



SHORT REPORT

Preschoolers benefit from sentential context in familiar- and unfamiliar-accented speech

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Abstract

To learn the meaning of a new word, or to recognize the meaning of a known one, both children and adults benefit from surrounding words, or the sentential context. Most of the evidence from children is based on their accuracy and efficiency when listening to speech in their familiar native accent: they successfully use the words they know to identify other words' referents. Here, we assess how accurately and efficiently 4-year-old children use sentential context to identify referents of known and novel nouns in unfamiliar-accented speech, as compared to familiar-accented speech. In a looking-while-listening task, children showed considerable success in processing unfamiliar-accented speech. Children robustly mapped known nouns produced in an unfamiliar accent to their target referents rather than novel competitors, and they used informative surrounding verbs (e.g., "You can eat the dax") to identify the referents of both known and novel nouns—although there was a processing cost for unfamiliar-accented speech in some cases. This demonstrates that 4-year-olds successfully and rapidly process unfamiliar-accented speech by recruiting the same strategies available to them in familiar-accented speech, revealing impressive flexibility in word recognition and word learning across diverse linguistic environments.

KEYWORDS

accents, language development, linguistic diversity, looking-while-listening, processing efficiency, sentential context

Research Highlights

- We examined 4-year-old children's accuracy and processing efficiency in comprehending known and novel nouns embedded in sentences produced in familiar-accented or unfamiliar-accented speech.
- Children showed limited processing costs for unfamiliar-accented speech and mapped known words to their referents even when these were produced in unfamiliar-accented speech.

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- Children used known verbs to predict the referents of upcoming nouns in both familiar- and unfamiliar-accented speech, but processing costs were evident for unfamiliar-accented speech.
- Thus, the strategies that support children's word comprehension and word learning in familiar-accented speech are available to them in unfamiliar accents as well.

1 | INTRODUCTION

Global immigration has increased by nearly 200 million over the past half century (World Migration Report 2022, 2021). This brings with it an increase in linguistic variability within communities, making us more likely than ever to encounter speakers with unfamiliar accents. This also raises questions as to how children adapt to such variable language environments. Processing unfamiliar accents can be effortful even for experienced language users: adults are slower and less accurate in understanding unfamiliar-accented than familiar-accented speech (Adank et al., 2009; Gass & Varonis, 1984; Munro & Derwing, 1995).

For children, too, unfamiliar-accented speech seems to incur processing costs, but the evidence is more mixed. While 15-month-old infants struggle to recognize known words presented in unfamiliar accents, 19-month-olds do so successfully (Best et al., 2009; Mulak et al., 2013; van Heugten & Johnson, 2014). Nevertheless, some processing costs remain: children are generally slower and less accurate in comprehending unfamiliar, compared to familiar, accents (see Cristia et al., 2012; Johnson et al., 2022 for reviews). These costs, evident throughout childhood, are also apparent in more challenging word learning tasks: toddlers fail to recognize a newly learned novel word-object pairing when the word is presented in an unfamiliar accent, though successfully do so when trained in an unfamiliar accent and then tested in their native accent (Schmale et al., 2011). More broadly, the magnitude of these processing costs varies across studies but tends to be greater for younger children, more demanding tasks, and more linguistically different or degraded speech (e.g., Bent & Holt, 2018; Escudero et al., 2014; Frye & Creel, 2022). Thus, while less research has examined children's processing of unfamiliar-accented speech, the evidence available suggests children likely understand adults who speak in unfamiliar accents, but they incur processing costs to do so.

There is, however, an important limitation: much of this evidence comes from tasks in which a single word is presented alone. Yet in everyday life, children rarely hear such single-word utterances: instead, words typically occur within a sentential context. Moreover, there is considerable evidence that children take advantage of the surrounding sentential context to identify known words and learn new ones. This evidence comes primarily from experiments in which children listen to speech produced in their native accent. For instance, toddlers identify the referent of a known noun (e.g., "car") more effi-

ciently when it is preceded by an informative verb (e.g., "Drive the car!") than an uninformative verb (e.g., "Find the car!") (Borovsky et al., 2016; Fernald et al., 2006; Mani & Huettig, 2012). Similarly, toddlers use the surrounding words in a sentence to identify the meaning of new words (Ferguson et al., 2014, 2018; Goodman et al., 1998; Yuan et al., 2011).

