THE SYLLABLE REPETITION TASK (SRT)

Technical Report No. 14

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CONTENTS

I. OVERVIEW

Shriberg, Lohmeier et al. (2008; hereafter SL et al.) describe the development of the

Syllable Repetition Task (SRT) and report findings from three substantive studies. The SRT is an

18-item imitation task that assesses a speaker's ability to repeat nonwords. This nonword

repetition task was designed specifically for speakers whose incomplete inventories invalidate

use of conventional nonword repetition tasks and/or who have speech production patterns that

are difficult to transcribe and score. The only speech sounds in the SRT nonwords are the four

voiced consonants /b/, /d/, /m/, and /n/ and the vowel /ɑ/. By limiting the target consonants to

just four of the 'Early-8' speech sounds (Shriberg, 1993), speaker and transcriber constraints

associated with more complex consonants and consonant environments are eliminated. Rationale

and findings from a proof of concept study are provided in SL et al. The SL et al. paper also

includes data supporting the use of the SRT to identify children with expressive language

impairment and reports findings from a substitution error analysis study that attempts to dissect

possible sources of speech processing constraints in speakers with lowered performance on the

SRT. This technical report provides (a) psychometric data on the SRT, (b) statistical findings

from several additional analyses, (c) comparison data obtained from 70 children ages 4-to-16

years with typical speech, (d) administration instructions, (e) scoring instructions, and (f) a form

for manual scoring of the SRT. A PowerPoint file that includes the audio stimuli for

administration of the SRT can be freely downloaded from the Phonology Project website located

at: http://www.waisman.wisc.edu/phonology/. For investigators interested in completing

additional analyses of SRT data, SL et al. describe procedures to calculate a respondent's

Percentage of Within-Class and Across-Class Substitution Errors and discuss the possible

sensitivity of this metric to encoding constraints underlying nonword repetition errors.

II. PSYCHOMETRIC DATA ON THE SRT

A. Distributional Characteristics

Table 1 is a summary of 9 distributional statistics findings for the Nonword Repetition Task (NRT: Dollaghan & Campbell, 1998) and SRT scores cross-tabulated by *task* (NRT, SRT), *group* (Typical Speech =TS, Speech Delay=SD, ALL), and task difficulty *level* (1-, 2-, 3-, 4-syllables, Total). Three observations on the findings in Table 1 support a conclusion that SRT scores meet customary psychometric requirements for parametric descriptive and inferential statistical analyses. First, the close agreement between the medians and means and the low skew and kurtosis values for most of the SRT scores support the normality of the distributions at each level. As with kurtosis values for the 1-syllable NRT nonwords, which were imitated correctly by most of the participants with TS, kurtosis values for the 2-syllable SRT nonwords were high. Second, the absolute and relative sizes of the standard deviations for each level of difficulty on the SRT (i.e., 2-, 3-, and 4-syllables) compare well to their respective means and to the comparable NRT standard deviations at each difficulty level. Third, the median, 25th and 75th percentiles, and range (minimum, maximum) findings for the SRT are orderly relative to the three levels of difficulty, and generally are not suggestive of floor or ceiling effects at the Total score level for speakers in this age range.

Several numerical characteristics of the entries in Table 2 provide additional support for the distributional adequacy of the SRT for parametric analyses at the level of individual age groups. Cell sizes for these data range from 8 to 30 participants per age group. Thus, the number of scores available for some cells is notably lower than those in Table 1, but marginally adequate to compare the distributional statistics associated with each of the two nonword repetition tasks. First, SRT values for the first six descriptive statistics in Table 2 (*M*, *SD*, Min., Max., Skew,

Kurtosis) are numerically orderly relative to task difficulty and age level and comparable to those obtained with the NRT. With the exception of the anticipated findings for the 2-syllable nonwords, skew and kurtosis values for the SRT scores at each age are generally well below 2.0 in each speaker group, which is consistent with a normally distributed variable. Second, data in the two columns for each row, A^2 and p values for Anderson-Darling tests of normality, provide inferential statistical support for the normality of the distributions. A^2 findings assessing the normality of the distributions in these relatively small n subgroups were generally comparable for speakers assessed with the NRT and the SRT. For the TS findings, for the relatively small cell sizes in Table 2, normality was not rejected for 14 of the 20 (70%) values for the NRT and 9 of the 16 (56%) values for the SRT. For the SD speakers, normality was not rejected for 17 of the 20 (85%) values for the NRT and 13 of the 16 (81%) comparisons for the SRT

B. Internal Reliability

Table 3 provides part-whole reliability findings for the speakers with TS and SD. Both the NRT and the SRT were scored using the PCCR metric, which, like the Percentage of Phonemes Correct used for NRT scoring (Dollaghan & Campbell, 1998) classifies speech sound distortions as correct. The primary part-whole reliability data — the association of task scores at each level of difficulty with total scores for each task — are shown in the bolded Pearson correlation coefficients at the bottom of each of the four sets of coefficients. Participants' scores on each of the 3-4 levels within each task were moderately-to-strongly correlated with their scores on each other difficulty level of the task and with Total task scores. For the NRT, the magnitudes of the 20 part-part and part-whole coefficients ranged from 0.37 to 0.91. For the SRT, the magnitudes of the 12 possible coefficients ranged from 0.49 to 0.92. These generally

high positive associations for both tasks are interpreted as providing statistical support for their internal stability

Table 4 provides additional internal reliability data, including information computed for participants in each of the four age groups. The bolded entries in the bottom row of each section provide the primary data, estimating the association of scores at each level of difficulty with total NRT and total SRT scores. As reported in Table 3, 1- and 2-syllable items have the lowest association with total scores because participants have the least difficulty in correctly repeating these items. Overall, keeping in mind the relatively small cell sizes at this level of analyses, these data are interpreted as support for comparable and adequate internal reliabilities for both nonsense word repetition tasks. Estimates of the test-retest reliability of the SRT were not available at the time of the present technical report.

C. Concurrent Validity

Concurrent validity support for the SRT is provided in Table 5, which provides a matrix of first-order Pearson coefficients for the SRT (rows) with the comparative standard, the NRT (columns). Coefficients are provided by speaker group (TS, SD) and task level (2-, 3-, 4-syllable and Total). The set of findings on the left side of the table was obtained using the standard scoring procedures for each task. The other two data sets on the right side of Table 5 provide alternative NRT-SRT comparisons: a comparison using only the consonant scores on the NRT task (PCCR) and a comparison using only the vowel/diphthong scores on the NRT (PVCR). The correlation coefficient indexing the linear association between scores on the two nonsense word repetition tasks was expected to be moderately, but not highly positive, that is, approximately .40 - .60. Rationale for this expectation was that although the SRT purports to assess the same construct as the NRT, differences in the production constraints on the NRT as documented in SL

et al. Study 1 (i.e., misarticulations) were expected to attenuate the magnitude of associations between scores on the two measures. Moreover, the larger number of phoneme targets on the NRT (96) compared to the SRT (50), including phonemes in respondents' phonetic inventories, may be associated with differences in the probability of correct response rates.

