stand much about the social and psychological world. To study the basic psychological processes that are involved, developmentalists have directed their attention toward infants and how they come to understand the self and other people as intentional agents. Tomasello et al. use this research to present a provocative and informative view as to how these early behaviors enable children to develop skills that immerse them psychologically in culture. This commentary concentrates on four aspects of the proposal: the developmental course outlined and three key conceptual features – motivation, planning, and culture – that are used to support this view.

Developmental course. A full accounting of development needs to include, in some integrated way, the social, emotional, cognitive, and physiological aspects of growth. Although such integration is a tall order, it is nonetheless critical for understanding and explaining development. Such integration is lacking in the conceptualization offered by Tomasello et al., though the potential to add this information exists in the model and would be a welcome next step. However, at present there is scant attention to emotional and physiological processes, either as concomitant factors or about how they may regulate the social and cognitive transactions involved in shared intentionality. These contributions undoubtedly play a critical role in this process, and much extant research could fill in some of the pieces. Another, more troubling, limitation for describing development crops up when one thinks about this process beyond the first few years of life. There is simply too little offered here to know how shared intentionality changes in its form and contribution from infancy to childhood as new skills at remembering, problem solving, planning, and self-regulation appear.

Motivation. Tomasello et al. use the concept of motivation as the underlying force that propels the child to share intentions with others. Unfortunately, a definition of motivation is not provided, which presents serious problems for a psychological explanation that is primarily concerned with how children learn complex information voluntarily. Is the motive a physiological process, such as an arousal state, that primes the child for learning in social context? Or is it related to survival, which may be more in keeping with the evolutionary view presented? Or is there some other type of need involved, perhaps reflecting psychological or social constructs like interest, curiosity, or affiliation? Without description of the underlying motive and how it may organize the timing and trajectory of this process, it is difficult to understand the role that shared intentions play in psychological development or explain variation in the process.

Plans and the development of planning. To provide a social explanation for learning complex behavioral streams, Tomasello et al. introduce the notion of shared intentionality in which children attend to sequences of goal-directed actions or the plans of other people. There is long-standing interest in psychology in plans and the development of planning (e.g., see Friedman et al. 1987; Miller et al. 1960). Linking early understanding of intentions to this capability is interesting and advances ideas that appeared in early research in this area (Bruner 1981). To develop these ideas further, Tomasello et al. need a clearer definition of plans and planning – one that describes how plans emerge from shared intentionality and how these relate to other future-oriented processes in infancy (Haith et al. 1994) and to the development of planning in childhood and adolescence. Articulating these connections may also help answer questions about the developmental course of shared intentionality and possibly link children's understanding of shared intentions with the ability to use plans that are already established in a culture, such as those involved in rituals and routines.

Culture. Many of the activities important to a culture become routine practices, and children are often asked to participate in these practices, especially rituals, long before they can understand the meaning and intention of these behaviors. This observation begs several questions: Can children participate in cultural routines without understanding their intentions? If understanding of intentions is needed, how much is sufficient? And does participation without full understanding of intentions have consequences for development? Rogoff (2003) suggests some answers to these questions. She describes children's thinking as an emergent process as children gradually assume new and more responsible roles in culturally organized activities. For instance, a very young child may be seated on her mother's lap as the family eats dinner. Is the child participating in dinner, a culturally organized and intelligent action? Yes, to the degree that she is able. Is the child engaging in shared intentionality? Probably not initially, but eventually she will be. At what point in this process, then, does cognitive development and immersion into culture commence? It seems to me that the child is participating in culture from the outset of this experience, albeit in a limited way, and that this participation helps the child, over time, piece together ideas about the activity, including shared intentionality. What Rogoff's ideas suggest seems quite different from what Tomasello et al. describe. Surely the basic processes described by Tomasello et al. are part of the overall mix, but in and of themselves they do not explain the full scope of cognitive development in sociocultural context.