Crucially, it is an open question how, and how early, children successfully use the sentential context to understand unfamiliar-accented speech. For instance, in a task requiring children to use sentential context to learn a novel noun (e.g., inferring from "The dax is dancing" that "dax" refers to an animal), toddlers hearing unfamiliar-accented speech failed to make these inferences (LaTourrette et al., 2021) while those hearing familiar-accented speech succeeded (Ferguson et al., 2018). However, while children may not use sentential context to infer word meanings, a larger literature suggests children successfully recruit sentence context in word *recognition* tasks (Bent et al., 2019). Toddlers listening to unfamiliar-accented speech more successfully recognize a word when it is presented in a sentence (e.g., "Where is the cow?") than presented alone (e.g., "cow") (van Heugten & Johnson, 2016). Similarly, preschoolers more accurately identify the referent of a word when it occurs in sensical sentences (e.g., "The farmer milked the cow") than non-sensical sentences (e.g., "The farmer milked the nose") (Creel et al., 2016). Moreover, informative sentential contexts benefit 5- to 7-year-olds' word recognition in unfamiliar-accented speech—though it remains unclear how robust these benefits are at 5 years (Bent et al., 2019; Holt & Bent, 2017).

Finally, Creel (2012) studied 3- to 5-year-olds' recognition of known words, produced in a non-canonical way (e.g., "feesh" instead of "fish"). Children were asked to identify the referent of the word among four items: the target item (e.g., a fish), two familiar distractors (e.g., an apple and a car), and a novel item for which children did not know a name (e.g., a microscope). This four-item display was designed to tease apart two alternatives: Do children spontaneously identify known words, even when non-canonically pronounced (fish as "feesh")? Or do they first interpret these pronunciations as novel words, but when presented with no novel candidate referent, then settle for mapping them to the referent with the most phonologically similar label? The 4-item display addressed this issue by assessing whether children would map non-canonical pronunciations to novel objects if one was available (e.g., mapping "feesh" to a microscope), and whether embedding these words in an informative sentential context would reduce this tendency. Results were straightforward. First, children rarely made



errors. Second, children's errors, however rare, were less likely when the mispronounced word was presented in an informative sentence ("Feed the feesh") than a neutral one ("Find the feesh"). Third, when children did err, they indeed tended to favor the novel distractor more for non-canonical pronunciations. This suggests that children may mistakenly interpret non-canonical pronunciations of known words as novel words, but introducing them in informative sentential contexts ameliorates this tendency.

However, this design does not illuminate how children will fare when listening to unfamiliar-accented speech. After all, only a single word within the sentence was pronounced non-canonically; the rest of the sentence was in a familiar accent. It therefore remains unknown whether (a) children take advantage of sentential context when hearing sentences entirely in unfamiliar-accented speech, and (b) children construe known words as novel words more often in unfamiliar-accented speech than familiar-accented speech. Only by addressing these gaps can we determine whether children successfully recruit the same strategies while listening to unfamiliar-accented speech and familiar-accented speech.

Here, we addressed these questions directly. Building upon Creel's (2012) design, we assessed 4-year-olds' accuracy and efficiency in identifying the referents of words embedded in fluent speech, including both known and novel nouns. What varied was whether children heard either a familiar accent (*Standard American English¹) or an unfamiliar accent (Turkish-accented English). We focused on Turkish-accented English because it is rarely encountered by 4-year-olds living in the U.S. (see Participants below). Our focus on 4-year-olds was also strategic. At this age, as children's social networks widen as they participate in activities (e.g., preschools, playgroups) outside their homes and beyond their neighborhoods, they are increasingly likely to engage with speakers from different language communities. Yet there is surprisingly little evidence examining preschool-aged children's success, and the strategies they deploy, when listening to unfamiliar-accented speech. Our analyses are designed to address three distinct, but inter-related questions in both accent conditions: (1) How successfully do 4-year-olds identify the referents of known nouns when a novel referent candidate is present? (2) Do 4-year-olds benefit from sentential context in identifying the referents of known nouns? (3) Do 4-year-olds leverage sentential context to infer the referent of a novel noun?

2 | METHOD

2.1 | Participants

Eighty-six monolingual English-speaking 4-year-olds ($M = 52.32$, $SD = 3.41$; 54 White, 17 Multiracial, 11 Asian, three Latinx/Hispanic, one unreported; 39 females) living in the U.S. were recruited and tested using the online platform Lookit (Scott & Schulz, 2017). All heard predominantly English (over 75% English exposure); none had prior exposure to Turkish or Turkish-accented English. Ninety percent

of children had college-educated parents. Seven additional children (three in the Familiar-Accent condition) were excluded, six due to technical issues (misalignment of participant and stimulus videos' timing) and one whose eye-movements could not be coded due to eyeglasses.

2.2 | Stimuli

Visual stimuli were 36 images of colorful objects, 24 familiar, and 12 novel (See Figure 1). Caregivers reported that children knew the names of every familiar item, but only a few (three, on average) of the novel items. Following Creel (2012), items were organized into 4-item displays, each including a target (e.g., cake), two familiar distractors (e.g., shirt, bunny), and a novel distractor (e.g., carriage). Each item appeared at a corner of the screen the same number of times throughout the design, serving as the target once and as a distractor three times. Item location was counterbalanced across trials.

