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**There might be more to syntactic bootstrapping than being pragmatic: A look at grammatical person and prosody in naturalistic child-directed speech**

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In *Being pragmatic about syntactic bootstrapping*, Valentine Hacquard argues that abstract syntax is useful for word learning, but that an additional cue, pragmatics, is both necessary and available for young children during the first steps of language acquisition. She focuses on modals and attitude verbs, where the physical context seems particularly impoverished as the sole basis for deriving meanings, and thus where linguistic cues may be particularly helpful. She convincingly shows how pragmatic and syntactic cues could be combined to help young language learners learn and infer the possible meanings of attitude verbs such as “think”, “know” or “want”. She also argues that in some circumstances, syntax and pragmatics would need to be supplemented by semantic information from context, for instance in the case of modals such as “might”, “can”, or “must”. We agree with Hacquard on the importance of the synergies between these different cues to meaning, and wish to add two other aspects of the input that might also be used by young children in these contexts. The aspects we describe can only be noticed when one analyzes concrete examples of what children *hear* in their everyday lives, something which Hacquard does very often in her work (e.g., Dieuleveut et al., 2022; Huang et al, 2022; Yang, 2022). Taking all these different cues for meaning together would help the field go beyond current models of syntactic bootstrapping, and create an integrated picture of the synergies between different levels of linguistic information.

The first additional piece of information that might make attitude verbs and modals easier for children to learn is their connection to the person being spoken to or about - grammatical person. With the exclusion of four examples, all examples of sentences provided by Hacquard are in the third or first person (e.g., “Alex denkt, dass Frankie hier wohnt.” or “I think it’s time for bed!”). However, the more common type of sentences children hear with modals or attitude verbs seems to be second person sentences. For example, when we examine the Nazzal Arabic corpus in CHILDES (Nazzal, 2022), we find a total of 147 mentions of *second person* with the verb *want*<sup>1</sup>, and only 14 mentions of the *third person want*, and 16 mentions of the *first person want singular*. Why does it matter whether the child mostly hears attitude verbs with the second and not third person? Consider the context these two different sentences might appear in: “Do you want an apple?” versus “Do you think they will be here soon?”. In the first case the speaker would potentially be presenting the child an apple, and an affirmative answer would get that apple delivered to them. In the second case, nothing concrete would happen in the world, other than the speaker maybe providing their own opinion on the matter. Thus, *want* and *think*, in the second person are very different in terms of their consequences, and additionally, require only knowledge of one’s own thoughts and desires (not other people’s). However, contrast this with “Does Alex want an apple?” versus “Does Alex think they will be here soon?”. These examples both require the child to consider what another person might wish or think, both will be more difficult than surveying their own desires and thoughts - and both have no real-world outcome. Note that children do not have to master the syntactic or morphological distinction between second and third person to benefit from the fact that the majority of input might be in the second person. Future corpus studies should look more closely at differences between these two types of sentences - be it in the different types of meaning conveyed by them or in the different verbs they are used with.

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<sup>1</sup> Including second person: *bidek* - you want[fem], *bidak* - you want[masc], and *bidkum* - you want[plural], as well as their negation, *bidkesh* - you do not want[fem], *bidkash* - you do not want[masc], *bidkumsh* - you do not want[plural]); and third person: *bidha* - she wants, *bidu* - he wants, *bidhum* - they want, and their negation. Note that in the case of Arabic, a sentence such as “Alex wants” would be pronounced as “*Alex bidu*”, so our analysis includes all third person sentences, not only those in which the subject is a pronoun. The verb root *think*, *f.k.r*, does not appear in this 10,000 token corpus.

