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Validation of Male Talker Recordings of the Spanish Pediatric Speech Recognition Threshold Test and the Spanish Pediatric Picture Identification Test

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ABSTRACT

Purpose: The purpose of this study was to validate recordings of the Spanish Pediatric Speech Recognition Threshold (SPSRT) test and Spanish Pediatric Picture Identification Test (SPPIT) for Spanish-speaking children using a native, bilingual Spanish–English male talker of Castilian peninsular dialect from Spain.
Method: Seventy native Spanish-speaking children from a variety of countries participated. Fifty-eight participants had normal hearing, and the remaining 12 had mild hearing loss in at least one ear. Male talker recordings of the SPSRT and SPPIT were administered to obtain baseline validation data. Participants listened to the stimuli and pointed to the appropriate item on the picture boards that represented the word they heard.
Results: Mean SRTs were within 5 dB of mean pure-tone averages resulting in a positive correlation. Performance–intensity functions for the SPPIT showed minimal significant differences across the three test lists, and performance increased as the sensation level increased.
Conclusions: The male talker recordings of the SPSRT and SPPIT are valid speech perception picture-pointing assessments that can be used with Spanish-speaking children. The recordings present the Spanish target word while simultaneously presenting the English interpretation for ease of scoring.

With a growing population of Spanish speakers in the United States, there is a need for validated Spanish speech perception materials to be used with both monolingual Spanish-speaking and bilingual Spanish–English individuals during audiologic evaluations. The few tests that do exist were validated on adults and not children (Aubanel et al., 2014). Audiologic test materials should be appropriate for the age, education, and linguistic background of the listener so that test materials are developmentally and culturally appropriate and free from cultural bias (American Speech-Language-Hearing Association [ASHA], 2002; Desjardins et al., 2019; Gaeta & John, 2015). In addition, because not all audiologists are fluent in Spanish, there is a need for Spanish speech perception tests that can reliably be administered by clinicians who do not speak Spanish. Stimuli for such assessments should consider the familiarity and complexity of test items, dialectical characteristics of test items, and ease of administration of the test by a clinician with limited language proficiency (Carlo et al., 2020; Shi & Sánchez, 2011).

Assessing speech understanding in listeners is particularly important with very young children, because the ability to develop and use oral language is closely related to the ability to process speech. Speech perception should be routinely assessed so that the development of speech, language, reading, and cognitive skills develop appropriately (Kirk et al., 1997). Speech recognition thresholds (SRTs) and word recognition testing are essential components of the audiometric test battery, yet for some Spanish-speaking children, speech recognition cannot be adequately measured using English word recognition tests

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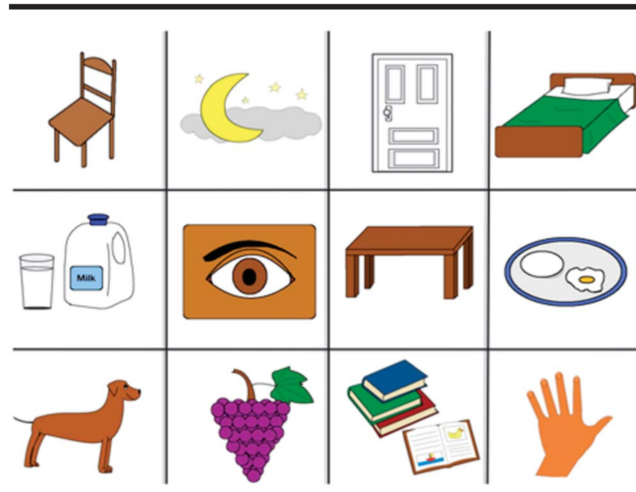
due to the level of knowledge, or lack thereof, of the English language. Gaeta and John (2015) suggest that valid and reliable tests in Spanish are necessary to appropriately diagnose patients who cannot be assessed using standard English-language materials. In addition, Calandruccio et al. (2014) recommended that for adults with low proficiency in their second language, speech recognition testing be conducted in one's first language. For children, however, it is more difficult to determine which language is appropriate for testing, because children are still in the process of acquiring both languages, and there may not be a definitive answer for determining which language to use for some children. Therefore, being able to assess speech perception in both languages can be very helpful for clinicians to determine any communication challenges the child may have.

Though a few tests exist to evaluate adults who speak Spanish as their first language (e.g., Spanish Picture-Identification Task; McCullough et al., 1994; Weisleder & Hodgson, 1989), only a few speech perception tests for Spanish-speaking children have been developed to date. Calandruccio et al. (2014) developed a pediatric Spanish–English speech perception task that evaluates children's English and Spanish speech perception abilities by using a forced-choice picture-pointing paradigm with noise or competing speech maskers. In addition, we recently developed two tests for use with Spanish-speaking children to assess both SRT and word recognition ability. The Spanish Pediatric Speech Recognition Threshold (SPSRT) test (Mendel et al., 2019) and the Spanish Pediatric Picture Identification Test (SPPIT; Mendel et al., 2020) were recorded by a bilingual Spanish–English female from Latin America and validated on monolingual Spanish-speaking and bilingual Spanish–English children. Both the SPSRT and the SPPIT are picture-pointing tasks, and their stimuli can be found in Appendixes A and B, respectively. The SPSRT and SPPIT are available from Auditec, Inc.

