

Intention and Motor Representation in Joint Action

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Abstract

On the assumption that motor representation plays a role in explaining how effective joint action is possible, is there also a role for motor representation in explaining 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 paper we identify a certain structure of motor representations—call it *social motor representation*—which can enable joint action, and we 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. Introduction

Which events are joint actions? We shall argue that fully answering this question involves appeal to structures of motor representation. By contrast, 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 and knowledge 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. This view is analogous to the view that, in the case of ordinary, individual action, for an event to be an action is for it to be appropriately related to an intention.

Few have argued for, or objected to, the view that for an event to be a joint action it must be appropriately related to a shared intention. This is striking because the parallel assumption about ordinary, individual action is not as widely held among leading theorists.¹ In fact, some allow that there could be agents whose actions are purposive—and, in some cases, even intentional—although the agents have no intentions at all.² 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 is to provide material for a parallel view about joint action. We shall offer considerations in favour of two claims: First, fully explaining which events are joint actions requires appeal to structures of motor representation and not only to shared intention. And, second, recognising a constitutive role for motor representation in joint action makes possible an account of shared intention which is simpler and more elegant than any of the leading alternatives.

2. Social motor representation

We start from the premise that reciprocal agent-neutral motor representation enables some joint actions. This needs unpacking. A representation (motor or not) is *agent-neutral* if its content does not specify any agent or agents.³ 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

¹ For instance, Velleman (2000, p.)

² For instance, Bratman (2000, p. 251) describes an agent called ‘Creature 2’ who ‘acts on the basis of its beliefs and considered desires’ only (not intentions) as doing things ‘intentionally’.

³ 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).

nowhere specified, only that they are not specified in the content of the representation.⁴ 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. We shall use the term *social* motor representation as an abbreviation for reciprocal agent-neutral motor representation. (Of course we cannot assume in advance of argument that 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.) So for two or more agents to have social motor representation is just for there to be a single outcome of which each agent has an agent-neutral motor representation.

Our premise is just that social motor representation is among the factors enabling some joint actions. It does not follow that social motor representation is involved in every joint action, nor that the existence of social motor representation would be sufficient for there to be joint action.

This premise is doubly controversial. While it is now well established both that there are motor representations of action outcomes (and not merely patterns of joint displacement, say), and also that there are motor representations of the outcomes of others’ actions rather than only of one’s own actions, less research has so far considered the conjecture that motor representations concern outcomes of actions which are partly but not entirely one’s own. There is also relatively little evidence for the further conjecture that such representations enable some joint actions. We shall not argue for either conjecture; they are empirical premises. What follows is speculative philosophy: an attempt to explain the consequences and significance of the conjecture that social motor representation enables some joint actions.

Why even consider the premise that social motor representation enables joint action? A direct way to test the premise would be to measure how (if at all) selective interventions on social motor representation affected agents’ performance of joint actions. As far as we know no one has done this and it may be impractical. But there are some indirect findings. We shall focus on just one, which will serve to illustrate the premise (but does not provide a decisive reason to accept it). Kourtis and colleagues report that ‘[s]imulation of another person’s action, as reflected in the activation of motor cortices, gets stronger the more the other is perceived as an interaction partner’ (Kourtis et al. 2010, p. 4). To establish this they had two subjects sit opposite each other at a table; there was also a confederate at the table, the ‘loner’. Sometimes the subjects acted alone, picking up and replacing an

⁴ 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 which concern actions which are partly but not entirely the agent’s own. In principle such representations could have contents which specify other agents or multiple agents. We focus on agent-neutral representations to simplify exposition.

object. And sometimes they had to act together, passing an object between them. The loner always acted alone. EEG measurements of motor activation were recorded. The researchers compared patterns of motor activation in four conditions: when the first subject acted, when the second subject acted, when the loner acted and when there was a ‘no go’ signal so that no one acted. They found that when one of the subjects acted, patterns of activation in each of the two subjects were similar regardless of which was acting and which was observing. By contrast, when the loner acted the subjects’ patterns of activation resembled those found in the ‘no go’ condition when there was no action. Since the researchers did not include a condition where there was a competitive, non-joint interaction, we cannot conclude that the effect they found is specific to joint action as opposed to other kinds of interaction. What we do take this paper to indicate, together with a body of other research on motor representation of observed action, is this. If you are engaged in a joint action with someone, one which involves moving an object by passing it between you, then each of you has motor representations of actions whose (perhaps improper) components include actions which will be performed by the other and these motor representations are functionally equivalent to motor representations of your own actions in the sense that they are just the sorts of representation that might have caused you to do what the other is doing if you were in her position.

