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Proceedings of the Annual Meeting of the Cognitive Science Society, 47(0)

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Publication Date

2025

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Learning novel intransitive verbs from input cues: Experiments with Mandarin-learning toddlers

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Abstract

In two novel verb experiments using the visual fixation paradigm, we investigated how Mandarin-learning toddlers employ distributional cues and semantic cues to categorize novel unaccusative and unergative verbs. In Experiment 1, 31-month-old (but not 19-month-old) participants were found to use the word-order cue to categorize two novel verbs V_{UA} and V_{UE}: after hearing "V_{UA}-*le* NP" and "NP V_{UE}-*le*" in the training phase, they categorized V_{UA} as unaccusative and V_{UE} as unergative, showing discrimination in looking times between grammatical trials "NP V_{UA}-*le*" and ungrammatical trials "V_{UE}-*le* NP" in the test phase. In Experiment 2, 31-month-olds used the semantic cue of telicity provided via novel events to make categorizations: watching a telic event paired with "V_{UA}-*le*" and an atelic event paired with "V_{UE}-*le*" led to differentiation between grammatical trials "V_{UA}-*le* NP" and ungrammatical trials "V_{UE}-le NP". The findings provide evidence for toddlers' ability to extract information from the input and make generalizations in verb learning.

Keywords: verb learning; unaccusativity; input cues; the visual fixation paradigm; toddlers; Mandarin Chinese

Introduction

Verb learning is one of the core issues of language acquisition. To learn the argument structure of verbs, children might rely on various information from their linguistic environment, among which syntactic distribution and semantic features could be prominent cues. In the current study, we investigate how Mandarin-learning toddlers make use of these input cues to distinguish two types of intransitive verbs, unaccusatives and unergatives.

Unaccusative and unergative verbs are well-acknowledged for their subtle syntactic and semantic differences as well as cross-linguistic variation (Levin & Rappaport Hovav, 1995). The two verb classes differ in argument structure: unaccusative verbs select an internal argument (which usually takes the theme or patient role), while unergative verbs selects an external argument (which bears the agent role). This contrast is reflected in both syntactic structures and semantic representations. Syntactically, the argument in unaccusative sentences is base-generated in the post-verbal position, and thus behaves like the transitive object in some constructions, while the argument in unergative sentences exhibits properties of the transitive subject (Burzio, 1986; Perlmutter, 1978). Semantically, semantic features such as telicity are considered indicators that distinguish unaccusative events from unergative events: the former tend to be telic (such as for *fall*) and the latter atelic (such as for *cry*) (Van Valin, 1990; Zaenen, 1988). Despite some cross-linguistic variation, previous acquisition studies have found that toddlers and preschoolers from different language backgrounds are generally sensitive to the unaccusative-unergative distinction in their native languages (Dutch: Randall, van Hout, Weissenborn & Baayen, 2004; English: Becker, & Schaeffer, 2013; French: Snyder, Hyams & Crisma, 1995; Hebrew, European Portuguese, Palestinian Arabic, and Spanish: Friedmann, & Costa, 2011; Italian: Vernice & Guasti, 2015; Japanese: Sano, Endo & Yamakoshi, 2001; see also Babyonyshev, Ganger, Pesetsky & Wexler, 2001 for Russian-speaking children's non-adultlike performance).

In Mandarin Chinese, the two verb classes differ syntactically with respect to word order (cf. (1)), which could be taken as a distributional cue (e.g., Huang, 1987; Lu & Lee, 2020). Besides, they have contrasting semantic features in terms of telicity: unaccusatives tend to be telic (as *lai* 'come' in (1a)) while unergatives are generally atelic (as *xiao* 'laugh' in (1b)).

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(1) a. Unaccusative:
lai le yi-zhi da-xiang
come LE one-CL elephant
'There came an elephant.'
b. Unergative:
*xiao le yi-zhi da-xiang
laugh LE one-CL elephant
Intended meaning: 'An elephant laughed.'.

