Original Article

https://doi.org/10.1590/2317-6431-2024-2907en

Audiology Communication Research
ISSN 2317-6431

Adaptation and content validity of the minimal contrasts perception instrument to Chilean Sign Language

Adaptação e validade de conteúdo do instrumento de percepção do contraste mínimo para a Língua de Sinais Chilena

Carlos González Herrera[1], *Themis Maria Kessler*[2], *Karina Carlesso Pagliarin*[2]

ABSTRACT

Purpose: to adapt and assess content validity of the the Minimal Contrasts Perception instrument to Chilean sign language (ChSL). **Methods:** this study was conducted in seven stages: stage 1: identification of minimal contrast pairs in sign language. Stage 2: Jugment by four expert judges. Stage 3: Drawings creation. Stage 4: the pairs were assessed by non-expert judges. Stage 5: development of test materials. Stage 6: a video recording of the test stimuli was produced. Stage 7: a pilot study was conducted. **Results:** in Stage 1, 69 minimal contrast pairs were identified. In Stage 2, the judges achieved acceptable agreement rates on 46 (CVR ≥ 0.95; AC1=0.659). After assessing their relevance and presence in children's vocabulary, the judges selected 29 pairs. This was followed by an assessment of representativeness, which narrowed down the stimuli to 24 pairs. In Stage 3, drawings of the 24 pairs were created. Non-specialist judges in Stage 4 revealed the need for six pairs to be re-drawn. Stages 5 and 6, the illustrations were adjusted, and a video was recorded to display the test instructions. In Stage 7, the pilot sample understood and completed the test successfully. **Conclusion:** the instrument was adapted and displayed adequate content validity.

Keywords: Psychometrics; Sign Language; Deafness; Child, Adolescent

RESUMO

Objetivo: Adaptar e validar um instrumento para avaliar a percepção de pares de contraste mínimo na língua de sinais chilena (ChSL). **Métodos:** Este estudo foi desenvolvido em sete etapas, sendo a primeira delas a identificação dos pares de contraste mínimo na língua de sinais (Etapa 1). Posteriormente, esses pares foram avaliados por quatro juízes especialistas (Etapa 2). Na Etapa 3, um ilustrador profissional criou os desenhos correspondentes a cada par. Na Etapa 4, os pares foram avaliados por juízes não especialistas. A Etapa 5 envolveu o desenvolvimento de materiais do teste. Na Etapa 6, foi produzida uma gravação em vídeo dos estímulos-teste. Na Etapa 7, foi realizado um estudo piloto envolvendo seis crianças e adolescentes surdos. **Resultados:** Na Etapa 1, foram identificados 69 pares de contraste mínimo. Na Etapa 2, os juízes alcançaram taxas de concordância aceitáveis em 46 (CVR ≥ 0,95; AC1=0,659, considerado substancial). Após avaliar sua relevância e presença no vocabulário infantil, os juízes selecionaram 29 pares. Isso foi seguido por uma avaliação de representatividade, que reduziu os estímulos a 24 pares. Na Etapa 3, foram elaborados desenhos para representar cada item dos 24 pares. Os juízes não especialistas (Etapa 4) revelaram a necessidade de redesenhar seis pares. Nas Etapas 5 e 6, as ilustrações foram ajustadas e um vídeo foi gravado para exibir as instruções do teste. Na Etapa 7, a amostra piloto entendeu o teste e o concluiu com sucesso em sua totalidade. **Conclusão:** O instrumento para avaliação da percepção de pares de contraste mínimo em ChSL foi adaptado com sucesso e apresentou validade de conteúdo adequada.

