

Motor Representation and Shared Intention

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<s.butterfill@warwick.ac.uk>

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Abstract

On the assumption that motor representation plays a role in explaining how effective joint action is possible, do we also need motor representation to explain what joint action is? Philosophers tend to assume that motor representation is only an enabling condition for joint action and of no direct interest to narrowly philosophical theories of joint action and shared intention. In this talk I shall argue that social motor representation and shared intention have distinctive roles in explaining the purposiveness of joint action. This gives rise to a challenge. On the one hand, effective joint action—imagine two people erecting a tent in a gale together—sometimes requires both shared intentions and social motor representations plus a certain kind of harmony between the two. On the other hand, recognizing their distinctive roles precludes the existence of direct inferential links between shared intentions and social motor representations. The challenge is to explain how these two kinds of representation could sometimes harmoniously contribute to effective joint action despite the lack of inferential integration.

1. ***REFRAME***

Shouldn't start with the question, Which events are joint actions? Instead: either it's about making sense of purposive joint action, or else it's the question about the relation between purposive joint actions and the goals to which they are directed. (Was just trying to make it sound more important by asking Which events are joint actions. But I don't think this question bears any weight.)

2. ***EVIDENCE***

I now think three bits of evidence are relevant:

1. The GROOP effect shows that there are representations which specify each agent's task in relation to the other (so they are not simple representing the outcomes to which each of their actions are directed; they are representing an outcome to which their actions taken together are directed.)
2. Kourtis et al. (2012) shows that motor planning can occur for others' actions when we are engaged in joint action with them.
3. Vesper's ESPP paper (on jumping together and imagining jumping together — jumping is published (Vesper et al. 2012), imagining jumping is about to be submitted (as of August 2012). This shows that individuals are capable of running motor simulations of multiple roughly simultaneous actions.
4. Vesper says forthcoming EEG paper using piano playing paradigm on agent-neutral identification of error: one brain wave signals whether there is an error, and a different brain wave signals whose error it is (also tells you whether the overall harmonics are affected)

3. Introduction

Which events are joint actions? Most philosophers and many (but not all) psychologists appear to assume that this question can be fully answered just in terms of a special kind of intention or structure of intention, knowledge and commitment often called a shared (or 'collective') intention. On this widely held view, for an event to be a joint action is for it to be appropriately related to a shared intention.

[Short version: One consideration in favour of this view is ... and jump to the second consideration towards the end of section 3.2 on page on page 4.]

3.1. What is shared intention?

Of course this answer to the question about which events are joint actions assumes that we know what shared or collective intention is. But there are many accounts of it. Still, I think most people would agree that shared intention stands to joint action approximately as plain vanilla intention stands to ordinary, individual action. Further, on all or most leading accounts of shared intention, each of the following is a necessary condition:

awareness of joint-ness Agents acting on a shared intention know that they are not acting individually; they have ‘a conception of themselves as contributors to a collective end.’¹

awareness of others’ agency When agents act on a shared intention, each is aware of at least one of the others as an intentional agent.²

awareness of others’ states or commitments When two agents share an intention that they F, each is aware of, or has individuating beliefs about, some of the other’s intentions, beliefs or commitments concerning F.³

I think we can go even further and say that, on most accounts, where joint action involves shared intention, the agents act in part *because* of their awareness of joint-ness, of others’ agency and of others’ states or commitments.

What follows assumes that where one or more of these three conditions is not met, there is no shared intention.

3.2. Why shared intention?

Why might anyone hold that for an event to be a joint action is for it to be appropriately related to a shared intention? Two considerations favour this view.

First, the view might be motivated by appeal to some well-known contrast cases. Contrast cases are pairs of events which are similar in terms of the behaviour and coordination they involve but where one is a joint action while the other is not. Thus Gilbert (1990) contrasts two people walking together with two people individually walking side by side. The two pairs’ movements may be the same and similarly coordinated (to avoid collision), but walking together is a joint action whereas merely walking side by side is not. Relatedly, Searle (1990) contrasts a case in which several park visitors simultaneously run to a central shelter in order to perform a dance with another case in which the park visitors run to the central shelter in order to escape a storm. The first is a case of joint action, the second is not; but

¹ Kutz (2000, p. 10). Compare Roth (2004, p. 361): ‘each participant ... can answer the question of what he is doing or will be doing by saying for example “We are walking together” or “We will/intend to walk together.”’ Relatedly, Miller (2001, p. 56) requires that each agent believes her actions are interdependent with the other agent’s.

