1   Parents fine-tune their speech to children's vocabulary knowledge

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5   Author Note

6   All data and code for these analyses are available at https://osf.io/3f8hy. Videos of

7 experiment sessions are available on Databrary: https://nyu.databrary.org/volume/1128.

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₁₀   Abstract

₁₁   Young children learn language at an incredible rate. While children come prepared with

₁₂ powerful statistical learning mechanisms, the statistics they encounter are also prepared for

₁₃ them: children learn from caregivers motivated to communicate with them. How precisely do

₁₄ parents tune their speech to their children's individual language knowledge? To answer this

₁₅ question, we asked parent-child pairs (n=41) to play a reference game in which the parent's

₁₆ goal was to guide their child to select a target animal from a set of three. Parents fine-tuned

₁₇ their referring expressions to their children's knowledge at the lexical level, producing more

₁₈ informative references for animals they thought their children did not know. Further, parents

₁₉ learned about their children's knowledge over the course of the game, and tuned their

₂₀ referring expressions accordingly. Child-directed speech may thus support children's learning

₂₁ not because it is uniformly simplified, but because it is tuned to individual children's

₂₂ language development.

₂₃   Statement of Relevance

₂₄   The pace at which children learn language is one of the most impressive feats of early

₂₅ cognitive development. One possible explanation for this rapid pace is that the language

₂₆ caregivers produce is tuned to children's developing linguistic knowledge, maintaining just

₂₇ the right level of complexity to support rapid learning. We present the first experimental

₂₈ evidence of just how precise this tuning is, showing that parents tune not just to children's

₂₉ holistic language development, but to their knowledge of individual words. We developed a

₃₀ new method in which we experimentally controlled what parents talked about, but not how

₃₁ they could talk or what they could say, increasing the chance that these results will

₃₂ generalize outside the lab. This work points to the importance of studying the parent-child

₃₃ dyad as a unit instead of focusing on children as isolated learners, both in the domain of

₃₄ language and in social learning more broadly.

35   *Keywords:* parent-child interaction; language development; communication

36   Word count: 1385

₃₇   Parents fine-tune their speech to children's vocabulary knowledge

₃₈   In just a few short years, children master their native language. Undoubtedly, a large

₃₉ share of the credit for this feat is due to powerful learning mechanisms that children bring to

₄₀ their input (Kuhl, 2004; Saffran, Aslin, & Newport, 1996; Smith, Suanda, & Yu, 2014).

₄₁ However, a share of the credit may also be due to the structure of linguistic input itself:

₄₂ individual differences in both the quantity and quality of the language children hear are

₄₃ associated with individual differences in those children's language learning (Hart & Risley,

₄₄ 1995; Huttenlocher, Waterfall, Vasilyeva, Vevea, & Hedges, 2010; Rowe, 2012). Further,

₄₅ associations between input and uptake are primarily driven by differences in speech directed

₄₆ to children. Differences in overheard speech do not predict differences in language learning,

₄₇ even in communities where child-directed speech is relatively rare (Romeo et al., 2018;

₄₈ Shneidman & Goldin-Meadow, 2012; Weisleder & Fernald, 2013). Why is child-directed

₄₉ speech so important to language learning?

₅₀   The way we speak to children is markedly different from the way we speak to adults.

₅₁ For instance, child-directed speech tends to be slower, higher pitched, and exaggerated in

₅₂ enunciation relative to adult-directed speech (Cooper & Aslin, 1990; Grieser & Kuhl, 1988).

₅₃ Beyond acoustic and prosodic differences, child-directed speech is also marked by repetition,

₅₄ simpler syntactic structures, and higher proportions of questions (Fernald & Simon, 1984;

₅₅ Newport, Gleitman, & Gleitman, 1977; Snow, 1972). Children preferentially listen to

₅₆ child-directed speech over adult-directed speech (Cooper & Aslin, 1990; ManyBabies

₅₇ Consortium, 2020), and their increased attention to child-directed speech may play a part in

₅₈ driving language acquisition (Soderstrom, 2007).

