

Active Learning in Language Development

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Recent evidence suggests that children play an active role in their own learning in many domains, yet the study of language development has focused on children as passive recipients of adult guidance. We argue that this approach overlooks language development as a fruitful domain in which to explore learners' active, self-directed learning — specifically, instances where the learner selects the linguistic information they want to receive, in order to enhance their own learning. We suggest that reframing the child as an active language learner introduces novel explanations for phenomena in language development, and offers researchers complex, ecologically valid tests of rational learning accounts.

Keywords: *language acquisition* | *active learning* | *self-directed learning* | *ecological learning* | *rational attention* | *lexical development*

Introduction

Children are famously scrappy learners. And yet within the study of language development — a complex social system that children are highly motivated to master — researchers often discuss children as the passive recipients of adult guidance. The idea that children learn language *passively* might be intuitive, as adults often appear to be *teaching* children to talk, by engaging them with simplified, exaggerated speech (Soderstrom, 2007). Moreover, the public sphere is rife with examples that highlight the importance of child-directed language, including messages that liken *talking* to children to *feeding* them (e.g., Zauche et al., 2017). We argue that the emphasis on the child's 'receipt' of linguistic input and adult support overlooks language development as a fruitful domain in which to explore learners' self-directed learning. Below, we show how adopting a more active view of children's language learning can yield insights and new research directions.¹

We define an active learner as a learner who selects the information they want to receive in order to enhance their own learning (Gureckis & Markant, 2012).² Prior research shows that children demonstrate active learning in diverse ways from early in life. Infants' attention to a stimulus is reliably related to its novelty, complexity, or learnability (e.g., Gerken et al., 2011; Kidd et al., 2012). Toddlers explore to re-

duce uncertainty (e.g., Sim & Xu, 2017a). Preschoolers conduct impromptu experimental tests of their hypotheses (Cook et al., 2011; Sim & Xu, 2017b), and school-age children ask increasingly strategic questions as they mature (Ruggeri & Lombrozo, 2015). Yet this vision of an intrepid, rational child learner — which has been central to research in causal and ecological learning — has been largely absent from research in language development. How might children's apparent self-directed learning prowess in non-linguistic domains translate to language learning?

Because languages are culturally-transmitted systems of communication, there are limits on what children can learn independently (e.g., a child cannot learn that dogs are called "dog" without exposure to English). At the same time, self-directed learning has a seemingly natural fit with language development. Children grasp the utility of linguistic communication from infancy (Martin et al., 2012), suggesting that they will be intrinsically motivated to learn language to communicate. Furthermore, language development is resilient: children learn language across diverse contexts, from multi-family dwellings where young children are primarily cared for by barely-older peers, to nuclear family units in the Western, industrialized middle class (Hoff, 2006; Schieffelin & Ochs, 1987). Children may learn across these different contexts by playing a driving role in the learning process, taking advantage of available sources of language input, and seeking out relevant information as needed (Bloom, 2000).

In this review, we explore how adopting a view of the child as an *active language learner* might give us purchase on basic questions about how language development unfolds, and on what language input is effective for learning. We focus on the child's developing lexicon to illustrate active learning in language development for two reasons: (1) as word forms are largely arbitrary conventions, they must be learned, and learned *from* someone; (2) although some of the words that children know (e.g., "boo-boo") likely come from language directed to them by caregivers, others are more likely to have been picked up from language directed to others (e.g., obscenities). Below, we review how children select the information they want to receive by (1) rationally deploying their attention, (2) tuning in to ambient language to reduce uncertainty, (3) eliciting input from knowledgeable interactants, and (4) eliciting and evaluating evidence to bear on linguistic hypotheses.

¹It is worth noting that 'nativist' perspectives on language development have also historically de-emphasized the role of adult teachers, and of linguistic input more generally. However, while nativist theories do suggest a substantial role for the child learner, it is because of the amount of language-specific machinery and expectations that the child is thought to bring to language development, rather than the amount of domain-general (rational) learning expertise they bring to the task.

²Note that we are not making any claims about the learner's conscious awareness of their own learning, nor explicit choices to advance their learning.