Sensitivity to this word order contrast has been observed in Mandarin-learning preschoolers (Lin & Deen, 2021), and toddlers as young as 19 months old in a visual fixation experiment (Wang, Yang & Shi, 2024). When tested with familiar unaccusative and unergative verbs (e.g., *lai* 'come' versus *xiao* 'laugh'), participants in Wang et al. (2024) distinguished grammatical from ungrammatical test sentences in terms of word order distribution (as shown in (1)). This early knowledge of unaccusativity raises the question for learning. How do toddlers learn the differences between unaccusative and unergative verbs? What do they extract from the input for learning?

Previous research has shown that preschoolers are able to make use of distributional and semantic cues in the input to learn verb use (e.g., Ambridge, Barak, Wonnacott, Bannard & Sala, 2018; Bowerman & Croft, 2008; Childers & Tomasello, 2001; Gropen, Pinker, Hollander & Goldberg, 1991). In Mandarin, the distributional cue of word order and the semantic cue of telicity are attested in the input as well. The word-order cue has been observed in adult input in Lu's (2019) corpus study: unaccusative verbs are used in both the canonical order and the inversed order, while unergative verbs are only observed in the canonical order. As for the telicity cue, preschoolers are able to associate telicity with unaccusative syntax, as shown in Lu (2019). In particular, four-to-five-year-old Mandarin-speaking children accepted the telic reading of "V-*le* NP" sentences with dual-class verbs (such as *pao*, which has both the unaccusative meaning 'escape' and the unergative meaning 'run') more often than the atelic reading, indicating sensitivity to the interaction between telicity and word order.

From the studies above, we know that children and toddlers are sensitive to syntactic and semantic features underlying unaccusativity, but whether and how these cues are actually used for learning remains unclear. Therefore, the current study aims at further filling the gap by investigating the role of these potential cues in learning the unaccusative-unergative distinction in Mandarin-learning toddlers. In what follows, we will report two novel-verb learning experiments using the visual fixation task that probed into the real-time learning processes of the syntactic contrast between unaccusative and unergative verbs. Experiment 1 examined toddlers' learning performance when the word-order cue was presented during the training phase, and Experiment 2 tested the telicity cue.

Experiment 1

In this experiment, we investigated whether the distributional cue of word order could help toddlers learn the unaccusative-unergative distinction. Two novel verb items V_{UA} and V_{UE} were taught to participants with the word-order cue, who were then tested on the ability of discriminating them in terms of verb use.

Participants

As reviewed above, 19-month-olds exhibited sensitivity to the different behavior of unaccusatives and unergatives in the inversion construction (Wang et al., 2024). Therefore, we recruited a total of sixty-four monolingual Mandarin-learning participants from two age groups: a younger group of 19-month-olds (n = 32; mean age: 603 days, range: 1;6;0-1;8;29, 22 boys and 10 girls), and an older group of 31-month-olds (n = 32; mean age: 960 days, range: 2;6;9-2;8;21, 18 boys and 14 girls). No hearing problems or language disorders were reported. Before the experiment, informed consent was obtained from the parents.

Stimuli and Design

The word order cue was manipulated in the auditory stimuli. The two novel verb items V_{UA} and V_{UE} occurred in different word orders during the training phase: V_{UA} was used in the inversed order sentence "V_{UA}-*le* NP" (-*le*: an aspect marker) while V_{UE} in the canonical order sentence "NP V_{UE}-*le*".[1] The training logic was as follows: if an intransitive verb is present in the inversed order, as in the case of V_{UA}, it should be categorized as unaccusative. In contrast, if it only occurs in the canonical order and is absent in the inversed order, as in the case of NP V-*le*, this can be indirect negative evidence that V_{UE} is not allowed in the inversed order sentences, which points to unergativity of V_{UE}. Each participant heard these two types of training trials in alternation for 65 seconds in the training phase, with a total of 12 V_{UA} sentences and 12 V_{UE} sentences.

