Journal of Experimental Psychology: General

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How do children learn to connect expressions (e.g., "that red apple") to the real-world objects they refer to? The dominant view in developmental psychology is that children rely on descriptive information, "red" and "apple." In contrast, linguistic theories of the adult language attribute primacy to grammatical elements: words such as "that" or "another" first establish the status of potential referents within the discourse context (old or new) before descriptions can factor in. These theories predict that reference can succeed even when the description does not match the referent. We explored this novel prediction in adults and children. Over four experiments, we found that (a) adults relied on the articles to identify the referent, even when the description did not fit, consistent with grammar-first accounts; (b) consistent with description-first accounts, and unlike adults, 3- to 5-year-old children prioritized the descriptions provided by nouns and adjectives, despite being sensitive to grammatical information. This suggests that children connect expressions to referents differently from adults.

Public Significance Statement
People can successfully communicate about things even when they describe them incorrectly. For instance, we all know who someone means if they say, "that queen who said: Let them eat cake!"— even if we know that Marie Antoinette never actually said that. How does this work? We found that adults handle such mismatching descriptions well by paying attention to the grammar of the sentence, in line with linguistic explanations of this phenomenon. In contrast, we found that 3- to 5-year-old children always expect descriptions to match; they do not think that a description can pick something out if it does not match what it is describing.

Keywords: reference, grammar, descriptions, object representation, false description

How do people connect expressions to the objects they are referring to? Research within developmental psychology tends to assume that descriptions are critical to establishing reference (e.g., Markman, 1992; Waxman & Lidz, 2006; Xu, 2007). Under description-first theories, what allows children to establish the connection between an expression (e.g., "that red apple") and the relevant physical object (a particular red apple) is the descriptive information provided by the content words, "red" and "apple." Under this analysis, the child's main task is to match the properties provided by language with the ones found in the physical world. For example, an utterance such as "Look at that red apple" includes descriptors such as "red" and "apple," while in the physical context, there might be an object that has the relevant properties of redness and applehood. The most important property to match is taken to be the object kind, typically described using common nouns (Markman, 1992; Xu, 2007).

This view contrasts sharply with Grammar-First theories, standard in linguistic semantics, which argue that the connection between what someone says and potential referents in the physical world is not direct, but mediated by an understanding of the discourse context. This involves keeping a list of the objects that are under discussion in a given context as a discourse unfolds (Heim, 1982; Kamp,

1981; Karttunen, 1976). New elements can be added to this list, or existing ones can be selected, depending on the grammar of an utterance. To see how this works, compare the contexts in which one would use the sentences in (1) and (2), which differ only in whether they contain an indefinite noun phrase ("a red apple") or a definite noun phrase ("that red apple").

1. A red apple is in my bag.
2. That red apple is in my bag.

Intuitively, someone would only use (2) if there was already some prior discussion of a relevant red apple. In contrast, using (1) would be appropriate to inform the addressee of a new apple, introducing it into the discourse. Grammar-First theories explain this difference by assuming that certain function words, such as definite and indefinite articles, affect the discourse context in different ways. Indefinites create a new entry in the list of things under discussion, while definites point back to an already existing entry (Heim, 1982; Kamp, 1981). In these theories, descriptions can only play a role after determining, based on the function words, whether reference is being made to a new or an already familiar entity.

Both theories might accommodate much of everyday referential communication, but one place where they differ is in how they handle mismatching descriptions. As an illustration, consider a classic example, due to Donnellan (1966). Imagine that you are at a party when you see an interesting-looking person with a martini glass. You might ask the host:

3. Who is that man drinking the martini?

This question would be no less sensible, nor would the host be any less able to answer it, if it turned out that the martini glass actually contained water. Indeed, the host would know who you mean even if they were the one who had poured the water, and so knew that your description did not apply.

Theories that treat establishing reference as a task of matching descriptions to entities cannot easily accommodate how mismatching descriptions can successfully refer. After all, in (3), there is no man drinking a martini. Grammar-First theories fare better: the definite noun phrase ("that man") forces you to find a suitable entity already in your shared context, so that exact descriptive (in)adequacy matters less. While the success of reference with mismatching descriptions can be taken as evidence for Grammar-First theories in adult language, to date there has been no systematic experimental investigation of how this ability works. For instance, how much does it matter that the speaker could plausibly think that there is, in fact, martini in the glass? Do mismatching descriptions only refer successfully if the addressee thinks that the speaker believes that the description they are giving is accurate?

At the same time, a robust demonstration of this capacity in children would challenge Description-First theories of how infants and children relate words to the world. These theories make a set of assumptions about cognitive development that help to simplify the learning problem children face. First, under Description-First—but not under Grammar-First—accounts, the task of word learning can be characterized as a straightforward mapping problem between referents (e.g., objects and events) and words (Markman, 1992; Waxman & Lidz, 2006). This problem space becomes radically more complex for the learner if this mapping is necessarily modulated by grammatical elements and pragmatic inference of speaker meaning right from the

start of word learning. Second, Description-First theories simplify how referential communication unfolds by sidestepping problems of how the referred to entities come to be represented as existing in the first place. For instance, developmental experiments often assume that hearing a noun (e.g., "Blicket!") in and of itself can create a mental representation of an object (e.g., Xu, 1997, 2007; cf. Brody, 2020). If Grammar-First theories apply to children, then nouns can only describe properties of an object representation; they cannot create one. Establishing the representation requires a separate mechanism. Typically, grammar serves as this mechanism, with a novel noun almost always accompanied by grammatical information in the carrier phrase (e.g., "Look, a blicket!"). In some contexts, other mechanisms, such as visual encoding of an object or pragmatic inference in response to a pointing action, could serve the same purpose. If children handle mismatching descriptions well, that would be evidence against Description-First theories and would force revising concomitant views of how word learning and referential communication get off the ground, with grammar playing a richer role earlier in word learning.

Importantly, existing developmental evidence would be consistent with such a revision. Young children already seem to possess the cognitive and linguistic prerequisites implicated by Grammar-First theories. A variety of nonlinguistic tasks have shown that toddlers are sensitive to whether their communicative partner introduces a novel object or refers back to a previously mentioned one (Moll et al., 2007; Tomasello & Haberl, 2003). Another set of studies has shown that by around 3 years of age, children can already produce and comprehend articles with their referential function (Aravind, 2018; Maratsos, 1976; Matthews et al., 2006, 2007; Rozendaal & Baker, 2008; Serratrice, 2005). Evidence that children prioritize grammar in identifying how words map to the world would not, therefore, require revising either what is known about children's grammatical sophistication or about their actual word-learning competence. It would require revising the theorist's explanation of how this learning works.

