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Brief article

The GROOP effect: Groups mimic group actions

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ABSTRACT

Research on perception–action links has focused on an interpersonal level, demonstrating effects of observing individual actions on performance. The present study investigated perception–action matching at an inter-group level. Pairs of participants responded to hand movements that were performed by two individuals who used one hand each or they responded to hand movements performed by an individual who used both hands. Apart from the difference in the number of observed agents, the observed hand movements were identical. If co-actors form action plans that specify the actions to be performed jointly, then participants should have a stronger tendency to mimic group actions than individual actions. Confirming this prediction, the results showed larger mimicry effects when groups responded to group actions than when groups responded to otherwise identical individual actions. This suggests that representations of joint tasks modulate automatic perception–action links and facilitate mimicry at an inter-group level.

1. Introduction

Social interaction involves not only individuals interacting with other individuals, but also groups interacting with groups. Prior research on inter-group relations has focused on the role of implicit social attitudes that shape individuals' behavior towards members of other groups (Dunham, Baron, & Banaji, 2008). Less is known about basic effects of inter-group relations on a perception–action level (Crosby, Monin, & Richardson, 2008; Semin & Smith, 2008). How does observing group actions affect group performance? Are people acting together more responsive to actions of another group than to actions performed by an individual? For instance, ballroom dancing is usually taught to couples by couples. It seems more difficult for couples to learn how to waltz from observing a single person.

A large body of research has addressed effects of action observation on performance at an interpersonal level (Blakemore & Frith, 2005). When we observe another's movements, this leads to an internal motor activation (Jeannerod, 2001; Prinz, 1997; Rizzolatti & Sinigaglia, 2010) that induces a tendency to mimic the perceived movements (Chartrand & Bargh, 1999; van Baaren, Janssen, Chartrand, & Dijksterhuis, 2009). For instance, Brass and colleagues demonstrated that participants were faster at executing a particular instructed finger movement when they saw a hand performing the same movement compared to seeing a hand performing the opposite movement (Brass, Bekkering, & Prinz, 2001). Such effects of action perception on performance can be explained by the assumption that perceived actions and self-generated actions are represented in the same way because actions are coded in terms of their perceptual consequences (Prinz, 1997). According to the theory of event coding (Hommel, 2009; Hommel, Müsseler, Aschersleben, & Prinz, 2001), the more features of observed events overlap with features of our own actions, the greater the interaction between perception and action.

Observed and performed actions may vary in similarity not only with respect to the kind of action being performed, but also in terms of the number of agents involved in producing and perceiving actions. The aim of the present

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study was to explore whether people's tendency to mimic observed actions is modulated by numerical differences in inter-group relations. Prior research has shown that individuals performing tasks next to each other tend to include each other's actions in their action planning (Milanese, Iani, & Rubichi, 2010; Sebanz, Knoblich, & Prinz, 2003, 2005; Tsai, Kuo, Hung, & Tzeng, 2008). Thus, a pair of actors may map their combined actions rather than their individual actions onto observed actions, so that perception–action matching occurs no longer at an interpersonal level, but at an inter-group level. If this is the case, then people acting together should have a stronger tendency to mimic actions performed by a pair compared to actions performed by an individual.

2. Experiment 1

To test this prediction we extended the mimicry task developed by Brass et al. (2001) and combined it with a numerical compatibility manipulation. Participants either observed two people acting (congruent condition, Fig. 1 top left) or a single person acting (incongruent condition, Fig. 1 bottom left). They performed the task together with a confederate. In the numerically compatible condition, movements of one hand required one response and movements of two hands required two responses. In the numerically incompatible condition, movements of one hand required two responses and movements of two hands required one response (Fig. 1, right).

Earlier findings on numerical compatibility (Miller, Atkins, & van Nes, 2005) predict faster reaction times (RTs) in the compatible condition, where the number of observed movements and performed movements is the same. We tested whether inter-group congruency modulates this numerical compatibility effect. If the participants in a group map their combined actions onto observed actions, rather than their own individual actions, then there should be a larger numerical compatibility effect when they observe actions performed by a group than when they observe actions performed by an individual.

2.1. Method

2.1.1. Participants

Eighteen right-handed undergraduates (five men, aged between 18 and 24 years) participated in Experiment 1. All participants had normal or corrected-to-normal vision. They were recruited by electronic advertisements and were paid 10 Euro.