In the test phase that came directly after the training phase, the two verbs occurred in the opposite word orders: V_{UA} in test sentences "NP V_{UA}-*le*" and V_{UE} in "*V_{UE}-*le* NP". The two types of trials formed a grammaticality contrast if the two novel verbs were correctly categorized in the training phase. Ten test trials (five for each verb) were played in alternation in the test phase. We measured participants' looking times in the two types of test trials to see whether they distinguished them. During all the training and test trials, the animation of a talking puppet was played on the screen synchronized with the auditory stimuli, as if the puppet was uttering the test sentences. In other words, there was no semantic matching relation between the auditory and visual stimuli.

Participants were divided into two groups. In Group 1, V_{UA} was realized as *shai* and V_{UE} as *man*. The pairings were exchanged for Group 2: *man* was V_{UA} and *shai* was V_{UE}. In

[1] In Experiment 1, there was no contextual information satisfying pragmatic demands of argument-drop, making it less possible to interpret "V-*le* NP" as subject-drop sentences.

this way, we can later conduct statistical analysis to see whether the items themselves somehow bias towards unaccusativity or unergativity, which would be an undesired confounding factor for the experiment.

Procedure

The participant sat on the parent's lap in front of a TV in a dimly lit acoustic booth. The visual stimuli were presented on the TV screen, and the auditory stimuli were played through loudspeakers on both sides of the TV. During the whole experiment, the parent wore headphones which played masking music so that he or she could not guide the child's looking behavior. The experimenter, who was blind to all stimuli, was in another room observing the children's looking performance on a monitor, which was connected to a video camera hidden under the display screen in the test room.

This experiment was run with an in-house computer program. During the training phase, each trial was initiated when the participant looked at the screen, and all trials were played in their full lengths whether the participant looked to the screen or not. The test phase was in an infant-controlled manner: all trials were started when children looked at the screen and ended when they looked away for over 2s or when the full trial length was played. The experimenter pressed a computer key when the participant looked at the screen, and looking time was automatically recorded by the computer program for later analysis.

Predictions

It was predicted that hearing "V_{UA}-*le* NP" during the training phase would lead participants to categorize V_{UA} as unaccusative and therefore judge "NP V_{UA}-*le*" in the test phase as grammatical. Similarly, if participants heard "NP V_{UE}-*le*" and took the absence of "V_{UE}-*le* NP" as the evidence for unergativity, they would treat "V_{UE}-*le* NP" as ungrammatical. The grammaticality contrast between "*V_{UE}-*le* NP" and "NP V_{UA}-*le*" would result in significant differences between looking times in the test phase. Besides, we also predicted that *shai* and *man* themselves did not bias towards unaccusativity or unergativity, which means no significant interaction between the within-subject factor Grammaticality and the between-subject factor Group.

Results

For each participant, the average looking time of grammatical trials ("NP V_{UA}-*le*") and that of ungrammatical trials (*V_{UE}-*le* NP") during the test phase were calculated. We compared their mean looking times in the two types of trials to see whether there was a significant difference showing discrimination behavior. Taken together, the two age groups exhibited a similar looking preference direction: the two-way ANOVA (with the within-subject factor being Grammaticality and the between-subject factor being Age) showed neither a significant interaction between Grammaticality and Age ($F(1, 62) = 2.415$, $p = .125$) nor a main effect of Age ($F(1, 62) = 1.225$, $p = .273$). We then zoomed in to see the performance within each age group.

The Older Age: Participants looked longer to grammatical trials (*Mean*: 14.377 s, *SE* = 0.850) than to ungrammatical trials (*Mean*: 12.517 s, *SE* = 0.722). The paired *t*-test showed a significant difference of looking times between the two types of trials ($t(31) = 2.741$, $p = .010$, two-tailed, Cohen's $d = 0.485$). Therefore, results in the older age group indicated that 31-month-olds distinguished sentences in the two orders with novel verbs V_{UA} and V_{UE}. They were able to learn the verb category of the novel verbs and made judgment on their syntactic distributions. See Figure 1 for looking times in the two types of trials.

