, 1981). Social perception involves multifaceted information processing of clues such as posture and gestures, vocal behavior, mutual gaze, and facial expressions, culminating in the formation of a person's impressions. Nonverbal movements are viewed as important components of social messages (e.g., Anderson, 1981) and are considered, for example, *conversational regulators* (e.g., head nods, gazing behavior) or *adaptors* (self-touching: rubbing, for example, face scratching, hair smoothing; Vinciarelli et al., 2009). Adaptors can be considered "non-communicative" but might still be unintentionally informative and interactive in conversation (Ekman & Friesen, 1969). Mimicry of adaptors (automatic imitation of face-rubbing and foot-shaking; Chartrand & Bargh, 1999) can have interactional consequences (for mimickers and mimickees). Furthermore,

when people talk or interact, they almost always gesture (e.g., move their hands; for a review, see Clough & Duff, 2020); even blind speakers gesture to blind listeners (Iverson & Goldin-Meadow, 1997). In situations where nonverbal movements should be normative, interacting with a person who does not engage in motor movements can be assumed to be unnatural and uncomfortable because social signals are highly diagnostic in social communication (Loth & de Ruiter, 2016). Elimination of gestures in experimental conditions (the confederates are instructed to make no gestures; Żywiczyński et al., 2017), or behaviors encountered in clinical or neurodiverse populations (where gesturing is naturally reduced; Kapp et al., 2019; Poliakoff & Gowen, 2025), may result in interactional losses for both speakers and listeners (e.g., making communication less smooth). People who observe subtle irregularities in an interaction partner's nonverbal behavior may notice a novel or atypical stimulus that contradicts their knowledge or expectations (Fiske, 1993). This process usually occurs outside conscious awareness (Bargh, 1994). To be precise: Nonverbal communication has indirectly approached the function of predictions in social relations. Findings have suggested the preference (more liking) for people who display prediction-consistent social cues in social interactions (than for those who present less predictable cues, Chanes et al., 2019).

Our study has some limitations, listed as follows:

1. The interactions were not video recorded, so it was impossible to verify whether the confederates followed research protocol and adhered to the instructions they were given regarding (i) mimicry, (ii) motor behaviors in control conditions, and (iii) the general structure of conversations. Nor did our research test for naturally occurring mimicry or behaviors alongside mimicry, such as eye contact or smiling by the confederates (conversation regulators, Ekman & Friesen, 1969), that may have interfered with data interpretation (liking). Importantly, interactions were not recorded in many previous mimicry–liking studies (see Table 1).

2. As our study was conducted as part of an academic course, the researchers spent minimal time manipulating training sessions (common in confederate paradigms in mimicry studies; see Table 1). However, even well-trained confederates can lack control over the exact timing and matching precision of their movements (Hale & Hamilton, 2016).

3. The number of confederates was large and, unfortunately, they did not participate in all conditions, as this could have caused inconsistency. For example, some confederates could have followed the protocol (instructions) more closely than others did, and a confederate's attractiveness could have

affected the study results. However, because of the large number of participants (> 500), the effects of the confederates should have been distributed fairly proportionally. The confederates' behavior could also be affected by knowledge of the experimental condition (Hale & Hamilton, 2016).

4. The double-blind condition differed from the other groups because the confederates were recruited from outside the university course and were invited to participate in research internships to collect data. Also, the number of confederates was smaller in this condition; in the other control groups the number was larger. This was the major limitation of our study as it might have biased our findings. There could have been confederate bias due to their smaller number and a higher probability that their specific characteristics influenced the results under this condition. Importantly, however, the participant recruitment method was the same across all conditions, as were the characteristics of the study setting and the procedure (except for instructions for confederates' nonverbal behavior in control conditions vs. no such instructions in the double-blind condition). Furthermore, under the double-blind condition, confederates were blind to the study's hypotheses, and the population to which they belonged was the same as in the other conditions (all confederates were psychology students in their twenties and in the middle years of their study). In future studies, it is advisable to use the same number of confederates in all conditions (preferably the same group of people).

5. There were no baseline scores for the dependent variable (pre-liking), which makes it impossible to analyze the changes from the baseline (post-liking) by looking at either absolute variations or a percentage change. This is a common limitation in mimicry studies (see Table 1).

In future research it will be rewarding to consider the fact that there is no standardization of the mimicry condition in the mimicry–liking link in terms of timing and of the qualification and type of imitative behavior. Seventh, non-manipulated confederate behaviors are not standardized in mimicry–liking link research. For example, sometimes confederates maintained a neutral facial expression in both conditions (mimicry and control; Chartrand & Bargh, 1999, Study 2), whereas in others studies they did not (they showed natural facial expressions; Kouzakova et al., 2010a). Facial expressions have been regarded as important conversational regulators (Ekman & Friesen, 1969) and a significant factor in the perception of people. For instance, people are rated as more likable when they show common (and predictable in certain social contexts) facial expressions (Chanes et al, 2018).

More studies are needed to examine mimicry in more naturalistic settings. At first, only the double-blind condition was truly close to natural, as the other groups only simulated natural situations. Furthermore, we examined isolated types of nonverbal mimicry instead of combining all types (verbal and facial mimicry). Finally, our article summarizes only the mimicry results on liking of confederates, which makes predictions beyond this variable difficult.

CONCLUSION

Our study found no evidence that contradicts the functional effects of mimicry in social interactions (Chartrand & Bargh, 1999; Lakin et al., 2003). Our goal was to deepen our understanding of mimicry and lack of mimicry (control conditions) in mimicry studies. Currently, there is no consistency regarding optimal control condition in this field. Our research suggests that future studies need to be transparent about how the movement of confederates is operationalized, monitored and compared with actual mimicry. This study should be replicated, and a more systematic comparison of various mimicry situations would surely improve our knowledge about the differences between control conditions commonly used in mimicry research. Also more meta-analysis should be carried out. Apart from the methodological application, our study findings can raise awareness among healthcare professionals (and generally our society) that atypical motor movements may significantly influence the perception of individuals who perform them.

CRediT Author Statement

WERONIKA TRZMIELEWSKA (60%): conceptualization, funding acquisition, methodology, project administration, resources, supervision, writing (original draft), visualization.

JAKUB DURAS (20%): conceptualization, formal analysis, investigation, visualization, writing (original draft, the result section).

ALEKSANDRA JUCHACZ (15%): investigation, writing (review and editing).

TOMASZ RAK (5%): formal analysis, visualization.

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