² Compare Bratman (1992, p. 333): ‘Cooperation ... is cooperation between intentional agents each of whom sees and treats the other as such’. See also Searle (1990, p. 105): ‘The biologically primitive sense of the other person as a candidate for shared intentionality is a necessary condition of all collective behavior’

³ This condition is necessary for shared intention even on what Tuomela (2000, p. 40) calls ‘the weakest kind of collective intention’. But it may not be necessary if, as Gold & Sugden (2007) suggest, shared intentions are constitutively intentions formed by a certain kind of reasoning.

the same movements occur in both. These sorts of contrast case invite the question, How do joint actions differ from individual but parallel actions? Gilbert's example shows that the difference can't just be a matter of coordination, because people who are merely walking alongside each other also need to coordinate their actions in order to avoid colliding. And Searle's example shows that the difference between joint action and parallel individual action can't just be that the actions have a common effect because merely parallel actions can have common effects too. If someone thought that it is possible to distinguish systematically between the contrast cases by appeal to shared intention (and perhaps only by appeal to shared intention), this could motivate holding that for an event to be a joint action is for it to be appropriately related to a shared intention.

A second consideration in favour of this view is a possible parallel between joint action and ordinary, individual action. If you think that events are actions in virtue of being appropriately related to intentions, and if you think that shared intention stands to joint action as plain vanilla intention stands to ordinary, individual action, then it seems reasonable to suppose that for an event to be a joint action is for it to be appropriately related to a shared intention (as Pacherie 2012 suggests).

3.3. My view

Let us focus on the second consideration, which hinges on a parallel between joint action and ordinary, individual action. We take for granted that the parallel obtains but we do not accept the view about ordinary, individual action.

Not everyone accepts that for an event to be an action is for it to be appropriately related to an intention. Some philosophers allow that there could be agents whose actions are purposive—and, in some cases, even intentional—although the agents have no intentions at all. For instance, Michael Bratman describes a creature who 'acts on the basis of its beliefs and considered desires' only (not intentions) as doing things 'intentionally' Bratman (2000, p. 251).

Others reject the standard view without asserting there can be action without intention. Instead they claim that ingredients other than intention are needed to say which events are actions. In particular, some claim that motor representation and intention are both needed in explaining which events are ordinary, individual actions (Pacherie 2000; Butterfill & Sinigaglia 2012). If any such view is correct, it is impossible to fully explain what it is for an event to be an action by appeal to intention alone.

Our aim in this talk is to defend a parallel view about joint action. We shall consider the possibility that fully explaining which events are joint actions requires appeal to structures of motor representation and not only to

shared intention.

Please bear in mind that we are not trying to get rid of, or replace, the notion of shared intention. In fact recognising that motor representation is needed to say which events are joint actions may make it easier to understand what shared intention is.

4. Intention and Motor Representation

[**Probably skip all of this section in the talk*]

So that you can see where this is going, let me briefly explain what stands behind the view that motor representation is needed in addition to intention in saying which events are actions.

A basic question about ordinary, individual action is: What is the relation between a purposive action and the outcome or outcomes to which it is directed? Purposive actions typically have many actual outcomes. Grabbing little Isabel by the hands I swing her around, causing her to laugh and, simultaneously, breaking a vase. Either or both of these might be outcomes to which my action is directed. Note also that some or all of the outcomes to which my action was directed might not be among its actual outcomes; after all, actions can fail. So among all the actual and possible outcomes of my action, one or some are singled out as specially related to this action. The question is what singles out the outcome or outcomes, actual or merely possible, to which a particular purposive is directed.

This question is closely related to a second. Ordinary purposive actions are sometimes composed of more than one motor action. My swinging Isabel around includes my reaching for her wrists, grasping them and then spinning us around. But my action doesn't include other things which I might be doing simultaneously, like refusing a cup of tea with my eyes or trying to determine whether that smell is coming from Isabel's sister Hannah's nappy. The second question, then, is this: For a particular action directed to a specified goal, what determines which activities⁴ comprise the purposive action and which do not?