The SPSRT consists of a two-channel recording that presents the carrier phrase, *"Enseñame (Show me),"* followed by the Spanish target word via one channel and the English translation to the examiner in the other channel. Stimulus selection for the SPSRT was based on word familiarity ratings from 12 Spanish-speaking adults and pictorial representations presented to 25 Spanish-speaking children of Latin American decent. Color, computer-generated images of the stimulus items were included in the final stimulus set assembled into a four-row by three-column 12-item grid (see Figure 1). Validation of the female SPSRT recording was completed on Spanish- and English-speaking children indicating that the SPSRT should be within 2–12 dB of the pure-tone average (PTA; 3- or 4-frequency PTA) for children with normal hearing or minimal hearing loss. Additional details regarding the development of the SPSRT can be found in the work of Mendel et al. (2019).

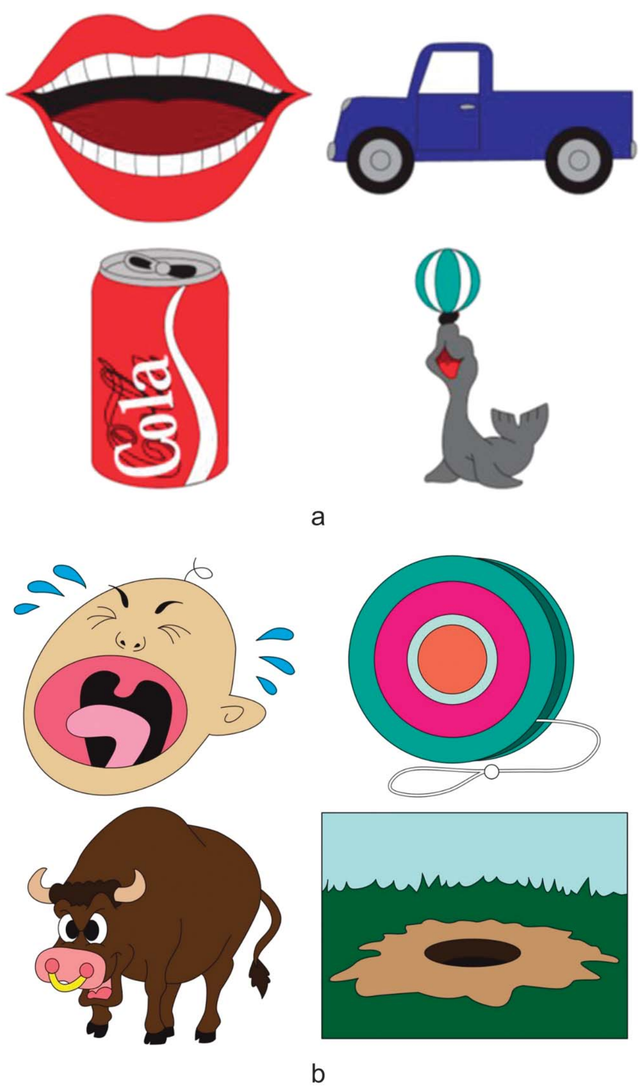
Figure 1. Spanish Pediatric Speech Recognition Threshold (SPSRT) picture board. Copyright: Images reprinted with permission from The University of Memphis. Copyright © 2018 University of Memphis Research Foundation, Inc.



The SPPIT is composed of word lists originally produced by Comstock and Martin (1984), who validated four lists of 25 Spanish words on Spanish-speaking children using a picture-pointing task. Unfortunately, the original recordings of these word lists were no longer available, so the SPPIT consists of rerecordings of the Comstock and Martin stimuli as well as improved digitally illustrated pictures that represent the stimuli in the word lists using Adobe Illustrator. Mendel et al. (2020) describe details of the validation of these stimuli with monolingual Spanish-speaking and bilingual Spanish–English children. Twenty-five picture boards were created with four illustrations on each representing 100 stimulus items (see Figure 2 for example items). Each picture board contains a target word from Lists 1, 2, and 3 as well as a randomly positioned distractor item from List 4. The position of each picture is randomly determined so that images are presented on each board in a random order. Stimulus items are presented in a consonant–vowel–consonant–vowel context such that the vowel used in each item was the same across lists. The SPPIT consists of a two-channel recording where the Spanish target word is presented to the listener via one channel and the English translation is presented to the examiner in the other channel. The same carrier phrase as the SPSRT, *"Enseñame (Show me),"* is used, and the same native English-speaking woman recorded the English translation. A detailed description of the development of the SPPIT can be found in the work of Mendel et al. (2020) including details regarding list equivalency and performance–intensity (PI) functions.

We created the male talker recordings of the SPSRT and SPPIT for two reasons. First, we wanted to create a test that presented Spanish stimuli using an alternative

Figure 2. (a) Sample Spanish Pediatric Picture Identification Test (SPPIT) picture board. Item 2: boca (mouth)/troca (truck)/coca (Coke)/foca (seal). Copyright: Images reprinted with permission from The University of Memphis. Copyright © 2018 University of Memphis Research Foundation, Inc. (b) Sample Spanish Pediatric Picture Identification Test (SPPIT) picture board. Item 3: lloro (crying)/yoyo/toro (bull)/pozo (hole). Copyright: Images reprinted with permission from The University of Memphis. Copyright © 2018 University of Memphis Research Foundation, Inc.



dialect from the Latin American dialect in the female version of these tests to account for differences in the intonation and pronunciation of words that can occur as a result of different dialects. The male talker recordings use a Castilian peninsular Spanish dialect, which is widely used. Second, many speech perception tests used in the audiologic test battery are recorded by both male and female talkers.