Children efficiently allocate their attention among potential sources of language input

Take a scenario that might be familiar: having just finished reading a story to a 3-year-old for the 12th time, you hear, “Again! Again!” Research tying children’s attention to stimulus ‘learnability’ raises the possibility that children ask to hear the same story again and again in part because there is still something for them to learn from it.

Do active language learners select the language data they want to receive so that their learning will be the most efficient? In support of this idea, Gerken and colleagues (2011) showed that the amount of attention infants paid to artificial language stimuli in the lab depended on the learnability of the artificial grammar. *Unlearnable* grammatical stimuli contained a conflicting blend of grammatical gender markings — half of the exemplars infants heard conformed to one set of rules, and half conformed to another. In contrast, *learnable* grammatical stimuli all conformed to the same set of rules. Interestingly, 17-month-old infants looked away more quickly when listening to the unlearnable grammar, and stayed looking longest when the grammar they heard was *subjectively learnable* — inferred to be such because a previous sample of same-age infants was able to learn the critical rule, given a similar period of familiarization.

More recently, we directly tested the link between preschoolers’ self-directed attention to spoken English and their learning (Foushee et al., n.d.). Children (4–6 years) listened to a story narrated at either a Simple (using age-appropriate words) or Complex (using later-acquired words) level, while an eyetracker captured their visual attention across a storybook display. The looping audio narration for each page accelerated if the child lost interest in the story and attended to a distractor instead. Hypothesizing that a child’s attention to spoken language reflects its subjective complexity — *i.e.*, how understandable or learnable it is for them — we expected that a given objective degree of complexity should be experienced differently by younger and older children, due to their different levels of linguistic competence. Indeed, children’s age predicted the degree to which the Complex versus Simple speech elicited and maintained their attention. In the Complex condition, older children were more likely to continue listening to the speech. The opposite was true in the Simple condition: younger children were more likely to continue listening. This is the pattern of results one would expect if a child’s attention to spoken language is responsive to how much they can learn from it. Indeed, individual children’s story comprehension and novel word learning, tested after the story, were systematically related to their attention to the speech.

Children learn from ambient language in the absence of adult support

The internet is awash with vivid recordings of children producing language they likely learned “actively.” For example, “where did my toddler learn to swear?” returns billions of search results, and clips of young children surprising us with

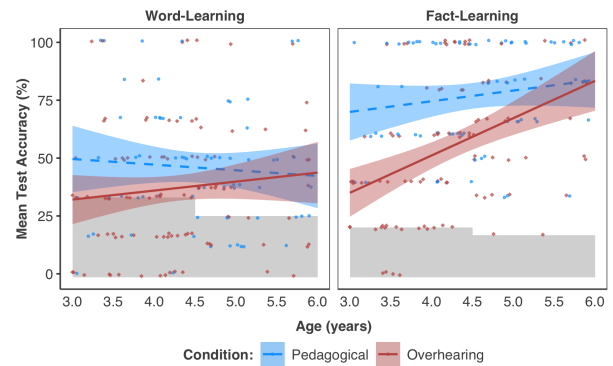


Fig. 1. Age Effect in *Foushee, Srinivasan, & Xu, 2021*. Mean test accuracy for two types of novel linguistic information corresponding to a set of unfamiliar toys: words (*e.g.*, *pimwit*; left panel) and facts (*e.g.*, *the one my sister loves*; right panel). Shaded region indicates accuracy at or below chance. *Note.* Children were tested in two age bins: 3–4.5-year-olds heard 3 novel words (*chance* = 33%; $M_{\text{Overhearing}}$ = 30%–39%), and 5 facts (*chance* = 20%, $M_{\text{Overhearing}}$ = 46%–57%), while 4.5–6-year-olds heard 4 novel words (*chance* = 25%; $M_{\text{Overhearing}}$ = 41%), and 6 facts (*chance* = 17%; $M_{\text{Overhearing}}$ = 64%).

their perfect mimicry of adult verbal behavior regularly go viral. In both cases, children are evincing knowledge of language that is unlikely to have been directed to them.

