Lecture 09 : Philosophical Issues in Behavioural Science

Stephen A. Butterfill
< s.butterfill@warwick.ac.uk >

Monday, 2nd December 2024

Contents

1. Conclusion to Philosophical Issues in Behavioural Science

This lecture is backwards. It starts with the conclusion to the whole course because the whole class is together only for the first half of the lecture.

1.1. Integration Questions

The course has centered on a set of *Integration Questions*.

> Where there are philosophical, psychological and formal theories which appear to target a single set of phenomena while saying incompatible things about it, we face two questions: * Are they actually inconsistent? * if so: how, if at all, should either or both theories be refined?

Such questions pose the Integration Question.

An Integration Question is interesting because apparent conflicts between philosophical, psychological and formal theories arise at the most fundamental level.

Hint The long essay questions for this course are about aspects of this integration Question (except those which are about an interface problem). You are asked to find significant inconsistencies or to advance our understanding of how integration is possible.

1.2. Five Integration Questions

By the end of this course we will have investigated five integration questions:

1. Standard Solution to The Problem of Action vs the dual-process theory of instrumental action (see *The Problem of Action meets Habitual Processes* in Lecture 02)

2. Standard Solution to The Problem of Action vs theories of motor control (see *Motor Representation and The Problem of Action* in Lecture 07)

3. Decision theory vs the dual-process theory of instrumental action (see *Dual Process Theory Opposes Decision Theory?* in Lecture 03 and ** **ERRoR! MISSING xref FOR** $unit$: $ellsberg_paradox_vs_dual_process_theory$ **)

4. Bratman's theory of shared intention vs team reasoning (see *From Team Reasoning to Shared Intention* in Lecture 06

and *From Team Reasoning to Shared Intention* in Lecture 06)

5. Bratman's theory of shared intention vs motor representations of collective goals (see *Could Motor Representations Ground Collective Goals?* (section §5))

2.   Introduction to Lecture 09

This lecture depends on you having studied some sections from a previous lecture:

- *Philosophical Theories of Action* in Lecture 01

- ** **ERRoR! MISSING xref FOR** $unit : philosophical_t heories_h abits$ **

- *The Problem of Action meets Habitual Processes* in Lecture 02

- *Goal-Directed and Habitual Processes* in Lecture 01

- *Motor Representation* in Lecture 07

- *Motor Representation and The Problem of Action* in Lecture 07

None of this lecture is required for the minimum course of study.

3.   Solution to the Problem of Action

This section presents a novel attempt to solve to the Problem of Action. This is not intended to convince you that the solution offered is correct, only to provoke further evaluation.

The Problem of Action is the question,

What distinguishes your actions from things that merely happen to you? (see *Philosophical Theories of Action* in Lecture 01)

The following candidate solution is limited to instrumental actions only. That is, actions which happen in order to bring about outcomes.

Terminology: When an action happens in order to bring about an outcome, it is directed to that outcome. And an outcome to which an action is directed is a goal.

Note that goals are outcomes. For example, the goal of your actions might be to fill Zac's glass. Goals are therefore not intentions, nor any other kind

of mental states.[1]

For an instrumental action to be initiated, sustaned and brought to a successful conclusion, various problems must be solved. These characteristically include:

- Which outcomes are achievable?
- For each outcome, which means of achieving it are available?
- Of the various means of achieving a given outcome, which best balance cost against well-suitedness?[2]
- Of the achievable outcomes, which best balance cost against expected benefit?
- Having settled on an outcome and means, when should these be maintained and when should they be abandoned?

Up to this point, the notion of 'directedness' has been specified in a narrowly schematic way only, by appeal to the idea that an instrumental action happens in order to being an outcome about. What does this amount to?

One answer is this:

> For an event to be directed to an outcome is for it to occur because there is one or more outcome in relation to which problems such as those above have been, or appear to have been, solved.

The idea, then, is that we can specify directedness by appeal to problems solving which is characteristic of action.

Note that in specifying directedness, we did not presuppose a notion of action. (The statement above is about an *event* being directed to an outcome.) This allows us to propose, without circularity, that:

> An *action* is an event that is directed to an outcome.

---

[1] It is helpful to distinguish a goal from a goal-state, which is an intention or other state of an agent linking an action to a particular goal to which it is directed. (Some authors use the term 'goal' for goal-states rather than outcomes.) A goal is a possible or actual outcome (such as filling a glass with prosecco). A goal-state is a psychological attribute of an agent (such as an intention to fill a glass with prosecco).

