Title: Joint task representations

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# Abstract

# Introduction

You and I are walking down a narrow pavement side by side, deep in conversation. Seeing a lamppost on your side, I anticipate that you will need to move over to my side to get around it and so I speed up to make space for you. As this illustrates, coordination often requires that people include others’ goals and actions in their planning and consider how they could respond to changing features of the environment to achieve these goals. In some cases this may be the result of conscious deliberation and negotiation, which might involve knowledge of, or beliefs about, others’ goals and actions. But in other cases conscious deliberation cannot explain coordination. For sometimes adjusting our plans to others’ goals and actions needs to happen too rapidly for conscious deliberation, in fractions of a second; sometimes these adjustments feel effortless or go unnoticed; and sometimes they occur without interrupting our conversation. All of this indicates that adjusting plans to others’ goals and actions can occur without conscious deliberation. To understand how people adjust their planning to others’ goals and actions, we need to identify mechanisms other than conscious deliberation, mechanisms that allow people to achieve rapid and effortless coordination even without breaking the flow of their conversation. What could these mechanisms be, and what is the evidence for their existence?

This question would make no sense if we conceived of planning as the conscious deliberative process that shape our actions. There is, however, a broader notion of planning. In general, control of action involves representations of outcomes, which generate representations of means by which these outcomes are to be realised. Not all such processes involve conscious deliberation or representations with propositional formats (\*refs: Prinz, Jeannearod, Pachiere). In fact humans could not interact with their environment at all without such non-deliberative processes. Because these processes involve representations of outcomes hierarchically structured by means to ends, we follow the psychological literature in using the term ‘planning’ to include these processes.

Our thesis is that in planning, adjustments to others’ goals and actions is sometimes achieved by including others in our planning in a special way. The familiar way of including others in our planning is to draw on our knowledge, or beliefs about, of their goals and actions. But, as we shall explain, planning others’ goals and actions can feature in our planning as representations functionally equivalent to those which specify our own goals and actions. Sometimes we plan not only our own actions but others’ actions as well.

There are at least three coordination functions that including others in our planning could serve. The first function is turn taking. To return to our opening example where we are walking down a narrow street, my speeding up to make space for you depends on recognising that it is you (not me) who has to avoid the lamppost ahead. The second function is action monitoring. In terms of our example, I need to monitor your actions to know whether you are slowing down to move behind me---if instead you are also speeding up, some adjustment will be necessary. The third and last function is coordination of planning: in moving behind me to avoid the lamppost, we aim to avoid colliding with each other or the lamppost while not getting too far apart. In what follows we develop the thesis that planning others’ actions as well as our own can facilitate coordination by considering each of the three functions in turn.

These three functions are linked to three different ways in which others can be included in your planning, or so we shall argue. Taking the functions out of order (to ease exposition), action monitoring can be facilitated by including other’s tasks in your planning. A task representation links objects or events to actions in such a way that, normally, encountering an object or event would trigger planning. Task representations are agent-neutral; that is, they do not specify which actor is to perform the represented actions. A *task co-representation* is a task representation of actions where the represented actions should be performed by another. Because task co-representations are task representations, they can trigger planning for actions which the planner is not supposed to perform. By means of task co-representations it is possible to include others’ tasks in your planning not by representing their task representations but, more directly, by planning their actions. We explain how task co-representation facilitates monitoring in Section \*\*\* below.

Turn taking was the first coordination function that can be served by including other’s in your planning. We shall argue that turn taking can be facilitated by *actor co-representations*, that is, representations specifying which others are responsible for acting on which objects or responding to which events where these representations concerning others are functionally related to similar representations concerning oneself in such a way that triggering any actor representation or co-representation will inhibit any other.

\*\*\*joint task co-representation can facilitate coordination of planning.

# Turn Taking

Sometimes coordination involve turn taking and requires each to agent to know when it is their turn to act. How could including others in your planning facilitate turn taking? Suppose that there arerepresentations which map event-types to actors, thereby specifying the agent responsible for responding to events of that type. To illustrate how this might be useful, imagine Ayesha and Beatrice are ushers at a wedding facing a stream of guests who need to be seated. Ayesha is responsible for the groom’s party, Beatrice for the bride’s. To perform this role they each need to decide rapidly whether to act when a person approaches. So it might be helpful for Ayesha’s actions to be controlled by a representation mapping *groom party member* to *my responsibility*; and likewise for Beatrice. Now if we were to suppose that Ayesha and Beatrice were acting alone, nothing more might be needed. Imagine, however, that they are acting together and, although lacking a common language, will nudge each other when one fails to welcome a guest she is responsible for. To this end it might be that Ayesha has a representation mapping *bride party member* to *other’s responsibility*; and Beatrice likewise. So far we have given Ayesha and Beatrice merely reciprocal representations. But we suppose, further, that Ayesha’s two actor representations are functionally related in such a way that triggering one will inhibit the other. That is, Ayesha has an *actor co-representation* concerning Beatrice.[[1]](#footnote-1) Actor co-representation carries a cost but can bring benefits in joint action. The cost is this: having an actor co-representation may make it harder to identify that it is your turn because there may be misleading cues pointing to another (as we shall see). But one benefit of actor co-representation in joint action is that it would assist you in helping another in taking her turn. Another it that it would allow you to distinguish between events that you collectively will handle and events for which none of you are yet prepared (as when a gate-crasher appears in the stream of guests). These ways in which actor co-representation could facilitate turn taking are depicted in Figure \*1.

Two actors have *reciprocal representations* if there is a single thing which they each represent; for example, *reciprocal actor representations* occur when Ayesha and Beatrice each represent a mapping from *bride party member* to *Ayesha’s responsibility*.

For example,

A *joint actor co-representation* is a representation mapping multiple event-types to actors including oneself and another.

which plays a role in your own planning that is functionally equivalent to representations of your own goals and actions.

So it is not just that Ayesha represents conditions under which Beatrice should act, but that this representation will play a role in controlling her own actions that is bound up with the role of the corresponding representation about conditions under which she herself should act.

that these representations play roles in their planning which are functionally equivalent to the first pair of representations, these would be actor co-representations.

A *co-representation* is a representations of another’s goal or action which plays a role in your own planning that is functionally equivalent to representations of your own goals and actions.

consider a situation in which you and another are presented with a sequence of stimuli, some green and others red. Your task is to press a button in response to the green stimuli,

1. An *actor representation* is representation linking an event-type to an actor. A *co-representation* is a representation which in some way concerns another’s role rather than one’s own and which is functionally related, or even functionally equivalent, to corresponding representations concerning one’s own role. And an *actor co-representation* is a representation mapping an event-type to another actor which is functionally related to representations mapping event-types to oneself in such a way that triggering an actor co-representation will inhibit other actor representations (and conversely). [↑](#footnote-ref-1)