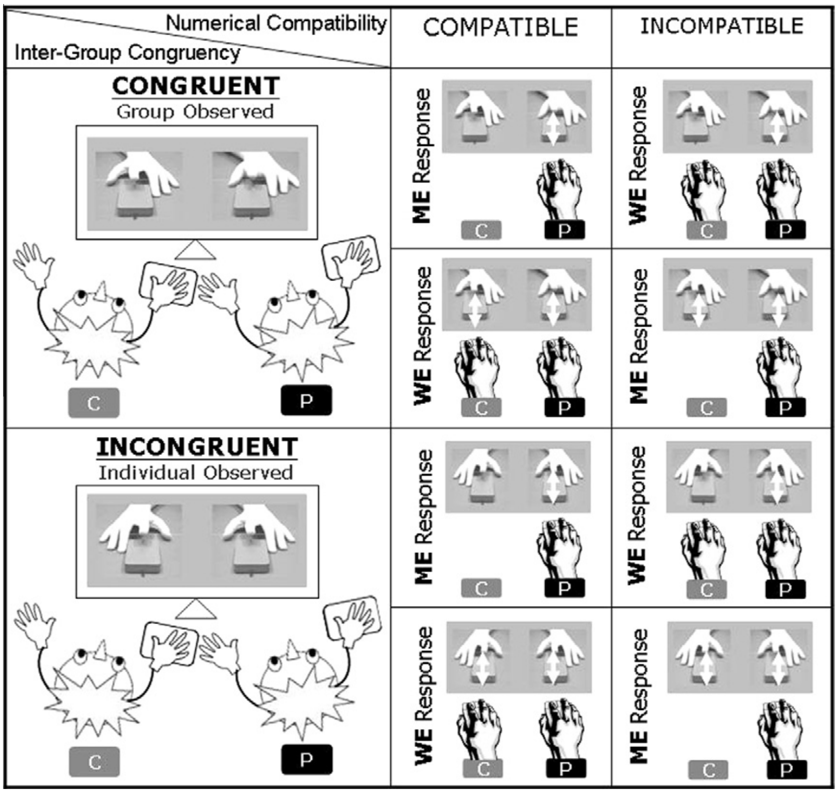

Fig. 1. Illustration of the experimental set-up and design. Left: Participants ("P") observed movements of two hands belonging to two different individuals (congruent condition: group observed) or movements of a left and right hand belonging to one individual (incongruent condition: individual observed). Right: Participants performed the same go/no-go task throughout the experiment with a confederate ("C"), responding to ipisilateral hand movements that occurred either alone (one hand moving) or together with another hand movement (two hands moving). The up-/downward white arrow(s) indicate the hand(s) that moved. The confederate's task varied between the compatible and incompatible condition in order to manipulate numerical compatibility. The four types of trials that occurred in the group congruent and group incongruent condition are illustrated.

2.1.2. Material and apparatus

The stimuli showed one or two index fingers moving towards response keys (see Fig. 1). The movements consisted of a three-frame image sequence (each picture: 211×158 pixels, each frame: 60 ms). Each frame displayed the finger(s) in a different position as the finger(s) approached the response key and returned to the starting position. Stimuli (9.3×6.3 visual degrees) were displayed on a 17-inch LCD computer screen (1024×768 pixels, 60 Hz refresh rate).

2.2. Procedure

Participants performed a numerical compatibility task together with a confederate. Their task was to press a key with the right hand in response to ipsilateral hand movements and to not respond when no such movement occurred (go/no-go task). Hand movements on the screen occurred either in isolation (one hand moving) or synchronously with a contra-lateral hand movement (two hands moving). Participants and the confederate could see each other's actions in peripheral vision and could hear when a response key was pressed.

The congruency between the number of people observed and the number of people responding was manipulated. In the congruent, "group observed", condition, participants and confederate observed two left hands belonging to two individuals whereas in the incongruent, "individual observed", condition they observed a left and right hand belonging to the same individual (Fig. 1 left). The instructions mentioned whether actions of one or two actors were shown. The two conditions were blocked.

The confederate's task varied in order to vary numerical compatibility (Fig. 1 right). In the numerically compatible condition, the confederate responded to hand movements on her side just as participants responded to hand movements on their side. Thus, whenever both hands moved, the participant and the confederate both responded ('we-response'), whereas only the participant or the confederate responded when the hand on their side moved alone ('me-response').

In the numerically incompatible condition, a movement on the participant's side required a response from the participant as well as from the confederate ('we-response') whereas two moving hands required only a response from the participant ('me-response'). Thus, the confederate responded to movements of a single hand occurring on either side and not to movements of both hands. The compatible and incompatible conditions were blocked.

