Comparing off- and on-line measures of AAE- and SAE-speaking children's comprehension of SAE tense

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Recent methodological advances have made it possible to investigate how children process language and arrive at sentence-level meaning on-line. For example, eye-tracking enables analysis of how individual words and morphemes are interpreted during comprehension. This allows results from traditional off-line measures to be integrated with on-line measures leading to a more complete understanding of how language processing operates.

The data presented here are drawn from a larger project investigating how speakers of African American English (AAE) comprehend Standard American English (SAE), the standard variety of English used in the US. Although the two varieties share many phonological forms, the grammars differ substantially. For example, SAE 3rd person singular present -s, future contracted 'l, and past allomorphs -t/-d do not regularly appear in the surface form of AAE. This, among other evidence, suggests that while these morphemes carry tense information in SAE, they may not in AAE. An important question therefore becomes how speakers of different varieties of English utilize SAE tense morphology during comprehension. The present study investigates how 1st and 2nd grade AAE- and SAE-speakers interpret SAE morphology during comprehension using off-line and on-line measures.

For the off-line measure, participants are asked to select one picture from a set that best matches a spoken SAE sentence. Some sentences contain explicit temporal words (e.g., yesterday), but in others, SAE morphology provides the only temporal information. The data show that when correct picture identification requires an understanding of SAE tense morphology, both 1st and 2nd grade AAE-speakers show lower comprehension scores than 1st and 2nd grade SAE-speakers. However, this general pattern is modulated by the particular SAE element tested: AAE-speakers show lower comprehension for -ed and 'l, but not present -s. Interestingly, for -s, 1st grade SAE-speakers also show chance performance, whereas 2nd grade SAE-speakers show higher comprehension, suggesting that an understanding of present –s is developing during this time for SAE-speakers.

The off-line measure shows global comprehension patterns that accord with differences in the morphological systems of the children's native language varieties. However, it does not tell us whether both groups of speakers are noticing the same information but are using it in different ways. For example, the off-line data suggests that AAE-speakers either (1) do not notice SAE tense marking during comprehension, or (2) notice SAE tense marking but are unsure of how to utilize it during comprehension, possibly showing slowed processing. In contrast, SAE-speakers are expected to utilize SAE tense marking during comprehension. In order to address this question, data from on-line measures are required.

For the on-line measure, participants are presented with the same stimuli but are eye-tracked during comprehension and picture selection. Preliminary data show that 1st and 2nd grade SAE-speakers interpret certain SAE tense morphemes correctly (i.e., past tense –ed), and utilize this information to rapidly select appropriate pictures and arrive at sentence-level meaning. Data collection for AAE-speakers has just begun and will provide information about how SAE morphological elements are interpreted on-line, and are used to arrive at sentence-level meaning.

Sound and language discrimination studies in early development:
Do visual fixation measures reflect processing differences between preterm and full term infants?

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Behavioural measures of attention towards auditory material of different level of complexity (single word-form stimuli or three-sentence passages) have been obtained in a sample of preterm infants (gestational age <32 weeks and birth weight <1,500g, with no congenital, physical or severe neurological anomalies) and a control group of full-terms, by 4 and 6 months of age (corrected age for preterms). Infants are participants in a broader prospective study of speech perception/discrimination abilities and lexical development over the first two years of life. Although differences between full term and preterm infants in attention, recognition memory and processing speed for visual stimuli have already been shown (Rose et al., 2001; 2002; Lawson & Ruff, 2004), data regarding possible differences in speech and language perception abilities in the first year of life are still scarce. This is a relevant area of research since language development is likely to be compromised in children born preterm with very low birth weight (Jansson-Versakalo, et al., 2004).

Speech sound discrimination and native versus non-native language differentiation have been assessed through the familiarization-preference procedure. This paradigm includes an extended familiarization phase, with presentation of the auditory stimuli contingent on infants' looking behavior and a test phase in which listening times to contrastive materials are monitored. Familiarization in this paradigm was fixed up to two minutes. A decline in attention was expected to happen during the second minute of repeated exposure to the familiarized material, as an indication that processing of the stimuli has been completed. Groups of preterm and full term infants were compared on both attention time during familiarization phase (processing) and attention time to same and switch test trials (discrimination) in three different experiments: /o/-/u/ and /s/-/f/ discrimination in non-words and native versus non-native language differentiation.

Preliminary results from the younger groups tested for vowel discrimination reveal significant differences in attention time during the familiarization phase and in the ability to perceive a vowel change in the test phase. Attention time decrement during familiarization phase is non-significant in the preterm group. Vowel discrimination in the test phase is not achieved. By 6 months of age, however, differences in attention time during the familiarization phase have disappeared and, when tested for fricative sound discrimination, similar results have been observed in both groups of infants (although no evidence of novelty reaction to a fricative sound change [s-f] in the test phase has been obtained so far). As for language discrimination abilities at 6 months of age, a significant difference between groups has been found, with full-terms showing shorter attention time throughout the whole test. However, both groups are able to differentiate native versus no-native language utterances and they do not differ in number of trials in the familiarization, nor in the amount of decrement in fixation time between first and last trials in that phase. The connection between processing time monitored during familiarization and discrimination outcomes in the test will be further discussed. Medical and cognitive factors for the at-risk population under study will also be considered.

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Mouse-tracking the visual world can illuminate syntactic processing in young to very young children

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Recently, studies of online syntactic processing in young children have been made possible by monitoring eye-movements in relation to real scenes. Although eye-tracking children has provided invaluable child-performance data, the technique can be expensive, it can involve slow hand-coding of data, and can sometimes be perceived as objectionable by parents.

As a supplement to eye-tracking, we demonstrate here that monitoring the continuous nonlinear trajectories recorded from the streaming x,y coordinates of computer-mouse movements can serve as an informative indicator of the cognitive processes underlying children's syntactic processing. In contrast to self-paced reading data, which affords ~2 data points (RTs) per second, and to eye-movement data, which allows for approximately 2-4 data points (saccades) per second, "mouse-tracking" yields somewhere between 30-60 data points per second, depending on sampling rate.

Since arm movements are relatively continuous and can be smoothly redirected mid-flight, mouse-movements can be used as a potential index of the activation (or attractor-strength) of alternative interpretations during spoken language comprehension (Spivey et al., 2005).

Mouse-tracking is a viable method for examining on-line language processing in a wide-array of cognitive tasks and across a relatively large age-range. Through a large-scale survey of children's computer use, Calvert et al. (2005) found that the mean age of the onset of autonomous computer use was 3.7 years. Moreover, the mean age at which a child was able to point and click a computer mouse was 3.5 years, suggesting that experiments employing the mouse-tracking procedure could be feasible with children as young as 3-and-a-half to four years.

In the current experiment, we utilize the continuous nature of mouse-tracking to explore five-year-old children's sentence processing abilities in the visual world paradigm (Spivey, et al., 2002; Tanenhaus et al., 1995).

(1a) Put the apple on the towel in the box.

(1b) Put the apple that's on the towel in the box.

Children heard either an ambiguous (1a) or unambiguous (1b) spoken command while viewing a display that contained either one referent (e.g. one apple) or two referents (e.g. two apples). In the critical instructions, the object to be moved (e.g. the apple) always appeared in the top-left portion of the screen and the correct destination (e.g. the box) always appeared in the bottom-right. Streaming x,y coordinates, sampled at ~ 36 Hz, were recorded during the movement of the referent to its destination. A wide variety of filler objects and movement directions were included to prevent anticipatory movements.

Results indicate that children as young as five can not only complete the task, but can even produce smooth and interpretable trajectories exhibiting spatiotemproal properties comparable to those of adults. Findings are interpreted with respect to theoretical claims regarding integrated use of visual context and verb structure preferences to resolve syntactic ambiguity (Snedeker & Trueswell, 2004).

We observe here that streaming x, y coordinates of goal-directed hand movement recorded via mouse-tracking provide information that can supplement data gathered through eye-tracking experiments. Notably, this technique can be used with very young children and in a wide-array of situations and locations, either by itself or in conjunction with eye-tracking methods.

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Auditory phonological priming effects during word repetition by children and adults

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Findings on spoken word recognition in adults suggest that when a word is heard, not only are memory representations of the word itself and its constituent phonemes/sublexical units activated, but also, to lesser extent, representations of similar-sounding words and their constituent parts. These different activations appear to interact with each other in complex ways. Additionally, this activity persists for some non-negligible amount of time and can influence the way new incoming speech information is processed.

In the present study, 30 children (ages 7-11 years) and 20 adults, all with normal hearing and typical language, were presented with recorded pairs of familiar CVC words. The offset of the first word and the onset of the second word were separated by 50 ms of silence. The children were instructed to ignore the first word (the prime) and to repeat the 2nd word (the target) as soon as they knew what the word was. The time taken to initiate repetition was measured. Three conditions were tested. In one condition the word pairs shared no phonemes. In another, the words rhymed. Under a third condition, the word was repeated. In this 'repeated word' condition, because our interest was in phonological, not acoustically-based priming, two different recorded instances of the word were used.

As in previous studies, reaction times were measured from the onset of the target word and each target word was tested under all three experimental conditions. Inter-stimulus intervals of 50 ms pose no difficulty to individual word identification, are brief enough to discourage strategic processing, and have been the most widely used delay in previous research on short-term phonological priming.

Both groups, on average, produced targets preceded by a rhyme or repetition reliably faster than targets preceded by a dissimilar-sounding word. These results replicate previous findings in the adult literature, although no study that we are aware of has examined these effects in children, nor included both a repetition prime and a rhyme prime condition in the same study. Reaction times in the rhyme and repetition conditions did not differ reliably from each other in either group. The size of the priming effect was larger in children than in adults, both in terms of absolute value and also when analyzed as a proportion of the average total response time.

One issue raised by these data is how use of a repeated stimulus token in past studies may have influenced results, specifically the degree to which acoustically-based representations might have enhanced faciliatory effects. An additional experiment therefore addressed the issue of whether acoustic-level equivalence is necessary to elicit reliably greater facilitation in a repetition condition than in a rhyme-prime condition. In the absence of acoustic equivalence, we hypothesize that only phonological overlap in rhyme drives the facilitation effect in both repetition and rhyme prime conditions. That is, we argue that initial segment overlap in the repetition condition did not contribute to the faciliatory effect observed in our first experiment. Data from a new sample of normal-hearing children will be presented.

