Title: When animacy overshadows word order in sentence comprehension: The case of late first-language acquisition

Unlike hearing individuals who always have full access to language from birth, deaf individuals often have impoverished early language experience in childhood. Under some extreme circumstances, deaf individuals may acquire American Sign Language (ASL) as their first language (L1) after late childhood, resulting in poor language outcomes (Mayberry, 1993; Mayberry et al 2002; Frejan Ramirez et al, 2013; Cheng & Mayberry, 2019). This population provides a rare opportunity to investigate the sensitive period for language. One unanswered question is what strategies late L1 signers use to comprehend simple transitive sentences in ASL.

When comprehending transitive sentences, young children often use heuristic strategies and rely on non-linguistic cues, such as animacy and event plausibility, before they can fully rely on word order (Dodson & Tomasello, 1998; Strohner & Nelson 1974). Cheng and Mayberry (2020) found that late L1 signers of ASL also predominantly rely on event plausibility rather than word order (SVO in ASL) or subject animacy when interpreting implausible sentences like BANANA BITE BOY or DUCK CARRY CLOWN. However, the animacy features of the participating nouns can be confounded with event plausibility. Also, given that event plausibility is a strong cue in this population, it may overshadow the use of both animacy and word order. Therefore, it is not clear if late L1 signers of ASL can make use of either animacy or word order when comprehending implausible and non-reversible transitive events in ASL. On the other hand, all late L1 signers in this study had an extremely late ASL onset (after 9 years of age). It is crucial to also examine individuals with less severe delays in L1 ASL, in order to understanding the role of ASL onset on the acquisition and use of basic linguistic cues such as word order.

In the current study, we conduct two experiments to explicitly test the roles of animacy and word order during sentence comprehension with deaf late L1 signers with extremely late language onset (Exp. 1), and with deaf signers with various ASL onsets (Exp. 2). We adopted a sentence-picture matching task and crossed the two nouns in SVO ASL sentences (subject, object) with noun animacy (animate, inanimate), yielding four sentence conditions (Figure 1). All transitive sentences consisted of two nouns and one plain verb indicating implausible events and involved no human characters. We also included 4 filler conditions including both plausible and implausible intransitive events and spatial relations. Each condition includes 15 items, yielding 60 target items and 60 filler items. Experiment 1 was conducted in person with 5 deaf late L1 signers and 5 deaf native L1 signers. All deaf late L1 signers were born profoundly deaf, did not use hearing devices, and had minimal spoken/written language proficiency based on self-report. They all had an extremely late onset to ASL, ranging from 11 to 25 years of age; they all had at least 3 years of ASL exposure by the time of testing, ranging from 3 to 42 years. Experiment 2 will be conducted online, and we are currently recruiting participants. We plan to include 4 groups of L1 ASL signers with at least 9 years of ASL experience: Native Signers (NS, N=10, ASL onset 0-2yo); Early Signers (ES, N=10, ASL onset 3-5yo); Late Signers (LS, N=10, ASL onset 6-8yo); Severely Late Signers (SLS, N=10, ASL onset >9yo). In addition to the online comprehension task, we will also gather the following information: a) detailed language background information using a questionnaire; b) English reading comprehension skills using Woodcock Reading Mastery Tests; c) non-verbal cognitive skills using a group of standardized cognitive tests.

Results from Exp. 1 (Figure 2) show consistent use of word order with little interference from noun animacy for the native signers. In contrast, the Late L1 Signer group performed above chance when there is no animacy conflict (animate-animate, $z=4.45^{***}$; animate-inanimate, $z=5.12^{***}$; inanimate-inanimate, $z=3.25^{**}$), but only at chance level when the subject was inanimate and object was animate ($z=0.34$). These results indicate that 1) late L1 signers make use of both word order and animacy when an event plausibility cue is available; and 2) animacy plays a more salient role when the two cues conlict with each other. When animacy conflicts with the syntactic role, late L1 signers are less likely to rely on word order. In Exp. 2,

we expect to see increasing reliance on word order with earlier ASL age onset (NS>ES>LS>SLS). Alternatively, there may be a cut-off age of language onset such that word order is robust when acquired before a certain age (e.g. NS=ES=LS>SLS).

The current findings confirm previous findings, showing that when early language is impoverished, even basic linguistic cues appear to be less accessible to the learner. This incomplete learning may affect subsequent learning mechanisms, such as syntactic bootstrapping, impeding the further development of more complex sentence structures.