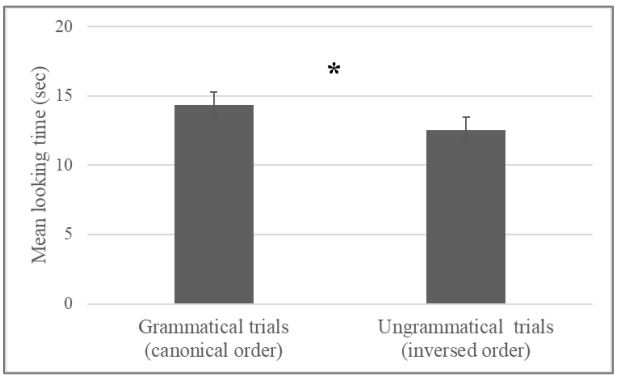

Figure 1: Mean looking time of the older age.

We further conducted a 2 x 2 mixed ANOVA to assess whether different verb items influenced participants' looking behavior. The within-subject factor was Grammaticality (grammatical vs. ungrammatical), and the between-subject factor was Group (Group 1 vs. Group 2). There was a significant main effect for Grammaticality ($F(1, 30) = 7.330$, $p = .011$, $\eta^2 = 0.043$), consistent with the paired *t*- test results. No significant main effect of Group ($F(1, 30) = 0.124$, $p = .727$) was found. Importantly, the interaction between Grammaticality and Group was not significant ($F(1, 30) = 0.245$, $p = .624$). That is, the discrimination pattern did not differ between Group 1 and Group 2, which suggested no verb item bias of *shai* and *man* towards unaccusativity or unergativity. Participants' categorization of these two verbs depended on the distributional information during the training phase.

The Younger Age: Overall, mean looking time during grammatical trials (*Mean*: 14.755 s, *SE* = 0.724) was slightly longer than that during ungrammatical trials (*Mean*: 14.345 s, *SE* = 0.808). Paired *t*-test results showed no significance difference in looking time between these two trial types ($t(31) = 0.641$, $p = .526$, two-tailed). There was no evidence that 19-month-old participants treated the two types of trials differently, unlike what we found in the older group. See Figure 2 for the looking time in the two types of trials.

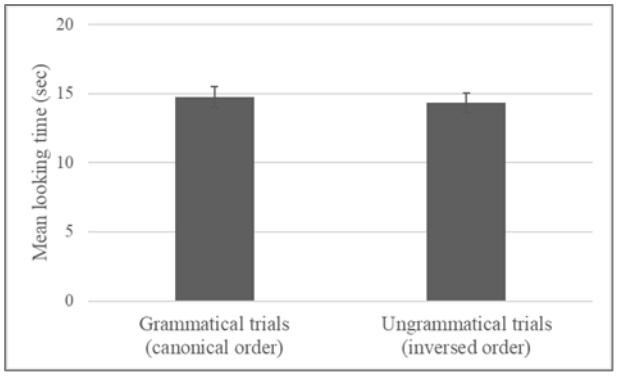

Figure 2: Mean looking time of the younger age.

The same 2 x 2 mixed ANOVA showed no main effect of Grammaticality ($F(1, 30) = 0.412$, $p = .526$), consistent with the results of the paired *t*-test. There was no significant main effect of Group ($F(1, 30) = 0.021$, $p = .887$). The interaction between Grammaticality and Group was not significant ($F(1, 30) = 1.054$, $p = .313$), suggesting similar looking patterns in the two groups.

Discussion

In this experiment, we taught participants novel intransitive verbs by providing only the distributional cue of word order. Results showed that 31-month-olds discriminated the types of trials in the test phase: they looked significantly longer to the grammatical trials "NP V_{UA}-*le*" than to the ungrammatical trials "*V_{UE}-*le* NP". This distinguishing behavior seemed to support the effect of indirect negative evidence: participants took the absence of "V_{UE}-*le* NP" in the training phase as evidence that V_{UE} cannot occur in the inversed order, leading to the particular looking pattern in the test phase when V_{UE} was used in this order. Note that in this experiment, the presence/absence contrast in inversed order sentences was made salient in the training phase: V_{UA} occurred exclusively in the inversed order while V_{UE} occurred exclusively in the canonical order. This contrast might draw participants' attention and make the indirect negative evidence strategy accessible to them, so that they can combine this incoming information with their prior knowledge on word order and unaccusativity to categorize novel verbs *shai* and *man*. This way, distributional cues act as a part of the learning processes towards full mastery of the unaccusative-unergative distinction.

