

Collective memory

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1 Collective memory and collective intentionality

There has been relatively little interaction between research on collective intentionality in philosophy and research on collective memory in psychology and the social sciences. Rather than being due to a lack of mutual relevance—as this chapter will demonstrate, the two traditions are very much relevant to each other—this lack of interaction is due largely to somewhat arbitrary disciplinary barriers. But disciplinary barriers, even when arbitrary, have real consequences, and one message of this chapter is that the lack of interaction has had negative consequences for both fields. Psychologists and social scientists have tended not to take advantage of philosophical resources that might sharpen their analyses of collective memory. Philosophers, meanwhile, have often presupposed overly simple models of the interactions among group members that are at work in the formation of collective memories and collective intentional states more broadly. There are thus important potential benefits to be realized for each field through increased interaction with the other.

1.1 Forms of collective memory

What sorts of *collectives* are at issue in collective memory? Collective remembering unfolds at a range of scales, and it is necessary to be alert to the possibility of real differences between *small-scale* collective memory and *large-scale* collective memory. It may turn out that the same process of collective remembering unfolds in both small-scale and large-scale groups, but it may be no coincidence that small-scale and large-scale collective memory have traditionally been investigated by different disciplines. The former, exemplified by

remembering in married couples (Harris et al., 2014) or in parent-child dyads (Reese et al., 1993), has been studied primarily in psychology. The latter has been studied primarily in the social sciences and history. Indeed, reflecting what has been termed a “memory boom” (Blight, 2009), an enormous amount of work on large-scale collective memory has appeared in recent years, building on older theories of remembering as a social process (Halbwachs, 1994; see Wertsch 2009; Erll and Nünning 2010; Erll 2011; Olick et al. 2011). This disciplinary division of labour reflects an apparent difference between the kinds of remembering of which small-scale and large-scale groups are, respectively, capable.

In the standard taxonomy of kinds of memory (Michaelian, 2016), *episodic* memory refers to memory for experienced events. Episodic remembering is normally accompanied by a characteristic phenomenology, a sense of reliving the past (Tulving, 1972). *Semantic* memory refers to memory for facts. Semantic remembering need not concern experienced events, and, when it does, it is not accompanied by a sense of reliving the past. Both episodic and semantic memory are declarative, in the sense that their contents can in principle be articulated; declarative memory aligns with what epistemologists refer to as “knowledge that”. *Procedural* memory, in contrast, is nondeclarative and aligns with what epistemologists refer to as “knowledge how”; the contents of procedural memory—e.g., acquired skills of various sorts—need not be articulable.

Memory in large-scale groups is typically memory for events which are of concern to the individuals who make up the group but in which those individuals did not necessarily take an active part and of which they often have only indirect knowledge. Extending the standard taxonomy to collective memory, large-scale collective memory thus appears often to be semantic. Consider the ways in which the citizens of a country might remember key events from its past: individual citizens may (episodically) remember personal experiences which

are linked to the events in question, but, to the extent that remembering is concerned with large-scale, public events, it lacks the characteristic features of episodic memory.

Memory in small-scale groups—groups sufficiently small to allow their members to interact directly with each other—can likewise be semantic. Research employing the collaborative recall paradigm, which compares the information recalled by groups of individuals who remember alone to that recalled by groups of individuals who interact with each other, for example, normally concerns learned information of no particular personal significance (Weldon and Bellinger, 1997). Small-scale collective memory can also sometimes be procedural. Research on transactive memory systems, for example, in some cases concerns group performance on a variety of practical tasks (Wegner, 1987; Liang et al., 1995). The existence of procedural memory in small-scale groups may constitute an important difference between small-scale and large-scale collective memory, since there is no obvious sense in which large-scale groups are capable of remembering how to do something, but we will not pursue this here. Our focus, instead, will be on episodic memory. It appears that small-scale collective memory, unlike large-scale collective memory, may sometimes be episodic, in the sense that it is memory for events in which group members took an active part and hence of which they have direct knowledge.