In this study, we empirically contrast Description-First and Grammar-First theories of referent identification in child language by investigating the main point on which they diverge: whether descriptions must match their intended referents. These theories constitute polar opposites along a broader spectrum of theoretical alternatives about how grammatical and descriptive information interact, which makes them useful for generating crisp empirical predictions. Description-First but not Grammar-First theories require that descriptors always match (e.g., "an apple" can only refer to an object that is an apple). In contrast, Grammar-First but not Description-First theories would allow referring to an object with a mismatching description in the relevant grammatical environment (e.g., within a definite noun phrase, given a prior discourse about that object). By investigating these predictions, we might also find more nuanced ways that different information sources can interact. We return to those in the General Discussion section.

We designed a novel referent selection paradigm to test these diverging predictions. In our paradigm, an object is first introduced into the discourse and then undergoes a magical transformation that changes its descriptive properties (e.g., from a car to a duck). This setup allows us to systematically ask questions about what utterances children and adults understand as referring to this transformed object. Participants heard requests for either a noun matching the object's initial state ("car") or final state ("duck"), using one of three articles: two indefinites ("a" and "another") and one definite ("that"). This let us ask (a) how both adults and children understand

referential utterances that use a mismatching pretransformation descriptor and (b) what the contribution of the articles is to their choice of referent. If participants prioritize grammatical over descriptive information, they should be willing to choose the previously mentioned transformed object (the car → duck object) when asked to pick "that car," even though the noun label no longer applies.

Notice that our setup is quite different from Donnellan's martini example: there is no one in our scenario who is either ignorant or has a false belief about whether any given description matches; everyone always knows the actual state of all objects. This makes the Grammar-First prediction even more striking, because interpreting "that car" as referring to a duck in this setup need not rely on thinking that the speaker mistakenly believes it really is a duck. It could also be critical for testing younger children. If adults do prioritize grammar in this setup, then by requiring less theory of mind or pragmatic sophistication, the same task could make it easier for children to do so as well.

Before testing how children map words to objects in this scenario, Experiment 1 investigates adults. Are adults willing to identify a previously introduced object with a label that no longer applies to it?

Experiment 1

Method

Transparency and Openness

Stimuli, anonymized data, analysis code, and research materials are available for all experiments on the Open Science Framework (OSF) at https://osf.io/q6wbs/. Experiment 2 was preregistered and conducted first. The other experiments were not preregistered separately, but followed the same analysis plan. All experiments were presented using the software PCIbex (Zehr & Schwarz, 2018). Data were analyzed using R Version 4.1.2 (R Core Team, 2021), and the packages ggplot, Version 3.3.5 (Wickham 2016), effectsize, Version 6.0 (Ben-Shachar et al., 2020) and car, Version 3.1-1 (WFox & Weisberg, 2019). Ethical approval was obtained from the Institutional Review Board at Brown University (1809002208) for all experiments.

Participants

We recruited 50 native English-speaking adults online through Amazon Mechanical Turk. We collected no other demographic information. One participant was excluded due to technical failure. All participants gave informed consent before completing the experiment. They received $1.20 as remuneration and the experiment took around 10 min for them to complete.

Design, Materials, and Procedure

Participants were first introduced to two on-screen cartoon characters (Tigger and Piglet), who served as the discourse participants throughout the experiment. Participants were told that they need help reaching objects on the shelf.

Figure 1 shows an example trial. Each trial consisted of two parts: the introduction phase and the measurement phase. In the introduction phase, three toys appeared and Piglet narrated: "Oh! Look! There are some toys on the shelf." Each toy belonged to one of two different categories (e.g., car, car, and duck). Next, one object magically transformed into a different kind of object with accompanying visual and sound effects. The object that transformed was always one of the objects that had two instances at the start (thus a car, car, and duck display at the start could end up being either a car, duck, and duck display or a duck, car, and duck display, depending on the counterbalancing). This magical event was narrated by Piglet: "Wow! Magical! An X has turned into a Y," with X labeling the initial object kind (e.g., "car") and Y labeling the object kind after transformation (e.g., "duck"). This narration verbally highlighted the transformed object and provided an opportunity for the next use of "that" to refer back to it.

In the subsequent measurement phase, Tigger made a request: "Can you click on [a/another/that] [X/Y]?" and participants chose a referent in response by clicking on one of the objects. We manipulated two variables in this request: the article ("a" vs. "another" vs. "that") and the noun (Initial: the noun corresponding to the initial state, e.g., "car" vs. Final: the noun corresponding to the transformed state, e.g., "duck"). We included two distinct indefinite articles. The indefinite "a" can occasionally (e.g., when it indicates indifference) pick out objects that are already part of the discourse. In contrast, "another" is more specific. It always requires a referent that is new and distinct from a previously introduced object. We opted for demonstrative "that" instead of the definite article "the" because (a) in our setup it was more natural to interpret it as referring back to a previously mentioned object and (b) looking ahead to the child experiments, prior research suggests that the anaphoric function of "that" is acquired earlier than of "the" Modyanova and Wexler (2007), Modyanova (2009), and Wexler (2011). Throughout, we will refer to the magical object as the "transformed object," to the object that matches the transformed object posttransformation as the "final kind distractor," and to the one that matches it pretransformation as the "initial kind distractor."

Taken together, this design resulted in six within-subject trial types. Table 1 illustrates the predictions of Description-First and Grammar-First theories on each trial type, using a trial with a car → duck transformation as an example.

The six trial types were grouped into blocks, and each block was presented three times to yield 18 total trials. Each trial used distinct pairs of object kinds. The relative position of the three objects and the position of the transformed objects were counterbalanced between trials, within-participants.

Results and Discussion

Figure 2 shows participants' responses to the different trial types. Except where noted otherwise, all experiments followed the same analytic strategy preregistered for Experiment 2, which had been conducted first.