As shown in the bolded diagonal values for each of the six sets of comparisons in Table 5, correlations between the two measures ranged from .28 to .73. A total of 5 of the 8 (63%) SRT/NRT comparisons at the same difficulty levels (bolded diagonals) were in the expected .40-.60 moderate range. The two SRT/NRT coefficients computed on the total scores for TS and SD speakers were the highest obtained at .73 and .65, respectively. The pattern of findings was essentially similar using the alternative, consonant-only NRT scores (PCCR), with moderate coefficients obtained for 5 of the 8 bolded coefficients, including totals score values of .70 for the speakers with TS and .67 for the speakers with SD. Coefficients based on the vowel/diphthong data from the NRT (PVCR) were somewhat lower, ranging from .28 to .67. Correlations across tasks and levels were also all generally moderate. As expected, the associations between the two measures tended to be strongest for the speakers with SD due to their greater range of scores on both tasks (see Table 1). These data indicate good concordance between participants' scores on the two measures, especially when using the conventional scoring metrics and the total scores for each metric.

D. Construct Validity

SRT scores increase with age. The first data set supporting the construct validity of the SRT is the orderly developmental differences in SRT scores shown in Table 2. As obtained with the NRT, older children had higher average total SRT scores than younger groups in each of the 24 comparisons within TS and SD speaker groups. Inferential statistics assessing age affects

were not calculated for the two measures because there is no *a priori* assumption from the

precedent literature that scores for groups of children whose average age differs by as little as six

months should be significantly different. As indicated in Table 2, age is significantly associated

with nonword repetition errors for children in the age range of participants in the present study.

We include in this technical report (see tables 10 and 11) additional support for developmental

differences in SRT scores from a research project that obtained SRT scores from 70 typically-

developing boys and girls, including 5 boys and 5 girls at ages 4, 6, 8, 10, 12, 14, and 16 years

(Potter et al., 2008).

SRT scores are lower for participants with SD. A second finding supporting the construct

validity of the SRT is also consistent with literature trends cited previously. In comparison to the

average SRT scores of speakers with TS (75.6%) in the current study (Table 1), with or without

expressive language involvement, participants with SD with or without expressive language

involvement scored significantly lower (62.3%; $t = 4.59$; $p = .001$; Effect size [Hedges corrected]

= - .75; C.I.: -0.42/-1.08). As also shown in Table 1, the magnitudes of between-group

differences at each task level (i.e., 2-, 3-, 4-syllables) are comparable to those obtained with the

comparison standard, the NRT. Because the SRT scores are not confounded by the speech

production issues reported in the SL et al. Study 1 description, these findings are considered the

first to document that children with SD perform significantly lower than children with TS on a

nonword repetition task.

Severity of speech involvement accounts for relatively little variance in SRT scores. A

third source of construct validity support for the SRT is provided in Table 6. The r^2 values for

each coefficient express the variance in the two nonword repetition tasks scores accounted for by

participants' speech development. Because the four consonants in the SRT were chosen to make

minimum demands on a child's articulation, correlations between a speaker's severity of speech involvement and his or her scores on the SRT were expected to be lower than similar correlations with scores on the NRT. That is, the magnitudes of the later correlations may be higher because children with language disorders are at higher risk for misarticulations.

Summary findings for the associations between severity of speech involvement and nonword repetition performance are shown in the last two columns (Total) in Table 6 for each nonword task. Coefficients for the six speech metrics and each of the two nonword repetition tasks were almost all lower for the speech-SRT comparisons than for the speech-NRT comparisons, for both speakers with TS and those with SD. Mean (standard deviation) coefficients and r^2 values for each of the six metrics are provided in the bottom rows for each speaker group. For the TS speakers, the speech variables accounted for an average of 12.9% (10.5) of common variance in the NRT scores, compared with 4.8% (3.3) of common variance for scores on the SRT. For SD speakers, the respective comparisons were 21% (6.6) of variance (NRT) compared with 8% (4.3). As above, because the SRT-based coefficients have removed the speech confound, we interpret these attenuated findings for the SRT as the first valid estimates of the strength of association between speech competence/delay and performance scores on a nonword repetition task. Notably, for children with SD in this age range, severity of delay accounted for a modest 8% percent of the variance in SRT scores, suggesting considerable dissociation between the speech processing mechanisms underlying deficits in each domain.

E. Transcription Reliability

Two experienced transcribers transcribed responses to the NRT and the SRT reported in SL et al. The NRT was administered to the same participants and used as the comparison measure for all substudies reported in SL et al. To estimate the transcribers' interjudge

agreement, 10% of the samples were randomly selected from the 158 participants (15 transcripts of each task) and transcribed by the alternate transcriber. The PEPAGREE transcription reliability program (Shriberg & Olson, 1988), a utility in the PEPPER suite (Shriberg, Allen, McSweeny, & Wilson, 2001), was used to compute the percentages of interjudge agreement for vowels and consonants. Separate analyses were completed for the 3- and 4-syllable items in each task (i.e., the two stimulus lengths on which participants made the most repetition errors) and as averaged across all three stimulus lengths.

Table 7 is a summary of the interjudge agreement estimate findings. The obtained percentages support the transcription reliability for both the NRT and SRT data reported in SL et al. As estimated in the present data, the interjudge consonant agreement percentage for the SRT is approximately 10% higher (88%) for all items than the percentage obtained for consonants on all items on the NRT (77.5%). The likely primary source for the higher transcription reliability for the SRT is the reduced number and types of sounds requiring repetition and transcription (1 vowel, 4 consonants) compared to task demands for the respondent and the transcriber for the NRT (9 vowels/diphthongs, 11 consonants).

III. ADDITIONAL ANALYSES OF THE SRT

A. Nonresponse Scoring Analysis

Nonsense word repetition tasks differ in the instructions provided for scoring responses for which participants have not produced a verbal response, i.e., a *nonresponse* (NR). As indicated in SL et al. and in Section V of this report, repeated trials are not allowed in the SRT because that would have uncontrolled effects on standardization. Children are instructed that they must respond to all items and will not be given a second opportunity to respond unless there is some technical problem affecting the audio signal for off-line scoring.

As in all stimulus-response assessment contexts, rationales can be marshaled for three alternative ways to score NRs:

Exclude Option. One option is to *exclude* nonresponses by not scoring items at the syllable level in which they occur. This yields scores only for syllable levels with complete data, and only the levels with complete data are used in calculating a participant's total score for the task.

Ignore Option. A second option is to *ignore* NRs by removing them from both the numerator and denominator of the syllable level and total score calculations. Only items that have been attempted are scored. This option is well-motivated if there is only an occasional NR due to inattention or some other momentary state, but problematic if NRs occur frequently because they may reflect participants' difficulty in repetition, and hence would bias performance scores.

Include Option. A third option is to *include* NRs as incorrect responses in the scoring, based on the rationale that they most likely reflect difficulty with the task. NRs are counted as errors and therefore affect both syllable level scores and the total score.