In a recent study, we assessed whether preschoolers tune in to overheard speech, across two experimental conditions that placed dramatically different demands on self-directed learning (Foushee et al., 2021). In both conditions, children (3–6 years) playing with a mixed set of familiar and novel toys had the opportunity to learn from dense, naturalistic speech a set of new words and facts about the objects. In the Pedagogical conditions, an experimenter cued the child’s attention to each object as it was discussed. In the Overhearing conditions, an experimenter spoke on a phone call nearby, looking at neither the objects nor the child (Fig. 2A).³ Our results indicate that, with age, children learned to coordinate their attention between the overheard speech and the unfamiliar set of objects, and also grew increasingly likely to demonstrate robust word-learning from the overheard speech (Fig. 1). Strikingly, older (4.5–6-year-old) children learned four novel object labels equivalently from just one minute of overheard as from one minute of child-directed speech.

Together, the studies reviewed here and in the preceding section may help resolve an apparent paradox in the language development literature: although even toddlers are able to learn new words from overheard speech in experimental studies in simplified conditions, there is surprisingly little

³This study builds on a previous literature comparing novel word-learning when children witness a third-party interaction, versus are directly addressed (*e.g.*, Floor & Akhtar, 2006). However, in many of these previous studies, children witnessed third-party interactions in which the speakers gazed at and pointed at the referents of new labels, minimizing the demands on children’s self-directed learning abilities (see Foushee et al., 2021 for a complete discussion).

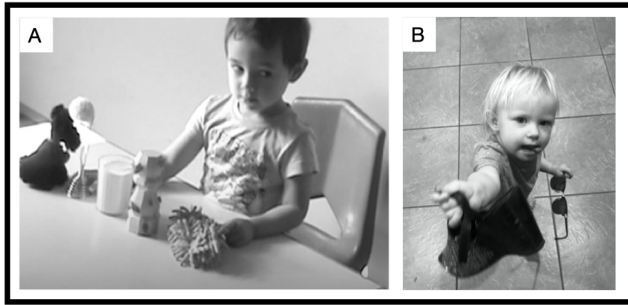


Fig. 2. Active Learning Behaviors in Language Development. **A:** Children ‘tune in’ to relevant ambient language. **B:** Children elicit language from caregivers through bids.

evidence that children learn words from overheard speech in their natural language environments (e.g., Shneidman & Goldin-Meadow, 2012). As rational learners “in the wild,” children may monitor all potential sources of language in order to learn most efficiently. In contexts where simplified child-directed speech is available, children may be less likely to attend to and learn from overheard speech that is relatively more complex; in contexts where child-directed speech is rare, children may adapt by attending to and learning more from overheard speech. This hypothesis may help explain why children appear to reach linguistic milestones on similar timetables cross-culturally (e.g., Casillas et al., 2020).

Children elicit labels from adults

A toddler waddles over carrying an unfamiliar object (Fig. 2B) and asks, “What’s this?” The caregiver replies with a label. As conventions, words only have value as much as they are agreed upon by others. Thus, a child who wants to be able to talk about animals or *this-thing-I-found* will need help finding the right words.

Both experimental and observational evidence illustrate how children expand their vocabularies by eliciting linguistic information from those around them. Laboratory studies show that infants use pointing to request information from knowledgeable adults (Begus & Southgate, 2012), and that preschoolers know both when they don’t know what something is called (Lipowski et al., 2013), and who to explicitly ask for the word (Koenig & Harris, 2005). Indeed, many of the questions that pepper children’s early productions represent requests for linguistic information: in an analysis of four children’s spontaneous speech, for example, between 28% and 65% of the questions children asked between their first and second birthdays were requests for labels (Chouinard et al., 2007). Along these lines, children’s “active language learning” may be part of the explanation for why the onset of locomotion is so often correlated with a marked increase in vocabulary growth (He et al., 2015; Walle and Campos, 2014, though see Moore et al., 2019). With a newfound visual perspective, autonomy (and freer hands), walkers encounter new and different things to name, and become more likely to make the sorts of attentional bids that elicit verbal responses from caregivers (Karasik et al., 2014). This re-

mains speculative: unlike infants’ points (Begus & Southgate, 2012), and children’s questions (Chouinard et al., 2007; Jimenez et al., 2018), evidence for children’s intentional role in eliciting information through bids — as opposed to merely sharing attention — is indecisive.