Linguistic stimuli were recorded in child-directed English by two females, one an L1 English speaker (Familiar-Accent condition) and the other an L2 English speaker with a Turkish accent (Unfamiliar-Accent condition). We selected carefully among these recordings, based on a preliminary study in which 21 adult native English speakers from the U.S. rated the L2 speaker's recordings for comprehensibility and "accentedness", using a scale of 0–100. We then selected those L2 speaker's recordings that were judged to be both "accented" ($M_{unfamiliar} = 58$, $SD_{unfamiliar} = 2.5$) and comprehensible ($M_{unfamiliar} = 86$, $SD_{unfamiliar} = 4.6$). Next, we selected recordings from the L1 speaker in which the utterance timing best matched the selected L2 recordings. We then conducted an independent survey with 15 additional adult native English speakers from the U.S., who judged that the selected familiar-accented recordings were significantly less accented ($M_{familiar} = 20$, $SD_{familiar} = 14.32$) and more comprehensible ($M_{familiar} = 95$, $SD_{familiar} = 6.55$) than the unfamiliar-accented recordings, both $ps < 0.01$. This converges well with evidence that L1 speakers rate L1 speakers' speech to be less "accented" and more comprehensible than L2 speakers' speech (e.g., Munro & Derwing, 1995, 1999; Verbeke & Simon, 2023). Finally, all recordings were time-locked to align the timing of the noun and verb onset, word length, pause length, phrase length and volume. See [Supplementary Materials A](#) (complete list of sentences) and [OSF](#) (complete set of recordings).

2.3 | Procedure

Children participated from their homes. After caregivers provided informed consent, they were instructed that once the video began, they should remain out of the child's sight and not interfere. We recorded children's eye gaze, a measure of real-time language processing. Children were assigned randomly to either the Familiar-Accent ($n = 40$) or Unfamiliar-Accent ($n = 46$) condition. We chose a between-subject design because a within-subject design would lengthen the task and could incur carry-over effects.



FIGURE 1 One representative stimulus set for each Trial Type (Neutral, Informative, Novel). Images appeared in silence for 2 s; then children heard the sentence. Approximately 3 s after the first sentence ended, children heard a prompt (e.g., “Can you see it?”). After the prompt, images remained on the screen in silence for 2 s.

2.3.1 | Warm-up trials

All children first completed four warm-up trials, designed to draw their attention to all four quadrants of the screen. On each trial, a familiar item was presented at each corner of the screen and labeled once (e.g., “You can find the apple”). Items from warm-up trials were not included in the experiment proper.

2.3.2 | Experimental trials

See Figure 1. Experimental trials immediately followed the last warm-up trial. Each began with an attention-getting image, presented at the center of the screen (2 s). Next, four items appeared (7 s), initially in silence (2 s), after which children heard a sentence directing them toward one item. The onset of the verb and noun always occurred approximately 700 and 1300 ms, respectively, after the sentence began. Approximately 3 s after the first sentence ended, children heard a neutral prompt (e.g., “Can you see it?”).

The experiment included 36 trials, evenly distributed among three distinct trial types (Figure 1). Trials were presented in one of eight pre-randomized orders. What varied across trial types was the familiarity of the nouns and the informativeness of the verbs. On Neutral trials, a known noun was presented with a neutral verb (e.g., “You can *find* the cake”); on Informative trials, a known noun was presented with an informative verb (e.g., “You can *eat* the cake”). All caregivers reported their children understood and produced the informative verbs (*eat*, *feed*, *wear*, and *drive*). Finally, on Novel trials, a novel noun was presented with an informative verb (e.g., “You can *eat* the dax”). Note that on Novel trials, because both the target and another distractor object were novel, the *only* way for children to succeed was to use the informative verb to identify which novel object was the appropriate referent. This provides an especially stringent test of children’s use of sentential context when learning new words in unfamiliar-accented speech.

Finally, caregivers completed the Developmental Vocabulary Assessment for Parents (Libertus et al., 2015) and a questionnaire assessing which accent(s) (e.g., U.S. Midwestern accent; U.S. Southern accent, French-accented English) the child was primarily exposed to (Supplementary Materials). Most caregivers (87%) completed the questionnaires.

2.4 | Analysis

2.4.1 | Coding

For each child, visual attention was coded manually at 30 frames/s (Datavyu Team, 2014). Trials were excluded from subsequent analysis if the child looked to the items for less than 1 s (of 5 s) after language onset. This occurred rarely, on <1% of all trials and did not differ across conditions ($p = 0.2$).