Tests of speech perception must adhere to principles of psychometric theory in order for them to meet appropriate development and standardization guidelines (Mendel & Danhauer, 1997). Although the test stimuli in the SPSRT and SPPIT have been standardized, the validity of these male talker recordings must still be established. Thus, the purpose of this study was to validate new recordings of the SPSRT and SPPIT stimuli for Spanish-speaking children using a male, native, bilingual talker with a Castilian peninsular Spanish dialect to broaden the usability of these tests.

Method

Digital Recordings

Digital recordings of the word lists from the SPSRT (Mendel et al., 2019) and the SPPIT (Mendel et al., 2020) were produced by a bilingual Spanish–English 29-year-old male native Spanish talker from Spain seated in a sound recording studio in the music department at the University of Memphis. The recordings were created by a sound engineer using Avid Pro Tools 2018 HDX digital audio workstation (Avid Pro Tools, 2020).

A Shure KSM 32 microphone (condenser fixed cardioid) with a wind screen was placed 6 in. from the talker's mouth, and the talker produced the carrier phrase, *"Enseñame (Show me),"* followed by each stimulus word as it would occur naturally. He was instructed to speak using a natural speaking rate and intonation. Each stimulus item was recorded 4 times, and the second or third presentation of each word was used in the final stimulus recording to avoid any variation in intonation during production. The full recording chain included Shure KSM 32 microphone, GML 8304 Microphone Preamp, and Avid HDX interface. The analog signal was converted to digital audio by the HDX interface with a sampling rate of 96 kHz and a bit depth of 24 bits.

Postproduction was completed in Pro Tools using three audio plugins to ensure that all stimuli were leveled such that their amplitude was consistent, equalization was appropriate, and sibilance and vocal plosives were controlled. The processing plug-ins in order included Bomb Factory BF76 compressor (for leveling and amplitude consistency), Massenburg Design Works MDWEQ5 equalizer (for removal of subsonic frequencies, increased intelligibility, and removal of unappealing vocal resonance), FabFilter Pro DS de-esser (to control sibilance), McDSP MC404 multiband compressor (for production consistency), and Massey L2007 mastering limiter (for peak leveling and transient control). Each word was faded up a couple of milliseconds before the waveform and gradually faded out after the word finished. The final export of each audio file was dithered to 16-bit for reduced file size using Avid's Pow-r dither plugin with "Noise Shaping Type-2" chosen. A 1000-Hz calibration tone was created, and a 2-s interstimulus interval was inserted between stimuli. The same male talker produced the English translation for the second channel on the recording.

Assessing List Equivalency

Participants

This study was approved by the institutional review board at The University of Memphis and St. Jude Children's Research Hospital. All participants provided written informed consent. A total of 70 children participated in the validation of the recordings. Twenty-three monolingual Spanish-speaking children (11 female, 12 male), aged 7–17 years (M = 12 years), and 47 bilingual Spanish–English children (22 female, 25 male), aged 6–17 years (M = 11.96), participated in the validation of the stimuli for both the SPSRT and the SPPIT. All participants were native Spanish speakers of Hispanic heritage from a variety of countries (e.g., Chile, Colombia, Cuba, Dominican Republic). For the monolingual listeners, Spanish was their only language, and for the bilingual Spanish–English listeners, Spanish was the first language they learned and the primary language used in and out of the home (see Table 1). Air-conduction thresholds were obtained at octave frequencies between 500 and 4000 Hz for both ears. Fifty-eight of the 70 participants had hearing within a normal limit (PTA of 20 dB HL or better) in both ears. The remaining 12 participants had mild hearing loss in at least one ear due to at least one threshold being greater than 20 dB HL. Of those 12 participants, only three had a PTA in either ear greater than 20 dB HL. All participants had no known cognitive, speech, or language deficits, and all had normal middle ear function on the day of testing as evidenced by Type A tympanograms in both ears.

Stimuli and Instrumentation

Validation data were collected in two locations in Memphis, Tennessee: (a) Speech Perception Assessment Laboratory (SPAL) at the University of Memphis and (b) St. Jude Children's Research Hospital (SJCRH). Three children were tested in the SPAL, and 67 children were tested at SJCRH. All children were evaluated in a sound-treated booth meeting American National Standards Institute (ANSI) standard S.31–1999 (ANSI, 1999). Air-conduction thresholds for children tested in the SPAL were obtained with a Grason-Stadler Inc. Model 16 (GSI-61) audiometer using TDH-50 supra-aural earphones. Tympanograms were obtained using a Madsen MI 34 middle ear analyzer. The stimuli were presented using a Sony CD player (RCD-W500C) routed through the GSI-61. The 67 participants at SJCRH had air-conduction thresholds obtained using a GSI AudioPro audiometer with Sennheiser HDA 200 supra-aural headphones. Tympanograms were obtained using GSI Tympstar and Tympstar Pro tympanometers. A Sony CD player (SCD-CE595) routed through the GSI AudioPro was used to administer the speech stimuli.

Procedure

The audiologists who administered the SPSRT and SPPIT were not Spanish speaking. Thus, all participants were offered the service of an interpreter from Interpreter Services at SJCRH to assist with informed consent and test instruction. The only time an interpreter's service was not used was when both the participant and guardian identified as bilingual, denied the need for an interpreter, and felt comfortable and confident with instruction given in English. Informed consent was offered in Spanish and English (for those who identified as bilingual). Spanish instructions are also available on the recordings of each test.

SRTs were measured in both ears after otoscopy, tympanometry, and hearing thresholds were obtained. The SPSRT was used to obtain SRTs using a picture-pointing task and procedures by Downs and Minard (1996). Participants were familiarized with the stimuli and instructed to point to the picture that represented the word they heard. The SRT was determined when the participant responded correctly to two out of three words in two out of three trials at the same level.