Palavras-chave: Psicometria; Língua de Sinais; Surdez; Criança; Adolescente

Study carried out at Universidade de Talca – UTALCA, Talca (VII región del Maule), Chile.
[1]Departamento de Ciencias de la Fonoaudiología, Facultad de Ciencias de la Salud, Universidad de Talca – UTALCA – Talca (VII Región del Maule), Chile.
[2]Programa de Pós-graduação em Distúrbios da Comunicação Humana, Universidade Federal de Santa Maria – UFSM – Santa Maria (RS), Brasil.
Conflict of interests: No.
Authors' contribution: KCP and TMK: conception and design of the study, critical review for relevant intellectual content, final approval of the version to be presented for publication; CGH data collection, analysis and interpretation, critical review for relevant intellectual content, final approval of the version to be presented for publication.
Funding: None.
Corresponding author: Karina Carlesso Pagliarin. E-mail: karina.carlesso@ufsm.br
Received: February 16, 2024; **Accepted:** June 26, 2024

INTRODUCTION

The deaf population has been investigated in several studies, many of which focus on sign language acquisition, comprehension, and expression[1-3]. In addition to significant visual and gestural components, sign languages - like most other languages - have linguistic features such as phonology, morphosyntax, semantics, and pragmatics[4] all of which differ between existing sign languages and must therefore be studied separately. This is because, much like spoken languages, sign languages around the world differ in how they represent or sign a given word[5].

William Stokoe[1] studied American Sign Language (ASL) and provided a basis for its description based on a sublexical approach to sign language that corresponds to its phonological level. The phonological level is composed of visual parameters that systematically work to convey different meanings. The rules and restrictions on the combination of these parameters are specific to each sign language community and system[6].

Minimal pairs in spoken language are words that differ by a single phoneme, where a change in one or two distinctive features (e.g. /m/ x /b/, "my" x "by") generates a new word in that language[7]. Due to the visual and gestural nature of sign language, minimal pairs in this medium are created when signs differ by only one formational parameter. These parameters are important as they create minimal phonological contrasts[8].

Formational parameters in sign language include handshape (the shape the hand takes when performing the sign); movement (the way the hands move when performing the sign); location (the location of the sign relative to the body of the signer)[1]; palm orientation (the direction the palm faces relative to the signer)[9]; and the non-manual component (movements of the body and head or facial expressions that must be performed simultaneously with the sign)[10]. The combination of these features creates signs much like phonemes combine to form words in spoken language[11].

Although sign language shares several linguistic features with spoken languages, few instruments are available to assess visual-gestural language[12,13]. There is, as such, a need for further investigation of the different linguistic components of sign language, and for the development of instruments that help clinicians understand the processes involved in sign language acquisition in children.

In response to this concern, Vargas et al.[13] developed an assessment protocol to evaluate the perception of minimal contrast pairs in deaf children in Brazil, using Brazilian Sign Language (Libras). This protocol contains 35 minimal contrast pairs that vary by a single parameter: handshape, location, hand movement, or orientation. The pairs are represented by drawings and shown to children on cards containing three answer alternatives. The first may contain two identical drawings (map x map), while the second could contain two different drawings (map x mat), and the third, two identical drawings that differ from the first (mat x mat). Each card contains a total of six images. Throughout the test, the child is shown a video of sign language interpreters performing pairs of signs, which can be identical or different depending on the target item. After each pair is shown, the child is given the response card for the item and asked to identify the pair of drawings to which the signs correspond.

Similar procedures have been evaluated in Brazilian[14] and Turkish sign language[15]. However, no studies have explored the assessment of minimal contrast pair perception in Chilean sign language (ChSL).

Therefore, the goal of this investigation was to adapt and validate an instrument to evaluate the perception of minimal contrast pairs in ChSL.

METHODS

This is a qualitative and quantitative cross-sectional study. This study was conducted as part of a project approved by the Research Ethics Committee of the Universidade Federal de Santa Maria, Brazil, under protocol 3.022.041. All children and adolescents who took part in the investigation, including expert and non-expert judges, assented to participate as determined by National Health Council resolution 510/16 and received written consent from their parents or guardians. The authors of the Brazilian instrument also authorized its adaptation to ChSL, as recommended by the International Test Commission (ITC)[16]. Furthermore, each stage has been carried out following the ITC Guidelines for Translating and Adapting Tests[16].

Participants and Procedures

This study was conducted in 7 stages: Stage 1 - Identification of minimal contrast pairs in ChSL; Stage 2 - Expert judge analysis; Stage 3 - Illustration of minimal contrast pairs; Stage 4 - Non-expert judge analysis; Stage 5 - Development of test materials; Stage 6 - Video recording; Stage 7- Pilot study. Chart 1 describes the sample selection criteria employed at each stage of the study.

