2- and 3-year-olds' sensitivity to pronoun case in English sentence comprehension

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Abstract

English learning children use SVO word order before 24 months of age to interpret transitive sentences when the nominals are full NPs; we test when they understand such sentences when the nominals are case- and gender-marked pronouns ("She is tickling him"). Children viewed reversible actions on side-by-side screens; the test audio matched only one of the screens. Children at 36 months (but not 27 months) looked more quickly and longer at the matching screen; however, they performed better with "she is verbing him' than 'he is verbing her.'

Every language includes way(s) to show relational information about agents and patients of an action to convey the idea of who does what to whom (O'Grady, 2005). According to most linguistic analyses (e.g., Greenberg, 1963; Comrie, 1981), languages may employ three grammatical devices to denote relations between agents and patients: case markers, word order, and verb agreement. While no language relies on any of these devices exclusively, some languages (e.g., English) rely more heavily on word order whereas other languages (e.g., Turkish) rely more heavily on case markers. Nonetheless, children and adults speaking both types of languages have all shown tendencies to use *word order* as a significant cue for sentence comprehension (Hirsh-Pasek & Golinkoff, 1996; Göksun, Küntay & Naigles, 2008). Moreover, children learning languages such as English have been shown to understand their canonical word order early in language development, frequently before 24 months of age (Gertner et al., 2006; Swensen et al., 2007). However, most investigations of children's early understanding of simple sentences have used full NPs as the nominal arguments (e.g., The girl washes the boy). The purpose of the current study is to add to a small but growing set of studies investigating English-learning children's use of *pronouns* in sentence comprehension.

Previous research has demonstrated that English-learning 2-year-olds treat pronouns as NPs that are relevant for understanding argument structure. For example, Childers and Tomasello (2001) found that children hearing sentences both with full NPs and with pronouns ("He is blicking it") were more likely to produce and understand new transitive sentences than children who just heard sentences with full NPs. Thus, the presence of the pronouns—perhaps in variation with full NPs—seemed to highlight or emphasize the transitive structure. Moreover, Fisher (2002) demonstrated that toddlers can use personal pronouns to distinguish transitive from intransitive sentences with novel verbs; that is, they treated *She's pilking over there* as referring to a one-argument event while *She's pilking her* referred to a two-argument event.

These studies demonstrate that children's early sentence frames are general enough to encompass either full or pronominal NPs in subject and object position; however, they do not yet show how much the children are indeed processing the pronominal NPs. That is, are these pronouns 'just' being used as general place holders for argument positions, or do they serve to illuminate specific arguments such as subjects and objects, agents and patients? Put another way, these pronouns may support general referential functions for children this young

(especially in a language where case marking is not widespread, as in English), but not grammatical relations.

The English pronoun *it* does not distinguish agents from patients, but the personal pronouns do: *he* and *she* can only refer to subjects (agents in active sentences) whereas *him* and *her* refer to direct or indirect objects (patients and recipients in active sentences). The above studies did not address this question because they did not assess the extent to which children could use the gender and case of personal pronouns to understand sentences. For example, either *He is blicking her/it* or *It/She is blicking him* can be understood as events in which one of the participants is male. If only one of the available referent events for these sentences includes a male character, then children may select the correct referent event solely by identifying the gender of the pronoun but without understanding its case and so role in argument structure. However, when both referent events include characters of both genders (or neuter gender), children need to exploit at least two cues—gender, case, and/or sentence position—to select the correct referent event. To our knowledge, only two studies have included such a gender contrast in investigating young children's use of pronouns in sentence comprehension.

Scholes (1981) gave children aged 3-7 years of age a picture verification task; the pictures included line drawings of boys acting on girls, or vice versa, in which the boys and girls were distinguished by hair styles and clothing. A variety of pronoun contrasts were investigated, including gender/case combined (*he touches her* vs. *she touches him*), case alone (*someone touches her* vs. *she touches someone*), and gender alone (*someone touches him* vs. *someone touches her*). Overall, above chance performance was seen only in the 5-year-olds and older children; even for the gender/case combined sentences alone, the 3-year-olds performed at chance levels. These findings suggest that children's use of case and gender information in understanding personal pronouns is acquired late in English learners; however, it is also possible that the use of static pictures in the stimulus materials, as well as requiring a pointing response, made the task more difficult for the younger children in the study (Hirsh-Pasek & Golinkoff, 1996).