Children test and refine their hypotheses about word meanings through feedback

Children use other, more capable language users not only to get new words, but also to refine their hypotheses about word meanings: e.g., a four-year-old in 2020 asks their mother, “is *coronavirus* really popular right now?” Their question seems aimed at triangulating a new word’s meaning: what does *coronavirus* refer to, such that all adults are suddenly talking about it?

Children seek linguistic information from the social world in a way that implicitly reflects their relative degree of uncertainty about how to use or interpret a given word. Children recruit help with how to define or interpret a word explicitly, as in the question above (Jimenez et al., 2018). They also engage in subtler information-seeking behaviors: preschool-aged (2–5 years) children scan an adult experimenter’s face more when the experimenter makes a referentially ambiguous request, e.g., asking them to give them the “modi” between two novel objects, relative to when the experimenter asks for the “dawnoo” between a novel object and a toy dinosaur (Hembacher et al., 2020).

Additional evidence for how young children monitor and reduce their uncertainty about different word meanings comes from a cross-situational word-learning study where children were shown novel and familiar object-word pairs. Some of the novel word-object pairs were ambiguous (e.g., the same two novel objects always co-occurred with the same two novel words), while others could be disambiguated via an inference (e.g., if the words are *leemu* and *dog*, *leemu* must refer to the non-dog object). When later given the opportunity to learn more about specific objects, children (3–8 years) preferentially chose to sample referents whose labels remained ambiguous, and became even more likely to do so with age (Zettersten & Saffran, 2021). Thus, learners track not only their hypotheses about potential word meanings, but also the strength of their evidence, and actively seek additional information to reduce their uncertainty.

Discussion

The preceding sections have reviewed how an active learning framework can be extended to explain children’s remarkable language learning success. Several key questions remain, which we hope will inform future research:

- (1) How can we characterize the mechanisms of active learning in language development, and do these mechanisms apply in other domains? Prior explanations for how children sample linguistic information rely heavily on notions of *complexity*, *learnability*, and *uncertainty*, but what are children tracking, implicitly, that makes their

behavior explicable via these variables (*e.g.*, comprehension rate? prediction error? entropy?) — and does that signal have analogies in other domains?

- (2) Where can we see active learning of other aspects of language knowledge? We have focused on the utility of active learning for acquiring the lexicon, but there are no doubt analogies for grammar-learning. For example, is there some ‘just right’ level of syntactic complexity to which children at a given stage of language development are most attentive?
- (3) How does affect intersect with cognitive motivations for language learning? One promising research area concerns the ways children’s lexical development reflects their *interests* (*e.g.*, dinosaur names; Mani & Ackermann, 2018). On functional accounts of emotions (Barrett & Campos, 1987) children’s attention to fruitful learning opportunities may be driven by positive affective experience, rather than metacognitive insight.

Conclusion

In our view, there is great potential in a research program at the intersection of active learning and language development — especially one with an eye toward ecologically valid demonstrations of children’s abilities. Diverse empirical questions lie at this intersection. As the work reviewed here reveals, reframing the child as an *active* language learner introduces novel explanations for phenomena in the development of language. At the same time, using language as a test domain for formal rational learning accounts can provide researchers with complex learning tasks that make sense to children, and are informative of how children navigate complexity within their daily lives. Finally, applying the active learning framework to language development presents an opportunity to make our science more inclusive: the one-on-one pedagogical contexts that research and public policy tend to emphasize represent only a sliver of the language learning contexts that young children experience over the course of the day, across different households, and across different cultures. That children across diverse milieus become capable adult speakers may reflect children’s active role in getting the linguistic information they need.

Recommended Reading

Saylor, M. M. & Ganea, P. A. (Eds.) (2018). *Active Learning from Infancy to Childhood: Social Motivation, Cognition, and Linguistic Mechanisms*. Springer International. New York, NY.

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