[2] The *cost of an action* may include, among other things, the energy required, the degree of discomfort involved, and extent to which performance of the action demands attention, working memory and other scarce cognitive resources. One action is more *well-suited* to bringing about an outcome in a situation if, in that situation, the first action is more likely to bring the outcome about than the second action. (For example, in most situations, walking over to the sink and carefully placing your plate into it is more likely to succeed in getting your plate into the sink than throwing it from the other side of the kitchen door would be.)

This is the solution to The Problem of Action.

This solution avoids the objectons to the Standard Solution which were elaborated in *The Problem of Action meets Habitual Processes* in Lecture 02 and in *Motor Representation and The Problem of Action* in Lecture 07.

It is an alternative to the two dominant approaches in philosophy of action, those inspired by Davidson (1980) and those inspired by Anscombe (1957). Accepting this novel solution also involves rejecting the Causal Theory of Action.

(The Causal Theory of Action might work if, necessarily, all actions involved just one kind of process. The fact that there are at least two kinds of process (see *Goal-Directed and Habitual Processes* in Lecture 01) makes pursuing this theory less clearly sensible.)

This solution is mechanistically neutral: that is, distinguishes actions from things that merely happen to you without making commitments concerning which states, or structures of states, cause instrumental actions.

As there is no published defence of the solution proposed here, and as it involves such a radical departure from the influential views, the above solution to The Problem of Action should be treated as almost certainly incorrect. Useful if it provokes independent critical thinking; not necessary to consider in essays.

4.   Collective Goals

An outcome is a collective goal of two or more actions involving multiple agents just if the actions are directed to this goal and this is not, or not just, a matter of each action being individually directed to that goal.

4.1.   Key Notions

A goal is an outcome to which one or more actions are directed. Someone might say, for example, 'the goal of our actions is to free Nelson Mandela.' Note that a goal is not an intention, nor any mental state of the agents. (At least, not usually.) The freedom of Nelson Mandela is not a mental state of those who ensured his freedom.

An outcome is a collective goal of two or more actions involving multiple agents if it is an outcome to which those actions are directed where this is not, or not only, a matter of each action being directed to the outcome.

Can you give sufficient conditions for there to be a collective goal? Yes!

If there is a single outcome, G, such that

1. Our actions are coordinated; and
2. coordination of this type would normally increase the probability that G occurs.

then there is an outcome to which our actions are directed where this is not, or not only, a matter of each action being directed to that outcome, i.e. our actions have a collective goal.

Question for a theory of joint action: In virtue of what could two or more agents' actions have a collective goal?

5. Could Motor Representations Ground Collective Goals?

Motor representations can ground collective goals in this sense: in some cases, two or more actions involving multiple agents have a collective goal in virtue of the actions being appropriately related to an interagential structure of motor representations. Or so the discoveries presented in this section suggest.

This section considers the conjecture that some motor representations specify collective goals.[3]

5.1.   Why suppose that the conjecture is true?

Various predictions of the conjecture have recently been tested and confirmed (Sacheli et al. 2022, 2018; della Gatta et al. 2017; Clarke et al. 2019). As this evidence is still quite limited, we cannot yet be very confident that the conjecture is true. There is also a larger body of evidence that indirectly motivates it, some of which is introduced in the video.

5.2.   If true, what could the conjecture explain?

Any account of joint action should answer the question,

In virtue of what could two or more agents' actions have a collective goal?

---

[3] this conjecture is a version of Pacherie & Dokic (2006, p. 111)'s view that in 'joint action control [...] each agent adjusts his own actions as a function of the common goal and of the predicted consequences of the actions of other participants.' Related ideas can also be found in della Gatta et al. (2017); Sacheli et al. (2018); Clarke et al. (2019). See Sinigaglia & Butterfill (2022) for an in-depth discussion.

In some cases, it is probably the agents' shared intention in virtue of which their actions have a collective goal (whatever exactly shared intention turns out to be.)

But if the conjecture is true, there are cases in which it is in virtue of an interagential structure of motor representations that actions have a collective goal (whatever exactly shared intention turns out to be.)

What is this interagential structure of motor representations?