1.2 Stages of collective remembering

What sorts of *remembering* are at issue in collective memory? In philosophy, remembering has sometimes been treated as a simple process in which a representation produced by a source other than memory is preserved over time. In psychology, in contrast, remembering is understood as a constructive, multi-stage process (Michaelian, 2016). The initial stage of the process, leading from an experience to the production of a short-term memory representation, is *encoding*. Short-term representations are not mere copies of experience but result from

processes of selection, abstraction, interpretation, and integration with existing knowledge (Alba and Hasher, 1983). Encoding therefore often amounts to the production of a new representation. Following encoding, a process of *consolidation* is responsible for transforming the labile, short-term representation into a stable, long-term representation, with the representation remaining labile—subject to further transformation—throughout the extended consolidation process. Consolidation thus likewise amounts to the production of a new representation. Only when consolidation is complete can the representation be said to have achieved stable *storage*. Moreover, *retrieval*, like encoding and consolidation, is a constructive process in which a stored representation is recombined with other relevant information to produce another new representation.

The concepts of encoding, consolidation, storage, and retrieval are normally applied to remembering understood as an individual-level process, and the social dimension of remembering sometimes makes its appearance in the form of external factors affecting the accuracy of individual memory at the encoding, consolidation, or retrieval stages—often negatively, as in work on social contagion (Roediger et al., 2001) or the misinformation effect (Loftus, 2005). Applying the concepts to remembering understood as a group-level process, however, may provide a useful means of distinguishing among different senses in which the memory process itself can be collective: rather than asking simply about “collective memory” in general, we can ask more precise questions about collective encoding, consolidation, storage, and retrieval.

2 Encoding and retrieval

Some stages of a given process of remembering might be best understood as occurring at the individual level, while others are best understood as group-level processes, giving rise to a range of more or less strongly collective forms of memory. Reflecting the emphases of the

existing literature, we focus initially (in this section) on encoding and retrieval in small-scale collective memory and then (in section 3) on consolidation and storage in large-scale collective memory. The wide range of views in the broader collective intentionality literature on what it takes for a phenomenon to be truly collective, and on the relations between individual and collective cognitive states and processes, will be reflected in discussions of memory as philosophers come to integrate these fields together more thoroughly. Here we aim to home in on stronger views, on which it is the small group itself that can in certain circumstances remember.

2.1 Memory in small-scale groups

Both encoding and retrieval in groups might be either *parallel*, in the sense that each group member implements the process without significant interaction with the others, or *interactive*, in the sense that group members interact. Putting the interactive/parallel distinction together with the encoding/retrieval distinction, we can distinguish among four forms of collective memory.

In cases of *parallel encoding/parallel retrieval*, there is significant interaction among group members at neither stage of the process; each individual learns and recalls on his own. While it might seem odd to include such cases under the heading of collective memory at all, they do correspond to the small-scale “nominal groups” (groups of non-interacting individuals) used in collaborative recall experiments (Weldon and Bellinger, 1997; Barnier et al., 2008). At the level of large-scale collective memory, they may correspond to what Olick (1999) has termed “collected memory”—in reference to the aggregated memories of a group, as opposed to properly “collective memory”—or to what Margalit (2002) has termed “common memory”—again, a purely aggregative notion, as opposed to “shared memory” (see Dessingué 2015). Collective memory in the parallel encoding/parallel retrieval sense is

thus useful primarily for purposes of comparison with more robustly collective forms of memory.

In cases of *parallel encoding/interactive retrieval*, there is no interaction among group members at the time of encoding, but there is interaction at the time of retrieval; individuals learn on their own but recall together. Such cases, which represent a more robustly collective phenomenon, correspond to the “collaborative groups”—groups of individuals who study material on their own and later recall it together—used in collaborative recall experiments. Cases with a similar structure figure in eyewitness memory research, much of which focuses on the risks of contamination of individual memories by post-event information (Loftus, 2005).

In cases of *interactive encoding/parallel retrieval*, there is interaction among group members at the time of encoding but none at the time of retrieval; individuals learn together but recall on their own. We might think here of a group of friends travelling together and interacting while they encode memories of the trip (Sutton, 2008); perhaps the group later disintegrates, the friends going their separate ways, so that, when each remembers the trip, he does so individually.