The following section contains a description of each of the 7 stages of the adaptation and validation of the instrument to evaluate the perception of minimal contrasts in ChSL.

Stage 1. Identification of minimal contrast pairs in ChSL

The instrument created by Vargas et al.[14] evaluates minimal contrast pairs in Libras and contains 35 pairs of signs that differ by a single formational parameter. The same stimuli could not be used in this instrument since ChSL and Libras differ in several linguistic and cultural aspects. This is among the most frequent issues observed when adapting tests in sign language[12]. The first author of this study, who has experience with ChSL, therefore identified new minimal contrast pairs through an extensive search of a ChSL dictionary[17]. The following formational parameters were considered: handshape, location, movement, and hand orientation. As in the original test[14] non-manual expressions were not considered, as they usually reflect emotions and are difficult to represent through images.

An additional aim of this process was to select words that were present in the vocabulary of 6-year-old children and could be represented through illustrations.

Stage 2. Expert judge analysis

Once the minimum contrast pairs were identified, their content validity was evaluated by four expert judges (three men and one woman), consisting of two congenitally deaf adults (50%) and two non-deaf interpreters of ChSL (50%) aged 29 to 42 years. One of the judges had a teaching degree (25%) while

Chart 1. Description of participants and selection criteria for each stage of development of a test to assess minimal contrast perception in Chilean sign language

Stages	n	Selection criteria
Stage 1	**1 speech-language pathologist**	**Study author**
Identification of minimal contrast pairs in ChSL		
Stage 2	2 congenitally deaf adults	Congenitally deaf adults
Expert judges	2 Chilean Sign Language (ChSL) interpreters	Professional ChSL interpreters certified by the ministry of education with over 5 years of experience
Stage 3	1 Illustrator	A professional illustrator was hired to create the drawings corresponding to each minimal contrast pair
Illustration of minimal contrast pairs		
Stage 4	6 non-expert judges	Deaf children and adolescents attending special schools for deaf children.
Non-expert judges	(n=3 female, n=3 male)	
Stage 5	2 speech-language pathologists	Study authors
Development of test materials		
Stage 6 Video recording	1 interpreter	Sign language interpreter certified by the ministry of education
Stage 7	6 deaf children (n=3 female, n=3 male)	Deaf children and adolescents attending special schools for deaf children
Pilot Study		

the other three had bachelors' degrees (75%). Participants were recruited through non-probabilistic convenience sampling in the cities of Talca (75%) and Santiago (25%).

Judges were contacted and invited to participate in this study through an e-mail message which also provided information on the goals of the study. The judges were asked to evaluate whether the minimum contrast pairs selected by the investigator differed by only one formational parameter (handshape, location, movement, and hand orientation); that is, if the words selected by the study author corresponded to minimum contrast pairs in ChSL.

The judges were asked to rate each pair as adequate or inadequate. Data analysis was performed by calculating the content validity ratio (CVR) for each item. The CVR was obtained using the formula CVR = (ne – N/2) / (N/2), where *ne* corresponds to the number of judges that rated the item as 'adequate' and *N* represents the total number of judges. Items would only be retained if they achieved a minimum CVR of 0.95. Inter-rater agreement was assessed using Gwet's first-order agreement coefficient (AC1). The AC1 was interpreted as recommended by Landis and Koch[18], with values > 0.8 considered indicative of near-perfect agreement; values of 0.61 to 0.8 indicative of substantial agreement; and values of 0.41-0.6, 0.21-0.4, and < 0.2 as indicative of moderate, regular, and poor agreement, respectively.

Subsequently, the judges were asked to determine whether the words should be present in the vocabulary of children aged 6 years or older. Lastly, the judges indicated whether the words could be represented as drawings by answering a dichotomous (yes/no) question for each item. These results were analyzed using Gwet's AC1 coefficient. Only the words with CVR = 1 were considered for inclusion in the instrument.

Stage 3. Illustration of minimal contrast pairs

After the expert analysis, a professional illustrator created and drew an illustration for each word. All drawings were produced in color as proposed in the original instrument by Vargas et al.[14].