The standard answer to both questions involves intention. An intention represents an outcome, coordinates the one or several activities which comprise the action, and coordinates these activities in a way that would normally facilitate the outcome's occurrence. What binds component activities together into larger purposive actions? It is the fact that these actions are all consequences of plans involving a single intention (and are all appropriately related to those plans). What singles out an actual or possible outcome

⁴ As we use the term 'activities', all actions are activities and so are things like reaching and grasping. This should make it clear that our position does not depend on whether or not reachings and the like are actions.

as one to which the component activities are collectively directed? It is the fact that this outcome is represented by the intention. So the intention is what binds component actions together into purposive actions and links the action taken as a whole to the outcomes to which they are directed.

Motor representations are relevantly similar to intentions, as some have recently argued (Pacherie 2008, pp. 189-90; Butterfill & Sinigaglia 2012).⁵ A *motor* representation is the sort of representation that enables us to reach for, grasp and transfer objects in a coordinated and fluid way. We follow several psychologists and philosophers in supposing that motor representations feature in planning and monitoring action (Wolpert et al. 1995; Miall & Wolpert 1996, e.g.).

How do motor representations resemble intentions? First, like intentions, some motor representations represent outcomes and not merely kinematic features of action. Like intentions, some motor representations play a role in coordinating multiple component activities by virtue of their role as elements in hierarchically structured plans. And, like intentions, some motor representations coordinate these activities in a way that would normally facilitate the outcome's occurrence. So anyone who accepts the standard story about purposive action and intention should also accept that a similar story about purposive action and motor representation. Given that the two basic questions about ordinary, individual purposive action can also be answered by appeal to intention, they can also be answered by appeal to motor representation. This motivates the following view. Not all purposive actions are bound together and linked to outcomes by intentions. In some cases what binds together purposive actions and links them to outcomes are motor representations. And of course in many cases it may be that both intention and motor representation are involved.

This is one reason for supposing that motor representation is not merely an enabling condition for ordinary, individual action but also plays a role in explaining which events are actions (and plays a role resembling that of intention). Now let's return to joint action. Could there be a parallel role for motor representation in explaining which events are joint actions?

5. Social motor representation

We start from the premise that some joint actions are facilitated by reciprocal, agent-neutral motor representations of outcomes whose obtaining would normally involve action on the part of each agent.

⁵ Of course motor representations differ from intentions in some important ways (as these authors note). But they are similar in the respects that matter for explaining the purposiveness of action.

This needs unpacking. As already mentioned, a *motor* representation is the sort of representation that enables us to reach for, grasp and transfer objects in a coordinated and fluid way. To repeat, motor representations are not concerned with merely kinematic or dynamic features of actions only. Rather, some motor representations represent outcomes, such as the movement of a target object from one place to another.

A representation (motor or not) is *agent-neutral* if its content does not specify any agent or agents.⁶ To illustrate, agent neutral representations are sometimes found at the early stages of planning. Imagine that you and some friends are tasked with preparing a holiday. You might first write down a plan of action without specifying who will act; the plan simply describes what is to be done. The plan will eventually be implemented by you and your friends but this is not written in plan itself and so it is agent-neutral. Of course the fact that this plan is your collective plan may be represented elsewhere; this fact may also be implicit in the plan's being stapled to the door of your communal kitchen. The agent-neutrality of a representation does not require that the agents are nowhere specified, only that they are not specified in the content of the representation.⁷

Two or more agents have *reciprocal* motor representations just if there is a single outcome and each agent has a motor representation of that outcome. It is hardly controversial that reciprocal motor representations exist, for their existence is suggested by a large body of research on motor cognition in action observation. It is more controversial that reciprocal motor representation occurs in joint action. Some of the research that Gunther Knoblich presented supports the claim that there are reciprocal motor representations in joint action, and he suggests that these enable joint action.⁸

I want to go a tiny step further and suggest that in joint action there are sometimes reciprocal, agent-neutral representations of outcomes whose obtaining would normally involve action on the part of each of the agents. So when we act together, some of my motor representations may concern outcomes that are partly but not entirely to be realised by my actions. For

⁶ Our use of the term 'agent-neutral' to describe motor representations bears no relation to the use of the same term to describe reasons (on the latter, see Parfit 1984).