But suppose that the group does not disintegrate; instead, it remains together, allowing its members to interact through conversation when they remember the trip. In such cases of *interactive encoding/interactive retrieval*, there is interaction among group members at both encoding and retrieval; individuals learn and recall together. Such cases correspond to the sorts of ongoing transactive memory systems—stable groups characterized by a division of cognitive labour, with group members responsible for remembering different aspects of events and playing different roles during encoding and retrieval (Wegner, 1987)—that have increasingly been investigated through the lens of distributed cognition (Theiner, 2013;

Harris et al., 2014). Of the four forms of collective memory distinguished here, interactive/interactive cases—which we will refer to as cases of *strongly shared memory*—may have the best chance of representing a truly collective phenomenon, in the sense that we may legitimately treat the group itself as the remembering subject.

2.2 Joint action and collective encoding

One concept from the collective intentionality literature that might help us to come to grips with the possibility of strongly shared memory is that of joint action. Joint *actions* are often understood as actions performed by groups as the result of joint *intentions* (though see Ludwig 2014). Different accounts of joint action are generated by different accounts of joint intention. Purely “summative” accounts—on which joint intentions are simply aggregations of group members’ identical individual intentions—are available. But some theorists reject these in favour of accounts on which joint intentions cannot be reduced to mere aggregations of ordinary individual intentions. In an oft-referenced illustration, Searle (1990) contrasts a group of individuals spontaneously running for shelter with a group running for shelter as part of a prepared artistic performance. The latter scenario provides us with an instance of genuinely joint action; the former does not.

In Searle’s view, the difference between the two scenarios lies in the nature of the group members’ intentions. In the former, each individual’s intention makes no reference to the other members of the group. In the latter, each individual intends to run to shelter as part of the group; his intention—a “we-intention”, as opposed to an “I-intention” (Tuomela and Miller, 1988)—essentially refers to the other members of the group. But on this approach joint action is still understood in terms of higher-level cognitive states. Hence it has difficulty recognizing joint action in cases where the participating individuals have not formed the relevant joint intention (Pacherie and Dokic, 2006). Further, it is arguably not

very robustly collective, in the sense that it only requires that group members share the contents of their intentions (Schmid, 2009); by the same token, it does not explicitly require communication or interaction among group members during performance of the joint action.

One alternative approach that is somewhat more robustly collective is that developed by Bratman (2014). In Bratman's view, what is required for genuinely joint action is not just that each individual himself intends the action of the group. In addition, group members' intentions must "mesh"—they need not be identical, but they must be compatible, and may require some mutual responsiveness in interaction. This approach arguably requires that more be shared among group members. Importantly, however, it manages this only by viewing joint action primarily as a cooperative activity. This third limitation—a tendency to downplay cases in which group members act together in a non-cooperative or conflictual manner — along with the two just noted, are shared by most accounts of joint action in terms of joint intention. Together, they threaten to render such accounts inapplicable to collective encoding.

We return to the role of conflict below; here, we focus on the roles of intention and interaction. Consider again the case of strongly shared memory described above. When the members of the group encode short-term representations of their trip, their encoding is collective in the sense that their conversational interactions shape the representations that they end up encoding. They might—through the operation of mechanisms such as socially-shared retrieval-induced forgetting (Hirst and Echterhoff, 2008), which can lead to convergent memories among group members—end up representing a common subset of the events that made up the trip as especially important, forgetting other events, endowing the remembered events with shared meanings in relation to the life of the group, and linking the remembered events in an overarching narrative structure. It is thus plausible to speak of encoding as a group-level process. Due to their lack of emphasis on interaction, accounts of

joint action in terms of joint intention do not fully describe the way in which collective encoding might amount to a form of joint action.

Such accounts also fail to capture the dynamics of collective encoding due to their reliance on the notion of joint intention. The process of generating a shared representation of the past need not be and normally is not the result of a joint intention to form such a representation. Shared representations, instead, typically emerge spontaneously through the process of conversational interaction. It should be noted that this limitation of joint intention accounts is due not to a feature of collective encoding qua collective phenomenon but rather to a feature that collective encoding inherits from individual encoding: encoding is not, in general, the result of an individual intention to form a short-term memory representation; it is, rather, a largely spontaneous process. The relevant intentions are thus typically lacking both in individual and in collective encoding.