Table 8 provides summary data for a quantitative approach to resolving the NR issue in scoring the SRT. We computed scores for the 158 participants in the four speech-language status groups using the three options described above: *exclude (ex), ignore (ig), and include (in).* The first two columns in Table 8 provide the means and standard deviations for total SRT scores for each group and for all 158 participants. The other two columns in the table provide the Pearson correlation coefficient and r^2 expressing the association of scores with scores on the NRT computed in the standard way (NRs are scored as incorrect). Using the NRT scores as the

standard, these association data were used as criterion validity support for the selection of a scoring option for the SRT.

The data in Table 8 are viewed as providing support for a decision to use the third option described above, the *include* option, in the scoring procedures for the SRT. As expected, it yielded the lowest mean scores of the three options, differing from one or both other options by approximately 3-4 percentage points and producing somewhat higher standard deviations. Also, with the exception of the findings for the ELI-TS group, this option had the highest general association with scores on the NRT.

Other procedures could be used to provide additional information on this issue (e.g., correlate number of NRs with a participant's score on all non-NRs). However, our anecdotal impressions are that NRs most frequently reflected difficulty with the task, especially on the 3- and 4-syllable SRT items, rather than attentional/motivational constraints. In combination with the findings in Table 8, this perspective underlies the decision to adopt the *include* option (i.e., score NRs as incorrect) as the standardized scoring procedure when reporting SRT data.

B. Item Analysis

Table 9 provides item-level percentage correct scores for each of the 18 SRT stimuli (see the scoring form, page 21, for the SRT stimuli, ordered from 1-18). To be scored as correct for this analysis, an item had to have all constituent consonants transcribed as correct. The left-most column divides the items into the three levels of difficulty, including the eight 2-syllable items, six 3-syllable items, and four 4-syllable items. Percentage correct data (mean, standard deviation) are cross-tabulated by speaker group (speakers with Typical Speech [TS], Speech Delay [SD], and ALL) and by age groups (see SL et al. for participant descriptions).

Visual inspection of the item-level data in Table 9 provides additional construct validity support for the SRT. The percentages generally follow the expected trends for the three-way interaction of syllable difficulty level, speaker groups, and age groups. Essentially, highest scores were obtained for the 2-syllable words said by participants with TS in the oldest age group. Lowest scores were obtained for the 4-syllable words said by participants with SD in the youngest age group. Ceiling effects are evident only for responses to the 2-syllable items by the oldest participants with TS. Elsewhere in Table 9, scores on the eight 2-syllable, six 3-syllable, and four 4-syllable items for speakers with TS and SD in the four age groups appear to have a range of difficulty. As noted in SL et al., part of this variance in the percentage correct for each item could be associated with order effects; only one standard order was administered to all participants. The other and more significant source of variance, as assessed in a substudy in SL et al., is understood to be perceptual and memorial differences in processing the constituent consonants within each level of difficulty.

C. Efficiency Analysis

A random sample of 20 recorded administrations of each nonsense word repetition task was drawn to estimate average administration times, including 10 children from each of the TS and SD groups with either two or three samples drawn from each of the eight age groups. Total administration times for each task were obtained by subtracting the beginning duration values from the end values on a digital time display. Administration times (M, SD) for the 16-item NRT averaged 2.35 (.51) min and times for the 18-item SRT averaged 1.72 (.42) min. The average difference in administration times (38 sec) was statistically significant ($t= 4.33$; df, 36; $p <$ .0001), but of negligible applied significance. Participants' times-to-completion for each of the two tasks were moderately associated ($r = .651$; $p = .002$). Additional statistical analyses

indicated no statistically significant difference in administration times for either task for the speakers with SD compared with those with TS. There was also no statistically significant difference in the times needed to complete tasks among the four age groups, although the trend was for older children to take less time. As described previously, two assistants independently transcribed both tasks for each participant. Although quantitative data were not kept on the times needed for them to transcribe responses on each task, both assistants indicated that, as expected given the fewer phonemes on the SRT, it typically took less time to transcribe the SRT.

IV. DEVELOPMENTAL COMPARISON DATA FOR THE SRT

The first estimate of comparative developmental performance on the SRT has been reported in Potter et al. (2008). Examiners assessed 70 children from 4- to-16 years of age on a two-hour battery that included the SRT. Five boys and five girls were tested at ages 4, 6, 8, 10, 12, 14, and 16. The children were ascertained from schools in Portland, Oregon. Additional information on their sociodemographic and speech-language status is reported in Potter et al. It is important to underscore that these comparison data do not meet conventional epidemiological criteria for normative reference data. Among other constraints, no attempt was made to construct representative demographic samples, the developmental data span two-year intervals, and sample sizes at each age are relatively small.

Table 10 provides means, confidence limits for the means, and standard deviations for each of the age x sex subgroups at each difficulty level (2-, 3-, and 4-syllable nonwords) of the SRT and total SRT scores. Table 11 provides similar information at each of the four difficulty levels of the NRT and total NRT scores. Figure 1 includes graphic displays of the total NRT and SRT scores. Figure 1a provides total scores for males, females, and combined males-females groups in each of the 7 age groups. Figure 1b provides data collapsed by age group, including

total score means for ages 4, 6-8, 10-12, and 14-16 years. Three aspects of these comparative developmental data for the SRT, compared to findings for the NRT, warrant comment.

First, although cell sizes are small for each age group divided by sex, the confidence limits for the means and standard deviations are generally not exceedingly large, particularly for the total SRT and NRT scores. Nevertheless, for the purposes of developmental comparisons with scores from atypically-developing children, the width of the confidence limits and variability in standard deviations suggest the need for extreme caution in using the means/variance data in Tables 10 and 11 as representative of typically-developing children.

Second, as found in a covariance analysis in SL et al., and replicated in other emerging studies of the SRT noted in SL et al., nonword repetition as assessed by the two tasks is essentially independent of sex. Therefore, use of the combined male-female scores for each age group (n = 10) provides a more stable estimate of the means and variance on each measure. As main effects for age were obtained for the limited age range (3-5 years) in the SL et al. and are clearly evident in Figure 1a, performance on the two tasks is strongly associated with age. However, as shown in Figure 1b, the separation for both tasks at higher ages suggests that data may be further consolidated over at least the four older age groups (i.e., 10-12 years, 14-16 years), generally providing additional stability to the means and standard deviations of scores on both tasks for speakers in these age ranges.

Third, as found with the younger-age, typically speaking children in SL et al., and shown in the present data, the NRT is more challenging than the SRT for typical speakers of every age, particularly for older children. As shown most clearly in Figure 1a, typical speakers' Total SRT scores begin to approach ceiling at 12 to 14 years, whereas NRT scores remain well below the high 90% through 16 years. Accordingly, as discussed in SL et al., the NRT appears to have

more sensitivity than the SRT for children beyond the ages at which they may have misarticulations. For studies in which correlates of nonword repetition are the focus of study, particularly when assessing older speakers, we have found it useful to include both nonword tasks in the assessment battery. A study in progress at the publication date of this report (August, 2008) will add 80 children to this comparison database, 5 males and 5 females at each odd year from ages 3-to-17.

V. THE SYLLABLE REPETITION TASK (SRT)

A. Instrumentation & Materials

1. Personal Computer (PC) with external speakers
2. File or disk containing SRT stimuli
3. Recording device and matching external microphone
4. SRT Scoring Form

B. Set-Up Procedures

1. If using an external, stand-held microphone, position the microphone 6 inches from the participant's lips aimed at the participant's nose.

