

# How Do Oral Deaf Individuals Comprehend Primary Metaphors and Idioms? Let's Begin to Dot the I's and Cross the T's

*Como surdos oralizados compreendem metáforas primárias e expressões idiomáticas? Colocando os pingos nos I's*

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**Abstract:** Oral deaf people (i.e., people with hearing loss who have learned an oral language) are typically less exposed to auditory and linguistic input than normal hearing peers and might struggle with figurative language comprehension. Our aim is to investigate primary metaphor and idiom comprehension by oral deaf who use hearing amplification devices or cochlear implants. To this end, we used a verbal primary metaphor task, a non-verbal primary metaphor task and an idiom comprehension task. One hundred fifty-one participants took part in the study (57 oral deaf and 97 normal hearing individuals, subdivided into three age levels). Results show that comprehension follows an improvement pattern as participants' age increases in both experimental and control groups. For the oral deaf individuals, a delay was found for all verbal tasks. For the non-verbal metaphor task, only kids differed statistically, with the oral deaf children performing worse than their counterparts. In conclusion, figurative language comprehension can be more challenging for oral deaf individuals when presented verbally than non-verbally, particularly from adolescence onwards, in comparison to normal hearing peers. This study contributes to informing clinicians and educators about comprehension of primary metaphors and idioms in oral deaf individuals, which may help to identify language impairments and create interventions for figurative language comprehension.

**Keywords:** figurative language comprehension; primary metaphor; idioms; deafness; cognitive linguistics.



**Resumo:** Surdos oralizados (pessoas com perda auditiva que se comunicam por meio de linguagem oral) podem ter um input auditivo e linguístico menor do que o de pessoas com audição dentro dos padrões de normalidade e, conseqüentemente, experienciar maior dificuldade para entender linguagem figurada. Neste artigo, tem-se por objetivo investigar a compreensão de metáforas primárias e expressões idiomáticas por pessoas surdas que usam aparelhos de amplificação sonora individual ou implantes cocleares. Para isso, utilizou-se uma tarefa verbal de metáfora primária, uma tarefa não-verbal de metáfora primária e uma tarefa de compreensão de expressões idiomáticas. Cento e cinquenta e um sujeitos participaram do estudo (57 surdos oralizados e 97 pessoas com audição normal, subdivididos em três grupos etários). Os resultados mostraram que a compreensão de linguagem figurada segue um padrão de desenvolvimento à medida que a idade dos participantes aumenta em ambos os grupos. Para os participantes com perda auditiva, houve pior desempenho nas tarefas verbais. Na tarefa não-verbal, somente as crianças diferiram estatisticamente, com pior performance das crianças surdas comparadas aos seus pares ouvintes. Em conclusão, a compreensão de linguagem figurada oral representa um maior desafio para surdos oralizados do que quando apresentada de forma não-verbal, particularmente a partir da adolescência, em comparação a pessoas com audição dentro dos padrões de normalidade. Este estudo tem por contribuição informar profissionais da saúde e da educação sobre a compreensão de metáforas primárias e expressões idiomáticas por surdos oralizados, o que pode ajudar na identificação de déficits de linguagem e na elaboração de intervenções nessa área.

**Palavras-chave:** compreensão de linguagem figurada; metáfora primária; expressões idiomáticas; surdez; linguística cognitiva.

## 1 Introduction

The ability to understand figurative statements is an important indicator of human linguistic and cognitive development (Lakoff; Johnson, 1980; Law, 2001). Among other necessary condi-

tions, being able to hear, in the case of oral language users, is crucial for an appropriate access to (figurative) language. Through auditory sensory experiences, combined with information from other senses, oral language is construed and concepts are formed as one explores their environment (Law, 2001; Tomasello, 2003). The occurrence of hearing loss (HL) can, therefore, as other clinical conditions (Siqueira *et al.*, 2016), negatively influence access to oral language and consequently cause deficits in language comprehension, as evidenced by a number of studies that investigated figurative language in individuals with HL (e.g., Bahrami *et al.*, 2018; Nicastrì *et al.*, 2014; Schorr *et al.*, 2008;). Factors related to HL, such as etiology, the moment in the lifespan in which the HL occurred, the exact location of the issue inside the ear, the range of frequencies affected by the HL, the type and degree of HL, as well as time and duration of any interventions can determine frequency and quality of sound access. In most cases, devices such as hearing aids or cochlear implants (CIs) are useful to minimize or resolve the impacts of HL. But do individuals who have been treated with hearing aids or CIs fully recover their figurative language comprehension abilities? Under the cognitive linguistics framework, the answer to this question might depend on the type of expression that is being considered (Gibbs; Colston, 2012; Lakoff; Johnson, 1980). Further, given that linguistic metaphors have an underlying conceptual mapping (Lakoff; Johnson, 1980), would a deficit be restricted to verbal/linguistic ability? Aiming at answering these questions, this paper investigates metaphor and idiom comprehension by oral deaf people at different ages with verbal and non-verbal tasks.