For each of the agents involved in a joint action to represent motorically actions whose (perhaps improper) components include the others’ action is not yet for there to be social motor representation. For there to be social motor representation there must be an outcome (such as the movement of an object from one place to another) which each agent has an agent-neutral motor representation of. The experiment by Kourtis et al. (2010) was not designed to distinguish cases in which each agent represents the outcome to which the whole joint action is directed (in this case, the entire movement of the object) from cases in which each agent represents separately outcomes to which each of the individual actions comprising the joint action (in this case, the several movements of the object each of which just one agent is responsible for). We are making a leap and assuming (without argument) that in cases like that studied by Kourtis and colleagues, there is sometimes social motor representation.

3. How could social motor representation enable joint action?

Suppose that social motor representation is present in some joint action contexts, and, inspired by Kourtis et al. (2010), that social motor representations are more likely to occur in joint action than when one is merely observing.

It doesn't follow, of course, that social motor representation enables some joint actions. But let us consider just the possibility that it might. How could social motor representation enable 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 the 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 Koutis et al's and others' findings, 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 their 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 (*refs: Knoblich circles following task).

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.

4. Grounding the purposiveness of joint action

So far we have only been considering a possible role for social motor representation in enabling joint action. Our primary concern, though, is with what joint action is. 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 what joint action is. To see why, let's go back to individual action for a moment again.

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 activities⁵ 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

⁵ 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.

all consequences of plans involving a single intention (and are all appropriately related to those plans). What singles out an actual or possible outcome 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 forthcoming 2012). 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. For, 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 what action is (just as intention does). Now let's return to joint action.

The same two questions we asked about ordinary, individual action 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 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.⁶ 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.

5. 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 sufficient⁷ conditions for you and I to have a shared intention that we 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)

⁶ This implies that social motor representation and the associated processes underwrite what Butterfill (submitted) calls *collective goals*.

⁷ 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.'

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.⁸

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.⁹ One possible justification for 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

⁸ 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.

⁹ 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.

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.¹⁰

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.

6. Joint action without shared intention

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 but not all joint actions involve social motor representation; and there could be joint actions which involve social motor representation but not shared intention. This is why fully understanding what joint action is requires understanding the coordinating role of social motor representation and not only understanding shared intention.

We are some way off having argued for this view. One consequence of our view is that there could be joint actions without shared intention. But this does not straightforwardly follow from the claim we have argued for, namely that social motor representation is involved in some joint actions. And it also goes against a widely held view. To focus on just one case, Alonso

¹⁰ Another possible line of justification for a common knowledge component of shared intention might start from Davidson's claim that '[a]ction does require that what the agent does is intentional under some description, and this in turn requires ... that what the agent does is known to him under some description' (Davidson 1971, p. 50). If we accepted this claim, then it seems we might have to conclude that not all joint actions are actions. While this may appear to be an obstacle to accepting our view, there is an independent reason for thinking that not all joint actions are actions. For if we also follow Davidson in accepting that all actions are bodily movements (or Hornsby in accepting that all actions are tryings), it turns out that few paradigm cases of joint action are actions. For instance, we might paint a house together or make a hollandaise sauce together without there being any bodily movements of which we are both agents.

says ‘the key property of joint action lies in its internal component [...] in the participants’ having a “collective” or “shared” intention’ (Alonso 2009, pp. 444-5).¹¹ If this were right, it would be false or at least unclear that social motor representation is needed to answer the question about which events are joint actions. We must therefore defend the view that joint action need not involve shared intention.

As far as we know, the claim that all joint action involves shared intention is not explicitly argued for. The best argument we know of hinges on so-called contrast cases. Contrast cases are pairs of actions which are similar in terms of behaviour and coordination but where one is joint but the other isn’t. 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 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.