2. Adjust the audio levels for a clear and non-distorted signal.

3. Position the PC speakers and adjust their loudness level so that the SRT stimuli are comfortably audible for the participant and audible on the recording.

4. **Position the PC display so that the information on the screen can be seen only by the examiner, not by the participant or caregiver.**

C. Administration Instructions

1. Provide the following instructions to the participant, repeating as necessary to ensure comprehension. Provide an example (using the sample stimulus "baba") if you think the participant may not readily understand the directions:

    "You are going to say some silly words. Every time you hear the woman say a word, you try to copy her. Say the word exactly the way she says it."

2. Press the down arrow key to progress through the test stimuli in PowerPoint. Each test item will appear on the PC screen in the order on the SRT Scoring Form.

3. If you need to repeat an item, press the up arrow key and then the down arrow key. Replays of items are permitted only for the following reasons:

    a) Overtalk or some other noise occurs during the stimulus, making it difficult for the participant to hear it, and/or during the response, making the item difficult to score live or from the recording.
    b) The participant is inattentive during the presentation of the stimulus, requests a repeat of the stimulus, or doesn't repeat the stimulus. **In each of these three**

cases, allow one repeat, but say something like, "I'll do that *now*, but I can't repeat any more items, so just do the best you can."

D. Scoring Instructions

Scoring Rules

1. Responses for each target vowel /ɑ/ are ignored.

2. Responses for each of the 50 target consonants are scored as correct or incorrect. Score a response as correct if it has both the same manner feature as the target consonant (stop or nasal) and the correct place feature (bilabial or alveolar). Score a response as incorrect if the target consonant is deleted or replaced by another consonant.

   a) Distorted consonants (e.g., devoiced stops, frictionalized stops, lengthened stops or nasals) are scored as correct.

   b) Cognate substitutions (i.e., p/b, t/d) are scored as correct (due to the limitations in the transcription reliability of voicing).

   c) Indicate responses that contain added sounds and/or syllables with a check mark in the last column. These additions do not affect scoring. If four or more responses (i.e., approximately 20% of the 18 items) include additions, the SRT score may be invalid.

3. Only one response is allowed for each item, other than in situations that permit a replay (see Administration Instructions, #3). All consonants in a non-response are scored as incorrect.

Completing the SRT Scoring Form

1. Use the SRT Scoring Form to score a participant's responses either during administration of the task or later from the audio recording.

2. "Response" column: Circle each consonant that is incorrect.

3. "Transcription" column: Enter "NR" if there is no response to the stimulus. Enter a transcription of the entire response if any of the target consonants are incorrect, or if there are added sounds or syllables.

4. "No. of Consonants Correct" column: Enter a digit indicating the number of correctly repeated consonants. Then, compute and enter the syllable-level (i.e., SRT 2, SRT-3, and SRT-4) scores and the total SRT score using the formulas for each.

   5. "No. of Additions" column: Enter a check mark for added sounds (see note on scoring form about added syllables.

THE SYLLABLE REPETITION TASK (SRT)
Scoring Form

Name_____ **Examiner**_____ **Scorer**_____

Age_____ **Date**_____ **Date**_____

No. of Syll-ables	Item No.	Response	Transcription	Number of Consonants Correct	Additions [a, b]
2	1	bada			
	2	dama			
	3	bama			
	4	mada			
	5	naba			
	6	daba			
	7	nada			
	8	maba			
				SRT-2 = _____% (____/16)*100	
3	9	bamana			
	10	dabama			
	11	madaba			
	12	nabada			
	13	banada			
	14	manaba			
				SRT-3 = _____% (____/18)*100	
4	15	bamadana			
	16	danabama			
	17	manabada			
	18	nadamaba			
				SRT-4 = _____% (____/16)*100	
Notes:				SRT = _____% (____/50)*100	Total _____

[a] Place a check in the box if the response includes one or more sound or syllable additions.

[b] If additions are to be used to compute a transcoding score, count only the responses with at least one added sound (i.e., disregard added syllables).

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Tables

Table 1.   Descriptive statistics for 63 3;0-4;6⁺ year-olds with Typical Speech (TS) and 95 with Speech Delay (SD) tested on the Nonword Repetition Task (NRT) and the Syllable Repetition Task (SRT).

Table 2.   Additional descriptive statistics (at the age group level) for 63 3;0-4;6⁺ year-olds with Typical Speech (TS) and 95 with Speech Delay (SD) tested on the Nonword Repetition Task (NRT) and the Syllable Repetition Task (SRT).

Table 3.   Internal (part-whole) reliability data for the Nonword Repetition Task (NRT) and Syllable Repetition Task (SRT).

Table 4.   Part-whole reliability data for the Nonword Repetition Task (NRT) and Syllable Repetition Task (SRT) for the four age groups of children with typically developing speech (TS) and speech delay (SD) in SL et al., 2008.

Table 5.   Associations (Pearson r) among Nonword Repetition Task (NRT) scores and Syllable Repetition Task (SRT) scores

Table 6.   Associations between six measures of speech production in conversational speech and nonword repetition ability, as assessed by the Nonword Repetition Task (NRT) and the Syllable Repetition Task (SRT).

Table 7.   Estimate of interjudge transcription agreement.

Table 8.   Scoring analysis findings for alternative treatment of nonresponses to SRT items.

Table 9.   Item analysis of the SRT stimuli by speech classification and age group.

Table 10.   Comparison data for the Syllable Repetition Task (SRT) obtained from a study of 70 typically developing children (5 males and 5 females assessed at each of the seven ages below). Scores are the percentage of the 50 consonant targets repeated correctly. Adapted from Potter et al., 2008.

Table 11.   Comparison data for the Nonword Repetition Task (NRT) obtained from a study of 70 typically developing children (5 males and 5 females assessed at each of the seven ages below). Scores are the percentage of the targets repeated correctly. Adapted from Potter et al., 2008.

Figure

Figure 1.   Total NRT and SRT percentage scores for developmental comparison groups. Figure 1a is a display of scores for males, females, and combined males-females in each of the 7 age groups. Figure 1b is a display of data collapsed by age group, including ages 4, 6-8, 10-12, and 14-16 years.