To calculate intercoder reliability, we adopted Arredondo et al.’s (2022) two-step calculation. First, we selected 16 participant videos varying in coding difficulty, asking five trained coders to code each video independently. Intercoder agreement was excellent, Fleiss’ kappa = 0.82, $p < 0.0001$. Next, to confirm these coders’ reliability on the broader dataset, we randomly selected videos from six additional children (yielding a total of 216 trials). These were each coded by a different pair of coders. The final inter-coder agreement was near perfect, Cohen’s kappa range = 0.86–0.95, all $ps < 0.0001$.

2.4.2 | Data preparation

Data preparation and analysis were conducted in R (R Core Team, 2021).

Accuracy

Following prior literature, we focused on children’s aggregate looking to the target from verb onset (approximately 700 ms post-sentence-onset) until the end of the trial (5000 ms post-sentence-onset) (cf. Ferguson et al., 2014; Waxman et al., 2009). This provided sufficient time for children to identify the target even if their processing was delayed in one condition or trial type. We calculated, for each child and trial, the mean proportion of looking to the target (total duration looking to the target divided by total duration looking to all items) after verb onset. We also calculated the mean proportion of looking to the novel distractor relative to the familiar distractors (total duration looking to the novel distractor divided by total duration looking to all three distractors). Because these calculations yield bounded proportions, the proportions were arcsine-square-root transformed for analysis with



linear models. For ease of interpretation, we report figures and means for untransformed data.

Reaction time

To assess children's processing efficiency, we calculated the speed with which they shifted their visual attention from a distractor to the target. For this calculation, we identified the point at which the linguistic information provided sufficient information to identify the noun's referent. On Neutral trials, this was the onset of the noun; on Informative and Novel trials, it was the onset of the verb. Following prior work, we excluded from this analysis trials in which children were already looking at the target at verb onset or shifted from a distractor to the target in under the 231 ms required to initiate a switch in response to the word (Swingle et al., 1999). After these exclusions, 51% of trials were available for analysis. At this point, we excluded trials more than 2.5 SDs from the mean for that trial type (3% of remaining trials) and any child who contributed fewer than three trials (of 12) of each trial type (12% of remaining trials). Reaction times were analyzed as raw values; analyses using log-transformed values yielded an identical pattern of effects. In total, the reaction time analyses included data from 67 (of 86) children (Familiar-Accent: $n = 30$; Unfamiliar-Accent: $n = 37$), each contributing an average of 17 trials.

3 | RESULTS

Our analyses assessed the impact of unfamiliar-accented speech on 4-year-old children's (1) identification of the referents of known nouns, (2) use of known verbs to identify the referents of known nouns, and (3) use of known verbs to infer the referents of novel nouns. We examined each question using linear mixed effects models. The R packages lme4 and lmerTest were used for model fitting and significance testing (respectively, Bates et al., 2015; Kuznetsova et al., 2017). All fixed effects were deviation-coded (i.e., with levels coded as 0.5 or -0.5). Preliminary analyses showed no effect of age, gender, trial number, or vocabulary on any of our dependent variables, all $ps > 0.5$.

3.1 | How successfully do children identify the referent of known nouns?

To address this, we focused on Neutral trials. As predicted, children in both accent conditions successfully identified the target on Neutral trials, looking to the target at levels exceeding chance (0.25) in both the Familiar-Accent ($M = 0.56$, $SD = 0.12$, $t(39) = 15.33$, $p < 0.0001$) and Unfamiliar-Accent conditions ($M = 0.51$, $SD = 0.09$, $t(45) = 20.79$, $p < 0.0001$). A mixed-effects model predicting children's performance with a fixed effect of Accent and random intercepts for participant and target item showed children in the Familiar-Accent condition looked longer to the target than children in the Unfamiliar-Accent condition, $\beta = 0.059$, $SE = 0.02$, $p = 0.018$ (Figure 2). Thus, the unfamiliar accent did affect children's processing of familiar words. To assess whether this was because children interpreted unfamiliar-accented

words as novel, we then calculated children's mean proportion of looking to the novel distractor, relative to the two familiar distractors. Children's looking to the novel distractor did not differ as a function of Accent, $\beta = 0.02$, $SE = 0.04$, $p = 0.58$. This outcome, which differs from Creel (2012), indicates that when 4-year-olds hear known words in unfamiliar-accented speech, they spontaneously recognize them—albeit with some additional processing cost—and do not interpret them as novel words.

3.2 | Do children use known verbs to identify the referents of known nouns?

To address this question, we compared performance on Neutral and Informative trials, predicting children in both accent conditions would be more accurate and efficient on Informative than Neutral trials.