As for the age difference, there are two possible reasons for lack of discrimination in the younger age group. To begin with, distinguishing the grammatical trials "NP V_{UA}-*le*" and the ungrammatical trials "V_{UE}-*le* NP" requires knowledge on word order. To be more specific, participants must know the asymmetry between the canonical order and the inversed order: verbs occur in canonical order sentences without extra conditions, but the inversed order is more selective in terms of verb categories. Though previous studies have found early sensitivity to canonical versus non-canonical word order in Mandarin at this young age, the knowledge might not be stable enough to be detected in experiments using fixation methods. Another reason is related to the experimental design. In this experiment, the training phase was relatively short. Participants were supposed to learn the uses of two novel verb items from the training input, combine it with prior knowledge of word order, and make generalizations in around one minute. It is possible that the current way of presentation in the training phase was not suitable for the younger group, and thus concealed their true abilities in verb learning. Further studies may explore alternative experimental settings to see whether younger children could learn better.

Experiment 2

In this experiment, we investigated whether the semantic cue of telicity could help toddlers learn the unaccusative-unergative distinction. The same two novel verb items V_{UA} and V_{UE} as in Experiment 1 were taught to participants, but this time with the telicity cue.

Participants

According to literature, knowledge of telicity was not observed until 2;6 (Behrend, Harris & Cartwright, 1995; Penner, Schulz & Wymann, 2003; Wagner, 2010). Therefore, we only recruited 31-month-old Mandarin-learning toddlers as participants. There were thirty-two participants in total (mean age: 956 days, range: 2;6;1-1;8;22, 16 boys and 16 girls), with no hearing problems or language disorders reported. Before the experiment, informed consent was obtained from the parents.

Stimuli and Design

The telicity cue was provided as visual stimuli. We created two novel events described by the two novel verb items V_{UA} and V_{UE}. In the unaccusative event, a cow character started from a standing position, and then toppled to its side until touching the ground. It was typical of an unaccusative event because it was telic and non-agentive. In the unergative event, the cow swung from side to side. It was typical of an unergative event because it was atelic and agentive. See Figure 3 and Figure 4 for the two novel events.

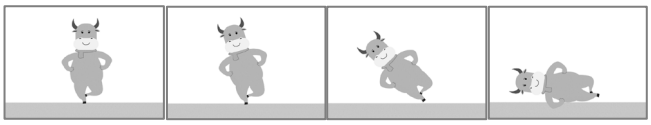
Figure 3: The novel unaccusative (telic) event.

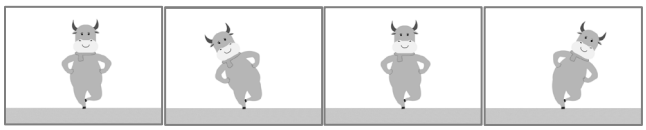
Figure 4: The novel unergative (atelic) event.

During the training phase, the unaccusative novel event was accompanied by the auditory stimulus of "V_{UA}-*le*", while the unergative novel event was accompanied by "V_{UE}-*le*". In this way, no clues on their syntactic distribution with respect

to word order were provided. In order to provide participants with enough time to process the events and to map them to the corresponding verb items, we presented the events and the "V-*le*" phrases multiple times in blocks. See Table 1 for an example of the unaccusative training block. Each participant was exposed to the two types of training blocks (i.e., V_{UA}-block and V_{UE}-block), which were played in alternation for three times, with a total of six training blocks (12 times for each type of training sentences) and roughly 90 seconds.