Stage 4. Non-expert judge analysis

Six deaf children and adolescents attending a special school for deaf children in the city of Santiago of Chile were selected for this stage of the study. Three of the participants were male (50%) while three were female (50%). The boys were 7 to 13 years old while the girls were 8 to 14. All participants had congenital hearing loss and no other diagnoses. Participants were recruited through convenience sampling, were all native to Santiago of Chile and had a minimum of four years of experiece with ChSL.

The non-expert judges analyzed the drawings to determine how well they represented each word. The drawings were printed in color on 216 x 279 mm cards and shown one by one to participants, who were asked to sign the word corresponding to each image shown. The results of this procedure were analyzed using Gwet's AC1 and the CVR for each item. Items would only be retained if they achieved a minimum CVR of 0.95.

Stage 5. Development of test materials

Test materials were developed as described by Vargas et al.[14]. The final set of stimuli consisted of sheets of paper with pairs of drawings distributed in columns. Each sheet contained three pairs, for a total of six illustrations per page. The items in each column could be the same or different (Figure 1). The drawings were randomly distributed using random.org to avoid perseverative responses. This method was based on that used to develop the Boston University Speech Sound Discrimination Picture Test[19].

Stage 6. Video recording

Subsequently, a video recording was made containing the minimal contrast pairs in the order of test administration. In the video, a ChSL interpreter certified by the Chilean Ministry of Education provided the test instructions and displayed the signs for the minimal contrast pairs. The video was edited to show one minimal contrast pair at a time so that examiners administering the test could pause after each item and give participants to respond by pointing out their answer on the corresponding response card. Items containing equal vs different signs were randomly distributed throughout the test using the random.org website.

Stage 7. Pilot Study

Figure 1. Format of a page in the minimal contrast perception test in Libras
Source: Vargas et al.[13]

A pilot study was performed to test the use of the instrument in a real data collection scenario and identify any issues in its adaptation. The pilot sample involved the same participants recruited for Stage 4 of the study (6 deaf children and adolescents, including both boys and girls). At this point in the investigation, participants were individually administered the complete version of the minimal contrast perception test in ChSL. The tests in the pilot study were administered by the first author of this study. The results of this procedure were analyzed using descriptive statistics.

RESULTS

The results of each stage of the study will be separately presented in the following sections.

Stage 1. Identification of minimal contrast pairs in ChSL

The initial investigation identified 69 minimal contrast pairs in ChSL that differed by handshape (n=15), location (n=8), movement (n=29), or orientation (n=17) (Chart 2).

Stage 2. Expert judge analysis

Forty-four of the 69 minimal contrast pairs identified in Stage 1 reached a CVR ≥ 0.95. Twelve of these differed by handshape, 7 by location, 21 by movement, and 4 by orientation. The Gwet's AC1 statistic revealed substantial agreement across all items (AC1 = 0.659). The judges reached perfect agreement for items that differed by handshape and substantial agreement for pairs that differed by location and movement. Agreement levels for items that differed by orientation were classified as regular (Table 1).

The second question answered by the judges was whether the words in each of the 44 pairs would be present in the vocabulary of deaf children and adolescents. Twenty-nine of the 44 minimal contrast pairs reached a CVR ≥ 0.95 for this question. The results showed substantial agreement between raters (AC1=0.686 [CI=0.555 - 0.818]). Lastly, the raters assessed the imageability of the 29 minimal contrast pairs. Twenty-two pairs reached a CVR ≥ 0.95, and the overall agreement level was classified as moderate (AC1= 0.597 [CI = 0.451 – 0.740]).

One of the deaf judges then suggested the inclusion of two additional minimal contrast pairs in the instrument: Wednesday – Play and Example – Sign language, which differ by handshape and orientation, respectively. These pairs were submitted to the judges who reached a CVR of 1. The selection of pairs that achieved a CVR of 1 resulted in the inclusion of 24 pairs in the instrument.

Stage 3. Illustration of minimal contrast pairs

Figure 2 shows a sample drawing of a minimal contrast pair in ChSL. The signs in question (turtle – snail) differ by handshape. The drawings were then submitted to the analysis of non-specialist judges (Stage 4).