Our primary question was how the rates of selecting the transformed object varied as a function of article and description. To test this, we built generalized logistic mixed effects models to predict the probability of choosing the transformed object—as opposed to either distractor—with Noun (Initial or Final), Article ("A," "Another," "That"), and their interaction as fixed effects, and a random intercept of a participant. Article was Helmert-coded into two independent variables: (a) Definiteness, which contrasted "that" with the two indefinites and (b) Specificity, which contrasted "a" with "another" to probe for whether "another" was more specifically tailored to picking out a new referent. Noun was treatment coded. To

Figure 1
A Timeline (Left to Right) of a Trial in Experiments 1 and 2, in Which a Car Transforms Into a Duck

(a) Trial Start

(b) Introduction Phase

(c) Measurement Phase

Note. The original figure with Piglet and Tigger is available on the OSF project page, but cannot be reproduced here for copyright reasons. (A) Trial start; (B) introduction phase; and (C) measurement phase. OSF = Open Science Framework. See the online article for the color version of this figure.

test for main effects and interactions, we used log-likelihood chi-squared tests to compare models with and without the relevant effect. To test for simple effects, we used Wald z-tests of the beta coefficients within the full model, including all fixed effects. In order to estimate the simple effects of Specificity and Definiteness at each level of Noun, the full model was computed twice, changing whether Final or Initial was set as the reference level of Noun and inspecting the corresponding coefficients of the two Article variables in each case.

Model comparisons revealed that Noun, $\chi^2(1) = 67.37$, $p < .001$, and both Article variables improved model fit, Definiteness: $\chi^2(1) = 155.44$, $p < .001$; Specificity: $\chi^2(1) = 17.66$, $p < .001$; while the interaction terms did not, Definiteness × Noun: $\chi^2(1) = .021$, $p = .65$; Specificity × Noun: $\chi^2(1) = 0.07$, $p = .787$. The effects of the two Article variables reflect that participants were overall more likely to select the previously mentioned transformed object when the request included "that" compared to the indefinites. Also, the "a" trials elicited greater selection of the transformed object compared to "another" trials, a result consistent with linguistic evidence showing that "a" can in some contexts refer back to a previously mentioned object, while "another" cannot. Looking at the simple effects reveals that participants selected different referents based on the definiteness of the article in both the Initial Noun ($\beta = 1.8$, $z = 8.45$, $p < .001$)

and Final Noun ($\beta = 1.93$, $z = 4.1$, $p < .001$) trials. Most importantly, on That Initial Noun trials, participants selected the transformed object on 61.2% of trials, prioritizing the grammatical information over the noun descriptor. For example, upon seeing a car transform into a duck, participants asked for "that car" chose an object that was now a duck more often than a car that had never transformed, but had also not been mentioned. However, excluding the effect of Specificity from the model, setting "that" as the reference level of Definiteness, and comparing the simple effect of That Initial Noun versus That Final Noun trials in a separate model, participants were still more likely to select the transformed object when the request involved a noun description that corresponded to its final, transformed state ($\beta = 3.16$, $z = 7.67$, $p < .001$), suggesting that they did consider the descriptive information in their choices.

Adults' behavior matched the predictions of Grammar-First theories. Their choice of referent incorporated descriptive information, but prioritized grammatical information. Importantly, and compatible only with Grammar-First theories, they understood a sentence as referring to an object even when the noun did not describe that object in its current state, so long as the grammar allowed for it. They tended to choose the object that transformed from a car into a duck when asked for "that car," but not "a car" or "another car."

At the same time, they did not always choose the transformed object given a mismatching description, even when "that" was used. This contrasts with their behavior in the That Final Noun condition, where they chose the transformed object nearly 100% of the time. This suggests that despite the strong role grammar plays in referent selection, adults still have a preference for using matching descriptors, that is, nouns that describe the object in its present state.

Experiment 2

In Experiment 1, we found that grammar influences adults' referent selection so strongly that it can override descriptive information provided by a kind label. Next, we explore whether the influence of grammar on referent identification changes across development. Experiment 2 adapts the same paradigm for children. One possibility

Table 1
Trial Types, Experiments 1 and 2

Request	Article	Noun	Description-First	Grammar-First
1. A duck	Indefinite	Final	✓	
2. Another duck	Indefinite	Final	✓	
3. That duck	Definite	Final	✓	✓
4. A car	Indefinite	Initial		
5. Another car	Indefinite	Initial		
6. That car	Definite	Initial		✓

Note. Checkmarks represent conditions where each theory (Grammar-First and Description-First) predicts that it is possible to interpret the utterance as referring to the transformed object.

Figure 2

Adults' Choices of the Transformed Object, and of the Initial and Final Kind Distractors, Broken Down by the Article and Noun in the Request in Experiment 1

Note. See the online article for the color version of this figure.

is that children start out prioritizing descriptions over grammar, as Description-First theories within developmental psychology have previously assumed. Alternatively, it is possible that, such as adults, children will prioritize grammatical information as soon as they understand the referential functions of words like "that," "a," and "another."

Method

This experiment was preregistered at OSF (https://osf.io/znye7). Methodological and analytical choices were as specified there, unless otherwise noted.

Participants

We analyze results from a sample of 32 monolingual English-speaking children ($M_{age} = 4.54$ years, range = 3.18–5.98 years) recruited from a database of participants at Brown University. We did not collect other demographic information for the study. When registering to the Brown database, parents are asked to indicate their child's sex (male, female, and prefer not to answer) and the languages they use at home (English, Spanish, Mandarin, Cantonese, ASL, French, Arabic, Portuguese, and other—specify). An additional five children were tested, but

excluded due to inattention (four) and experimenter error (one). In all experiments with children, parents gave informed consent and received $5 Amazon vouchers.
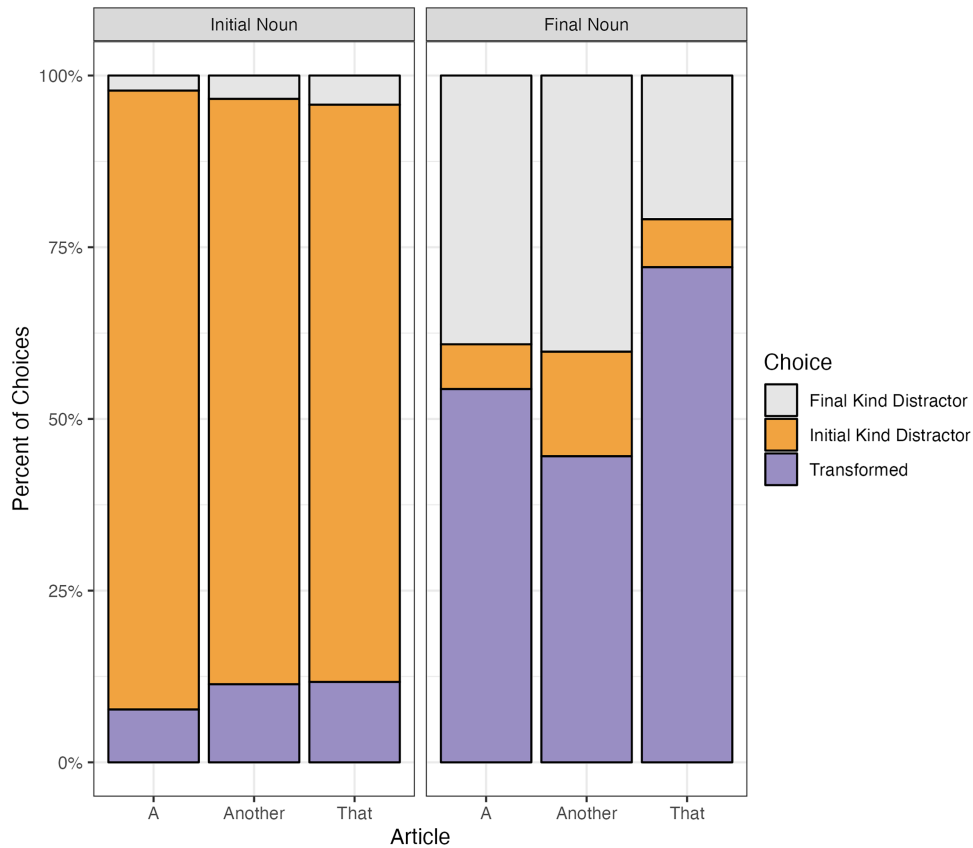
Procedure

