Children's interpretation of ambiguous pronouns based on prior discourse

Language learning and use is a fundamentally social behavior – when children hear ambiguous or novel words they can rely on social information to infer meaning (e.g., Tomasello, 2008; E. V. Clark, 2009). As discourse unfolds, interlocutors build up common ground - a set of shared knowledge and beliefs - that serves as a background against which new utterances are interpreted (H. H. Clark, 1996). To use common ground in this way, children not only have to pay attention to what is said earlier but also with whom they have had this conversation and share this common ground. Children as young as 18 months interpret an ambiguous pronoun as referring to a previously mentioned object - even when it was absent from the scene (Ganea & Saylor 2007; Lidz, Waxman & Freedman, 2003). Children can also rely on prior discourse to learn new words. For instance, when a speaker first states that they were hungry and then asks for a *wug*, 2-year-olds map the novel word onto an edible object (Sullivan and Barner, 2016).

In almost all of these studies, the loose construct of "discourse" or "common ground" is operationalized as including the specific objects that had been explicitly mentioned. In conversation, however, discourse is often organized in terms of an overarching topic rather than a specific object. Further, this topic is rarely stated explicitly; instead it is typically inferred based on the content of utterances (Clark, 1996). Moreover, common ground built up during discourse is often partner-specific. Subsequent inferences therefore incorporate both the conversational topic(s), but crucially also social information - the participants engaging in the conversation. Children keep track of their conversational partners from a very young age (Bohn, Zimmermann, Call & Tomasello, 2018). However, these social inferences based on the identity of the conversational partners have rarely been studied in conjunction with discourse inferences. Thus, it is unclear whether discourse inferences involve social reasoning at all.

In the present set of studies, we investigated the impact of partner specific discourse topics or the impact of common ground between specific group of individuals on ambiguous pronoun resolution in 2- to 4-year-old children. First, we examined how children interpret ambiguous utterances in light of an overarching topic that guides conversation, but was never explicitly mentioned (and must be inferred in context). Second, we examined how their interpretation changes depending on the common ground shared with specific partners. The procedure, predictions, and analyses are pre-registered and can be found at https://osf.io/5e9pk?view_only=dd914ba1b0cd4728b631135b5782be79.

Study 1

71 2-, 3-, and 4-year-olds participated in Study 1. The experimenter introduced the study as a visit to the house of the little animals, during which the animals would show the child the things they have at home. On each trial, children saw one animal (the speaker) in the middle of the screen with three objects above them. Each of the objects belonged to a different category. Trials started with six training rounds, in which the speaker named one of the three objects displayed above them and asked the child to touch it ("Look at that, can you touch the X?"). From one round to the next, the pictures changed but the three categories remained the same and the speaker consistently asked the child to touch the object from one category. For example, on the first training round, children saw a skirt (from the category of clothing), a horse (from the category of animals), and a motorcycle (from the category of vehicles) and the speaker asked "Can you touch the motorcycle?" On the second training round, children saw a jacket, a dog, and a bus and the speaker asked "Can you touch the bus?" After the six training rounds, children moved to the test trial and saw a new set of three objects (e.g. a hat, a cat and a train). However, instead of using a label, the speaker used

an ambiguous pronoun to refer to one of the objects ("Look at that, can you touch *it*?"). Children could identify the referent of the pronoun by assuming that the speaker continues to talk about objects from the same category as they did previously (vehicles in the example above). However, in order to do so, children had to infer the category by which all of the previous objects the speaker mentioned were grouped.

The dependent variable in all analyses was whether the object chosen at the test trial was from the same category as the objects named throughout the training rounds. We found little evidence that 2-year olds performed above chance (mean = 0.42, BF_{10} = 0.59) but found substantial evidence for 3-year-olds (mean = 0.60, BF_{10} = 90.77) and 4-year-olds (mean = 0.55, BF_{10} = 10.39). Thus, based on hearing a speaker consistently refer to objects from a certain category, children as young as age 3 interpreted the ambiguous pronoun *it* as referring to another object of the same category. This suggests that children track common ground with a speaker not just in terms of remembering what has been talked about previously, but also in the form of an overarching topic that guides the conversation and allows predictions about what will be talked about in the future.

Study 2

In study 2 we tested whether these judgments were specific to particular speakers. 30 3-year-olds and 30 4-year-olds participated in study 2. Children carried out the same task as in Study 1. However, in half of the critical trials it was the same speaker who produced the ambiguous pronoun ("Can you touch *it*?") as the speaker who presented the training trials and in the other half of the critical trials, it was a new speaker.

We tested the effect of speaker change on children's discourse inferences via a model comparison. We compared a base model including only age as a fixed effect to models including speaker type, either as a main effect or as an interaction with age. The interaction model was estimated to be three times more likely than the other models considered to make better predictions on new data. The interaction term in the model itself was large and reliably different from zero (B = 1.55, 95% CI = 0.23 - 2.95) and showed that while younger children did not take into account speaker identity, older children (starting at around age 4) only interpreted the ambiguous pronoun in light of the previous discourse topic when the speaker remained the same.

Taken together, the studies reported here illustrate the development of children's ability to balance different layers of discourse. Thinking of discourse as organized by overarching topics allows listeners to predict what will be talked about next and, assuming that these predictions hold, increases the likelihood of successful comprehension. But discourse is also a form of social interaction and thus requires making inferences about the common ground shared between specific conversational partners. Here we show that children can use these processes to identify the referent of an ambiguous utterance. Because referent identification is a first step in language learning, we expect the same processes to also be recruited for language learning.