₅₉   In addition to attentional effects, structural simplifications in child-directed speech

₆₀ have been tied to specific benefits in children's language learning (e.g. Brent & Siskind, 2001;

₆₁ Ma, Golinkoff, Houston, & Hirsh-Pasek, 2011). For instance, when parents refer to a

₆₂ particular object, they tend to place this object in the final position of their utterances, even

63 in languages where this is not the canonical word order (Aslin, Woodward, LaMendola, &

64 Bever, 1996). This structural tendency has been tied directly to ease of word segmentation

65 and subsequent word learning (Endress, Nespor, & Mehler, 2009; Yurovsky, Yu, & Smith,

66 2012).

67   Crucially, both acoustic and structural properties of child-directed speech change over

68 development, with sentences getting longer, more complex, and less acoustically variable

69 (e.g. Huttenlocher et al., 2010; Liu, Tsao, & Kuhl, 2009; Phillips, 1973). The linguistic

70 tuning hypothesis suggests that this changing nature of child-directed speech is what allows

71 it to be such a powerful driver of language development (Snow, 1972). If parents tune their

72 speech to children's developmental level, increasing the complexity of input at the same rate

73 that children are developing their linguistic knowledge, input may always be at the optimal

74 level of complexity to support language learning (Vygotsky, 1978).

75   How precisely do parents tune their speech? One possibility is that tuning is *coarse*:

76 caregivers could tune the complexity of their speech generally, using a holistic sense of their

77 children's developing linguistic abilities. Consistent with a coarse-tuning hypothesis, parents

78 tune their utterance lengths, articulation of vowels, and diversity of clauses to children's age

79 (Bernstein Ratner, 1984; Huttenlocher et al., 2010; Moerk, 1976). Over and above this

80 coarse-tuning, parents might *fine-tune* their speech, taking into account not only children's

81 global linguistic development, but their specific knowledge of smaller units of language, such

82 as lexical items. Fine-tuning would provide a particularly powerful and efficient vehicle for

83 scaffolding language acquisition because of its specificity. If parents could fine-tune

84 utterances containing specific words, phrases, or constructions, they could keep each aspect

85 of language at a desirable difficulty to support learning, retention, and generalization (Bjork

86 & Kroll, 2015; Vlach & Sandhofer, 2014).

87   To date, the only evidence for fine-tuning comes from two observational studies, one

88 showing that parents are more likely to provide their child with labels for novel as compared

89 to familiar toys (Masur, 1997), and the second showing that one child's caregivers produce

90 their shortest utterances containing a particular word just before the child first produces

91 that word (Roy, Frank, & Roy, 2009). Here, we present the first *experimental* evidence for

92 fine-tuning.

93   Children and their parents played a reference game in which the parent's goal was to

94 guide their child to select a target animal from a set of three. Parents tuned the amount of

95 information in their utterances not just to the average difficulty of each animal word, but to

96 their prior estimates of their individual child's knowledge of that animal. Further, parents

97 sensitively adapted over the course of the game, providing more information on subsequent

98 trials when they discovered that their child did not know an animal. Together, these results

99 show that parents leverage their knowledge of their children's language development to

100 fine-tune the linguistic information they provide.

Method

Participants

103   Toddlers (aged 2-2.5 years) and their parents were recruited from a database of families

104 in the local community or approached on the floor of a local science museum in order to

105 achieve a planned sample of 40 parent-child dyads. Because our method was novel, we chose

106 a sample size that would give us 95% power to detect a medium-sized effect ($d=.6$)

107 within-subjects and rounded up to the nearest multiple of 10. A total of 48 parent-child

108 pairs were recruited, but data from 7 pairs were dropped from analysis because of failure to

109 complete the experiment as designed. Of the 7 pairs that were dropped, 5 children fussed

110 out, 1 had an older sibling interfering with the study, and 1 was a twin (only the twin who

111 participated first was included). The final sample consisted of 41 children aged 24 mo.; 5

112 days to 29 mo.; 20 days ($M = 26$ mo.; 0 days), 21 of whom were girls.

113   In our recruitment, we made an effort to sample children from a variety of racial and

socio-economic groups. Our final sample was roughly representative of the racial composition

of the Chicago Area and the US more broadly (56.1% White, 26.8% Black, 7.69% Hispanic).

However, our sample was significantly more educated than the broader community (85.4% of

mothers had a College or Graduate Degree).