The three lists of the SPPIT were then presented at six sensation levels (SLs: 0, 8, 16, 24, 32, and 40 dB) above the child's SRT. Each child heard the three lists of the SPPIT 2 times. In order to minimize learning and practice effects, the first presentation of the lists was always at a very low SL and the second was at a higher SL. Counterbalancing the lower SLs (0, 8, and 16 dB) with the higher SLs (24, 32, and 40 dB) ensured that the first presentation of each stimulus would have been more difficult to hear and should have reduced chances of learning the stimuli. The right and left ears were also counterbalanced for every three participants to ensure a balance of test ears and lists at each level. For example, Participant 8 heard List 1 at 8 and 32 dB SL, List 2 at 16 and 40 dB SL, and List 3 at 0 and 24 dB SL in the right and left ears, respectively. A minimum of 20 data points was obtained for each list at each SL. The participants were instructed to point to the picture that represented the word they heard using the SPPIT picture board, which consisted of a two-row by two-column four-item grid with one image on each board representing the target stimulus and the remaining three images as distractors (see Figure 2).

Results

SPSRT

PTAs for the group with normal hearing ranged from −2 to 18 dB, and SRTs ranged from −10 to 15 dB. The mean difference between the PTA and SRT was 5 dB. PTAs for the group with hearing loss ranged from 2 to 35 dB, and SRTs ranged from 0 to 25 dB. The mean PTA for all test

Table 1. Demographic information for the participants (N/A = not available; F = father; M = mother).

Participant no.	Country of Spanish language	Birth country	Current place of residence	Preferred language–participant	Preferred language–family	Other fluent languages of family
1	Mexico	Mexico	Mexico	Spanish	Spanish	N/A
2	Puerto Rico	Puerto Rico	USA	Spanish	Spanish	N/A
3	Guatemala	USA	USA	Spanish	Spanish	N/A
4	Mexico	USA	USA	English	Spanish	N/A
5	Venezuela	Venezuela	USA	Spanish	Spanish	English
6	Mexico	USA	USA	Spanish	English	English
7	Guatemala	USA	USA	Spanish	Spanish	N/A
8	Ecuador	USA	USA	Spanish	Spanish	N/A
9	Mexico	USA	USA	Spanish	Spanish	N/A
10	Venezuela	Venezuela	USA	Spanish	Spanish	N/A
11	Guatemala	USA	USA	Spanish	Spanish	N/A
12	Guatemala	USA	USA	Spanish	Spanish	N/A
13	Puerto Rico	Puerto Rico	Puerto Rico	Spanish	Spanish	English
14	Honduras	Honduras	USA	Spanish	Spanish	N/A
15	Puerto Rico	Puerto Rico	Puerto Rico	Spanish	Spanish	N/A
16	Peru	Peru	USA	Spanish	Spanish	English
17	Honduras	Honduras	USA	Spanish	Spanish	N/A
18	Puerto Rico	Puerto Rico	USA	English	Spanish	English – F
19	Puerto Rico	Puerto Rico	Puerto Rico	Spanish	Spanish	English – M
20	Ecuador	Ecuador	Ecuador	Spanish	Spanish	N/A
21	Chile	Chile	USA	Spanish	Spanish	N/A
22	Peru	Peru	Peru	Spanish	Spanish	N/A
23	Mexico	Mexico	USA	Spanish	Spanish	N/A
24	Chile	Chile	USA	Spanish	Spanish	N/A
25	Mexico	Mexico	USA	English	Spanish	English – F
26	Colombia	Colombia	Colombia	Spanish	Spanish	N/A
27	Puerto Rico	Puerto Rico	Puerto Rico	Spanish	Spanish	N/A
28	Honduras	Honduras	USA	Spanish	Spanish	N/A
29	Honduras	Honduras	Honduras	Spanish	Spanish	N/A
30	Honduras	USA	USA	English	Spanish	N/A
31	Puerto Rico	Puerto Rico	USA	Spanish	Spanish	N/A
32	Mexico	USA	USA	Spanish	Spanish	N/A
33	Mexico	Mexico	USA	English or Spanish	Spanish	N/A
34	Puerto Rico	Puerto Rico	Puerto Rico	English	Spanish	English
35	Honduras	Honduras	Honduras	English	Spanish	N/A
36	Puerto Rico	Puerto Rico	Puerto Rico	English	Spanish	English
37	Puerto Rico	Puerto Rico	USA	English	Spanish	N/A
38	Mexico	USA	USA	English	Spanish	N/A
39	Mexico	USA	USA	English	Spanish	N/A
40	Puerto Rico	Not noted	Puerto Rico	Spanish	Spanish	N/A
41	Mexico	Mexico	USA	English	Spanish	N/A
42	Nicaragua	Nicaragua	Nicaragua	Spanish	Spanish	N/A
43	Mexico	Mexico	Mexico	Spanish	Spanish	N/A
44	Venezuela	USA	Venezuela	Spanish	Spanish	English
45	Mexico	Mexico	USA	Spanish	Spanish	N/A
46	Mexico	USA	USA	Spanish	Spanish	English – F
47	Puerto Rico	Puerto Rico	Puerto Rico	English	Spanish	N/A
48	Puerto Rico	Puerto Rico	USA	Spanish	Spanish	N/A
49	Mexico	Mexico	USA	Spanish	Spanish	N/A
50	Peru	Peru	Peru	Spanish	Spanish	N/A
51	Mexico	USA	USA	Spanish	Spanish	N/A
52	Mexico	USA	USA	Spanish	Spanish	N/A
53	Venezuela	Venezuela	USA	English	Spanish	N/A
54	Guatemala	Guatemala	Guatemala	Spanish	Spanish	N/A
55	Puerto Rico	Puerto Rico	Puerto Rico	Spanish	Spanish	N/A
56	Mexico	USA	USA	English	Spanish	N/A
57	Mexico	Mexico	USA	Spanish	Spanish	N/A
58	Colombia	USA	USA	English	Spanish	N/A
59	Mexico	Mexico	Mexico	Spanish	Spanish	N/A
60	Bolivia	Bolivia	Bolivia	Spanish	Spanish	N/A
61	Cuba	Cuba	USA	Spanish	Spanish	N/A
62	Puerto Rico	Puerto Rico	Puerto Rico	Spanish	Spanish	N/A
63	Puerto Rico	Puerto Rico	USA	English	Spanish	English – M
64	Mexico	Mexico	Mexico	Spanish	Spanish	N/A

