Sentence Comprehension Performance in Malay School-Age Children: A Preliminary Study

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ABSTRACT

When children struggle in understanding what they hear, it hinders them from learning optimally, which subsequently impacts their academic performance, and socially, their ability to develop friendships. The aim of the study was to examine children's ability in comprehending Malay sentences using a newly developed sentence comprehension task comprising of different sentence structures and cognitive demands. A conventional picture-pointing task was administered to 30 typically developing Malay children between the ages of 7;0 and 12;11 years old (Mean age in months = 119.33, SD = 16.09). Sentences consisted of (i) both canonical (subject-verb-object, SVO; subject relative, SR) and non-canonical structures (passives; object relative, OR), which were also (ii) manipulated in low, intermediate, and high cognitive load conditions. Analysis revealed that there were clearer distinctions in performance on the canonical vs. non-canonical sentences for children in the older age group (10;0 to 12;0) compared to the younger group (7;0 to 9;11), with better comprehension on the canonical structures. Both groups showed a developmental increment in comprehension performance from the simpler SVO and SR sentences to more complex passives and ORs. Although children in the older age group performed comparatively better on the canonical sentences across all cognitive loads, all children struggled as the cognitive demands increased from low to high load conditions within the sentences. In speech-language therapy practice, understanding typical developmental patterns helps clinician identify when a child may need support. The study provides valuable information for clinicians working with school-age children to better gauge their sentence comprehension abilities while being mindful of the diverse ways in which language can develop, particularly for those with neurodevelopmental conditions.

Keywords: Malay sentence comprehension; speech-language therapy assessment; school-age children; developmental language disorder

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INTRODUCTION

Sentence comprehension involves understanding the meanings conveyed by a sequence of words with the guidance of linguistic structures and constraints (Safi et al., 2020). It plays a crucial role in language development, especially for school-age children in the classroom, as they need to comprehend both oral and written instructions (Westby, 2005). Inadequate sentence comprehension abilities have been linked to struggles and negative effects on academic success, communication abilities, social and emotional wellbeing as well as relationships (Dalen, 2002; Desmarais et al., 2012).

In Malaysia, speech and language delay and/or disorder is the largest pediatric caseload seen by speech-language therapists (SLTs). A substantial portion of these children continue to receive educational support through, for example, Program Pendidikan Khas Integrasi (PPKI) school services throughout their school years. Both SLTs in the medical and educational sectors face a myriad of challenges in diagnosing and managing these children, particularly due to the lack of locally suitable resources, i.e., no available assessment tools and intervention programs that are based on local languages, culturally suited, and with relevant or timely content for primary school-age children. At present, there are works currently underway (e.g., Language Learning Lab, ICaRehab, UKM) to develop local language assessments to cater to this pressing need for improved identification tools to facilitate children's language remediation efforts (Joginder Singh et al, 2016; Chu et al, 2019).

To comprehend a sentence, listeners need to create the structure and meaning of the sentence word by word immediately (Traxler & Tooley, 2007; Borovsky et al., 2012) and begin comprehending from the sentence's onset (Marslen-Wilson et.al., 1980; Marslen-Wilson & Zwitserlood, 1989). They also build structure and meaning from available cues in the input, namely phonological, morphological, syntactic, and semantic cues (MacWhinney, 2001). Thus, comprehending sentences with a variety of grammatical elements such as passive, pronominal, and reflexive has been an area of interest in studies of children who present with language impairment such as developmental language disorder (DLD) (Montgomery & Evans, 2009) as they exhibit poorer performances on sentence comprehension tasks consistently compared to their typically developing (TD) peers (Marton & Schwartz, 2003; Montgomery & Evans, 2009).

DLD refers to a neurodevelopmental disorder which affects language acquisition and learning, with the person developing typically showing no signs of neurological damage, sensorial disabilities, cognitive impairment, and other pervasive neurodevelopmental disorders (Leonard, 2014; Bishop et al., 2017; Delage & Frauenfelder, 2020). Individuals with DLD often demonstrate clear indications of inadequate language skills, including speech-language intelligibility, syntax, vocabulary, grammatical skills, comprehension, and conversational abilities, when compared to their peers of the same age group (Rapin, 1996; Leonard, 2014; Bishop et al., 2017). Children with DLD's poorer performance in sentence comprehension compared to TD children has been linked with limitations in phonological short-term memory (Archibald & Gathercole, 2007), language long-term memory (LTM) (Gillam et al., 2019; Montgomery et al., 2021), controlled attention (CATT) (Lum et al., 2007; Marton et al., 2014; Gillam et al., 2019; Smolak et al., 2020) and verbal complex working memory (cWM) (Archibald & Gathercole, 2007; Gillam et al., 2019; Weismer et al., 1999).