Stimuli

Eighteen animal images were selected from the Rossion and Pourtois (2004) image set,

a colorized version of the Snodgrass and Vanderwart (1980) object set. Animals were

selected based on estimates of their age of acquisition (AoA) for American English learners.

To obtain these estimates, we used two sources of information: parent-report estimates of

children's age of acquisition from Wordbank (Frank, Braginsky, Yurovsky, & Marchman,

2017), and retrospective self-report estimates of AoA from adults (Kuperman,

Stadthagen-Gonzalez, & Brysbaert, 2012, see Supplemental Materials for details). The AoA

of the selected animals ranged from 15 to 32 months. Half of the animals were chosen to

have an early AoA (15-23 months), and the other half were chosen to have a late AoA (25-32

months). Each trial featured three animals, all from either the early AoA or late AoA

category. This separation was designed to lower the likelihood that children could use

knowledge of early AoA animals to infer the correct target on late AoA trials.

A modified version of the MacArthur-Bates Communicative Development Inventory

Short Form (CDI; Fenson et al., 2007), a parent-reported measure of children's vocabulary,

was administered before the testing session via an online survey. The selected animal words

were added to the standard words, producing an 85 word survey. Two of the animal

words–one in the early AoA (pig) and one in the late AoA category (rooster)–were

accidentally omitted, so trials for those words were not included in analyses as we could not

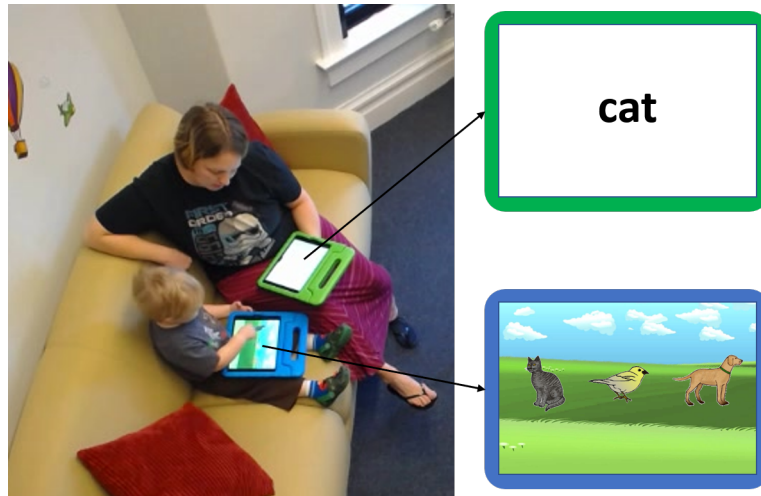obtain individual-level estimates of children's knowledge.

Figure 1. A parent-child dyad playing the reference game. On each trial, the parent's goal was to use language to communicate to their child which animal to choose.

Design and Procedure

Each parent-child pair played an interactive reference game using two iPads (Figure 1). Children began with two warm-up trials in which they tapped on circles that appeared on the iPads. Following these warm-up trials, children and their parents moved on to practice and then experimental trials. On each trial, three images of animals were displayed side by side on the child's screen, and a single word appeared on the parent's screen. Parents were instructed to communicate as they normally would with their child, and to encourage their child to choose the object corresponding to the word on their screen. The child was instructed to listen to their parent for cues. Once the child tapped an animal, the trial ended, and a new trial began. There were a total of 36 experimental trials, such that each animal appeared as the target twice. Trials were randomized for each participant, with the constraint that the same animal could not be the target twice in a row. Practice trials followed the same format as experimental trials, with the exception that images of fruit and vegetables were shown. All sessions were videotaped for transcription and coding.