Finally, a view of cognitive development in sociocultural context needs to explain the psychological processes that underlie the historical coherence of culture. Along these lines, it seems far more obvious why a dependent infant would be motivated to seek information from conspecifics than why adults would want to create shared intentions with infants. To answer this question, a description of cognitive development in social and cultural context needs to include the vantage of the adult as well as the infant. Tomasello et al. focus on the infant. In contrast, a focus on the adult role requires more consideration of the socioemotional components of these transactions. Although there are cognitive aspects of the adult's activity – for example, adults need to learn how to care for and engage infants – the vital part from the adult's viewpoint has more to do with relationships than cognition. Stated differently, cognition develops in culture in the context of social relationships (Hinde 1989). These relationships entail powerful motivational forces, emotional connections, and sustained opportunities for children and adults to get to know one another as well as each other's peculiar and routine ways of behaving. An evolutionary explanation could undoubtedly be crafted that would include most, if not all, of these factors, but such a description would be far too distal to explain the types of questions psychologists have about individual and cultural variation in cognitive development and the connections between the two. Although the human evolutionary story is largely a story about cognition, this story is inseparable from two other stories, one regarding the social nature of the species and the other, the developmental story, which explains how high levels of cognitive, social, and emotional functioning manage to come about in the lifetime of an individual.

A few reasons why we don't share Tomasello et al.'s intuitions about sharing

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Abstract: Tomasello et al.'s two prerequisites, we argue, are not sufficient to explain the emergence of Joint Collaboration. An adequate account must include the human-specific capacity to communicate relevant information (that may have initially evolved to ensure efficient cultural learning). This, together with understanding intentional actions, does provide sufficient preconditions for Joint Collaboration without the need to postulate a primary human motive to share others' psychological states

Tomasello et al. propose two basic prerequisites for Joint Collaborative Activities: (1) understanding intentional actions of others and (2) a primary motivation to share psychological states of oth-

https://doi.org/10.1017/S0140525X05330123 Published online by Cambridge University Press

ers. They argue that, whereas apes have the basics of prerequisite 1, they can't collaborate, because they lack prerequisite 2, the species-unique adaptation allowing humans to share goals and create Joint Collaborative Activities.

In our view, however, without a third prerequisite, the ability to *communicate relevant information* (Csibra & Gergely, in press; Sperber & Wilson 1986), Joint Collaborative Activities could neither be formed nor realized, even if both of Tomasello et al.'s preconditions were available. That the ability to communicate relevant information is necessary for Joint Collaborative Activities is clearly realized by the authors as apparent from their discussion of the "coordination problem" that permeates Joint Collaborative Activities. Participants must *negotiate and coordinate* at all levels of Joint Collaborative Activities by means of communicating relevant information: when agreeing on a goal to share, planning the sequence of intended means, allocating complementary roles, or scheduling complementary action plans. Neither could Joint Collaborative Activities be *performed* without communicating relevant information. Participants must monitor online their own and the other's actions, exchanging relevant information while comparing them to the planned sequence represented in their Joint Collaborative Activity. They also need to monitor the environment for unforeseen blocking conditions and be ready to communicate such relevant information to each other, and renegotiate how to modify the Joint Collaborative Activity online, changing complementary roles or action sequencing, if necessary.

One wonders why, having granted that the ability to communicate relevant information is necessary for Joint Collaborative Activities, the authors haven't included it as a third prerequisite in their magic formula producing cooperative intentionality in evolution and ontogeny. It's as if they considered the ability to communicate relevant information as derivable from the (more basic) capacity and motivation to share the psychological states of others. It's unclear to us, however, why (and in what sense) a motivation to share others' mental states could be more basic than the inclination to communicate relevant information to others, or how a primary motivation to share intentional mental states would imply or automatically yield the capacity to communicate relevant information.