The task and materials were identical to Experiment 1, except for changes aimed at adapting the task for children. The study was carried out live via Zoom video-conferencing with the experimenter and took around 15 min after setting up. Children pointed to their selections and their caregiver clicked on the corresponding image. If they were able to, children were also allowed to click themselves. To familiarize children with the task, each session began with a set of warm-up trials asking them to point to an object on the screen. We also introduced a break halfway through.

Results and Discussion

Figure 3 shows the results. The modeling strategy was identical to Experiment 1. Model comparisons revealed significant effects of Definiteness, A and Another versus That: $\chi^2(1) = 11.39$, $p < .001$; and Noun, Final versus Initial: $\chi^2(1) = 104.81$, $p < .001$. We found neither a significant effect of Specificity, A versus Another: $\chi^2(1) = .62$, $p = .43$ nor any interaction, Definiteness × Noun:

Figure 3
Children's Choices of the Transformed Object, the Initial and Final Kind Distractors by the Article and Noun in the Request in Experiment 2

Note. See the online article for the color version of this figure.

$\chi^2(1) = 2.65$, $p = .103$; Specificity × Noun: $\chi^2(1) = 0.07$, $p = .146$. The main effect of Noun revealed that, across all articles, children were more likely to select the transformed object when the noun descriptor matched its final, transformed state. In fact, they rarely ever selected the transformed object when the Initial Noun was used, irrespective of the article (mean 11%). However, as the main effect of Definiteness reveals, children did show sensitivity to the article, selecting the transformed object more in the context of "that." In exploratory analyses of this behavior, we looked at the simple effects of Article at each level of Noun. We found that children distinguished "that" from the indefinites only when given the Final Noun ($\beta = 0.37$, $z = 3.7$, $p < .001$) and not the Initial ($\beta = 0.08$, $z = 0.614$, $p = .539$), in which case they virtually always chose the final kind distractor—the only object on offer that matched the noun descriptor. We also explored the effect of children's age on their responses in a separate model, but found no significant main effect or interactions involving age. Detailed results from the analyses of age in this and all subsequent experiments can be found in the annotated codebase on OSF.

Finally, in order to directly compare adults and children in their differentiation of definite versus indefinite articles, we fit two models to the data, including the two Article variables and their interactions with Experiment (1 vs. 2) and analyzing the Final and Initial Noun conditions separately (this was not preregistered, since Experiment 1 was planned after Experiment 2 was conducted). When looking only at the Final Noun, model comparisons revealed a main effect of Experiment as children selected the transformed object more often than adults, $\chi^2(1) = 8.21$, $p = .004$, and main effects of the Article at both levels, Definiteness: $\chi^2(1) = 54.33$, $p < .001$; Specificity: $\chi^2(1) = 15.07$, $p < .001$, showing that taken together participants distinguished all of the articles. However, significant interactions between these terms, Definiteness × Experiment: $\chi^2(1) = 50.84$, $p < .001$; Specificity × Experiment: $\chi^2(1) = 5.04$, $p = .024$, revealed that adults differentiated all of the articles more than children. In the model looking at the Initial Noun, we found somewhat similar results. Model comparisons revealed significant effects of Definiteness, $\chi^2(1) = 25.23$, $p < .001$, but not Specificity, $\chi^2(1) = 0.14$, $p = .706$, and a significant effect of Experiment, $\chi^2(1) = 4.61$, $p = .031$; children chose the transformed object less than adults overall, and again, we found a significant interaction between Definiteness and Experiment, $\chi^2(1) = 44.594$, $p < .001$. While, participants on average chose the transformed object more given definite than indefinite articles, the critical interaction with the Experiment highlights that this was driven by adults' willingness to select the transformed object in That Initial Noun trials.

Even though we found that children, much as adults, were sensitive to both the noun and the article, children's behavior was

otherwise quite different. They rarely chose the transformed object given a mismatching description (a kind of label that did not match its current state). This suggests that they prioritized descriptive over grammatical information, and thus, that their behavior is better explained by Description-First than Grammar-First theories.

However, two issues limit this interpretation. First, we only have limited evidence that children encoded and understood the grammatical structures in our task. Rather than prioritizing descriptions, it is possible that children did not differentiate definite from indefinite articles reliably enough for them to guide reference identification in this task. Second, there are multiple ways to interpret children's reluctance to select the transformed object in the That Initial Noun condition. It could be driven by children requiring descriptions to match a referent, as Description-First theories predict, but it could also be driven by another constraint on referential communication. A variety of studies (for a review, see Doherty & Perner, 2020) have found that young children have trouble with "dual naming," that is, applying two distinct noun-descriptors to an object even when they both match, whether they are basic-level and superordinate terms (e.g., "rose"/"flower") or two basic-level terms (e.g., "bunny"/"gardener"). One possibility, consistent with these findings, is that children expect objects to be referred to using only the single best description available. For the transformed object in the present experiment, the best (least ambiguous) descriptor would be the noun that describes its final and current state. Experiment 3 tests whether children initially employ a Description-First approach to reference, or else whether they avoid dual naming in particular but use Grammar First when an object does not receive two distinct labels.

Experiment 3

Experiment 3 tested two questions: first, can children distinguish between the referential functions of the articles "that," "a," and "another" under more ordinary circumstances, when the description does not mismatch? Second, do children assume that any matching description can be used to refer to an object, or do they have a further constraint against interpreting two different descriptions as referring to the same object (i.e., dual naming)?