Comprehension of case marking and word order cues by German preschoolers

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Two key cross-linguistic cues are word-order and case-marking. Studies within the framework of the Competition Model have examined which cue speakers follow when the two conflict in identifying different noun phrases as e.g., agent. However, previous such studies with German children have used known verbs so that it is impossible to determine whether the use of such cues is based on abstract grammatical knowledge about the transitive construction (Lindner, 2003; Schaner-Wolles, 1989).

Therefore, we conducted a pointing comprehension experiment using novel verbs to examine whether German children are able to use these grammatical cues to interpret semantic roles and whether they weigh these two cues differently across development.

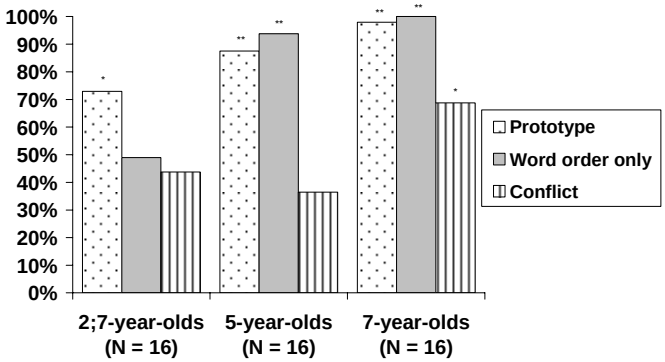
We tested 16 2;7-year-olds, 16 4;10-year-olds and 16 7;3-year-olds in three within-subjects conditions: The “prototype-condition” in which both case-marking and word-order refer to the first NP as agent (e.g., 'the(+NOM) dog is weefing the(+ACC) lion’), the “conflict-condition” in which word-order refers to the first NP as agent but case-marking to the second NP (e.g., ‘the(+ACC) bear is weefing the(+NOM) tiger’), and finally the “word-order-only-condition” in which case-marking is ambiguous, i.e., through use of feminine or neuter articles (e.g., ‘the(-CASE) sheep is weefing the(-CASE) horse’). During the test the children heard a pre-recorded linguistic stimulus: 'Look, the dog is weefing the lion' while watching two simultaneous scenes with the same action but reverse agent and patient roles. Afterwards the children were asked to point to the correct still picture (e.g., 'Show me: where did the dog weef the lion').

Our results show that by 2;7 German children can identify the agent of a novel verb when both word-order and case-marking collaborate in referring to it. Between 4-5-years of age the single word-order cue is sufficient for agent identification and reliance on word-order is stronger than on case-marking. However, only at around seven years can children weigh cues in relation to their reliability and appropriately resolve sentences with conflicting cues (see figure 1).

We compared our results to findings from a corpus study in which we investigated the use of these cues in the input (six German mothers; age of children: 1;8 and 2;5). In most of the transitive sentences (68%) both cues refer to the first noun as agent (subject-first order, marked with nominative). But 21% of the transitives in German CDS appear in object-first order, so that children have to rely on case-marking rather than on word-order to interpret semantic roles. The remaining 11% of the transitives in CDS show ambiguous case-marking for agent and patient and therefore children can only rely on word-order to find out that the first noun of the sentence is the agent. Cue validities calculated from this input data were found to be 86% for case-marking and 68% for word-order.

This comparison suggests that the order of acquisition is not entirely predictable from the input cue validity of single cues in isolation (Bates & MacWhinney, 1987). Rather, the important factor is whether available cues support each other or conflict with each other (McDonald, 1986).

Figure 1. Mean proportion of correct points to the target screen.



On-line resolution of pronominal anaphora in written discourse: A developmental approach in French

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The Centering Theory (Gordon et al. 1993; Walker et al. 1998) predicts a maximized local coherence when discourse is centered on the most salient entity: 1) continuing the grammatical subject is better than shifting to the object; 2) continuing with a pronoun is better than repeating a name. In English, Song & Fisher (2005) show that 3-year-old children interpret pronouns with this continued-subject bias. The present study tests these predictions in French children and adults, addressing the controversial question whether sentence process in discourse follows a continuous development.

The time course of the interpretation of anaphoric elements is examined in discourse transitions (continue and shift) with a reduced left context. A non-cumulative self-paced reading task is used in a moving-window condition. Reading times and answers to comprehension questions are analyzed. The general hypotheses for adults are: 1) a pronoun is easier to process than a repeated expression in the continue-condition; 2) the penalty of repeated names can be extended to non-repeated anaphoric NPs; 3) reading times are faster when no gender ambiguity occurs. We also predict that children are sensitive to the same factors, but are slower in reading. 50 children (10;6) selected on their reading ability and 25 adults participated in two experiments.

In experiment 1[1], pronouns and repeated first-names refer to entities of same or different gender. For adults, a repeated-name penalty is observed in the continue-condition ($F1(1\text{-}24)=7.09$; $p<.01$, $F2(1\text{-}46)=3.86$;$p<.05$), although it also occurs in the shift-condition ($F1(1\text{-}24)=5.14$;$p<.03$, $F2(1\text{-}46)=2.82$;$p<.09$). Processing utterances in the continue-condition is easier with names of different gender ($F1(1\text{-}24)=18.91$;$p<.0002$, $F2(1\text{-}46)=4.51$;$p<.03$). For children, the repeated-name penalty is only observed in the continue-condition ($F1(1\text{-}49)=3.98$;$p<.04$; $F2(1\text{-}46)=2.27$;$p<.1$) where reduced times are obtained with names of different gender ($F1(1\text{-}49)=4.68$;$p<.03$, $F2(1\text{-}46)=1.58$;$p<.2$).

Experiment 2[2] uses the same syntactic structure but without gender ambiguity. It manipulates the semantic relations between the antecedent and the anaphor. Pronouns (she) are compared to repeated nouns (the violinist), intermediate nouns (the musician) and basic nouns (the woman). The adults' reading times show that the repeated-name penalty can be extended to a repeated-definite-NP-penalty both in the continue-condition ($F1(1\text{-}24)=91.27$; $p<.00001$, $F2(1\text{-}23)=34.63$;$p<.00001$) and in the shift-condition ($F1(1\text{-}24)=25.52$;$p<.00001$, $F2(1\text{-}23)=10.92$;$p<.003$). The same extended repeated-penalty exists in children in the continue-condition ($F1(1\text{-}49)=65.25$;$p<.00001$, $F2(1\text{-}23)=11.74$;$p<.002$) and in the shift-condition ($F1(1\text{-}49)=32.33$;$p<.00001$, $F2(1\text{-}23)=11.88$;$p<.002$). Moreover, basic nouns are significantly easier to process than other NPs with children and adults in both conditions.

The expected repeated-name penalty is found in the continue-condition in French adults as well as in children. Nevertheless, our results do not support some hypotheses of the Centering Theory. The reduced left context is not sufficient to improve the salience of a unique entity, leading to a generalized repeated-noun penalty in adults (experiments 1&2) and in children (experiment 2). In the second experiment, we demonstrate that the first-name cannot represent the whole class of anaphoric expressions which have to be ranked according to their ability to refer to a salient entity: pronoun<basic noun<intermediate noun and repeated expression. Taken together, the results show continuity in the development of written sentence processing in discourse.

1. André - a cherché - Mario/Elisa - devant l'aéroport.
Il/André/Mario/Elle/Elisa - a posé - les valises - sur un chariot.
(André - picked up - Mario/Elisa - in front of the airport. He/André/Mario/She/Elisa - put - the cases - on a trolley.)

2. La violoniste - a rencontré - le gardien de but - à Paris.
Elle/ La violoniste/ La musicienne/ La femme - a parlé - de sport - avec difficulté.
(The violonist - met - the goalkeeper - in Paris. She/ The violonist/ The musician/ The woman - talked - about sports - with difficulty.)

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Reading in child and young-adult bilinguals: An fMRI study

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Previous work in our laboratory has found that Spanish-English bilingual children transition from Spanish dominance in early childhood to English dominance by early adolescence. In addition, neuroimaging studies with bilinguals have shown that language proficiency is an important modulator of neural activity. The purpose of the present study was to use functional magnetic resonance imaging (fMRI) to examine how language proficiency modulates neural activity in a group of child and adult bilinguals. Participants were shown words that were both low and high frequency in separate Spanish and English blocks. For adults the results revealed larger frequency effects in Spanish than in English. In Spanish, the less dominant language there was increased activity in the left and right thalamus and the left medial frontal gyrus for high frequency words. Low frequency words elicited increased activity in the right anterior cingulate gyrus and middle frontal gyrus. In English, high frequency words revealed increased activity in the left angular gyrus and the right occipital-temporal juncture at the midline. However, no areas revealed increased activity for low frequency words in English. Hence, adult bilinguals revealed larger frequency effects in Spanish the less dominant language than in English the more proficient language. Preliminary results from a group of 12-year-old Spanish-English bilinguals revealed important differences when compared to adults. Specifically, younger bilinguals revealed more activity in the frontal lobes in both languages for low frequency words. These results are consistent with the view that child bilinguals are more balanced in their proficiency profile during development. The results will be discussed with regard to current emergentist views of bilingual language development.

Children's understanding of "some":
Exploring real-time processing of semantic and pragmatic interpretations

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Understanding language not only involves identifying words and determining the structural relations between them, but also making pragmatic inferences that allow us to determine the speaker's intended meaning. This division between semantics and pragmatics raises the question of how these processes unfold over time. Does semantic processing always precede pragmatic enrichment or are interpretations of words guided by pragmatics from the moment they are encountered? We explored this question through a well understood test case of pragmatic enrichment, scalar implicature. Horn (1972) noted that scalar quantifiers like some have distinct readings that reflect these two interpretive levels. Semantically, some does not possess an upper-bound, making it compatible with the total quantity, thus I can say "I ate some, in fact all, of the candy." However typically, interpretations involve a pragmatic implicature which adds an upper-bound excluding the total set, thus "I ate some of the candy" usually implies "not all"

If children's acquisition of words and structures are initially guided by the understanding of speaker's intent (Tomasello, 1998), we might expect that children would be more inclined to interpret words pragmatically or might initially misinterpret the upper-bound as part of the word's meaning. In contrast, studies using explicit judgment tasks suggest that children are more literal than adults (Noveck, 2001; Papafragou & Musolino, 2003). We investigated the time-course of semantic and pragmatic processing by employing the visual-world eye-tracking paradigm. Adults and five-year-olds were presented with four characters: girl with two socks, boy with two socks, girl with three soccer balls and boy with none. During critical trials, participants were asked to select the target character, e.g. "Point to the girl that has some of the socks." These instructions were initially semantically ambiguous—in the absence of an implicature the sentence is consistent with both girls prior to the phonological disambiguation of the noun. However pragmatically, these instructions uniquely identify a target (girl with two socks) from the onset of the quantifier. During control trials, participants heard identical instructions using words with semantically specified upper-bounds (e.g. two, three, all). This comparison verifies whether interpretations of some parallel or diverge from cases where meanings are unambiguously determined.