Table 1: An example for the unaccusative training block.

Visual	Audio	Timeline
	Xiaopengyou, kuai lai kan! 'Kid, come and look!'	2.5 sec
Unaccusative event	***shai*** *le* (two times)	5 sec
Black	*Fasheng le shenme ne?* 'What happened?'	2.5 sec
Unaccusative event	***shai*** *le* (two times)	5 sec

In the test phase, both verbs were used in the inversed order sentences. Grammatical trials contained test sentences "V_{UA}-*le* NP" while ungrammatical trials contained test sentences "*V_{UE}-*le* NP'. Ten test trials (five for each verb) were played in alternation, and we measured participants' looking times in the two types of test trials to see whether there was discrimination. During all the test trials, the animation of a talking puppet was played on the screen synchronized with the auditory stimuli, as if the puppet was uttering the test sentences.

A similar group division was conducted in this experiment: in Group 1, *shai* was V_{UA} and *man* was V_{UE}, whereas in Group 2, *man* was V_{UA} and *shai* was V_{UE}.

Procedure

The procedure was the same as in Experiment 1.

Predictions

If participants detected the contrast in the semantic features of the two novel events during the training phase and linked it to verb categorization, they would manifest different looking behavior in the two types of trials during the test phase. Again, no verb item bias was expected; that is, no significant interaction should be found between the within-subject factor Grammaticality and the between-subject factor Group.

Results

Similar to Experiment 1, participants in this experiment also looked significantly longer to grammatical trials (*Mean*: 14.796 s, *SE* = 0.749) than to ungrammatical trials (*Mean*: 12.411 s, *SE* = 0.921; paired *t*-test ($t(31) = 2.857$, $p = .008$, two-tailed, Cohen's $d = 0.505$), as shown in Figure 5. Again, no interaction between Grammaticality and Group was not significant ($F(1, 30) = 0.052$, $p = .822$) was found in this experiment, indicating no verb item bias between *shai* and *man*. 31-month-old Mandarin-learning toddlers distinguished the two novel verb items, indicating their ability to use the semantic cue of telicity to learn the unaccusative-unergative distinction.

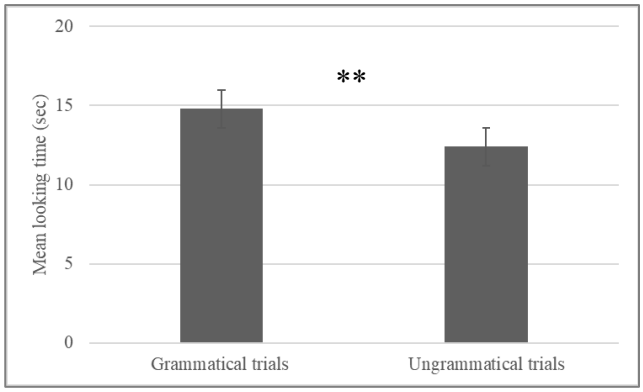

Figure 5: Mean looking time in the two types of trials.

Discussion

In this experiment, we taught 31-month-old participants novel intransitive verbs with the semantic cue of telicity. After watching two novel events that contrasted in the telicity feature, participants successfully distinguished the two novel verbs in the "V-*le* NP" constructions. In other words, toddlers linked the semantic representations of the two intransitive verbs to their syntactic structures during the learning process. This linking knowledge has been seen in studies with older children in other languages. For example, in Randall et al. (2004) the telicity feature guides German- and Dutch-speaking children aged 4-5 to choose between auxiliary BE and HAVE, which is relevant to the unaccusative-unergative distinction in the two languages. Our results further show that certain linking rules are present in early grammar before age 3, and are available in toddlers' verb learning processes.

General Discussion and Conclusions

In the current study, we investigate the role of input cues in learning the unaccusative-unergative distinction with two verb learning experiments. 31-month-old Mandarin-learning toddlers distinguished between novel unaccusative and unergative verbs in terms of verb use when they were trained with the distributional cue of word order (Experiment 1) and with the semantic cue of telicity (Experiment 2).