Table 1. Descriptive statistics for 63 3;0-4;6[+] year-olds with Typical Speech (TS) and 95 with Speech Delay (SD) tested on the Nonword Repetition Task (NRT) and the Syllable Repetition Task (SRT). [a]

		NRT (%)										SRT (%)								
		n	*M*	*SD*	25th	MDN	75th	MIN	MAX	Skew	kurtosis	*n*	*M*	*SD*	25th	MDN	75th	MIN	MAX	skew	kurtosis
TS	1 syll	63	88.1	13.5	83.3	91.7	100	25.0	100	-2.00	6.33										
	2 syll	63	85.2	12.2	75.0	85.0	95.0	35.0	100	-1.21	3.14	63	91.7	11.3	87.5	93.8	100	37.5	100	-2.25	7.51
	3 syll	63	72.9	19.2	60.7	75.0	85.7	17.9	100	-0.75	0.13	63	74.1	19.1	66.7	77.8	88.9	11.1	100	-1.11	1.90
	4 syll	63	50.6	20.0	36.1	52.8	66.7	0	83.3	-0.49	-0.18	63	61.3	25.6	50.0	68.8	81.3	0	100	-0.77	0.09
	Total	63	69.0	14.7	59.4	69.8	79.2	30.2	92.7	-0.62	0.07	63	75.6	15.6	70.0	76.0	88.0	30.0	98.0	-1.07	1.12
SD	1 syll	95	68.5	18.9	50.0	66.7	83.3	25.0	100	-0.25	-0.68										
	2 syll	95	58.8	19.7	46.3	60.0	75.0	5.0	95.0	-0.56	-0.14	93	78.2	18.0	68.8	81.3	93.8	31.3	100	-0.71	-0.13
	3 syll	95	49.9	21.0	35.7	50.0	67.9	0	98.0	-0.31	-0.54	93	58.6	21.5	44.4	61.1	72.2	0	100	-0.22	-0.28
	4 syll	95	41.2	20.6	27.8	40.3	55.6	0	94.4	0.11	-0.08	93	50.4	22.4	35.9	50.0	62.5	0	100	-0.10	-0.18
	Total	95	50.8	17.3	38.5	53.1	63.5	9.4	92.7	-0.22	-0.34	93	62.3	18.1	50.0	63.0	74.0	10.0	98.0	-0.27	0.03
ALL	1 syll	158	76.3	19.5	66.7	83.3	91.7	25.0	100	-0.68	-0.33										
	2 syll	158	69.3	21.4	55.0	75.0	85.0	5.0	100	-0.72	0.04	156	83.6	16.9	75.0	87.5	100	31.3	100	-1.13	0.77
	3 syll	158	59.0	23.2	42.9	64.3	75.0	0	100	-0.35	-0.51	156	64.9	21.8	50.0	66.7	80.6	0	100	-0.50	-0.14
	4 syll	158	44.9	20.8	30.6	47.2	58.3	0	94.4	-0.12	-0.37	156	54.8	24.2	37.5	56.3	75.0	0	100	-0.31	-0.37
	Total	158	58.0	18.6	46.9	59.4	71.9	9.4	92.7	-0.35	-0.39	156	67.6	18.3	56.0	70.0	82.0	10.0	98.0	-0.53	-0.08

[a] NRT data includes responses from 63 TS and 95 SD participants; SRT data includes responses from 63 TS and 93 SD participants.

Table 2. Additional descriptive statistics (at the age group level) for 63 3;0-4;6[+] year-olds with Typical Speech (TS) and 95 with Speech Delay (SD) tested on the Nonword Repetition Task (NRT) and the Syllable Repetition Task (SRT).

Variable	Level	Group	n	M	SD	Min.	Max.	Skew	Kurtosis	A^2	p	n	M	SD	Min.	Max.	Skew	Kurtosis	A^2	p
						Typically-Developing Speech									Speech Delay					
NRT (PPC)	1 syll	1	16	81.3	18.1	25.0	100.0	-2.12	5.89	1.11	<.005	30	57.5	17.0	33.3	91.7	0.35	-0.45	0.57	0.13
	2 syll		16	77.2	13.4	35.0	95.0	-2.10	6.51	1.03	0.007	30	51.5	20.1	5.0	90.0	-0.46	0.10	0.57	0.13
	3 syll		16	62.1	21.2	17.9	92.9	-0.43	-0.33	0.18	0.90	30	36.8	19.8	0	71.4	0.20	-0.79	0.35	0.45
	4 syll		16	40.9	20.1	0	80.6	0.15	0.22	0.34	0.46	30	28.7	21.7	0	86.1	0.57	0.17	0.39	0.37
	Total		16	59.7	14.5	30.2	83.3	-0.09	-0.13	0.20	0.85	30	39.4	16.0	9.4	69.8	0	-0.81	0.22	0.82
	1 syll	2	20	89.6	10.4	66.7	100.0	-1.09	0.57	1.29	<.005	20	67.9	19.7	25.0	91.7	-0.89	0.48	0.80	0.03
	2 syll		20	85.0	11.2	65.0	100.0	-0.22	-1.06	0.51	0.17	20	57.3	19.4	15.0	85.0	-0.62	-0.37	0.41	0.31
	3 syll		20	68.9	19.2	28.6	100.0	-0.40	-0.41	0.32	0.52	20	48.2	20.8	0	85.7	-0.30	0.01	0.33	0.48
	4 syll		20	46.4	20.2	0	72.2	-0.61	-0.07	0.44	0.27	20	43.1	20.7	13.9	83.3	0.76	-0.55	0.86	0.02
	Total		20	66.4	14.7	33.3	88.5	-0.68	0.56	0.42	0.30	20	50.6	17.7	14.6	79.2	-0.06	-0.40	0.38	0.38
	1 syll	3	19	89.0	12.4	66.7	100.0	-0.96	-0.56	1.78	<.005	29	72.1	15.5	50.0	91.7	-0.10	-1.45	1.05	0.01
	2 syll		19	87.9	10.5	65.0	100.0	-0.72	-0.25	0.60	0.11	29	63.8	19.3	15.0	90.0	-0.69	-0.19	0.56	0.13
	3 syll		19	79.9	14.6	42.9	100.0	-0.61	0.69	0.43	0.28	29	56.7	16.4	14.3	78.6	-0.74	-0.06	0.71	0.06
	4 syll		19	59.1	17.5	13.9	83.3	-0.83	1.08	0.30	0.55	29	42.5	13.7	0	61.1	-1.15	1.95	0.63	0.09
	Total		19	74.9	12.2	43.8	92.7	-0.63	0.96	0.27	0.63	29	54.8	11.2	31.3	71.9	-0.19	-0.69	0.30	0.55
	1 syll	4	8	95.8	6.3	83.3	100.0	-1.32	0.88	1.06	<.005	16	81.8	15.6	50.0	100.0	-0.39	-0.83	0.58	0.11
	2 syll		8	95.0	4.6	90.0	100.0	0.0	-2.1	0.67	0.05	16	65.6	18.0	25.0	95.0	-0.65	0.40	0.27	0.64
	3 syll		8	87.5	8.5	71.4	100.0	-0.63	1.14	0.25	0.65	16	62.5	16.2	21.4	89.3	-1.16	2.04	0.69	0.06
	4 syll		8	60.9	14.0	44.4	80.6	-0.08	-1.68	0.37	0.32	16	55.7	18.0	16.7	94.4	-0.05	1.30	0.35	0.43
	Total		8	80.1	6.9	69.8	90.6	-0.08	-0.71	0.23	0.71	16	63.0	15.9	24.0	92.7	-0.76	1.85	0.55	0.13
SRT (PCCR)	2 syll	1	16	88.7	17.3	37.5	100.0	-2.00	4.39	1.68	<.005	29	73.1	18.8	31.3	100.0	-0.51	-0.54	0.65	0.08
	3 syll		16	71.5	19.1	27.8	100.0	-0.48	0.42	0.19	0.89	29	52.0	22.5	0	94.4	-0.34	-0.22	0.29	0.59
	4 syll		16	51.6	25.1	0	87.5	-0.61	0.11	0.35	0.43	29	43.5	22.8	0	87.5	-0.37	-0.30	0.35	0.46
	Total		16	70.6	16.1	34.0	92.0	-0.61	0.17	0.28	0.61	29	56.0	18.0	12.0	88.0	-0.48	0.04	0.35	0.45
	2 syll	2	20	90.9	8.23	68.8	100.0	-0.89	1.21	0.92	0.02	19	76.3	17.6	43.8	100.0	-0.69	-1.11	1.24	<.005
	3 syll		20	74.4	20.7	11.1	100.0	-1.42	3.50	0.63	0.09	19	60.8	22.1	11.1	100.0	-0.48	0.33	0.46	0.24
	4 syll		20	57.5	27.1	0	93.8	-0.45	-0.41	0.28	0.61	19	53.2	24.5	6.3	100.0	0.17	0.13	0.27	0.63
	Total		20	74.3	16.1	32.0	98.0	-0.90	1.24	0.45	0.25	19	63.4	19.7	22.0	98.0	-0.26	0.16	0.32	0.50
	2 syll	3	19	92.8	8.1	75.0	100.0	-1.19	0.63	1.44	<.005	29	81.4	17.4	35.7	100.0	-1.12	1.22	1.12	0.01
	3 syll		19	74.9	19.3	16.7	100.0	-1.60	3.09	0.73	0.05	29	61.4	19.5	22.2	94.4	0.15	-0.50	0.44	0.28
	4 syll		19	66.1	20.9	0	87.5	-2.08	5.13	1.44	<.005	29	55.4	19.2	18.8	93.8	0.04	-0.34	0.32	0.51
	Total		19	77.8	13.9	30.0	94.0	-2.32	7.69	1.15	<.005	29	65.9	17.0	28.0	96.0	-0.12	-0.04	0.36	0.42
	2 syll	4	8	99.2	2.2	93.8	100.0	-2.83	8.00	2.40	<.005	16	88.3	13.7	68.8	100.0	-0.49	-1.76	1.73	<.005
	3 syll		8	84.0	12.0	66.7	100.0	0.12	-0.94	0.24	0.69	16	71.2	17.5	38.9	100.0	0.07	-0.55	0.17	0.91
	4 syll		8	84.4	15.3	56.3	100.0	-0.93	0.17	0.35	0.37	16	58.2	23.5	12.5	87.5	-0.67	-0.68	0.68	0.06
	Total		8	89.0	8.4	72.0	98.0	-1.30	1.62	0.49	0.15	16	72.5	14.8	46.0	90.0	-0.52	-1.08	0.60	0.10