Typically developing children have consistently shown superior performance in comprehension tasks across various sentence types (Van Der Lely, 1996; Friedmann & Novogrodsky, 2004; Montgomery & Evans, 2009; Montgomery et al., 2017; 2018) and cognitive

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loads (Robertson & Joanisse, 2010; Leonard et al., 2013) when compared to children with DLD. However, there is a gap in the existing literature with very few studies examining the relationship between sentence types, cognitive loads, and sentence comprehension for children using local languages. This gap underscores the significance of our current study, which seeks to examine the comprehension abilities in Malay school-age children on Malay sentences. Understanding sentence comprehension not only helps us learn more about language development in Malay native speakers, but also reveals how children process and interpret language in real-time. Having reference data on sentence comprehension abilities would subsequently allow researchers and clinicians to further examine the underlying mechanisms involved in understanding Malay sentence structures and meaning to inform identification and remediation.

RELATIONSHIP BETWEEN SENTENCE TYPES AND SENTENCE COMPREHENSION

Syntactically, Malay is very similar to that of English in which it is a strict word order language with subject-verb-object (SVO) sentences being the most used structure in its repertoire (Ahmad Rusli & Montgomery, 2020). Word order in sentences is associated with the statistical properties of the language. Canonical noun (subject)-verb-noun (object) (NVN) structures, such as SVOs and subject relatives (SR) sentences, allow for linear processing to determine "who did what to whom," with noun phrase 1 (NP1) representing the agent and noun phrase 2 (NP2) representing the patient (Montgomery et al., 2017) (e.g., "*Abang* (NP1) *menendang* (V) *bola* (NP2)"). These sentence types are processed seamlessly in an automatic fashion and is anticipated to pose minimal difficulty for native comprehenders compared to non-canonical noun (object)-verb-noun (subject) structures, which include passives and object relative (ORs) sentences (Van Der Lely, 1996; Friedmann & Novogrodsky, 2004; Montgomery & Evans, 2009; Wells et al., 2009; Montgomery et al., 2017) (e.g., passive: "*Bola* (NP2) *ditendang oleh* (V) *abang* (NP1)").

There are many crosslinguistic studies that have been conducted to examine children's developmental trajectory on their sensitivity to word order cues (in the case of canonical vs. non-canonical structures) when comprehending sentences. These studies reveal that children's sensitivity to word order improves with age, with older children demonstrating greater sensitivity to this cue compared to younger children (Dick et al., 2004; Montgomery et al., 2017). Studies by Dick et al. (2004) and Roland et al. (2007) found that comprehension abilities for different sentence types follow a pattern: SVO = SR > passive > OR. Within non-canonical sentence structures, children demonstrated better comprehension of passives compared to ORs (Dick et al., 2004; Montgomery et al., 2017). When comparing sentences with relative clauses, ORs were found to be more challenging for children to comprehend and were acquired at a later age compared to SRs, even though the words used in the clauses were similar (Abu Bakar et al., 2016; Choong, 2016). This tendency is observed in both children and adult speech in Malay since subject relative clauses are more prevalent than object relative clauses in the language repertoire (Razak, 2014).

Of more recent studies, the GEM (Gillam-Evans-Montgomery) model proposed by Gillam et al. (2019) and Montgomery et al. (2021) provides an insight into the complexities of sentence comprehension. Underlying sentence comprehension is the interplay of various cognitive constructs. These constructs include the mediating influence of fluid reasoning in pattern recognition, controlled attention (i.e., sustained attention, attention switching), language LTM (i.e., involving chunking of input and use of word order templates), and the indirect influence of

working memory (i.e., WM, comprising central storage and peripheral storage components). The model suggests that fluid reasoning, controlled attention, and language knowledge in LTM collectively contribute to variations in complex WM, subsequently impacting children's comprehension of both canonical and non-canonical sentence structures. It is important to note that the mechanisms underlying sentence comprehension differ slightly between TD children and children with DLD. For TDs, language-based LTM and fluid intelligence play indirect roles in influencing sentence comprehension, while controlled attention assumes a more substantial indirect role for children with DLD (Montgomery et al., 2021). All these constructs coupled with task requirements would influence how well children perform on sentence comprehension tasks.

Previous studies have also provided evidence that verbal complex working memory (cWM) is linked to the comprehension of different sentence types in children with DLD. For instance, verbal cWM has been found to be related to the comprehension of verbal *be* passive and lengthy subject-verb-object (SVO) structures (Montgomery, 2000; Montgomery & Evans, 2009). Similarly, studies involving TD children have shown a correlation between verbal cWM and the comprehension of passives and object relatives (OR) (Montgomery et al., 2008; Ahmad Rusli & Montgomery, 2017; Weighall & Altmann, 2011).

Studying the relationship between sentence types and sentence comprehension is crucial as it helps us understand how children navigate through understanding and using complex sentence constructions as they progress through their academic or school years, especially around the ages of 9- to 10-year-old (Curran, 2020; Montag & MacDonald, 2015). It is within these years that children have been reported in Western studies to begin using language more sophisticatedly (e.g., reliably comprehends noncanonical sentences) in their everyday learning (e.g., reading, writing), conversations, and narratives. These language mediums have typically been the platforms that speech-language therapists use in therapy to provide language intervention and support learning for school-age children in their academic endeavors.

