Moving together: in the body or the mind?

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Abstract

When people move together, as they dance, march or flirt, it increases affiliation between them. But what about 'moving together' produces affiliation: the movements themselves, or the social context of moving 'together'? We instructed pairs of participants to listen to music and move their arms or legs according to shapes appearing on screen. They either carried out the same movements, or when one moved their arms the other moved their legs. They either saw shapes on one laptop, or each had their own laptop. Surprisingly, participants did not like each other more if they carried out the same movements, but affiliation did increase if they danced looking at the same screen. Rather than their movements, instructions, intentions or perceptual experiences, here it is the social context of the actions that produces affiliation, a surprising finding that is not easily accounted for by the dominant theories of mimicry and behavioural synchrony.

Keywords: synchrony; coordination; mimicry; affiliation; joint action

Introduction

People have danced, marched and moved together across cultures and history (McNeill, 1995). One reason, suggested by the literature, is that mimicry and synchronous movement acts as a form of 'social glue', increasing liking when two people mimic each other's gestures (Chartrand & van Baaren, 2009), walk in step with each other (Wiltermuth, 2012), tap in synchrony (Hove & Risen, 2009), or move together to a common beat (Reddish, Fischer, & Bulbulia, 2013).

Dance as one particularly social form of human coordination (Dunbar, 2012; Tarr, Launay, Cohen, & Dunbar, 2015), usually takes place in a shared social context: people in the same room, co-present with others, are listening to the same music. Similarly, demonstrations of motor mimicry increasing affiliation also take place in the shared social context of an experiment. What is the contribution of these two factors, a shared social context and similarity in movement, in changing affiliation when people dance together? From research to date this is not clear, as the two factors are confounded in dance as it typically occurs in society, and mimicry as it is typically studied in the laboratory. Which provide the psychological conditions for dancing 'together'?

The recent invention of the "silent discos" separates these factors and raises an interesting question. At these events, each person wears a set of wireless headphones that can be connected to different DJs playing different pieces of music. So two people next to each other may be engaging in similar, synchronised bodily movements, or not. Each person may or may not know if the person next to them is listening to the same music. What conditions will produce affiliation between the dancers: the similarity between their movements, or the knowledge that they are dancing together to the same music? We created an experimental version of this situation to find out. Rather than manipulating shared music, however, we manipulated shared social context.

This question does not just relate to our specific understanding of silent discos, of course, but raises much broader questions about the function of bodily mimicry for the affective states of social relationships. The dominant prediction from the psychological literature is that movement similarity causes affiliation. One proposed mechanism is that action observation activates a representation of a similar motor plan in the observer (Chartrand & Bargh, 1999). This mirroring has been linked to a particular set of visuo-motor neurones in the brain known as the 'mirror system' (Di Pellegrino, Fadiga, Fogassi, Gallese, & Rizzolatti, 1992; Mukamel, Ekstrom, Kaplan, Iacoboni, & Fried, 2010), which are claimed to contribute to social cognition and affiliation (Gallese & Goldman, 1998; Pineda, 2009). Supported by many experimental findings, these theories predict that what is required to increase affiliation between two silent disco dancers is a match between their bodily movements.

However, there are two reasons to hypothesize that social context may play an important part in the relationship between affiliation and mimicry. Firstly, imitation can be modulated by social factors such as eye contact (Wang, Newport, & Hamilton, 2010), group membership (Yabar, Johnston, Miles, & Peace, 2006), or the circumstances under which people meet (Miles, Griffiths, Richardson M., & Macrae, 2010). Secondly, one lab experiment has shown that affiliation can be increased by action *contingency* alone. Catmur and Heyes (2013) asked participants to perform either a hand or a foot movement at random. In response, they either saw the same action that they had just performed onscreen, or the opposite one. The actions onscreen either occurred contingently, every time participants acted, or non-contingently, sometimes appearing and sometimes not.