Stage 4. Non-expert judge analysis

The judges displayed near-perfect agreement on the 24 minimal contrast pairs (AC1=0.848 [CI=0.726 – 0.970]. However, some items displayed CVR < 1 and therefore had to be redrawn (January – February; Yellow – Green; Near – Far; Young – Suffer; What? – busy; and Example – Sign Language). The new illustrations were then shown to the judges and reached a CVR of 1.

Stage 5. Development of test materials

The illustrations were created as explained in the methods section and separated into 24 pairs (8 differing by handshape, 5 by location, 8 by movement, and 3 by orientation). Two of the 24 pairs were selected as examples (January – February, and Young – Suffer). At this stage, a recording form for participant responses was also created using a similar format as that proposed by Vargas et al.[14], where answers can be given a score of 0 (incorrect) or 1 (correct). The maximum score on the test is 22 points.

Stage 6. Video recording

The video was recorded with a professional camera in a silent room. The interpreter was asked to wear a black shirt to

Chart 2. Minimal contrast pairs that differ by a single formational parameter

Minimal contrast pair	Formational parameter
Wednesday – Friday Cheese – celebrate Give – help Tree – December Duck – chicken Turtle – snail Pencil – Marker Eat – Pizza Cow – bull H – K January – February June – July I – My Giraffe – Dinosaur Center – Flag	Handshape
Butter – paint Orange – fruit Yellow – green Single – crazy Listener – crazy Pretty – Son Chillán– militar Lavar – acariciar	Location
Near – far Live – verb Beer – yellow Sympathetic – Affectionate Punished – Obstinate Black – white Llama – giraffe Backpack – jacket Notebook – book Car – truck Train – annoy Brother – lover N – Ñ Friend – enemy E – January F – February L – Monday Snake – fish Walk – jump Bee – fly Red – jealous Gun – pencil Universe – university Young – suffer Boyfriend – interpreter Tuesday – Municipality Bathe – Panic Bright – Brazil Street – Path	Movement
Positive – negative What? – busy To shelter – Shelter Accustomed – October Agreement – Camp Get up – small Interest – interesting Attend – attack Attack – casket Strike – axe Disorder – untidy Car – vest Weak – walk War – group Guide – far Humble – Caress Tape – thread	Orientation

Table 1. Agreement between expert judges for each item in the instrument

Minimal contrast pairs	Formational parameter	CVR	AC1/formational parameter/69 pairs	AC1/69 pares
1. Wednesday – Friday	Handshape	1	0.808 [CI=0.647 - 0.970]	0.659 [CI=0.5658 - 0.7532]
2. Cheese – celebrate		1		
3. Give – help		0.95		
4. Tree – December		0.95		
5. Duck – little chicken		1		
6. Turtle – snail		1		
7. Cow – bull		1		
8. H – K		1		
9. January – February		1		
10. June – July		1		
11. I – My		1		
12. Giraffe – dinosaur		1		
13. Orange – fruit	Location	0.95	0.610 [CI = 0.291- 0.929]	
14. Yellow – green		0.95		
15. Single – crazy		1		
16. Listener – crazy		0.95		
17. Pretty – son		1		
18. Chillán– military		1		
19. Wash – Caress		0.95		
20. Near – far	Movement	1	0.746 [CI = 0.609 - 0.884]	
21. Live – verb		1		
22. Llama – giraffe		1		
23. Jacket – backpack		1		
24. Notebook – book		1		
25. Train – annoy		1		
26. Brother – lover		1		
27. N – Ñ		1		
28. Friend – enemy		1		
29. E – January		1		
30. F – February		1		
31. L – Monday		1		
32. Walk – skip		1		
33. Bee – fly		1		
34. Red – jealous		0.95		
35. Gun – pencil		0.95		
36. Universe – university		1		
37. Young – suffer		1		
38. Boyfriend – interpreter		1		
39. Tuesday – municipality		1		
40. Street – path		1		
41. Positive – negative	Orientation	0.95	0.388 [CI = 0.180 - 0.597]	
42. What? – busy		0.95		
43. To shelter – shelter		1		
44. Disorder – untidy		1		
		1		