However, in Malay, there are marked distinctions between colloquial and standard language usage. For colloquial use, sentences tend to be more casual, shortened, and sometimes grammatically simplified to prioritize ease and speed of communication. On the other hand, standard Malay as used in schools or formal settings, is more structured and adheres more strictly to grammatical rules. Sentences are fully formed with proper syntax to ensure clarity and completeness and are required for writing and formal oral communication. While it is crucial for children to be versed in both forms of Malay to navigate different social contexts effectively (e.g., switching from casual conversations with peers to academic tasks in the classroom), balancing these two language forms remains a challenge for speech-language therapists. In therapy, determining whether a child's difficulties stem from a language impairment or a challenge in mastering the different language forms adds another layer of complexity.

RELATIONSHIP BETWEEN COGNITIVE LOAD AND SENTENCE COMPREHENSION

Apart from sentence types, sentence comprehension performance is also influenced by cognitive load or the demands inherent within the sentence itself (Robertson & Joanisse, 2010). Cognitive load refers to the amount of processing, storage, computational space, and energy needed to perform a task (Kail & Salthouse, 1994; Michael et al., 2001). In the context of sentence comprehension, cognitive loads can be manipulated by making the stimuli more "informative,"

thereby increasing the effort required to process the cognitive demands and comprehend the sentence (Frank, 2013). Overcoming increased cognitive load in sentence comprehension necessitates cognitive capacity. Leonard et al. (2013) defined cognitive capacity as a broad ability that encompasses various cognitive processes such as attention, speed of processing, the use of processing strategies, storage, rehearsal, and retrieval of information, among others. For children who have limitations in their cognitive domains, comprehension of the language input may only be partially processed which may result in a slow and potentially inaccurate buildup of lexical and grammatical representations stored in LTM, ultimately resulting in inaccurate sentence comprehension outcomes (Leonard et al., 2013).

One of the challenges when designing sentence comprehension tasks is in disentangling sentence complexity from the load that it imposes on comprehenders. In Leonard et al's (2013) study, to determine the effect of children's cognitive capacity on their sentence comprehension performance, sentences were categorized into a low, intermediate, and high demand condition by manipulating the information contained within the sentences, while keeping the sentence type constant (by using only SVO sentences). Children were presented with 4 pictures and were asked to select the picture representing the target sentence amidst the foils. Findings revealed that interference resulting from the similarity between the target sentence and the information reflected in the foils contributed to differences among the conditions and between young TD children and children with DLD. While children with DLD showed similar scores for low and intermediate demand items, young TD children performed less accurately only on the intermediate demand items. These results align with a study by Robertson and Joanisse (2010), which also demonstrated that children's sentence comprehension performance decreased across different cognitive loads when the tests were manipulated not just for different sentence types but also sentence length. In studies where sentence length was manipulated, children with DLD have also been found to also perform poorer in comprehending longer sentences that contained redundant or non-essential modifying lexical material compared to shorter sentences. The poorer comprehension of longer sentences cannot be attributed to a lack of syntactic-semantic knowledge since the sentence structure and semantic information of both short and long sentences contain identical core semantic information (i.e., agent, action, patient); instead, it is linked to the difficulty in managing increased demands on phonological working memory (Montgomery, 2004).

Understanding how these linguistic and cognitive aspects in sentences interact not only informs us on the developmental milestones in children's language comprehension abilities, but also help uncover the strategies that children use in comprehension as well as possible underlying mechanisms that govern comprehension, which may work differently for different languages. The present study aims to use this linguistic and cognitive intersection to examine children's ability to comprehend Malay sentences.

METHODS

PARTICIPANTS

A total of thirty Malay school-age children, between the ages of 7;0 and 12;11 years old (*Mean* age in months = 119.33, *SD* = 16.09), who are studying in standard 1 to 6 across Malaysia participated in the study. All the children spoke Malay as their dominant language. Background information was obtained by the parents or caregivers to ensure that children have no report of any diagnosis of developmental difficulties or neurodevelopmental disorders (e.g., autism, attention

deficit hyperactive disorder, language impairment, specific learning disability) or indications of academic struggles (i.e., learning difficulty, specific learning disorders, slow learner etc.). Consent by parents and the children themselves were obtained prior to the study. The study was approved by the Human Research Ethics Committee of the Universiti Kebangsaan Malaysia (JEP-2023-052). A summary of the children's demographics is displayed in Table 1.

TABLE 1. Summary of children's demographic data

Children's age group (years; months)	Age (months)		Gender (%)		N
	Mean	SD	Male	Female	
Younger group (7;0-9;11)	105.93	6.88	3 (20%)	12 (80%)	15
Older group (10;0-12;11)	132.73	10.19	11 (73.3%)	4 (26.7)	15
Total	119.33	16.09	14 (46.7%)	16 (53.3%)	30

GENERAL TESTING PROCEDURES

Children completed a sentence comprehension task online using the video conferencing platform ZOOM individually from their respective locations. Some children had assistance from their parents in setting up their workstations to ensure that they were able to see and hear the task stimuli satisfactorily, however all children completed the study tasks by themselves without assistance. While this study was part of a bigger study on developing comprehensive language assessments for Malay-speaking school-age children and took much longer in completing the study's protocol, each session on the sentence comprehension task itself lasted for 10 to 15 minutes, depending on the children's speed and rest breaks in between when necessary.