How could the contrast cases be used to argue that all joint action involves shared intention? The argument rests on this premise: It is possible to distinguish systematically between the contrast cases by appeal to shared intention and only by appeal to shared intention. To defeat this argument we shall show that there is another, more general way to distinguish contrast cases.

Take Searle’s example of several people running to the shelter. In the joint case, there is a single outcome to which each person’s actions is individually directed, namely their collective arrival at the shelter. In the contrasting individual case, where park visitors individually run to the shelter to escape a storm, there is no single outcome to which each of their actions is individually directed. Instead each visitor’s actions are directed to that visitor’s own arrival at the shelter. Similarly, turning to Gilbert’s example, when two people walk together, there is a single outcome to which both of their actions are individually directed (their collective arrival at a corner,

¹¹ ***others

say); whereas when two people merely walk side by side there is no single outcome to which each agent's actions are directed. In general, where two or more agent's actions constitute a joint action, there is an outcome to which each agent's actions are individually directed such that it is possible for them all to succeed relative to this outcome.¹² Since this is not true in the contrasting cases of non-joint action, it allows us to distinguish systematically between joint actions and their non-joint but behaviourally and coordinatively indistinguishable counterparts.

For concision let us stipulate that an outcome is a *distributive goal* of two or more agents' actions just if two conditions are met. First, this outcome is a goal to which each agent's actions are individually directed. Second, each agent's actions are related to the goal in such a way that it is possible for all the agents (not just any agent, all of them together) to succeed relative to this goal. Let us also say that a structure is *something like shared intention* if it stands to joint action roughly as intention stands to ordinary, individual action. In these terms, our claim is that joint actions involve distributive goals and that this distinguishes joint actions from non-joint actions in the standard contrast cases. Given that the existence of a distributive goal need involve nothing like a shared intention, we can conclude that systematically distinguishing between the contrast cases does not require anything like shared intention.

I think this argument is mistaken for two reasons.

7. Slide

First because there are contrast cases in which the joint action does not involve shared intention. For instance, contrast our lifting a sofa together with us each individually raising either end of the sofa, coincidentally at the same time. The former is a joint action whereas the latter is arguably not. But I don't think it's right to assume that lifting a sofa together necessarily involves shared intention (although our *buying* a sofa together might). So it seems to me that the contrast cases give us no reason at all to suppose that all joint actions involve shared intention.

In fact the existence of cases like the sofa indicate that appeal to shared intention does not provide a sufficiently general way of explaining the difference illustrated by the contrast cases.

This brings me to a second consideration. There is a more general notion

¹² Some readers may be sceptical of this claim. But note that it is a consequence of the view we are opposing, the view that all joint actions involve shared intention. Or, rather, it is a consequence of this view given a further premise which is a consequence of any standard account of shared intention: Where several agents act on a shared intention that they J, each will perform an action directed to J and it is possible for them all to succeed in J-ing.

appeal to which enables us to distinguish the contrast cases. Genuine joint action differs from merely parallel action because the former involves each agent's representing an outcome to which all of their actions are directed where these outcome representations coordinate their actions in a way that would normally facilitate their collective success in bring about this outcome.

8. Slide

(Actually I don't think this is quite general enough because I think some joint actions involve non-representational coordinative structures only; I am also doubtful that there is a sharp distinction between merely parallel and genuinely joint action and I think it is possible to see the difference as a matter of degree. But I don't want to get into that here. It's sufficient that we have moved away from the bare shared intention account. [*WHAT WE REALLY NEED IS A COLLECTIVE OR SHARED GOAL, and the possibility of gradual construction shows that there's no magic moment separating joint from parallel action.]

To sum up so far, I reject the claim that reflection on the contrast cases provides any support for the idea that all joint action involves shared intention.

9. Slide

So far I have been assuming that there is an inconsistency between two claims: (1) my claim that reciprocal agent-neutral motor representation can ground purposive joint action (2) many philosophers' claim that all joint actions involve shared intention.

But maybe it is a mistake to think that these are inconsistent. Why not suppose that some social motor representations are shared intentions?

