

Original Article

'Huh – That's Not Possible!' Comprehension Monitoring in Children With Developmental Language Disorder and Typically Developing Peers at Kindergarten and School Age

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Purpose Comprehension monitoring (CM) refers to the ability to detect one's own misunderstanding and to respond appropriately, for instance, by asking questions. This study aimed to compare CM in children with typically developing language (TDL) in kindergarten (n = 30) and school age (n = 30) with children with developmental language disorder (DLD) in kindergarten (n = 26) and school age (n = 22).

Methods In this exploratory, hypothesis generating study, the children received instructions on a digital device that were sometimes incomprehensible for various reasons (e.g., ambiguity, impossibility, unknown words). Reactions to incomprehensible instructions were assessed by identifying misunderstandings as the first step in the comprehension monitoring (CM) process.

Results The results revealed significant age effects in overall CM for children with TDL, as well as in reasons for non-comprehension. In contrast, such effects were largely absent in children with DLD, except for minor differences in the area of ambiguity. Regarding language status, differences between children with TDL and DLD at kindergarten age were found only for ambiguity. At school age, however, clear group differences emerged in overall CM and across all reasons of non-comprehension, except for overly complex utterances.

Conclusions These findings suggest that CM difficulties in children with DLD are not particularly pronounced at an early age but appear to stagnate with age. By school age at the latest, many children with DLD experience significant impairments in CM, which can have a long-term negative impact on their learning success.

Keywords comprehension monitoring, developmental language disorder, digital diagnostic

INTRODUCTION

A teacher asks a child with a developmental language disorder (DLD) to bring him a triangle. The child retrieves a book and hands it to the teacher. This example illustrates that the child fails to recognize a breakdown in comprehension, specifically the unfamiliar word 'triangle', and is therefore unable to initiate clarification. The process by which an individual detects and responds to comprehension failures is referred to as *comprehension monitoring* (CM) [1].

Children with developmental language disorder (DLD) frequently encounter difficulties in communication and learning during both preschool and school years as a result of their language impairments. These challenges can lead to significant long-term consequences, including an elevated risk of learning and behavioural problems [2,3]. *Comprehension monitoring* (CM), described by Dollaghan and Kaston as a "survival skill" [1], is considered a particularly crucial strategy in this context. However, CM is often impaired in children with DLD. The present study aims to compare CM in children with typical language

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development (TDL) and those with DLD at both kindergarten and school age, to examine potential age- or DLD-related effects.

Theoretical background

Comprehension monitoring (CM) attracted considerable interest during the 1970s and 1980s, particularly in the context of referential communication, although this interest later declined. In recent years, however, CM has regained attention as a critical strategy for reading and listening comprehension [4]. Educational research has identified CM as a key skill contributing to academic success [5].

CM is a higher-order cognitive skill closely associated with listening comprehension and oral language abilities [6,7]. Research interest in CM lies at the intersection of pragmatics, higher-level language skills, and cognition [8,9]. CM encompasses two core processes: evaluation/identification and clarification/reaction [10,11]. Figure 1 illustrates these two complex steps involved in oral communication.

In the first step, the listener attempts to construct a mental representation of the intended meaning. If this attempt fails (e.g., due to inadequate acoustic conditions), and the individual is aware of the failure, a comprehension problem is identified. However, if no effort is

made to construct meaning, or if the effort is perceived as successful despite a misunderstanding, the problem may go unnoticed. Recognition occurs only when the individual evaluates the representation (e.g., an impossibility or an unfamiliar word), using appropriate criteria (e.g., plausibility, ambiguity, completeness). Ambiguities in particular require the listener to adopt the speaker's perspective or to recognize whether a definite or indefinite article was used when referring to objects (e.g., show me the girl or a girl). If utterances are too complex, the listener must realize that he cannot process all aspects.

Once a problem is recognized, a response as the second step may follow, such as a specific clarification request (e.g., "What does xy mean?"), a general question (e.g., "What?" or "Huh?"), a nonverbal signal (e.g., a puzzled expression), or inferencing based on contextual or world knowledge. If the problem is not recognized, there may be no reaction or an inappropriate one [11,12]. However, distinguishing between these two processes—identification and reaction—poses methodological challenges and has received limited attention in empirical studies.

Our understanding of CM in oral contexts remains particularly limited [7]. One challenge is that comprehension is not a binary process; instead, varying degrees of understanding—often based on inference—are possible. Consequently, it is difficult to define what constitutes complete compre-

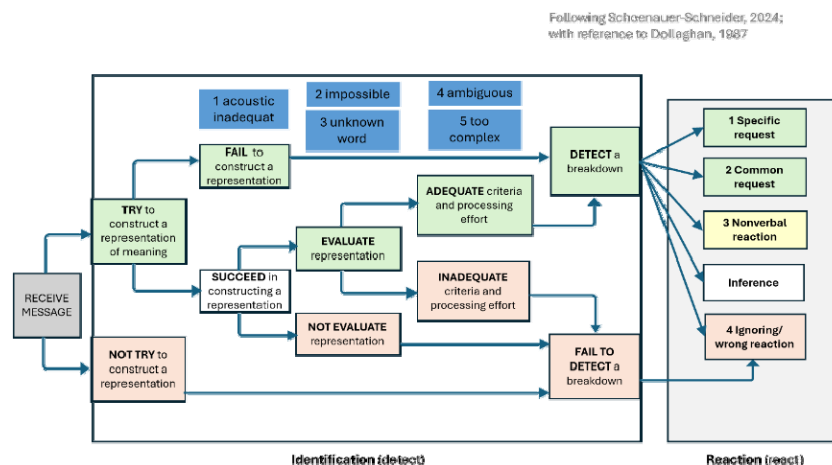


Figure 1. two-step model of CM

hension or CM, to establish consistent criteria for it, or to determine how it is acquired during language development [13].