Table 3. Internal (part-whole) reliability data for the Nonword Repetition Task (NRT) and Syllable Repetition Task (SRT).[a]

		NRT (PPCR Scores)					SRT (PCCR Scores)			
		1 syll	2 syll	3 syll	4 syll	Total	2 syll	3 syll	4 syll	Total
TS	1 syll	—								
	2 syll	.64	—				—			
	3 syll	.61	.65	—			.49	—		
	4 syll	.46	.37	.68	—		.51	.55	—	
	Total	**.69**	**.69**	**.91**	**.89**	—	**.71**	**.84**	**.88**	—
SD	1 syll	—								
	2 syll	.63	—				—			
	3 syll	.62	.72	—			.68	—		
	4 syll	.45	.47	.66	—		.57	0.73	—	
	Total	**.72**	**.79**	**.91**	**.86**	—	**.83**	**.92**	**.88**	—

[a] NRT data includes responses from 63 TS and 95 SD participants; SRT data includes responses from 63 TS and 93 SD participants.

Table 4. Part-whole reliability data for the Nonword Repetition Task (NRT) and Syllable Repetition Task (SRT) for the four age groups of children with typically developing speech (TS) and speech delay (SD) in SL et al., 2008.

Classification	Age Group	n		NRT (PPCR Scores)				SRT (PCCR Scores)		
				1 syll	2 syll	3 syll	4 syll	2 syll	3 syll	4 syll
TS	1	16	1 syll							
			2 syll	0.65						
			3 syll	0.70	0.77			0.60		
			4 syll	0.55	0.50	0.54		0.69	0.57	
			Total	**0.78**	**0.81**	**0.88**	**0.85**	**0.86**	**0.85**	**0.87**
	2	20	1 syll							
			2 syll	0.71						
			3 syll	0.69	0.74			0.84		
			4 syll	0.31	0.36	0.69		0.29	0.34	
			Total	**0.67**	**0.73**	**0.94**	**0.86**	**0.79**	**0.85**	**0.77**
	3	19	1 syll							
			2 syll	0.60						
			3 syll	0.67	0.57			0.69		
			4 syll	0.54	0.28	0.72		0.52	0.60	
			Total	**0.74**	**0.60**	**0.92**	**0.90**	**0.76**	**0.90**	**0.87**
	4	8	1 syll							
			2 syll	-0.10						
			3 syll	0.18	0.24			0.51		
			4 syll	-0.21	-0.14	0.42		0.60	0.32	
			Total	**-0.00**	**0.10**	**0.71**	**0.92**	**0.73**	**0.77**	**0.85**
SD	1	30	1 syll							
			2 syll	0.71						
			3 syll	0.38	0.68			0.43		
			4 syll	0.21	0.39	0.62		0.23	0.55	
			Total	**0.56**	**0.79**	**0.88**	**0.83**	**0.66**	**0.88**	**0.78**
	2	20	1 syll							
			2 syll	0.61						
			3 syll	0.72	0.72			0.57		
			4 syll	0.53	0.51	0.75		0.63	0.95	
			Total	**0.75**	**0.79**	**0.94**	**0.89**	**0.76**	**0.96**	**0.97**
	3	29	1 syll							
			2 syll	0.43						
			3 syll	0.45	0.51			0.70		
			4 syll	0.22	0.20	0.61		0.60	0.76	
			Total	**0.58**	**0.70**	**0.90**	**0.74**	**0.85**	**0.93**	**0.89**
	4	16	1 syll							
			2 syll	0.75						
			3 syll	0.66	0.86			0.60		
			4 syll	0.62	0.70	0.79		0.50	0.51	
			Total	**0.78**	**0.90**	**0.94**	**0.92**	**0.79**	**0.84**	**0.85**

Table 5. Associations (Pearson r) among Nonword Repetition Task (NRT) scores and Syllable Repetition Task (SRT) scores. [a]

		Standard NRT Scoring (PPCR: Consonants and Vowels)				Alternative NRT Scoring (PCCR:Consonants Only)				(PVCR: Vowels Only)			
		2 syll	3 syll	4 syll	Total	2 syll	3 syll	4 syll	Total	2 syll	3 syll	4 syll	Total
TS SRT(PCCR)	2 syll	**.39**	.61	.30	.50	**.35**	.59	.29	.47	**.28**	.55	.31	.46
	3 syll	.30	**.47**	.60	.59	.33	**.42**	.55	.54	.10	**.48**	.57	.58
	4 syll	.45	.64	**.58**	.68	.50	.62	**.55**	.67	.13	.56	**.53**	.58
	Total	.46	.69	.64	**.73**	.49	.65	.59	**.70**	.18	.63	.60	**.67**
SD SRT(PCCR)	2 syll	**.50**	.63	.43	.60	**.51**	.64	.45	.63	**.35**	.50	.36	.47
	3 syll	.33	**.54**	.42	.52	.35	**.52**	.43	.52	.22	**.46**	.37	.43
	4 syll	.49	.60	**.47**	.61	.51	.59	**.49**	.63	.34	.50	**.40**	.49
	Total	.49	.66	.50	**.65**	.51	.65	.51	**.67**	.34	.55	.43	**.53**

[a] NRT data includes responses from 63 TS and 95 SD participants; SRT data includes responses from 63 TS and 93 SD participants.