We found that both adults and children preferred to look at the target that matched the quantifier after hearing two, three, and all, indicating early disambiguation via lexical semantics. However, upon hearing some, participants initially looked equally often at the girl with some socks and the girl with all the soccer balls, resulting in a significant difference between some and the other quantifiers ($p < .01$). Nevertheless, adult preference for the target on critical trials preceded phonological disambiguation of the noun, suggesting on-line calculation of pragmatic implicatures ($p < .05$). Children, in contrast, failed to disambiguate the target until well after the completion of the noun, demonstrating considerable reliance on lexical information ($p < .01$). These results demonstrate that both children and adult's initial interpretations of words are predominately guided by lexical semantics with limited application of even the most robust pragmatic inferences.

Cross-modal picture naming detects antecedent reactivation in children with low verbal memory span

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Introduction. Cross-modal lexical priming has been adapted to children by replacing lexical decisions with picture categorization tasks (Love & Swinney, 1997; McKee, Nicol, & McDaniel, 1993). However, such tasks place a heavy burden on children's processing resources. For example, (Roberts, Marinis, Felser, & Clahsen, 2004), using this method, observed antecedent reactivation only in participants with high verbal working memory. To address this issue, we modified the task by using picture-naming instead of picture categorization. Naming is fast, effortless and natural for children, and should require less working memory resources during divided attention tasks.

Method. 20 typically developing children (half boys, mean age 9.2, range 8-11) participated in an antecedent reactivation experiment. Design and sentence materials were adapted from (Love & Swinney, 1997), with pictures from (Rossion & Pourtois, 2001; Snodgrass & Vanderwart, 1980). Each auditorily presented sentence was matched to a primed picture and a control picture in either a control position or a gap position:

"The bear that the gorilla in the mist [BEAR/TIGER] had scared [BEAR/TIGER] by accident went swimming in the pool."

Pictures were presented for a maximum of 2 seconds. Naming latencies were recorded with voice key. After every experimental sentence, the child answered a comprehension question (asking "who did what to whom"). 128 sentences (mixed with fillers) were counterbalanced across four sessions.

Results. Trials with naming errors (10%) and 4 items with mean naming accuracy below 90% were removed, as well as fast outliers. We then removed trials with incorrect comprehension question answers, which left subjects with an average of 45% of the original trials. This resulted in the following cell means and standard deviations:

	Control pictures	Primed pictures
Control position	901 (134)	842 (127)
Gap position	914 (148)	784 (125)

In order to compare our results with (Roberts, Marinis, Felser, & Clahsen, 2004), we divided the subjects into a low and a high verbal working memory group on the basis of the group median score (2.5) from the Competing Language Task (Gaulin & Campbell, 1994). This placed 9 children (5 girls) in the low, and 11 children (5 girls) in the high verbal memory span group. Each subject's cell means were then computed and used as within-subject dependent measures in a 2 (Probe) x 2 (Position) mixed factorial repeated measures ANOVA, with memory span group as between-subjects factor. This resulted in a main effect of Probe ($F(1,18)=21.9$, $p<.001$), and an interaction Probe X Position ($F(1,18)=4.74$, $p=.043$; observed power: 0.54), such that the difference between primed and control probes were greater at the gap position. There were no main effects or interaction involving working memory group. Bonferroni-protected pairwise comparisons confirmed that the priming effect was significant at the gap but not control position in both groups (low memory span: $p < 0.015$; high memory span: $p < 0.039$.) We also performed an analysis where we included all correct naming trials but also trials with incorrect comprehension questions. In this case, we only observed a main effect of Probe (i.e., priming).

Dsicussion. First, cross-modal picture naming can be used as an alternative to binary categorization tasks for measuring antecedent reactivation during children's processing of filler-gap sentences. Second, it proved critical to use comprehension questions to filter out trials where subjects apparently did not pay attention to the sentence meaning. Third, and most importantly, whereas the cross-modal picture categorization task requires high verbal working memory span, the current method did not show any effect of differences in verbal memory span. Therefore, the method should also be applicable to populations with low verbal working memory span, such as children with Specific Language Impairment (Marton & Schwartz, 2003).

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Developmental gains in spoken word recognition by Latino children learning Spanish as their first language

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Studies using eye-tracking methods show that English-learning children make rapid gains in the speed and accuracy of online speech processing over the second year (Fernald et al.,1998, Zangl et al., 2005). In one version of this procedure, infants' eye movements are monitored as they look at pairs of pictures while listening to speech naming one of the pictures. Children approach adult-like levels in how quickly they shift to the correct picture, and older infants can initiate a response based on partial phonetic information (Swingley et al. 1999; Fernald, et al., 2001). Further, this ability is related to individual differences in lexical development, as indexed by parent report (MacArthur-Bates CDI). Longitudinal research has shown that English-learning infants who respond to spoken words more quickly and accurately at 24 months are those who had faster rates of vocabulary growth across the second (Fernald, Perfors, & Marchman, in press).

Here we extend this research on early online processing to a broader socio-economic spectrum of children from Latino families in which Spanish is the primary language. Experiment 1 evaluated 15-37-month-old Spanish-learners as they looked at pairs of pictures while listening to familiar object names (perro/bebé "doggie/baby," carro/globo "car/balloon," zapato/plátano "shoe/banana," and pelota/galleta "ball/cookie"). As with English-learners, Spanish-learners make substantial gains in the speed and efficiency of spoken language understanding over the 2nd and 3rd years as they are building a larger productive vocabulary.

Experiment 2 investigated sentence processing in Spanish. We explored whether 25- to 37-month-olds can use information from the verb to anticipate the noun. Adults use linguistic and contextual information to get a "head start" in interpreting what people are talking about (Altmann & Kamide, 1999); however, few studies have examined this ability in infants. Four objects (galleta (cookie), jugo (juice), libro (book), pelota (ball)) were presented in either a related (cómete la galleta "eat the cookie") or unrelated verb frame (dame la galleta "give me the cookie"). Children who were older and children with larger vocabularies were faster to look at the target picture in the related-verb condition, than in the unrelated-verb condition, indicating that they can use verb semantics to identify the noun referent in continuous speech.

These two studies revealed developmental increases in the efficiency of speech processing as Spanish-learning children get older and develop larger vocabularies, replicating and extending previous studies with English-learners. Given broad differences in the SES background of these Latino children as compared to English-learners, and the well-established relations between SES and language outcomes (Hoff, 2003; Hart & Risley, 1995), it is important to examine the influence of SES on the development of efficiency in speech processing. Indeed we found correlations between SES (via maternal education) and various processing measures, suggesting that environmental factors affect not only growth in productive vocabulary, but also the development of speed and accuracy in receptive language skills.

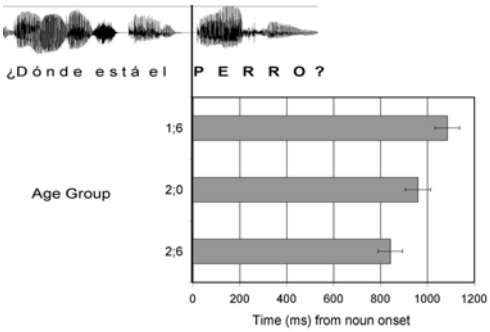

Figure 1. Mean reaction time (in ms) to initiate a shift in gaze from the distracter to the target picture as a function of age group (1;6, 2;0, 2.6); error bars represent SEs. The graph is aligned with an amplitude waveform of one of the stimulus sentences.

Children's and adults' processing of implausible and anomalous thematic relations during reading

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Research into on-line written language comprehension has tended to focus on adult populations, thereby overlooking the process of reading development itself. The present study aimed to investigate the earliest point at which plausibility information influenced children's as compared to adults' reading performance. Following Rayner, Warren, Juhasz & Liversedge's (2004) adult study, the eye movements of 24 children (aged 7-11) and 24 adults were monitored as they read sentences containing plausible, implausible, and anomalous thematic relations (see i -iii).

(i) The man used a pan to boil the thin spaghetti yesterday evening.

(ii) The man used a kettle to boil the thin spaghetti yesterday evening.

(iii) The man used a feather to tickle the thin spaghetti yesterday evening.

In the implausible condition (ii), the patient (spaghetti) was incongruous with the combination of the instrument (kettle) and the verb (tickle). In the anomalous condition (iii), the patient (spaghetti) was not a possible argument of the verb (tickle). In an off-line pre-screen experiment, 20 adults and 60 children reliably rated anomalous sentences as stranger than implausible sentences and implausible sentences as stranger than controls.

Following Rayner et al., we predicted that anomalous thematic violations would elicit more immediate disruption to processing than implausible thematic combinations, which in turn would produce more disruption than the control condition, in both adults and children. Critically, however, we anticipated that children would exhibit less immediate effects in the detection of thematic violations than adults, and that younger children (aged 7-9) would exhibit less immediate effects than older children (aged 10-11).

Results for the adult participants showed that readers were delayed in their detection of implausible compared with anomalous thematic relations, replicating the findings of Rayner et al. More importantly, results also showed that anomaly and implausibility detection in children was delayed relative to that observed for adults. Unlike adults, children did not detect anomalous thematic relations during first pass reading but re-reading times were longer in this condition than the other two conditions. While adults detected implausible thematic relations during second pass, children exhibited no reliable on-line effects of implausibility. Finally, disruption due to anomaly detection occurred later in the eye movement record for younger than older children.

These data show that while children do compute thematic relations, such processing is delayed relative to adults, indicating reduced immediacy in the relationship between oculomotor behaviour and linguistic (thematic) processing (both for children relative to adults, as well as younger compared to older children). The temporal lag between ongoing linguistic processing and overt eye movement behaviour in children as compared to adults may be due to delayed generation of an oculomotor interrupt signal. Alternatively, the delay may occur as a direct consequence of delayed thematic computation during sentence comprehension, that is, due to immaturity within the language comprehension mechanism. The dissociative effects observed in children for on and off-line methodologies suggest that children may require additional time to engage higher order cognitive processes necessary to develop a fully specified sentential representation and thereby an appreciation of subtle semantic distinctions.