Research on CM in listening comprehension has primarily focused on sentence- and text-level processing. At the text level, studies have examined whether children can detect violations of expectations or inconsistencies within narratives [4,9,14,]. Such investigations have sought to capture the identification of comprehension breakdowns, for example, by asking children to judge whether a short story was “silly” and to explain why [4], or by using evaluative prompts such as “What do you think?”, “Do you have any questions?” “Did I forget to tell you anything?”, or “Did everything make sense?” [15]. In reading contexts, comprehension monitoring has also been explored through eye-tracking measures [16].

At the sentence level, the identification component of CM is more challenging to assess. Consequently, studies have primarily focused on children's responses as indicators of effective CM—specifically, whether they reacted to acoustically degraded utterances (e.g., rapid or garbled speech, background noise), semantically implausible or ambiguous statements, syntactically complex constructions, or sentences containing unfamiliar vocabulary by asking clarification questions [1,17,18].

When CM was assessed under neutral experimental conditions, children's recognition of comprehension breakdowns was often low. Only when children were explicitly instructed to detect inconsistencies or misunderstandings did they show improved problem identification. This highlights that knowing *when* and *how* to request additional information is a critical skill for effective listening [19,20]. Other factors that enhanced CM in experimental designs included low levels of abstraction, e.g., using concrete objects, high task structure, and increased motivation [21,22].

The present study focuses on CM at the sentence level, as this closely resembles the process of identifying and repairing comprehension breakdowns during instructional interactions in educational settings—making it partic-

ularly relevant to academic success. We will therefore limit ourselves to CM at the sentence level in the following.

Developmental perspectives

There is ongoing debate in the research literature regarding the age at which effective CM emerges, whether CM improves with age, and whether such developmental progress applies equally across different communicative contexts. Furthermore, CM is subject to considerable individual variability [23].

Some studies suggest that children as young as 18 to 24 months can indicate comprehension difficulties non-verbally, for example, through questioning facial expressions or spontaneous utterances such as “huh?” or protest with „no” [24,25]. Three-year-olds are capable of signalling misunderstanding with general questions (e.g., “What?”), although these questions are not consistently linked to actual comprehension problems. More consistent use of such questions in response to misunderstanding typically emerges around age four [26]. Among five- to six-year-olds, the use of specific clarification strategies increases [27,28], indicating that fundamental CM abilities are present during kindergarten.

However, message characteristics significantly influence the effectiveness of CM [11]. Preschool children can reliably detect acoustically inadequate or impossible utterances [1,27], but they are less successful at identifying ambiguities or excessively complex instructions. Younger children may apply different criteria when evaluating ambiguous or complex utterances. For example, rather than expecting a sentence to apply uniquely to a single referent, they may be satisfied if it matches at least one plausible object or includes a familiar keyword [29]. Another possible explanation is that these types of comprehension challenges require children to consider multiple perspectives and engage in more advanced cognitive evaluation processes [26,30].

Compared to preschoolers, primary school children

demonstrate marked improvements in CM [21,31,32]. Children aged 6 to 8 increasingly ask specific clarification questions when they face comprehension difficulties. They are also more likely to identify and verbalize the source of their misunderstanding (e.g., “I didn’t hear you”/ „Which book...“). Nevertheless, even at this age, children tend to respond more effectively to acoustically inadequate or lexically unfamiliar utterances than to ambiguous or syntactically complex ones [33]. Compared to kindergartners, primary school children exhibit fewer difficulties with ambiguity [34], supporting the idea that age-related improvements in CM are evident, particularly when tasks are appropriately matched to developmental level [29].

However, not all studies have found apparent age-related effects. Walters and Chapman [35], in a study involving three-, six-, and nine-year-olds, did not observe consistent developmental trends. Even the oldest group had difficulty understanding overly lengthy and complex sentences, and all age groups were more responsive to impossible instructions than to other types of comprehension challenges. These findings suggest that the *kind* of comprehension problem may significantly influence whether CM is triggered. Similarly, Wellmann et al. also found no clear age-related patterns in their data with very young children [25].

CM in children with DLD

Research on CM in children with DLD is relatively limited [11,14]. Findings vary depending on task type, task demands, and individual differences [36]. Overall, studies consistently report that children with DLD exhibit lower CM skills than their TDL peers, even though they are more frequently confronted with instances of misunderstanding and non-understanding due to their language difficulties.