(*table continues*)

Table 1. *(Continued).*

Participant no.	Country of Spanish language	Birth country	Current place of residence	Preferred language–participant	Preferred language–family	Other fluent languages of family
65	Bolivia	Bolivia	USA	Spanish	Spanish	N/A
66	Puerto Rico	Puerto Rico	USA	Spanish	Spanish	N/A
67	Guatemala	Guatemala	Guatemala	Spanish	Spanish	N/A
68	Dominican Republic	Dominican Republic	USA	Spanish	Spanish	N/A
	Guatemala	Guatemala			Spanish	
69	Chile	Chile	Guatemala	Spanish	Spanish	N/A
70			Chile	Spanish		English – M

ears combined was 8 dB, and the mean SRT was 3 dB with a difference between the PTA and SRT of 5 dB (see Table 2). A Pearson product–moment correlation of 0.56 ($p < .0001$) comparing SRTs and PTAs indicated as PTA improved, so did the SRT. The relationship between the PTA and SRT is displayed in Figure 3. Similar significant positive correlations ($p < .0001$) were found for the younger (0.61) and older children (0.50) as well as for the monolingual (0.71) and bilingual (0.60) children.

SPPIT

Mean percent correct scores for the three SPPIT word lists (see Table 3) ranged from 50% to 69% at 0 dB SL, 81% to 89% at 8 dB SL, and were above 90% at the remaining SLs (16, 24, 32, and 40 dB SL). Figure 4 displays the PI functions obtained for the children for the three SPPIT word lists presented at all SLs.

A binomial generalized linear mixed model (BGLMM) analysis was conducted to assess possible differences among the three lists and SLs (0, 8, 16, 24, 32, and 40 dB). A two-factor (list and level) mixed model repeated-measures design on all SPPIT scores was conducted. Both list and SL were included as fixed effects, and participant and item were included as random effects. Results from the fixed effects Type III sum of squares indicated significant effects due to list, $F(2, 195) = 13.44$, $p < .001$; level, $F(5, 189) = 147.61$, $p < .001$; and a List × Level interaction, $F(10, 189) = 2.03$, $p = .032$. Using Bonferroni post hoc tests, we compared the expected (predicted) means of scores in the form of odds ratios between lists at each SL and found significant differences at 0, 24, and 32 dB SL where performance on Lists 1 and 2 was significantly poorer than on List 3 (adjusted $p < .001$).

In addition, we divided the participants based on whether they were (a) Spanish-speaking (monolingual, $N = 23$) or (b) Spanish–English speaking (monolingual, $N = 46$). A BGLMM was again conducted with the two language groups. The monolingual language group showed significant main effects on list, $F(2, 58) = 4.11$, $p = .0214$, and level, $F(5, 56) = 58.47$, $p < .001$, but no significant interaction term, $F(10, 56) = 1.64$, $p = .1182$. Similarly, for the bilingual group, there were significant main effects due to list, $F(2, 128) = 9.46$, $p < .001$; level, $F(5, 124) = 95.6$, $p < .001$; but no interaction term, $F(10, 124) = 1.54$, $p = .1332$. Post hoc Bonferroni pairwise comparisons revealed significant differences at 0 dB SL for Lists 1 and 2 compared to List 3 ($p < .05$), 24 and 32 dB SL for Lists 1 and 3 ($p = .006$, $p = .035$, respectively) for monolinguals, and at 32 dB SL for Lists 1 and 3 ($p = .0315$) for bilinguals.