152 **Data analysis**

153   Our primary quantity of interest was the amount of information that parents provided
154 in each of their utterances. To approximate this, we measured the length of parents' referring
155 expressions–the number of words they produced on each trial before their child selected an
156 animal. Length is an imperfect proxy for information, but it is easy to quantify and
157 theory-agnostic. Because utterance length is highly right-skewed (i.e. most utterances are
158 short), we log-transformed length in all analyses. However, to facilitate interpretability, we
159 show raw utterance length in our figures. Subsequently, utterances were manually coded for
160 the following: (1) Use of an animal's canonical label (e.g., "leopard"), (2) Use of a descriptor
161 (e.g., "spotted"), (3) Use of a comparison (e.g., "like a cat"), (4) Use of a superordinate level
162 category label (e.g., "bird" for peacock), and (5) Use of a subordinate level category label
163 (e.g., "Limelight Larry," a fictional character from a children's book, for peacock). Parent
164 utterances irrelevant to the game (e.g. asking the child to sit down) were not analyzed.
165 Children's utterances were coded when audible, but were not analyzed. Our second source of
166 data was the vocabulary questionnaire that parents filled out prior to participation. Parents
167 indicated whether their child produced each of the 85 words on the survey. In addition to
168 analyzing parents' judgments for the animals in the task, we also computed the total number
169 of words judged to be known for each child as a proxy for total vocabulary.

170   All of our analyses were done using mixed-effects models. In all cases we began with
171 maximal random effects structures and pruned random effects until the models converged.
172 We removed interaction terms before removing main effects, and opted to keep the most
173 theory-relevant random effects when only a subset of main effects could be kept. For clarity,
174 we present only the key findings and statistics here, but full model details can be found in
175 the Supplemental Materials.

<center>**Results**</center>

176

177   We begin by confirming that our a priori divisions of animals into early and late age of

178   acquisition (AoA) in the study design were reflected in parents' survey judgments, and that

179   children were able to follow parents' references to select the correct target animal on each

180   trial. After this, we show that parents fine-tune their referring expressions, producing more

181   information in their references to animals that they think their individual children do not

182   know. Further, parents updated their tuning over the course of the experiment, producing

183   more information on subsequent references to animals they thought their children knew after

184   observing evidence to the contrary (i.e. children made an incorrect selection).

185   **Target animal difficulty**

186   We first confirm that the early AoA animals were more likely to be marked "known" by

187   the parents of children in our studies. As predicted, parents judged that their children knew

188   94% of the animals in the early AoA category, and 33% of the animals in the late AoA

189   category, which were reliably different from each other (β = -6.48, $p < .001$, d = -3.57 [-4.48,

190   -2.67]). Parents' judgments for each target word are shown in the Supplemental Materials.

191   **Selection accuracy**

192   On the whole, parents communicated effectively with their children, such that children

193   selected the correct target on 69.05% of trials, reliably greater than would be expected by

194   chance (33%, β = 2.07, $p < .001$, d = 1.14 [0.93, 1.36]). Children were above chance both for

195   animals that parents thought they knew (M = 75.08%, β = 2.61, $p < .001$, d = 1.44 [1.18,

196   1.70]), and for animals that parents thought their children did not know (M = 55.19%, β =

197   1.23, $p < .001$, d = 0.68 [0.52, 0.84]). Thus, parents successfully communicated the target

198   referent to children, even when parents thought their children did not know the name for the

199   animal at the start of the game.

200   Was this accuracy driven by children's knowledge or parents' referring expressions?

201   Because we did not measure children's knowledge of each animal directly, we used parents'

202   estimates of children's knowledge as a proxy to answer this question. We fit a mixed-effects

203   logistic regression predicting children's accuracy on each trial from children's total estimated

204   vocabulary, parent-reported knowledge of the target animal, and the (log) length of parents'

205   expressions. We found that children with bigger vocabularies were more accurate in general

206   ($\beta = 0.40$, $p = .001$, $d = 0.22$ [0.09, 0.36]), and that children were less accurate for animals

207   whose names parents thought they did not know ($\beta = -1.86$, $p < .001$, $d = -1.02$ [-1.46,

208   -0.58]). Longer referring expressions were associated with greater accuracy for animals that

209   parents thought their children did not know ($\beta = 0.46$, $p = .025$, $d = 0.25$ [0.03, 0.47]), but

210   not for animals that parents thought their children knew ($\beta = -0.40$, $p = .007$, $d = -0.22$

211   [-0.38, -0.06]).

212   Thus, longer referring expressions were associated with more successful communication

213   for animals that parents thought their children did not know, but not for animals that

214   parents thought they knew. This suggests that parental tuning contributed to children's

215   success. We next ask whether parents tuned the lengths of their utterances appropriately,

216   producing longer expressions for animals they believe their children do not know.

