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RESEARCH ARTICLE

# The role of group membership on the modulation of joint action

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**Abstract** Two experiments were conducted to assess whether the emergence of shared representations, as indexed by the joint Simon effect, is modulated by perceived group membership. In both experiments, participants were required to perform a Simon task along another person who was perceived as belonging either to the same group or to a different group. In Experiment 1, ingroup–outgroup discrimination was obtained by dividing participants into two groups based on a superficial criterion; in Experiment 2, it was obtained by manipulating the interdependence experienced by the two acting individuals. The mere social categorization of co-acting participants into groups did not modulate the joint Simon effect which was observed even when participants believed to perform the task along with an individual belonging to a different social group (Experiment 1). On the contrary, the effect was modulated by perceived interdependence, with a null effect when participants experienced negative interdependence (Experiment 2). These results suggest that when acting in a social context, by default, individuals may perceive positive interdependence with co-acting individuals, even when cooperation is not explicitly requested.

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The need to investigate cognition and action in a social context has become more and more evident in recent years, and several research efforts are focusing on studying joint action, that is, the ability to coordinate our actions with those of others (Sebanz et al. 2006a). Joint action requires to understand others and to anticipate their behavior in order to successfully coordinate with them. As recent studies suggest, these abilities may depend on the creation of shared representations that integrate in the same action plan current and predicted self and other's actions (cf. Sebanz et al. 2006b; see also Tomasello et al. 2005).

A task recently used to investigate joint action is the Simon task (Sebanz et al. 2003). In the classical Simon task, participants respond to a nonspatial feature (e.g., color) of stimuli presented left or right of fixation with assigned right and left key-presses. The Simon effect refers to the finding that performance is faster and more accurate when stimulus and response location correspond compared to when they do not (Simon and Rudell 1967; for a review see Proctor and Vu 2006), hence indicating that stimulus location affects performance even if task-irrelevant. It is widely assumed that the effect is due to a conflict, emerging at the stage of response selection (e.g., Rubichi and Pellicano 2004; Rubichi et al. 2000), between two alternative response codes, one generated on the basis of task instructions and the other automatically activated through preexisting associations linking a stimulus to its spatially corresponding response (e.g., De Jong et al. 1994). In corresponding trials, the two activated responses are the same, hence no conflict arises. In contrast, in non-corresponding trials, the two activated

responses do not correspond and the conflict must be resolved before the execution of the correct response, this leading to a slowing of response times.

Sebanz et al. (2003) showed that the Simon effect occurs even when the Simon task is shared between two participants. In their study, participants were presented with photographs of a centrally presented right hand pointing to the right, to the left, or straight, with the instruction to press one of two lateralized keys according to the color of a ring appearing on the index finger. They were required to perform the task either alone or paired with another participant (joint Simon task). Response times were faster when the response spatially corresponded to the pointing direction of the hand (corresponding trials) compared to when they did not correspond (non-corresponding trials). This advantage for corresponding trials was evident not only when the participants performed the task by themselves, responding to both colors (standard Simon effect), but also when they performed the task alongside another participant, each responding to only one color (joint Simon effect). In contrast, it was absent when participants performed the task alone, responding only to one color (go/no-go Simon task). The occurrence of the joint Simon effect suggests that each participant represented the other's part of the task and integrated this representation in his/her action planning. Indeed, in the absence of such a shared representation, the effect would not have been evident due to the lack of a competition between two alternative responses.

Shared representations have been shown to emerge even when the task would in principle allow participants to act without considering and representing the other's action (Atmaca et al. 2008; Milanese et al. 2010; Sebanz et al. 2003, 2005), hence suggesting that they are automatically created any time individuals act in a social context. Such a conclusion is supported also by neurophysiological data showing that individuals need to engage in inhibitory control processes to withhold from responding when is the other's turn (Sebanz et al. 2006a, 2007; Tsai et al. 2006).