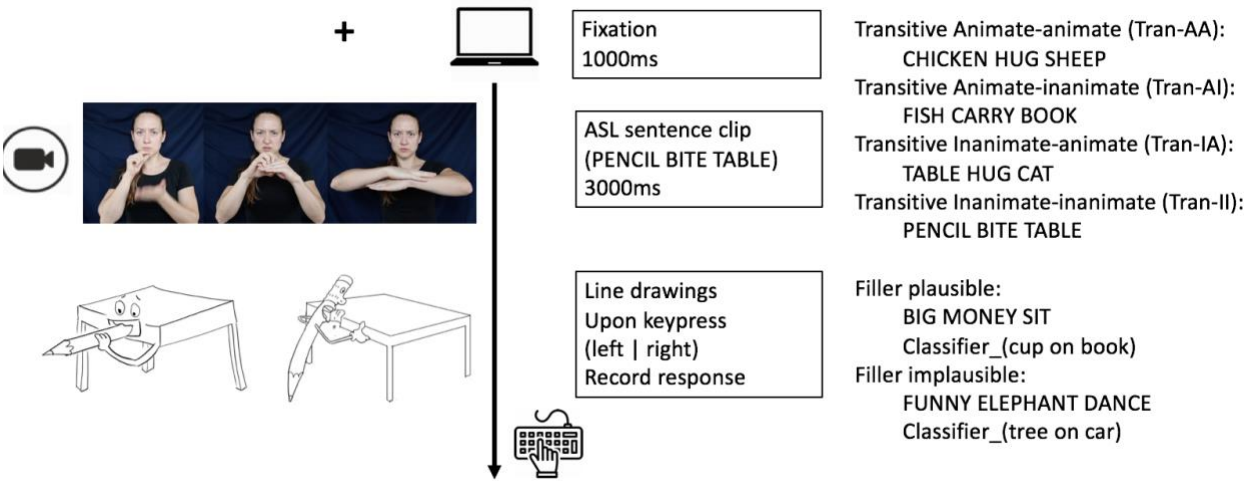

Figure 1: Experimental paradigm and conditions (with ASL gloss examples in upper case English)

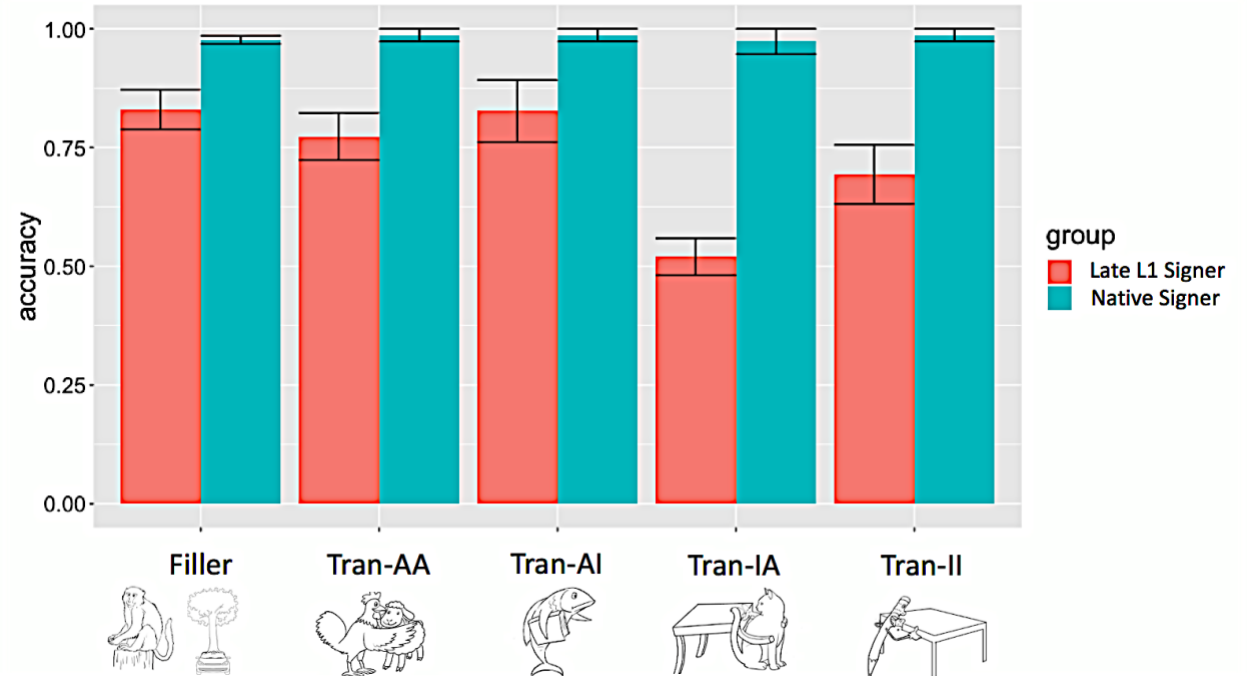

Figure 2: Group accuracy results of filler and target conditions (with matched picture examples)

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