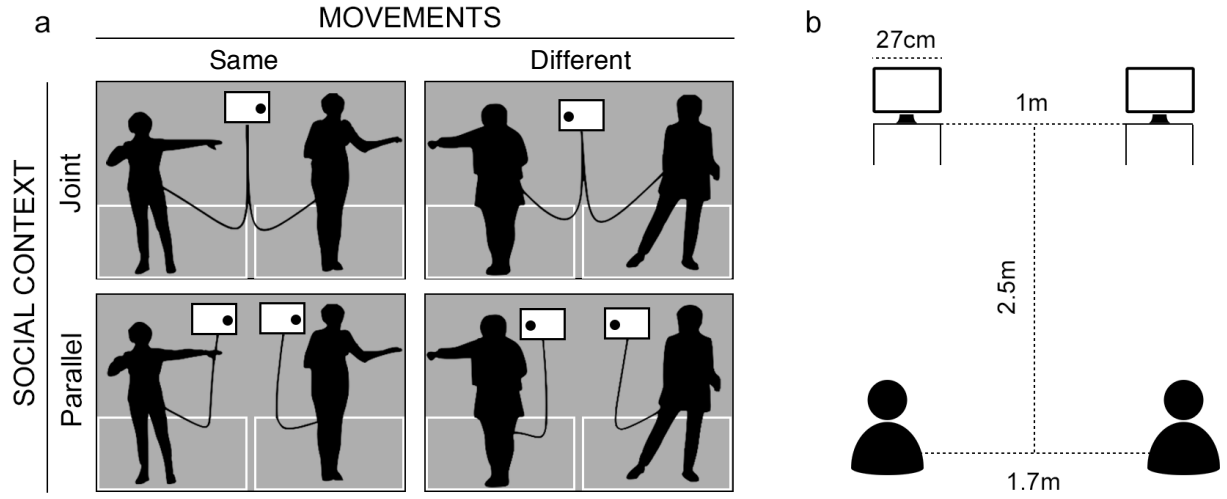

Figure 1. (a) In the joint condition, participants' headphones were plugged into a splitter and they shared a screen. In the parallel condition, participants had two separate screens and their headphones were plugged in separately. In response to a shape appearing on screen, participants either moved the same limb at the same time as each other, or when one moved a hand the other moved a foot (or vice versa). (b) Laboratory layout in the parallel context condition. In the joint condition the screen was placed in the middle.

Participants' pro-social feelings were influenced by the contingency of their actions, but not by the match between the actions they made and the actions they saw.

This leads to the prediction that for our two dancers at a silent disco, what will increase affiliation is the social context that leads them to interpret their actions as linked and contingent upon each other – that they are dancing 'together'. In contrast, the prediction from the behavioural coordination literature is that affiliation will be higher when the participants' movements are the same.

To test these predictions, we instructed pairs of participants to listen to music on headphones and to perform the same or different movements in one of two conditions: in the joint social context, participants danced 'together' looking at a single computer screen that guided their movements. In the parallel social context, they each had their own screens, side by side, showing the same movement instructions. Afterwards, we measured participants' levels of affiliation to tease apart the contribution of social context and movement similarity in producing liking.

Methods

We performed two experiments manipulating movement similarity and social context between pairs of participants. In the first experiment, as well as using a single screen, the joint social context was additionally established by giving participants the task of first untangling their headphone cables before plugging into their shared display. In our second experiment, we aimed to replicate our methods, but with the untangling task removed, so that the joint social context was established by the shared display alone. Since the experiments and analyses are identical in every other regard, we describe them together here.

Participants

We estimated an effect size of d = 0.7, following Lumsden, Miles and Macrae (2014) for affiliation effects arising from mimicry, and an a priori power analysis using G*Power (version 3.1.9.2; Faul, Erdfelder, Lang, & Buchner, 2007) suggested a sample size of 76 to achieve 85% power (with α = 0.05). To be conservative, Experiment 1 tested 80 participants (58 females; mean age = 24.66 years; SD = 6.84 years, 29 non-UK nationals) and Experiment 2 tested 82 participants (62 females; mean age = 21.8, SD = 6.1, 45 non-UK nationals), recruited from the UCL Psychology Subject Pool. No participants were excluded. Participants in both studies were compensated through course credit or a monetary reward of £4. It was ensured that the members of each dyad did not know each other prior to the experiment.

Ethics Statement

Ethical approval was obtained from the UCL Research Ethics Committee. All participants provided written informed consent before the beginning of the study and were fully debriefed upon completion.

Procedure

Experiments had a 2 x 2 (social context: joint or parallel; movements: same or different) between-subjects design with pairs randomly assigned to conditions (Figure 1). In Experiment 1, participants in the joint condition were first given the task of untangling headphone cables together then plug them in. In the parallel condition, the headphones were already plugged into separate laptops. In Experiment 2, the untangling task was not included in either condition.