The automatic nature of shared representation, however, has been put into question by the results of two recent studies suggesting that social and emotional factors may modulate their emergence. For instance, Kuhbandner et al. (2010) found a larger joint Simon effect when the joint Simon task was performed after the induction of a positive mood, while no effect was observed after the induction of a negative mood. Similarly, Hommel et al. (2009) found that the joint Simon effect was modulated by the valence of the interaction between two co-acting individuals. Specifically, they found a joint Simon effect only when participants performed along with a likable co-actor. To explain this latter finding, Hommel et al. suggested that positive relationships strengthen the connection between attributes and actions related to oneself, and attributes and actions related to the other (Aron et al. 1991), hence paving the way for the integration of self-generated and other-generated actions in a common representation. On the contrary, negative relationships may increase the self-other distinction, hence preventing this integration. From this view, it derives that the emergence of shared representations strictly depends on the strength of the psychological connectedness between co-acting individuals: stronger is this connectedness, more likely is that self and other actions are integrated in a common representation.

Social psychology studies indicate that the process of social categorization, that is the perception of belonging to a social group, can influence thinking, feeling, and behaving toward members of the ingroup (i.e., the group the individual is a member of) versus members of the outgroup (i.e., the other group). For instance, social categorization enhances perception of differences between groups and of similarities within the group (Allen and Wilder 1975, 1979; Doise et al. 1978). More relevant for the present study, there are indications that when individuals categorize themselves as group members, the group to which they belong becomes included in the self (Smith and Henry 1996). The aim of the present study was to assess whether shared representations, as indexed by the presence of the joint Simon effect, are modulated by group membership. Stated differently, we hypothesized that the joint Simon effect should emerge when co-acting individuals perceive themselves as part of the same social group. On the contrary, it was expected to disappear when co-actors perceive themselves as belonging to different social groups.

The available literature suggests that identification with a group may occur at different degrees. According to some authors, awareness of belonging to a common category is the necessary and sufficient condition for group formation. Crucially, the manipulation of minimal cues is often sufficient to motivate identification with a group (Billig and Tajfel 1973; Tajfel and Billig 1974; Tajfel et al. 1971). In these works, the differentiation between ingroup and outgroup occurred even when allocation into groups was arbitrary and virtually meaningless. Other authors posit that individuals perceive themselves as part of the same group if they are aware of belonging to a category, share a common goal, and perceive themselves as positively interdependent with respect to goals and means to attain these goals (Rabbie and Horwitz 1969).

Based on these considerations, we ran two experiments in which individuals were required to perform a Simon task along another person who was perceived as belonging either to the same group or to a different group and manipulated group formation. In Experiment 1, participants were divided arbitrarily into two groups, based on a trivial and almost completely irrelevant basis and were then asked to perform a Simon task with an individual who was

supposed to belong to the same group or to a different group. In Experiment 2, we manipulated whether the goals of two jointly acting individuals were positively related and hence the success of one individual made the success of the other more likely or whether they were negatively related and hence the success of one member rendered the success of the other less likely. In both experiments, the joint Simon effect was expected to show up when participants perceived themselves as ingroup members and to be absent when they perceived the other as an outgroup member.

## Experiment 1

The present experiment aimed at investigating whether the differentiation between ingroup and outgroup obtained by manipulating minimal cues is effective in modulating the arising of the joint Simon effect. This would suggest that the activation of shared representations is sensitive to minimal ingroup–outgroup distinctions.

Based on the performance on two cognitive tasks, participants were ostensibly placed in either the "synesthetic" or the "differentiator" group depending on their "cognitive style" (Cadinu and Rothbart 1996). In reality, performance on the two tests was not scored and participants were arbitrarily divided. After being categorized, participants performed a joint Simon task along with an individual who was believed to belong either to the same group or to a different group. If perceiving oneself as part of a group decreases the distinction between self and others belonging to the same group and increases the distinction between self and others belonging to a different group, a joint Simon effect should be evident when coupled individuals are categorized as belonging to the same group, while it should be absent when they are categorized as belonging to two different groups.

### Method

#### *Participants*

Thirty-two undergraduates (22 women; age range 19–31 years) took part in the experiment for monetary reward (5 €). All were right-handed, reported normal or corrected-to-normal vision, and were naive as to the purpose of the experiment. Once recruited, they were randomly paired. Each couple was randomly assigned to one of two experimental conditions.