TASK DEVELOPMENT

A conventional picture-pointing task was developed based on references from the Test for Receptive of Grammar version 2 (TROG-2) (Bishop, 2003), which is a widely used sentence comprehension assessment tailored primarily for English-speakers (from 4 years old to adults) in Western countries. Additionally, to discern cognitive capacity from syntactic complexity in the development of the sentence comprehension task, elements from the experimental task designed by Leonard et al. (2013) which focused on simple reversible SVO sentences and increases in cognitive demands as discussed above were used as a guide (see Table 2).

STIMULI DEVELOPMENT

SENTENCE TYPES

For this preliminary round of sentence development, a total of 32 sentences were constructed for the sentence comprehension task. The task consisted of 12 subject-verb-object (SVO) sentences, 12 subject relative (SR) center-embedded sentences, 4 passive sentences and 4 object relative (OR) center-embedded sentences. For each sentence, familiar words were used for the subject (NP1), object (NP2), and verbs across all sentences, ensuring control over potential lexical influences on children's sentence comprehension (Borovsky et al., 2012; Kidd & Bavin, 2007). Additionally, it was also important that the sentences were drawable. Therefore, the words selected required

similar considerations to ensure high imageability and were developmentally appropriate or familiar for school-age children. A total of 42 noun phrases, 36 verbs and 21 adjectives were included in the sentence constructions.

TABLE 2. Example of sentences used in the sentence comprehension task

Sentence types	**Low cognitive load**	**Intermediate cognitive load**	**High cognitive load**
	Sentences with basic word phrase elements.	*Sentences with additional semantically superfluous or* ***non-contrastive*** *adjectives to one or both NPs –* (*italicized below*).	*Sentences have additional* ***contrastive*** *adjectives to one or both NPs – (italicized below).*
Canonical sentences:			
Subject-verb-object	Anjing itu mengejar kucing.	Abang (*berbaju biru*) itu sedang minum jus oren (*dengan ais batu*).	Atuk yang *bertongkat* itu sedang membeli *sebuah* buku untuk nenek.
Subject relative	Lelaki yang sedang makan itu menonton televisyen.	Perempuan yang sedang menjual di pasar itu membungkus ikan (*yang segar*).	Perempuan *bertudung kuning* yang memegang tangan adik itu terjatuh di tangga *batu*.
Noncanonical sentences:			
Passive	Bayi itu dicium oleh atuk.		
Object relative	Tikus yang adik kejar itu melompat.		

COGNITIVE DEMANDS

To manipulate the cognitive demands of the sentences, sentences were categorized into three sets of cognitive load conditions: low, intermediate, and high. Following the design of sentences constructed in Leonard et al.'s (2013) study, in the *low load condition*, children were required to interpret basic subject-verb-object relations without any other accompanying details in the sentence (1); this was considered as the baseline or control level in terms of cognitive load. Sentences were the shortest in this condition compared to the rest. A post hoc test revealed a significant difference in the number of morphemes between sentences with low cognitive demand and those with other cognitive demand levels, while no statistical difference was observed in the number of morphemes between sentences with intermediate and high cognitive demands. All SVO, SR, passive, and OR sentence types were designed for this condition to determine how well children would progress in comprehending from simple to complex sentences. Since it is difficult to disentangle sentence complexity in non-canonical structures from the cognitive load that these types of structures impose on comprehenders (i.e., requiring syntactic movement), non-canonical sentences were only designed within the low load condition.

(1) Example low load condition for subject-verb-object, SVO (see Figure 1)
Target sentence: Anjing itu mengejar kucing.
Distractor NP1: Abang itu mengejar kucing.
Distractor verb: Anjing itu melihat kucing.
Distractor NP2: Anjing itu mengejar tikus.

In the *intermediate load condition*, to increase the difficulty from the baseline or control level, sentences were designed to be longer by adding semantically superfluous or non-contrastive adjectives to one or both NPs (2). This increases the length of the sentences that children would have to process but does not require them to discriminate between the details of the NPs in the sentence, when choosing the picture that corresponds to the sentence that they hear. Instead, children were required to make these decisions for sentences in the *high load condition*, whereby sentences have additional adjectives or descriptors that needed to be contrasted to determine "who did what to whom" (3). In this condition, children had to retain more information in memory and navigate between the sentences that they hear (auditory modality) and the target picture (visual modality) that depicts the NP with the correct descriptors.