Table 6. Associations between six measures of speech production in conversational speech and nonword repetition ability, as assessed by the Nonword Repetition Task (NRT) and the Syllable Repetition Task (SRT).

Speaker Group	NRT										SRT							
	1 syll		2 syll		3 syll		4 syll		Total			2 syll		3 syll		4 syll		Total	
TS	r	r²ᵃ	r	r²	r	r²	r	r²	r	r²		r	r²	r	r²	r	r²	r	r²
PCC	.24	6	.34	12	.33	11	.25	6	**.34**	**12**		.14	2	.04	0	.20	4	**.16**	**3**
PCCR	.34	12	.46	21	.48	23	.42	18	**.51**	**26**		.21	4	.15	2	.34	12	**.29**	**8**
PVC	.03	0	.17	3	.12	1	.07	0	**.12**	**1**		.16	3	.15	2	.04	0	**.13**	**2**
PVCR	.16	3	.19	4	.13	2	.16	3	**.18**	**3**		.11	1	.26	7	.04	0	**.16**	**3**
PPC	.21	4	.33	11	.31	10	.23	5	**.32**	**10**		.17	3	.09	1	.18	3	**.17**	**3**
PPCR	.34	12	.45	20	.46	21	.41	17	**.50**	**25**		.22	5	.21	4	.31	10	**.31**	**10**
									M	.33	12.9							*M*	.20	4.8
									SD	.16	10.5							*SD*	.08	3.3
SD																			
PCC	.53	28	.52	27	.44	19	.34	12	**.51**	**26**		.32	10	.21	4	.32	10	**.32**	**10**
PCCR	.53	28	.53	28	.46	21	.33	11	**.51**	**26**		.35	12	.22	5	.37	14	**.35**	**12**
PVC	.26	7	.26	7	.21	4	.24	6	**.28**	**8**		.09	1	.08	1	.09	1	**.10**	**1**
PVCR	.44	19	.38	14	.32	10	.32	10	**.41**	**17**		.21	4	.15	2	.24	6	**.22**	**5**
PPC	.49	24	.48	23	.41	17	.34	12	**.48**	**23**		.28	8	.19	4	.28	8	**.28**	**8**
PPCR	.54	29	.51	26	.48	23	.35	12	**.51**	**26**		.34	12	.21	4	.35	12	**.34**	**12**
									M	.45	21							*M*	.27	8
									SD	.08	6.6							*SD*	.10	4.3

ᵃ NRT data includes responses from 63 TS and 95 SD participants; SRT data includes responses from 63 TS and 93 SD participants. All r² values are expressed as percentages.

Table 7. Estimate of interjudge transcription agreement.

Task	Items	Vowel Agreement	Consonant Agreement
NRT	3- and 4- syllable	75.6%	75.9%
	All	77.4%	77.5%
SRT	3- and 4- syllable	84.1%	83.1%
	All	84.8%	88.0%

Table 8. Scoring analysis findings for alternative treatment of nonresponses to SRT items.

| Group | SRT | | NRT | |
	$\overline{X}$	SD	r	r^2
TL-TS				
SRTex	80	11.5	.67	45
SRTig	79.4	12.7	.66	44
SRTin	77.2	15.1	.76	58
TL-SD				
SRTex	71.0	13.6	.37	14
SRTig	70.0	14.2	.43	18
SRTin	68.7	15.9	.45	20
ELI-TS				
SRTex	75.8	10.6	.82	67
SRTig	77.5	11.5	.63	40
SRTin	71.8	16.6	.61	37
ELI-SD				
SRTex	60.1	17.2	.80	64
SRTig	60.3	16.7	.77	59
SRTin	56.8	18.9	.80	64
ALL				
SRTex	71.6	15.7	.72	52
SRTig	71.1	16.1	.70	49
SRTin	68.6	18.2	.72	52

Table 9. Item analysis of the SRT stimuli by speech classification and age group.

