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DOI:
10.1111/cdep.12269

Document Version
Accepted author manuscript

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Article in press at *Child Development Perspectives*

Abstract

Language and other forms of communication are inherently ambiguous and therefore require some form of common ground to specify the intended meanings of utterances. Theoretical accounts usually focus on interactions between adults and see recursive mindreading to be a prerequisite of establishing common ground. In contrast to this, we want to offer a developmental perspective on common ground in this review. We propose that instead of using recursive mindreading, infants initially rely on the expectation that communicative partners act rational in light of previous interactions. This serves as a starting point for common ground to develop. Subsequently, we describe the changing role of common ground across development. Initially, common ground constrains the meaning of ambiguous communicative acts and facilitates children's acquisition of language. Later in development, common ground makes communication efficient by helping speakers to coordinate their actions and intentions, and eventually to arrive at recursive mindreading.

Introduction

Philosophical and psychological theories often refer to some form of "common ground" as one of the constituents of human communication (1,2). Due to its inherently ambiguous nature, language and other forms of communication require inferential reasoning from both communicative partners. The common ground shared by communicative partners supposedly sets the boundaries in which these inferential processes take place. Developmental theories have stressed the importance of common ground for early non-verbal communication (3) as well as language acquisition (4-6). Yet, what common ground is - its cognitive and motivational constituents - remains rather vague in the developmental literature. More importantly, it is unclear if/how the ability to form common ground develops. In this article, we want to offer a theoretical account of common ground that is cognitively and developmentally plausible, while conserving the idea of the inference constraining effect of common ground.

Almost all accounts of common ground converge on the idea that communicators use recursive mindreading to assess which epistemic states (knowledge, beliefs, etc.) are shared between communicative partners. While some accounts argue that the recursive process is potentially unlimited or reflexive (1,7), more empirical accounts suggest that it can be limited to a few recursive steps (6,8). In this paper, we will follow a different approach that conceptualizes common ground as a property of a social interaction rather than the consequence of individual recursive mindreading (9). In this approach, common ground is something that holds *between* two (or more) individuals who are engaged in communicative interaction. While being in this situation might lead individuals to engage in recursive reasoning about each other's mental states, this reasoning is not a prerequisite of their being in

this situation. What is required to use common ground in communication is an expectation that the partner will act in line with their shared experience. Thus, communication is a "risky business" and it takes supplementary cognitive abilities to assess whether the assumption that something is part of common ground is warranted. These abilities improve during ontogeny and make children more effective and efficient communicators.

In the next section, we define a basic set of abilities and expectations that infants need to participate in communicative interactions involving ambiguous signals and to gradually develop a more sophisticated understanding of common ground. We do not attempt to cover the full scope of common ground as discussed in the philosophical literature; we seek to provide a developmentally plausible starting point.

Defining Common Ground

According to our view, common ground has a cognitive as well as a motivational component. *Cognitive*: Representing some X as shared with another individual P. *Motivational*: Representing something as shared entails interacting with P in a way that is rational in the light of X and expecting P to act in the same way. These two components are inextricably linked because the sharedness of X in the cognitive part is defined by the expectations of the motivational part. This definition raises a number of questions.

What is X?

X is the focal topic of a social interaction, which could be, an object, a sequence of actions, a conversational theme and so on. The *social* aspect distinguishes common ground from the physical context because it picks out those parts that are relevant for X which also includes past interactions. X is identified by the communicative partners during episodes of spatiotemporal alignment of their attentional states within the

broader social interaction (see e.g. 10). As we will later explicate, successful alignment improves with the development of certain socio-cognitive abilities. Early in infancy however, adults facilitate the joint encoding of a common X by tuning in to the infant's focus of attention.

Who is P?

Even though we usually think of P as a specific individual, it is not limited to that. P could also be conceived as a generic member of a specific social group. For example, children's early play routines might not be specific to certain individuals but open to adults in general. Most prominently, when using language, children generalize from direct interactions and expect unfamiliar others to share a certain vocabulary - unless they show signs that they speak a different language (e.g. 11). That is, the expectation that X is part of common ground may be rooted in the conventional use of X within a group.

What is acting rational?