Our findings offer several insights to the study of learning mechanisms. To begin with, Experiment 1 found that the distributional contrast in the input acts as a useful cue for verb learning, proving the role of indirect negative evidence. This effect of indirect negative evidence has been observed in infants in other studies as well. For example, 14-month-olds used the absence of certain word orders to learn structures of an artificial grammar (Koulaguina & Shi, 2019; Shi & Emond, 2023). Young children are able to make inductions and generalizations on syntactic distribution by keeping track of direct and indirect evidence of the verb itself and of other items.

Secondly, results in Experiment 2 show that toddlers can make use of a semantic cue to predict syntactic distributions of unaccusative and unergative verbs. Previous findings show that 4-5-year-olds understand that telicity and word order interact in Mandarin, which influences their interpretation of dual-class familiar verbs (Lu, 2019). Our study further illustrates how this interaction facilitates the learning of novel verbs in early childhood. Considering the cross-linguistic variation on key features related to unaccusativity (see Levin & Rappaport Hovav (1995) for details), our findings suggest that at least in Mandarin Chinese, the telicity feature can be a robust cue for distinguishing the two types of intransitive verbs.

Thirdly, the age effect in Experiment 1 invites us to rethink about how experimental design might influence participants' performance at different ages. For now, we do not know the exact reason why 19-month-olds exhibited sensitivity to the word order contrast in previous studies but failed to show learning effects in this study, but this study can serve as a starting pointing for further exploration of younger children's learning processes as well as experimental settings that better reveal their abilities.

To conclude, the current study investigates how toddlers learn novel unaccusative and unergative verbs in the experimental environment, providing evidence for the role of input cues in verb learning. These findings demonstrate robust verb knowledge and powerful learning capacities in early childhood, shedding light on the learning mechanisms as well as theoretical issues of verb argument structure.

Acknowledgments

We are grateful to the children and parents who participated in the study, as well as members of Tsinghua Language Acquisition Lab as helpers: Miao Miao, Deming Shi, Le'an Luo, Jiarui Zhang, Yanting Li, and Yulun Wu. This work was supported by the National Social Science Fund of China (21BYY019) to Xiaolu Yang.

References

Ambridge, B., Barak, L., Wonnacott, E., Bannard, C., Sala, G. (2018). Effects of both preemption and entrenchment in the retreat from verb overgeneralization errors: Four reanalyses, an extended replication, and a meta-analytic synthesis. *Collabra: Psychology*, *4*(1): 23. DOI: https://doi.org/10.1525/collabra.133

Babyonyshev, M., Ganger, J., Pesetsky, D., & Wexler, K. (2001). The maturation of grammatical principles: evidence from Russian unaccusatives. *Linguistic Inquiry*, *32*(1), 1-44.

Becker, M., & Schaeffer, J. (2013). Animacy, argument structure and unaccusatives in child English. In M., Becker, J., Grinstead, & J., Rothman (Eds.), *Generative linguistics and acquisition: studies in honor of Nina M. Hyams*, 13-54. John Benjamins Publishing.

Behrend, D. A., Harris, L. L., & Cartwright, K. B. (1995). Morphological cues to verb meaning: verb inflections and the initial mapping of verb meanings. *Journal of Child Language*, *22*, 89-106.

Bowerman, M., & Croft, W. (2008). The acquisition of the English causative alternation. In M., Bowerman, & P., Brown (Eds.), *Crosslinguistic perspectives on argument structure: Implications for learnability*, 279-308. Lawrence Erlbaum Associates.

Burzio, L. (1986). *Italian syntax: a Government-Binding approach* (Vol. 1). Springer Science & Business Media.

Childers, J. B., & Tomasello, M. (2001). The role of pronouns in young children's acquisition of the English transitive construction. *Developmental psychology*, *37*(6), 739.

Friedmann, N., & Costa, J. (2011). Acquisition of SV and VS order in Hebrew, European Portuguese, Palestinian Arabic, and Spanish. *Language Acquisition*, *18*(1), 1-38.