For example, Brinton and Fujiki found that 5- to 6-year-old children with TDL asked clarification questions three

times more often than children with DLD of the same age [37]. Similarly, children with DLD at primary school age have been shown to exhibit CM behaviours comparable to those of younger TDL children [38,39]. Furthermore, children with DLD were more likely to attribute communication breakdowns to themselves as listeners (“listener-blamers”). In contrast, their TDL peers were more likely to hold the speaker responsible (“speaker-blamers”) [40].

Differences between DLD and TDL children appear especially pronounced in response to ambiguous or syntactically complex utterances [1,17,18,33]. In general, children with DLD exhibit a decreasing likelihood of CM across different types of triggers, with the following hierarchy: acoustically inadequate > impossible > unfamiliar vocabulary > ambiguous > overly complex utterances (see Figure 1) [12].

Nevertheless, several critical gaps remain in the literature. First, most studies have classified effective reactions to misunderstanding as CM and thus the second processing step (see Figure 1). They primarily focused on verbal responses, which tend to pose particular difficulties for children with DLD. It is therefore possible that children with DLD experience fewer difficulties in the initial step of utterance identification. Thus, assessing the identification of comprehension difficulties may offer more differentiated insights into the CM of children with DLD. Second, many studies have focused exclusively on school-aged children with DLD, often examining a single age group, rather than comparing across developmental stages [10]. As a result, it remains unclear whether children with DLD demonstrate age-related changes in CM or whether they differ from TDL children both at preschool and school age. Third, much of the research has concentrated on children’s ability to clarify ambiguous utterances—tasks that demand a high degree of perspective-taking [38]. Additionally, in many studies, the conditions that triggered CM were not well controlled or focused on specific types of comprehension breakdowns [32,37,39], making

it difficult to determine whether different types of comprehension breakdowns consistently elicit CM across age groups and among children with DLD. Finally, many existing studies suffer from small sample sizes and are relatively dated, further limiting the generalizability of their findings.

The current study

The primary aim of this study was to examine the effects of age and DLD on CM performance, specifically on the ability to identify comprehension breakdowns. The study sought to determine whether children with TDL show improved identification of comprehension problems with increasing age, whether a similar developmental trend is observed in children with DLD, and whether there are differences between children with TDL and DLD. Additionally, the study investigated whether different types of comprehension challenges (i.e., CM triggers) produce age- and language-status-related effects in TDL and DLD groups.

Accordingly, the following research questions were addressed:

1. Are there overall effects of age and DLD on CM (identification)?
 - Do school-aged children show more CM than kindergarten-aged children in both groups, TDL and DLD? (age effect)
 - Do children with DLD show less CM than children with TDL in both age groups? (language effect)
2. Are there special effects of age and DLD on different CM item types?
 - Do school-aged children show more CM than kindergarten-aged children in both groups in their responses to specific types of comprehension problems (i.e., acoustically inadequate, impossible, unfamiliar words, ambiguous, overly complex structures),
 - Do children with DLD show less CM than children

with TDL in both age groups in their responses to specific types of comprehension problems?

It was assumed that age-related improvements in CM performance would be observed in both groups, with school-aged children outperforming kindergarten children. Furthermore, it was expected that children with DLD would show generally lower CM performance than their TDL peers at both age levels. Finally, it was predicted that these age effects in DLD would also be reflected across CM item types, with children with DLD exhibiting the most significant difficulties with ambiguous sentences.

METHODS

Participants

The participants ($N = 108$; 48 boys and 60 girls) were recruited from kindergartens and schools in southern Germany. Written informed consent was obtained from the parents of all participating children prior to data collection. The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki and with applicable institutional and national guidelines for research involving human participants. All participants spoke German as either their first or second language. Children with DLD attended special kindergartens ($n = 26$, first language $n=8$) and schools ($n = 22$, first language $n=12$) for children with speech and language impairments and met the established criteria for DLD [41]. None had a hearing loss and all were required to be within the normal range on cognitive tests ($IQ < 85$, carried out as part of ongoing statementing procedures). Language scores on formal assessment were scoring below 1.5 SD of age norm on one or both of these subtests: picture naming/expressive vocabulary and manipulation/sentence comprehension (Sprachstandserhebungstest für Kinder (SET): kindergarten: SET 3-5 [42], school: SET 5-10 [43],

see Table 1).

TDL children attended public kindergartens ($n = 30$, first language $n=18$) and schools ($n = 30$, first language $n=29$). There was no known history of language or learning difficulties in this group. Language Scores on formal assessment were within normal range (see Table 1). Due to illness and lack of parental consent, group sizes were approximately equal across conditions.

As CM, particularly the identification process, is not considered a language-specific ability, the potential influence of multilingualism was not further analyzed in this study. Initial analyses found no significant differences between children with German as their first or second language (see Table 1), and all group effects for monolingual children were similarly significant. Previous research has shown that both monolingual and multilingual children with DLD exhibit weaker performance in CM tasks, with no significant differences between them, compared to typically developing children [33].

Research tasks

CM at the sentence level is often assessed using quasi-experimental methods in which children are asked to perform actions based on incomprehensible or inadequate instructions, and their reactions are recorded. Flavell et al. were among the first to describe such tasks [21]. Variations of these methods can be found in Dollaghan and Kaston [1] and Schönauer-Schneider [18], among others, and served as the basis for the present study.