By definition, in oral language, metaphor comprehension relies more on embodied, sensory channels to be acquired while idiom comprehension relies more on one sensory channel, that of auditory experience (Gallese; Lakoff, 2005; Grady, 1997; Lakoff, 2014; Lakoff; Johnson, 1980; Langlotz, 2006; Nippold *et al.*, 1996). In conceptual metaphor theory (Lakoff; Johnson, 1980; Lakoff, 2014), a metaphor is defined as understanding and experiencing one kind of thing (usually a more abstract concept, such as difficulty) in terms of another (usually more concrete and accessible to the senses, such as weight). That is, we not only speak metaphorically, but we structure concepts via metaphors (Lakoff; Johnson, 1980; Boroditsky, 2000; Lakoff, 2014). Primary metaphors (PM) are a specific type of metaphor, which emerge from universal sensory experiences (such as carrying weight) that occur concomitantly with subjective responses (such as experiencing difficulty) in our daily lives (Grady, 1997; Gallese; Lakoff, 2005). This type of recurrent co-occurrence gives rise to primary metaphorical conceptual mappings (e.g. DIFFICULTY IS HEAVINESS), and, eventually, these mappings are expressed linguistically (e.g., “Ana has a *heavy* meeting today”). The main basis for understanding PM, thus, is one’s bodily experience, which results from their interaction with objects and people in daily situations (Gallese; Lakoff, 2005; Grady, 1997; Lakoff, 2014). In more recent research, this has been evidenced by many neuroimaging studies, which found activation of sensory-motor areas in the brain when individuals read or hear PM, for instance (Citron; Goldberg, 2014; Desai *et al.*, 2011; Lacey *et al.*, 2012).

On the other hand, to understand most idioms, cultural and linguistic experiences are necessary (Boers *et al.*, 2004; Carrol; Littlemore, 2020; Libben; Titone, 2008; Nippold *et al.*, 1996; Sprenger *et al.*, 2019; Tabossi *et al.*, 2009;). Idioms are more fixed expressions, which may or may not have an underlying embodied motivation (Langlotz, 2006). The experiences lived in a particular culture (e.g., baseball in the United States of America) can strongly motivate idioms (e.g. *to hit out of the park*), and, depending on characteristics such as decomposability and imageability (Boers; Demecheleer, 2001; Gibbs *et al.*, 1989; Langlotz, 2006), they might

only be understood after being heard a few times in different contexts of use (Boers *et al.*, 2004; Nippold *et al.*, 1996). Thus, familiarity, as it relates to frequency of use in a certain linguistic community, is an important factor for understanding idioms (Carrol; Littlemore, 2020; Libben; Titone, 2008; Sprenger *et al.*, 2019). In addition, other parameters that can influence the comprehension of their meanings are its degree of conventionality, complexity, and syntactic, morphosyntactic and lexical frozenness, as well as the context in which they are used (Cain *et al.*, 2009; Langlotz, 2006; Tabossi *et al.*, 2009). Therefore, according to the literature, the aspects that contribute to idiom comprehension are not necessarily the same as those that promote PM comprehension, hence these two specific phenomena were chosen for this study.

Studies on figurative language comprehension specifically by oral deaf individuals (*i.e.*, individuals with HL who wear hearing aids or CIs) are still somewhat rare. In general, there are more differences than similarities between the studies, as in the theoretical approach to the phenomena and methods, and especially regarding instrument type and stimulus presentation. Most of the recent studies investigated oral deaf children (Afonso, 2012; Bahrami *et al.*, 2018; Do; Chung, 2015; Nicastrì *et al.*, 2014; Schorr *et al.*, 2008), and the general finding is that participants with HL presented poorer figurative language comprehension when compared to normal hearing (NH) peers. This pattern was found in tasks with verbal stimuli, both considering metaphors in general (Nicastrì *et al.*, 2014), addressing PM specifically (Afonso, 2012) and novel metaphors (Bahrami *et al.*, 2018). In Schorr *et al.* (2008), results indicated worse performance by children with HL who wore CI compared to NH children in an idioms task. There is also evidence that oral deaf young adults perform worse than NH peers in metaphor and sarcasm tasks (Edwards *et al.*, 2021), although Gold & Segal (2017) found no accuracy difference, only a delay in reaction times by young adults with HL when processing novel metaphors.