Method

To investigate these questions, we changed the request made by Tigger, while keeping all other aspects of the task constant. We leveraged prior findings that, by age 3, children can identify referents given requests for "this one" or "that one" in the absence of informative descriptions, based on pragmatic cues about the communicator's intent (Matthews et al., 2007). Instead of hearing a noun describing either the initial or final state, children were presented with requests that either (a) had no descriptive content ("one") or (b) used a superordinate descriptor ("toy") that matched both kinds of objects. By removing the descriptive information in the one condition, we can probe children's grammatical performance without influence from any descriptive content, either matching or mismatching. The toy condition allows us to test how children treat descriptors that match, but nevertheless fail to meet the "single best descriptor" criterion. If, in Experiment 2, children avoided choosing the transformed object in the That Initial Noun condition because of a failure to understand the grammatical terms, we should continue to

see analogous failures here, in both the one and toy conditions. If children struggled only with dual naming, they should continue to avoid the transformed object when asked for "that toy," but start selecting it when asked for "that one."

Participants

We analyze results from a new sample of 32 children ($M_{age} = 4.39$ years, range $= 3.07–5.98$ years) recruited from a database of participants at Brown University. One additional child was recruited but excluded due to inattention.

Materials and Procedure

All materials and procedures were identical to Experiment 2, with a crucial difference in the form of the request, which now involved either "that/[null]/another one" or "that/a/another toy." Since "a one" would be ungrammatical, no overt article was used in that condition.

Results and Discussion

Figure 4 shows the results of Experiment 3. Again, our modeling strategy was identical to Experiments 1 and 2, only with toy and one as the two levels of the Noun variable. Model comparisons indicated a significant effect of Definiteness, $\chi^2(1) = 30.04$, $p < .001$, but no significant effects of Specificity, $\chi^2(1) = 0.23$, $p = .633$; Noun, $\chi^2(1) = 1.15$, $p = .283$; or their interactions, Definiteness × Noun: $\chi^2(1) = 1.89$, $p = .17$; Specificity × Noun: $\chi^2(1) = 0.22$, $p = .992$. Altogether, we found that children again chose the transformed object more often when the request contained the article "that" relative to the indefinite articles and that children were willing to select the transformed object with both "one" and "toy." As in Experiment 2, exploratory analyses found no significant main effects or interactions with age.
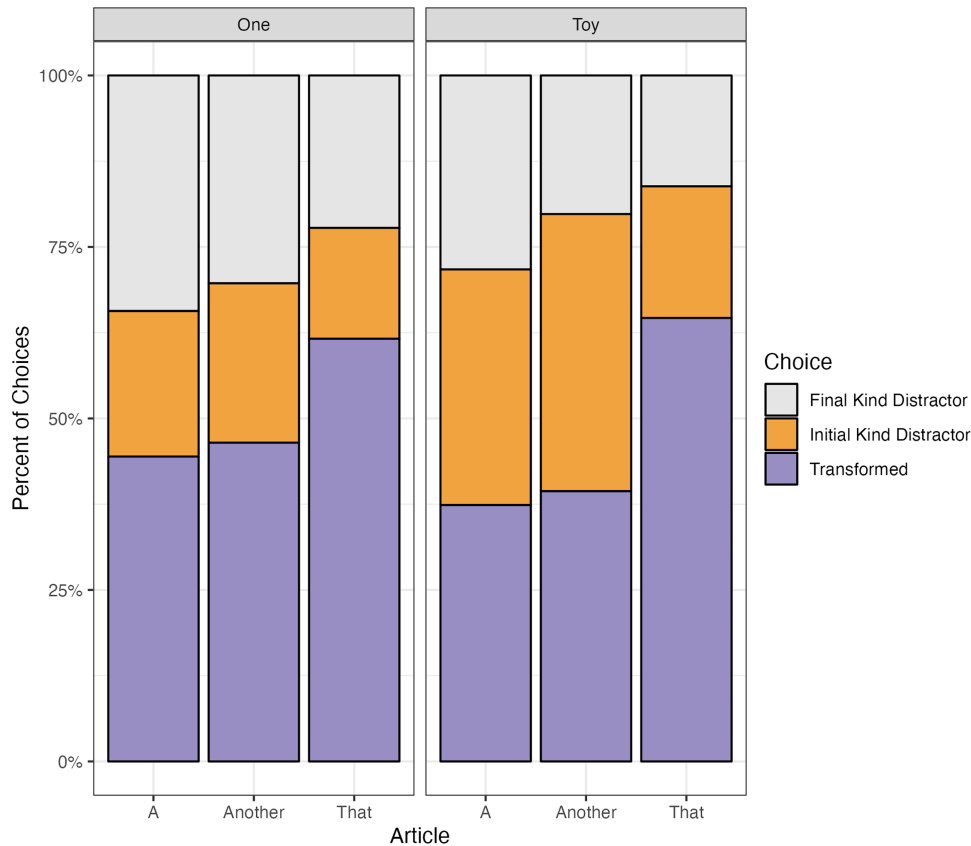
The contrast between the definite article and the two indefinites provides evidence that children encode the grammatical distinction that is crucial to adults' referent identification in Experiment 1. Together with the finding that children distinguished the definite article from the two indefinites in Experiment 2, we can conclude that children understand and use this grammatical contrast in an adult-like way—but only as long as the description matches the referent. In other words, their behavior in Experiment 2 indicates that they prioritize descriptive over grammatical information, even as Experiment 3 confirms that they do not disregard or misunderstand that grammatical information.

Importantly, children also chose the transformed object at comparable rates when asked for both nouns, "toy" and "one." This shows that children have no problem referring to the transformed object using descriptions that diverge from the final noun (calling a duck "that toy"), so long as the descriptive content applies to the entity at that time. This argues against interpreting the results of Experiment 2 as the product of children's inability to accept multiple labels for a single object (Doherty & Perner, 2020; Perner & Leahy, 2016).

While problems with "dual naming" cannot explain our findings, it is still possible that children's expectation that descriptions must match their referents is specific to nouns rather than to descriptive content in general. Nouns are argued to provide individuation criteria for objects and thus be special both developmentally (Macnamara, 1986; Xu, 1997, 2007) and semantically (Wiggins, 1997). Figuring out the generality of the effect can determine whether children prioritize

Figure 4

Children's Choices of Transformed Object, the Final Kind Distractor, and the Initial Kind Distractor by Article and Noun in the Request in Experiment 3

Note. See the online article for the color version of this figure.

other, even less central descriptive information over grammatical information in identifying what a speaker is referring to.