In the context of increasing digitalization, a web-based application was developed to administer CM tasks digitally. Studies suggest that digital tasks are comparable to concrete tasks in terms of effectiveness and are particularly engaging for children [44,45]. In designing the digital version, factors that support CM were taken into account. For example, a simple task format ("Put ... in ...") was used, along with concrete objects drawn from children's everyday vocabulary (e.g., ball, heart, shoe, cat, worm).

To further enhance engagement, the instructions were embedded within a motivating narrative involving a wizard. In the story, the child helps the wizard either prepare a magic potion or tidy up his room by following instructions presented on a tablet, such as placing objects into a cupboard or pot (see Figure 2).

The task consisted of 20 instructions, 15 of which were deliberately inadequate, with each of five types of CM triggers represented by three items [46]:

- **Inadequate acoustic signal:** "Put [Sneeze] in the cupboard."
- **Impossible instruction:** "Put the snail on the swing."
[Note: swing not available]
- **Unknown word (pseudoword):** "Put the fatong in the pot."
- **Ambiguous instruction:** "Put the animal in the pot."
- **Overly complex instruction:** "After you have placed the sheep in the pot, place the crown in the pot before you put the little worm in the cupboard. Place the snail and the heart in the pot as soon as you have also placed the little ball in the cupboard. Put the cat and the shoe in the pot first, and then the big worm in the cupboard."

These items were pilot-tested and produced results similar to those of earlier CM elicitation methods [12].

To explicitly prompt CM reactions, an explanatory video was created featuring a raven character (the wizard's assistant) demonstrating the expected responses based on prior work [19,20]. In the video, the raven shows both an appropriate response to a clear instruction and a clarifying response to an unclear one, encouraging children to seek clarification ("Today you should ask if you don't understand the magician"). When the instruction is clear, the raven presses the checkmark and completes the task. When the instruction is unclear, it presses the question mark and asks a specific question.

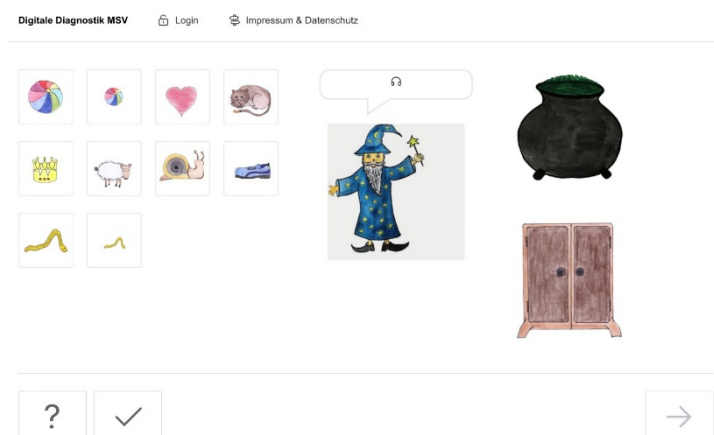


Figure 2. Interface of the web-based tool for CM assessment (images from zabulo [47]; <https://paedalogis.com/zabulo>)

Procedure and data analysis

Multiple task versions with different item sequences were developed using pseudorandomization. After every two to four CM items, a clearly understandable instruction was inserted to maintain motivation. Children were randomly assigned to one of the versions. Each child was tested individually using an iPad in a quiet room within their kindergarten or school setting. Testing was conducted by trained graduate students [48-51].

To begin each item, children tapped the headphones icon above the wizard character to listen to the instruction. Using the tablet's touchscreen, they could then either press the question mark or checkmark and move the objects into the designated cupboard or pot (see Figure 2). The examiner assisted with interactions when necessary.

Scoring was based on quantitative identification of CM behaviour. One point was awarded for each instance in which the child correctly pressed the question mark in response to an inadequate instruction, resulting in a maximum score of 15 points (three per CM trigger category). Additionally, all sessions were video-recorded, and children's verbal and nonverbal reactions were transcribed. These qualitative data—such as whether the child asked specific or general questions, responded non-verbally, did nothing, or followed the instruction incorrectly—were al-

so analyzed. However, this aspect is beyond the scope of the present article. Inter-rater reliability was calculated for 10% of the items assessed by each graduated student. The agreement was 100% for quantitative identification of CM and 97,5 % for qualitative reactions.

Internal consistency was assessed using Cronbach's α for each subscale. Given that each subscale comprised only three items, Spearman inter-item correlations were also calculated, as they provide a more informative estimate of reliability for very short scales. For three subscales, Cronbach's α was negative and close to zero (acoustically inadequate: $\alpha = -.22$; unknown word: $\alpha = -.18$; overly complex: $\alpha = -.16$) or small (impossible: $\alpha = .55$; ambiguous: $\alpha = .57$). However, the corresponding inter-item correlations were in the small-to-moderate range ($\rho = .16-.52$), suggesting possible meaningful associations between the items despite the low Cronbach α .