A second common finding is the relevance of the amount of time that patients are exposed to oral language for metaphor comprehension performance. The age at which an individual is habilitated with a hearing device proved to be a relevant factor in different studies (Dahlby-Skoog *et al.*, 2025; Gold; Segal, 2017; Nicastrì *et al.*, 2014; Schorr *et al.*, 2008). These data suggest that the sooner the individual is adequately exposed to linguistic input, both in terms of taking advantage of the typical language development window and in terms of the amount of time for which they are exposed to language, the better their performance in understanding figurative language will be. Thus, the longer the exposure to oral language, the better the performance (Dahlby-Skoog *et al.*, 2025; Nicastrì *et al.*, 2014;). Rittenhouse & Kenyon, 1991; Schorr *et al.* 2008). Interestingly, Do & Chung (2015) also found that oral deaf children's figurative language knowledge was associated with their level of reading ability, which may suggest that auditory input can be (at least partially) replaced with visual/reading input.

Also regarding age, some other studies offer parameters for the acquisition of figurative language in typical development. Starting at 3-4 years old, children present some competence in PM comprehension, with better performance in tasks that employ pictorial stimuli rather than verbal stimuli (Di Paola *et al.*, 2020; Siqueira; Gibbs, 2007). Siqueira & Gibbs (2007) showed that children aged 5-6 showed significantly better understanding of PM with both kinds of stimuli than younger kids, while children above 7 years of age demonstrated a PM comprehension comparable to that of adults (Siqueira; Gibbs, 2007). However, for idiom comprehension, in a task in which participants had to explain what different expressions meant, 7-year-old children still showed predominance of literal interpretations (Siqueira *et al.*, 2017). Between 7 and 9 years old, participants start to look for clues (usually related to

linguistic compositionality) that lead to less literal interpretations (Siqueira *et al.*, 2017). In Orlando e Shulman (1989), similarly, typically developing children performed well in comprehending simile, metaphors, and idioms at 9 years old. Around 10, idiom comprehension skills appear to be quite well developed (Siqueira *et al.*, 2017; Vulchanova *et al.*, 2011). This can be explained both by the development of general pragmatic abilities, that is, by reading communicative intentions (Tomasello, 2003) and considering contextual/cultural information (Cain *et al.*, 2009), as well as by children's exposure to more figurative expressions in everyday communication (Libben; Titone, 2008; Nippold *et al.*, 1996; Tabossi *et al.*, 2009).

The present study aims at understanding whether oral deaf individuals show similar patterns as NH peers in both (verbal and non-verbal) metaphor and idiom comprehension at different ages. We considered six groups of individuals (children, teenagers, and adults, half of them with HL and half with NH) in order to assess the comprehension of these two figures of speech. These were chosen particularly because, as mentioned, metaphor comprehension is presumably more determined by universal, sensory, and perceptual experiences (primary metaphors), and idiom comprehension is more determined by exposure to language and culture. With the addition of a non-verbal metaphor task, we will also be able to differentiate between verbal metaphor ability and conceptual metaphor ability. Specifically, our aims are (a) to compare PM and idiom comprehension between oral deaf and NH people; (b) to analyze the age factor in PM and idiom comprehension for the groups with HL; (c) to compare the influence of the task type (verbal or non-verbal) on PM comprehension by individuals with HL.

Considering the theoretical framework described above, the following hypotheses for each objective are as follows: (a) children with NH will perform better in PM comprehension when compared to children with HL (but teenagers and adults groups will not differ), and participants with NH at all ages will perform better at idiom comprehension than the groups with HL; (b) PM and idiom comprehension will gradually improve with participants' age for both NH and HL groups; (c) in PM, children with HL will perform better in the non-verbal task compared to the verbal task; for all other groups, performance will be similar in both task types.

## 2 Method

### 2.1 Participants

The sample for this study was composed of 151 participants. The experimental groups were 57 participants with hearing loss (HL) with unknown etiology, stratified in three groups according to age: 15 children ( $M_{age} = 8.09$ ;  $SD = 1.86$ ); 10 teenagers ( $M_{age} = 14.06$ ;  $SD = 1.53$ ); 32 adults ( $M_{age} = 45.49$ ;  $SD = 18.47$ ). The control groups were 94 normal hearing (NH) participants, also stratified along three age groups: 34 children ( $M_{age} = 7.52$ ;  $SD = 1.38$ ); 30 teenagers ( $M_{age} = 14.42$ ;  $SD = 1.45$ ); 30 adults ( $M_{age} = 36.97$ ;  $SD = 10.31$ ). Each HL and NH age groups were matched in age and years of education (see Table 1 for details). In the experimental groups, 13 participants used hearing aids (one child, one teenager and 11 adults) and 44 had cochlear implants (CIs) (two children and three adults used bilateral CI; all of the others had CI in one ear only).

Sample selection was by convenience. Participants in the experimental groups were patients treated by speech therapists in a public hospital in a major city in Brazil. Participants

in the control groups were students and employees of public and private schools and universities in the same city and relatives of the participants in the HL groups.