10. Slide

If some reciprocal agent-neutral motor representations are shared intentions, then there is no inconsistency. And what I've just been arguing is that agent-neutral motor representations resemble shared intentions in that both play a role in coordinating agents' actions by virtue of representing outcomes. Isn't that enough to justify identifying them as shared intentions?

This issue might easily seem narrowly conceptual or terminological. At the end of the day it doesn't much matter if we want to call some motor representations 'shared intentions'. After all, on most accounts shared intentions are neither shared nor intentions so we would hardly be doing more violence

to the term than is already being done. So insofar as labeling some social motor representations shared intentions might help to avoid unnecessarily philosophical discussion, I'm all in favour. However, there is an important difference between the states normally regarded as shared intentions and any motor representations. And this difference matters for understanding the interface between shared intention and motor representation.

[*PLAN for what follows:*

Difference in format. Leads to the interface problem. Shared intentions can be inferentially integrated with other shared intentions; but not they cannot be inferentially integrated with social motor intentions (two disjoint planning processes). Elisabeth Pacherie's proposal: shared intentions set outcomes to be achieved by social motor representations. I borrow this idea from her, but it raises a further problem. The problem is how the one sets outcomes for the other given the difference in representational format.

11. Slide

In what respects do reciprocal agent-neutral motor representations differ from shared intentions?

12. Slide

As background we first need a generic distinction between content and format. Imagine you are in an unfamiliar city and are trying to get to the central station. A stranger offers you two routes. Each route could be represented by a distinct line on a paper map. The difference between the two lines is a difference in content.

13. Slide

Each of the routes could alternatively have been represented by a distinct series of instructions written on the same piece of paper; these cartographic and propositional representations differ in format.

Format matters because only where two representations have the same format can they be straightforwardly inferentially integrated.

14. Slide

To illustrate, let's stay with representations of routes. Suppose you are given some verbal instructions describing a route. You are then shown a represen-

tation of a route on a map and asked whether this is the same route that was verbally described. You are not allowed to find out by following the routes or by imagining following them. Special cases aside, answering the question will involve a process of translation because two distinct representational formats are involved, propositional and cartographic. It is not enough that you could follow either representation of the route. You will also need to be able to translate from at least one representational format into at least one other format.

15. Slide

This brings me to the argument ...

1. Only representations with a common format can be inferentially integrated.
2. Any two intentions can be inferentially integrated in practical reasoning.
3. My intention that I visit Paris on Friday is a propositional attitude.

16. Slide

It follows that All intentions are propositional attitudes

17. Slide

But it is also widely agreed that: No motor representations are propositional attitudes.

18. Slide

So we can conclude that: No motor representations are intentions

19. Slide

This step—Any two intentions can be inferentially integrated in practical reasoning—is questionable. I don't have an argument for this and I'm not sure it isn't terminological. What I care about is that we distinguish attitudes according to the processes in which they feature. So if you like we could

distinguish two kinds of intention, one propositional the other motor. As long as we distinguish representations of different formats I don't see that it matters too much whether we call them all intentions or whether we use that term for only some of them.

20. Slide

So where does this leave us? The question was whether reciprocal agent-neutral motor intentions could count as shared intentions.

21. Slide

In answer to that question, I think this: (a) IF you agree motor representations are not intentions, THEN reciprocal agent-neutral motor representations are not shared intentions.

And (b) IF motor representations are a non-propositional variety of intention, THEN reciprocal agent-neutral motor representations are a non-standard variety of shared intentions.

The key thing is that, either way, reciprocal agent-neutral motor representations cannot be inferentially integrated with shared intentions in practical reasoning. This leads to what I'll call 'The Interface Problem'

22. Slide

It will take me a moment to explain what the problem is.

23. Slide

The first step is to note that: Some joint actions involve both shared intention and reciprocal agent-neutral motor representation. Imagine two people setting up a tent in a gale together, for example. It seems success will often require many ingredients including shared intention for the large-scale planning and reciprocal agent-neutral motor representation for passing objects and bending the poles together.

24. Slide

Earlier I argued that reciprocal agent-neutral motor representations:

- represent outcomes;

- ground the purposiveness of some joint actions; and

25. Slide

This means, I think, that in at least some cases of effective joint action there will be a certain kind of harmony between the contents of reciprocal agent-neutral motor representations and the contents of shared intentions. Further, I think it's probable that, in some cases, the harmony is non-accidental.