Prior to each block participants always received the same instruction (react to movements of the ipsilateral hand as fast as possible) and read the instructions for the confederate. Note that participants could perfectly perform the task by responding to hand movements on their side.

A picture of the hands with the index fingers raised was permanently shown except when one or both fingers moved. Each trial started with a central fixation displayed for a variable interval (500 ms, 700 ms, and 1000 ms). Then the index finger of either one hand or both hands started moving incrementally downward from the first to the second frame and returned back to the initial position during the final frame. The inter-trial interval was 1000 ms.

Participants completed four blocks of 135 trials each (congruent/compatible, congruent/incompatible, incongruent/compatible, incongruent/incompatible). Each block comprised 45 trials requiring me-responses, 45 trials requiring we-responses, and 45 trials requiring only a response from the confederate. The order of blocks was counterbalanced.

To determine whether individuals acting alone have a stronger tendency to mimic individual actions than group actions, we also assessed the performance of participants performing the task alone. In the "solo condition" participants performed exactly the same task without the confederate. The congruent condition showed actions performed by an individual, whereas the incongruent condition showed actions performed by two individuals. These conditions were blocked (135 trials each). Each block comprised 45 compatible trials (one moving hand), 45 incompatible trials (two moving hands), and 45 no-go trials.

2.3. Results

Error rates were low (<2%) in all conditions and are not further reported. There was no indication of a speed-accuracy trade-off.

2.3.1. Joint performance

Fig. 2A displays the reaction times. As predicted, participants showed a larger compatibility effect when performing in a group and observing another group's actions than when performing in a group and observing another individual's actions. A repeated-measure $2 \times 2 \times 2$ ANOVA with the factors inter-group congruency (group observed vs. individual observed), number of observed movements (one hand moving vs. two hands moving), and number of performed movements (ME response vs. WE response) on RTs showed that the predicted three-way interaction was significant [$F(1, 17) = 4.6$, $p < .05$, $\eta^2 = 0.21$]. Inter-group congruency modulated the compatibility effect between the number of observed and performed movements (two-way interaction: $F(1, 17) = 17.3$, $p < .001$, $\eta^2 = 0.5$). Separate analyses of the compatibility effect in the congruent and incongruent condition showed that there was a significant compatibility effect when groups responded to group actions [$F(1, 17) = 13.5$, $p < .01$, $\eta^2 = 0.44$]. There was no significant compatibility effect when groups responded to individual actions [$F(1, 17) = 2.7$, $p = .12$, $\eta^2 = 0.14$].

2.3.2. Solo performance

A 2×2 repeated measures ANOVA with the factors congruency (group observed vs. individual observed), and number of observed movements (one hand moving vs. two hands moving) was performed. It revealed a main effect of number of observed movements [$F(1, 17) = 19.0$, $p < .001$, $\eta^2 = 0.53$], with slower performance in response to movements of two hands ($M = 393.0$ ms; SD = 62.1) compared to single hand movements ($M = 382.1$ ms; SD = 63.6). There was also a main effect of congruency