Hough dou yu gnow wat tou sai?

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When a child encounters an unfamiliar word, what information is used to guide his/her pronunciation of this new word? Previous explorations of this question have produced mixed results. Some studies indicate that children use grapheme-to-phoneme correspondence (GPC) rules to “sound-out” unfamiliar words (Coltheart and Leahy, 1992). Others indicate that children will pronounce these new words in an analogous way to words they already know (Goswami, 1992). One downfall of these previous studies is that the methods and words used did not allow certainty in the method (GPC rules or analogy) that children used to pronounce the new words. The present experiment was designed to resolve this issue. Specifically, we examined the pronunciation patterns for nonwords that vary on rime unit consistency and regularity. We did this with nonwords with rime units which fall into 4 categories varying according to the regularity and consistency of their pronunciations. See Table 1, below, for descriptions of the nonword groups and examples of word neighbors (i.e., words that share the rime units of the nonwords). A previous study examining pronunciation patterns of adults indicates that the use of analogy-based versus GPC rule based pronunciations depends on the consistency and regularity of the nonword rime-units (Andrews & Scarratt, 1998). We extended this examination to children.

In the present experiment, children completed an intervention in which they learned the pronunciation, spelling, and meaning of words that are rime-unit neighbors to our target nonwords. In addition to the intervention, participants completed pre- and post-intervention tests in which their patterns of nonword pronunciations were measured along with their knowledge of the words in the intervention corpus. We performed this intervention along with pre- and post-intervention assessments to see if exposure to words that vary on rime-unit regularity and consistency may have an effect of the pronunciation method used by the young readers.

Our results indicate that the method (GPC rules vs. rime-unit analogy) used to pronounce nonwords depends on the regularity and consistency of the rime-units. Specifically, we found that GPC rules were used in the majority of the pronunciations. However, the frequency with which the GPC rules were used varied between the nonword groups. The nonwords from the irregular/consistent and the No Regular Analogy groups were pronounced according to the GPC rules the least often. Instead, these two groups of nonwords yielded analogy-based pronunciations more often than the other groups. Furthermore, we found that after exposure to these rime-unit neighbors, participants were more likely to use Analogy-based pronunciations for nonwords with irregular/consistent and No Regular Analogy rime units.

These findings suggest that the pronunciation of unfamiliar words largely depends on the pronunciation patterns of words that share the rime unit with the unknown word. We evaluate these findings according to current models of word recognition. Furthermore, we discuss how this paradigm can be expanded to examine additional methods of word learning. Finally, we discuss how these findings can be used by psychologists and educators in the development of reading instruction and interventions.

Table 1. Nonword groups.

Group	Nonword Example	Word Neighbors (regularity of rime)
Regular/Consistent	Pern	fern, stern (always regular)
Ambiguous	Heaf	deaf, leaf (1/2 regular, ½ irregular)
Irregular/Consistent	Choll	toll, poll, stroll, doll (most irregular)
No Regular Analogies	Moup	soup, group, coup (never regular)

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Emergence of the "mutual exclusivity" strategy for interpreting novel words: A longitudinal study of online processing from 14 to 18 months

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When young children see a familiar and a novel object (e.g. ball and whisk) and hear Which one's the dax?, they typically choose the whisk, as if assuming the novel word must refer to the novel object. Numerous studies using offline measures show this type of exclusionary learning, dubbed "mutual exclusivity (ME)" by Markman (1989). Although theorists disagree on how to interpret this (Merriman&Bowman,1989; Mervis&Bertrand,1994), the ME effect has been widely observed in children as young as 15 months (Markman, Wasow, Hansen,2003). Halberda (2003) used a preferential-looking method to ask whether even younger infants show an ME response when hearing a novel name. 14- to 17-month-old infants saw pictures of a car and a phototube and heard Where's the car? or Where's the dax? Halberda found that only 17-month-olds looked reliably at the novel object in response to dax; 16 month-olds were at chance, and 14-month-olds fixated the familiar image instead. This finding was interpreted as evidence that the ME strategy emerges around 17 months.

Our goal was to replicate Halberda's experiment using more sensitive online measures in a longitudinal design with additional controls, testing the same children at 14, 16, & 18 months (n=36). We also asked whether infants' use of an ME strategy was associated with more advanced lexical development. At each age, infants viewed two images of objects and heard sentences labeling one object on three trial types: 1) familiar target word doggie, with objects dog and car; 2) familiar word doggie, with dog and novel object; 3) novel word dax, with dog and novel object. Different novel objects and novel names were used at each age. While Halberda paired only one familiar object with the novel object, four familiar objects were used here as distracters, to eliminate possible item effects. Infants' eye movements were coded at 33-ms-resolution. When hearing a familiar target word, children at 14, 16 and 18 months reliably oriented to the correct object regardless of distracter, with mean RT decreasing with age. When hearing a novel target word, 16- and 18-month-olds oriented reliably to the novel object, but 14-month-olds overall failed to do so. However, when 14-month-olds were grouped by vocabulary size based on parental report, those infants reported to comprehend more words were more successful in mapping the novel label to the novel object. For 16- and 18-month-olds, those infants with more words in their productive vocabulary were also relatively more likely to seek out the novel object in response to the novel name. Consistent with previous research showing that children's speech processing efficiency is related to level of lexical development (Fernald, et al., 2006), these findings suggest that the emergence of the ME strategy varies with both age and vocabulary size.

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Cortical event-related potentials to speech sounds in 3- month old breast and formula-fed infants

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Breast feeding has been associated with higher scores for general cognitive development (Anderson et al., 1999), and it is known that some factors which promote central nervous system development and could benefit cognitive development are present in breast milk, but absent from or in lower concentration in formulas (e.g., sialylated oligosaccharides, nerve growth factor, thyroid-stimulating hormone ;Tram et al, 1997). Yet studies showing that infants can process and discriminate speech stimuli have not considered the influence of diet as an experimental variable.

To investigate the potential effects of infant diet on speech sound perception, cortical auditory evoked potentials to syllables were recorded (128 electrodes) from 3 month old infants exclusively breast fed (BF: n=59 , males=31), or fed milk (MF: n=64 , males=37) or soy (SF: n= 49, males = 23) formula since at least 2 months of age. Two syllables were presented in an oddball paradigm (/pa/, 80% and /ba/, 20%, duration: 300 ms, 72 dB, ISI: 2550 ms). This report focused on responses to the frequent syllable.

As previously described (Kurtzberg et al, 1989), two positive peaks were observed at ~200 ms (P1) and ~350 ms (P2) in response to our consonant-vowel syllable. These peaks have been associated, respectively, with processing of acoustic and phonemic stimulus features. Peak amplitudes and latencies were analyzed using ANCOVAs with group, gender, sites (frontal, central, and anterior temporal), and hemisphere as independent variables, and birth-weight, birth-length, gestation age, mom's IQ, and social economic status as covariates. These covariates have been identified as confounding variables in studies comparing behavioral correlates of breast and formula infant feeding (Anderson at al, 1999), and also significantly differed among the three diet groups in our study.

Both peak amplitudes were greater at central relative to temporal sites (ps ≤ .001), consistent with maturation occurring earlier in primary and later in secondary auditory cortex. Larger amplitudes were observed in females compared to males for P1 (p =.044) and P2 (p = .066), indicating the presence of gender differences in responses to auditory stimuli at this early age. Since responses to non-speech sounds were not studied, we cannot determine whether this difference reflects a female advantage in speech sound perception, and / or the presence of brain morphological differences noted in females, e.g., greater density of neurons in posterior temporal cortex (Witelson et al, 1995), or larger extent of neuronal processes (de Courten-Myers, 1999).

Diet-related group differences were present for both peak latencies. BF infants had a shorter P1 latency than the SF group ($p < .01$). For P2, longer latencies were found in BF compared to SF ($p = .05$), and in BF relative to MF females ($p < .05$). In keeping with the suggested advantages of breast feeding for cognitive development, the longer interval between the two peaks may support more extensive phoneme processing in the BF infants. The response similarities of the MF and SF groups suggest a general equivalence of these formula types on speech sound processing at this age. (Supported by USDA CRIS 6521-51000-004-01S)

School-aged children's sentence processing:
An investigation into the developmental characteristics of expectancy violation

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The current investigation examined school-aged children's ability to suppress contextually irrelevant information by comparing naming latencies (NLs) for different expectancy resolutions for high-cloze sentences in a real-time experiment. The aims were threefold: (a) to investigate the effect of a violation of a linguistic expectancy evoked through auditorily presented high-cloze sentences (>87%), (b) to determine developmental changes associated with such a violation and (c) to examine the temporal activation and attentional characteristics of priming for this expectancy violation by manipulating processing conditions, namely interstimulus interval (ISI) and expectancy proportion (EP).

Method: The current study involved 16 girls and 17 boys aged between 6;0 and 14;0 years (M= 9.65, SD= 2.18) without remarkable medical or developmental histories. The current sentential auditory word repetition experiment design consisted of one between-subjects factor, age band (participants divided into four groups according to age: 6-8, 8-10, 10-12 and 12-14 year olds) and two within-subject factors, processing mode (low EP/short ISI and high EP/long ISI), and prime level (expected, unexpected, semantically anomalous and neutral). The task required participants to listen to sentences (e.g., The chair has four legs [expected], parts [unexpected], games [anomalous]; You can now say the word house [neutral]) and repeat the cloze words signalled by a voice shift.

Results: The resulting NL data was analysed using Linear Mixed Model analysis and revealed significant main effects for age band, processing mode, and prime level, $p \leq .001$ (see Table 1). Also significant were two-way interactions of age band by prime level, F (12, 107) = 2.915, p = .002, and processing mode by prime level, F (4, 3073) = 24.662, $p < .000$. Significant priming occurred for both expected and unexpected sentences when compared to semantically anomalous sentences in each age band ($p \leq .011$). Suppression (anomalous versus neutral) was significant in the younger two age bands ($p \leq .002$), but non-significant in the older two age bands ($p > .229$). In contrast, enhancement for expected sentences (neutral versus expected) was only significant in the youngest and oldest age bands ($p \leq .015$). Furthermore, independent of age, the low EP/short ISI task evidenced only significant suppression ($p < .001$), whereas the high EP/long ISI task evidenced only significant enhancement (p = .005). In contrast to the high EP/long ISI task (p = 0.762), participants evidenced faster processing of sentences ending in expected cloze words as compared to unexpected cloze words (associative boost) in the low EP/short ISI task (p = 0.039).