Just recently, Ibbotson, Theakston, Lieven and Tomasello (2011) have alleviated one of these concerns by using dynamic videos to present the events. In their study, 34- and 43-month-olds were shown two novel transitive events performed by characters that contrasted in gender (male/female, male/inanimate, female/inanimate). The children were pretested to ensure they could identify the gender of the characters. After viewing the dynamic events, they saw side-by-side presentations of frozen frames from each, and were asked to point to the event that matched the stimulus sentence. For our purposes, the relevant results were that even the younger group of children performed above chance with the active sentences including two case-marked pronouns (*she is blicking him*) as well as including just one case-marked pronoun (*she is blicking it*). Moreover, the children performed better with the former sentences than the latter, suggesting that case markers provide additional useful information about argument structure for children close to three years of age.

One of the goals of the current study was to investigate whether the combination of dynamic videos *plus* an easier task would elicit above-chance performance in personal pronoun comprehension by children even younger than 34 months of age. Thus, we presented 27- and 36-month-old children with side-by-side videos of reversible transitive actions using characters contrasting in gender, but only asked them to *look* at the matching scene, using the Intermodal Preferential Looking (IPL) paradigm (Hirsh-Pasek & Golinkoff,

1996; Swensen et al., 2007). Moreover, whereas Ibbotsen et al. (2011) presented children with only one grammatical active sentence of 'he verbs her', and one of 'she verbs him', we sought to systematically compare children's facility with masculine vs. feminine pronouns by presenting several instances of each. Our rationale for this comparison comes from a pattern observed in children's developing *production* of personal pronouns, to which we now turn.

Using two separate datasets, Rispoli (1994, 1999) has tracked the emergence and usage of pronominal case by English toddlers aged 1-4 years. Errors in case usage were observed even in 3-year-olds; moreover, these errors were asymmetric both by gender and by position. Overall, children produced masculine pronouns—both 'he' and 'him', at least—correctly most of the time, with masculine subjects being produced correctly close to 100% of the time and masculine objects somewhat less (85%). In contrast, feminine pronouns were often produced incorrectly, with 'her' frequently (45% of the time) appearing in subject position (but 'she' rarely appeared in object position). The underlying reasons for these case errors have been the source of much discussion (Rispoli, 2000; Schutze, 2001); for our purposes, though, it suffices to acknowledge at least part of the children's asymmetrical difficulty seems traceable to the fact that the pronoun 'her' is polysemous. That is, 'her' can be used as in either subject or object position as a possessive pronoun ('*Her* juice is cold'/'I like *her* socks'), as well as as a pronoun in object position ('I like *her*'). The masculine part of the paradigm shows none of this polysemy ('*He* is wearing socks'/'*His* juice is cold'/'I like *him*'). The ambiguity of the feminine paradigm, coupled with the infrequent use of 3rd person pronouns referring to humans in maternal input to toddlers (Oshima-Takane & Derat, 1996) might explain these errors (see also Loeb & Leonard, 1991; Pelham, 2011); however, the phonological difficulty of producing the sibilant 'sh' could also be playing a role. That is, children may be avoiding producing 'she' in subject position because the word is hard to articulate, and not because they really think 'her' belongs in that position. In the current study, we compare children's *comprehension* of 'she verbs him' vs. 'he verbs her' to see if a similar asymmetry emerges.

Method

Participants

A total of 36 children from the Northeastern area of the U.S. participated, of which 19 (11 girls) were two years of age (*MA* = 27.84 months, *SD* = 1.42) and 17 (12 girls) were three years of age (*MA* = 36.07 months, *SD* = 1.98). All were developing normally, with mean MBCDI scores (toddler version; Fenson, Dale, Reznick, Bates, Thal, Bates & Pethick, 1994)) of 447.64 words for the 27-month-olds (*SD* = 199.59) and 599.35 for the 36-month-olds (*SD* = 69.03). Potential participants were found via birth announcements in local newspapers; letters were sent to all families whose children were of the appropriate age and then parents were contacted by telephone. All participants were growing up as monolingual speakers of English.