Subtitle: CVR = content validity ratio; AC1= Gwet's first-order agreement coefficient; CI = confidence interval

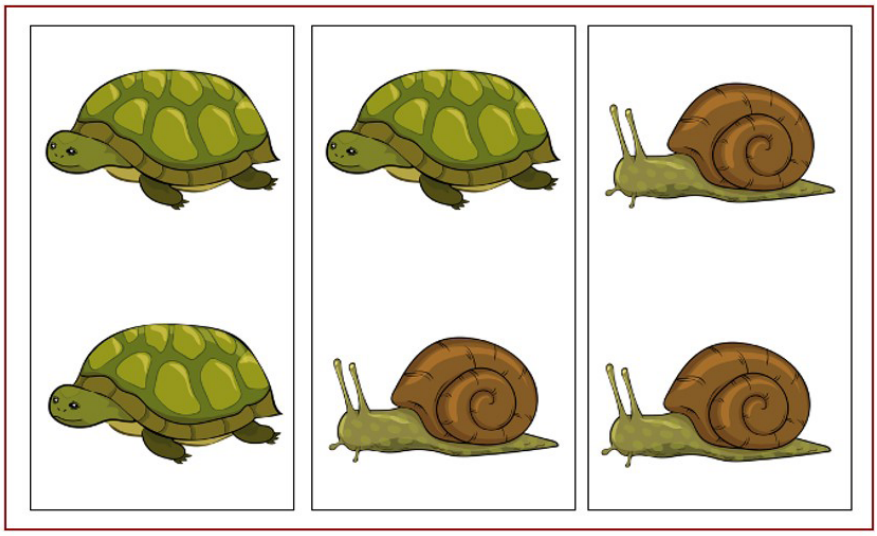

Figure 2. Format of a page from the minimal contrast perception test in Chilean Sign Language

contrast with the white background, and short sleeves to ensure his hands were visible. The video was 7 minutes and 34 seconds long and was recorded on a CD-ROM.

Stage 7. Pilot Study

The minimal contrast perception test was administered to a pilot sample to evaluate its performance in a realistic assessment scenario. Participants watched the video instructions and received additional explanations in sign language from the examiner to ensure they understood the test instructions, which were as follows: "The interpreter will show 2 signs. Please identify them in this booklet and point them out to me, understand? Let us begin." The video was paused after each item to ensure a steady pace throughout the test. All children were able to complete the entire test, confirming the suitability of the items.

DISCUSSION

The adaptation and validation of any instrument should follow a rigorous approach and consider the linguistic and cultural features and differences of each country where the instrument is used[20]. This is also true for instruments developed for the deaf population as sign languages present linguistic and cultural variations by country[13]. Problems during the adaptation process can arise due to linguistic differences between the source and target languages as well as differences between the source and target culture[21,22]. Both aspects must be considered in the adaptation of instruments between different sign languages[23]. The present study adapted an instrument that was originally developed in a Latin language, which facilitated the adaptation process and resulted in an instrument whose content validity was satisfactory and similar to original instrument.

The number of minimal contrast pairs that differed by handshape in the ChSL test was the same as that of items that differed by movement in the instrument developed by Vargas et al.[15]. Additionally, in both studies, the expert judges made significant contributions to the process, especially in the content validation stage, where they made important observations and suggested the removal of certain stimuli. In this study, we also included an analysis by non-expert judges (deaf children and adolescents) who contributed significantly to test development by identifying six minimal contrast pairs that needed to be redrawn (Stage 4). The pilot study demonstrated that deaf children and adolescents could complete the entire test. The test instructions and stimuli were clearly understood by all participants and no adjustments were necessary.

As observed in Stage 2 of this study, the expert judges reached a near-perfect agreement level regarding minimal contrast pairs that differed by handshape, possibly because these pairs were easier to identify in ChSL. Signs that differed by movement and location displayed substantial agreement levels, which is satisfactory but not ideal. Lastly, signs that differed by orientation displayed regular agreement levels, as their meaning depends on the context in which they are displayed.