Prosody is the second source of information that might help children learn the different types of meaning conveyed by attitude verbs and modals. Hacquard addresses important questions about how and when children can learn the differences between declaratives, interrogatives and imperative sentences and the types of meanings (or speech acts) they tend to convey: assertions, questions, or requests. She proposes that pragmatics could serve as a filter which would allow children to reason about speakers' intentions when they hear these types of sentences, but the presence and use of prosodic information is left out of the discussion (but see discussion about it in a recent dissertation supervised by Hacquard: Yang, 2022). Prosodic information seems extremely relevant to the expression of pragmatic meaning across the world's languages, as speakers tend to use prosody for many linguistic and communicative purposes. Prosody is used, for example, to highlight important information (e.g., contrasting focus, marking old vs new information), to communicate the speaker's state of knowledge about what they are saying (e.g., uncertainty, doubt, or disbelief), and for many other purposes (e.g., Armstrong et al., 2016; Jun, 2014, 2005; Ladd 2008; Brown & Prieto 2021; Pierrehumbert & Hirschberg, 1990). Hacquard herself started investigating the presence of prosodic information in these types of sentences in recent studies (see e.g., Goodhue, et al., 2022; Zaitso, et al., 2021), but has left the role it could play in children's interpretations out of her current analysis.

Speakers can change the intonation contour of a sentence depending on whether they give an order (e.g., You must eat meat!) vs a suggestion (e.g., You may eat meat). Prosody can also vary depending on how certain the speaker is about the information they are giving. Note for instance that the prosody used in a sentence like "Alex must eat meat" when it is conveying that it is likely that Alex eats meat, is different from the prosody used when the same sentence is used to require Alex to eat meat: "Alex must eat meat!". Thus, it is likely that parents would not use the same intonation when they ask a question, give an order or make a request, and they would not use the same intonation when they are certain about what they are saying compared to when they are uncertain about the information being conveyed.

Previous studies have found that young children can rely on such prosodic information to distinguish between declarative, questions and assertions (see e.g., Patel & Brayton, 2009; Patel & Grigos, 2006; Zhou, Crain, & Zhan, 2012) and to signal and understand internal states such as beliefs, disbeliefs, desires, feelings and emotions (Armstrong & Hübscher, 2018; Armstrong, Esteve Gibert, Hübscher, Igualada, & Prieto, 2018; Hübscher, Vincze, & Prieto, 2019; Krahmer & Swerts, 2005; Pronina, Hübscher, Vilà-Giménez, & Prieto, 2022; Swerts & Krahmer, 2005). It is therefore highly possible that prosodic information can be used as an additional cue that might help young language learners learn the different types of meaning that attitude verbs and modals can convey. However, more studies are needed to carefully investigate this question, especially when analyzing naturalistic input addressed to children, and measuring the natural prosodic cues available in their input.

For us, syntactic bootstrapping, pragmatic bootstrapping, prosodic bootstrapping and bootstrapping word learning from context (such as in the case of second-person sentences), can all be combined within a larger framework. According to this framework, young children learn by attempting to predict which word, semantic field or linguistic structure comes next (Babineau et al., 2022; Rabagliati et al., 2016). This larger framework views the child's language-learning task as figuring out the intended meaning of an interlocutor using prediction. Since human communication and behavior follow specific distributional patterns - be they syntactic, pragmatic, or any other structural field - the child could use prediction to master these, and adapt their predictions when they prove wrong.

While there has been an abundance of research on syntactic bootstrapping in the past decades, and research on pragmatic and prosodic bootstrapping in young children is beginning to emerge, there is very little research examining how different sources of distributional information combine in language learning, how their weights might differ, and what factors

affect this weighing in children, across different languages. Previous research found that 4- to 5-year-olds change the weight they assign to different sources of information as a function of the relative reliability of these sources of information in context (Beretti et al., 2020; Yurovsky et al., 2017). One other study found that 2- to 5-year-old Turkish children use multiple distributional linguistic cues for transitivity (not only the number of NPs but also a nominal accusative marker), and suggests that Turkish children may rely less on the number of NPs than English-speaking children, given that they expect multiple cues for transitivity (Göksun et al., 2008). More cross-linguistic studies are needed to map children's ability to combine different cues, and the factors that affect the weight of these cues to support word learning in real-life. With those in hand, we will be in a better position to judge the relative role of pragmatic cues, and how they interact with other cues present in children's input across the world's languages.

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