Discussion

SPSRT

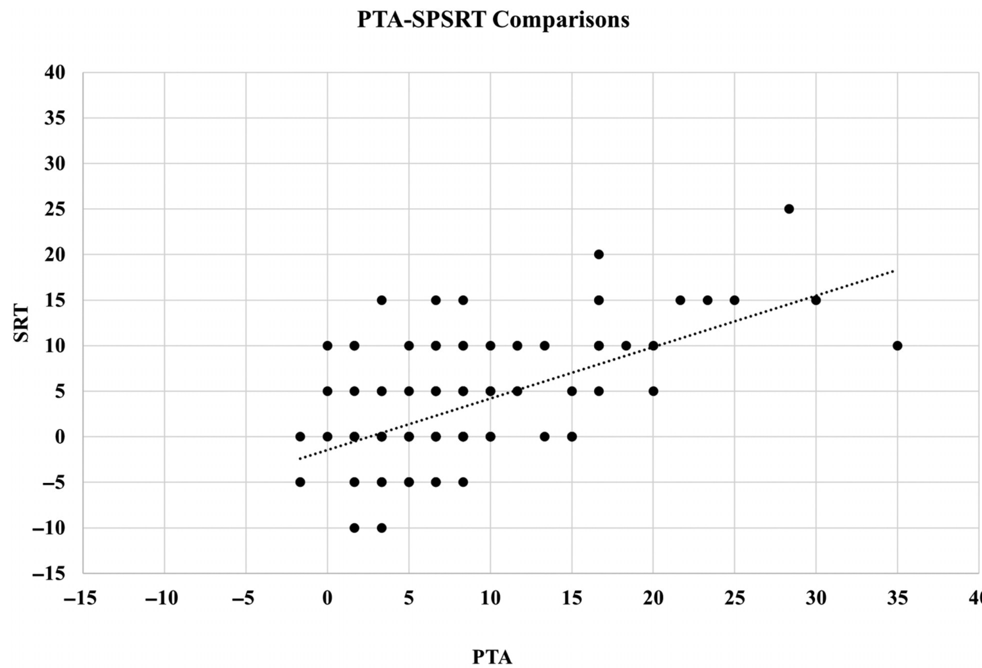
The normative data obtained on the male talker SPSRT recordings established the baseline relationship

Table 2. Means, ranges, standard deviations (*SD*s) in dB HL for speech recognition thresholds (SRTs) obtained with the Spanish Pediatric Speech Recognition Threshold test.

		PTA			SRT			PTA–SRT	
Group	*n*	*M*	*SD*	Range	*M*	*SD*	Range	Mean difference	Correlation
NH	116	7	4.20	–2 to 18	2	5.35	–10 to 15	5	.31*
HL	24	15	9.15	2 to 35	9	6.95	0 to 25	6	.75*
All ears	140	8	6.20	–2 to 35	3	6.18	–10 to 25	5	.56*

Note. Correlations between pure-tone averages (PTAs) and SRTs are also shown. Data reflect PTAs and SRTs for both ears for the participants with normal hearing (NH) and those with hearing loss (HL) for a total of 140 ears.
*$p < .0001$.

Figure 3. Comparison of pure-tone average (PTA) and speech recognition threshold (SRT) obtained using the Spanish Pediatric Speech Recognition Threshold (SPSRT) test.

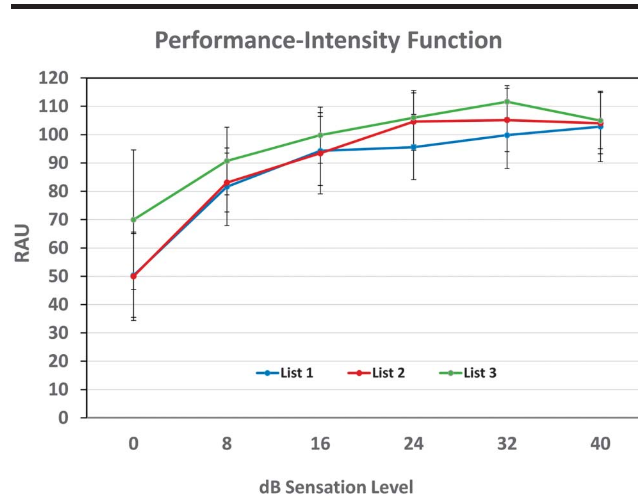


between the PTA and the SRT when using the SPSRT picture-pointing task. The significant, positive correlations for all participants as well as for the age (6–10 years; 11–17 years) and language (monolingual; bilingual) groups confirm that, as PTA increases, so does the SPSRT. For the male talker recordings, the mean SRT was within 5 dB of the mean PTA. For comparison, the mean SRT obtained with the female recordings of the SPSRT was within 10 dB of the mean PTA. The disparity found between the male and female recordings is likely due to the difference in the procedure used to obtain the SPSRT. When validating the female SPSRT,

Table 3. Mean percent correct performance and standard deviations (*SD*s) for each list of the male recorded Spanish Pediatric Picture Identification Test at the six presentation levels.

Presentation levels	List 1	List 2	List 3
0 dB SL			
M	50	50	69
Range	20–76	20–84	24–100
SD	16.04	16.69	22.72
8 dB SL			
M	81	83	89
Range	40–100	64–96	68–100
SD	7.86	8.81	8.32
16 dB SL			
M	91	90	94
Range	64–100	52–100	84–100
SD	7.86	10.91	5.19
24 dB SL			
M	92	96	97
Range	80–100	84–100	88–100
SD	6.26	4.44	4.08
32 dB SL			
M	94	96	99
Range	80–100	76–100	92–100
SD	6.48	5.78	2.05
40 dB SL			
M	95	96	97
Range	72–100	84–100	92–100
SD	6.82	5.12	4.33

Figure 4. Performance–intensity (PI) Functions reflecting performance in rationalized arcsine units (RAU) as a function of dB SL for the male recordings of the Spanish Pediatric Picture Identification Test (SPPIT) recording. Error bars reflect ±1 *SD*.



SRTs were obtained using a modified Martin and Stauffer (1975) 5-dB step procedure (ASHA, 1988). When validating the male recordings, we chose to use the more efficient procedure by Downs and Minard (1996), which requires presentation of a smaller number of stimuli at fewer levels.