#### *Stimulus materials and display*

The material for the first and second tasks was taken from Cadinu and Rothbart (1996, Experiment 4) and was presented on paper. For the first task, participants were presented with a sheet showing a list of 15 nouns (five animals, five trees, and five tools) for 30 s. and, at the end of the time interval, they were asked to write down as many of the nouns of the list as they could recall. For the second task, participants were presented with a sheet containing a pattern of seven large letters (one A, one C, two Ds, two Es, one F), each of them made of small letters (for example, a big A could be made of small Ds) for 30 s. and were then required to report how many times they saw the big E and how many time they saw a letter composed of small Es.

Stimuli in the Simon task were red or green solid squares (2 × 2 cm). They were presented on a color screen controlled by an IBM computer, 4.5 cm to the left or to the right of a central fixation cross (1 × 1 cm). Responses were executed by pressing the "$z$" or "-" key of a standard Italian keyboard with the left or right index finger, respectively. Viewing distance was about 60 cm.

#### *Procedure*

The experimenter explained that the study was aimed at studying the effect of different cognitive styles on task performance. To this aim, participants were informed that they would perform three separate tasks. After completion of the first two tasks, participants were required to respond to a brief questionnaire while the experimenter left the room allegedly to score the participants' performance. When the experimenter returned to the room, she communicated to the participants their results, telling them that they displayed either the same cognitive style (same-group condition) or two different cognitive styles (different-group condition). Even though participants believed that the style assignment was based on their performance to the two tasks, it was random.

Participants were then provided with information about people who display their cognitive styles and informed that they would have to perform a task together. In the same-group condition, the experimenter emphasized that, based on their cognitive style, participants were expected to display a very similar performance. In the different-group condition, the experimenter emphasized that, based on their different cognitive styles, performance on the following task was expected to be remarkably different.

Participants were then required to perform a Simon task jointly, sitting side-by-side in front of the same computer screen. Each participant was instructed to respond to only one stimulus color. For half of the pairs, the participant sitting on the right chair was instructed to press the right key to the red stimulus whereas the participant sitting on the left chair was instructed to press the left key to the green stimulus. The other half experienced the opposite stimulus–response mapping.

A trial began with the presentation of the fixation cross at the center of a black background. After 1 s, the stimulus appeared to the right or to the left of fixation and remained visible for 800 ms. Maximum time allowed for a response was 1 s. A response terminated the trial and the inter-trial-interval was 1 s.

The Simon task consisted of 20 practice trials and 160 experimental trials that were divided into two blocks of 80 trials each. For half of the trials, stimulus and response location corresponded (corresponding trials), and for the other half, they did not correspond (non-corresponding trials).

At the end of the experiment, participants were asked to rate the experimental situation using a 7-point bipolar semantic differential scale on the following dimensions: easy versus difficult (1 = easy, 7 = difficult), pleasant–unpleasant (1 = pleasant, 7 = unpleasant), positive–negative (1 = positive, 7 = negative), and cooperative–competitive (1 = cooperative, 7 = competitive).

### Results and discussion

Error trials were less than 1% and were excluded from further analyses. Correct response times (RT) were entered into a repeated-measures analysis of variance (ANOVA) with condition (same-group vs. different-group condition) as between-subjects factor and stimulus–response correspondence (corresponding vs. non-corresponding trials) as within-subject factor. The respective data are shown in Fig. 1.

The effect of condition did not reach significance, $F(1,30) = 1.25$, MSe = 3,761.36, $P = .28$. Corresponding responses (329 ms) were faster than non-corresponding responses (340 ms), $F(1, 30) = 40.9$, MSe = 47, $P < .001$, $\eta_p^2 = .58$. The advantage for corresponding responses was evident in both experimental conditions with a 13-ms Simon effect in the same-group condition and a 10-ms effect in the different-group condition. Even though the effect was numerically smaller in the different-group condition than in the same-group condition, this difference did not reach statistical significance, as indicated by the lack of a significant correspondence × condition interaction, $F < 1$.