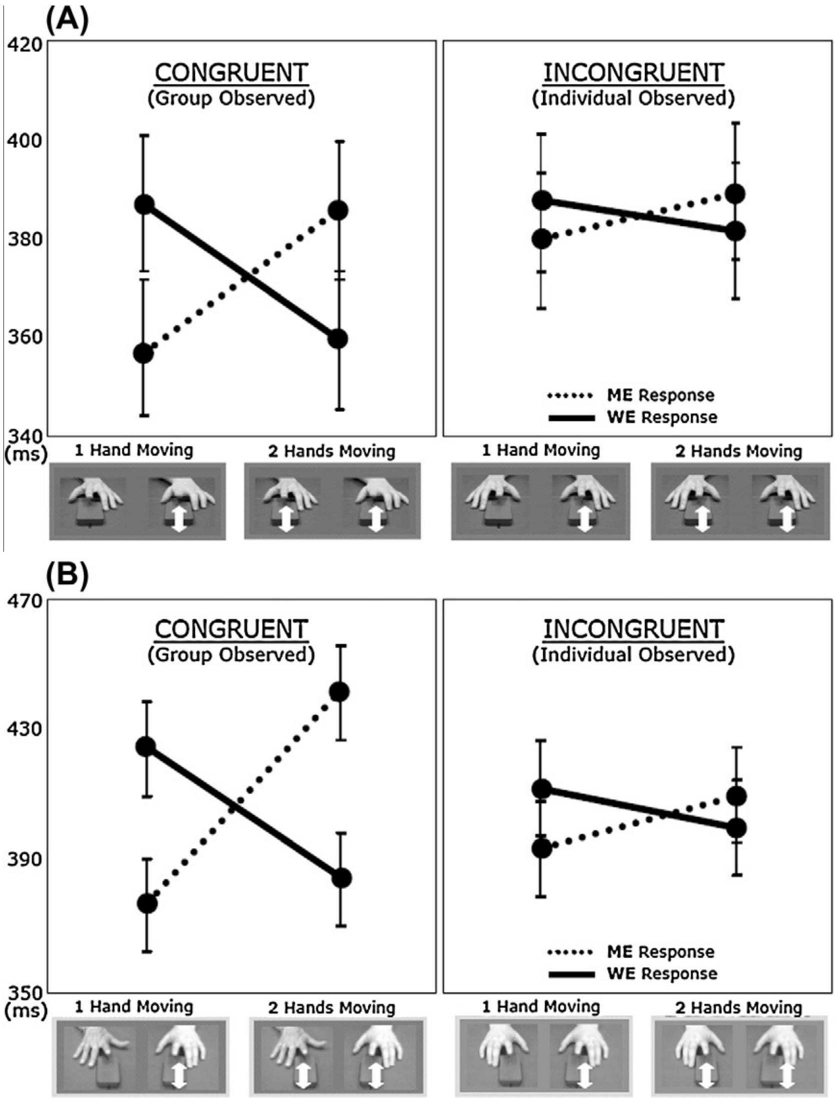

Fig. 2. Mean reaction times of Experiments 1 and 2. (A) Experiment 1: Stimuli were two hands belonging to two different females, or a pair of female hands. (B) Experiment 2: Stimuli were a left and right hand belonging to a young female and an elderly female, or a pair of female hands. The error bars display the within-subjects (95%) confidence intervals according to Loftus and Masson (1994).

[$F(1, 17) = 8.4$, $p < .01$, $\eta^2 = 0.33$]. Participants were faster when responding to one individual's movements ($M = 367.5$ ms; SD = 57.8) than when responding to two individuals' movements ($M = 407.6$ ms; SD = 61.8). There was no significant interaction.

2.3.3. Confederate performance

To determine whether the confederate's responses affected participants' RTs, we correlated participants' average RTs and the confederate's average RTs on "we response" trials in each condition. No significant correlations were found (congruent/compatible: $r = -.01$, $p = .96$; congruent/incompatible: $r = -.04$, $p = .88$; incongruent/compatible: $r = .27$, $p = .27$; incongruent/incompatible: $r = -.07$, $p = .80$).

2.4. Discussion

Congruency between the number of observed actors and the number of performing actors modulated the extent to which observed actions had an impact on action performance. Single participants showed larger numerical compatibility effects when observing single actors, whereas pairs showed larger numerical compatibility effects when observing pairs of actors. The latter finding is of particular interest because it suggests that participants formed a representation of the actions to be performed jointly, mapping their combined actions onto another dyad's actions. However, it is possible that groups' tendency to mimic groups was not due to inter-group congruency. It may simply be easier to map one's own and a partner's right hand actions onto two identical hands than onto a left and right hand. Thus, the modulation of numerical compatibility effects may reflect anatomical matching (Tsai & Brass, 2007) rather than matching of observed and performed group actions.

3. Experiment 2

To rule out anatomical matching as an alternative explanation, Experiment 2 tested whether inter-group congruency depends on anatomical features. Whereas participants in the group congruent condition in Experiment 1 had observed two left hands, participants in Experiment 2 observed a left and a right hand that differed in age (Fig. 2B). This provided a clear indication that the left and right hand belonged to two different individuals. In the group incongruent condition, the left and right hand did not differ in age and thus clearly looked like the hands of one individual.

If anatomical matching modulates the tendency to mimic observed actions, no difference should occur in the size of the numerical compatibility effect between the congruent and the incongruent condition. However, if participants map observed group actions to performed group actions they should show a larger compatibility effect when responding to group actions than when responding to individual actions.

3.1. Method

3.1.1. Participants

Twelve new participants (four men, aged between 20 and 25 years) took part in Experiment 2. They were paid 5 Euro.

3.1.2. Material, apparatus, and procedure

These were the same as in Experiment 1, with the following exceptions. In the group congruent condition, the observed hands consisted of a right and left hand of two different females (a young girl and an elderly lady, Fig. 2B). There was no solo condition because our main question was whether participants would map jointly performed actions onto observed group actions.