Discussion: The expectancy violation was evident in the longer NLs for semantically anomalous versus expected cloze resolutions across all age bands. The source of the latency difference, however, varied with age: whereas younger children evidenced significant suppression, a facilitatory mechanism determined older children's processing. The presence of an associative boost for the low EP/short ISI task, but not the high EP/long ISI task irrespective of age, may reflect the temporal activation pattern of expected concepts and their semantically valid competitors.

Table 1. Mean naming latencies in ms (SE) for low EP/short ISI and high EP/long ISI experimental blocks as a function of prime level and age.

Age (yrs)	Low EP/ Short ISI				High EP/ Long ISI			
	Exp	Unexp	SA	N	Exp	Unexp	SA	N
6-8	291 (42)	343 (43)	448 (42)	301 (42)	354 (44)	417 (43)	485 (44)	411 (42)
8-10	217 (36)	253 (36)	341 (36)	233 (36)	282 (38)	285 (35)	368 (37)	301 (37)
10-12	128 (40)	177 (40)	226 (40)	137 (40)	217 (42)	185 (39)	241 (42)	244 (41)
12-14	65 (53)	115 (53)	163 (54)	90 (53)	81 (55)	88 (54)	219 (56)	168 (54)
MM	185 (20)	232 (20)	306 (20)	200 (20)	248 (21)	252 (20)	337 (21)	292 (20)

SE= Standard Error, EP= Expectancy Proportion, ISI= Interstimulus Interval, Exp= Expected, Unexp= Unexpected, SA= Semantically Anomalous, N= Neutral, MM= Marginal Means.

Response time of grammaticality judgments by adolescents

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Children with specific language impairment (SLI) are known to make grammatical errors by omitting tense and agreement morphology such as the third person singular present tense –s (3S) and past tense –ed (ED). However, they are not likely to produce ungrammatical sentences by using 3S and ED when these morphemes are not obligated. Children with SLI are also less sensitive to grammatically incorrect sentences in which 3S and ED are omitted, but correctly reject intrusions of the morphemes. As they develop, individuals with SLI perform better on production and grammaticality judgment. Still, residual deficits may remain that cannot be detected by accuracy measures. We used response time (RT) to assess the sensitivity of adolescents with SLI to omissions and intrusions of tense and nontense morphemes.

Adolescents aged 16 years participated. They received a diagnostic test battery and were assigned to categories: normal language development (NLD; n = 108); specific language impairment (SLI; n = 47), and nonspecific language impairment, i.e., below normal limits in both language and nonverbal IQ (NLI; n = 25)

Stimulus sentences were created using the nontense morphemes progressive –ing (ING) and possessive ‘s (POSS), and tense-carrying morphemes 3S and ED. For each morpheme, 12 sentences with obligatory contexts were created. In half of the sentences, the morpheme was missing. An additional 12 sentences for each tense morpheme were created, in which the morpheme was not obligated. In half of these sentences, the morpheme was used, creating an intrusion error. The sentences were presented over headphones. Participants were instructed to press one button on a response box for a “good” sentence and another for a “bad” sentence, as accurately and quickly as possible. We predicted that adolescents with SLI and NLI would be slower than the NLD group to correctly reject ungrammatical items involving tense, but would perform similarly to NLD peers on nontense items.

Inaccurate trials and outliers were removed for calculation of RTs. Three repeated-measures ANOVAs (for nontense, tense omission, and tense intrusion items) were conducted with alpha = .05. Each analysis included one between-subjects variable, group (NLD, SLI, NLI) and two within-subjects variables: morpheme (ING and POSS for nontense, 3S and ED for tense omission and intrusion) and presence (morpheme present or absent). For nontense and tense omission analyses, “present” items were grammatical and “absent” items ungrammatical. For the tense intrusion analysis, the reverse was true.

No significant main effect of group was found in any of the RT analyses. For nontense and tense omission items, group did not interact significantly with any other factors. For tense intrusion, there was a significant group by presence interaction, such that the SLI group was slower on present (ungrammatical) items than the NLD and NLI groups. The pattern of results suggests that adolescents with language impairment were not generally slower than typically developing peers in judging grammaticality. The RT measure did not detect special difficulty with correct rejection of sentences with tense omission, but did indicate that adolescents with SLI experienced difficulty with tense intrusions.

Examples

Nontense ING present: The wolf is howling at the moon tonight.
Nontense ING absent: The wolf is howl__ at the moon tonight.
Nontense POS present: During the storm the man’s boat was damaged.
Nontense POS absent: During the storm the man__ boat was damaged.
Tense 3S present: Every day he tells a joke at lunch.
Tense 3S absent: Every day he tell__ a joke at lunch.
Tense ED present: Sue dreamt that she kicked the soccer ball into the goal.
Tense ED present: Sue dreamt that she kick__ the soccer ball into the goal.
Tense intrusion 3S present: I want to help him builds his treehouse.
Tense intrusion 3S absent: I want to help him build his treehouse.
Tense intrusion ED present: It is impolite to stared at people at the mall.
Tense intrusion ED absent: It is impolite to stare at people at the mall.

Children's real-time discourse bridging: Acquiring a definiteness distinction

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The appropriate use of English definites is complex to master. We investigate the development of children's understanding of definite and indefinite descriptions in situations of discourse bridging. We examined their interpretation of whole-part bridges, where a discourse-novel part term is linked to a previously-mentioned whole, e.g. "My computer is acting up. *The screen* keeps flashing on and off."

Previous work (Avrutin & Coopmans, 2000) has shown that kindergarten-age children bridge novel parts to discourse, rather than to any perceptually available referent. However, this may be due to the attentional salience of the mentioned referent, rather than to familiarity (or uniqueness) constraints on definites. Experiment 1 sought to clarify this by testing whether children distinguish between definites and indefinites with respect to bridging.

Participants were tested in a modified truth-value judgment task. They were presented a scene containing two objects, e.g. a turtle with a green shell, and a snail with a white shell. They heard a discourse that indirectly introduced both referents, mentioned one of them, and in the target statement, used either a definite or indefinite description for a discourse-novel part (1).

4-year-olds and 5-year-olds relied on the mentioned whole to interpret a subsequent part, but did not discriminate between definites and indefinites. At the age of 6 years children began to bridge definites more than indefinites, a trend that was significant in a group of 7- to 8-year-olds. Therefore, controlling the constraints on definites vs. indefinites with respect to bridging emerges around the age of six.

Conventionally, definites in the target sentences force a link between the referring expression and mentioned referent, while indefinites can be satisfied by either of the pictured shells. However, the use of the indefinite in this context may trigger a pragmatic inference: the part is not linked to the mentioned referent, because, had the speaker intended this, he/she would have used the definite form. While conventional constraints allow the indefinite to refer to either referent, Gricean inferencing may cause a shift to the unmentioned referent.

Experiment 2 used eye-tracking to examine whether such pragmatic inferences are evidenced during processing. If hearers are sensitive only to the conventional aspects of indefinites, they may continue to look at the mentioned referent when interpreting them. However, pragmatic inferencing should surface as shifts of attention to the unmentioned referent upon hearing the indefinite description. Adults and 6- to 8-year-olds were tested.

A difference score of fixations on the mentioned minus unmentioned referent, "mentioned-referent preference," was computed. Adults had a reliably smaller mentioned-referent preference while hearing indefinite than definite descriptions. That is, they looked towards the unmentioned referent in response to indefinites, suggesting that pragmatic inferencing occurs quickly. In contrast, children did not display this bias, nor did they look at the mentioned referent alone when hearing both definites and indefinites, as an attention account would predict. Off-line judgments reflect individual differences: most children displayed either an adult-like distinction between definites and indefinites, or a less mature tendency to bridge both indiscriminately. We compare the on-line processing of these two groups of children, to observe how the recently acquired pragmatic distinction is reflected in their processing.

Example

(1) "The picture is of some animals by a pond.
A snail is by the water.
The/A shell is green."

Mentioned referent: snail

Unmentioned referent: turtle

On-line thematic integration processing in children with specific language impairment

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Children with specific language impairment (SLI) show consistent problems in language comprehension. The majority of studies that investigated sentence processing impairment in SLI, focused on potential impairments in components of grammar using off-line methods (e.g. Bishop, 1979, 1982; van der Lely, 1996). However, to our knowledge, no study has investigated whether the deficits lie in the integration of information in the course of sentence processing using on-line methods. In the current study we used on-line behavioural measures to investigate thematic integration processes and to see how syntactic, semantic and pragmatic information, indicated by the thematic structure of a sentence, are combined.

Three groups were considered: a group of French children with SLI; a control group of younger children matched with the children with SLI on receptive vocabulary test scores (RVC); and a group of children matched on chronological age (CA). Three experiments were conduced: (a) a sound discrimination task, (b) an auditory lexical decision task and (c) a primed auditory lexical decision task in which subjects made a lexical decision on a “target” word (the last word of each sentence) preceded by a “prime” (a subject noun and a verb). In the priming task we investigated to what extent semantic/pragmatic information influence combinatory thematics. The same prime was presented with two target words: one had a high cloze probability (e.g. The doctor nursed - the patient), one had a low cloze probability (e.g. The doctor nursed - the lion). In order to assess the role of syntactic structure in lexical integration, in one condition the “target” word was preceded by an “asyntactic prime” (e.g. The nursed doctor - the patient). The presence and the magnitude of the priming was compared to a base-line in which the target word was preceded by a “scrambled prime” (e.g. The watered gardener - the patient).

The results indicated that the performance of children with SLI was comparable to that of RVC group and CA group in the sound detection task and in lexical decision one, but that, on the contrary, in the sentence lexical decision task their were slower than both control groups (cf. figure 1). Concerning how different information are integrated on-line, children with SLI showed a larger sensitivity to pragmatics than both control groups (cf. figure 2). Additionally, children with SLI showed a priming effect in the asyntactic condition (though reduced in comparison with the syntactic condition), which was not the case for control groups who did not show any priming effect in the asyntactic condition (cf. figure 3).

On the whole, these results demonstrate that children with SLI have a deficit in combinatory thematics: thematic integration processing in children with SLI relies more on pragmatic information and depend less on syntactic structure compared to normal developing children. We hypothesize that children with SLI have problems with integrating incrementally lexical items following syntactic structure, and compensate extensively using information derived from pragmatics and semantics, which would be less efficient and slower.