TABLE 1 - Sample description

Characteristics	Experimental (n = 57)	Control (n = 94)	p
	n (%)	n (%)	
Age group			0.012
Children (under 12)	15 (26.3)	34 (36.2)	
Teenagers (12-17)	10 (17.5)	30 (31.9)	
Adults (18 and older)	32 (56.1)	30 (31.9)	
Educational level			0.821
Elementary and middle school	33 (57.9)	59 (62.8)	
High school	21 (36.8)	30 (31.9)	
Higher Education	3 (5.3)	5 (5.3)	
Hearing aid type			-
Conventional hearing aid	13 (22.8)	-	
Cochlear implants	44 (77.2)	-	

Elaborated by the authors. Shapiro-Wilk test was performed at alpha level .05. See Results for details.

The inclusion criteria for the participants in the HL groups were as follows: i) they should be monolingual speakers of Brazilian Portuguese; ii) they should have a diagnosis of moderate to profound sensorineural HL; iii) they should be users of a hearing aid and/or cochlear implant. In the case of children and teenagers, HL should be pre-lingual. For adults, it should be post-lingual. This last criterion was adopted because, at present, in Brazil, pre-lingual hearing-impaired adults typically have not been through rehabilitation (hearing aid/CI, speech therapy) and most often have not had access to basic education, which would have granted them acquisition of Portuguese as a first language. As such, it is the case that most pre-lingual deaf adults are not fluent in Portuguese (or any other language). The exclusion criterion for the HL groups was the presence of cognitive impairment and/or sensory comorbidities to hearing. For the control groups, the presence of cognitive impairment and/or sensory comorbidities and/or any reports of learning difficulties in school were used as exclusion criteria.

## 2.2. Instruments and Procedures

This study is a cross-sectional design. The independent variables are age (children, adolescents or adults), auditory status (HL or NH), type of figurative phenomenon (primary metaphors or idioms) and type of metaphor task (verbal stimuli or non-verbal stimuli). The first two were manipulated between subjects and the last two were within-subject variables. Dependent variables are participants’ answers to the primary metaphor (PM) non-verbal task, to the PM verbal task and to the idioms verbal task.

### 2.2.1 Screening Tasks

In order to standardize our samples in terms of linguistic and cognitive abilities and select participants for the experimental groups, two tests were carried out. The Vocabulary Test that is part of ABFW - Child Language Test (Befi-Lopes, 2004), widely used in research in Brazil, was used to assess vocabulary. Of note, we do not have validated versions of globally used instruments in Brazilian Portuguese that address oral language abilities, such as the Peabody Picture Vocabulary Test<sup>1</sup>. The ABFW Vocabulary Test consists of the assessment of nine semantic fields: clothing; animals; foods; transportation; furniture and utensils; professions; places; shapes and colors; toys and musical instruments, which can be analyzed qualitatively and quantitatively, in age groups from 4:0 to 6:0 years old. In this investigation, it was of interest to use its quantitative parameters, which are arranged by means of the expected performance percentage and by conceptual field. As a minimum for participation, children should perform equivalent to (or better than) the expected for their age group, by conceptual field. In the case of teenagers and adults, as there are no minimum points defined by the test, it was considered that they should have a performance of 90% of correct answers in all conceptual fields. This percentage was chosen so that there was a margin for error. Further, Raven's Colored Progressive Matrices test (Raven *et al.*, 1988) was employed to assess children's non-verbal reasoning in both groups. The Raven test was chosen because it is possible to be carried out regardless of the participant's verbal ability. This was to ensure that none of the participating children had an associated intellectual deficit so that we did not depend on the parents' typically subjective assessment.

### 2.2.2 Experimental Tasks

In order to evaluate figurative language comprehension, three tasks from a figurative language comprehension instrument (COMFIGURA) were used; two to assess PM comprehension (adapted from Siqueira, 2004; Siqueira *et al.*, 2023a), and one to assess the comprehension of idioms (Siqueira; Marques, 2018). The PM comprehension measures are a non-verbal and a verbal task. The different formats had different overall aims. In the non-verbal PM task, comprehension of the conceptual mapping is addressed, whilst the verbal one serves to identify metaphor comprehension in oral language via their linguistic instantiations. The conceptual primary metaphor used in the PM tasks in each of the items are respectively: HAPPINESS IS UP, GOOD IS CLEAR, EMOTIONAL INTIMACY IS PROXIMITY, INTENSITY OF EMOTION IS HEAT, DIFFICULTY IS HEAVINESS, and IMPORTANCE IS SIZE. Conceptual metaphors used in both tasks are the same.

The non-verbal PM task consists of six items that contain drawings of simple human-like figures (dubbed Dunis) in all items (see example in Appendix). Each drawing was designed to test one conceptual PM mapping. Thus, items can have higher or lower Dunis on the page (HAPPINESS IS UP metaphor), Dunis that are closer or farther apart (INTIMACY IS

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<sup>1</sup> Unlike in the English language, in Brazilian Portuguese there is a lack of assessments available and validated to test older children, teenagers, and adults. Thus, the ABFW test was used to make sure participants had basic lexical knowledge to allow them to understand instructions given and vocabulary contained in test items, although we cannot be sure that they had similar linguistic skills.