RESULTS

Mean scores for age, language and CM (identification) are presented in Table 1. On average, all children demonstrated the ability to identify comprehension problems, although individual variability was evident. This variability, including scatter and outliers, is illustrated in

Table 1. mean scores for total CM (identification)

	Kiga TDL (n = 30)	Kiga DLD (n = 26)	School TDL (n = 30)	School DLD (n = 22)
Age in months (SD)	62 (12,9)	66 (10,4)	94 (5,6)	99 (13)
Vocabulary (T-value)	49,33 (8,18)	36,15 (9,43)	49,23 (9,22)	33,23 (9,57)
Sentence comprehension (Manipulation) (T-value)	48,37 (7,01)	36,27 (7,32)	59,60 (14,50)	35,23 (7,95)
CM total M (SD)	10,03 (3,24) Md = 11	9,35 (3,31) Md = 10	13,17 (1,98) Md = 13,5	9,95 (3,443) Md = 10
CM total M (SD) First language German	10,78 (2,56)	10,00 (2,67)	13,24 (1,98)	9,58 (3,87)
CM inadequate acoustic M (SD)	2,37 (0,96) Md = 3	2,58 (0,76) Md = 3	2,90 (0,30) Md = 3	2,59 (0,666) Md = 3
CM impossible M (SD)	2,5 (0,73) Md = 3	2,38 (0,90) Md = 3	2,97 (0,18) Md = 3	2,32 (0,945) Md = 3
CM unfamiliar word M (SD)	2,57 (0,86) Md = 3	2,31 (1,01) Md = 3	2,83 (0,18) Md = 3	2,41 (0,796) Md = 3
CM ambiguous M (SD)	1,77 (0,90) Md = 2	0,92 (0,85) Md = 1	2,71 (0,596) Md = 3	1,41 (1,008) Md = 1,5
CM too complex M (SD)	0,83 (0,95) Md = 1	1,15 (1,08) Md = 1	1,76 (1,265) Md = 2	0,72 (1,152) Md = 1

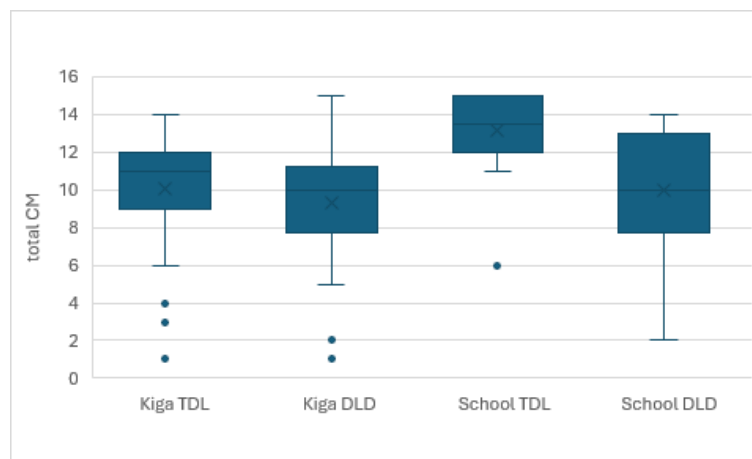
**Figure 3.** Boxplots for overall CM (identification)

Figure 3. An analysis of the individual CM categories reveals that acoustic inadequacies, impossible utterances, and unfamiliar words were more readily identified than ambiguous or syntactically complex utterances. Complex utterances were most difficult to detect (see Figure 4).

Since the data for the groups were not normally distributed and the assumption of homogeneity of variances was violated (Brown-Forsythe test: $F(3, 85.68) = 9.068$, $p < .001$), a Welch ANOVA was conducted. The Welch ANOVA indicated a significant difference between the groups (Welch- $F(3, 52.695) = 13.891$, $p < .001$).

Due to the lack of normality, Mann-Whitney U tests were used as post hoc tests to examine group differences. One-sided Monte Carlo significance estimates were applied, as specific group differences were hypothesized based on theoretical considerations. Effect sizes were calculated using the formula $r = z / \sqrt{N}$, where N represents the total sample size. According to Cohen, an r value of .1 indicates a small effect, .3 a medium effect, and .5 a large effect [52].

The results show that children with TDL in preschool (Md = 11, $n = 30$) demonstrated significantly lower com-

prehension monitoring (CM) than TDL children in primary school ($Md = 13.5$, $n = 30$), $U = 151.500$, $z = -4.459$, $p < .001$, $r = -0.576$. This indicates a large age-related effect in CM performance among children with TDL. In contrast, no such age-related effect was found in children with DLD, whose median scores remained at 10 across both age groups ($U = 253.500$, $z = -0.677$, $p = .248$, $r = 0.098$). This suggests that children with DLD show little to no developmental progress in CM up to primary school age.

Regarding DLD, no significant difference in CM was observed between preschool children with TDL ($Md = 11$, $n = 30$) and those with DLD ($Md = 10$, $n = 26$), $U = 321.500$, $z = -1.135$, $p = .129$, $r = -0.152$. However, in primary school, children with DLD ($Md = 10$, $n = 22$) performed significantly worse on CM than their TDL peers ($Md = 13.5$, $n = 30$), $U = 127.500$, $z = -3.790$, $p < .001$, $r = -0.526$. These findings suggest that while CM is relatively comparable in the preschool years, children with DLD show markedly lower CM performance in the school years.