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Seeking a referent or fleeing a mismatch?
How should we interpret infants' responses in "preferential looking" procedures?

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Procedures in which infants look at pictures while listening to speech naming one of the pictures are widely used in research on early comprehension. In such procedures "word recognition" is operationalized in terms of looking time to the named target picture relative to the unnamed distracter. Some procedures rely on summary measures of looking time (e.g., Golinkoff) while others provide real-time measures of infants' gaze patterns in response to the unfolding speech signal (e.g. Fernald et al. 1998; Swingley & Aslin, 2002). The implicit assumption has been that if the infant shifts reliably from the picture of the dog to the baby in response to Look at the baby, this is evidence that the child is rejecting the dog and seeking the baby as the referent for the familiar object word. However, it is not clear from such a response whether the child is "seeking" a referent that matches the target word, or merely "fleeing" a mismatch. When 18-month-olds were presented with a familiar target word with referent absent (e.g. ball in the presence of visual car and shoe), Swingley & Fernald (2002) found that infants were just as fast to shift away from the distracter when the target object was not present in the visual array as when an appropriate referent was present. This surprising finding suggested that infants might be rejecting a mismatch without seeking a specific referent, i.e. that their response might not be guided by memory of the particular target object seen earlier. However, this issue could not be resolved using a two-alternative procedure.

To enable dissociation of "fleeing" from "seeking" responses, we devised a three-alternative version of the looking-while-listening procedure. In Expt. 1, 26-month-olds were first presented with two pictures left and right (e.g. dog, baby) in silence; after 4sec, a third picture appeared at center (e.g. rabbit) and they heard Hey, look at the bunny! Where's the DOG? Children were just as likely to shift first to the distracter as to the named target picture, suggesting that first shifts were not guided by memory of the particular target object in a particular location. Because naming an interesting object at center prior to testing might have interfered with memory for the two objects previously seen on left and right, the center object was replaced by a bullseye in Expt. 2 and children heard Look! Where's the DOG? Even on these less distracting trials, children shifted first to the wrong picture on half the trials. When they did so, however, they rejected the distracter picture within 400ms, shifting directly to the correct picture and remaining on the target. Thus, although children did not seem to keep the location of the target object "in the mind's eye", they did keep the target word "in the mind's ear", continuing their search for a referent that matched that word until they found one. We discuss these findings in relation to current assumptions about how to interpret children's responses to spoken language in preferential looking procedures.

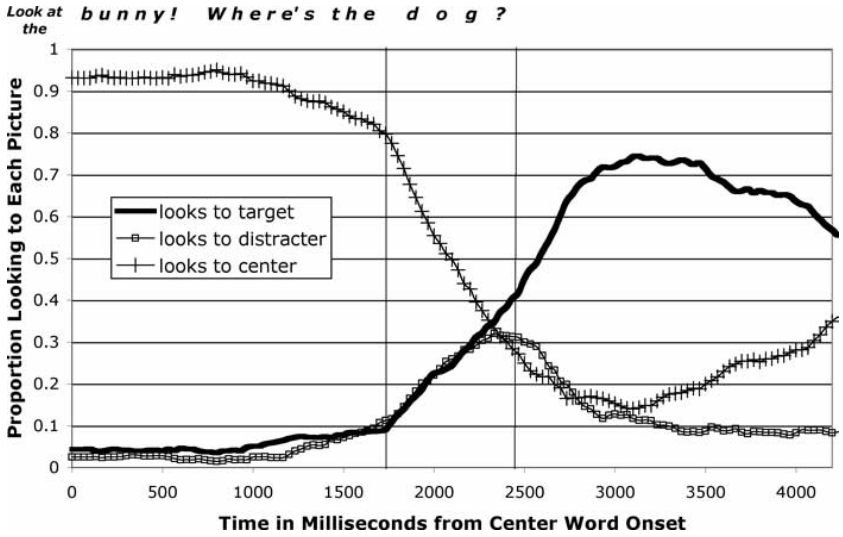

Figure 1. Proportion of trials on which 26-month-olds fixate each of the three pictures at each 33ms interval in Expt. 1, measured from the onset of the name of the center object (bunny in this example). The target object in this example is the dog.

Do children with specific language impairment differ from typically developing children? A study investigating brain responses during sentence comprehension

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Oberecker et al.(2005) report that upon hearing a syntactic phrase-structure violation, children (32-months of age) exhibit an ELAN-like ERP component followed by a P600. This suggests that even very young children process online phrase structure information as soon as it becomes available. This raises the question of which linguistics factors play a role and when? Studies show that prosody is utilized in the early stages of adult online sentence processing (Eckstein & Friederici, 2005). Whether or not this is the case for children, is an open question. This study compares the auditory syntactic and lexical-semantic comprehension abilities of typically developing children(TD) with those with specific language impairment(SLI). A comparison of the ERP data from these two groups is used to argue that prosody plays an important role in the initial stages of children's on-line syntactic processing.

Sixteen children with SLI(mean age M=9;7, SD=1;9) and sixteen TD children, matched pair wise on age, gender and non-verbal IQ, participated in an auditory ERP experiment. The following three conditions were tested: (a) correct, (b) syntactic violation, and (c) semantic violation. The syntactic violation condition contained a phrase structure violation, in which the past participle appeared where a noun was expected. In the semantic violation condition, the selectional restriction of the verb did not match with the type of the noun phrase at the subject position in a sentence. Children judged overall correctness of the sentence after each sentence was played. ERPs of the violation conditions(b, c), timed-locked to the onset of a past participle (underlined below), were compared against the correct condition(a).

When confronted with a syntactic violation, the TD children showed an early anterior negativity with a bilateral distribution whereas in the SLI children, this negative component, though present, was delayed and elicited only in the left hemisphere. The topographical difference between the two groups of the children is suggestive, implicating a problem with prosodic processing for the SLI children as recent studies for adults have shown that the right fronto-temporal network is recruited for prosodic processing (cf. Friederici & Alter, 2004). The results of behavioral and neural studies converge here as the behavioral studies also suggest prosodic problems for the SLI children (Weinert, 1992). Assuming that prosodic information is closely tied to syntactic structure of a sentence (e.g., Selkirk, 1984), we can say that the problem with prosody for the SLI children is the source of the difficulty, which was further supported by the late latency for the effect. Following the negativity, a P600 effect was found for both groups, indicating that both TD and SLI children perform syntactic reanalysis. This suggests that while prosodic information is important in the early stages of sentence processing, it may not be critical at the reanalysis stage as the SLI children, who have a problem with prosody, perform reanalysis successfully. In addition, the semantic violation elicited an N400 for the TD children, but not for the SLI children. Whether or not this difference lies on the children's use of prosody will also be discussed.

Examples

a) Das Brot wurde gegessen. "The bread was eaten." (Correct)

b) Das Eis wurde im gegessen. "The ice cream was in-the eaten." (Syntactic violation)

c) Der Vulkan wurde gegessen. "The volcano was eaten." (Semantic violation)

Processing long-distance grammatical relationships in children with SLI

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Children with Specific Language Impairment (SLI) appear to have difficulties with long-distance grammatical relationships. A particular area of difficulty is in binding relations (van der Lely 1998; van der Lely & Stollwerck,1997). Only off-line comprehension tasks (e.g., picture-pointing) have been employed and have yielded somewhat mixed results. This experiment used a cross-modal picture priming (CMPP) task (McKee et al., 1993) with auditory sentences and picture probes to examine SLI children's activation of antecedents for pronouns and reflexives.

Twenty children with SLI and 24 age-matched children with TLD (8;3-10;11) participated. The stimuli were 30 experimental sentence triplets, each consisting of a sentence with two nouns and, for the three conditions, a pronoun, a reflexive, or a third noun(***(****P):* The alligator knows that the leopard with the green eyes is patting him* on the head with a soft pillow. (illegal). *(R):* The alligator knows that the leopard with the green eyes is patting himself* on the head with a soft pillow. (legal) *(N):* The alligator knows that the leopard with the green eyes is patting the girl* on the head with a soft pillow. (unrelated)). For each triplet, a single picture was selected that represented the embedded subject (second noun/legal antecedent of the reflexive). The same picture was presented with each of the three members of a given triplet. Thus, there were 30 sentences in which the probe corresponded to the legal, activated antecedent. At the offset of the **pronoun, reflexive, or third noun;** a picture probe was presented (e.g., leopard). The child pressed one of two buttons indicating whether the picture was something "alive" or "not alive." RTs to accurate responses were analyzed. To verify children's attention, the had to repeate ten randomly selected sentences in each session.

Children with SLI were less accurate (86%) in their picture judgments than children with TLD (95%). A Hierarchical Linear Modeling (HLM) Analysis compared the RT data across the three conditions and across groups. SLI children were slower than TLD children (intercept = 819, SLI coefficient +145ms, se =43 t(35) =3.35, p=.002). The pronoun condition was significantly slower than the reflexive condition. There was no difference between noun and reflexive conditions. With a pronoun intercept, noun effect is -27ms (SE= 12.9, t(35) =2.15, p=.04) and reflexive effect is -30ms (SE=10.8, t(35)=2.78, p=.009). There was no Group X Condition interaction, indicating that SLI children exhibit the same pattern of responses as the TLD children.

Both groups showed the expected activation of the pronoun antecedent and of reflexive antecedent. Children with SLI establish long-distance binding relations in language processing similar to their age-matched TLD peers in contrast to previous findings (van der Lely & Stollwerck,1998). The slower picture-decision RT of children with SLI may reflect slower processing overall or simply slower and less accurate lexical (picture) decisions. The RT for the noun condition was not significantly different from the reflexive condition, but they were faster for different reasons. The fast noun RT may reflect the absence of a search for an antecedent at the probe point.