PROXIMITY metaphor), etc. The interviewer showed each participant one picture containing at least two Dunis at a time and read a question (e.g., “point to the happiest Duni”). After choosing one of the two options, participants were encouraged to explain why they made that choice (e.g., “why is this one the happiest?”).

The verbal PM task consists of six items with sentences containing linguistic expressions of each conceptual mapping (e.g., “Lucia is uplifted after meeting Rodrigo”, which instantiates HAPPINESS IS UP). In the task, the interviewer gave the following verbal instructions: “I’m going to tell you a few sentences and then ask you some questions about them. There isn’t only one possible answer, and the sentences are not related to each other.” Then they proceeded to read metaphorical sentences (e.g. “Lucia is uplifted after meeting Rodrigo”) and question their meaning. Meaning was probed via an open-ended (e.g. “How is she feeling?”) and a close-ended question (e.g., “Did he give her good or bad news?”), the latter of which was only asked in case the first question was not answered correctly. Participants did not have a time limit for their answers.

Finally, the idioms comprehension task also consists of six items, each starting with a stimulus sentence that contains an idiom and followed by an open-ended question and a closed-ended question (see Appendix). Each stimulus item contained a highly familiar, non-ambiguous idiom in Brazilian Portuguese in a decontextualized sentence. Familiarity, ambiguity (that is, the possibility of it being interpreted both figuratively and literally), syntactic and semantic structure were controlled for in item sentences and questions. Norming procedures are described in a previous study (Siqueira; Marques, 2018).

Participants (or their legal guardians) expressed their intention to participate and signed a consent form, in accordance with the local institutional review board. They were interviewed in person and individually, in one or two sessions that together lasted one hour, on average. Participants first performed the non-verbal PM task, then the verbal PM task, then the idioms task. The questions were read to them and they responded verbally. All answers were recorded manually by the interviewer (during the interview) and then discussed with other researchers from the group for response coding.

For coding participants’ responses, the criteria proposed by Siqueira (2004) and Siqueira; Marques (2018) were adopted. Regarding the closed question of the non-verbal task, the expected answer was the one that was consonant to the metaphorical interpretation. For the evaluation of the open question on the non-verbal task, answers were considered correct when physical features compatible with the metaphor in question were specified. For example, in item 1, responses such as “because he is up”, “because he is jumping with joy” were accepted, but not answers such as “because he has a happier face” or “because his smile is bigger” (these were also not true, as Dunis had the exact same features). Answers given by opposition were also considered correct (e.g. “the other is bad because he is in a darker place”). As for the idiom comprehension task, scores of one were given for answers demonstrating the expected figurative interpretation of the idiom, and scores of zero were given in the case of responses evidencing literal interpretations or lack of responses, such as “I don’t know”. The maximum score was 36 points (12 points for each task), considering the six items of the three tasks and their open and closed questions.



## 2.3 Statistical Analysis

In order to proceed with data analysis, the variables were described by median and interquartile range due to the distribution asymmetry of these variables found by the Shapiro-Wilk test ( $n < 50$ ,  $W < 0.915$ ,  $p < .01$ ). To compare medians between the three age groups, we carried out a Kruskal-Wallis test for non-parametric data, complemented by Dunn's test. When comparing experimental and control groups, the Mann-Whitney test was used. Data were analyzed via SPSS, v. 21.0. For all analyses, a 5% significance level was adopted ( $p < .05$ ).

## 3 Results

In the non-verbal PM task, statistical analysis revealed that, when comparing hearing loss (HL) and normal hearing (NH) groups, the difference in performance was statistically significant among children only ( $p = .01$ ). Children with NH understood non-verbal mappings better than children with HL. There was no statistically significant difference between the groups of adolescents and adults, as both NH participants and those with HL performed well in the non-verbal task.

Regarding tasks with verbal stimuli, for both PM and idioms, there was a statistically significant difference in comprehension between the HL and NH groups for all ages. Performance of NH groups was better than groups with HL, and it increased as age increased (Table 2).