In addition, the different types of comprehension monitoring (CM) triggers were analyzed for effects of age and DLD status (see Figure 4).

The Welch ANOVA revealed significant group differences for several triggering conditions: for acoustic in-

adequacies (Welch- $F(3, 48.780) = 4.442$, $p = .008$), impossible utterances ($F(3, 43.851) = 9.652$, $p < .001$), unknown words ($F(3, 43.687) = 8.283$, $p < .001$), and ambiguities ($F(3, 53.932) = 29.594$, $p < .001$). Only the category complexity did not yield a significant group difference ($F(3, 55.434) = 2.330$, $p = .084$).

To further explore these group differences, Mann-Whitney U tests with one-sided Monte Carlo significance were conducted. The results indicate clear age effects in children with TDL across all triggering categories, with preschool-aged TDL children showing significantly lower CM compared to their school-aged peers:

- Inadequate acoustic cues: $U = 309.000$, $z = -2.756$, $p = .007$, $r = -0.356$
- Impossible instructions: $U = 298.000$, $z = -3.225$, $p < .001$, $r = -0.416$
- Unknown words: $U = 357.500$, $z = -2.316$, $p = .009$, $r = -0.299$
- Ambiguities: $U = 154.500$, $z = -4.585$, $p < .001$, $r = -0.592$
- Too complex sentences: $U = 298.000$, $z = -2.347$, $p = .009$, $r = -0.303$

In contrast, children with DLD showed minimal age-related differences, with only a marginally significant effect

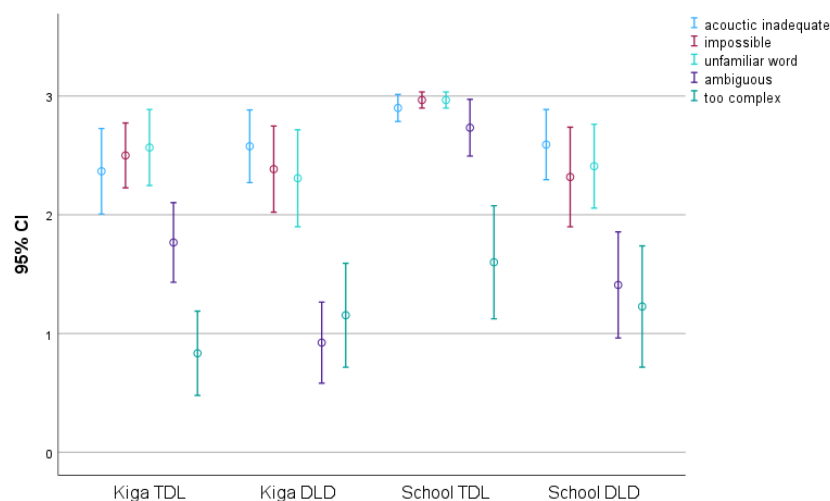


Figure 4. Error bars for CM (identification) across different triggering categories.

in the ambiguity category ($U = 206.000$, $z = -1.735$, $p = .047$, $r = -0.250$).

When comparing children with TDL and DLD, no significant group differences were found in preschool for most categories, except for ambiguous utterances, where DLD children performed significantly worse ($U = 197.000$, $z = -3.313$, $p < .001$, $r = -0.443$). However, in primary school-aged children, significant group differences emerged in multiple categories:

- Acoustic inadequacies: $U = 255.000$, $z = -2.027$, $p = .031$, $r = -0.281$
- Impossible instructions: $U = 203.500$, $z = -3.411$, $p < .001$, $r = -0.473$
- Unknown words: $U = 204.000$, $z = -3.400$, $p < .001$, $r = -0.471$
- Ambiguities: $U = 90.500$, $z = -4.835$, $p < .001$, $r = -0.670$

No significant difference between TDL and DLD children in the school-aged group was found for complex utterances.

DISCUSSION AND CONCLUSION

Age-related development of overall comprehension monitoring

The first hypothesis predicted age-related improvements in overall CM. This expectation was confirmed for children with TDL but not for children with DLD. The developmental gains observed in the TDL group are consistent with previous research demonstrating improvements in children's responses to comprehension difficulties during the pre-school and early school years (21,31,32).

CM relies on sophisticated metacognitive and metalinguistic abilities that continue to develop throughout early childhood. According to the model presented in Figure 1, younger children may be capable of constructing a se-

mantic representation of an utterance but are less likely to evaluate its adequacy using explicit criteria. As proposed by Markman, they may remain at a "novice" stage of CM, characterised by limited metacognitive knowledge and underdeveloped verification strategies [13]. Consequently, they often fail to distinguish genuine understanding from guessing [53] and are therefore particularly susceptible to the "illusion of understanding" [54].