(2) Example intermediate load condition for subject relatives, SR
Target sentence: Perempuan yang sedang menjual di pasar itu membungkus ikan (*yang segar*).
Distractor NP1: Lelaki yang sedang menjual di pasar itu membungkus ikan (*yang segar*).
Distractor verb: Perempuan yang sedang menjual di pasar itu memotong ikan (*yang segar*).
Distractor NP2: Perempuan yang sedang menjual di pasar itu membungkus sayur (*yang segar*).

(3) Example high load condition for subject-verb-object, SVO
Target sentence: Atuk yang bertongkat itu sedang membeli sebuah buku untuk nenek.
Distractor NP1: Atuk (tidak bertongkat) itu sedang membeli sebuah buku untuk nenek.
Distractor verb: Atuk yang bertongkat itu sedang menjual sebuah buku kepada nenek.
Distractor NP2: Atuk yang bertongkat itu sedang membeli beberapa buku untuk nenek.

*Words underlined are the distractors (categorized and NP1-, verb- and NP2 distractors), while *italicized* words are the additional adjectives or descriptors designed for the intermediate load condition.

TASK DESIGN

The task consisted of sentences as described (see Table 2) and the corresponding pictures drawn by professional artists to represent all the sentence types and cognitive demands above. The pictures were presented in a 4 x 4 format within the Microsoft PowerPoint interface, labeled numerically from (1) to (4) (see Figure 1) with the correct answer (target sentence) randomized across the task items. Each picture represented either the (i) target sentence, (ii) sentence with NP1 (subject) as the distractor, (iii) sentence with the verb as the distractor and (iv) sentence with NP2 (object) as the distractor. The distractors were systematically designed to capture error patterns that may potentially indicate strategies that the children used while comprehending sentences. In some instances, the sentences were semantically reversible, in which both NP1 or NP2 had equal chances or could plausibly serve as the agent (doer of the action) or patient (receiver of the action)

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in the sentence. For example, in the sentence '*Bayi itu dicium oleh atuk*' (the baby was kissed by the grandfather) either the baby or the grandfather could be interpreted as the subject or object.

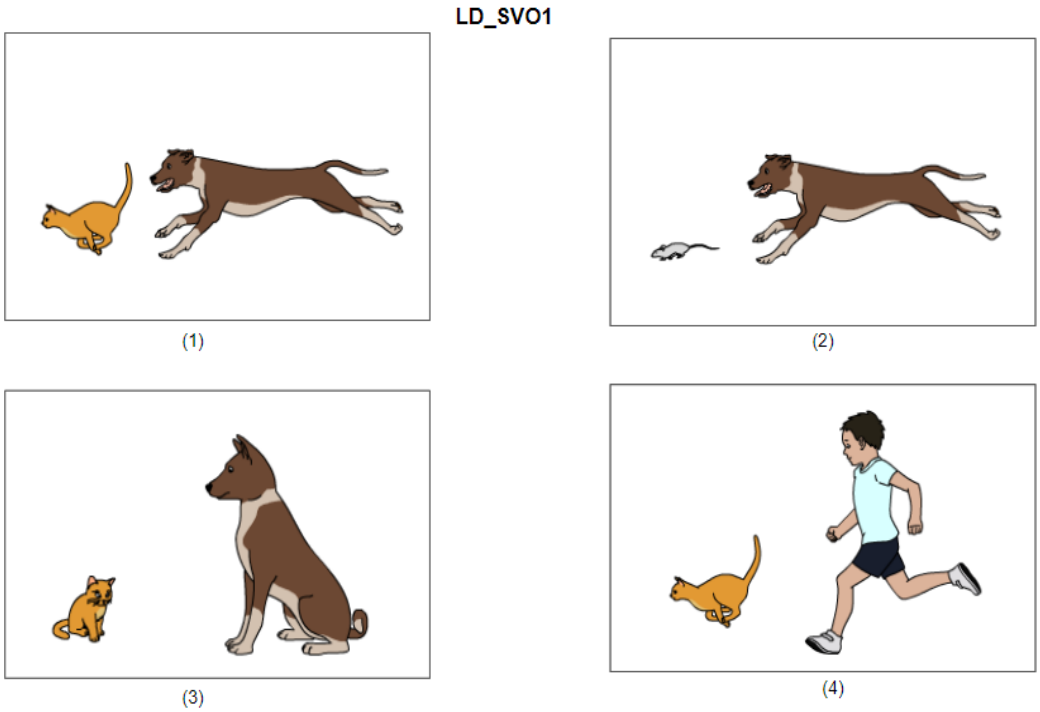

FIGURE 1. Example of pictures used and the arrangement in the sentence comprehension task

PROCEDURE

The children were instructed to listen to a sentence that was read aloud by the tester and point to the picture that best represents the sentence. They were instructed at the beginning of the task to listen very carefully since no repetitions were allowed (to avoid bias). Since testing was conducted online, children were asked to call out the number of the picture (from 1 to 4) to the tester. Practice items were presented to children prior to presentation of the test items which all children passed to ensure that the children understood the task requirements and instructions.

