Tracking the Acquisition and Processing of English Passives: Using Acoustic Cues to Disambiguate Actives and Passives

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Introduction. English-speaking normal and language impaired (SLI) children and agrammatic aphasics misunderstand spoken passives (1) more often than actives (2). In addition, normal adults read passives more slowly than actives. When people misunderstand passives, they typically interpret passives as if they were active.

Design. Although much psycholinguistic work has investigated English passives, this is the first on-line study of processing of spoken passives. Subjects listened to 12 passive sentences (1) and 12 active sentences (2) and chose which of two pictures corresponded to each sentence. Pairs of pictures differed only in who was the agent. The verbs kiss, push, shove, sniff, tickle and touch were used because they are easily depictable, and have an ed passive participle.

(1) The girl was pushed by the boy
(2) The girl was pushing the boy

In half of the trials, the nouns were a boy and a girl, and in half they were a man and a woman. Each subject heard each verb twice in actives and twice in passives, once with adult NPs and once with child NPs. Whether the left or right picture was the target picture, whether the agent was to the left or the right of the patient, and whether a male or female character was the agent was balanced within subjects.

Non eye-tracked children. Eight 3-year olds (mean 3;4) and 9 4-year olds (4;3) participated. Children were faster (5289 ms vs. 5739 ms, p < .01, all reaction times for correct responses) and more accurate on actives than on passives (74% vs. 58%, p < .05). Three-year olds tended to do worse than 4-year olds (61% vs. 71%, p = .10), and there was an age x sentence interaction (p < .005): 3-year olds were 160 ms faster on actives, whereas 4-year olds were 1062 ms faster on actives.

Eye-tracked children. 16 school-age children (mean 5;8) participated. They were faster (4043 ms vs. 4643 ms, p < .005) and more accurate (94% vs. 78%, p < .01) on actives than passives. Analyses of eye-movement data collected using a mobile eye-tracker revealed that, for active sentences, from the onset of the sentence until the onset of the final noun, children consistently looked at the correct picture approximately 55% of the time. Look to the target picture then increased linearly at a rate of 30 looks/sec until they reached approximately 75% correct looks 300 ms after the sentence was finished. Factoring in the amount of time it takes to program an eye-movement, this suggests that children 'decide' an active sentence is active when they learn it contains a progressive participle (or perhaps lack a by phrase). For passive sentences, from the onset of the sentence until the end of the sentence, children consistently looked at the correct picture approximately 45% of the time. Look to the target picture then increased linearly at a rate of 25 looks/sec to approximately 70% correct 1000 ms after the passive sentence was finished, suggesting that children don't 'decide' a passive is passive until they begin processing the second N.

Eye-tracked adults. 23 college students were faster (2280 ms vs. 2499 ms, p < .0005) and more accurate (100% vs.96%, p < .05) on actives than passives. For both actives and passives, adults consistently looked at the correct picture 50% of the time until the onset of the participle, at which point correct looks diverged for actives and passives. For actives, correct looks increased linearly at a rate of 75 looks/sec to approximately 80% correct during the final noun. Correct looks remained at 80% until 300 ms after the sentence was over. For passives, correct looks remained at 50% until the onset of the final noun, at which point correct looks monotonically increased at an average rate of 27 looks/sec to 90% correct 1300 ms after the sentence was over. Factoring in time needed to program eye-movements, our results suggest that adults can distinguish spoken actives from passives before they hear the participle (i.e., before the sentences are disambiguated in text). Acoustical analyses conducted to determine how adults were able to do this revealed that active verb stems were shorter than passive verb stems (289 ms vs. 322 ms, p < .01), the second the was shorter in actives than passives (64 ms vs. 92 ms, p < .0005) and the second N was longer in actives than passives (408 ms vs. 379 ms, p < .05). Thus, adults' early eye-movement data probably reflects adults' ability to use the differences in the duration of active and passive verb stems to disambiguate actives and passives.

Discussion. The children's 55% correct looks for actives vs. 45% looks for passives during the first half of the sentences suggest that, upon hearing a sentence, even 5- and 6-year olds initially adopt a Bever-like "First NP as Agent" strategy. Although they appear to distinguish between actives and passives when they access the participle, and they begin to correctly interpret actives at this point, children's interpretation of passives is quite delayed and, in many cases, appears to occur "off-line". Adults' initial looks show no sign of a "First NP as Agent" strategy. Furthermore, adults appear to use subtle acoustic cues to quickly disambiguate spoken actives from passives at a point when written actives and passives are still ambiguous. Despite this ability, adults are still faster at processing spoken actives than passives. Existing accounts of children's and aphasic adults' processing of passives all assume that the problem is solely due to syntactic limitations. Our eye-movement results suggest that children's (and perhaps aphasic adults') difficulties with passives might partly reflect an inability to use phonetic correlates for syntactic structure in the processing of complicated structures.