> First, there must be an outcome to which the actions are, or could be, collectively directed, and in each agent there must be a motor representation of this outcome.
>
> Second, these motor representations must trigger planning-like processes which result in plan-like hierarchies of motor representations in each agent.
>
> Third, the plan-like hierarchy in each agent must involve motor representations concerning not only actions she will eventually perform but also actions another will eventually perform.
>
> Fourth, the plan-like hierarchies of motor representations in the agents must non-accidentally match.

When all four conditions are met, the result is an interagential structure of motor representations.

Because the existence of this interagential structure would provide for the coordination of the agents' actions around the outcome represented motorically, it ensures that sufficient conditions are met for the existence of a collective goal of their actions. (The sufficient conditions featured in the section on *Collective Goals* (section §4).)

Note that this does not imply that there are any cases of joint action which do not involve shared intention. The challenge to the philosophical accounts (e.g. *Bratman on Shared Intentional Action* in Lecture 04) is not that they fail to give necessary conditions. It is that there are basic questions about joint action which cannot be fully answered without going beyond philosophical frameworks to consider scientific discoveries.

5.3.   Appendix: More Detail

Does the interagential structure of motor representations identified above really provide for coordination?

How could it do so?

To fully understand this, we need two things. An understanding of bimanual coordination in ordinary, individual action. And the notion of parallel planning.

5.3.1.   Bimanual Coordination in Ordinary, Individual Action

Consider what is involved when, in acting alone, you move a mug from one place to another, passing it between your hands half-way. In this action there is a need to coordinate the exchange between your two hands. If your action is fluid, you may proactively prepare to release the mug from your left hand moments in advance of the mug's being secured by your right hand (compare Diedrichsen et al. 2003). How is such tight coordination achieved? A full answer cannot be given by appeal to physiology alone (Jackson et al. 2002; Piedimonte et al. 2015). Instead, part of the answer involves the fact that there is a motor representation for the whole action which triggers planning-like motor processes, so that the motor representations and processes concerning the actions involving each hand are not entirely independent of each other (compare Kelso et al. 1979 and Rosenbaum 2010, pp. 244–8). Such planning-like processes result in motor representations concerning different parts of the action which can be hierarchically arranged by the means-ends relation and ensure that relational constraints on components of the action are satisfied. So when you move a mug from one place to another, passing it between your hands half-way, and when this action and its components are represented motorically in a plan-like hierarchy, it is this plan-like hierarchy which ensures the movements of one hand constrain and are constrained by the movements of the other hand.

This is how motor representations of outcomes can coordinate the actions of an individual agent using two hands.

Now switch from an individual agent performing a bimanual action to two agents acting together.

Motor representation can play a similar role when two agents act together. To see how, we need the notion of parallel planning.

5.3.2.   Parallel Planning

When we considered *Bratman on Shared Intentional Action* in Lecture 04, we followed him in focussing on interconnected planning. This is planning in which facts about your plans feature in mine and conversely:

> 'each agent does not just intend that the group perform the [...] joint action. Rather, each agent intends as well that the group perform this joint action in accordance with subplans (of the

intentions in favor of the joint action) that mesh.' (Bratman 1992, p. 332)

On Bratman's view,

'shared intentional agency consists, at bottom, in interconnected planning agency of the participants.' (Bratman 2011).

Our planning is *parallel* just if you and I are each planning actions that I will eventually perform and actions that you will eventually perform, where the resulting plans non-accidentally match.

For parallel planning to be possible without irrationality, it can involve only agent-neutral representations and processes. It must also result in intentions that are open-ended with respect to who will act.

It may be controversial whether parallel planning involving practical reasoning and intentions is actually at all possible without irrationality. But our concern is different: we know that some motor processes are planning-like in that they involve computing means from representations of ends and in that they involve satisfying relational constraints on actions happening at different times. Perhaps there is something like parallel planning that involves not practical reasoning and intentions but motor processes and representations?

But is there any evidence that parallel planning involving motor representations ever occurs? Planning concerning another's actions sometimes occurs not only in observing her act but also in exercising collective agency with her (Kourtis et al. 2013; Meyer et al. 2011). Such planning can inform planning for your own actions, and even planning that involves meeting constraints on relations between your actions and hers (Vesper et al. 2013; Novembre et al. 2014; Loehr & Palmer 2011; Meyer et al. 2013).[4]

5.3.3.   How the Interagential Structure Coordinates

So how does the interagential structure of motor representations identified above provide for coordination of two agents' actions?