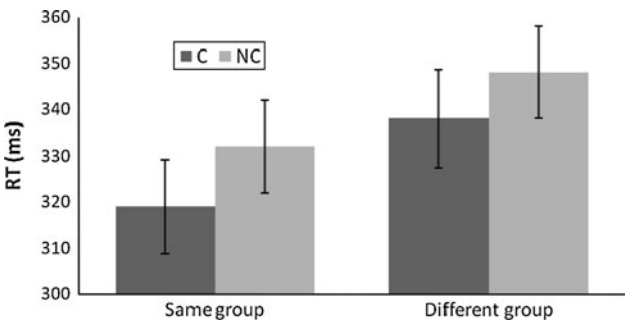


**Fig. 1** Experiment 1: Reaction times (ms) for corresponding and non-corresponding trials as a function of group membership (same group vs. different group). *Error bars* show standard errors of the means

Overall participants judged the situation as easy ($M = 1.93$, SD = 1.13), pleasant ($M = 2.19$, SD = 1.03), positive ($M = 1.69$, SD = .86), and cooperative ($M = 2.87$, SD = 2.03). A $t$ test was used to assess whether the scores significantly differed from the neutral point (4). For the participants in the same-group condition, all judgments were significantly lower than the neutral point ($P$s < .001). For the participants in the different-group condition, only the cooperative–competitive dimension obtained a score equal to 4, $t(1,15) = -0,81$, $P = .43$, while scores in the other dimensions were lower than 4 ($P$s < .01). A $t$ test for independent samples indicated that for all dimensions, the scores were significantly lower for the same-group condition ($P$s < .05).

Our results indicate that shared representations, as indexed by the joint Simon effect, emerged even when participants believed to perform the task along with a member of a different group. The observation that under the same-group condition, the joint Simon effect was comparable to the effect reported in previous studies (Milanese et al. 2010; Sebanz et al. 2003), clearly demonstrates that simply perceiving themselves as part of the same group as a co-actor does not enhance the creation of shared representations.

## Experiment 2

Experiment 2 was aimed at assessing whether the differentiation between ingroup and outgroup obtained by manipulating the interdependence experienced by two acting individuals is effective in modulating the arising of the joint Simon effect. This would indicate that the activation of shared representations is sensitive to complex ingroup–outgroup distinctions.

It is important to note that positive interdependence implies cooperation since individuals need to work together to attain a common goal (Deutsch 1949, 1962). In contrast, negative interdependence implies competition since individuals work one against the other to attain a personal goal. The effects of competition and cooperation on the emergence of shared representations have been recently investigated by Ruys and Aarts (2010). In their study, two participants performed together an auditory Simon task under one of three experimental conditions: in the independent condition, a reward was given to the 10 best-performing participants, thus attainment of a personal goal was relatively independent of the co-actor; in the

cooperation condition, both participants of the five best-performing couples earned a reward, thus attainment of a personal goal depended on the co-actor; and finally, in the competition condition, 10 winners were randomly selected for the reward. A joint Simon effect was evident under all conditions; however, the size of the effect was significantly smaller in the independent condition compared with the other two conditions. The authors explained these findings by assuming that in the latter two conditions, performance of two co-actors was interdependent and hence co-actor needed to attend to the intentions of the other to perform the task. Hence, according to their view, the emergence of shared representations does not depend on whether the co-agents need to cooperate or compete, rather it depends on whether they attend to the intentions of the other. Although we find the results of this study interesting, we believe that their competitive condition does not satisfy the widely accepted definition of competition that is generally defined as involving one individual attempting to outperform another in a zero-sum situation (Kelley and Thiabut 1969). Accordingly, in the present experiment, participants were randomly coupled and asked to perform the Simon task together, each responding to one stimulus color. Under the positive interdependence (cooperative) condition, participants were told that the couple with the fastest and most accurate responses would receive an economic reward. Under the negative interdependence (competition) condition, they were told that the participant of the couple with the fastest and most accurate responses would receive an economic reward.

## Method

### *Participants*

Thirty-two new undergraduates (18 women; age range 19–34 years), selected as in Experiment 1, took part in Experiment 2. Participants were randomly coupled, and each couple was randomly assigned to one of two experimental conditions.