SCORING

A score of 1 was given when children called out the number of the picture of the target sentence and 0 for incorrect responses. Total scores for each sentence type (for the low cognitive load condition; SVOs, SRs, passives and ORs-- each sentence type over 4 points, totaling to over 8 points for canonical and non-canonical structures respectively) and for each cognitive load condition (for the canonical sentences; SVO and SRs-- each sentence type totaling to over 8 points within each condition) were tabulated. Errors that children made were also analyzed based on the distractors (i.e., subject, verb, or object distractors) that they selected incorrectly as the target sentence, across both canonical- and non-canonical structures.

DATA PREPARATION

Due to ceiling effect in children's performance in comprehending all SVO structures and sentences within the low load cognitive condition, data were found to violate the assumption of normality and failed to meet assumptions of sphericity and homogeneity of variance. Thus, a non-parametric test, Kruskal-Wallis One-Way ANOVA was utilized to investigate the developmental increment in comprehending different sentence types and cognitive demands within each age group (younger vs. older children). Subsequently, the Mann-Whitney U test was used to compare the overall performance in comprehending different sentence types and cognitive demands between the younger and older age groups of children.

RESULTS AND DISCUSSION

EXAMINING CHILDREN'S SENTENCE COMPREHENSION PERFORMANCE

The aim of this study was to determine the sentence comprehension performance of Malay school-age children by (i) examining the developmental improvement in comprehending sentences with different structures (canonical, non-canonical) and types (SVOs, SRs, passives, ORs), and (ii) investigating the effect of increasing cognitive loads (low, intermediate, high) on canonical sentence structures when controlling for sentence complexity.

PERFORMANCE ACROSS WORD ORDER AND SENTENCE TYPES

As anticipated from the literature, based on the performance mean scores on the sentence comprehension task, both younger and older groups of children performed better in comprehending sentences with canonical word order structures compared to the non-canonicals (see Table 3a). However, pairwise comparison results from Mann-Whitney *U* test revealed that these differences were not statistically significant; both younger and older children performed similarly in comprehending both canonical and non-canonical sentences ($p > 0.05$), implying that they did not find non-canonical sentences in the task to be substantially harder to comprehend.

Although no significant differences were found, this does not necessarily imply the absence of an effect. The small effect size obtained suggests that there was an influence of age on comprehension of canonical sentences between older and younger groups (Cohen's d = 0.125). Children from the older age group (*Mean Rank* = 16.40, n = 15) exhibited slightly higher performance metrics compared to their younger counterparts (*Mean Rank* = 14.60, $n = 15$), $U = 99.00$, $z = -0.638$ (corrected for ties), $p = 0.523$. Similarly, for non-canonical sentences, there was a small effect size of 0.208, with the older group (*Mean Rank* = 17.73, $n = 15$) performing better than the younger group (*Mean Rank* = 13.27, $n = 15$), $U = 79.00$, $z = -1.475$ (corrected for ties), $p = 0.140$, two-tailed. The relatively small sample of children and/or sentences used in this study may have contributed to the study's lack of statistical strength in detecting these trends significantly as only four sentences were assessed for each sentence type in the low cognitive load condition. In addition, the small effect size could also suggest that both groups of children may overlap in the use of sentence processing strategies, particularly with low cognitive load sentence types. These sentences are relatively easy to comprehend and are not likely to require distinct or more advanced processing strategies, which could also explain the minimal differences observed between the groups.

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TABLE 3a. Children's sentence comprehension performance according to word order categories and breakdown in sentence types

Children's age group	Word order	Mean	SD	Mean rank	*p*	d
Younger (7;0-9;11)	Canonical	7.40	0.737	14.60	0.140	*0.125
	Non-canonical	6.80	0.862	13.27	0.140	**0.208
Older (10;0-12;11)	Canonical	7.60	0.507	16.40	0.523	
	Non-canonical	7.27	0.799	17.73	0.523	

*Effect size for between age group (younger vs. older) comparison for canonical word order
**Effect size for between age group comparison (younger vs. older) for non-canonical word order

TABLE 3b. Children's sentence comprehension performance breakdown according to sentence types

Children's age group	Word order	Sentence types	Mean	SD	Mean rank	*p*	η^2_p
Younger (7;0-9;11)	Canonical	SVO	3.87	0.352	37.70	0.171	0.747
		SR	3.53	0.516	28.20	0.171	
	Non-canonical	Passive	3.53	0.640	29.40	0.171	
		OR	3.33	0.900	26.70	0.171	
Older (10;0-12;11)	Canonical	SVO	4.00	0	38.00	0.035	1.265
		SR	3.60	0.507	30.27	0.035	
	Non-canonical	Passive	3.67	0.617	29.77	0.035	
		OR	3.60	0.632	23.97	0.035	