There is also a potential methodological limitation on the interpretation of all our findings up to this point. In principle, it is possible that adults and children differ in how they understand the magical transformation in Experiments 1–3. For instance, children could believe that the magical transformation actually involves switching one object for another rather than transforming a single object. This would explain why they think that referring back to that object using the initial noun is impossible. While there is prior evidence that 3- and 4-year-old children can interpret both plausible (Gelman et al., 1980) and magical transformations (Goddu et al., 2020), in Experiment 4, we directly test whether children would continue to prioritize descriptions even when the transformation is less magical.

Experiment 4

Experiment 4 asked whether children's requirement that descriptions match referents generalizes from nouns to a different type of descriptor that is less important for kind membership and generally more mutable: color adjectives. The switch from the nominal to the adjectival domain also allowed us to seamlessly move away from using a magical transformation in our stimuli. In Experiment 4,

instead of changing their kind, objects were painted and only changed color.

Method

Participants
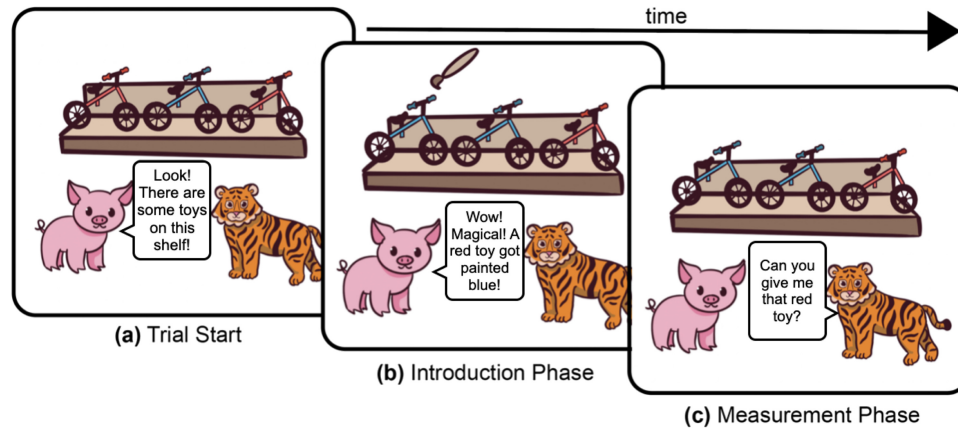
A new sample of 32 children ($M_{age} = 4.35$ years, range = 3.17–5.86 years) were recruited from a database of participants at Brown University. An additional eight children were excluded (five due to inattention, and three due to technical failure during the experiment).

Materials and Procedure

The materials and the design of the study were similar to Experiment 3, except for the changes detailed below. Figure 5 shows an example trial. In Experiment 4, the three toys belonged to the same kind and looked identical except for their color. Each toy was one of two different colors (e.g., blue car, red car, blue car), drawn from a pool of four colors organized into four pairs. Instead of a magical transformation, the introduction phase included a painting event, in which one object changed color. The repainted object was always one of the two identically colored objects at the start (thus a blue, red, and blue display at the start could end up being either a red, red, and blue display or a blue, red, and red

Figure 5

A Timeline (Left to Right) of a Trial in Experiment 4, in Which a Red (Light Gray) Bike Is Painted Blue (Dark Gray)

Note. The original figure with Piglet and Tigger is available on the OSF project page, but cannot reproduced here for copyright reasons. (A) Trial start; (B) introduction phase; and (C) measurement phase. OSF = Open Science Framework. See the online article for the color version of this figure.

display, counterbalanced between trials). This painting event was narrated by Piglet: "Wow! Magical! A [adj1] toy got painted [adj2]." Similarly to the previous experiments, this narration verbally highlighted the changed object and provided an opportunity for the subsequent use of "that" to refer back to it.

In the measurement phase, Tigger said: "Wow! That was so cool! Can you click on [a/another/that] [adj1/adj2] toy?" As before, we manipulated two variables in this request: the article "a" vs. "another" vs. "that") and the descriptor (Initial: the adjective corresponding to the initial state, e.g., "blue," vs. Final: the adjective corresponding to the painted state, e.g., "red"). Both in the introduction phase and in the measurement phase, we decided to use the noun "toy" in the carrier phrases, as in Experiment 3 and unlike Experiment 2. This was to make the requests felicitous, while highlighting the toys' color rather than their kind as the relevant dimension of change both within and across trials.

Results and Discussion

Figure 6 shows children's responses. Our modeling strategy was identical to the previous experiments, except that Adjective replaced Noun in all analyses. Model comparisons revealed significant main effects of Definiteness, $\chi^2(1) = 8.92$, $p = .002$, and Adjective, $\chi^2(1) = 93.90$, $p < .001$, and an interaction between the two, $\chi^2(1) = 5.40$, $p = .003$. In contrast to Definiteness, we found neither a main effect of Specificity, $\chi^2(1) = 1.58$, $p = .209$, nor an interaction with Adjective, $\chi^2(1) = 0.67$, $p = .412$. The main effect of Adjective shows that across all articles, children were more likely to select the painted object when the description matched its final color. The main effect of Definiteness revealed that children selected the painted object more frequently in definite frames. Children rarely ever selected the painted object when the initial adjective was used, irrespective of the article. In exploratory analyses of the simple effects of Article at each level of Adjective, we found that children distinguished "that" from the indefinites when they heard the final adjective ($\beta = 0.37$, $z = 3.8$, $p < .001$), but not the initial one ($\beta = -0.01$, $z = 0.08$, $p = .937$). Exploratory
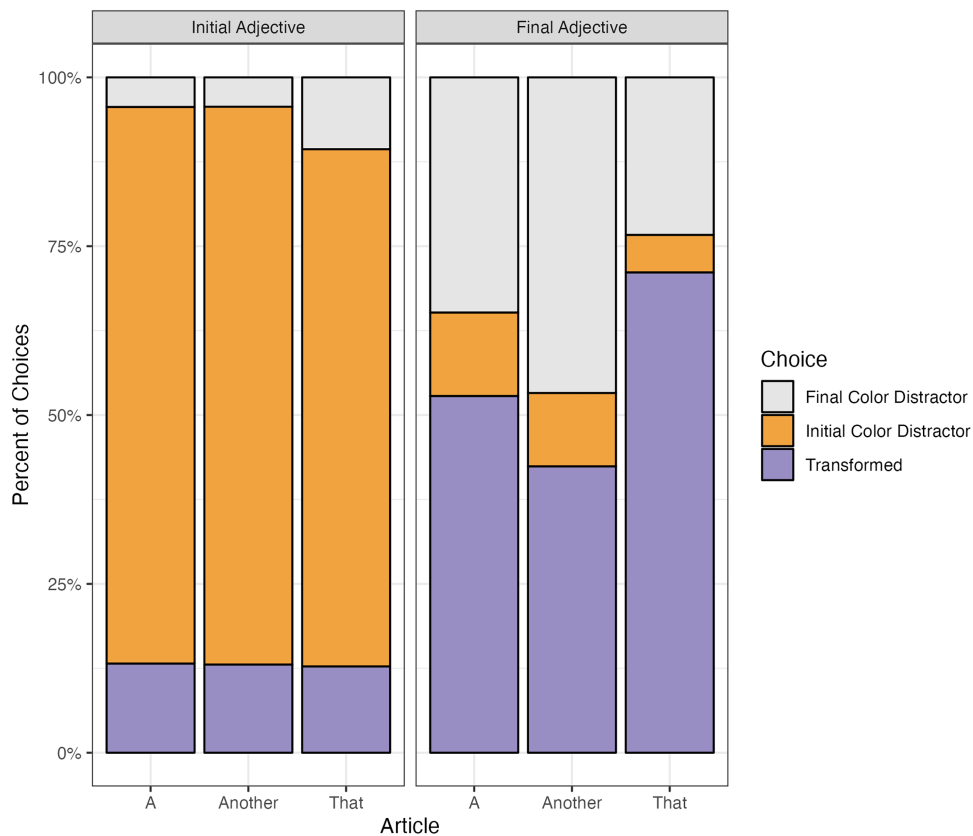
analyses revealed an interaction between age and descriptor, $\chi^2(1) = 8.66$, $p = .013$, as older children were more likely to select the transformed object with the initial adjective than younger children. However, this effect was not modulated by Article, $\chi^2(1) = 2.68$, $p = .262$, so it does not mean that older children were acting more in line with Grammar-First theories.