Gropen, J., Pinker, S., Hollander, M., & Goldberg, R. (1991). Affectedness and direct objects: The role of lexical semantics in the acquisition of verb argument structure. *Cognition*, *41*(1-3), 153-195.

Huang, C-T. J. (1987). Existential sentences in Chinese and (in) definiteness. In E., Reuland, & A., terMeulen (Eds.), *The Representation of (in) Definiteness*, 226-53. The MIT Press.

Koulaguina, E. & Shi, R. (2019). Rule generalization from inconsistent input in early infancy. *Language Acquisition. 26*(4), 416-435.

Levin, B., Rappaport Hovav, M. (1995). *Unaccusativity: at the syntax-lexical semantics interface* (Vol. 26). The MIT Press.

Lin, K., & Deen, K. U. (2021). Unaccusativity in Mandarin child language. In D., Dionne & L. V., Covas (Eds.), *Proceedings of the 45th Annual Boston University Conference on Language Development*, 486-98. Cascadilla Press.

Lu, Y. (2019). *The acquisition of unaccusativity in Mandarin Chinese.* Doctoral dissertation, The Chinese University of Hong Kong.

Lu, Y., & Lee, T. H. (2020). Hanyu feibinge yu feizuoge dongci de jufa ji yuyi jieding biaozhun [Syntactic and

semantic criteria for unaccusative and unergative verbs in Mandarin Chinese]. *Dangdai Yuyanxue* [Contemporary Linguistics] *22*(4): 475-502.

Penner, Z., Schulz, P., & Wymann, K. (2003). Learning the meaning of verbs: What distinguishes language-impaired from normally developing children? *Linguistics*, *41*(2), 289-319.

Perlmutter, D. M. (1978). Impersonal passives and the unaccusative hypothesis. In J. Jaeger (Ed.), *Proceedings of the 4th Annual Meeting of the Berkeley Linguistics*, 157-189. University of California Press.

Randall, J., van Hout, A., Weissenborn, J., and Baayen, H. (2004). Acquiring unaccusativitity: A cross-linguistic look. In A., Alexiadou, E., Anagnostopoulou, & M., Everaert (Eds.), *The unaccusativity puzzle: explorations of the syntax-lexicon interface*, 332-70. Oxford University Press.

Sano, T., Endo, M. and Yamakoshi, K. (2001). Developmental issues in the acquisition of Japanese unaccusatives and passives. In A. H.-J., Do, L., Domínguez, & A. Johansen (Eds.), *Proceedings of the 25th Annual Boston University Conference on Language Development*, 668-83. Cascadilla Press.

Shi, R., & Emond, E. (2023). The threshold of rule productivity in infants. *Frontiers in Psychology*, *14*, 1251124.

Snyder, W., Hyams, N., & Crisma, P. (1995). Romance auxiliary selection with reflexive clitics: evidence for early knowledge of unaccusativity. In E. Clark (Ed.), *Proceedings of the 26th Annual Child Language Research Forum*, 127-36. CSLI, Stanford University.

Van Valin Jr, R. (1990). Semantic parameters of split intransitivity. *Language*, *66*(2), 221-60.

Vernice, M., & Guasti, M. T. (2015). The acquisition of SV order in unaccusatives: manipulating the definiteness of the NP argument. *Journal of Child Language*, *42*(1), 210-37.

Wagner, L. (2010). Inferring meaning from syntactic structures in acquisition: The case of transitivity and telicity. *Language and cognitive processes*, *25*(10), 1354-79.

Wang, Z., Yang, X., & Shi, R. (2024). Mandarin-learning 19-month-old toddlers' sensitivity to word order cues that differentiate unaccusative and unergative verbs. *Journal of Child Language*, *51*(2), 249-270.

Zaenen, A. (1988). Unaccusative verbs in Dutch and the syntax-semantics interface. *CSLI Reports*, 88-123. CSLI, Stanford University.