217   **Tuning**

218   If parents calibrate their referring expressions to their children's linguistic knowledge,

219   they should provide more information to children for whom a simple bare noun

220   (e.g. "leopard") would be insufficient to identify the target. Parents did this in a number of

221   ways: with one or more adjectives (e.g. "the spotted, yellow leopard"), with similes (e.g. "the

222   one that's like a cat"), and with allusions to familiar animal exemplars of the category

223   (e.g. "Limelight Larry"). In many of these cases, parents would be required to produce more

224   words (see below for further qualitative analyses). Thus, we first analyzed the (log) length of

225   parents' referring expressions as a proxy for informativeness.
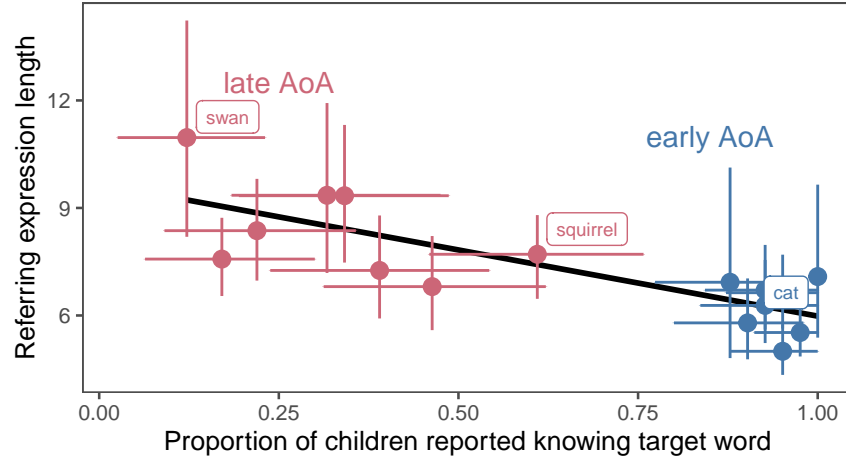
Figure 2. Parents produced longer referring expressions to communicate about animals that children were generally less likely to know. Animals in blue are those that were estimated to be earlier learned from prior norms, animals in red are those that were estimated to be later learned. Error bars show 95% confidence intervals computed by non-parametric bootstrap.

When do parents produce longer referring expressions? One possibility is that parents tune at the coarsest level, using more words when speaking to children with smaller vocabularies. This was not the case–the total number of words parents thought their children knew did not reliably affect the length of their referring expressions (β = -0.02, p = .595, d = -0.17 [-0.79, 0.45]). A second possibility is that parents have a sense for how difficult each animal is in general, and tune coarsely to this. Our analyses confirmed this coarse-tuning: parents said reliably fewer words for animals that more children were reported to know (β = -0.17, p = .034, d = -1.19 [-2.26, -0.09]); Figure 2). Finally, parents could fine-tune their referring expressions to their children's individual knowledge, over and above the average difficulty of each animal. Our analyses supported this conclusion: parents used reliably fewer words to refer to animals that they thought their individual child knew (β = 0.25, p = .003, d = 0.98 [0.34, 1.61]); Figure 3A). Thus, parents fine-tuned the amount of information in their referring expressions, calibrating the amount of information they provided to their children's knowledge, even after accounting for the average difficulty of the target animal.
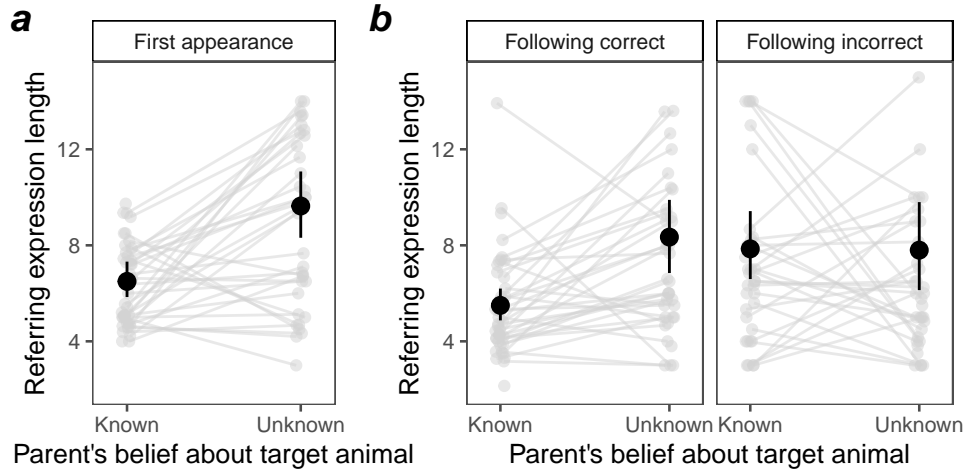
Figure 3. (A) Parents produced longer referring expressions for animals they thought their child did not know (first appearance). (B) When children chose the correct animal, parents continued to produce longer expressions for animals they thought their children did not know (left). However, if parents thought their child knew an animal, and they chose incorrectly, parents produced longer expressions on its second appearance (right). Gray points and lines represent individual participants, black points and lines show group averaged proportions; error bars show 95% confidence intervals computed by non-parametric bootstrap.