To be clearer about what 'harmony' means, we need the 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 constitute or cause, at least partially, the occurrence of B or vice versa.

In some cases of joint action, the outcomes each kind of representation specifies non-accidentally match.

26. Slide

This leads to a question: how are non-accidental matches between the outcomes specified by shared intentions and by reciprocal agent-neutral motor representations possible?

A natural suggestion is that matching is achieved through practical reasoning. It is in this way that the contents of shared intentions could partially determine the contents of reciprocal agent-neutral motor representations. But there is **an obstacle** to this idea.

27. Slide

For as we saw earlier, reciprocal agent-neutral motor representations

- differ in format from (the constituent attitudes of) shared intentions.

Given that only representations with a common format can be inferentially integrated in practical reasoning, we cannot appeal to reasoning to explain how the outcomes specified by shared intentions match the outcomes specified by reciprocal agent-neutral motor representations. This is why the interface problem is a problem.

28. Slide

In conclusion, I have suggested that reciprocal agent-neutral motor representations can ground purposive joint action for they can coordinate two or more agents' actions in virtue of representing a single outcome to which each agent's actions are directed.

I also suggested, further, that reciprocal agent-neutral motor representation and shared intention have distinctive roles in explaining the purposiveness of joint action.

And this suggestion has two consequences. One is that we cannot properly understand what joint action is if we focus only on shared intention. The other is that we face a challenge. The challenge is to explain how these two kinds of representation could sometimes harmoniously contribute to effective joint action despite not being inferentially integrated in practical reasoning.

29. ***CUT

So what are intentions for?

Let us to assume that intentions are something over and above basic beliefs and desires; that an intention is not, for instance, merely a strongest desire or, as Donald Davidson held at an early stage of his thinking, merely a belief-desire pair. Intention involves more than this.

There is a temptation to assume that intention is involved in every case of purposive action. But it's hard to see what the argument for this assumption could be. In many cases it seems that beliefs, desires and motor representations are all that is needed to explain purposive action. You offer me a biscuit. I want one, and I believe I can get one by reaching out for it. So I do reach for it. As far as I can see, there's no need to suppose that, in addition to the belief and desire, it must be the case that I also intend to take a biscuit. (At least not unless we take 'intention' to mean 'strongest desire', which it does not.) Maybe I do intend this. But it's possible for an agent to take and eat a biscuit, and to do so purposively, without having any intentions at all. Beliefs, desires and motor representations are sufficient.

So if we don't need intentions merely to perform a purposive action, what are intentions for?

This question becomes more pressing if you consider that motor representations enable quite sophisticated planning over short periods of time and sequences of action; for example, how you grasp a pointer will depend on what you are about to do with it (Zhang & Rosenbaum 2007).

This sort of planning does not need intentions at all. So (again) what are intentions for?

Bratman suggests that *Intentions are for planning multiple separate actions over longer periods of time; and for planning multiple separate actions whose execution is mutually constraining where the outcomes cannot be represented motorically.*

This is a case where intentions are really needed [see figure in slide] — here one can't act on strongest desire (for the big reward) if want to maximise rewards by collecting the small and the large reward. And one can't rely on motor representation because the motor system doesn't care about things that cannot be represented in motor terms.

I don't think, of course, that intentions are only involved in actions which require planning of this sort. But I do think it's only in such actions that absolutely require intentions.

Not all purposive actions involve any planning of this sort.

Now you could imagine a two-person version of this task where we are rewarded for what we collectively achieve. In this case it's optimal if one of us goes for the small reward and the other goes for the large reward. I think it's this kind of planning that shared intention is really for.

By contrast, in many ordinary cases of joint action there is no need for planning of this sort and so no need for shared intention. Actions such as these *might* involve shared intention but they do not *necessarily* involve shared intention.

We are suggesting that some joint actions—like the one two people move an object in a way that involves passing it between them—don't require this kind of planning and so don't necessarily involve shared intentions. In some cases, social motor representation alone is sufficient for purposive joint action.

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