TABLE 2 - Performance comparison between experimental and control groups

Age group	Experimental ( <i>n</i> = 57)	Control ( <i>n</i> = 94)	<i>p</i>
	Md (P25 - P75)	Md (P25 - P75)	
Primary metaphor: non-verbal task			
Children	7 (6 - 9)	10 (7 - 10)	0.011*
Teenagers	10 (8.8 - 10)	10 (8 - 11)	0.508
Adults	9 (8 - 10)	10 (8.8 - 11.3)	0.074
Primary metaphor: verbal task			
Children	4 (1 - 6)	9.5 (8 - 11)	<0.001*
Teenagers	6.5 (4.8 - 8.5)	11 (11 - 12)	<0.001*
Adults	11 (9 - 12)	12 (11 - 12)	0.001*
Idioms			
Children	0 (0 - 3)	5 (3 - 6)	<0.001*
Teenagers	3 (3 - 5)	10 (8 - 10)	<0.001*
Adults	8.5 (4.5 - 10.8)	10 (9.8 - 12)	0.002*

Elaborated by the authors.

\* Significant differences at  $\alpha < .05$ .

Analysis of the age variable in both PM and idiom comprehension specifically for the experimental groups pointed to a gradual improvement in performance in verbal tasks as age increased, as expected. For the non-verbal task, there was a significant improvement in comprehension for adolescents when compared to children. However, adults did not differ significantly from these two, as some participants had a score performance similar to that of children, and others did similar to that of adolescents (see Table 3).

TABLE 3 - Figurative language comprehension by experimental groups

	Children ( <i>n</i> = 15)	Teenagers ( <i>n</i> = 10)	Adults ( <i>n</i> = 32)	<i>p</i>
	Md (P25 – P75)	Md (P25 – P75)	Md (P25 – P75)	
Non-verbal PM	7 (6 – 9) <sup>a</sup>	10 (8.8 – 10) <sup>b</sup>	9 (8 – 10) <sup>ab</sup>	0.010*
Verbal PM	4 (1 – 6) <sup>a</sup>	6,5 (4.8 – 8.5) <sup>ab</sup>	11 (9 – 12) <sup>b</sup>	<0.001*
Idioms	0 (0 – 3) <sup>a</sup>	3 (3 – 5) <sup>ab</sup>	8,5 (4.5 – 10.8) <sup>b</sup>	<0.001*

Elaborated by the authors.

<sup>a, b</sup> Equal letters do not differ given Dunn's test at 5% significance. \* Significant differences at alpha < .05.

When analyzing PM comprehension performance, we found significantly higher scores in the non-verbal format by children ( $p < .01$ ) and adolescents ( $p < .05$ ) in comparison to the verbal format. Adults presented a different pattern, i.e., better performance in the verbal tasks compared to the non-verbal one, although the difference between the tasks was not statistically significant ( $p > .05$ ) (see Table 4).

TABLE 4 - Primary metaphor comprehension via different stimuli by experimental groups

Variables	Non-verbal	Verbal	<i>p</i>
	Md (P25 – P75)	Md (P25 – P75)	
Children	7 (6 – 9)	4 (1 – 6)	0.004*
Teenagers	10 (8.8 – 10)	6.5 (4.8 – 8.5)	0.036*
Adults	9 (8 – 10)	11 (9 – 12)	0.097

Elaborated by the authors. \* Significant differences at alpha < .05.

At the request of an anonymous reviewer, we have further conducted a logistic generalized mixed-effects model in R/RStudio (version 4.5) to control for random effects of participant and item. We included group (hearing or hard of hearing), age (children, adolescents, adults) and task (non-verbal PM, verbal PM, idiom) as predictors of accuracy. Random intercepts revealed meaningful variability in baseline accuracy across individuals ( $SD = 0.82$ ) and items ( $SD = 0.90$ ). Still, our pattern of results remained the same, with participants in the oral deaf group showing significantly lower accuracy than those in the hearing group overall ( $\beta = -1.47$ ,  $SE = 0.16$ ,  $z = -9.14$ ,  $p < .001$ ) and accuracy significantly increasing with age in both groups ( $\beta = 0.97$ ,  $SE = 0.09$ ,  $z = 10.53$ ,  $p < .001$ ). Additionally, accuracy was significantly lower in the verbal tasks compared to the non-verbal PM task ( $\beta = -0.57$ ,  $SE = 0.19$ ,  $z = -3.00$ ,  $p = .003$ ).

## 4 Discussion

Recognizing the pervasiveness of figurative language in thought and in diverse forms of communication underscores the significance of mastering it. This mastery is essential for ensuring effective communication in everyday life. From a sample of participants of a specific population (individuals with hearing loss who speak Brazilian Portuguese) we found that there are important differences in the ability to understand primary metaphors and idioms. Indeed, having access to sound from an early age is a relevant variable for the development of figurative language comprehension in an oral language (Libben; Titone, 2008; Nippold *et al.*, 1996; Tabossi *et al.*, 2009). Our results suggest that age and other specificities of the phenomena, factors intrinsic to participants (e.g., hearing) and also task presentation (verbal or non-verbal) influence comprehension performance.