By school age, however, children with TDL appear increasingly able to evaluate comprehension systematically, interpret uncertainty as evidence of a comprehension failure, and initiate appropriate repair strategies, corresponding to Markman's "expert" stage of CM [13,55]. In addition, the explanatory video may have contributed to this developmental advantage. By modelling an explicit questioning strategy, it may have provided older children with a concrete behavioural framework that they were able to adopt. This interpretation is consistent with the findings of Ironsmith and Whitehurst [32], who reported that older children were considerably more likely than younger children to adopt comprehension-monitoring behaviours after observing a model. A single modelling episode, however, may be insufficient for pre-school children or for school-aged children with DLD, an assumption that warrants empirical investigation.

The influence of DLD on overall comprehension monitoring

Contrary to our second hypothesis, DLD did not significantly affect overall CM during the pre-school years. Children with DLD performed only marginally below their peers with TDL. Evidence regarding CM in children younger than 5;6 years with DLD remains scarce. Nevertheless, our findings are broadly consistent with those of Hargrove et al., who reported comparable rates of responses to comprehension failures in predominantly pre-school children with DLD and language-matched controls, although the responses of children with DLD tended to be less

explicit and less informative [39]. Together, these findings suggest that the ability to detect comprehension difficulties may initially develop relatively independently of language impairment. However, this conclusion should be interpreted cautiously, as both studies included substantial individual variability and limited information regarding participants' broader cognitive abilities.

Future research should therefore examine CM development in even younger children, particularly between two and three years of age. During this period, language learning and comprehension monitoring are likely to influence one another reciprocally. Wellman et al. argued that recognising an unfamiliar word is a prerequisite for seeking its meaning, making CM an important mechanism supporting vocabulary acquisition [25]. This principle underlies vocabulary intervention programmes such as *Lexicon Pirate* [56]. Early identification of unfamiliar words or comprehension failures may therefore represent an important intervention target before children enter formal education and afterwards as well.

In contrast, clear group differences emerged during the school years, with children with DLD demonstrating significantly poorer CM than their peers with TDL. This finding corresponds to previous reports of persistent CM difficulties in school-aged children with DLD [1,12,36]. One explanation is that the developmental trajectory of metacommunicative skills is delayed in DLD. Reduced vocabulary, weaker sentence comprehension and limited metalinguistic knowledge may impair children's ability to evaluate whether a message has been understood successfully and to recognise or repair communication breakdowns [37]. Furthermore, evaluating comprehension often requires explicit linguistic knowledge, for example when deciding whether a word is unfamiliar or whether an utterance has been perceived accurately. Children with DLD may therefore rely more heavily on salient keywords, inferring missing information from contextual knowledge rather than critically evaluating whether their interpretation is complete [28,40].

Potential mechanisms underlying reduced CM in DLD

Language impairment alone is unlikely to account fully for the observed differences. Executive functions may also play an important role, although they were not assessed in the present study. Successful CM requires children to maintain attention to incoming information, inhibit premature interpretations and revise initial assumptions when contradictory information becomes available. Consequently, reduced sustained attention, inhibitory control or cognitive flexibility may limit children's ability to detect comprehension failures [25]. Evidence from text comprehension supports this interpretation. Doebel et al. demonstrated that executive functions and working memory contribute substantially to inconsistency detection, an important component of CM [57]. Since children with DLD frequently show weaknesses in sustained attention [58], inhibitory control and cognitive flexibility [59], these broader cognitive processes may contribute to their delayed CM development. Future studies should therefore investigate the relative contributions of language ability and executive functioning.

Psychosocial factors may provide an additional explanation. Children with DLD often participate less confidently in conversations and may be reluctant to initiate clarification requests [36,60]. Johnson suggested that these children frequently proceed without fully understanding an utterance and subsequently rely on conversational feedback to correct their actions. Rather than attributing communication breakdowns to insufficient information provided by the speaker, they may assume that the problem lies within themselves, reflecting a tendency towards "listener-blaming" [36,40]. Consequently, even explicitly signalling uncertainty, such as pressing the question-mark button in the present task, may have represented an unusually demanding response.

Social learning experiences may further influence CM. Children with DLD attending special language support

classes may encounter fewer peers who model active clarification behaviour. Karabenick [61] demonstrated that learners were more likely to acknowledge their own confusion when their peers also expressed uncertainty. Reduced exposure to such modelling may therefore contribute to lower rates of overt CM behaviour.

Comprehension monitoring across different triggering conditions

Age-related improvements in the TDL group were observed across all CM item types, whereas children with DLD showed little developmental change except for ambiguous instructions. The developmental gains in ambiguity detection may reflect increasing ability to evaluate alternative interpretations rather than accepting the first plausible meaning. Younger children often rely on a single referent or keyword [32,34] or execute only parts of a complex instruction [29]. They may also prioritise completing the task over evaluating whether their interpretation is correct, resulting in reduced CM.

Walters and Chapman [36] similarly reported developmental improvements in responses to impossible and overly complex utterances between three and six years of age before performance plateaued. Longitudinal studies are required to determine whether different CM categories follow distinct developmental trajectories.