Did children respond differently when seeing painting events that changed an object's color compared to magical transformations that changed its kind? In order to directly compare Experiment 2 (nouns) and Experiment 4 (adjectives), we fit two models to the data, each corresponding to the final and initial descriptor conditions of the two experiments (grouping Noun in Experiment 2 with Adjective in Experiment 4; sum coded). These were planned, but not preregistered. When looking only at the final descriptor, model comparisons revealed a significant effect of Definiteness, $\chi^2(1) = 27.29$, $p < .001$, and a significant effect of Specificity, distinguishing the two indefinites, $\chi^2(1) = 4.27$, $p = .039$. No effect of Experiment, $\chi^2(1) = .07$, $p = .797$, or interactions, Definiteness × Experiment: $\chi^2(1) < .01$, $p = .994$; Specificity × Experiment: $\chi^2(1) < .01$, $p = .94$, were found. Looking at the initial descriptor, there were no significant effects of any variable on children's choice of object: no main effects of Experiment, $\chi^2(1) = .4$, $p = .528$; Definiteness, $\chi^2(1) = .17$, $p = .679$; or Specificity, $\chi^2(1) = .2$, $p = .653$; and no significant interactions, Definiteness × Experiment: $\chi^2(1) < .47$, $p = .492$; Specificity × Experiment: $\chi^2(1) < .79$, $p = .373$. Children in both experiments rarely chose either the transformed or the painted object when its appearance did not match the description they were given, whether in terms of its kind or its color.

Taken together, we found no statistical differences between Experiments 2 and 4. In both experiments, children distinguished referents based on Definiteness in the final descriptor conditions but not in the initial descriptor conditions. In both experiments, they almost exclusively chose objects that matched the descriptor, whether in current color or kind. In neither experiment were children willing to entertain that a descriptor that is out of date can refer to an object that no longer has the described property. On the other hand,

Figure 6
Children's Choices of the Initial and Final Color Distractors and the Transformed Object by Article and Adjective in the Request in Experiment 4

Note. See the online article for the color version of this figure.

General Discussion

In four studies, we compared the role of descriptive versus grammatical information—nouns and adjectives versus articles—in how adults and children determine what object a speaker is referring to. Experiment 1 revealed that adults prioritize grammatical information. When the request involved the article "that," which picks out a referent that has already been established in the discourse, adults chose the transformed object—the object that was made salient immediately prior to the request—even when given a mismatching descriptor. Asked for "that car," they picked the object that used to be a car, but had since transformed into a duck—a result that is compatible only with Grammar-First theories. Adults also distinguished between "a" and "another," perhaps because they sometimes interpreted "a" as indicating indifference on the speaker's part (i.e., give me anything such that it matches the description), rather than as introducing a new object. On the other hand, they almost never chose the transformed object when asked for "another," confirming that this article always requires that the referent contrast with one that had been previously established.

In contrast, 3- to 5-year-old children behaved very differently from adults. In Experiment 2, we found that they almost never picked the transformed object when the noun did not describe that object's final state. Experiment 3 further tested and confirmed that children at these ages do have the requisite grammatical understanding of how the definite and indefinite articles in our paradigm distinguish different referents.

Experiment 3 then helped to tease apart two different kinds of expectations children could have about how descriptions refer. It contrasted two types of noun phrases: "one," which provides no descriptive information and thus gives a clearer test of sensitivity to grammar, and "toy," which describes all the objects on the screen truthfully but less specifically, and so does not pick out any one object in the best way. This assessed whether children would behave any differently when each object only received one label. We found

combining the data from two structurally similar experiments increased our power enough to find that children as a group can indeed distinguish the indefinite articles "a" from "another," even if they do so less consistently than adults. This highlights that children's refusal to identify referents with mismatching descriptions is not a consequence of their lacking the relevant grammatical tools. Experiment 4 thus replicated the pattern of results of Experiments 2 and 3 while excluding two critical alternative explanations for those findings. Children's performance in previous experiments was not driven either by a failure to understand the persistence of object identity through a magical transformation, or by specific expectations about nouns that describe object kinds.

that children distinguished all of the articles given both noun phrases and that they had no trouble resolving reference to the transformed object with a less-than-ideal, but still matching, descriptor (i.e., "toy"). Together, these results make it unlikely that the results from Experiment 2 were due either to a lack of grammatical understanding or to confusion about two labels referring to the same object (i.e., a prohibition against dual naming).