To further examine children's performance in comprehending different sentence types within their respective age groups, Kruskal-Wallis One-Way ANOVA was computed (see Table 3b). For older children, results showed that there were significant differences in performance across sentence types; comprehension of SVOs (*Mean Rank* = 38.0), SRs (*Mean Rank* = 30.27), passives (*Mean Rank* = 29.77), and OR sentences (*Mean Rank* = 23.97), $H = 8.616$ (corrected for ties), $df = 3$, $n = 60$, $p = 0.035$, Cohen's $f = 1.265$. Results from older children align with previous research indicating distinct developmental trajectories in the comprehension of various sentence types (Montgomery et al., 2017). For canonical structures, children in the older age group demonstrated the highest comprehension scores for SVOs followed by SRs consistent with Montgomery et al.'s (2017) study which reported that their older children performed significantly better in comprehending SVOs (80%) compared to SRs (66%; $p<0.05$). For non-canonical structures, the older group exhibited better comprehension performance for passives compared to ORs which is in line with Ahmad Rusli and Montgomery's (2017) findings. Overall, the comprehension of different sentence types displayed a decreasing trend from SVOs, SRs, passives to ORs (easiest to hardest to comprehend sentence types) among the older age group.

However, a similar trend was not observed among children in the younger age group, with no statistically significant differences obtained between the sentence types and comprehension performance: comprehension of SVOs (*Mean Rank* = 37.70), SRs (*Mean Rank* = 28.20), passives (*Mean Rank* = 29.40), and OR sentences (*Mean Rank* = 26.70), $H = 5.011$(corrected for ties), $df=3$, $n=60$, $p=0.171$, Cohen's $f=0.747$. Although similar to the older age group, whereby children achieved the highest score in SVOs and the lowest score in ORs, their performance on SRs was slightly poorer than on passives. One possible explanation for the lower performance on SR sentences could be the longer sentence length presented in the SR sentences (*Mean sentence length* = 7.5 words) compared to passive sentences (*Mean* sentence length = 5 words). This finding is somewhat related to Montgomery's (2004) sentence comprehension task, which suggested that

sentence length poses a challenge to the phonological working memory capacity in children with language impairment, although no detrimental effect was observed in typical developing children's comprehension performance.

For both age groups, SVO sentences posed the least difficulties as the children could process these canonical sentences linearly (Friedmann & Novogrodsky, 2004; Montgomery & Evans, 2009; Van Der Lely, 1996) while OR sentences proved to be the most challenging. The increased difficulty of the non-canonical OR structures likely stems from their complex linguistic-working memory demands, requiring the children to temporarily store both NP1 and NP2 while also reactivating NP1 from memory to establish a long-distance syntactic dependency (Finney et al., 2014; Roberts et al., 2007; Ahmad Rusli & Montgomery, 2017).

PERFORMANCE ACROSS COGNITIVE DEMANDS

Descriptive analysis depicts a declining trend in sentence comprehension performance scores across low to high cognitive load conditions for children in both age groups. Within each cognitive load condition, children from the older age group performed better than the younger group (see Table 4). Recall again that only canonical structures (i.e., SVO and SR sentences) were examined for this purpose.

TABLE 4. Children's sentence comprehension performance according to cognitive demands

Age group	Cognitive load conditions	Mean	SD	Mean rank	*p*	η^2_p
Younger (7;0-9;11)	Low	7.40	0.737	28.32	0.031	0.427
	Intermediate	7.13	0.743	24.37	0.031	
	High	6.20	1.424	16.40	0.031	
Older (10;0-12;11)	Low	7.60	0.507	27.90	0.098	0.342
	Intermediate	7.27	0.704	22.70	0.098	
	High	6.60	1.454	18.40	0.098	

Kruskal-Wallis One-Way ANOVA was used to further examine the relation of cognitive demand and sentence comprehension within age groups. For younger children, results indicated that there were statistically significant differences between their performance on sentences in the low (*Mean Rank* = 28.32), intermediate (*Mean Rank* = 24.37), and high cognitive load condition (*Mean Rank* = 16.40), $H = 6.973$ (corrected for ties), $df = 2$, $n = 45$, $p = 0.031$, Cohen's $f = 0.427$. However, results for older children did not yield statistical significance although the trend of performance (from the descriptive statistics) was similar on the low (*Mean Rank* = 27.90), intermediate (*Mean Rank* = 22.70), and high cognitive load conditions (*Mean Rank* = 18.40), $H = 4.640$ (corrected for ties), $df = 2$, $n = 45$, $p = 0.098$, Cohen's $f = 0.342$.

Findings support the hypothesis that as the cognitive demand imposed in sentences increases, sentence comprehension performance decreases significantly. These results are consistent with previous studies that show a consistent decrease in comprehension performance of canonical sentences as cognitive demand increases from low to high levels and a better comprehension performance in older compared to younger children (Leonard et al., 2013; Robertson & Joanisse, 2010).

ANALYSIS OF ERROR PATTERNS

Finally, we examined the types of errors made by the children on the sentence comprehension task. Errors were categorized within the respective distractor groupings based on the incorrect responses made. Analysis encompassed the canonical sentence structures within all cognitive load conditions and non-canonical sentence structures for the low load condition only. It is important to highlight that these distractors were deliberately designed to observe error patterns that may help us infer on comprehension strategies employed by children, particularly among the younger age group and for sentence types that is presumed to impose more cognitive demands in processing (i.e., high load conditions, non-canonical structures) (see Table 5).