⁷ Strictly the following argument does not hinge on the agent-neutrality of representations. It is sufficient for our purposes that there are reciprocal motor representations of outcomes whose obtaining would normally involve action on the part of each of the reciprocating agents. In principle such representations could have contents which specify other agents or multiple agents. We focus on agent-neutral representations to simplify exposition. It may be important that our view is consistent with the possibility that reciprocal motor representations are agent-neutral.

⁸ See Kourtis et al. (2012): 'the partner's expected action is simulated at the motor level, which probably facilitates effective performance of the joint action.' Kourtis et al. (2010) show that reciprocal motor representation is more likely to occur in joint action than is mere observation. See also Knoblich & Jordan (2003).

example, suppose our task is to move an object from A to B, where you pick it up and pass it to me so that I can then place it. In this case I may represent the movement of the object from A to B and not only the component movements. I represent a collective outcome of our actions and not just outcomes to which each of our actions are individually directed.

We shall use the term *social* motor representation as an abbreviation for the reciprocal, agent-neutral motor representation of outcomes whose obtaining would normally require action on the part of each reciprocating agent. (Of course we cannot assume in advance of argument that such reciprocal, agent-neutral motor representations are social in any interesting sense; but we are using the term ‘social’ in a non-standard way as an abbreviation, one that reflects our aim.)

What follows is speculative philosophy: we take for granted that social motor representation sometimes facilitates joint action and ask whether this conjecture bears on our question about which events are joint actions.

6. How could social motor representation facilitate joint action?

Suppose that social motor representation is present in some joint action contexts. It doesn’t follow, of course, that social motor representation facilitates some joint actions. But let us consider just the possibility that it might. How could social motor representation facilitate joint action even in principle?

To answer this question let us take a step back and consider an individual action. Suppose an agent moves a mug from one place to another, passing it from her left hand to her right hand half way. It is a familiar idea that motor planning, like planning generally, involves starting with relatively abstract representations of outcomes and gradually filling in details. We can capture this by supposing that motor representations for planning and monitoring action involve a hierarchical structure of representations. At the top we might find a relatively abstract representation of an outcome, in this case of the movement of the object from one location to another. Action-relevant details are progressively filled in by representations at lower stages of the hierarchy. Now in the action we are considering there is a need, even for the single agent, to coordinate the exchange between her two hands. How is this achieved? We suppose that part of the answer involves the fact that planning for the movements of each hand is not done entirely independently. Rather there is a plan for the whole action and plans for the movements of each hand are components of this larger plan. It is in part because they are parts of a larger plan that the plan for one hand constrains and is constrained by the plan for the other hand.

How is this relevant to the case of joint action? In joint action the agents

have the same goal, to move the object from one place to another. They also face a similar coordination problem, requiring a precisely timed swap from one hand to another. Now suppose, inspired by Kourtis et al. (2010, 2012) and other findings mentioned above, that the same planning is involved in the individual case (where one agent performs the whole action) and in the joint action case (where the action is distributed between two agents). The planning is the same almost up to the actual muscle contractions.

How could this be helpful? Suppose the agents' planning processes are similar enough that, for a given context and problem, they will produce approximately the same plans. Then having each agent plan the whole joint action means that (i) each agent plans the other agent's action, (ii) each agent's plan for the other agent's action is approximately the same as that agent's plan for her own action, and (iii) each agent's plans for their own action are constrained by the plans for the other agent's action.

So what enables the two agents' plans to mesh is not that they represent each other's plans but more simply that they plan each other's actions as well as their own actions as if they were each about to do the whole thing themselves.

Each agent is planning (and monitoring) both their actions almost as if a single agent were going to execute the whole action. And of course this is exactly what we want for small-scale joint action—we want two or more agents to act as one. This may be why the performance of dyads in joint actions often resembles the performance of individuals tasked with performing the whole action alone (Knoblich & Jordan 2003).