3.2. Results and discussion

Error rates were low (<2%) and were not further analyzed.

3.2.1. Joint performance

Fig. 2B displays the RTs. Participants showed a larger numerical compatibility effect when performing in a group and observing another group's actions than when performing in a group and observing an individual's actions. A repeated-measure 2 × 2 × 2 ANOVA with the factors inter-group congruency (group observed vs. individual observed), number of observed movements (one hand moving vs. two hands moving), and number of performed movements (ME response vs. WE response) was conducted to analyze participants' performance. As in Experiment 1, there was a significant three-way interaction [$F(1, 11) = 16.9$, $p < .01$, $\eta^2 = 0.61$]. Inter-group congruency modulated the compatibility effect between the number of observed and performed movements (two-way interaction: $F(1, 11) = 4.95$, $p < .05$, $\eta^2 = 0.31$). Separate analyses of the compatibility effect in the congruent and incongruent condition showed that there was a significant compatibility effect when groups responded to group actions [$F(1, 11) = 12.2$, $p < .01$, $\eta^2 = 0.53$], but not when groups responded to individual actions [$F(1, 11) = 0.8$, $p = .40$, $\eta^2 = 0.06$].

3.2.2. Confederate performance

No significant correlations between participants' average RTs and the confederate's average RTs were found (congruent/compatible: $r = -.06$, $p = .85$; congruent/incompatible: $r = -.22$, $p = .50$; incongruent/compatible: $r = -.10$, $p = .78$; incongruent/incompatible: $r = -.01$, $p = .98$).

The results replicate the findings of Experiment 1. Group congruency modulated numerical compatibility, demonstrating that groups were more affected by group actions than by individual actions. Anatomical matching cannot account for this finding because actions of a left and right hand were observed in all conditions.

4. General discussion

The results provide converging evidence that congruency between the number of perceived actors and the number of acting individuals modulates effects of action observation on performance. In particular, groups were more strongly affected by actions performed by a group than by actions performed by an individual, even though the observed actions were identical. We term this the "GROOP effect".

The GROOP effect suggests that participants formed task representations that specified not only the actions to be performed by them ('me-representation'), but also the actions to be performed jointly ('we-representation'). Whenever participants saw the ipsilateral hand moving, the 'me-representation' was activated. Whenever participants saw that both hands moved, the 'we-representation' was activated.

Common coding for perception and action (Hommel, 2009; Hommel et al., 2001; Prinz, 1997) can explain why these representations led to a numerical compatibility effect. According to this view the me-representation links a perceived hand movement on the right with the participant's individual action through a common code that specifies the perceptual consequence of the action as 'right'. Therefore, observing movements of the hand on the right activated me-responses and led to faster RTs than observing movements of both hands. The we-representation links perceived hand movements on both sides with the perceptual consequences of jointly performed actions (left and right). Accordingly, we-responses to movements performed by both hands were faster than we-responses to movements of the ipsilateral hand.

However, the modulation of numerical compatibility effects by group congruency (GROOP effect) can only be explained by the assumption that we-representations require equivalence between the number of perceiving and performing actors. The GROOP effect demonstrates that we-representations can take precedence over me-representations when there is a close match between perceived and performed group actions.

To summarize, the findings suggests two theoretical insights. First, co-actors may not only form separate representations of their own and the other's task but may form task representations that specify the actions to be performed jointly. If participants had represented their partner's task and their own, they should have produced slower responses whenever it was their partner's turn to act (Sebanz et al., 2005). Second, group-level task representations ('we-representations') facilitate mimicry on an inter-group level, indicating that in addition to intrapersonal (Heyes, Bird, Johnson, & Haggard, 2005; Liepelt, von Cramon, & Brass, 2008; Longo, Kosobud, & Bertenthal, 2008) and interpersonal factors (Liepelt et al., 2008; van Baaren et al., 2009), inter-group relations can affect mimicry.

It remains to be determined whether the valence of the interpersonal relation between the two co-actors (Hommel, Colzato, & Van den Wildenberg, 2009) and the valence of inter-group relations modulates group mimicry. Just as co-actors represent each other's task only when in a neutral or positive relationship, 'we-representations' may emerge selectively when groups like each other. Future research is needed to test whether "us" mimicking "them" only applies to in-group members (Wojnowicz, Ferguson, Dale, & Spivey, 2009).

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