In a study of education professionals in Germany regarding their perception of language assessment in deaf children, a study[12] found that most respondents identified limitations in the assessment instruments available for this population. The professionals surveyed observed that existing tests were not sufficiently comprehensive and did not assess the linguistic characteristics of sign language, which is especially problematic for children who have it as their first language. Such findings underscore the importance of evaluating minimal contrast perception in sign language, as it provides a visual and gestural assessment that is crucial for the deaf population. Secondly, this instrument will help expand our knowledge of the development of minimal contrast perception in sign language and the development of sign language itself. Furthermore, it will allow clinicians and educators to identify aspects that children may find especially difficult, facilitating the implementation of direct language interventions.

Although other studies have also evaluated the aforementioned characteristics[24], found that they have several limitations, including the use of tests with a narrow target age range, lack of normative data or poorly studied psychometric properties, and the reliance on instruments that are unsuitable for educational settings (due to the duration of application, for instance). In this

context, studies such as that of Vargas et al.[14] and the present investigation are especially important, as they provide evidence of instrument validity and a basis for future clinical interventions.

Future studies should focus, firstly, on expanding the sample, as this study was conducted at the height of the COVID-19 pandemic and the associated public health emergency, and had to adhere to several precautions (e.g., use of masks, face shields, hand sanitation), all of which may have interfered with the communication of deaf children and adolescents. Furthermore, the same sample was utilized in two stages (non-experts judges analysis and pilot study), which may have contributed to positive results in the pilot study as they already know the pictures of the instrument.

Future studies should also search evidence of minimal contrast pair perception in non-manual formational components. In Turkish sign language, for instance, the study of these components yielded significant findings[16]. Furthermore, in LIBRAS, a study confirmed that movement is the most easily perceived parameter among CODA (children of deaf adults), followed by location and handshape, while orientation was the most difficult to[13]. These findings are similar to those obtained through descriptive analysis in our pilot study. However, our protocol contains only three pairs that differ by orientation, as these were more difficult to identify in ChSL. The test contains a much higher number of pairs (eight) that differ by handshape and movement, which the literature states are more difficult for children to perceive[25,26]. Therefore, the administration of the Minimal Contrast Pair Perception Test in ChSL will provide clinicians and educators with more opportunities to assess the perception of children and adolescents regarding these formational parameters.

CONCLUSION

This study was developed to address a major gap in the literature on the assessment of children and adolescents who communicate using ChSL. Our findings indicate that the Minimal Contrast Perception Test in ChSL has adequate content validity. Further studies must be conducted to collect evidence of its construct and criterion validity as well as its reliability.