Here we follow Grice's (12) original suggestion that communication is a form of rational action. Acting rational means producing one's communicative acts in light of X and expecting P to do the same. Acting in light of X in combination with the assumption that the other's acts are based on X ensures that common ground narrows the potential interpretations of ambiguous acts. Based on this assumption, the interpretation of the utterance is the one that follows from X. For example, in a study by Liebal and colleagues (13) children played two games, each with a different adult but involving the same toys. Later, when one of the adults ambiguously pointed to one of these toys, children resumed playing the game they played previously with that particular adult. The pointing gesture alone, even in the same physical context, could have had many other interpretations such as a request for the object, a desire to share

interest, etc. Based on our account, children continued playing the previous game because they expected that P (the adult) produced this gesture in light of X (the previous game), because this is the rational thing to do and offers a straightforward interpretation of an otherwise ambiguous act.

Since most social interactions, especially those of young infants, are cooperative, the expectation that others communicate rationally also implies that others communicate in a cooperative/informative/relevant way. This expectation is reminiscent of Grice's cooperative principle (12) and has been highlighted as fundamental to human communication (1,2,6,14).

What is the basis to represent something as shared?

On a behavioral level, the basis for representing something as shared is, at least early in development, direct social interaction. The consequence of direct social interaction is that both partners have a similar representation of the interaction and its topic so that they *share* this representation [the cognitive component of common ground]. This interaction creates the tendency to interact with P in light of X in the future and the expectation that P will do the same [the motivational component of common ground]. We argue that infants act based on this assumption but they need not represent the recursive structure of the situation (see 15 for a similar argument regarding self conscious thoughts). Early in development, this is sufficient because infants mostly communicate with adults who actively scaffold the communicative interactions by correctly interpreting the actions/intentions of the child and by making their actions/intentions transparent and easily interpretable for the child.

However, active scaffolding by adults decreases over time and is virtually absent in interactions with same-aged peers. Given a certain level of social understanding and experience with communicative interactions (normally in place

around age 3), early peer interactions provide an especially rich context in which children experience various failures in communication and practice fixing these failures in communication because peers are less accommodating than adults. As a consequence, children learn about the constitutive conditions (see below) that have to hold in order for another individual to form a specific representation that matches one's own. Furthermore, once linguistic abilities advance, children also learn about what others experience without directly interacting with them. Taken together, this requires the gradual development of an insight into others' minds and could progress along the following lines: P must have interacted with me around X in the same way before; P must have been present at a certain time and place; P must have attended to X; P must know/believe that X; P must believe that I believe that X; P must believe that I believe that P believes that X, and so on.

In traditional accounts, recursive mindreading is taken to be a necessary precondition for common ground. Yet, the corresponding explicit theory of mind abilities only develop around six years of age (16). Thus, our account addresses this mismatch and argues that these simple set of expectations can have the inference constraining effect that characterizes common ground.

Common ground in development

In this section, we describe the changing role of common ground in children's communicative development by providing empirical evidence for early common ground understanding from the literature. We present three main functions of common ground: 1) It clarifies ambiguous communicative acts (gestures and early words) in infancy. 2) It constrains the potential meanings of novel words and facilitates language acquisition. 3) It makes communication efficient by constraining

if/how something needs to be explicitly communicated and how something is referred to.

Ambiguous communicative acts

Infants' earliest communicative interactions are naturally restricted by the limited size of their communicative repertoire. The elements of this repertoire, gestures, and single words, are therefore re-used for different purposes and partners have to rely on common ground to constrain their meaning in a given situation.

From 12 months onwards, infants produce and interpret ambiguous communicative acts in the light of common ground. They interpret ambiguous verbal requests for an object based on how they interacted with that person previously (17). For example, 17-month-olds interpret an ambiguous request for "the ball" as referring to the ball that they and the requester previously played with (Saylor & Ganea, 2007; see also Liebal et al., 2009). Importantly, direct social interaction around the object seems to be crucial for infants to make this kind of inference and form the expectation for the partner to act in line with their shared experience (19). Importantly, direct interaction even leads children to overestimate their common ground with others. Moll, Carpenter, and Tomasello (20) showed that 2-year-olds expected their partner to know about an object when they were engaged in a conversation with the partner while looking at the object, even though the partner never actually saw the object.

Infants also use common ground in their production (21,22). For example, 12-month-olds request absent objects by pointing to the location in which they and the experimenter previously saw the object (23,24). In these studies, the referential connection between the location and the absent object was established during an earlier interaction and children expected their partner to act based on it.