Participants wore headphones and stood 1m apart from each other, 2.5m away from a table, in a square marked on the floor (Figure 1). In the parallel social context, there were two screens (diameter: 27cm, diagonal: 33.78cm) 1m apart on the table that showed identical stimuli throughout the experiment. In the joint social context, there was one screen midway between participants.

In the same movement condition, both participants were given same shape-movement instructions (e.g., circle = leg movement and triangle = hand movement). In the different movement condition, one participant had the mapping reversed. Shapes were presented randomly on the left, right or middle of the display, indicating the direction that participants were to move their limbs. After a practice stage, participants danced for 4:50 min to shapes appearing every 1.2 seconds, matching the tempo of the song 'I turn my camera on' by Spoon. Participants were then led into different rooms. We measured affiliation in two ways. First, participants responded to a 15 item subset of the Subject Impressions Questionnaire (SIQ) from the Intrinsic Motivation Inventory (Ryan, Koestner, & Deci, 1991). Second, we measured affiliation with the Inclusion of Other in Self (IOS) scale (Aron, Aron, & Smollan, 1992), in which participants chose between 7 pairs of differently overlapping circles to represent their relationship with the other participant. Finally, as a manipulation check, we asked how much the participants attended to each other, and if they felt like they were dancing 'together'. The experiment lasted for approximately 30 minutes. All measures and manipulations have been reported here, and analysis did not begin in each experiment until we had collected our target of 80 participants in each.