So what is the difference between the individual and the joint case? From the point of view of motor representation, the primary difference may be that in joint action there is a need to prevent execution of the parts of the action which are not one's own.

7. Grounding the purposiveness of joint action

So far we have only been considering a possible role for social motor representation in facilitating joint action. How does any of this bear on our main question about which events are joint actions? The details of how social motor representation enables joint action already give us grounds for holding that motor representation has a role to play in explaining which events are joint actions. To see why, let's go back to individual action for a moment again.

Earlier, in section 4 on page 5, we asked two questions we asked about ordinary, individual action; the same two questions also arise for joint action. What singles out the outcome or outcomes to which a purposive joint action is directed? And what binds together the various activities (of several agents)

that make up the joint action?

If we appeal to a notion of shared intention, we can answer these questions about joint action in a way that is superficially similar to way we answered the parallel questions about ordinary, individual action. A shared intention is what relates purposive joint actions to the outcomes to which they are directed. For the shared intention involves a representation, on the part of each agent, of an outcome, coordinates the several agents' activities and coordinates the several agents' activities in such a way that would normally facilitate the occurrence of the represented outcome. This is how a shared intention can bind together the activities comprising a joint action and link them to an outcome.

Our earlier discussion of how social motor representation might enable joint action already shows that social motor representation resembles shared intention in this respect. Return to the example of two agents moving an object in a way that involves passing it between them. Suppose that their passing involves a social motor representation of the outcome, which is the movement of the object. Then there are motor representations, one for each agent, of an outcome to which the joint action is directed. And these representations coordinate the several agents' activities, and do so in ways that would normally facilitate the occurrence of the outcome represented.⁹ So social motor representation can bind together the activities comprising a joint action and link them to an outcome in much the way that shared intention can.

What we are suggesting is very simple. Given the correctness of a standard view about shared intention in joint action, and given that in ordinary, individual action, motor representations bind together activities and link them to outcomes, it is plausible that in joint action, several agents' activities can be bound together and linked to an outcome by social motor representation. That is, the purposiveness of a joint action can be grounded not only in shared intention, but also in social motor representation.

8. Social motor representation: like shared intention

It may be helpful to compare and contrast the notion of social motor representation with a notion of shared intention. We shall use Bratman's account of shared intention as it is the best developed. Here are Bratman's collectively sufficient¹⁰ conditions for you and I to have a shared intention that we

⁹ This implies that social motor representation and the associated processes underwrite what Butterfill (submitted) calls *collective goals*.

J:

- '1. (a) I intend that we J and (b) you intend that we J
- '2. I intend that we J in accordance with and because of la, lb, and meshing subplans of la and lb; you intend that we J in accordance with and because of la, lb, and meshing subplans of la and lb
- '3. 1 and 2 are common knowledge between us' (Bratman 1993, p. View 4)

Let us take each of these three conditions in turn.

To see a parallel with the first condition, (1), recall two (empirical) claims on which the notion of social motor representation is based. First, some motor representations represent outcomes. Second, some motor representations represent the outcomes of actions not all of whose components will be executed by the agent whose motor representation it is. Given these claims, there is a direct parallel with Bratman's first condition, (1). Where some agents have either a shared intention or a social motor representation, there is an outcome to which their actions are directed and each agent represents this outcome. Of course there is also a difference: In the case of social motor representation, the outcome is represented motorically and need not feature in the content of any intention.¹¹

Concerning the second condition, (2), there is clearly no direct parallel. Whereas one intention can be about another intention, we assume that one motor representation cannot be about another motor representation. But there is a parallel of sorts. A function of the second condition, (2), is to ensure meshing of subplans. Each agent's having a motor representation of the outcome to which all their actions are together directed does ensure meshing of subplans. What ensures this meshing is not the fact that each agent represents the other's plans as the other's plans. Rather what ensures meshing of subplans is this: Each agent plans all of the agents' actions, and the agents rely on planning strategies that are sufficiently similar to ensure meshing subplans.