Stimuli

The children first saw sequentially-presented 4-second clips of the boy and girl actors, paired with audios using their full NP and pronoun labels (i.e., "Here's the girl (boy)! Look at her (him)! There she (he) is!" The children then saw the 6-second clips of the transitive event stimuli, which included six pairs of familiar reversible actions, each carried out by the boy and the girl. The six actions and verbs were presented in this order: *ride, kiss, push, hug, wash,* and *tickle.* After two sequential familiarization trials, the two versions of each event appeared twice simultaneously, paired first with a nondirecting audio (the control trial) and

then again with the directing audio (the test trial). For three of the verbs (*ride, hug, wash*), the subject of the transitive sentence was *he* and the object *her;* for the other three verbs (*kiss, push, tickle*) the subject was *she* and the object *him.* Table 1 presents the layout sequence for the 'tickle' event.

Table 1

Video 1	Audio	Video 2
1. Girl tickles boy	Look, tickling!	Blank
2. Blank	See, tickling!	Boy tickles girl
3. Girl tickles boy	Control trial: Wow, tickling!	Boy tickles girl
4. Girl tickles boy	Test trial: She is tickling him! See, she is tickling him!	Boy tickles girl

For each child, trials were counterbalanced so that the match was on the left for half and on the right for the other half (a XYYXXYY pattern).

Procedure

The video stimuli were displayed on two video monitors placed 12 inches apart on a table. A speaker hidden between and behind the two monitors played the audio stimuli. Mounted between the monitors was a rope of red chase-lights used to attract the child's attention to the center between trials. The children were seated in a booster seat two feet away from the monitors while their parent sat on a chair behind. Parents were told that their children's looking behavior will be filmed and were instructed not to guide their children towards any of the videos (those who did so in any overt way would have been eliminated from the final sample, but none did). The children's faces were filmed by a digital camera hidden behind the light. The experimenter administered the experiment from a desktop PC outside the testing room.

Coding and dependent variables

The child's visual fixations to each screen, to the center, and away from the projection screen during the control and test trials were coded frame by frame from silent video. An individual trial was considered missing if the child looked at both scenes, combined, for less than 0.6 seconds. Among the 27-month-olds, fewer than 1% of trials (n = 3 across all children) were missing whereas among the 36-month-olds, none of trials was missing. Missing trials were replaced by the mean for the given item in the given age group.

Five dependent variables were calculated. The first three were (a) the percent of time the child spent looking at the video designated as the 'match' out of the total looking time to one of the videos, (b) the percent of looking time to the match during the 1st half of each test trial, and (c) the percent of looking time to the match during the 2nd half of each test trial. For all three measures, the expectation is that the children who understood the test audio would look longer at the matching scene during the test trial compared with the control trial. Additional measures assessed the children's efficiency or speed of finding the matching screen: (d) the *latency* of the first look to matching versus the nonmatching screen during the test trials, where the prediction is that children who understood the test audio would look first/more quickly at the matching scene, and (e) the number of switches of attention that occurred, compared for the control and test trials. For this last measure, the expectation is that children who understood the test audio would switch attention more during the control trial,

when they would be sampling both scenes, than during the test trial, when they would be guided by the test audio to look at the matching scene. All measures analyzed for all verbs together, and then compared the 'he-V her' trials vs. the 'she-V-him' trials. One-tailed tests were performed for all measures because we had clear predictions concerning the expected directionality of the findings.

<div align="center">Results</div>

Table 2 presents the results for the two age groups. None of the comparisons reached significance for the 27-month-olds; that is, they did not look longer at the matching scene during the test vs. control trials, they did not look more quickly at the matching vs. nonmatching scene during the test trials, nor did they switch attention more during the control than test trials. Therefore, we have no evidence that English-learning children as young as 27 months of age are using the nominative and accusative animate pronoun gender-and-case markers to distinguish who-does-what-to whom.

The findings were more promising for the 36-month-olds. The switches of attention measure provides a minimal test of comprehension, because if children switch attention less during the test than control trials, then at the very least they are showing some sensitivity to the presence of the test audio, allowing it to (at least partially) direct their attention. And indeed, the 36-month-olds switched attention more during the control than test trials, $t(16) = 2.07$, $p = .027$. The latency of first look measure provides a stronger test of comprehension, because here the children, if they understand the nominative and accusative pronouns in the sentence, should take less time to look at the matching scene than at the nonmatching scene, and indeed they did ($t(16) = 2.31$, $p = .017$). Finally, the percent looking to match measures provide the strongest tests of comprehension, in that children who understand the test audio should actually *prefer* to look at, and look longer at, the matching scene. For the 'full trial' comparison, this effect was only marginally significant, ($t(16) = 1.57$, $p = .07$). This was likely because their preferences for the match during the first half (3 seconds) of the trial were more variable (see Table 2 and Figure 1; $t(16) = 1.29$, $p = .10$) than during the second half of the trial ($t(16) = 1.64$, $p = .059$).