---

[4]   This evidence is compatible with two possibilities. It could be that there is a single planning processes concerning all agents' actions, just as parallel planning requires; but it might also be that, in each agent, there are two largely separate planning processes, one for each agent's actions. But, as mentioned above, there is evidence that collective goals are represented motorically. This evidence suggests that sometimes when exercising collective agency, the agents have a single representation of the whole action, not only separate representations of each agent's part (see also Tsai et al. 2011; Loehr et al. 2013; Ménoret et al. 2014). It follows that the second possibility obtains, at least sometimes.

The plan-like structure of motor representations in you concerns not only actions you will perform but also actions I will perform. This ensures that your actions are constrained by your plan for my actions. But because your plan-like structure matches my plan-like structure, this means that your actions are, in effect, constrained by my plan for my actions. And conversely.

So the interagential structure of motor representations identified above provides for the coordination of our actions in something like the way that motor representations coordinate the bimanual actions of an individual agent.[5]

5.4.   Appendix: Further Sources

There are lots of additional sources in the references section of a guide to psychological research on coordination in joint action written for philosophers (Butterfill 2017).

As you can see from the video, quite a bit has happened since that guide was written. The new research mostly confirms and extends the earlier research.

6.   Conclusion

In this lecture we investigated the role of motor representations of collective goals in joint action. We also considered task co-representations as providing a possible joint counterpart to the stimulus–action links involved in habitual processs.

The findings indicate that there may be joint counterparts of the integration challenges and interface problems that we identified in considering the roles of motor representation, and, separately, habitual processes, in individual action.

7.   Task Co-Representation

Habitual processs play a role in individual action. What, if anything, plays a corresponding role in joint action?

This was not part of the lectures given in 2024–25.

---

[5]   There are some important differences, of course. Most obviously, in the case of joint action there is more than one agent and so more than one plan-like structure of motor representations. And since in each of us there are representations of actions the other will eventually perform, something must prevent these motor representations from producing actions.

'The terms 'task co-representation' and 'shared task representations' refer to the idea that during joint task performance, each co-actor represents not only her own part, but also the part to be performed by the co-actor.' (Atmaca et al. 2011, p. 372)

Glossary

agent-neutral A representation or plan is *agent-neutral* if its content does not specify any particular agent or agents; a planning process is *agent-neutral* if it involves only agent-neutral representations. 9

bimanual two-handed 8

Causal Theory of Action According to this view, an event is action 'just in case it has a certain sort of psychological cause' (Bach 1978, p. 361). 5

collective goal an outcome to which two or more agents' actions are directed where this is not, or not only, a matter of each action being directed to that outcome (Butterfill & Sinigaglia 2022). 3, 5, 6, 10

co-representation Two or more individuals *co-represent* something if they each individually represent it and their representations are of the same kind (for example, they are both motor representations). Co-representation is not metarepresentation: instead of representing another's representation, co-representation involves representing the thing represented. 15

decision theory I use 'decision theory' for the theory elaborated by Jeffrey (1983). Variants are variously called 'expected utility theory' (Hargreaves-Heap & Varoufakis 2004), 'revealed preference theory' (Sen 1973) and 'the theory of rational choice' (Sugden 1991). As the differences between variants are not important for our purposes, the term can be used for any of core formal parts of the standard approaches based on Ramsey (1931) and Savage (1972). 2

directed For an action to be *directed* to an outcome is for the action to happen in order to bring that outcome about. 3

dual-process theory of instrumental action Instrumental action 'is controlled by two dissociable processes: a goal-directed and an habitual process' (Dickinson 2016, p. 177). (See instrumental action.) 2

goal A *goal* of an action is an outcome to which it is directed. 3–5

goal-state an intention or other state of an agent which links an action of hers to a particular goal to which it is directed. 4

habitual process A process underpinning some instrumental actions which obeys *Thorndyke's Law of Effect*: 'The presentation of an effective [=rewarding] outcome following an action [...] reinforces a connection between the stimuli present when the action is performed and the action itself so that subsequent presentations of these stimuli elicit the [...] action as a response' (Dickinson 1994, p.48). (Interesting complication which you can safely ignore: there is probably much more to say about under what conditions the stimulus–action connection is strengthened; e.g. Thrailkill et al. 2018.) 10, 15