3.2.1 | Accuracy

A mixed-effects model, with fixed effects of Accent and Trial type, by-participant random slope of trial type, and random intercepts of participants and target items, revealed a main effect of Accent, $\beta = 0.06$, $SE = 0.02$, $p = 0.024$, and Trial type, $\beta = 0.08$, $SE = 0.01$, $p < 0.001$. There was no interaction, $\beta = 0.003$, $SE = 0.03$, $p = 0.88$. In both Accent conditions, then, children looked at the target significantly more on Informative than Neutral trials, successfully leveraging the familiar verb (Figure 2).

We then examined children's looking to the novel distractor, as opposed to the familiar distractors, as a function of accent and sentential context. We submitted this preference to a mixed-effects model with fixed effects of Accent, Trial type, and their interaction; random intercepts for target item and participant; and trial-type-by-participant random slopes. A main effect of Trial type, $\beta = -0.10$, $SE = 0.03$, $p = 0.0007$, revealed that children were more likely to look at the novel distractor on Neutral ($M = 0.54$, $SD = 0.12$) than Informative trials ($M = 0.48$, $SD = 0.15$). This suggests that they used the informative sentential context to correctly reject the novel distractor. Moreover, this effect was robust across accents: there was no main effect of Accent, $\beta = -0.02$, $SE = 0.03$, $p = 0.51$, or interaction, $\beta = -0.001$, $SE = 0.06$, $p = 0.98$.

3.2.2 | Reaction time

To measure the processing cost of listening to unfamiliar-accented speech, we submitted children's reaction time (i.e., how quickly they looked to the target after the onset of the disambiguating word) to a model with fixed effects of Accent and Trial type, trial-type-by-participant random slopes, and random intercepts for participants and target items. This analysis revealed a significant effect of Accent, $\beta = -173.4$, $SE = 41.2$, $p < 0.0001$, an effect of Trial type approaching significance, $\beta = 72.5$, $SE = 37.3$, $p = 0.052$, and an Accent x Trial type

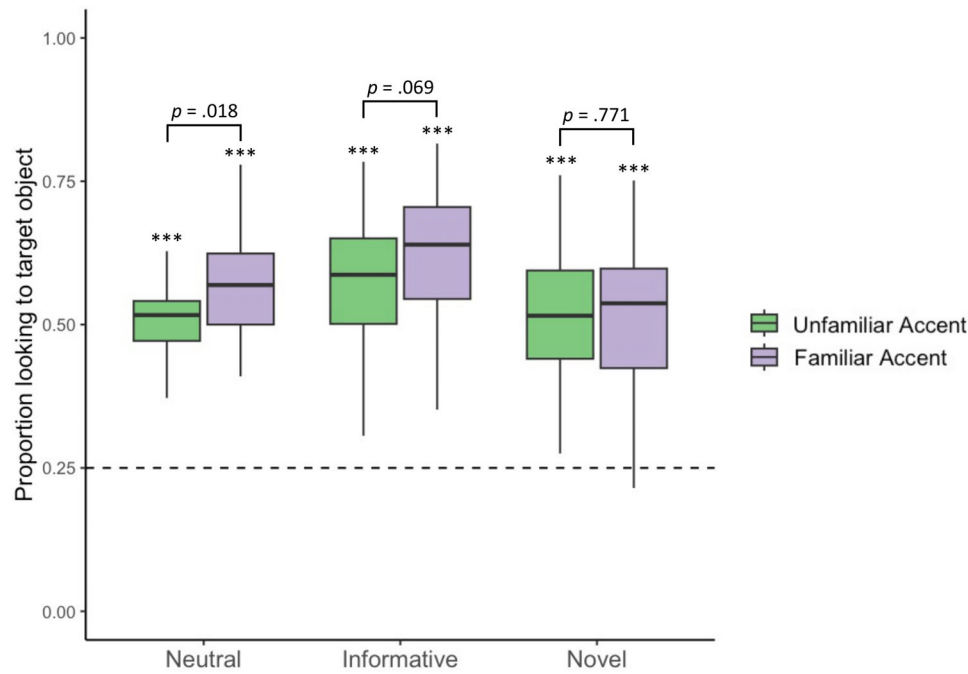


FIGURE 2 Aggregate proportion of looking to the target after verb onset for each trial type in Unfamiliar- and Familiar-Accent conditions. On all trial types, looking to the target was significantly above chance (0.25), $p < 0.0001$. Horizontal lines indicate median values. Vertical lines represent range of values.