Table 2 Means and standard deviations for each measure of comprehension		
Measure	27-month-olds	36-month-olds
Percent to match		
Control Trial	56.5 (8.5)	49.31 (10.1)
Full Test Trial	52.5 (8.7)	55.99 (11.1)
Test Trial—1st half	47.0 (15.6)	56.92 (17.4)
Test Trial—2nd half	55.9 (16.9)	55.47 (12.5)
Latency of first look to match in seconds during test		
Matching scene	2.26 (.89)	1.57 (.84)
Non-matching scene	2.14 (.74)	2.41 (1.31)
Switches of attention		
Control Trial	5.33 (.86)	5.61 (.65)
Test Trial	5.09 (.61)	5.15 (.83)

When we compared the 36-month-olds' looking behavior during the 'he is verbing her' trials vs. the 'she is verbing him' trials, we found significant and close-to-significant effects only for the latter. That is, when the children were hearing "she is pushing/kissing/ tickling him", they looked more quickly at the matching scene than the nonmatching scene (Ms of 1.23 seconds vs. 1.57 seconds, $t(16) = 2.21$, $p = .02$), and they looked longer at the matching scene during the 2nd half of the test trials compared with the control trials (see Figure 1; $t(16) = 1.611$, $p = .06$). When they were hearing "he is riding/hugging/ washing her" they exhibited no significant effects.

Figure 1: Children's match preferences
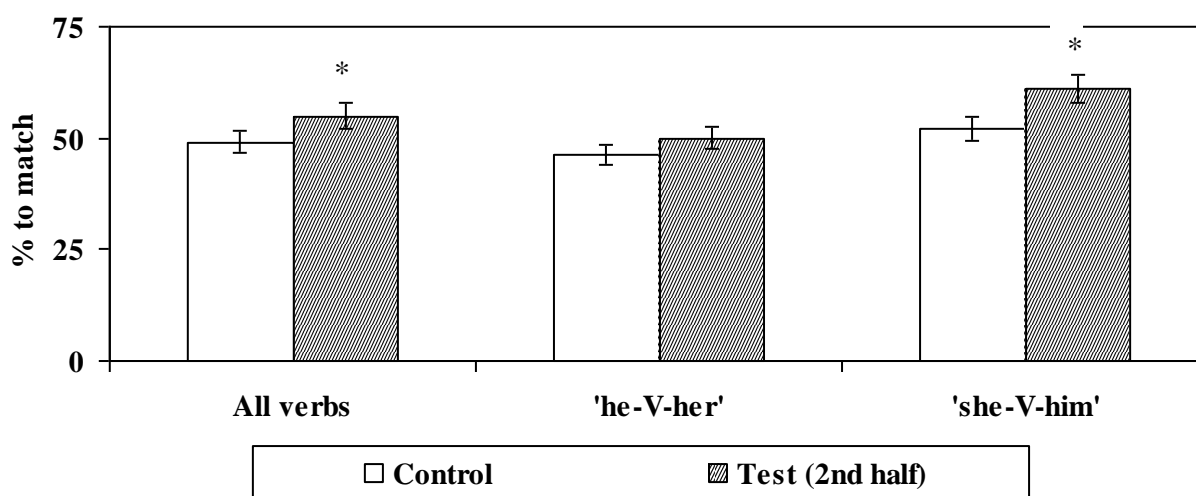
Discussion

Consistent with previous research on children's comprehension (Ibbotsen et al., 2011), the barely 3-year-old English learners in this study showed a strong tendency to use pronoun case, gender, and order information to understand reversible transitive sentences. Even with the easier task of looking rather than pointing or speaking, though, the 2-year-olds found this much more difficult and essentially looked randomly. Moreover, consistent with previous research on children's production (Rispoli, 1994, 1999), the 3-year-olds performed better with sentences with 'him' in object position than with 'her' in object position. Taken together, these findings shed light on the relative ease of processing of pronominal vs. full-NP transitive sentences, as well as on the acquisition of the case paradigm in English.