### *Stimulus materials and display*

Stimuli were the same as those used in the Simon task of Experiment 1.

### *Procedure*

The experiment consisted of 20 practice trials and 260 experimental trials that were divided into two blocks. Participants were required to perform the Simon task jointly. Half couples were assigned to the cooperative condition, and the other half were assigned to the competitive condition.

In the cooperative condition, each couple of participants was placed in competition against the other couples. Participants in the couple were told that the best-performing couple, in terms of both speed and accuracy, would receive a 10 Euro reward (five Euro to each participant). The experimenter emphasized the importance of coordinating their efforts as they worked on the task to attain the goal. In the competitive condition, participants in the couple were placed in a competition against one another. They were told that at the end of the experiment, the best-performing participant, in terms of both speed and accuracy, would receive a five Euro reward.

At the end of the experiment, participants were asked to rate the experimental situation using a 7-point bipolar scale on the following dimensions: easy versus difficult (1 = easy, 7 = difficult), pleasant–unpleasant (1 = pleasant, 7 = unpleasant), positive–negative (1 = positive, 7 = negative), and cooperative–competitive (1 = cooperative, 7 = competitive).

## Results and discussion

Error trials were less than 1% and were excluded from further analyses. Correct RTs were entered into a repeated-measures ANOVA with condition (cooperative couples vs. competitive couples) as between-subjects factor and stimulus–response correspondence (corresponding vs. non-corresponding trials) as within-subject factor. The respective data are shown in Fig. 2.

Condition did not reach statistical significance, $F(1,30) = 1.65$, MSe = 3,837.10, $P = .21$. There was a main effect of correspondence, $F(1, 30) = 20.88$, MSe = 53, $P < .001$, $\eta_p^2 = .41$, with faster RTs in corresponding (317 ms) than in non-corresponding trials (324 ms). Most important, there was a significant condition × correspondence interaction, $F(1,30) = 8.85$, MSe = 53, $P < .01$, $\eta_p^2 = .23$. The Newman–Keuls test

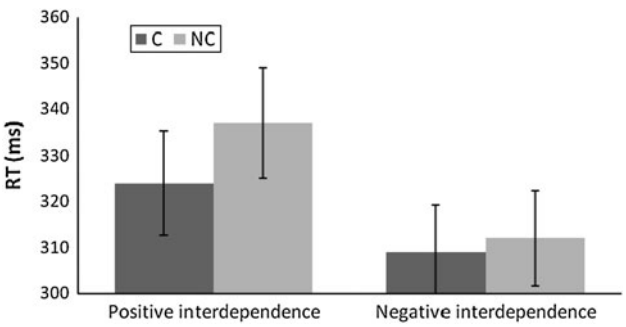


**Fig. 2** Experiment 2: Reaction times (ms) for corresponding and non-corresponding trials as a function of interdependence between co-actors (positive interdependence or cooperation vs. negative interdependence or competition). *Error bars* show standard errors of the means

showed that the advantage for corresponding responses was significant in cooperative couples (13 ms) but not in competitive couples (3 ms). An analysis with the magnitude of the effect as dependent variable indicated that these two values significantly differed, $F(1,30) = 8.84$, $P < .01$.

Overall participants judged the situation as easy ($M = 1.87$, SD = .79), pleasant ($M = 2.37$, SD = 1.52), positive ($M = 2.03$, SD = 1.38), and cooperative ($M = 3.56$, SD = 2.39). For cooperative couples, all judgments were lower than the neutral point 4 ($P$s < .03). For competitive couples, judgments on the cooperative–competitive dimension were equal to 4, $t(1,15) = .47$, $P = .64$, all other judgments were lower than 4 ($P$s < .001). Importantly, competitive couples tended to judge the situation as more competitive than cooperative couples (2.8 vs. 4.3 for cooperative and competitive couples, respectively), $t(1,30) = 1,84$, $P = .07$. No other difference between couples reached statistical significance ($P$s > .10).