PTA–SRT agreement using traditional SRT materials (Huff & Nerbonne, 1982) suggests PTA–SRT agreement should be between 6 and 8 dB depending on the procedure used. The significant correlations found between PTA and SRT for the participants in the current study support this relationship. Any differences observed using the SPSRT compared to other English SRT test materials are likely due to variations in the test procedures used as few studies have examined PTA–SRT agreement for stimuli presented using a picture-pointing task.

SPPIT

The range of scores obtained on the SPPIT at the different SLs fell within expected levels and were comparable to each other for those with normal hearing and minimal hearing loss. The range of scores obtained on the SPPIT for the male recordings varied broadly at low presentation levels (12%–88%) and narrowed considerably (92%–96%) as the presentation level increased. Analysis of the SPPIT scores showed some significant differences across the three lists at 0, 24, and 32 dB SL, but not at 8, 16, or 40 dB SL. It is important to note that even though we did not find significant differences between the lists at these SLs, we cannot directly determine if the lists are equivalent. However, the lack of significant differences at 8, 16, and 40 dB SL supports the fact that there is insufficient evidence to conclude that the lists are different.

Validation of speech perception materials often requires PI functions to be conducted in order to establish expected scores at various levels and to determine when a plateau in performance might occur. As a result, the stimuli were presented at levels ranging from very low to comfortable SLs. Although the participants heard each list twice with the first presentation at the lower of the two SLs, performance did not seem to be negatively affected by hearing the less-audible stimuli first. It is unlikely that these lists would be presented at the lowest of these levels in a clinical situation.

We compared the PI functions we obtained with the SPPIT to the PI functions obtained with the original Comstock and Martin (1984) lists. The slopes of our PI functions were relatively flat (1.04%/dB, 1.06%/dB, −0.9%/dB for Lists 1, 2, and 3, respectively) compared to a reported slope of 2.9%/dB for all lists studied by Comstock and Martin, which is likely due to modifications that had to made to some of the stimulus items and pictures that represented them. In the development of the SPPIT, we did have to eliminate some of the original stimuli used by Comstock and Martin and substitute a few different words (Mendel et al., 2020). Our shallow slopes, however, were consistent with data reported by Carlo et al. (2020) who compared the impact that the number of syllables in a word had on performance. Their PI functions for bisyllabic words were also very shallow.

When comparing list performance between the monolingual and bilingual children, the bilinguals had significantly poorer performance on List 2 compared to List 3 at 32 dB SL, whereas monolinguals had significantly poorer performance on List 1 compared to List 3 at 0, 24, and 32 dB SL and List 2 compared to List 3 at 0 dB SL. As with the full group of participants, the significant differences found between lists at these SLs suggest that the other SLs (e.g., 8, 16, and 40 dB) would be appropriate presentation levels if all three lists are used. Perhaps, these findings also suggest that the SPPIT actually may be more appropriate for bilinguals than for monolinguals. The fact that differences were observed between lists only at 32 dB SL for the bilinguals compared to 0, 24, and 32 dB SL for the monolingual children suggests that the SPPIT is likely more appropriate for bilingual Spanish speakers.

Research by Shi and Sánchez (2010) also supports this conclusion. These researchers investigated speech perception assessments with Spanish–English bilingual listeners and found that Spanish word recognition tests yielded more favorable results for the bilingual listeners whose dominant language was Spanish or who acquired English over the age of 10 years. Further Shi and Sanchez suggest that listeners who acquired English at 7–10 years should be assessed in both English and Spanish. In addition, Kohnert et al. (1999) indicated that bilinguals' first language may not remain their best language and they suggest that there may be a developmental shift in language dominance. One's native language may not necessarily be one's dominant language, which makes the classification of whether the individual is monolingual or bilingual challenging.

It is also possible that any differences seen between the female and male recordings of these tests could be due to dialectical differences produced by the talkers or the reception of the spoken word by the listeners. The female recordings favor a Latin American dialect, whereas the male recordings reflect a Castilian dialect. These dialects not only may pronounce certain words somewhat differently, they also may have different translations for various pictorial representations. Analysis of the random item effects in this study showed that the difficulty of some items likely contributed to differences in scores on List 3 compared to the other lists. For example, "mecha" could be translated as "dynamite" in some regions or it could be translated as “match” in others. In addition, differences in talker sex could also have impacted our findings, though the effect of talker sex on speech perception is unclear in the literature and was not a direct focus of this study.

Research on the mutual intelligibility of different regional Spanish dialects suggests that the Castilian dialect is often considered the original Spanish language, whereas Latin American Spanish is the most common Spanish dialect in the United States. Though there are noted differences between the dialects, vocabulary, and accent, it is generally reported that even though each dialect has its own set of variations on all linguistic descriptions, individuals using both dialects would ultimately understand each other very well. No matter what dialect is learned, people are able to adapt to the other dialect quite easily (Gooskens et al., 2018; Jenson, 1989).

Nevertheless, dialectical differences from country to country may have contributed to the variability seen in speech recognition performance across the lists of the SPPIT. Weisleder and Hodgson (1989) observed differences in word recognition scores when participants from several different countries listened to Spanish stimuli spoken by a male Mexican talker. In their study, the participants of Mexican origin performed better than those from other countries. Shi and Canizales (2013) also found that dialect and language dominance have significant effects on listener performance for word recognition. They observed that word familiarity may also have an impact on performance. Furthermore, Gordon-Salant et al. (2010) found evidence that accented speech, especially in noise, is a particularly challenging communication task for older people, especially those with hearing loss.