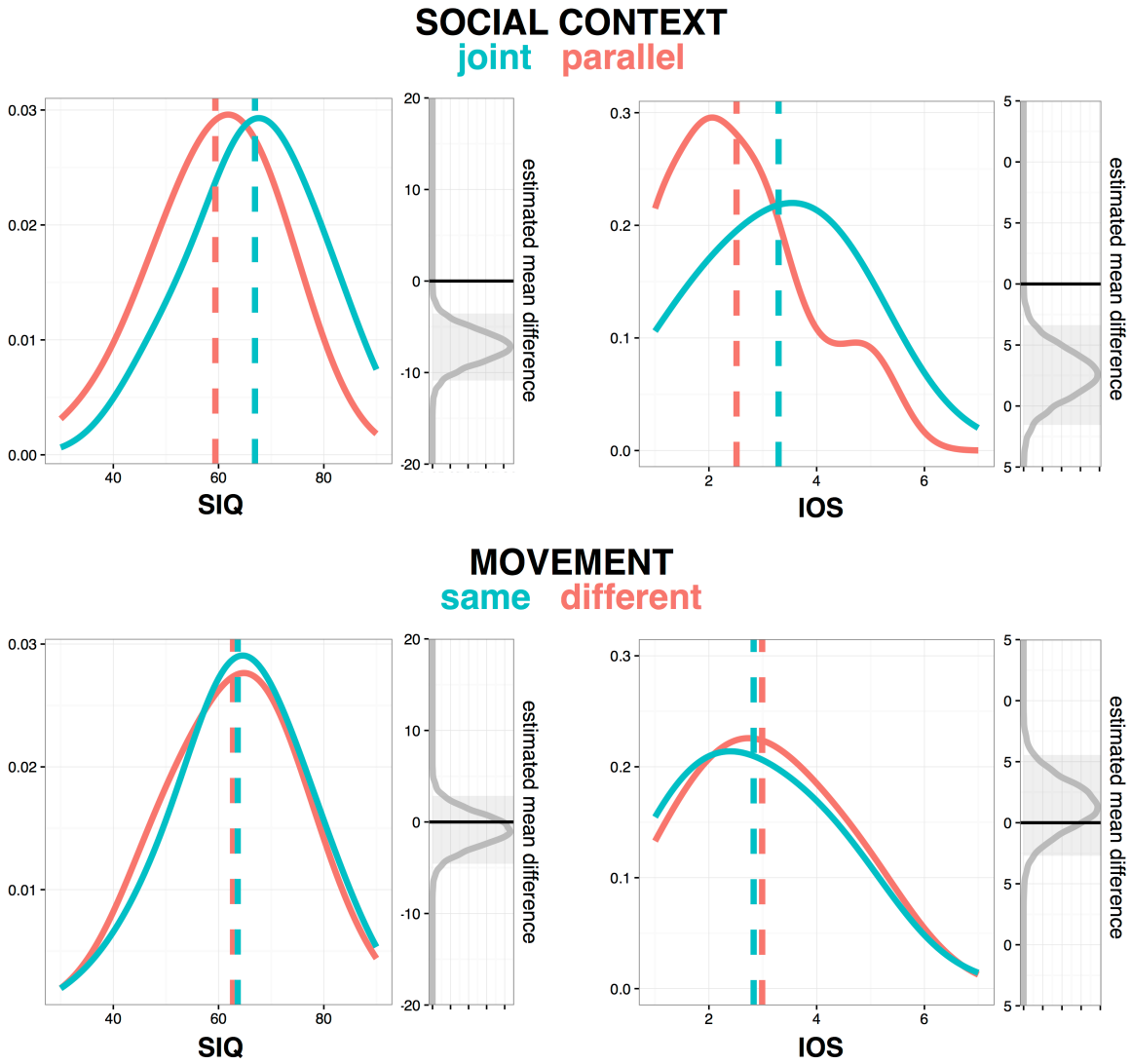

Figure 2. The main effects of social context and movement conditions on two measures of affiliation: SIQ and IOS. There were no significant interactions between the effects. Red and blue lines show the distribution of scores in each condition, with dotted lines giving mean. Grey lines show the Bayesian estimate of distribution of the difference between conditions; grey areas show the 95% credibility intervals.

Results

Across two different measures we found strong evidence that affiliation was increased by a joint social context, but was unaffected by movement similarity. We employed a Bayesian analysis of our results, since in addition to avoiding some of the problems of null hypothesis significance testing (Kruschke, 2010), these analyses are able to estimate the relative strength of evidence for and against null and alternative hypotheses (Wagenmakers, Wetzels, Borsboom, & van der Maas, 2011). Analyses were conducted in R using the BayesFactor package (Morey & Rouder, 2015) and default parameter values. For our analyses, we used the default Cauchy prior with a scale of $\sqrt{2}$ / 2, which is seen as appropriate under a broad array of situations (see Rouder, Speckman, Sun, Morey & Iverson, 2009), following the emerging practice in this application of Bayesian techniques (e.g. de Moliere & Harris, 2016), and compared against the null hypothesis that the conditions had no effect.

Figure 2 presents the distribution of SIQ and IOS scores across our manipulations and to the right of each plot, Bayesian credibility intervals (Kruschke, 2010) for the differences between conditions. These analyses suggest that between the social context conditions there is difference between mean SIQ and ISO scores, but no difference between the movement similarity conditions. Since there was no evidence in our analyses for an interaction between social context and movement conditions, the main effects are plotting in Figure 2.

To quantify the strength of these effects further we calculated Bayes factors. On SIQ scores, a Bayesian Type II ANOVA found very strong evidence in favour of a main effect of social context (Bayes factor: 300:1) over the null hypothesis, but evidence *against* a main effect of movement similarity in favour of the null hypothesis (Bayes factor 6:1) and against there being a difference between the two experiments (Bayes factor 5:1). There was also evidence against any interaction effects between conditions (Bayes factors between 3 and 4:1). A similar pattern of likelihoods was found for IOS scores. There was strong evidence in favour of an effect of social context (Bayes factor 101:1), evidence against an effect of movement condition (Bayes factor 4:1), evidence against a difference between experiments (Bayes factor 5:1), and against any interaction effects (Bayes factors between 3 and 4:1).

The conclusions we reached from Bayesian analyses were echoed by more orthodox null hypothesis testing. We ran a 2 (movement condition) x 2 (social context) x 2 (experiment) ANOVA. There was a main effect of social context on SIQ scores ($F(1,154)=16.58$; $p<.001$, $\eta_p^2=.1$) and on IOS scores $F(1,154)= 13.78$; $p<.001$, $\eta_p^2=.08$). But there was not a significant main effect of movement similarity on either measure, and no interaction between social context and movement conditions (all Fs<1).

Our manipulation check showed that there is strong evidence that participants in the joint social context felt that they were 'dancing together' more (Bayes factor 900:1), but no evidence that this was affected by movement condition (Bayes factor 0.68:1). There was weak evidence that joint social context resulted in participants paying more attention to each other (Bayes factor 3:1), but evidence in favour of the null hypothesis and against an effect of movement condition on attention (Bayes factor 6:1).