TABLE 5. Children's sentence comprehension error patterns according to canonical vs. noncanonical structures and cognitive load conditions

Age group	Sentence structures	Sentence types	Cognitive load conditions	*Correct responses	Categories of distractors (n = inaccurate responses)			
					Subject	Verb	Object	Reversible
Younger (7;0-9;11)	Canonical	SVO	Low	57	0	0	3	
			Intermediate	57	0	1	2	
			High	42	2	5	11	
		SR	Low	53	1	2	4	
			Intermediate	53	1	0	6	0
			High	50	3	1	6	
		Total canonical errors			7	9	32	0
	Non-canonical	Passive	Low	58	1	1	0	5
		OR	Low	48	1	7	4	
		Total non-canonical errors			2	8	4	5
Older (10;0-12;11)	Canonical	SVO	Low	60	0	0	0	
			Intermediate	58	0	0	2	0
			High	47	4	6	3	
		SR	Low	53	1	0	5	
			Intermediate	50	3	2	5	
			High	52	4	3	1	
		Total canonical errors			12	11	16	0
	Non-canonical	Passive	Low	57	1	1	1	1
		OR	Low	55	1	3	1	
		Total non-canonical errors			2	4	2	1

*The total number of correct responses per each sentence type x cognitive load condition is over 60.

The Cronbach's alpha value for the 32 items in the sentence comprehension task is 0.806, which signifies good reliability. However, within these 32 items, three specific ones, namely, SR item #3 (low load), SR item #7 (intermediate load), and SVO item #10 (high load), were answered incorrectly by at least 70% of the children. This suggests a need for revisions in the picture choices associated with these sentences, rather than the design of the sentences themselves.

While children's overall correct responses were high, it indicates that both older and younger age groups find canonical sentences relatively straightforward to comprehend and demonstrate proficiency in using word order cues to navigate through non-canonical sentence structures. This corresponds to the literature for typically developing English speaking children. Initially, children relied primarily on animacy cues to interpret sentences at their early stages of

language development. They subsequently transition to using word order cues to process canonical word order (SVO) (e.g., by 4 years old) but still depend on animacy cues for non-canonical word orders (i.e., passives, OR). Finally, as children transition to school-age, they are able to use word order cues to process non-canonical sentences (Evans & MacWhinney, 1999).

In terms of the errors made at this stage of the task development, there did not seem to be a clear pattern on why they were made, most likely due to the relatively small number of children recruited in the study (n=30). However, certain anticipated errors did occur, such as a higher overall error count across all types of distractors when the cognitive load increased for both groups of children, which could indicate that as it was harder for children to retain and discriminate the information heard in memory, children were guessing to determine who did what to whom. Additionally, younger children struggled to select the correct target picture when presented with reversible sentences. This challenge may have come about from the absence or ambiguity of animacy cues, which can complicate sentence processing especially in reversible sentence structures or when animacy is not explicitly stated (Shi et al, 2022). There were also others that were not predicted, for example, higher overall selection of objects distractors as the target, even for canonical sentence structures. Nevertheless, it would be beneficial to reemploy similar analysis in future studies and in the case of the present study, to clearly delineate what the selection of different distractors implies regarding children's sentence processing strategies.

CONCLUSION

The present study offers valuable insights into the relationship between sentence types, cognitive demands, and sentence comprehension performance in Malay school-age children. Findings revealed that as the complexity and processing demands of sentences increase, children generally encounter greater challenges in understanding and processing the information. It presents trajectories of developmental improvement in children's sentence comprehension abilities across younger to older ages in primary school-age children, with ease in comprehension more evident for simpler and commonly used sentence types in the Malay language.

Insights gained from this study can also inform the field of speech language therapy as well as educational practices in developing the much-needed language assessments for school-age children with language difficulties and to pave the way for more evidence-based intervention and language teaching materials to support children's language development and learning. Notwithstanding the sentence comprehension task utilized in the present study was first and foremost intended to be used as a screening tool for speech-language therapists in determining children's receptive abilities in the sentential domain, to identify children with developmental language disorder specifically, and other neurodevelopmental disorders with accompanying language impairment generally, instead of indexing scholastic performances.

Future studies can continue to disentangle how sentences of different complexities are used in everyday Malay conversations, and/or in the school context to provide a blueprint on the designs of language assessment tool. As such, efforts to consolidate the sentence comprehension task used in the present study into a more comprehensive language assessment would also be timely, primarily to add on the total number of stimuli per sentence types and cognitive load conditions, as well as increasing the number of children across the different age ranges for more robust statistical and error analysis. Studies could also include other types of familiar sentences that are often used in schools (e.g., negations, questions, etc.), and include data from the clinical population

(e.g., children with developmental language disorder) to determine the utility of the test in identifying children who have comprehension difficulties.

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