instrumental action An action is *instrumental* if it happens in order to bring about an outcome, as when you press a lever in order to obtain food. (In this case, obtaining food is the outcome, lever pressing is the action, and the action is instrumental because it occurs in order to bring it about that you obtain food.) You may encounter variations on this definition of *instrumental* in the literature. For instance, Dickinson (2016, p. 177) characterises instrumental actions differently: in place of the teleological 'in order to bring about an outcome', he stipulates that an instrumental action is one that is 'controlled by the contingency between' the action and an outcome. And de Wit & Dickinson (2009, p. 464) stipulate that 'instrumental actions are *learned*'. 3, 11

interagential planning Our planning is *interagential* just if you and I are each planning actions that I will eventually perform and actions that you will eventually perform, where the resulting plans non-accidentally match. Contrast interconnected planning. 12

interconnected planning Our plans are *interconnected* just if facts about your plans feature in mine and conversely. Contrast interagential planning. 8, 12, 14

interface problem An interface problem may arise when two kinds of representation sometimes non-accidentally match: the problem is to explain how such matches are possible. 2, 10

joint action Many of the things we do are, or could be, done with others. Mundane examples favoured by philosophers include painting a house together (Bratman 1992), lifting a heavy sofa together (Velleman 1997), preparing a hollandaise sauce together (Searle 1990), going to Chicago together (Kutz 2000), and walking together (Gilbert 1990). These ex-

amples are supposed to be paradigm cases of a class of phenomena we shall call 'joint actions'.

Researchers have used a variety of labels including 'joint action' (Brooks 1981; Sebanz et al. 2006; Knoblich et al. 2011; Tollefsen 2005; Pettit & Schweikard 2006; Carpenter 2009; Pacherie 2010; Brownell 2011; Sacheli et al. 2018; Meyer et al. 2013), 'social action' (Tuomela & Miller 1985), 'collective action' (Searle 1990; Gilbert 2010), 'joint activity' (Baier 1997), 'acting together' (Tuomela 2000), 'shared intentional activity' (Bratman 1997), 'plural action' (Schmid 2008), 'joint agency' (Pacherie 2013), 'small scale shared agency' (Bratman 2014), 'intentional joint action' (Blomberg 2016), 'collective intentional behavior' (Ludwig 2016), and 'collective activity' (Longworth 2019).

We leave open whether these are all labels for a single phenomenon or whether different researchers are targeting different things. As we use 'joint action', the term applies to everything any of these labels applies to. 10

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

To illustrate, one way of matching is for the B-outcomes to be the A-outcomes. Another way of matching is for the B-outcomes to stand to the A-outcomes as elements of a more detailed plan stand to those of a less detailed one.

[of plan-like structures] In the simplest case, plan-like hierarchies of motor representations *match* if they are identical. More generally, plan-like hierarchies *match* if the differences between them *do not matter* in the following sense. For a plan-like hierarchy in an agent, let the *self part* be those motor representations concerning the agent's own actions and let the *other part* be the other motor representations. First consider what would happen if, for a particular agent, the other part of her plan-like hierarchy were as nearly identical to the self part (or parts) of the other's plan-like hierarchy (or others' plan-like hierarchies) as psychologically possible. Would the agent's self part be different? If not, let us say that any differences between her plan-like hierarchy and the other's (or others') are *not relevant* for her. Finally, if for some agents' plan-like hierarchies of motor representations the differences between them are not relevant for any of the agents, then let us say that the differences *do not matter*.

[of motivational states] Two motivational states match in a particular context just if, in that context, the actions one would cause and the actions the other would cause are all proper ways of fulfilling both motivational states. 7, 10

mechanistically neutral A characterisation of instrumental action (or of joint action) is *mechanistically neutral* just if it does not involve making commitments concerning which states, or structures of states, cause instrumental actions (or cause joint actions). 5

motor representation The kind of representation characteristically involved in preparing, performing and monitoring sequences of small-scale actions such as grasping, transporting and placing an object. They represent actual, possible, imagined or observed actions and their effects. 3, 6, 7, 10

outcome An outcome of an action is a possible or actual state of affairs. 5, 11

parallel planning Our planning is *parallel* just if you and I are each planning actions that I will eventually perform and actions that you will eventually perform, where the resulting plans non-accidentally match. Contrast interconnected planning. 8, 9

planning-like A process is *planning-like* if has features characteristic of planning. For instance, it may start with representations of relatively distal outcomes and gradually fill in details, resulting in representations whose contents can be hierarchically arranged by the means–end relation (compare Grafton & Hamilton 2007 on motor processes). Or a process may be *planning-like* in that it involves meeting constraints on the selection of means by which to bring about one outcome that arise from the need to select means by which, later, to bring about another outcome (Rosenbaum et al. 2012). 8, 9