In addition, because each animal appeared as a target twice, we asked whether parents tuned their referring expressions over successive appearances. We found that parents used fewer words on the second appearance of each animal (β = -0.08, p = .044, d = -1.06 [-2.07, -0.03]). This effect is shown in Figure 3: the mean length of referring expression is lower on the second appearance (Fig. 3B) when compared to the first (Fig. 3A). However, the difference in utterance length between animals they thought their children knew versus didn't know was smaller on their second appearance (β = -0.14, p < .001, d = -0.17 [-0.22, -0.12]; Figure 3B). Why might that be? One possibility is that parents obtain information from the first appearance of each animal: they may have thought their child knew "leopard," but discovered from their incorrect choice that they did not. If so, they might provide more information the second time around.

251   To test this prediction, we fit a model predicting the (log) length of parents' referring

252 expressions from appearance type (first, following correct, following incorrect), whether the

253 parent thought their child knew the animal prior to the experiment, and their interaction

254 between appearance type and prior belief. Relative to their utterances on an animal's first

255 appearance, parents produced shorter referring expressions on an animal's second

256 appearance following both correct responses (β = -0.14, p = .036, d = -0.12 [-0.23, -0.01])

257 and incorrect responses (β = -0.28, p = < .001, d = -0.22 [-0.34, -0.11]). As before, parents

258 produced shorter utterances for animals they thought their child knew (β = -0.31, p = <

259 .001, d = -0.92 [-1.43, -0.41]). When children were correct on an animal's first appearance,

260 parents' referring expressions on its second appearance did not differ in length based on

261 whether they thought their child knew the animal prior to the experiment (β = -0.02, p =

262 .771, d = -0.02 [-0.13, 0.10]). However, when children were incorrect on an animal's first

263 appearance, and parents thought they knew the animal prior to the experiment, they

264 produced reliably longer referring expressions on its second appearance (β = 0.43, p = <

265 .001, d = 0.24 [0.13, 0.35]; Figure 3B).

266   As we predicted, when parents thought their children knew an animal, but then

267 observed evidence to the contrary, they provided more information in their referring

268 expressions to help children make the correct selection the second time. However, we did not

269 find the opposite pattern: when children were successful for animals that parents thought

270 they did not know, parents did not update their beliefs. Why should parents update their

271 beliefs in one direction but not the other? One likely explanation comes from parents'

272 linguistic tuning itself. Parents' goal in this task is to produce a referring expression that

273 allows their children to select the target animal whether or not they know its canonical label.

274 Consequently, when children select correctly on these trials, parents cannot know how their

275 child arrived at the correct target. For example, if a parent said "spotted leopard" and their

276 child was correct, they could not know whether their child succeeded because they actually

277 knew the word "leopard," or instead because the word "spotted" was sufficiently informative.

278   Together, these two sets of analyses suggest that parents tune their referring

279 expressions not just coarsely to how much language their children generally know, nor their

280 knowledge about how hard animal words are on average, but finely to their beliefs about

281 their individual children's knowledge of specific lexical items. Further, when parents discover

282 that they have incorrect beliefs about their children's knowledge of an animal, they update

283 these beliefs in real-time and adjust subsequent references to the same animal.