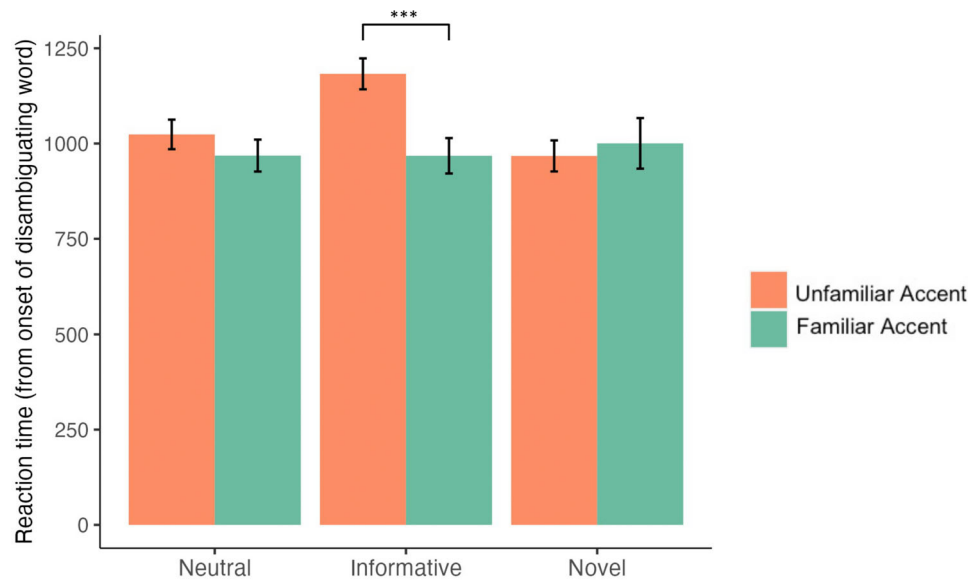


FIGURE 3 Average reaction time (from onset of disambiguating word) for gaze shifts from a distractor to the target. On Neutral trials, reaction time is calculated after noun onset. On Informative and Novel trials, reaction time is calculated after verb onset. On Informative trials, gaze shifts to the target were slower in the Unfamiliar-Accent than the Familiar-Accent condition, $p = 0.001$.

interaction, $\beta = -164.9$, $SE = 74.5$, $p = 0.027$. Bonferroni-adjusted pairwise comparisons revealed that performance in the two accent conditions differed on Informative trials, $t(61) = 4.48$, $p < 0.001$, but not Neutral trials, $p = 0.60$ (Figure 3). More specifically, on Informative trials, children in the Unfamiliar-Accent condition shifted more slowly

to the target ($M = 1183$ ms, $SD = 247$ ms) than did children in the Familiar-Accent condition ($M = 968$ ms, $SD = 255$ ms). This suggests that children reliably use the surrounding sentential context to identify the referent but are slower to do so when listening to unfamiliar- than familiar-accented speech.

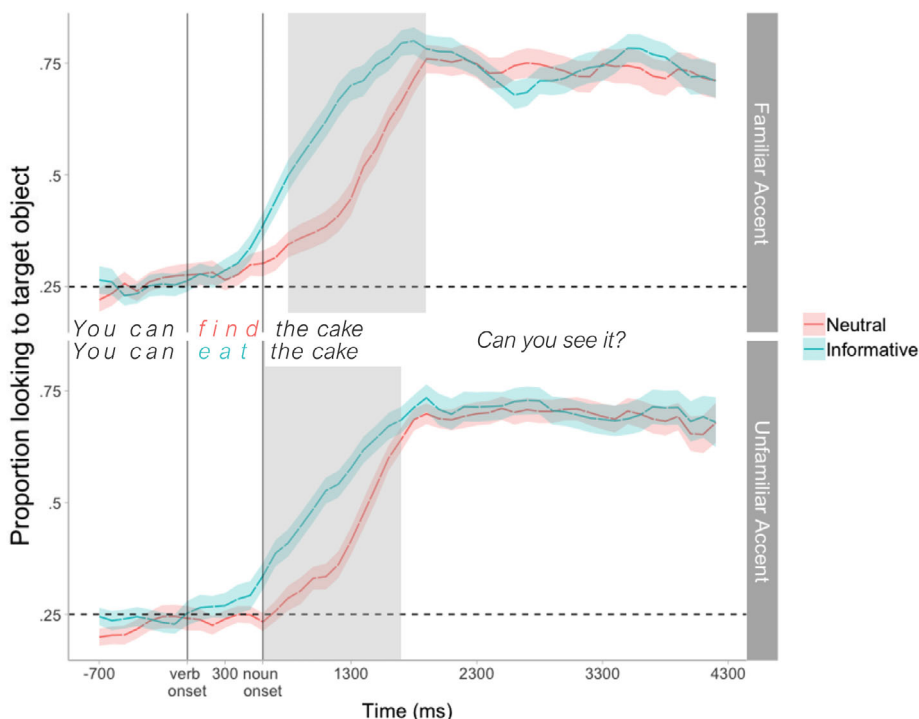


FIGURE 4 Timecourse data of looking to target in Familiar- and Unfamiliar-Accent conditions. Differences between Neutral and Informative trials emerged between 800 to 1900 ms and 600 to 1700 ms in Familiar-Accent and Unfamiliar-Accent conditions, respectively, as indicated by the gray-shaded regions. Colored shaded regions represent SEM for each trial type.