practical reasoning 'The mark of practical reasoning is that the thing wanted is *at a distance* from the immediate action, and the immediate action is calculated as a way of getting or doing or securing the thing wanted' (Anscombe 1957, p. 79). See also Millgram (2001, p. 1): 'Practical reasoning is reasoning directed towards action: figuring out what to do, as contrasted with figuring out how the facts stand.' 9

shared intention An attitude that stands to joint action as ordinary, individual intention stands to ordinary, individual action. It is hard to find consensus on what shared intention is, but most agree that it is neither

shared nor intention. (Variously called 'collective', 'we-' and 'joint' intention.) 2, 3, 7

Standard Solution (to The Problem of Action). Actions are those events which stand in an appropriate causal relation to an intention. 2, 5

task co-representation A task representation that is co-represented. 10

task representation A *task representation* links a representation of an event, such as the timer's ringing, and a motor representation that specifies an action, such as taking the stew out of the oven, in such a way that if the event occurs, the subject becomes disposed to prepare and perform the action represented. (These are perhaps the same as the stimulus–action links involved in habitual processs.) 15

team reasoning 'somebody team reasons if she works out the best possible feasible combination of actions for all the members of her team, then does her part in it' (Bacharach 2006, p. 121). 2

The Problem of Action What distinguishes your actions from things that merely happen to you? (According to Frankfurt (1978, p. 157), 'The problem of action is to explicate the contrast between what an agent does and what merely happens to him.') 2, 3, 5, 15

References

Anscombe, G. E. M. (1957). *Intention.* Oxford: Blackwell.

Atmaca, S., Sebanz, N., & Knoblich, G. (2011). The joint flanker effect: sharing tasks with real and imagined co-actors. *Experimental Brain Research*, *211*(3-4), 371–385.

Bach, K. (1978). A representational theory of action. *Philosophical Studies*, *34*(4), 361–379.

Bacharach, M. (2006). *Beyond Individual Choice.* Princeton: Princeton University Press.

Baier, A. C. (1997). Doing Things With Others: The Mental Commons. In L. Alanen, S. Heinamaa, & T. Wallgren (Eds.), *Commonality and particularity in ethics* (pp. 15–44). Palgrave Macmillan.

Blomberg, O. (2016). Common Knowledge and Reductionism about Shared Agency. *Australasian Journal of Philosophy*, *94*(2), 315–326.

Bratman, M. E. (1992). Shared cooperative activity. *The Philosophical Review*, *101*(2), 327–341.

Bratman, M. E. (1997). I intend that we J. In R. Tuomela & G. Holmstrom-Hintikka (Eds.), *Contemporary Action Theory, Volume 2: Social Action.* Dordrecht: Kluwer. Reprinted in Bratman, M. (1999) *Faces of Intention.* Cambridge: Cambridge University Press (pp. 142-161).

Bratman, M. E. (2011). Acting over time, acting together. *(draft)*, *0*(0), 0.

Bratman, M. E. (2014). *Shared Agency: A Planning Theory of Acting Together.* Oxford: Oxford University Press.

Brooks, D. H. M. (1981). Joint action. *Mind*, *90*(357), 113–119.

Brownell, C. A. (2011). Early Developments in Joint Action. *Review of Philosophy and Psychology*, *2*, 193–211.

Butterfill, S. A. (2017). Coordinating joint action. In M. Jankovic & K. Ludwig (Eds.), *The Routledge Handbook of Collective Intentionality* (pp. 68–82). New York: Routledge.

Butterfill, S. A. & Sinigaglia, C. (2022). Towards a Mechanistically Neutral Account of Acting Jointly: The Notion of a Collective Goal. *Mind*, *132*(525), 1–29.

Carpenter, M. (2009). Just how joint is joint action in infancy? *Topics in Cognitive Science*, *1*(2), 380–392.

Clarke, S., McEllin, L., Francová, A., Székely, M., Butterfill, S. A., & Michael, J. (2019). Joint action goals reduce visuomotor interference effects from a partner's incongruent actions. *Scientific Reports*, *9*(1), 1–9.