Corroborating the initial hypothesis of the present study, our data shows that there is a delay in primary metaphor and idiom comprehension by participants with pre-lingual hearing loss (HL) who use hearing aids or CI (i.e., children and teenagers) in relation to normal hearing (NH) people when it comes to verbal tasks. It is reasonable to infer that poor domain of oral language in general interfered with oral deaf participants' task performance, which is an interpretation consistent with studies using non-figurative language stimuli (Geers *et al.*, 2009; Rinaldi *et al.*, 2013). This was expected as this population has less exposure to oral language (Bahrami *et al.*, 2018; Nicastrì *et al.*, 2014). Additionally, reading ability (Orlando; Shulman, 1989; Do; Chung, 2015) and level of education (Gold; Segal, 2017) are factors that contribute to improving figurative language comprehension. In Gold & Segal (2017), for instance, all participants had at least 12 years of education and deaf young adults showed similar performance for metaphor processing to NH peers. Thus, we conclude that the delay we found is at least partly due to a lesser amount of linguistic exposure by the HL groups.

Our results in relation to PM are in accordance with the study by Afonso (2012), performed with the same PM task as our study with children who use CI. She also reported that hearing impairment had an effect on verbal PM comprehension but not in the understanding of conceptual PM via non-verbal stimuli. In the case of the non-verbal task, we only found statistical differences between the groups of children. There was no difference between the HL and NH groups in this non-verbal task for teenagers or adults. As Afonso (2012) explains, although performance in the two types of tasks, verbal and non-verbal, involves the activation of a more concrete domain in the conceptualization of a more abstract domain (Lakoff; Johnson, 1980), children with HL exhibited greater ease in dealing with the realization of mappings in the visual and tactile sensory planes (assessed by the non-verbal task) than they did with conceptual expressions on an auditory plane.

Further, our results for idioms can be explained by the fact that these tropes are acquired later in the lifespan, along with more formal aspects of language. As in our investigation, the results found by Schorr *et al.* (2008) showed a poorer performance by the group of CI users in an idiom task, when compared to the group with NH. The authors concluded that this performance pattern indicates that the development of higher order language skills, such as that involving idiom comprehension, is reinforced by a better understanding of basic language skills (Schorr *et al.*, 2008). It should be noted that, in this type of figure of speech, other aspects such as familiarity, compositionality and transparency can strongly influence comprehen-

sion. Considering that these aspects were controlled for during task elaboration (Siqueira; Marques, 2018), and as supported by previous literature (Libben; Titone, 2008; Nippold *et al.*, 1996; Tabossi *et al.*, 2009), the results found in the present study seem to be more related to participants' level of language development. For both the verbal PM and idioms tasks, we noticed improvement in performance as participants age increased. This additionally suggests that a better comprehension of the linguistic expressions in the task occurred only when participants had greater lexical and world knowledge, and perhaps even experience with the linguistic expressions themselves. Again, this gradual pattern is expected, since positive correlations between age and these abilities have been observed in other experiments (Levorato; Cacciari, 1995; Schorr *et al.*, 2008; Siqueira *et al.*, 2017).

Regarding our aim to investigate task type influence (verbal or non-verbal stimuli) in PM comprehension by the HL groups, our hypothesis that the performance in the non-verbal task would be better when compared to the verbal one by the group of children was corroborated. Indeed, children with HL performed significantly better in the non-verbal metaphor task than in the verbal task, while adults presented the opposite pattern, performing better in the verbal task. This indicates that children's embodied experiences influence knowledge of metaphorical mappings from an early age (Gallese; Lakoff, 2005; Lakoff; Johnson, 1980), whereas adults benefit from oral language experience (before HL and after rehabilitation). Oral deaf teenagers, in turn, showed a pattern similar to that of children in the verbal task, and to that of adults in the non-verbal task. We believe these results in the verbal task are associated with the fact that their HL was pre-lingual, like the children and unlike the adults. On the other hand, teenage performance in the non-verbal task could potentially be explained by increased world knowledge in general. This could be reflecting the fact that typical development takes place in a continuous fashion.

Results regarding adults revealed that some of them had similar scores to those of adolescents and others to those of children on the non-verbal task. This response pattern was also reported by Siqueira (2004) in a qualitative analysis of the items, when applying the same task to NH adults. In that study, as well as in the present one, adult participants answered expectedly in the verbal task but unexpectedly in the non-verbal task to items related to one specific conceptual metaphor, namely IMPORTANCE IS SIZE. For the open question related to the sentence "Today is a big day for Silvia," adults have provided answers such as "it is an important day for her." However, for the non-verbal item, they chose the smaller Duni figure as being more important. It is likely that this choice was not due to a (mis)understanding that adults have about the conceptual metaphor, but to social and emotional experiences they have had, such as parenthood. This is evidenced by answers such as "because my son is the most important thing I have" to the open question "Why is he [the small figure] the most important one?"