Why was there no effect of movement similarity? One possibility, the 'attention only' account, is that participants' movements did not influence their affiliation because they simply didn't pay attention to each other, but if they had, then movement similarity would have had an effect. Logically, on this account, the more attention participants paid to each other's identical movements, the larger the increase in affiliation would be. And the more they paid attention to each other's dissimilar movements, the larger the decrease in affiliation would be. However, when we looked at the attention participants paid to each other, there was no such pattern of results. In fact, an increase in participants' attention to one another did not affect SIQ and increased it for both similar and dissimilar movements for ISO.

In the case of IOS scores, attention was positively related to affiliation in both the same movement (Bayes factor 70:1) and, crucially, in the different movement condition as well (Bayes factor 50:1). Moreover, the evidence was against a model for ISO scores with attention, movement condition and an interaction between them, over a model that just included attention (Bayes factor 12:1). In the SIQ scores, there was no evidence that attention to others was related to affiliation (Bayes factor 0.35:1), and strong evidence against the hypothesis that a model with SIQ scores, movement condition and an interaction between them was preferred over the null hypothesis (Bayes factor 50:1).

We ran correlational analyses between our measure of 'attending to others' and the two measures of affiliation overall, and splitting the data according to social context and movement, to see if those relationships changed between conditions. We calculated Zou's (2007) 95% confidence intervals for differences between conditions. In each case, the CI encompassed 0, suggesting that the correlations did not differ between conditions, supporting the conclusions drawn from Bayesian analysis.

Discussion

We found two surprising results. Firstly, participants did not like each other more if they had been performing the same actions, despite the clear prediction from a host of behavioural coordination studies in the literature. Secondly, they did feel closer to each other if they had been moving together in a joint social context. This joint context was established merely by attending to a common display. If participants moved their bodies in the same way, in the same synchronised fashion, but attended to two displays a few degrees apart, then they did not feel increased affiliation towards each other.

Standard mimicry and imitation theories cannot account for these results. Their prediction is that, ceteris paribus, when participants make the same movements, their affiliation should be higher than when they are making different or

incongruent movements. However, our results did not support this prediction, and Baysian analyses strongly suggested that the likelihoods were in favour of there being no effect of movement similarity at all.

How can we explain both our finding that affiliation is dependent on social context, but also past findings that it is caused by motor mimicry? One possibility follows the associative sequence learning model, which holds that 'mirror systems' are the byproducts of learning sensorimotor contingencies in a social context (Catmur, Walsh, & Heyes, 2009). From infancy, we perceive and perform the same actions as others in the context of rewarding social interactions (Heyes, 2001). These contingencies are learnt, and in adulthood, they continue to produce mimicry, associated with pro-social feelings. Critically, as Cook, Dickinson and Heyes (2012) showed, these sensorimotor contingencies become tied to the context in which they are learned. So, crucially for our results, the sensorimotor contingencies learned from multiple social interactions would only be re-evoked in a *social context*. This provides a plausible explanation of why only our joint dancing condition affected affiliation: only when participants shared a screen, they perceived themselves to be in a social situation in which their actions were contingent upon one another.

Elsewhere in the literature, it has been shown that forms of joint action and joint attention can have widespread cognitive consequences. For example, there is interference between the stimulus-response mappings of two people engaged in a Simon task together (Sebanz, Knoblich, & Prinz, 2003). When someone believes that another person is looking at the same stimuli as them, it changes their visual attention (Richardson D., Street, Tan, Hoover, & Ghane Cavanaugh, 2012) and memory encoding (Shteynberg, 2010; He, Lever, & Humphreys, 2011). Pro-social feelings are also increased when two people attend to the same stimuli (Fridlund, 1991; Wolf, Launay, & Dunbar 2015). It seems plausible that our participants who shared a screen cognitively framed their activity in a particular manner (Huhn, Potts, & Rosenbaum, 2016), as a shared, joint activity, and from this, changes in affiliation were produced.

The interrelated roles of movement similarity and social context cannot be determined from previous results in the literature. Past experimental studies have either confounded social context with movement similarity, failed to manipulate it explicitly, or used reduced, artificial stimulus-response tasks. Indeed, our findings suggest that many past results linking motor mimicry with affiliation may have occurred, in part, because the experimental situation has established a social context in which behavioural coordination is interpreted as contingent. And we would predict that in a silent disco, if two people do not share the same music, and do not interpret their actions as shared and contingent, they will not become friends as quickly.

Acknowledgments

We thank Aastha Chadha, Michelle Huh and Ashley Kleeberg for their help with collecting data for these experiments. This research was supported in part by an ESRC transformative research grant (ES/M000680/1) awarded to G. Orgs and D. Richardson.

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