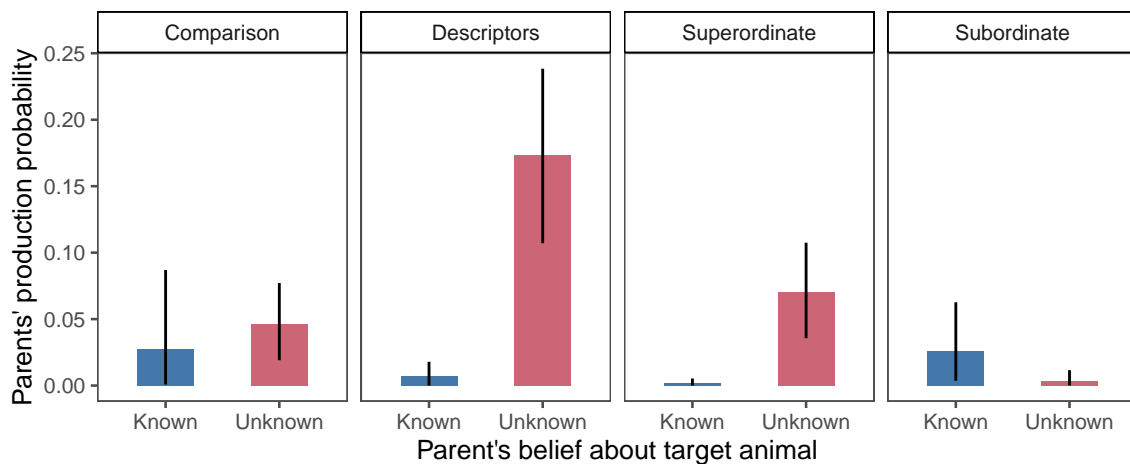284 **Content of referring expressions**

Figure 4. Proportion of trials on which parents used comparison, descriptors, superordinate category labels, and subordinate category labels in their referring expressions. Colored bars show means across parents, error bars show 95% confidence intervals computed by non-parametric bootstrap.

285   Parents produced reliably longer referring expressions when trying to communicate

286 about animals that they thought their children did not know. In the analyses presented so

287 far, we used length as a theory-agnostic, quantitative measure of information. *How* did

288 parents successfully refer to animals that their children did not know? As a post-hoc

289 descriptive analysis, we coded five qualitative features of referring expressions: (1) Use of the

290 animal's canonical label (e.g., "leopard"), (2) Use of a descriptor (e.g., "spotted"), (3) Use of

291 a comparison (e.g., "like a cat"), (4) Use of a superordinate level category label (e.g., "bird"

for peacock), and (5) Use of a subordinate level category label (e.g., "Limelight Larry" for peacock). Because the rates of usage of each of these kinds of reference varied widely (e.g. canonical labels were used on 94.48% of trials, but subordinates were used on 1.21% of trials), we fit a logistic mixed effects model separately for each reference kind, estimating whether it would be used on each trial from whether the parent thought their child knew the animal.

Canonical labels were used on almost all trials, and did not differ in frequency between animals parents thought their children did not know ($M = 94.68\%$) and animals they thought their children knew ($M = 93.43\%$, $\beta = 0.43$, $p = .216$, $d = 0.23$ [-0.14, 0.61]). Parents thus produced canonical labels even when they thought their children did not know these labels. One plausible explanation for this is that the target animal on each trial was identified in writing for the parent, activating the canonical label and thus lowering the cost of retrieving and producing it (Wingfield, 1968). Another possibility is that this reflects parents' general tendency to produce basic-level category labels when talking to children (e.g., Blewitt, 1983). Finally, it could have been produced for implicitly or explicitly pedagogical reasons even though it was not referentially necessary. We expand on this possibility in the Discussion below.