We have used almost-identical videos to the current ones (i.e., with a girl and a boy) to test toddlers' comprehension of transitive reversible sentences with full NPs, and found reliable performance in English learners as young as 21 months of age (Swensen et al., 2007). Similar good performance has been reported for videos with animal characters who are referred to with full NPs (Candan et al., 2010; Gertner et al., 2006). Therefore, the random performance of the 27-month-olds in the current study stands out, and indicates that comprehension of sentences in which pronominal resolution is necessary to determine who did what to whom, is more challenging than comprehension of sentences with full NPs, and is not fully acquired by this age group. Thus, even though previous findings have demonstrated that children of this age do process pronouns as *arguments* (Childers & Tomasello, 2001;

Fisher, 2002), the current findings illuminate that understanding a pronoun to be an argument in a sentence is not equivalent to understanding how the pronoun fills the different argument roles of the sentence. Clearly, the acquisition of pronominal use and reference progresses in multiple steps.

The current findings are actually somewhat surprising, though, because the children really needed only to resolve the reference of the first pronoun to select the correct video. That is, if they had understood that 'he' referred to male agents, or 'she' to female agents, they could have looked longer at the scene in which the boy was acting on the girl (or the girl acting on the boy) without fully understanding the object pronoun, or even the verb. The finding that the 2-year-olds did not consistently look longer at the matching scene suggests that they were processing the entire sentence, and working on resolving *both* pronouns. The finding that the 3-year-olds matched most consistently during the 2nd half of the test trial further promotes this interpretation, because at the point when the 2nd half of the test trial began, the children had heard the test audio twice (once during the inter-trial interval and once during the 1st half of the trial). If they needed to hear the sentence twice to successfully locate the matching scene, they then likely needed to hear (at least) the subject pronoun itself twice, if not the entire sentence. By either interpretation, these results contrast with those from Arnold, Brown-Schmidt and Trueswell (2007), who found that children aged four years and older *were* able to successfully resolve pronoun reference based on the gender and case of the *first* pronoun in the sentence. It is possible that we have identified an earlier point in development, when the gender/case information in a single personal pronoun is not sufficient to support consistent and successful scene selection.

Interestingly, the 3-year-olds in this study performed reliably with the three 'she verbs him' sentences, but less consistently with the three 'he verbs her' sentences. These trials were not blocked (i.e., the children heard one trial with 'he verbs her', followed by two trials with 'she verbs him', followed by two more trials with 'he verbs her', and a final trial of 'she verbs him'), so the facilitation of the 'she verbs him' trials cannot be attributable to either practice or fatigue effects. The current manipulation does confound pronoun order with specific verb, so future conditions will need to separate these; however, it is not immediately obvious that 'she pushes him', for example, should be easier to understand than 'he hugs her'. Moreover, the previous version of the task, when full NPs were used, yielded no effects of verb or gender-arrangement-of-characters (Swensen et al., 2007). We did further scrutinize the data to examine whether the girls and boys who participated in the study performed differently, with null results: Two of the five male participants did not look longer at the match during the test trials compared with the control trials, for the 'she verbs him' trials, and two *different* boys showed the same pattern for the 'he verbs her' audios. Overall, 12 of the 17 3-year-olds looked longer at the match during the test relative to the control trials for the 'she verbs him' trials whereas only 10 of the 17 did the same for the 'he verbs her' trials.

It seems possible, then, that the 3-year-olds' difficulty with understanding sentences with 'her' in object position may mirror their errors in production (Rispoli, 1994; 1997). That is, children around this age may expect 'her' to appear in subject position (having heard numerous instances of 'her + NP'), and may not fully understand that this lexical item also serves as a pronoun that designates female patients of actions. This interpretation is supported by another condition of Ibbotsen et al. (2011): Some of their test sentences included 'her' and 'him' in subject position, and 'he' and 'she' in object position, and the 43-month-olds (although not the 34-month-olds) consistently followed word order (and gender)

information rather than case information. As with their grammatical condition, though, each child only heard one 'him verbs she' and one 'her verbs he' sentence, so any asymmetry of gender would be difficult to uncover. Our current design, though, does not allow us to conclusively disentangle whether the difficulty with 'he verbs her' sentences is attributable to the presence of 'her' in object position or the specific verbs used. What remains intriguing is the possible parallel between the observation that 3-year-olds tend to produce 'her' in subject position (Rispoli, 1994), and the current finding that children of the same age have trouble understanding sentences with 'her' in object position.

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