Davidson, D. (1980). *Essays on actions and events.* Oxford: Oxford University Press.

de Wit, S. & Dickinson, A. (2009). Associative theories of goal-directed behaviour: A case for animal–human translational models. *Psychological Research PRPF*, *73*(4), 463–476.

della Gatta, F., Garbarini, F., Rabuffetti, M., Viganò, L., Butterfill, S. A., & Sinigaglia, C. (2017). Drawn together: When motor representations ground joint actions. *Cognition*, *165*, 53–60.

Dickinson, A. (1994). Instrumental conditioning. In N. Mackintosh (Ed.), *Animal Learning and Cognition.* London: Academic Press.

Dickinson, A. (2016). Instrumental conditioning revisited: Updating dual-process theory. In J. B. Trobalon & V. D. Chamizo (Eds.), *Associative learning and cognition*, volume 51 (pp. 177–195). Edicions Universitat Barcelona.

Diedrichsen, J., Verstynen, T., Hon, A., Lehman, S. L., & Ivry, R. B. (2003). Anticipatory adjustments in the unloading task: Is an efference copy necessary for learning? *Experimental Brain Research*, *148*(2), 272–276.

Frankfurt, H. (1978). The problem of action. *American Philosophical Quarterly*, *15*(2), 157–162.

Gilbert, M. P. (1990). Walking together: A paradigmatic social phenomenon. *Midwest Studies in Philosophy*, *15*, 1–14.

Gilbert, M. P. (2010). Collective action. In T. O'Connor & C. Sandis (Eds.), *A Companion to the Philosophy of Action* (pp. 67–73). Oxford: Blackwell.

Grafton, S. T. & Hamilton, A. (2007). Evidence for a distributed hierarchy of action representation in the brain. *Human Movement Science*, *26*(4), 590–616.

Hargreaves-Heap, S. & Varoufakis, Y. (2004). *Game theory: a critical introduction*. London: Routledge.

Jackson, G. M., German, K., & Peacock, K. (2002). Functional coupling between the limbs during bimanual reach-to-grasp movements. *Human Movement Science*, *21*(3), 5–21.

Jeffrey, R. C. (1983). *The Logic of Decision, second edition*. Chicago: University of Chicago Press.

Kelso, J., Southard, D., & Goodman, D. (1979). On the coordination of two-handed movements. *Journal of Experimental Psychology: Human Perception and Performance*, *5*(2), 229–238.

Knoblich, G., Butterfill, S. A., & Sebanz, N. (2011). Psychological research on joint action: Theory and data. In B. Ross (Ed.), *Psychology of Learning and Motivation*, volume 51 (pp. 59–101). San Diego, CA: Academic Press.

Kourtis, D., Sebanz, N., & Knoblich, G. (2013). Predictive representation of other people's actions in joint action planning: An EEG study. *Social Neuroscience*, *8*(1), 31–42.

Kutz, C. (2000). Acting together. *Philosophy and Phenomenological Research*, *61*(1), 1–31.

Loehr, J. D., Kourtis, D., Vesper, C., Sebanz, N., & Knoblich, G. (2013). Monitoring individual and joint action outcomes in duet music performance. *Journal of cognitive neuroscience*, *25*(7), 1049–1061.

Loehr, J. D. & Palmer, C. (2011). Temporal coordination between performing musicians. *The Quarterly Journal of Experimental Psychology*, *64*(11), 2153–2167.

Longworth, G. (2019). Sharing non-observational knowledge. *Inquiry*, *0*(0), 1–21.

Ludwig, K. (2016). *From Individual to Plural Agency: Collective Action*. Oxford University Press.

Ménoret, M., Varnet, L., Fargier, R., Cheylus, A., Curie, A., des Portes, V., Nazir, T., & Paulignan, Y. (2014). Neural correlates of non-verbal social interactions: A dual-eeg study. *Neuropsychologia*, *55*, 75–97.

Meyer, M., Hunnius, S., Elk, M. v., Ede, F. v., & Bekkering, H. (2011). Joint action modulates motor system involvement during action observation in 3-year-olds. *Experimental Brain Research*, *211*(3-4), 581–592.

Meyer, M., van der Wel, R. P. R. D., & Hunnius, S. (2013). Higher-order action planning for individual and joint object manipulations. *Experimental Brain Research*, *225*(4), 579–588.

Millgram, E. (2001). Practical reasoning: The current state of play. In *Varieties of Practical Reasoning* (pp. 1–26). Cambridge, Massachusetts: MIT Press.

Novembre, G., Ticini, L. F., Schutz-Bosbach, S., & Keller, P. E. (2014). Motor simulation and the coordination of self and other in real-time joint action. *Social Cognitive and Affective Neuroscience*, *9*(8), 1062–1068.