Contrasting effects of semantic associates and coordinates in picture naming:
A developmental study of cross-modal picture-word interference

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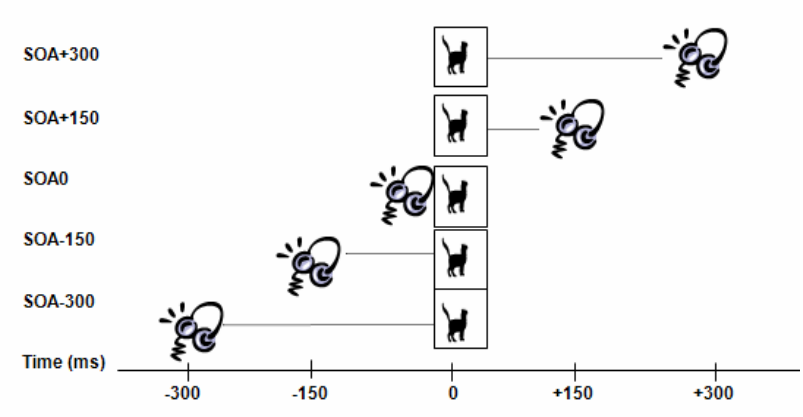
Children's successful access and retrieval of lexical items during language production depends on their degree of semantic knowledge. In picture naming, semantic context words produce either facilitation or inhibition depending on the nature of their relatedness to the target picture name. Coordinates overlap substantially in their semantic dimensions, causing them to compete for activation and retrieval during language production. This competition results in a longer period of lexical selection (i.e., inhibition effect). Associates are linked in the mental lexicon due to their co-occurrence, e.g., in collocations such as 'salt and pepper', and provide additional activation to the target item that leads to its faster selection (i.e., facilitation effect).

Our study used a cross-modal picture-word interference paradigm to tease apart the effects of coordinate competition (e.g., hearing 'mouse' when attempting to name a rabbit) and associative facilitation (e.g., hearing 'carrot' when attempting to name a rabbit) in children (mean age 9;5, range 8;0-10;8) and adults. Our goals were to compare the time course of the inhibitory effect of coordinates with the facilitative effect of associates, and the magnitude of the two effects across development. In the cross-modal picture-word interference paradigm, the presentation of pictures is manipulated in time relative to the presentation of auditory distractor words, i.e., Stimulus Onset Asynchrony (SOA).

In the adult literature, some researchers (e.g., Alario et al., 2000) have reported associative facilitation at earlier SOA than coordinate competition, suggesting that association is a strategic factor. In contrast, other researchers (e.g., Bolte et al., 2005) have reported that a similar time course for both effects, suggesting that they affect the same stage of lexical processing. In our experiment, the onset of the distractor word appeared before (SOA -300ms & –150ms), with (SOA 0ms), or after (SOA +150ms & +300ms) the presentation of each picture, with SOA manipulated across blocks of trials. Five types of interfering words were paired with each of the target pictures: coordinates, associates, non-coordinate unrelated controls (constructed by re-pairing the coordinates with unrelated pictures), non-associate unrelated controls (constructed by re-pairing the associates with unrelated pictures), and neutral (i.e., 'good').

Results revealed that associates produced faster latencies than their controls, with facilitation spanning SOAs ranging from –300 to 0 in children, and –300 to –150 in adults. Coordinates produced slower latencies than their controls across all SOAs (–300 to +300 in children, -300 to +150 in adults). While both effects were observed at the earliest SOAs, the coordinate effect showed a more extended time course. Despite the similarities in the time course of the two effects in children and adults, the magnitude of the effects differed: For children, but not adults, interference from coordinates was significantly weaker than facilitation from associates. Taken together with our earlier findings that strongly associated coordinates (e.g., boy-girl, shoe-sock) produce massive facilitation in lexical retrieval in children as young as 4-5 years of age, the present results confirm that association is the dominant organizer of the mental lexicon, with associative connections emerging in childhood and remaining stable with development.

Figure 1. Cross modal picture-word interference paradigm.



Recency and inference in children's on-line processing of Korean reference: Evidence from preferential looking tasks

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This research investigates how Korean children process different types of referential expressions in their language. In Korean, which is a topic-prominent language, null pronouns are used to encode a topic-referring noun phrase and pronouns are infrequent (Givon 1983). Previous studies provide ample evidence that Korean children are sensitive to discourse-pragmatic factors on early production of reference (Clancy 1987, Kim 2000), but little is known of their on-line referential resolution. This study addressed the question of whether Korean children's on-line reference comprehension is affected by discourse-pragmatic principles such as subject or 1st-mentioned NP bias, topic prominence, functional parallelism and recency, and how children develop processing strategies for referential resolution in topic-prominent languages.

Thirty 2- to 4-year-old Korean children participated in preferential looking tasks in which they looked at a series of pictures of two characters while listening to short stories (see examples 1-3). In Experiment 1, the subject of the test sentences referred to either the 1st- mentioned character (a grammatical subject) in the context, or the 2nd-mentioned one (the oblique). In Experiment 2, the subject of the test sentences referred to the pragmatically salient character (a topic in the context), or the other (the oblique). In Experiment 3, the grammatical object of the test sentences referred to either a character with the same grammatical function (the object) or a different one (the subject). These referential expressions were realized as a repeated lexical noun, a pronoun, or a null pronoun. Overt or null pronoun subjects/objects were ambiguous until disambiguating word(s) (underlined in the examples) denoted the referent of the pronouns on the screen. Children's eye movements to the story characters were coded frame by frame.

The children's eye-fixations provided information about their difficulties in assigning referents to null pronouns. In Experiment 1, they initially showed more fixations on the character established in the context as the oblique (the 2nd-mentioned NP) than as the subject (the 1st-mentioned NP), which showed a recency effect rather than subject or 1st-mentioned NP bias. In Experiment 2, they looked equally at the two characters which were mentioned as a topic or an oblique in the context, which implies that their interpretation of the null subject was influenced not by topic prominence but by the inference (from the comitative particle meaning 'with') that the two characters were involved in the sequence of events together. In Experiment 3, they did not show more fixation toward the character mentioned as an object in the context, which is in contrast with functional parallelism. During overt pronoun items in Experiments 1-3, they initially looked at either the target or the competitor, which indicates that they could not decide on the referent of an overt pronoun. The children's sensitivity to recency and inference rather than to subject or 1st-mentioned NP bias, topic prominence or functional parallelism suggests that their initial processing mechanism is different from those of adults and that subsequent developmental changes take place.

Test sentences (translated into English)

(1) Experiment 1: Subject Continuity

Context:	Mickey is going to the mountains with Pooh now.
Test Sentences:	Mickey/Pooh/He is catching something in the mountain.
	Look, he is catching a rabbit/butterfly. Where is the rabbit/butterfly?

(2) Experiment 2: Topic Continuity

Context:	Minnie is going to school with Betty.
	She is studying with Betty in the classroom.
Test Sentences:	Minnie/Betty/She is drawing a picture now.
	Look, she is drawing a flower/house. She draws well.

(3) Experiment 3: Object Continuity

Context:	The friends are fighting on the street.
	Donald hit Pooh.
Test Sentences:	Then, Mickey hit Donald/Pooh/him.
	Look, he hit his head/shoulder. That must hurt a lot.

From sequential processing to incremental integration:
A developmental shift in the efficiency of children's interpretation of prenominal adjectives

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Children's interpretation of adjectives has traditionally been assessed using all-or-none tasks that ask children to choose the blue one from a set of colored objects. Based on their response, children are then categorized as either knowing or not knowing the word blue (e.g., Bartlett, 1978; Shatz et al., 1996). While this provides a starting point for understanding when children can interpret property terms, such categorical measures are not sufficiently sensitive to capture developmental changes that occur with increasing proficiency in interpreting fluent speech. On hearing red car, the child's task is not just to access the meaning of each word independently, but to interpret the adjective in relation to the noun it modifies, and then to identify very rapidly a single referent that is simultaneously red and a car.

By 2-years-old children are quite efficient in identifying the referents of familiar object words without prenominal modifiers in fluent speech and they "listen through" prenominal adjectives that are uninformative (Thorpe & Fernald, in press). But what happens if the adjective is informative? When a prenominal modifier is sufficient to specify one object in a set, adults can identify the correct referent before the noun is spoken (Sedivy et al., 1999). When are young children able to use adjectives in online processing? Here we asked how efficiently 2- and 3-year-olds can integrate a familiar color word with the following noun.

Two experiments investigated incremental interpretation of adjective/noun phrases by 36-month-olds (n=30) and 30-month-olds (n=30). Children's eye-movements were monitored as they looked at pictures while listening to sentences combining familiar adjectives (red/blue) with nouns (car/house). Children heard e.g., Where's the red car? with pairs of pictures in three conditions (1:red car/red house, 2:red car/blue car, 3:red car/blue house). In Expt1 36-month-olds oriented to the correct picture during the adjective, without waiting for the noun, when the adjective could uniquely identify the referent. In Expt2 30-month-olds demonstrated two qualitatively different response patterns. While all these children could correctly produce red and blue, only half of the 30-month-olds responded as rapidly as the 36-month-olds in Expt1. The other half responded only after they had heard both adjective and noun, 450 ms slower than their peers. These children also exhibited difficulty integrating adjective/noun combinations by shifting between the two pictures (red car, blue car) as they heard the noun, as if they had difficulty linking the adjective and noun to identify the referent that was both red and a car.

Thus around 30 months, children seem to make a qualitative shift in the efficiency of processing adjective/noun combinations. Half the children at this age seemed to process this noun phrase sequentially, (first red, then car, with delayed integration), while the other half processed the same noun phrase incrementally (integrating red car immediately). Since all children at 36 months used the more efficient pattern of incremental processing, this appears to reflect a developmental shift to a more mature processing strategy that begins halfway through the second year.

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Lexical processing in hearing impaired children with cochlear implants

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Children with cochlear implants experience a period of auditory deprivation and with the activation of the implant, the establishment of hearing that differs from normal hearing in systematic ways. Although some of these children achieve age-appropriate language skills, many do not. Few studies have examined the language abilities of these children or the nature of language processing and representation. We compared the speed and quality of word retrieval in children with cochlear implants (CI) to typically developing, normal hearing children (NH). We also examined the semantic and phonological organization of the lexicon with a timed picture-naming task and a verbal-fluency naming task.

In the picture-naming task, drawings of objects were presented on a computer screen. The child named, as quickly as possible, pictures of objects that appeared on the computer screen. Reaction time was measured form the onset of picture presentation to the initiation of the verbal response.

In the verbal-fluency naming task, the child generated as many words as possible that belong to a certain category (animals, food) or that begin with a given sound (/t/, /f/, and /l/). The child was given one minute to respond for each category type.

Results from six children with CIs (7;5 to 11;4, M = 9 years and 3 months) and 23 NH (7;2 to 12;8, M = 9 years and 11 months) with similar non-verbal IQ range, are included in this preliminary analysis. Hearing impairment onset (for children in the CI group) was prior to the age of 2;7. The children had at least 1.25 years of experience with their cochlear implant.