Comparisons were used reliably more for animals parents believed their children did not know than for animals they thought their children knew ($\beta = 2.29$, $p = .001$, $d = 1.26$ [0.49, 2.04]), as were descriptors ($\beta = 3.09$, $p < .001$, $d = 1.71$ [1.07, 2.35]) and superordinate category labels ($\beta = 3.01$, $p = .026$, $d = 1.66$ [0.20, 3.12]). Subordinates were used less for animals parents thought their children did not know than for animals they thought their children knew ($\beta = -2.19$, $p = .025$, $d = -1.21$ [-2.26, -0.15]). Thus, parents used a variety of strategies to refer to animals that they believed their children do not know, but the use of descriptors was the most prominent (Figure 4). These descriptors are particularly apt to facilitate children's learning, connecting parents' fine-tuning for reference with their

children's language acquisition.

Discussion

Parents have a wealth of knowledge about their kids, including about their linguistic development (Fenson et al., 2007). In this study, we asked whether parents leverage this knowledge to communicate successfully with their children. When playing a referential communication game, parents drew on their knowledge of their children in three ways: (1) parents produced longer, more informative referring expressions for animals that children generally learn later, (2) over and above this coarse-tuning, parents fine-tuned information to their individual children's knowledge of specific animals, and (3) when children did not know an animal that parents thought they did, parents subsequently produced longer referring expressions for that animal. Further, this tuning was associated with more successful communication: children were more likely to correctly select animals whose names parents thought they did not know if parents produced more informative referring expressions.

These data are consistent with prior evidence of coarse-tuning in child-directed speech, but importantly provide the first experimental evidence for fine-tuning at the lexical level. When communicating with their children, parents not only take into account the average difficulty of each animal word, but they also rely on (and update) their estimates of their individual child's knowledge of those animals. Coarse-tuning and fine-tuning may be distinct adaptations that happen independently at different timescales, but our data suggest an intriguing alternative possibility: parents' coarse-grained estimates of their children's language development may be built hierarchically. That is, parents may use estimates of their children's knowledge of specific lexical and syntactic items to form their general representations of their children's overall language development. Hierarchical representations are a powerful vehicle for maximizing both speed and generalizability of learning, and they may play the same role here, allowing parents to efficiently track and use their knowledge of their children's language development (Tenenbaum, Kemp, Griffiths, & Goodman, 2011).

³⁴⁴ While parents' speech to children is unlikely to reflect an explicit goal to teach, it is
³⁴⁵ nonetheless goal-oriented: parents want to communicate successfully (Bruner, 1983). Our
³⁴⁶ reference game was designed to manipulate and measure a particular communicative goal
³⁴⁷ that can be instantiated in the laboratory, but similar communicative pressures structure the
³⁴⁸ daily conversations between children and their parents (Tamis-LeMonda, Kuchirko, Luo,
³⁴⁹ Escobar, & Bornstein, 2017). When talking about animals that they thought their children
³⁵⁰ did not know, parents used referring expressions rich with descriptors and comparisons, as in
³⁵¹ previous observational studies (Blewitt, 1983; Masur, 1997; Mervis & Mervis, 1982). These
³⁵² strategies scaffold communication–parents use what they think their children know
³⁵³ (e.g. color words) in order to communicate about animals they think their children do not
³⁵⁴ know. Because communication and learning are intertwined, these same strategies may work
³⁵⁵ in the service of language acquisition (Yurovsky, 2018). While parents produced rich
³⁵⁶ descriptions to help their children select unfamiliar animals, they almost always produced
³⁵⁷ the canonical label as well. These referring expressions are thus an ideal opportunity to learn
³⁵⁸ the relationship between the referent, its label, and its important identifying features. We
³⁵⁹ did not independently measure children's knowledge of each animal, so we cannot determine
³⁶⁰ whether they learned any new animals while playing the game. The relationship between
³⁶¹ referential strategies and ultimate learning is a promising direction for future work.

³⁶² Parents fine-tune language to their children's knowledge in order to communicate
³⁶³ successfully. In the service of proximal communicative goals, they may also provide children
³⁶⁴ with input that ultimately accelerates learning. Focusing on the interactive and
³⁶⁵ communicative nature of language captures a more complete picture of language
³⁶⁶ development: while children bring powerful learning mechanisms to language acquisition,
³⁶⁷ these mechanisms are supported by an ecological niche designed for their success.

Acknowledgements

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