Pacherie, E. (2010). The phenomenology of joint action: Self-agency vs. joint-agency. In A. Seemann (Ed.), *Joint Action*. MIT Press.

Pacherie, E. (2013). Intentional joint agency: shared intention lite. *Synthese*, *190*(10), 1817–1839.

Pacherie, E. & Dokic, J. (2006). From mirror neurons to joint actions. *Cognitive Systems Research*, *7*(2-3), 101–112.

Pettit, P. & Schweikard, D. (2006). Joint Actions and Group Agents. *Philosophy of the Social Sciences*, *36*(1), 18 –39.

Piedimonte, A., Garbarini, F., Rabuffetti, M., Pia, L., Montesano, A., Ferrarin, M., & Berti, A. (2015). Invisible Grasps: Grip Interference in Anosognosia for Hemiplegia. *Neuropsychology*, *29*(5), 776–781.

Ramsey, F. (1931). Truth and probability. In R. Braithwaite (Ed.), *The Foundations of Mathematics and Other Logical Essays*. London: Routledge.

Rosenbaum, D. A. (2010). *Human motor control* (2nd ed.). San Diego, CA, US: Academic Press.

Rosenbaum, D. A., Chapman, K. M., Weigelt, M., Weiss, D. J., & van der Wel, R. P. R. D. (2012). Cognition, action, and object manipulation. *Psychological Bulletin*, *138*(5), 924–946.

Sacheli, L. M., Arcangeli, E., Carioti, D., Butterfill, S., & Berlingeri, M. (2022). Taking apart what brings us together: The role of action prediction, perspective-taking, and theory of mind in joint action. *Quarterly Journal of Experimental Psychology*, *75*(7), 1228–1243.

Sacheli, L. M., Arcangeli, E., & Paulesu, E. (2018). Evidence for a dyadic motor plan in joint action. *Scientific Reports*, *8*(1), 5027.

Savage, L. J. (1972). *The Foundations of Statistics* (2nd rev. ed ed.). New York: Dover Publications.

Schmid, H. B. (2008). Plural action. *Philosophy of the Social Sciences*, *38*(1), 25–54.

Searle, J. R. (1990). Collective intentions and actions. In P. Cohen, J. Morgan, & M. Pollack (Eds.), *Intentions in Communication* (pp. 90–105). Cambridge: Cambridge University Press. Reprinted in Searle, J. R. (2002) *Consciousness and Language.* Cambridge: Cambridge University Press (pp. 90–105).

Sebanz, N., Bekkering, H., & Knoblich, G. (2006). Joint action: Bodies and mind moving together. *Trends in Cognitive Sciences*, *10*(2), 70–76.

Sen, A. (1973). Behaviour and the Concept of Preference. *Economica*, *40*(159), 241–259.

Sinigaglia, C. & Butterfill, S. A. (2022). Motor representation in acting together. *Synthese*, *200*(2), 82.

Sugden, R. (1991). Rational Choice: A Survey of Contributions from Economics and Philosophy. *The Economic Journal*, *101*(407), 751–785.

Thrailkill, E. A., Trask, S., Vidal, P., Alcalá, J. A., & Bouton, M. E. (2018). Stimulus control of actions and habits: A role for reinforcer predictability and attention in the development of habitual behavior. *Journal of Experimental Psychology: Animal Learning and Cognition*, *44*, 370–384.

Tollefsen, D. (2005). Let's pretend: Children and joint action. *Philosophy of the Social Sciences*, *35*(75), 74–97.

Tsai, J. C.-C., Sebanz, N., & Knoblich, G. (2011). The GROOP effect: Groups mimic group actions. *Cognition*, *118*(1), 135–140.

Tuomela, R. (2000). *Cooperation: A Philosophical Study*. Dordrecht: Springer.

Tuomela, R. & Miller, K. (1985). We-Intentions and Social Action. *Analyse & Kritik*, *7*(1), 26–43.

Velleman, D. (1997). How to share an intention. *Philosophy and Phenomenological Research*, *57*(1), 29–50.

Vesper, C., van der Wel, R. P. R. D., Knoblich, G., & Sebanz, N. (2013). Are you ready to jump? predictive mechanisms in interpersonal coordination. *Journal of Experimental Psychology: Human Perception and Performance*, *39*(1), 48–61.