3.2.3 | Timecourse

To assess whether, and when, children’s looking to the target diverged between Neutral and Informative trials (Figure 4), we first calculated the aggregate proportion of looking to the target as a function of time, using 100 ms time-bins. We submitted this data to cluster-based permutation analyses (Maris & Oostenveld, 2007) using the eyetrackingR package (Forbes et al., 2021) to compare performance across trial types. For this, we conducted t-tests within each time-bin and summed the t-statistics of adjacent bins showing significant ($\alpha = 0.05$) effects to quantify the size of divergences. To assess whether these divergences were significantly larger than expected by chance, we then compared these divergences against a chance-based distribution, created by selecting the largest divergences from each of 1000 simulations in which trial type labels were randomly shuffled.

As predicted, children in both conditions benefited from sentential context, looking to the target earlier when the known noun was preceded by an informative verb than a neutral verb (Figure 4). For children in the Familiar-Accent condition, performance on Informative and Neutral trials diverged significantly from 800 to 1900 ms post-verb-onset, $t_{cumulative} = 40.55, p = 0.001$. For children in the Unfamiliar-Accent condition, performance diverged significantly from 600 to 1700 ms post-verb-onset, $t_{cumulative} = 36.79, p = 0.003$. This indicates that children listening to unfamiliar-accented speech rapidly use informative verbs to predict the referents of upcoming nouns, just as they do in familiar-accented speech (Ferguson et al., 2014, 2018; Fernald et al., 2008).

3.3 | Do children use known verbs to identify the referents of novel nouns?

On Novel trials, we predicted children would successfully identify the referent of a novel noun in both accent conditions but would be more accurate and efficient in the Familiar-Accent than Unfamiliar-Accent condition. As predicted, looking to the target after verb onset was significantly above chance (0.25) for children in both the Familiar-Accent, $M = 0.51, SD = 0.15, t(39) = 10.96, p < 0.0001$, and Unfamiliar-Accent conditions, $M = 0.51, SD = 0.11, t(45) = 16.48, p < 0.0001$. A mixed effects model, using a fixed effect of Accent and random intercepts for participants and target items, revealed no difference between conditions in either accuracy, $\beta = 0.01, SE = 0.03, p = 0.77$, or reaction time, $\beta = -10.19, SE = 58.62, p = 0.86$. Thus, children successfully recruited the verbs they know to infer the meanings of novel nouns, regardless of accent familiarity².

3.4 | Does children’s exposure to accent variability affect their performance?

Finally, we considered whether children’s prior exposure to accents affected their performance on this task. Based on caregivers’ responses on the accent exposure questionnaire, we identified two groups of children: those whose input included only a single accent ($n = 23$) and those whose input regularly included multiple accents ($n = 52$). We compared performance in these two groups on accuracy and



reaction time, using linear mixed-effects models with fixed effects of Accent condition and Accent exposure group, and random intercepts for participants and target items. For accuracy, there was no effect of Accent condition, Accent exposure, or their interaction, $p_s > 0.3$. For reaction time, there was a significant effect of Accent condition, $\beta = -142.14$, $SE = 45.05$, $p = 0.003$, but no effect of Accent exposure or an interaction, $p_s > 0.15$. Although reaction times were numerically faster in the multiple-accent than single-accent exposure group ($M = 992$ ms vs. $M = 1091$ ms, respectively), this difference was not significant, $\beta = -90.86$, $SE = 64.34$, $p = 0.16$. In a subsequent analysis, we focused on children's accent exposure using a different metric, comparing children whose exposure to English comes exclusively from native speakers of English ($n = 48$; including, e.g., English produced in a British, Texan or other native English accents) versus children whose exposure to English also comes from non-native English speakers ($n = 27$; including, e.g., English produced in French, Cantonese, or other non-native English accents). This analysis yielded no main effects or interactions for either accuracy or reaction time, $p_s > 0.39$. Thus, we find no evidence that children's own exposure to accent variability exerts a significant effect on their performance in the current task.

4 | DISCUSSION

Preschool-aged children successfully processed unfamiliar-accented speech in real time, recruiting the same sentence processing strategies as they do in processing familiar-accented speech. More specifically, we demonstrate that when processing unfamiliar-accented speech, 4-year-old children successfully (1) identified the referent of a known word, rejecting a novel candidate referent, (2) used sentential context to predict the referent of upcoming known words, and (3) used sentential context to infer the referent of a novel word.