These results indicate that the activation of shared representations occurs only when individuals cooperate but not when they compete. This result is inconsistent with the finding by Ruys and Aarts (2010) showing that shared representations emerge when individuals attend to the co-actor intentions, irrespective of the cooperative or competitive nature of the interaction. The observation that both groups perceived the experimental situation as equally positive and pleasant allows us to exclude that differences in performance could be due to emotional factors.

## General discussion

Previous studies suggest that shared representations emerge whenever complementary actions are distributed across different individuals (Sebanz et al. 2003). The joint Simon effect has indeed been taken as an indication that when two individuals perform the Simon task each responding to one stimulus color, each individual forms a representation of both action alternatives. One open question is whether shared representations are automatically formed any time individuals act in a social context or whether they depend on the perceived psychological connectedness between co-acting individuals. To address this question, we assessed whether joint action, as indexed by the joint Simon effect, is modulated by perceived group membership and by the strength of the differentiation between ingroup and outgroup.

Our results indicate that mere social categorization of co-acting participants into groups did not modulate the emergence of shared representations that were evident even when participants believed to perform the task along with an individual belonging to a different social group ("Experiment 1"). On the contrary, joint action was influenced by the type of interdependence between co-actors. Specifically, shared representations were not activated when co-acting individuals were required to compete one against the other and their performance was negatively interdependent ("Experiment 2").

Although research using Tajfel's (1970) minimal group paradigm suggests that social categorization is a sufficient antecedent of ingroup–outgroup distinction and of consequent ingroup-favoring discrimination, some authors raised questions about whether social categorization alone is sufficient for group formation and intergroup discrimination. For instance, drawing on Lewin's (1948) idea, Rabbie and Horwitz (1969) proposed that a perceived positive interdependence is the precondition for group formation and for subsequent ingroup–outgroup differentiation. Our findings may contribute to this long-lasting debate. Indeed, the finding that only the ingroup–outgroup distinction produced by negative interdependence was strong enough to disrupt the emergence of shared representations favors the view that ingroup–outgroup discrimination processes are enhanced by perceived interdependence.

Notably, the finding of a joint Simon effect when participants were required to cooperate and its absence when they were required to compete is at odd with the view proposed by Ruys and Aarts (2010) that shared representations emerge even in competitive contexts as long as individuals attend to the intentions of the co-actor. Indeed, under the competitive condition used in our study, since the participants' goal was to outperform their co-agents, they were likely to observe and pay attention to the others' actions and intention to monitor their progress toward their goal (cf. Poortvliet and Darnon 2010).[1] Nevertheless, no joint Simon effect was observed. On the contrary, a joint Simon effect was observed under the cooperative condition.

Even though the findings of the present study do not support the view that shared representations emerge any time individuals act in a social context, they suggest that the tendency to integrate the co-actor's action into our own action system is quite strong. Such a conclusion is indeed also suggested by the results of those studies showing that the joint Simon effect occurs even when individuals believe to perform the task along with another person sitting in a different room (e.g., Tsai et al. 2008; but see

[1] According to the literature on achievement goals (see Poortvliet and Darnon 2010 for a review), people whose aim is to outperform others, as occurs in competitive situations, develop an "other-referenced focus" since, to monitor their progress toward the goal, they tend to compare their performance with the performance of others. On the contrary, people whose aim is to improve one's own performance develop a "self-referenced focus" since they tend to compare their present performance with their previous performances.

Welsh et al. 2007 for different results). The finding of a joint Simon effect under both conditions of Experiment 1 and the observation that it was of comparable magnitude under these two conditions and under the cooperative condition of Experiment 2 seem to suggest that when acting in a social context, by default, individuals may perceive positive interdependence with co-acting individuals, even when cooperation is not explicitly requested and ingroup–outgroup differentiation is not supported by negative interdependence (i.e., competition). The perception of positive interdependence may enhance the willingness to invest in the interaction (Poortvliet and Darnon 2010), hence paving the way for the emergence of shared representations. Differently, when the other represents an obstacle toward the attainment of a personal goal, as occurs in explicit competitive situations, individuals may be less willing to coordinate their efforts, to depend on, and to be influenced by the other's actions, this blocking the integration of self and other's action.

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