Learning language

In learning novel words, the child has to infer what the intended referent is. The assumption that the speaker communicates based on common ground greatly limits the potential referents of the novel word and thereby allows the child to complete the mapping successfully. For example, if a parent and a child have been naming objects based on their color and the adult introduces a novel object, the child might interpret a novel word as referring to the object's color as opposed to other properties. Evidence from the word learning literature supports this. At 17 months of age, children expect speakers to refer to the object they previously played with, even if the speaker later has a false belief about the object's location (25). From age 2 onwards, children also learn words based on novelty (26), preference (27), or familiarity (28). In these studies, what is novel, preferred or familiar was established during prior social interaction and by expecting their partner to act rational in light of this interaction, children could infer the intended referent of the novel word.

Efficient communication

Around age 2, children rely on various communicative strategies, such as using demonstratives (e.g., "Look at that!") or repeating what they hear to build common ground with their conversational partners (5). In these conversations, however, it is still the caregiver that does most of the interactive work, such as tailoring the conversation around the objects that children are attending to. Around ages 2-3, children begin to use common ground to achieve social goals especially with their same-age peers. For these interactions to be smooth/successful, children often need to have a joint goal (e.g, "how do we play this game?") and coordinate their actions/intentions to solve problems together. Reaching joint decisions or solving problems with partners is a difficult cooperative task, as it requires accommodating the needs of the conversational partners (e.g., desires, intentions, knowledge states),

all of which are anchored in the common ground. Children not only monitor their partners' actions, intentions, knowledge states in their interactional history, but they also have specific expectations for how their partners *should* act like based on the common ground they share.

From 3 years onwards, children coordinate their language and jointly agree on some ad hoc conventions, or "referential pacts", with their partners. (29). Once they refer to a toy as *pony*, children consistently refer to that referent as *pony* and expect their conversational partners to do the same (30). This binding character of common ground becomes especially apparent in pretend play in which children assign pretend identities to various objects. For instance, Wyman and colleagues (31) have shown that once preschoolers agree to pretend a pen to be a toothbrush, they expect their play partners (and not others who do not share this common ground) to treat the pen as the toothbrush and correct their partners' use of an incorrect pretend identity for the pen, by using normative language ("No this has to be the toothbrush"). Children's protests for violation of local conventions provides strong evidence for children's partner-specific expectations that acting based on common ground is indeed the "correct" and "rational" thing to do.

Beyond their word choices, children also appeal to common ground in their more complex language such as in their explanations (32). When 3- and 5-year-old peers were asked to jointly decorate a zoo, children adjusted the informativeness of their justifications for their proposals depending on the common ground they share with their partners to reach the correct joint decisions (33,34). Similarly, Köymen and colleagues (35) had preschoolers play a sorting game with a peer, who either did not know the game or knew the game (as they learned about the game together) but played it incorrectly. When playing with a naïve partner, 3-year-olds used normative

explanations, which were more informative (e.g., “One must put the flower with the flower”). However, when playing with a partner who knowingly violates the rule, children relied on their common ground and used less informative statements in their interventions (e.g., “No that goes here!”). Thus, preschoolers actively use and modify common ground to coordinate their actions and intentions with their peer partners. Importantly, in all of these studies, direct social engagement is key to establishing common ground. It leads children not only to act in accordance with their common ground but also to form specific expectations about how their partners *should* act to achieve their social goals.

With advanced linguistic and socio-cognitive abilities, children make inferences about what other people know and how they will behave based on their knowledge states without directly interacting with them. Grueneisen and colleagues (36) asked peer dyads to individually deposit their marbles in one of four boxes, and if both children placed their marbles in the same box, they would both get a reward. Crucially, each of the three boxes had the same picture while one box had a different picture. 5/6-year-old children were able to correctly guess which box would be more salient to their peers and which box their peers would think would be salient to them without having direct interaction with one another (see also 37). Six-year-olds were even successful when one child had a false belief about their peer partner’s belief (38). Thus, around age 6, children can engage in recursive mindreading to figure out what is common ground and use this skill to successfully coordinate their actions to achieve joint goals.

Conclusion

We argued that recursive mindreading is not a necessary prerequisite to “get common ground off the ground”. Children can enter the world of communication by acting

239 rational in light of previous social interactions and expecting others to do the same.
240 Taken together with accounts about the intentional structure of human communication
241 (39,40), the argument put forward in this paper emphasizes the social and
242 interactional nature of human communication while making fewer demands on the
243 cognitive abilities that are involved in it, thereby offering a truly developmental
244 perspective.
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