Communicative efficiency is present in young children and becomes more adult-like with age

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One of the most striking commonalities across the world's languages is the tendency to assign less linguistic material to more predictable or frequent meanings (Gibson et al., 2019; Haspelmath, 2021). The association between form length and meaning is argued to derive from speakers' bias for efficient communication, reflecting the need to balance competing pressures: minimizing production effort while maximizing understandability (Levshina & Moran, 2021; Zipf, 1949). An efficient trade-off between these two pressures involves producing less linguistic material whenever possible, e.g., when the meaning is predictable, and producing more linguistic material only when it is essential for being understood, e.g., when the meaning is unpredictable or when there is noise. Indeed, there is abundant evidence showing that speakers tend to reduce or omit elements when that does not compromise understandability, and tend to use longer forms when shortening or omitting them would impede understanding (Kanwal et al., 2017; Levshina & Moran, 2021). However, virtually all of this evidence comes from adults. It is not clear whether children's language use is also shaped by communicative efficiency. Investigating whether such a pressure is already present in children is important for understanding both the development of communicative behaviour and the respective roles of adults and children in shaping language structure. Here, we investigate the developmental trajectory of communicative efficiency using a novel experimental paradigm. Children between the ages of 4 and 10 play a communication game with a simulated interlocutor using visual icons: they have to tell the simulated interlocutor which action they should perform when meeting another character (kiss or hit). The design simulates effort and understandability in the following way. To simulate effort, messages can vary in length (1-3 icons), with longer messages taking more effort to produce than shorter messages. To simulate environmental noise, in some communicative turns messages are corrupted, and longer messages are robust to that corruption

while shorter messages are not (see Figure 1). If efficient communication is present already in younger children, then longer messages should be used in the presence of noise and shorter messages in non-noisy environments, regardless of age. If, however, this tendency is tied to development, then the relation between noisiness and message length should vary with age. Importantly, communicative efficiency could develop with age in two ways. If young children show a weaker preference to maximize understandability, we should see a developmental increase in the tendency to use longer messages in noisy environments; If young children show a weaker preference to minimize effort, we should see a developmental increase in the tendency to use shorter messages in non-noisy environments. 61 Hebrew-speaking children participated in the experiment (mean age: 6;10y). Results show that communicative efficiency is attested already in young children and becomes more adult-like with age: Even young children produce longer messages in noisier environments, but as they grow, they are more likely to shorten messages (minimize effort) when a short message is sufficient for accurate communication (see Figure 2). We discuss the implications of our results for theories of language evolution and change as well as cognitive development.

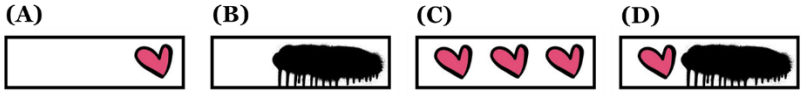

Figure 1: Example message types conveying the kiss action. Note that the noise obscures the first two icons when being "read" from right to left, as in Hebrew (participants' native language). (A) A 1-icon length message, without noise. (B) A 1- or 2-icon length message, with noise. (C) A 3-icon length message without noise. (D) A 3-icon length message with noise.

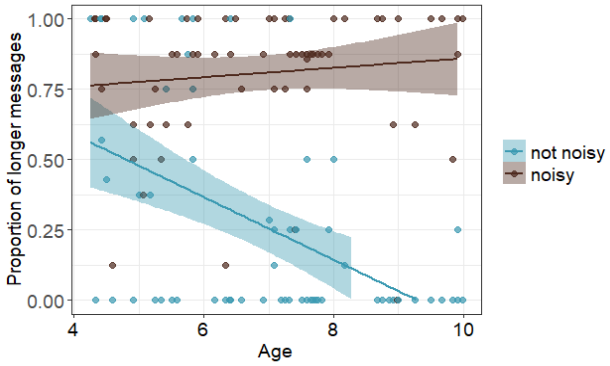

Figure 2: Proportion of longer messages as function of age (in years) and noise. Individual points represent by-participant means. Solid lines show estimated regression lines for noisy and not noisy trials, along with 95% confidence intervals.

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