Reaction time (RT) measures for correct responses in the picture-naming task indicated that the CI group performed more poorly (slower RTs) than the age-matched NH group. The children in the CI group also generated fewer words on the verbal-fluency task than the NH children. Qualitative analysis of the children's performance on these tasks will be reported. The presentation will also discuss the scores of individual children on each task.

Results will be discussed in term of their implications for lexical development in NH children and children with CIs and intervention. We will explore factors related to hearing impairment and CI use that may contribute to performance.

Language-specific processing beyond the first year:
Online interpretation of grammatical gender by children and adults learning Spanish

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Young language learners must discern regularities in the sequences of sounds used by speakers of the ambient language. A growing literature has documented infants' perceptual specialization and processing capacities over the first year of life (Werker & Tees, 1984; Taso, Liu, & Kuhl,, 2003; Saffran, Aslin, & Newport, 1996), but little research has explored language-specific processing strategies as they develop beyond the first year. Here we explore how 2- to 3-year-old Spanish-learning children take advantage of morphosyntactic cues to grammatical gender to identify familiar words during the processing of natural language.

Spanish nouns are classified into two grammatical genders: masculine and feminine. Other parts of speech agree with the gender of nouns, such as the preceding articles $la_{[fem.]}$ and $el_{[masc.]}$. Adult speakers of languages with grammatical gender have been shown to use the gender marking on articles and other prenominal modifiers to rapidly identify the subsequent noun (e.g., Dahan, et al., 2000; Bates, et al., 1996). To investigate this ability in children and expand upon previous studies, we tested two groups of participants: 34-42-month-old Spanish-learning children (n=26) and monolingual Spanish-speaking adults (n=26) from families recently immigrated from rural Mexico. Children and adults were tested in a looking-while-listening procedure (Fernald, et al., 1998), in which their eye movements were monitored as they viewed two images and listened to a prerecorded sentence naming one of the images, e.g., ¿Dónde está el pájaro? ('Where's the bird?'). On Same Gender trials, the names for target and distracter were both feminine or both masculine, e.g., el pájaro ('the bird') and el caballo ('the horse'). On Different Gender trials, one was feminine and the other masculine, e.g., el pájaro and la vaca ('the cow'). The dependent measure was the speed of orienting to the correct image, measured from the onset of the article. Spanish-learning children as well as Spanish-speaking adults were significantly faster to orient to the named image when the gender-marked article was informative, i.e., on Different Gender trials (see figure). We also collected parental report data on children's language development using the MacArthur-Bates Inventario del Desarrollo de Habilidades Comunicativas (Jackson-Maldonado, et al., 1993). Children who were better at using la and el to identify referents in online comprehension were more advanced in grammatical development, suggesting that children's attention to regularities in language may play a role in bootstrapping the formation of noun classes.

Current investigations are underway to determine whether this processing advantage depends on early exposure to the gender-marking language, as suggested by Guillelmon & Grosjean (2001). We are testing English-speaking undergraduates in the early stages of learning Spanish who have the same vocabulary levels as the child participants. This study will speak to the issue of what type of exposure is necessary in "becoming a native listener" (Werker, 1989).

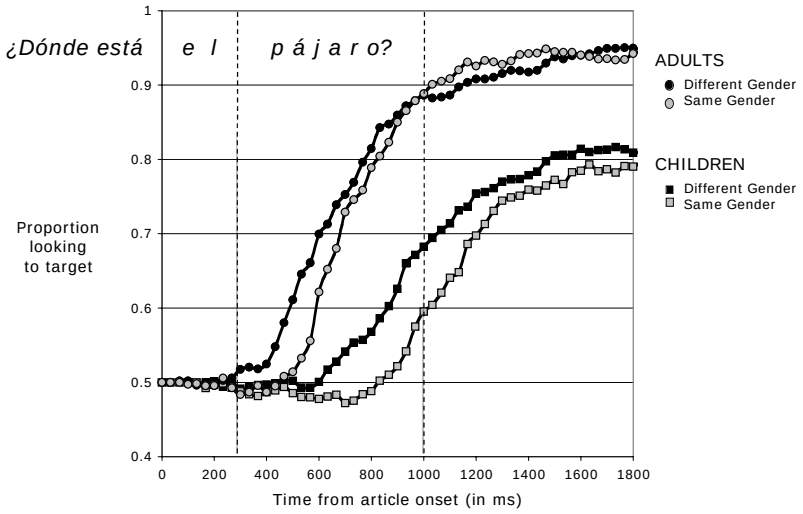

Figure 1. This figure depicts the time course of adults' and children's looking to the target picture on Same Gender trials and Different Gender trials. Curves depict changes in the proportion of looking to the picture named by the familiar target word preceded by its appropriate gender-marked article. The vertical dashed lines indicate offsets of the article and target word.

Chinese children's counterfactual thinking:
Evidence from sentence comprehension in a self-paced reading task

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Counterfactual conditionals such as 1(a) generally require special syntactic or lexical marking to distinguish from the factual reading 1(b). English marks counterfactuals with the subjunctive mood fairly consistently. Chinese, in contrast, is thought to provide no consistent linguistic forms for expressing counterfactual ideas. Sentences 2(a) and (b), Chinese equivalent of 1(a) and (b), look remarkably similar. Bloom (1981) showed that Chinese speakers were not as proficient in counterfactual reasoning compared with English speakers because the lack of linguistic marking of counterfactuals. Nonetheless, subsequent studies find minimal differences between adult speakers of the two languages (Au, 1983; Wu, 1999; Yeh & Gentner, 2005).

1(a) You could have got on that bus if you came earlier

1(b) You can get on the bus if you come earlier.

2(a) Ruguo ni zaodian lai, ni jiu neng ganshang qiche le.
(if you earlier come, you then can catch bus [Aspect: perfective])

2(b) Ruguo ni zaodian lai, ni jiu neng ganshang qiche.
(if you earlier come, you then can catch bus)

We report three studies showing that (a) like English, the Chinese language marks counterfactuals using lexical and syntactic forms, and (b) that these counterfactual markers may change on-line processing of counterfactual conditionals. Study 1 establishes the existence of markers in the Chinese language that reliably predict the counterfactual reading of the whole sentence. Over 4,000 sentences containing potential markers were selected from a modern Chinese corpus and were classified by naïve native Chinese speakers as factual or counterfactual sentences. A number of lexical and syntactic forms were found to be predictive of counterfactuality, some as high as 95%. One of the markers is the perfective aspect marker “LE” in 2(a), which has been overlooked in previous research. Study 2 further demonstrates that these markers affect Chinese speakers’ counterfactuality judgment even after semantic information is controlled. This pattern was found with adult and 10^{th} graders, but 5^{th}-graders answered at chance level, suggesting they have not acquired the usage of these markers.

Study 3 is an on-line reading study, looking at whether counterfactual markers affect on-line sentence comprehension. Using a self-paced reading paradigm, we asked adult Chinese and English speakers to read sentences word-by-word on a computer screen. Word reading time showed that counterfactual sentences took longer time to read, and the differences primarily lies the end of sentences. 10^{th} grade students showed similar pattern as adults, whereas 5^{th}-graders showed no change in reading time.

In conclusion, findings from 3 studies suggest that (1) linguistic marking of counterfactuals exists in Chinese, and is potentially a linguistic universal; (2) Chinese speakers change their sentence processing as a result of seeing/hearing these counterfactual markers; and (c) Chinese counterfactual markers are not yet fully mastered by 11 years of age. The slow acquisition of the linguistic forms for counterfactual in Chinese may be due to the fact that most of the markers are probabilistic in nature. This, however, is not a problem unique to Chinese; English counterfactual conditionals often allow multiple readings, too. Challenges associated with the acquisition and on-line processing of counterfactuals will be discussed.

Knowing when it matters:
3-year-olds use contextual cues to resolve ambiguity in online sentence interpretation

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When interpreting spoken language, adults rapidly resolve ambiguities through online integration of linguistic and visual information (Chambers, et al., 2002). Research on children's use of morphosyntactic cues in ambiguous situations has relied primarily on offline methods, e.g. when 3-year-olds are shown unfamiliar animate and inanimate objects and hear a novel word in a common-name-frame (Where's the DAX?) they select either object, but in a proper-name-frame (Where's DAX?), they choose the animate object (Jaswal & Markman, 2001). Gerken & McIntosh (1993) showed that younger infants also attend to determiners, results recently extended in a study of online processing by 18-to-36-month-olds. With 18-month-olds, an unstressed nonce syllable replacing the determiner (Where's po CAR?) interfered with recognition of the familiar object name. Somewhat surprisingly, for 3-year-olds the nonce syllable did not disrupt processing. However, when the same nonce syllable was followed by a recently learned object name (Where's po DAX?) 3-year-olds were disrupted when identifying the correct referent. This suggests that 3-year-olds 'listen through' a nonce syllable in a highly predictable context – but no longer do so in a more challenging context involving newly learned words. However, in both contexts the nonce syllable was uninformative such that the referent mapped uniquely onto one object in the visual display.

However, what if the same nonce syllable is heard in a context in which it is potentially informative? Then the child must know when to pay attention to it in establishing reference. For example, the referent of the proper noun in Where's Michelle? is a person, although the referent could also be interpreted as a count noun preceded by a nonce syllable (Where's mi SHELL?). In a context where both animate and inanimate objects are available as potential referents, will 3-year-olds attend to the ambiguous syllable in Where's po DAX? Using a looking-while-listening procedure monitoring gaze patterns, 3-year-olds (n=34) were presented with novel words preceded either by a grammatical determiner (e.g. Where's the MEEK?) or by an unstressed nonce syllable (e.g. Where's loo MEEK?), as they looked at pairs of animate and inanimate objects, both unfamiliar. In this ambiguous context, the identity of the correct object can only be inferred using information from the visual context, i.e. the animacy/inanimacy of the objects, in combination with linguistic information. We predicted that 3-year-olds would interpret "the MEEK" as referring to either the animate or inanimate object, since animate objects can be named by both count nouns (doll) and proper nouns (Michelle). However, given the absence of a familiar determiner in "loo MEEK" , we expected this would be interpreted as the first syllable of a proper name that refers to the animate object. Indeed 3-year-olds parsed the nonce syllable as part of a proper name, increasing their fixations to the animate object. In contrast, when the preceded the novel word, they interpreted the novel word as a common name, fixating both objects equally. Three-year-olds, like adults, can integrate linguistic and visual information online in resolving ambiguity, rapidly assessing the compatibility of potential referents as the sentence unfolds.

References

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