Joint Motor Action in Social Space

This paper argues in favour of the hypothesis that certain kinds of joint actions are made possible by what I call "social space". The actions in question are interactions in which a shared motor goal is pursued by two or more agents who synchronously coordinate their bodily contributions. Pertinent examples include, amongst many others: rowing a canoe together (Knoblich & Sebanz, 2006), playing a piano duet (Wolf et al., 2018), or the many scenarios that are discussed in the context of collective intentionality, such as going for a walk with someone (Gilbert, 1990). Social space is a framework that enables joint action. The hypothesis is that in joint action, the areas around each participant are peripersonal spaces in which sensorimotor information is integrated so as to make motor coordination possible.

The main argument (and organization of the paper) is as follows. Some social creatures, including people, deploy joint know-how in acting together. On one plausible view, joint skill consists in knowing how to move so as to prepare the ground for one's co-agent's contribution to a joint task (Birch, 2018). This requires predicting the other person's contributing movements as well as one's own. Making such predictions relies, for each participating agent, on the representation of one's partner's as well as one's own future movements. The question then arises how these representations can be integrated into a unified structure that is conducive to skilled interaction. Sinigaglia and Butterfill (2020, 2021) suggest that agents rely on "agent-neutral representations" that enable them to develop non-accidentally matching plan-like hierarchies of motor representations in each agent. Much will depend on how the notion of agent-neutrality is interpreted. I opt for a weak interpretation in terms of "agent symmetry", according to which do the representations of joint motor goals specify the *kinds* of bodily

movements by way of whose execution the joint motor goal is realized and thus the kinds of agents whose movements are apt to realise these goals.

I then ask how the agent-symmetrical representation of joint motor goals is possible and appeal to the concept of peripersonal space in answering the question. In peripersonal space, agents integrate information internal and external to their bodies to represent and perform motor actions. One possibility, suggested by e.g., De Vignemont and Iannetti (2015), then is that joint agents use their bodies to represent others' contributions in their own action space. I argue against this possibility, on the grounds that joint agents effortlessly cooperate on objects towards which they occupy different standpoints and that in such cases predictively representing a partner's contribution to a joint motor action requires cognitively costly mental rotation. Instead, I suggest that agents operate in social space, in which they integrate sensorimotor information at both their own and their co-agent's locations (see Seemann (2019) for an earlier treatment). Two joint agents then each operate with a spatial framework in which their own and their partner's locations serve as origins of action. I briefly discuss some experiments that at least tentatively support this view (e.g., Maister et al., 2015; Teneggi et al., 2013), as well as some pertinent evidence from psycholinguistics (Peeters et al., 2015; Peeters & Özyürek, 2016).

The appeal to social space triggers the question how joint agents' contributions are unified into one representation of their joint motor goals, so that these contributions are represented as subserving one complex action rather than as two separate ones. I suggest that this is accomplished via a joint body schema (Soliman et al., 2015). The body schema represents in a sensorimotor format parameters that support action execution and control (De Vignemont et al., 2021). The joint body schema draws on proprioceptive information from the agent's body to

model the co-agent's contribution at the place occupied by that agent and in this way integrates both agents' contributions. The hypothesis of social space, in conjunction with appeal to the joint body schema, thus explains how agent-symmetrical representations of joint motor goals are possible.

This outcome is presented as a hypothesis in need of further empirical investigation. The benefits of such an investigation are significant: the hypothesis, if confirmed, can make valuable contributions to debates about social cognition, joint action, perspective-taking, and agent recognition.

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