Experiment 4 replicated and further extended these findings in three major ways. First, it showed that children's behavior is not due to a nonadult-like encoding of the magical transformation of object kind. In this experiment, objects were painted a different color rather than magically transformed into a different kind, and children still behaved similarly: they used grammatical information as long as the descriptors matched the final state of the object, and only in that case. Second, Experiment 4 extended our findings from the nominal to the adjectival domain, showing that children prefer matching descriptions even if those do not specify a category or sortal kind, but instead a more mutable property, color. This implies that children's preference for matching descriptions in Experiment 2 was not due to special properties of kind descriptors, but to a more general expectation about descriptive information. Third, we found evidence that children—much as adults—do differentiate the two indefinites ("a" and "another") in terms of how much they require a novel object. Summing across experiments, we find that children understand and differentiate these articles much like adults do, though less reliably. This makes it unlikely that children's reluctance to identify a referent with a mismatching description is due to their understanding the task differently than adults, perhaps as a game of find-what-matches-the-description.

Is it possible that children have adult-like competence, but were hindered by somehow misconstruing the communicative context? If, for instance, children considered all three target objects as equally discourse-familiar, irrespective of the fact that the transformed object was verbally highlighted, that could explain their preference for matching descriptors. After all, if all objects are equally salient in the discourse, then there is no reason not to select one with a matching descriptor. The simplest form of this explanation is ruled out by children distinguishing between requests involving definite and indefinite articles, which requires differentiating the objects based on discourse familiarity. But it is not impossible that children not only misconstrued the context, but also made this grammatical distinction in a nonadult-like manner. For instance, they might also assume that definite noun phrases should refer to objects that are salient from their own first-person perspective rather than in the shared discourse. Notably, this explanation would require two stipulations: a nonadult-like construal of the context, and a nonadult-like use of "that," in which it only incorporates the child's perspective. A significant body of work argues against the latter possibility, showing that children interpret articles in a way that incorporates a shared discourse (Aravind, 2018; Maratsos, 1976; Matthews et al., 2006, 2007; Rozendaal & Baker, 2008; Serratrice, 2005).

Still, it is possible that under some other circumstances, children could behave more like adults. Maybe making the transformed object more salient, or salient in a different way (e.g., if one of the characters owns it or expresses special interest in it pretransformation) might provide sufficient pragmatic scaffolding for children to be willing to override the descriptive information in favor of the grammar. Maybe other contextual support is needed. For instance, it might be that contexts that are more similar to Donnellan's original

martini example would actually be easier for children. In that example, the speaker using the false description is ignorant about the true descriptor, which can better justify using a mismatching one. Taking advantage of this would require children to have a pragmatically sophisticated encoding of the context, in which they represent the speaker's information state as differing from the actual state of affairs, but children (especially older children) could be up to the task.

While all of these are open possibilities for future research to explore, we think that children's nonadult-like behavior in the present experiments does provide tentative empirical support for Description-First theories of how children identify which objects a speaker is referring to. To that extent, it also supports these theories' concomitant and highly influential assumptions about the nature of word learning, communicative development, and children's use of descriptive information. Just as Description-First theories would predict, children in our task matched the descriptive content of utterances directly and exclusively to objects that the description applies to. Consistent with these theories, grammatical and pragmatic factors influenced this process only as long as descriptions matched. In this way, children as old as five differed sharply from adults.

Our results further constrain exactly how descriptions factor into children's referent identification. On most Description-First theories, basic-level nouns such as "car" and "duck" are privileged descriptors (Perner & Leahy, 2016; Xu, 2007), compared to words that describe inherently mutable properties, such as color adjectives. Although basic-level nouns might well be privileged for other uses, such as counting (Macnamara, 1986), our results show that children do not prioritize them over grammatical information any more than they prioritize the theoretically less central adjective descriptors. It is therefore not only sortals or basic-level kind nouns that appear to be privileged in referent identification.

What can then explain why children and adults would prioritize descriptive and grammatical information differently when identifying a communicator's intended referent? And what might develop when children eventually become adult-like?

One possibility is that putting descriptions first might be a useful simplification. If the learner assumes that descriptions always match their referent, then the complexity of word learning and referential disambiguation decreases in the typical case, even if this approach might not always provide an adult-like interpretation (as in our experiments). After all, we did find that children encode all the same types of information as adults do. Perhaps they prioritize this information differently from adults because doing that has some benefit for them. If this is right, then the shift in prioritization might happen when children start to notice counter-evidence—cases where Description-First assumptions hinder rather than help communication—and recalibrate their referential expectations as a response. One possibility is that this could happen once there is no more pay-off from having a simplified hypothesis space for word learning; that is, once children have acquired a good command of a wide variety of descriptors.

Another possibility is that pragmatic abilities beyond simply tracking the discourse status of referents (new or old) are responsible for shifting children's prioritization. Mismatching descriptions might require a form of presupposition accommodation, where the listener has to revise their model of the conversational common ground to interpret an utterance (Karttunen, 1974; Stalnaker, 1973; e.g., "Has Dana stopped smoking?" presupposes that the speaker

thinks Dana smoked). Maybe in order to understand a mismatching reference, listeners have to adjust what they take to be shared assumptions (e.g., if Tigger uses a definite article to pick out an object, but the object that he had previously mentioned does not match the descriptor, then maybe Tigger is thinking of the transformed object as belonging to the pretransformation category). Prior work shows that children struggle with accommodating other kinds of presuppositions at least until 5 years of age, suggesting that a more general developmental challenge might explain their failure to accommodate mismatching descriptions (Aravind et al., 2023; Schulz, 2003). If indeed mismatching descriptions require accommodating a presupposition, then the shift to a Grammar-First approach might fall out from increased pragmatic sophistication at a later age.

Conclusion

Our evidence shows that children between 3 and 5 years of age interpret referential utterances quite differently from adults. While adults identify referents the way that linguistic theories predict, with grammatical elements of the expression having primacy, children instead prioritize descriptions, as assumed in theories of language acquisition within developmental psychology. This finding raises novel questions about what exactly the difference between adults and children is, suggesting new directions for investigations of the relationship between descriptions and grammar in both populations. Taken together, there seems to be more to attaining an adult understanding of referring expressions—mapping words to the world—than just having a command of the grammar and descriptors of one's language. One must also come to put the grammar first.

Constraints on Generality

Our participant pool was restricted to people located in the United States who are native speakers of English. These two sampling choices limit the generality of our findings. It is possible that cultural factors may have an effect on how participants behave in such tasks in general, depending on how they perceive the goal of the experiments. Additionally, cross-linguistic differences in how grammar interacts with reference may influence the understanding of "mismatching descriptions" across languages. While we see no a priori reason that this should be the case, future research could reveal whether these factors affect reference resolution.

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