Another relevant finding regarding our sample of adults was the difference in performance between experimental and control groups. This difference might seem unwarranted given that our adult HL participants were all post-lingual, i.e. they had full language exposure and acquisition before becoming deaf. We attribute this difference to two main reasons: one regards individual language competence and the other regards the type of task. Since all language emerges from usage contexts, one's linguistic ability at any given point derives from their accumulated experience of use (Tomasello, 2003). Thus, for optimal ability, exposure to language should be continued. Our results suggest that auditory deprivation, even after a typical and long period of language acquisition, may interfere with figurative language

comprehension, particularly in a task where there are no contextual cues (Cain *et al.*, 2009; Levorato, 1993). Recall that, in our study, comprehension was measured by an instrument that presented decontextualized stimuli.

Summing up, when comparing NH and oral deaf individuals in relation to primary metaphors and idiom comprehension, our data indicates a poorer performance by the oral deaf participants at all ages in verbal tasks. In the task with non-verbal stimuli, however, taking the control group as a parameter, we observe a delay in PM comprehension by the HL group only in the case of children. Therefore, the type of task proved to be more distinctive than the type of phenomenon investigated. Further, this study shows that figurative language comprehension by people with HL who speak an oral language follows an improvement pattern as age increases, though with some delay at younger ages, as found for NH people in the same tasks. This is to say that we realize there might be a delay for deaf people to understand oral language as a whole and that figurative language is not an exception.

## 5 Final remarks

The present study intends to have contributed both for the analysis of the figurative language phenomena and for the study of language acquisition by oral deaf people. Further analysis should be performed to verify the influence of other relevant variables related to HL that we have not analyzed. Among these, we highlight the time of loss (pre- or post-lingual), the type of loss (progressive or sudden), the type of rehabilitation (hearing aid or cochlear implants), and whether this was uni- or bilateral. We also acknowledge the absence of hearing age as a variable in this study as a limitation. We chose chronological age instead as a variable following the literature reviewed (Afonso, 2012; Nicastri *et al.*, 2014; Rittenhouse; Kenyon, 1991; Schorr *et al.*, 2008; Wolgemuth *et al.*, 1998). In recent years, the research community has become more and more aware of hearing age as an important factor to assess auditory and linguistic development and this should be considered as well in future studies.

Another limitation of our study is that we did not include literal paraphrases comparing primary metaphor and idiom comprehension to that of literal language. This decision was made for the sake of task objectivity and standardization regarding other tasks within COMFIGURA. This analysis was conducted with a former version of the instrument by Siqueira (2004), which found a significant difference ( $p < 0.01$ ) between the comprehension of verbal primary metaphors and their literal paraphrases. In that study, literal sentences were significantly more understood by a normal hearing population than primary metaphors. Such an investigation with individuals with HL is encouraged for future studies.

This study is part of a research effort to develop a standardized instrument in Brazilian Portuguese and English that encompasses other types of figurative language (Siqueira *et al.*, 2023a; Siqueira *et al.*, 2023b). In developing this instrument, dubbed COMFIGURA, we aim at having a test that could establish expected age parameters for the comprehension of each figurative language phenomenon in typical development. More specifically, different phenomena such as metonymy, metaphor, idiom, proverb would be acquired in this order at predictable ages (Siqueira; Ferrari, 2025). With this study and with the instrument overall, we aim to inform speech therapists, psychologists and educators in different settings to identify and eventually intervene in cases of figurative language comprehension deficits.

## Authorship contribution statement

DM and MS conceived the study and created materials. DM collected data, administered the study and wrote the original draft of the manuscript. LB wrote the manuscript and assisted on data analysis and visualization. MS supervised the study and wrote the manuscript.

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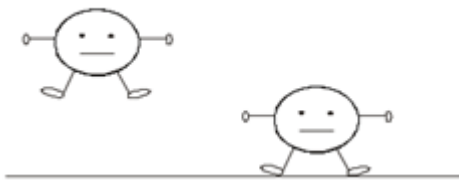
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## Appendix 1 - Sample items used in the tasks

	Sentences	Questions
Verbal metaphor	Lúcia está se sentindo para cima depois de encontrar Rodrigo.	a) Como Lúcia está se sentindo?
	[Lucia is feeling uplifted after meeting Rodrigo.]	[How is Lucia feeling?]
		a') Rodrigo deu boas ou más notícias pra ela?  [Did Rodrigo give her good or bad news?]
Non-verbal metaphor		a) Aponte para o Duni mais feliz.
		[Point to the happiest Duni.]
		a') Por que ele está feliz?  [Why is he happy?]
Idiom	Antonio comprou gato por lebre.	a) O que aconteceu com ele? [What happened to him?]
	[lit.: Antonio bought a cat for a hare.  meaning: Antonio was fooled.]	a') Ele fez uma compra ruim ou boa?  [Did he make a good or a bad deal?]

Elaborated by the authors.