The third condition, (3), concerns common knowledge. Why is this condition needed? Bratman himself says little.¹² One possible justification for

¹⁰ In Bratman (1992), the following were offered as jointly sufficient *and individually necessary* conditions; the retreat to sufficient conditions occurs in Bratman (1997, pp. 143-4) where he notes that 'for all that I have said, shared intention might be multiply realizable.'

¹¹ Here and below we are assuming that no motor representations are intentions. If this assumption is wrong (as Pacherie 2008 suggests), social motor representation may be even more closely related to shared intention than we suggest here.

¹² See Bratman (1993, p. 117): 'it seems reasonable to suppose that in shared intention the fact that each has the relevant attitudes is itself out in the open, is public.' In other words, common knowledge is needed because it is.

supposing that shared intention involves common knowledge concerns a normative link between intention and reasons. In acting on an intention, there should be reasons for which the agent acts. And, arguably, a consideration can only be among the reasons for which an agent acts if she knows that consideration (or at least is in a position to know it). So the need for common knowledge may arise from the need to explain how reasons for which an agent acts could include facts about others' intentions. This need does not arise in the case of social motor representation (at least not in the same way). For, arguably, where actions involve motor representations, it is not true that there should be reasons for which the agent acts. (Of course there are reasons which explain why motor actions happen; but these need not be reasons for which agents act.) So motor joint action does not require that one agent's motor representations provide reasons for which another agent acts. Instead, what is required is this. There should be a good chance—good relative to the potential costs and benefits of attempting this particular joint action now—that social motor representation will provide the necessary coordination. Of course this could be guaranteed by common knowledge. But common knowledge is not required. Alternatively it can be ensured by common planning processes and a common background of dispositions, habits and expectations.¹³

If, as we have just argued, social motor representations play a role analogous to the structure of intentions and knowledge which Bratman identifies as sufficient for shared intention, then this is a (non-decisive) reason to think that motor representations can ground the purposiveness of a joint action.

9. Conclusion

Our opening question was, Which events are joint actions? The standard view is that for an event to be a joint action it must be appropriately related to a shared intention. We are in the process of arguing that this is not the whole truth about joint action, and that some events are joint actions by virtue of being appropriately related to a structure of motor representations we call social motor representation. We don't mean to suggest that all joint actions involve social motor representation. The view we are aiming to establish is rather this: Some events are joint actions in virtue of being appropriately related to social motor representations which bind their components together and ensure that there is a single outcome to which these components are collectively directed. This is why understanding which events are joint actions

¹³ Another possible line of justification the claim that common knowledge is involved in shared intention might start from a generalisation of Davidson's claim that '[a]ction does require ... that what the agent does is known to him under some description' (Davidson 1971, p. 50).

requires understanding not only shared intention but also the coordinating role of social motor representation.

This gives rise to a challenge. Effective joint action—imagine two people erecting a tent in a gale together—sometimes requires both shared intentions and social motor representation plus a certain kind of harmony between the two. To characterise the harmony required, let us define a notion of matching:

Two outcomes, A and B, *match* in a particular context just if, in that context, either the occurrence of A would normally cause or constitute, at least partially, the occurrence of B or vice versa.

When joint action involves both shared intention and social motor representation, the outcomes each of these representations specify should match. This is the required harmony. The challenge is to explain how matching could ever non-accidentally occur.

I think we can see a possible solution to this challenge by considering another problem. In constructing realisers of shared intention from ordinary individual intention, we need intentions *that we J*. As has been much discussed, the contents of these intentions cannot all refer to actions involving shared intentions. For this reason Michael Bratman suggests that things we intend are cooperatively neutral activities. It is then necessary to add further intentions in order to transform cooperatively neutral activities into joint actions. But it also seems possible that in some cases, what we intend when we intend that we J is not a cooperatively neutral activity but instead a joint action of the sort which involves social motor representation.

So perhaps harmony between shared intention and social motor representation is sometimes achieved in this way: what we intend when we share an intention is the sort of joint action that involves social motor representation.

In conclusion, two things. First, some events are joint actions in virtue of being appropriately related to social motor representations which bind their components together and ensure that there is a single outcome to which these components are collectively directed. Second, and much more tentatively, in some cases social motor representation may be among the ingredients that realise a shared intention.

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