REFERENCES

1. Stokoe WC Jr. Sign language structure: an outline of the visual communication systems of the American deaf. J Deaf Stud Deaf Educ. 2005;10(1):3-37. http://doi.org/10.1093/deafed/eni001. PMid:15585746.
2. Ortega G, Morgan G. Phonological development in hearing learners of a sign language: the influence of phonological parameters, sign complexity, and iconicity. Lang Learn. 2015;65(3):660-88. http://doi.org/10.1111/lang.12123.
3. Mann W, Roy P, Morgan G. Adaptation of a vocabulary test from British Sign Language to American Sign Language. Lang Test. 2016;33(1):3-22. http://doi.org/10.1177/0265532215575627.
4. Newman AJ, Supalla T, Hauser PC, Newport EL, Bavelier D. Prosodic and narrative processing in American Sign Language: an fMRI study. Neuroimage. 2010;52(2):669-76. http://doi.org/10.1016/j.neuroimage.2010.03.055. PMid:20347996.
5. Fenlon J, Schembri A, Rentelis R, Vinson D, Cormier K. Using conversational data to determine lexical frequency in British Sign Language: the influence of text type. Lingua. 2014;143:187-202. http://doi.org/10.1016/j.lingua.2014.02.003.
6. Simms L, Baker S, Clark MD. The standardized visual communication and sign language checklist for signing children. Sign Lang Stud. 2013;14(1):101-24. http://doi.org/10.1353/sls.2013.0029.
7. Cooper R. The method of meaningful minimal contrasts in functional articulation problems. J Speech Hear Assoc. 1968;10:17-22.
8. Brentari D. Sign language phonology. Cambridge: Cambridge University Press; 2019. http://doi.org/10.1017/9781316286401.
9. Battison R. Lexical borrowing in American sign language. Washington: Linstok Press; 1978.
10. Liddell SK, Johnson RE. American sign language: the phonological base. Sign Lang Stud. 1989;64(1):195-277. http://doi.org/10.1353/sls.1989.0027.
11. Saldías PA. Análisis descriptivo de la categoría gramatical de aspecto en la lengua de señas chilena [tesis]. Santiago: Universidad de Chile; 2015 [cited 2024 Feb 16]. Available from: https://repositorio.uchile.cl/handle/2250/137641
12. Haug T, Mann W. Adapting tests of sign language assessment for other sign languages: a review of linguistic, cultural, and psychometric problems. J Deaf Stud Deaf Educ. 2007;13(1):138-47. http://doi.org/10.1093/deafed/enm027. PMid:17569751.
13. Vargas DZ, Mezzomo CL, Kessler TM. O desenvolvimento da percepção dos contrastes mínimos na língua brasileira de sinais em um grupo de Codas. Rev CEFAC. 2016;18(4):835-42. http://doi.org/10.1590/1982-021620161842016.
14. Vargas DZ, Mezzomo CL, Kessler TM. A elaboração de um instrumento para investigar o domínio da percepção dos contrastes mínimos na língua brasileira de sinais. CoDAS. 2017;29(4):e20160234. http://doi.org/10.1590/2317-1782/20172016234. PMid:28746464.
15. Makaroğlu B, Uzun I, Arik E. Evidence for minimal pairs in Turkish Sign Language. Pozn Stud Contemp Linguist. 2014;50(3):207-30. http://doi.org/10.1515/psicl-2014-0015.
16. International Test Comission. Guideliness for Translating and Adapting Tests [Internet]. 2nd ed. England: International Test Comission; 2017 [cited 2024 Feb 16]. Available from: www.intestcom.org
17. Quintela DA, Robterson XA, Ramírez IC. Diccionario bilingüe lengua de señas chilena/español: un desafío lexicográfico. RLA Rev Linguist Teor Apl. 2013;51(2):173-92. http://doi.org/10.4067/S0718-48832013000200009.
18. Landis JR, Koch GG. The measurement of observer agreement for categorical data. Biometrics. 1977;33(1):159-74. http://doi.org/10.2307/2529310. PMid:843571.
19. Kaplan E, Goodglass H, Weintraub S. Boston naming test. USA: Lippincott Williams & Wilkins; 2001.
20. Astepe BS, Köleli I. Translation, cultural adaptation, and validation of Australian pelvic floor questionnaire in a Turkish population. Eur J Obstet Gynecol Reprod Biol. 2019;234:71-4. http://doi.org/10.1016/j.ejogrb.2019.01.004. PMid:30665079.
21. Fonseca MS, Pérez A, Pineda MI, Lemus FJ. Comunicación oral y escrita. London: Pearson Education; 2011.
22. Khouri NDMAA, Silva JC. Revisão narrativa: metodologias de adaptação e validação de instrumentos psicológicos. Rev Eixo. 2019;8(2):220-9.

23. Haug T. Methodological and theoretical issues in the adaptation of sign language tests: an example from the adaptation of a test to German Sign Language. Lang Test. 2012;29(2):181-201. http://doi.org/10.1177/0265532211421509.

24. Mann W, Prinz P. An investigation of the need for sign language assessment in deaf education. Am Ann Deaf. 2006;151(3):356-70. http://doi.org/10.1353/aad.2006.0036. PMid:17087446.

25. Bochner JH, Christie K, Hauser PC, Searls JM. When is a difference really different? Learners' discrimination of linguistic contrasts in American sign language. Lang Learn. 2011;61(4):1302-27. http://doi.org/10.1111/j.1467-9922.2011.00671.x.

26. Napoli DJ, Ferrara C. Correlations between handshape and movement in sign languages. Cogn Sci. 2021;45(5):e12944. http://doi.org/10.1111/cogs.12944. PMid:34018242.