Regarding group differences, ambiguity proved particularly challenging for children with DLD at both age groups, whereas differences for acoustically degraded utterances, impossible utterances and unfamiliar words emerged only during the school years [1,12,27,36]. These findings replicate previous reports identifying ambiguity as a particular area of difficulty [18,38]. Successful processing of ambiguous instructions requires children to evaluate competing interpretations and coordinate both speaker and listener perspectives, abilities closely associated with Theory of Mind (ToM) [61]. Since language delay during the pre-school years is associated with de-

layed ToM development [62], and school-aged children with DLD continue to show reduced ToM abilities [63], ToM may represent an important mechanism underlying their difficulties with ambiguity.

Across all groups, acoustically degraded utterances, impossible utterances and unfamiliar words elicited substantially higher CM rates than ambiguous or overly complex utterances, consistent with previous findings [1,12,36,64] and with the proposed CM model (Figure 1). Acoustic inadequacy was identified most successfully, particularly by children with DLD. One explanation is that the explanatory video explicitly demonstrated an appropriate response to acoustically inadequate speech, thereby providing children with concrete evaluative criteria [19]. Furthermore, children are likely to have prior experience of transmission problems during telephone or internet communication and may therefore more readily attribute acoustic failures to external causes. Future studies could investigate whether modelling evaluation criteria for other CM categories similarly improves performance.

School-aged children with TDL also outperformed children with DLD when identifying impossible utterances and unfamiliar words. Their more advanced vocabulary knowledge may facilitate discrimination between familiar and unfamiliar lexical items, while stronger semantic representations may enable them to generate expectations regarding plausibility and detect inconsistencies more efficiently. In contrast, children with DLD may experience greater difficulty generating semantic expectations and evaluating plausibility, possibly because these processes place greater demands on working memory and sentence comprehension.

Finally, overly complex utterances elicited the lowest CM rates across all groups and showed the greatest individual variability. Children may have prioritised completing the requested action or considered partial task completion to be sufficient [29]. Together with the very low and negative Cronbach's α observed for this category, these findings suggest that overly complex items require substantial re-

vision or should potentially be excluded from future diagnostic versions of the instrument.

Limitations

The findings suggest age- and language-status-related differences in CM. However, several limitations should be acknowledged. First, the relatively small sample size reduced the statistical power of the analyses. Furthermore, participants were grouped into only two broad age categories (kindergarten and school age), each encompassing a relatively wide age range. It is possible that a more fine-grained age classification would have revealed different developmental patterns. However, further subdivision of the sample was not feasible, as it would have resulted in even smaller group sizes.

In addition, children's language abilities were not characterised beyond the distinction between TDL and DLD. Differentiating between children with predominantly expressive DLD and those with mixed receptive–expressive DLD may have revealed distinct patterns of CM performance.

A further limitation relates to the assessment instrument. The digital measurement of CM, which required children to indicate non-understanding by pressing a dedicated button, poses several methodological challenges. Assessing CM using a single session comprising 15 items may have resulted in over- or underestimation of individual performance. Moreover, particularly within the TDL school-age group, many subcategory scores approached the maximum score of three, accompanied by small standard deviations, indicating ceiling effects. This restricted variability may have limited the ability to detect group differences and developmental changes.

In addition, the internal consistency of the CM subcategories was below the desirable level, suggesting that the inclusion of additional items or the removal of less informative items could improve the instrument's sensitivity and reliability.

Although the task was designed to be engaging and

motivating, it nevertheless constituted a test situation, which may have encouraged children to respond more readily and to signal non-understanding less frequently than they would in everyday communication. Finally, it remains uncertain whether this digital assessment adequately captures the demands of communicative monitoring in naturalistic interactions. Consequently, it is unclear to what extent the observed performance reflects children's general CM competence rather than behaviour specific to a structured testing context.

Implications

Future cross-sectional studies with larger and more evenly distributed samples, together with longitudinal designs, are required to replicate and extend the present findings and to clarify the developmental trajectories and influences underlying CM. In particular, studies employing adequately powered multiple regression models are needed to disentangle the relative contributions of age, language ability, and other cognitive factors.

Despite these limitations, the present findings have important clinical and educational implications. They suggest that the early identification and systematic support of CM are particularly important for children with DLD and that explicit intervention may be especially beneficial during the early school years. Effective CM enables children to recognise comprehension failures, seek clarification, and actively regulate their own learning. As such, it supports not only vocabulary acquisition but also successful participation in classroom activities, where accurate comprehension of spoken instructions is essential.

Assessment of CM should therefore form part of routine language evaluation. Clinicians and teachers should monitor whether children recognise when they have not understood an utterance and whether they initiate appropriate clarification requests. This can be assessed using deliberately incomprehensible, ambiguous, or otherwise inadequate instructions that require children to signal

comprehension difficulties rather than simply respond to the task.

The present findings further highlight the need for intervention programmes that explicitly target CM within educational settings. Such programmes should promote children's ability to evaluate spoken messages by teaching explicit criteria for identifying different types of comprehension failure (e.g. plausible versus implausible, unambiguous versus ambiguous). In addition, children should be taught effective repair strategies, including the production of specific clarification requests tailored to the source of the communication breakdown. Preliminary case-study evidence suggests that targeted CM intervention may produce relatively rapid improvements [1,36,64], although larger controlled intervention studies are needed to establish its effectiveness and long-term benefits.

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