Dialectical differences appeared to have less of an impact on our participants’ performance in this study because speech perception scores occurred at expected levels. Nonetheless, dialectical differences and word familiarity should be considered in the administration of the SPPIT and SPSRT for other individuals. Documenting whether the listener is monolingual or bilingual as well as their language dominance are important considerations in the determination of which speech perception test is best to administer.

Limitations

This study is limited in its external validity for several reasons. First, because most participants had hearing within a normal range, the data may not be generalizable to the broad population of people with hearing loss. In addition, though we tried to control for learning by having the first presentation of a list occur at a very low SL, it is possible that when the child heard the list again at a higher SL, some of the stimuli could have been familiar. We recognize that the data collection design would have been improved if each participant only heard each list 1 time. As a result, we were unable to adequately assess within-subject variability to ensure that test scores obtained would be stable over time. Because there are only three lists of the SPPIT available and each participant heard all three lists, re-administering the lists for reliability purposes more than what was already done would certainly have had an effect on learning.

Though we did collect information regarding the participants’ language use, we had limited information regarding their language proficiency. If a patient or family reported Spanish as the preferred language, we assumed the patient was proficient in his/her preferred language of Spanish. We also did not have information regarding the age at which these children acquired English. More direct information regarding the participants’ language use would have provided more definitive evidence regarding whether they were truly bilingual. The use of a language dominance scale would have been an effective addition to our study as well.

The wide range of ages among the participants in this study made it difficult to determine the impact of age on the results. Though not a specific goal of this study, having a better understanding of age as it impacts speech perception performance for the SPSRT and SPPIT would strengthen the generalizability of these tests. Lastly, the potential effect of dialectical differences (i.e., Castilian speaker and Latin American listener) on listener age was not assessed in this study. Although our study results suggested that dialectical differences did not appear to impact the participants’ performance as scores fell within the expected range, validating the recording on younger age groups and different dialects is an area for future research.

Conclusions

The SPSRT and SPPIT recordings by a male talker from Spain and by a female talker from Latin America produce similar speech perception results for children using a picture-pointing task. These tests provide ease and accuracy of scoring speech perception ability for the monolingual English clinician. Instead of judging the accuracy of an oral response, the audiologist can simply judge if the appropriate word/picture was identified. The novelty of providing the simultaneous translation of the stimulus items to the clinician makes these tests uniquely useful for Spanish-speaking adults with limited or no English proficiency. Future research will investigate speech perception performance on the male SPPIT recordings in a background of multitalker babble because assessment of speech perception in noise provides a more realistic evaluation of one’s speech understanding in a typical listening environment compared to speech perception in quiet. In addition, future research should focus on providing these materials in a digital format for use with a tablet.

Declaration of Interest

Portions of this article were presented at the annual convention of the American Speech-Language-Hearing Association in November (2014) in Orlando, Florida; at AudiologyNOW! in March (2015) in San Antonio, Texas; and at the American Academy of Audiology Conference in April (2018) in Nashville, Tennessee. The SPSRT and SPPIT are available from Auditec, Inc.

Data Availability Statement

Data are available from the authors at https://www.memphis.edu/spal/index.php. The data that support the findings of this study are available from the corresponding author, L.L.M., upon reasonable request.

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Appendix A

Stimulus Set of 12 Items on the SPSRT Picture Board

Item no.	Spanish	English translation
1	Silla	Chair
2	Luna	Moon
3	Puerta	Door
4	Cama	Bed
5	Leche	Milk
6	Ojo	Eye
7	Mesa	Table
8	Huevo	Egg
9	Perro	Dog
10	Uva	Grape
11	Libro	Book
12	Mano	Hand

Appendix B

Lists 1, 2, and 3 Contain Stimulus Items, and List 4 Contains Distractors

List 1	List 2	List 3	List 4
mala (sick female)	sala (living room)	pala (shovel)	ala (bird's wing)
boca (mouth)	troca (truck)	coca (Coke)	foca (seal)
toro (bull)	lloro (crying)	yoyo	pozo (hole)
ojo (eye)	oso (bear)	ocho (eight)	oro (gold)
caja (box)	cara (face)	cama (bed)	capa (cape)
beso (kiss)	hueso (bone)	queso (cheese)	peso (dollar)
pasa (raisin)	taza (cup)	casa (house)	masa (flower)
saco (coat)	taco	gallo (rooster)	callo (corn blíster)
carro (car)	sapo (frog)	mano (hand)	palo (stick)
perro (dog)	burro (donkey)	pelo (hair)	pecho (chest)
rojo (red)	pollo (chicken)	lodo (mud)	codo (elbow)
soda	luna (moon)	sopa (soup)	cuna (crib)
papa (potato)	rama (branch)	rata (rat)	faja (belt)
niña (girl)	piña (pineapple)	risa (laughing)	misa (mass)
plato (plate)	uno (one)	gato (cat)	pato (duck)
correr (to run)	comer (to eat)	llover (to rain)	coser (sew)
vaca (cow)	bata (bathrobe)	pata (foot)	mata (plant)
bote (tin can)	bota (boot)	boda (wedding)	borra (erase)
pera (pear)	uña (fingernail)	baña (to bathe)	garra (rag)
brazo (arm)	baño (bathtub)	mono (monkey	vaso (glass)
mesa (table)	reza (to pray)	vela (candle)	tela (screen)
chiva (goat)	tía (aunt)	silla (chair)	liga (rubber band)
foco (light bulb)	coco (coconut)	moto (motorcycle)	roto (torn)
cena (supper)	ceja (eyebrow)	fecha (date)	mecha (match)
dedo (finger)	seco (to dry)	huevo (egg)	velo (veil)