What is required, then, is an approach that captures both the fact that encoding is typically not the result of an intention to remember and the fact that it involves interaction among group members, through which they shape and reshape what each of them ends up remembering in such a way that it is legitimate to describe them as forming a shared memory. Tollefsen et al. (2013) provide the outlines of one approach that has these features. They argue for the existence of an “alignment system”, an evolved set of interconnected processes designed to facilitate social interaction and joint action. While the alignment system is responsive to higher cognitive states operating at longer timescales, including intentions, it can also give rise to such states through bottom-up processes such as real-time coordination of bodily movements and use of common linguistic structures during conversation. Alignment refers to the dynamic matching of the behaviour or cognitive states of group members over time, in a process of mutual adaptation, i.e., a mutually responsive

coordination of behaviour and cognition; it is thus well-suited to capture the interactive nature of collective encoding (see also Chapter 7 in this handbook). Critically, alignment can occur spontaneously; it is thus capable of respecting the fact that collective encoding can occur without the formation of joint intentions. Overall, an understanding of joint action which incorporates attention to the interactions of alignment systems at faster timescales might become central to a more adequate understanding of collective encoding as joint action (Bietti and Sutton, 2015). Indeed, Tollefsen et al. suggest that the formation of transactive memory systems, in particular, might be seen as the outcome of iterated interaction among group members' alignment systems. During encoding, for example, coordination of eye gaze patterns might influence the types of information stored as well as the cues associated with stored information.

2.3 Joint attention and collective retrieval

Strongly shared memory involves interaction not only during encoding but also during retrieval, and research conducted within the transactive memory framework has looked, for example, at how couples interact during retrieval to construct shared representations of their shared pasts (Harris et al., 2014). A concept from the collective intentionality literature that might help us come to grips with this aspect of strongly shared memory is that of *joint attention*. (See also Chapter 10 in this handbook.)

In order for two or more agents to count as jointly attending to the same object, it does not suffice for them simply to attend to the same object at the same time; each must, in addition, be aware that the other is attending to the same object. Much of the empirical work on joint attention has adopted a developmental perspective, focusing on the early emergence of the capacity for joint attention and its relation to capacities such as mindreading (e.g., Moore and Dunham 1995). Philosophical work, meanwhile, has been devoted primarily to the

development of general theoretical accounts of joint attention; building on theories of mindreading, the main debates here have been between partisans of theory-theoretic approaches and partisans of simulation-theoretic approaches. While there are deep differences between these approaches, both understand joint attention as an interactive phenomenon emerging out of lower-level processes, and a view of collective retrieval as involving joint attention to the past thus has the potential to fit well with the understanding of collective encoding sketched above.

One view of this sort has been proposed by Hoerl and McCormack (2005), who combine philosophical and developmental approaches to argue that the very capacity to think about events as situated in time only develops in the context of learning to attend to past events together with others. In their view, it is through such joint attention to the past that the child comes to understand that later events in a causal sequence can alter the effects of earlier events, thus shaping the present, and it is through conversation about past events that children learn to construct temporally structured narratives that explain the influence of the past on the present. While Hoerl and McCormack provide a thorough exploration of the idea that the development of collective remembering can be understood in terms of joint attention, there is room for further work to develop an account of collective remembering as joint attention in mature subjects.

Assuming that such an account can be developed, there remains a question about how we are to understand the ultimate products of collective remembering—the collective memories produced by collective retrieval. Another concept from the collective intentionality literature, that of *collective belief*, has the potential to be of help here. Just as some theorists reject summative accounts of collective intention, some reject summative accounts of collective belief, which treat a group as believing a given proposition just in case all (or most) of its

members believe it. (See also Chapter 8 in this handbook.) Nonsummative accounts of collective belief, similar in spirit to the nonsummative accounts of collective intention reviewed above, are motivated by apparent counterexamples to both the necessity and the sufficiency of shared individual belief for collective belief. Against the sufficiency of shared individual belief, Gilbert (1989) argues that two groups might count as having different beliefs despite having the same members (and thus the same shared individual beliefs). Against the necessity of shared individual belief, she argues that a group might count as having a given belief even if none of its members have that belief. This is not the place to attempt to identify analogous cases in the collective memory literature, but, to the extent that there are such cases, similar arguments would support viewing collective remembering as a group-level process. A distinct issue in the literature on collective belief is whether collective beliefs are states of the same kind as individual beliefs; on many accounts, collective beliefs do not behave much like individual beliefs, and this has led to debates over whether the notion of collective belief should be replaced with a notion of collective acceptance (e.g., Tuomela 2000). Future work might draw on analyses of differences between individual beliefs and group beliefs or acceptances to explore differences between individual memories and collective memories.