Overall, the processing costs for unfamiliar-accented speech were limited but consistent. When identifying the referents of known words on Neutral and Informative trials, children listening to unfamiliar-accented English devoted a smaller proportion of looking time to the target referent than those listening to familiar-accented English. This difference was small, but statistically significant, emerging within the first 2000 ms after word onset. Processing costs were also evident in reaction times: children in the Unfamiliar-Accent condition were significantly slower than those in the Familiar-Accent condition to use informative verbs to predict upcoming noun referents, though there was no difference in their speed to identify the referents of known nouns. There are two possible interpretations of these effects. Perhaps it is more difficult for children to make predictive semantic inferences when listening to unfamiliar, than familiar, accents. Alternatively, perhaps the particular verbs in the current experiment were somehow especially challenging for children to parse in the unfamiliar accent. Notice, however, that children's performance on Novel trials, which used these same verbs, showed no difference between accent conditions in either accuracy or reaction time. Future work may adjudicate between these interpretations by testing a broader set of verbs and

nouns, as well as examining children's retention of the novel words and tracing the development of these effects in younger children.

Children's success in the Unfamiliar-Accent condition may stem from at least two sources—both of which take advantage of the pervasive and regular patterns of variation in accents. First, children's success may reflect rapid adaptation: while performance did not significantly improve over the course of the experiment, it is possible that even a few sentences were sufficient for children to adapt to the unfamiliar accent (Cooper et al., 2022; Schmale et al., 2012; van Heugten & Johnson, 2014). Second, children's success may reflect our decision to present children with entire sentences, rather than isolated words, in unfamiliar-accented speech. Recall that Creel (2012), who presented children with a single known word produced in a non-canonical way (e.g., “feesh”) within a sentence that was otherwise canonically pronounced, reported that children were more likely to select the novel item as the referent for non-canonically pronounced words than canonically-pronounced ones. A similar pattern emerged for children's visual fixations on neutral verb trials. However, in the current experiment, we document that when a non-canonical pronunciation of a known word is embedded in a full sentence produced in unfamiliar-accented speech, children showed no such tendency, even when the preceding verb is not informative. Instead, their looking time indicated that they reliably identified the referents of unfamiliar-accented words. This outcome converges well with prior evidence that children's fixations to novel distractor items do not differ as a function of accent familiarity when target words are presented in full sentences consistently produced in a real accent (Creel et al., 2016).

These findings lend additional strength to the importance of distinguishing between mispronunciations and accents (van Heugten et al., 2018): accents are more predictable and feature a more consistent pattern of deviation in pronunciation than single-word mispronunciations. Indeed, children benefit from this predictability (real accents: Schmale et al., 2012; van Heugten & Johnson, 2014; pseudo-accents: Von Holzen et al., 2023; White & Aslin, 2011). In addition, a speaker's accent carries social meaning, but we are aware of no evidence that mispronunciations do the same (Hwang & Markson, 2018; for a review Kinzler et al., 2007). Indeed, 4-year-olds make inferences about a speaker's social group membership from their accent (Weatherhead & Werker, 2022; Weatherhead & White, 2021).

The current findings also open new areas for future investigation. It will be important to specify how children's prowess in processing new accents is influenced by factors including their own prior exposure to other accents and the psychoacoustic distance between their native accent and the new accent. Although there is evidence suggesting exposure to multiple accents supports word recognition and word learning in unfamiliar-accented speech (children exposed in their daily lives to more than one dialect of a language: Kartushina et al., 2021; van der Feest & Johnson, 2016, children exposed briefly to a new accent in an experimental session: Potter & Saffran, 2017; Schmale et al., 2012, 2015), here we find no reliable benefit for children who had previously been exposed to multiple accents. Evidence from larger samples, using more precise measures of accent variability, is required to address these questions.

In conclusion, 4-year-old children—even those with little exposure to accents other than their own—are impressively flexible in processing and learning from unfamiliar-accented speech. Moreover, the sentence processing strategies that support children's comprehension and word learning in their native accent remain available to them when they interact with speakers whose accents differ from their own.

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CONFLICT OF INTEREST STATEMENT

The authors have declared no conflict of interest.

DATA AVAILABILITY STATEMENT

Deidentified data, analysis code, and study materials are openly available in Open Science Framework (OSF) at <http://osf.io/myhsn>.

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ENDNOTES

¹We acknowledge that there can be no objectively standard accent for any language and recognize the systemic issues inherent in language standardization. Therefore, we use the notation “Standard American English” to describe an accent we expected to be familiar to our participants (Lippi-Green, 2012).

²This effect remains even if we exclude the few novel trials for which a child was reported to know the name of the target.

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