On the contrary, we suggest to modify Tomasello et al.'s magic equation slightly. Imagine two mutant apes (or let's call them homo) who had (1) the capacity to fully understand others' intentional states, including their choice of action-plans, and (2) the ability to communicate relevant information, but would have somehow lost their gene coding for a primary motivation to share psychological states of others. Could they create and perform Joint Collaborative Activities without such a basic motivation to share others' mental states? We believe they could. Joint Collaborative Activities enable their participants to realize goals they couldn't achieve alone, yielding extra gains for them. That this is so could clearly be understood by the participants given their capacity for understanding the intentions of others, and by applying their ability to communicate relevant information they could negotiate a coalition, plan, and carry out a Joint Collaborative Activity to realize their egoistic but complementary interests. We see no reason why these fiercely competitive – but clever and communicating – creatures couldn't even make a habit of joining up for a promising Joint Collaborative Activity from time to time increasing their gains sufficiently to provide a selective advantage, eventually stabilizing their useful cultural habit. If this were indeed possible – and we submit it is – then a primary motivation to share psychological states of others could turn out to be unnecessary and substitutable by the ability to communicate relevant information in the race for the winning formula for the development of Joint Collaborative Activities – this time, however, among egoistically interested partners of a basically competitive nature. (Doesn't it sound so human?)

Furthermore, in contrast to Tomasello et al.'s hypothesis that apes don't collaborate because they lack the primary motivation to share the psychological states of others, we would emphasize the fact that apes lack the capacity to communicate relevant information (Gergely & Csibra 2005), which could explain why they cannot form Joint Collaborative Activities.

When comparing the plausibility of these alternative evolutionary formulae that claim to yield Joint Collaborative Activities, it may be informative to consider the evolutionary "just-so" stories offered about the conditions that may have facilitated the selection of a primary motivation to share psychological states of others *versus* the inclination and capacity to communicate relevant information to others. Tomasello et al.'s basic suggestion is that, as collaboration evolved due to the selective advantage it provided, the primary motivation to share the intentional mental states of others became selected as well since, by hypothesis, it's a necessary precondition for collaboration. However, as already argued, the evolution of collaboration can be plausibly accounted for *without a basic motivation to share others' psychological states*, if one assumes that the ability for understanding the other's intentional states *and* the capacity for communicating relevant information were both available.

As to the possible evolutionary origins of the inclination and capacity to communicate relevant information to conspecifics, we speculate that the increasingly sophisticated teleofunctional understanding of tools during hominid evolution led to complex skills of tool manufacturing that became practically impossible to acquire based on observable evidence through existing forms of social learning (including emulation) (Gergely & Csibra 2005). For example, when tools were manufactured at locations distant from their application, or when tools were used to make other tools, neither the goal nor the tool's efficient functional use was observable. Therefore, the procedure remained cognitively opaque for the juvenile who was deprived of the information necessary for inferring which (parts of) the observed action(s) or their multiple consequences were *relevant* for the tool's intended function(s) or affordances. This cognitive opacity represented a learnability problem endangering the chances of vertical transmission of important cultural skills that had significant survival value. This created the selective pressure for a new type of cultural learning mechanism that ensured transmission of relevant knowledge by making it *manifest* for the observer, leading to the emergence of the specialized communicative system of human "pedagogy" (Csibra & Gergely, in press). Humans became adapted both to communicate relevant knowledge to conspecifics and to be specifically receptive to such ostensive communicative knowledge manifestations. Knowledgeable humans became spontaneously inclined to ostensively manifest (not simply to use) their relevant cultural knowledge for the benefit of ignorant conspecifics, directing them to identify the relevant information to be learned. In turn, ignorant humans developed special sensitivity to ostensive cues that triggered a receptive attitude in them to infer and learn the new and relevant knowledge conveyed by the communicative manifestation.

Tomasello et al. view the formation of human culture as a mere by-product of an overarching species-specific drive to cooperate and share mental states with others. In contrast, our alternative proposal considers the species-unique capacity for cultural learning by communication of relevant knowledge to form the basis of human sociality and views the motivation for cooperation and sharing information as its consequences. But we certainly fully share Tomasello et al.'s belief that the best source of evidence to decide between these accounts will be provided by more data on the nature of early human development.

https://doi.org/10.1017/S0140525X05330123 Published online by Cambridge University Press