Acquisition of the passive in English-learning children from different socio-economic statuses (SES): A comparison using computational cognitive modeling

English-learning children seem sensitive to certain lexical semantic features of verbs in their input when learning which verbs passivize [3]. Nguyen & Pearl (2019) (**N&P**) found that modeled children who attended only to certain available lexical features in their input, matched the observed passivization behavior from English five-year-olds.

But would the same learning strategy be effective across SES? That is, would we predict that the lexical variation present across SES would cause different learning outcomes in passivization because of the learning strategy's reliance on lexical items?

We use computational cognitive modeling to implement this learning strategy concretely and investigate the impact of SES-based input variation on the predicted acquisition of the passive. Using realistic estimates of input directed at 4- and 5-year-old children from both higher- and lower-SES backgrounds, our modeled learners across SES matched the observed performance in higher-SES children; this result suggests qualitative similarity in learning outcomes, despite input variation.

Following N&P, we model a child's decision about whether a verb with specific lexical features should be passivized as a classification problem implemented via Bayesian inference (1): given the profile's lexical feature values ($v_{f_1}...v_{f_n}$), should that profile be part of the class of passivizable profiles (c_{+pass})? We extracted the likelihood of lexical feature values (Table 2) from children's input across SES at the respective ages using the CHILDES Tree- bank [5] (Table 1). Our modeled learners attempt to passivize only verbs that four-year-olds (Profiles 1-3) and five-year-olds (Profiles 1-5) have been observed to passivize [3], based on the lexical feature probabilities in their input.

We find all modeled learners were able to generate the target behavior, given their input, by selectively learning from different subsets of lexical features. Interestingly, we found overlap within the age groups across SES: five-year-olds can attend to only (i) +TRANSITIVITY, or (ii) +OBJECT-EXPERIENCER or +ACTIONAL; four-year-olds can attend to only +TRANSITIVITY, +OBJECT-EXPERIENCER, +AGENT-PATIENT and (i) +SUBJECT- EXPERIENCER, or (ii) +ACTIONAL. Despite lexical input variation across SES, our modeled learners predict children to be able to learn passives from their input by selectively keying into particular lexical features across individual lexical items.

Word Count: 350

Table 1: Summary of the child-directed speech analyzed from the Brown-Adam, and the Brown-Eve (Brown, 1973), and Valian corpora (Valian, 1991) for high-SES families and the Brown-Sarah (Brown, 1973) and the HSLLD corpora (Dickinson and Tabors, 2001) for low-SES families.

	Corpus	Age Range	# of utterances	# of verb types	# of verb tokens
High SES	Adam, Eve, Valian	1;06-5;02	68,552	691	47781
Low SES	Sarah, HSLLD	1;06-5;01	65849	755	46,335

Table 2: Likelihood probabilities for individual lexical semantic features of verbs that appear in the passive, calculated from child-directed speech (CDS) input of four- and five-year-olds from higher- (*hi*) and lower-SES (*low*) backgrounds.

Age:	**four-year-old CDS**		**five-year-old CDS**	
SES:	*hi*	*low*	*hi*	*low*
ACTIONAL	0.81	0.81	0.82	0.78
STATIVE	0.08	0.11	0.07	0.11
VOLITION	0.88	0.82	0.88	0.79
AFFECTED	0.83	0.70	0.83	0.65
OBJ-EXP	0.07	0.04	0.07	0.04
SUBJ-EXP	0.03	0.07	0.03	0.08
AGT-PAT	0.80	0.74	0.80	0.71
TRANS	0.92	0.89	0.93	0.89

Table 3: Lexical semantic profiles comprised of the seven lexical semantic features taken from Nguyen and Pearl (2021). Example verbs are given above the profiles.

	chase	*annoy*	*find*	*forget*	*hate*
Profile	**1**	**2**	**3**	**4**	**5**
STATIVE	-	+	-	-	+
VOLITIONAL	+	+	-	-	-
AFFECTED	+	+	-	-	-
OBJ-EXP	-	+	-	-	-
SUBJ-EXP	-	-	-	+	+
AGT-PAT	+	-	+	-	-
ACTIONAL	+	-	+	-	-
TRANSITIVE	+	+	+	+	+

(1) $$P(c_{+pass}|v_{f_1},\ldots v_{f_n}) \propto \prod_{f_i \in F} P(v_{f_i}|c_{+pass}) \cdot P(c_{+pass})$$

References. [1] **Brown**. 1973. A First Language: The Early Stages. · [2] **Dickinson & Tabors.** 2001. Beginning Literacy With Language: Young Children Learning At Home And School. · [3] **Nguyen & Pearl.** 2019. Using Developmental Modeling to Specify Learning and Representation of the Passive in English Children. · [4] **Nguyen & Pearl.** 2021. The Link Between Lexical Semantic Features And Children's Comprehension Of English Verbal *Be*-Passives. · [5] **Pearl & Sprouse.** 2013. Syntactic Islands And Learning Biases: Combining Experimental Syntax And Computational Modeling To Investigate The Language Acquisition Problem. · [6] **Valian**. 1991. Syntactic Subjects In The Early Speech Of American And Italian Children.