Pending such work, however, we should not take it for granted that analyses of collective belief or acceptance can be extended to collective memory in any straightforward way. An initial concern here is analogous to one that arises for attempts to understand individual memory in terms of individual belief. Just as individuals can in certain cases remember an event without believing that it occurred (Otgaar et al. 2014), a group might in principle remember an event without believing that it occurred. Individuals are capable of employing metacognitive monitoring which enables them to reject even subjectively compelling

memories. Similarly, groups of individuals constituting transactive memory systems may be capable of employing group-level metacognitive monitoring which enables them to reject memories that they would otherwise accept (Michaelian and Arango-Munoz, forthcoming). The notion of collective belief or acceptance may thus simply fail to capture the nature of the states that are produced when we remember together.

A distinct concern is specific to collective memory: whereas analyses of collective belief focus on cases in which a group can be said to believe a single, determinate proposition, it is, in many cases of collective memory, implausible to ascribe a single, determinate memory to the group. The point is not merely that a group might be said to have a memory that diverges from the memories of its members. It is, rather, that, in many cases of collective memory, the group can be seen as remembering an event from its shared past despite the fact that we cannot ascribe a determinate narrative or representation even to the group as a whole. A group of friends remembering an event together might converge on a common representation of the event, but there is no guarantee that it will do so. If negotiation over the meaning of the shared past is perpetual and ongoing, it may make little sense to ascribe a determinate memory to the group, even while it remains meaningful to say that the group remembers the event. There is thus a need for work developing a notion of collective memory that would allow us to count a group as having a memory of an event despite a lack of internal consensus on the nature and significance of the represented event.

3 Consolidation and storage

The potential for lack of consensus should remind us that collective remembering is not always a purely cooperative process; indeed, as we will see in this section, conflict among group members is arguably at the very heart of collective remembering.

3.1 Memory in large-scale groups

As our focus shifts from cooperation to conflict, it also shifts from small-scale to large-scale collective remembering. The latter shift raises a difficult question. The discussion so far has concentrated on strongly shared memory. We initially characterized strongly shared memory as involving interaction among group members during both encoding and retrieval, and this characterization can be extended to include interaction during consolidation (e.g., the role of a dominant narrator in shaping collective memory; Cuc et al. 2006) and storage (e.g., responsibilities of group members for remembering different components of an event; Wegner 1987). Due to their sheer scale, it is unclear whether large-scale groups are capable of anything like this form of strongly shared memory.

Even if forms of interaction analogous to those at work in small-scale memory can be identified, remembering in large-scale groups, since it is typically memory for events in which group members did not take an active part, is bound to lack the phenomenology characteristic of episodic memory. We return to the question of phenomenology below. Setting it aside for the moment, we consider a general model of large-scale collective memory developed recently by Anastasio et al. (2012). In addition to calling attention to the role, noted above, of *conflict* in collective consolidation, their model calls attention to the role of material *artifacts* in collective storage.

3.2 Conflict and collective consolidation

Anastasio et al.'s model explicitly builds both on social scientific research on large-scale collective memory and on psychological and neuroscientific research on individual memory. It thus aligns with our conception of collective remembering as involving processes of encoding, consolidation, storage, and retrieval analogous to those involved in individual remembering. In fact, Anastasio et al. take this analogy quite literally, arguing that the very

same consolidation process that unfolds at the level of the individual also unfolds at the level of large-scale groups, including entire societies.

They argue, in particular, that both individual and collective consolidation depend on the workings of a selector/relator, which is responsible for selecting encoded short-term representations for consolidation into long-term representations and for determining how these are related to each other to produce a coherent whole. In the individual, the selector/relator is realized by the hippocampus. In a large-scale group, they argue, it is realized by groups of opinion leaders (e.g., intellectuals and journalists), who in effect constitute a “social hippocampus”. Anastasio et al.'s overall claim is that, because the individual hippocampus and the social hippocampus play the same role in shaping long-term representations at their respective levels, we may speak of the same consolidation process unfolding at both levels.

While this claim is intriguing, there is reason to be sceptical of it. As Anastasio et al. themselves admit, there is, within a given society, not in fact a single social hippocampus but rather multiple, competing “social hippocampi”. No one group of opinion leaders directs the overall process of collective consolidation. Instead, the course taken by collective consolidation—which events end up being represented in long-term collective memory and how they end up being represented—is determined by competitive and often outright conflictual interactions among different groups of opinion leaders. This amounts to a fundamental disanalogy between individual and collective consolidation.

This conclusion about Anastasio et al.'s model suggests a lesson both for research on small-scale collective memory and for research on collective intentionality. The former has tended to focus primarily on cooperative interactions, but there is room for additional work on ways in which memory in small-scale groups can be collective while being conflictual.

The latter has tended to treat collective action as a basically cooperative phenomenon, but there is room for work, building on empirical studies of conflict in collective memory and social processes more broadly, on the ways in which conflictual interactions can underwrite collective action.

3.3 Artifacts and collective storage

In addition to this negative lesson, Anastasio et al.'s model suggests a positive lesson for research on small-scale collective memory and collective intentionality. Consolidation is the process responsible for transforming the short-term representations produced by encoding into long-term representations. At the level of the individual, such long-term representations can be understood as traces distributed across the brain (Sutton, 1998). At the level of a large-scale collective, Anastasio et al. suggest, they are distributed across the society, in part in the form of material artifacts, such as museum collections and textbooks; short-term representations, on their approach, are likewise realized in part by a variety of material artifacts, such as articles in news media and scientific journals.

In line with this suggestion, we note that research on the role of material artifacts in remembering has implications for research both on small-scale collective memory and on collective intentionality. The former has tended to focus on purely social groups, ignoring the possibility that remembering might in many cases be best understood as a process executed by a distributed sociotechnical (as opposed to purely social) system (Michaelian and Arango-Munoz, forthcoming), and there is a need for additional work on ways in which remembering unfolds through interactions not only among human subjects but also among human subjects and technological resources. The latter has tended to treat collective intentionality and collective belief as purely social phenomena, ignoring the possible contributions of material memory traces and other material artifacts. It is, of course, highly counterintuitive to think of

a system including not only agents but also artifacts as engaging in actions or holding beliefs. But if we are willing to think of groups of agents as doing so, there may be little reason to resist thinking of groups of agents and artifacts as doing so as well.

4 Open questions: Memory, mentality, and phenomenology

Throughout this chapter, we have suggested that strongly-shared forms of collective memory may not be reducible to individual memory. Complementing older antireductionist arguments (tracing back to Halbwachs 1994), recent arguments (Huebner, 2013; Theiner, 2013) have sought to show more directly that certain forms of collective memory are irreducible. These recent arguments have focused on small-scale groups, such as transactive memory systems, and we might wonder whether they can be extended to large-scale groups. We will not attempt to determine this here. But we do note that any attempt to establish the existence of group-level episodic memory, in particular, will have to deal with a pair of important worries.

First, acknowledging group-level memory raises a worry about group-level mentality. Does acknowledging group-level memory require us to acknowledge group-level mentality? Group-level mentality seems implausible to many. However, though it is natural to suppose that, where there is memory, there must be mind (Rupert, 2005), there may be space for views which divorce attributions of memory from attributions of mind (Sutton, 2008).

Second, even if this worry about group-level mentality can in principle be overcome by driving a wedge between the notion of group-level memory and the notion of group-level mentality, there remains a worry about group-level phenomenology. Does acknowledging group-level memory require us to acknowledge group-level phenomenology? We noted above that episodic memory is characterized by a specific phenomenology: when one episodically remembers, one has a sense of reliving the past. If episodic memory implies episodic phenomenology, then, if groups—or perhaps even sociotechnical systems—are

capable of episodic memory, they would have to be capable of episodic phenomenology. Group-level phenomenology is even less plausible than group-level mentality. We thus seem to face a choice between denying that episodic memory requires episodic phenomenology and thus leaving open the possibility that collective episodic memory and individual episodic memory are of the same kind and granting that individual episodic memory requires episodic phenomenology and hence admitting that collective “episodic” memory is different in kind from individual episodic memory. Given the centrality of episodic phenomenology to contemporary accounts of episodic memory, the latter option is likely to be preferable.

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Related topics

See also chapters 2 (Collective action and agency), 3 (Non-reductive views of shared intention), 4 (Reductive views of shared intention), 7 (Psychology of joint action), 8 (Collective belief and acceptance), 10 (Joint attention), and 19 (Distributed cognitive systems).

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