| | TS | | | | | SD | | | | | ALL | | | | |
| | Age Group | | | | | Age Group | | | | | Age Group | | | | |
Item No.	1 M (SD)	2 M (SD)	3 M (SD)	4 M (SD)	ALL M (SD)	1 M (SD)	2 M (SD)	3 M (SD)	4 M (SD)	ALL M (SD)	1 M (SD)	2 M (SD)	3 M (SD)	4 M (SD)	ALL M (SD)
1.	87.5 (34.2)	85.0 (36.6)	89.5 (31.5)	100.0 (0.0)	88.9 (31.7)	63.3 (49.0)	55.0 (51.0)	72.4 (45.5)	81.3 (40.3)	67.4 (47.1)	71.7 (45.5)	70.0 (46.4)	79.2 (41.0)	87.5 (33.8)	75.9 (42.9)
2.	93.8 (25.0)	95.0 (22.4)	100.0 (0.0)	100.0 (0.0)	96.8 (17.7)	66.7 (47.9)	80.0 (41.0)	86.2 (35.1)	93.8 (25.0)	80.0 (40.2)	76.1 (43.1)	87.5 (33.5)	91.7 (27.9)	95.8 (20.4)	86.7 (34.1)
3.	81.3 (40.3)	65.0 (48.9)	73.7 (45.2)	87.5 (35.4)	74.6 (43.9)	50.0 (50.9)	45.0 (51.0)	55.2 (50.6)	62.5 (50.0)	52.6 (50.2)	60.9 (49.3)	55.5 (50.4)	62.5 (48.9)	70.8 (46.4)	61.4 (48.8)
4.	75.0 (44.7)	90.0 (30.8)	84.2 (37.5)	100.0 (0.0)	85.7 (35.3)	53.3 (50.7)	55.0 (51.0)	55.2 (50.6)	81.3 (40.3)	58.9 (49.5)	60.9 (49.3)	72.5 (45.2)	66.7 (47.6)	87.5 (33.8)	69.6 (46.1)
5.	56.3 (51.2)	85.0 (36.6)	89.5 (31.5)	100.0 (0.0)	81.0 (39.6)	50.0 (50.9)	45.0 (51.0)	62.1 (49.4)	68.8 (47.9)	55.8 (49.9)	52.2 (50.5)	65.0 (48.3)	72.9 (44.9)	79.2 (41.5)	65.8 (47.6)
6.	93.8 (25.0)	90.0 (30.8)	100.0 (0.0)	100.0 (0.0)	95.2 (21.5)	66.7 (47.9)	65.0 (48.9)	82.8 (38.4)	81.3 (40.3)	73.7 (44.3)	76.1 (43.1)	77.5 (42.3)	89.6 (30.9)	87.5 (33.8)	82.3 (38.3)
7.	75.0 (44.7)	70.0 (47.0)	78.9 (41.9)	100.0 (0.0)	77.8 (41.9)	46.7 (50.7)	50.0 (51.3)	55.2 (50.6)	87.5 (34.2)	56.8 (49.8)	56.5 (50.1)	60.0 (49.6)	64.6 (48.3)	91.7 (28.2)	65.2 (47.8)
8.	68.8 (47.9)	90.0 (30.8)	73.7 (45.2)	100.0 (0.0)	81.0 (39.6)	40.0 (49.8)	65 (48.9)	58.6 (50.1)	81.3 (40.3)	57.9 (49.6)	50.0 (50.6)	77.5 (42.3)	64.6 (48.3)	87.5 (33.8)	67.1 (47.1)
9.	50.0 (51.6)	65.0 (48.9)	89.5 (31.5)	62.5 (51.8)	68.3 (46.9)	26.7 (45.0)	25.0 (44.4)	24.1 (43.5)	56.3 (51.2)	30.5 (46.3)	34.8 (48.2)	45.0 (50.4)	50.0 (50.5)	58.3 (50.4)	45.6 (50.0)
10.	37.5 (50.0)	50.0 (51.3)	31.6 (47.8)	50.0 (53.5)	41.3 (49.6)	26.7 (45.0)	25.0 (44.4)	20.7 (41.2)	31.3 (47.9)	25.3 (43.7)	30.4 (46.5)	37.5 (49.0)	25.0 (43.8)	37.5 (49.5)	31.6 (46.7)
11.	31.3 (47.9)	40.0 (50.3)	57.9 (50.7)	50.0 (53.5)	44.4 (50.1)	26.7 (45.0)	30.0 (47.0)	27.6 (45.5)	43.8 (51.2)	30.5 (46.3)	28.3 (45.5)	35.0 (48.3)	39.6 (49.4)	45.8 (50.9)	36.1 (48.2)
12.	50.0 (51.6)	55.0 (51.0)	73.7 (45.2)	75.0 (46.3)	61.9 (49.0)	20.0 (40.7)	45.0 (51.0)	34.5 (48.4)	81.3 (40.3)	40.0 (49.2)	30.4 (46.5)	50.0 (50.6)	50.0 (50.5)	79.2 (41.5)	48.7 (50.1)
13.	50.0 (51.6)	40.0 (50.3)	57.9 (50.7)	87.5 (35.4)	54.0 (50.2)	20.0 (40.7)	15.0 (36.6)	37.9 (49.4)	25.0 (44.7)	25.3 (43.7)	30.4 (46.5)	27.5 (45.2)	45.8 (50.4)	45.8 (50.9)	36.7 (48.4)
14.	31.3 (47.9)	45.0 (51.0)	36.8 (49.6)	87.5 (35.4)	44.4 (50.1)	6.7 (25.4)	30.0 (47.0)	31.0 (47.1)	37.5 (50.0)	24.2 (43.1)	15.2 (36.3)	37.5 (49.0)	33.3 (47.6)	54.2 (50.9)	32.3 (46.9)
15.	37.5 (50.0)	35.0 (48.9)	47.4 (51.3)	75.0 (46.3)	44.4 (50.1)	16.7 (37.9)	15.0 (36.6)	31.0 (47.1)	43.8 (51.2)	25.3 (43.7)	23.9 (43.1)	25.0 (43.9)	37.5 (48.9)	54.2 (50.9)	32.9 (47.1)
16.	18.8 (40.3)	30.0 (47.0)	52.6 (51.3)	50.0 (53.5)	36.5 (48.5)	6.7 (25.4)	25.0 (44.4)	31.0 (47.1)	31.3 (47.9)	22.1 (41.7)	10.9 (31.5)	27.5 (45.2)	39.6 (49.4)	37.5 (49.5)	27.8 (45.0)
17.	18.8 (40.3)	30.0 (47.0)	10.5 (31.5)	62.5 (51.8)	25.4 (43.9)	3.3 (18.3)	10.0 (30.8)	10.3 (31.0)	12.5 (34.2)	8.4 (27.9)	8.7 (28.5)	20.0 (40.5)	10.4 (30.9)	29.2 (46.4)	15.2 (36.0)
18.	6.3 (25.0)	15.0 (36.6)	15.8 (37.5)	62.5 (51.8)	19.0 (39.6)	10.0 (30.5)	10.0 (30.8)	3.4 (18.6)	0.0 (0.0)	6.3 (24.5)	8.7 (28.5)	12.5 (33.5)	8.3 (27.9)	20.8 (41.5)	11.4 (31.9)

Age	Syllables	Male			Female			Both		
		M	*SD*	95% CI	*M*	*SD*	95% CI	*M*	*SD*	95%CI
4	2	95.0	8.1	87.1-100.0	91.3	13.7	79.3-100.0	93.1	10.8	86.4-99.8
	3	75.6	20.3	55.8-82.1	71.1	24.0	50.1-92.1	73.3	21.1	60.2-86.4
	4	77.5	11.4	67.5-87.5	65.0	27.5	40.9-89.1	71.3	20.9	58.4-84.3
	All	82.4	11.2	73.1-86.1	75.6	19.9	58.2-93.0	79.0	15.6	69.3-88.7
6	2	95.0	8.1	87.9-100.0	98.8	2.8	96.4-100.0	96.9	6.1	93.1-100.0
	3	93.3	7.2	87.0-99.6	84.4	4.6	80.4-88.4	88.9	7.4	84.3-93.5
	4	83.8	9.5	75.5-92.1	76.3	14.9	63.2-89.4	80.0	12.4	72.3-87.7
	All	90.8	5.4	86.1-95.5	86.4	4.8	82.2-90.6	88.6	5.3	85.3-91.9
8	2	97.5	3.4	94.5-100.0	100.0	—	—	98.8	2.6	97.2-100.0
	3	88.9	6.8	82.9-94.9	95.6	4.6	91.6-99.6	92.2	6.5	88.2-96.2
	4	81.3	17.7	65.8-96.8	83.8	10.5	74.6-93.0	82.5	13.8	74.0-91.1
	All	89.2	6.6	83.4-95.0	93.2	3.9	89.8-96.6	91.2	5.5	87.8-94.6
10	2	96.3	8.4	88.9-100.0	98.8	2.8	96.4-100.0	97.5	6.0	93.8-100.0
	3	86.7	18.7	70.3-100.0	83.3	14.2	70.9-95.8	85.0	15.7	75.3-94.7
	4	81.3	17.1	66.3-96.3	91.3	7.1	85.1-97.5	86.3	13.4	78.0-94.6
	All	88.0	12.9	76.7-99.3	90.8	6.6	85.0-96.6	89.4	9.8	83.3-95.5
12	2	100.0	—	—	100.0	—	—	100.0	—	—
	3	96.7	5.0	92.3-100.0	94.4	9.6	86.0-100.0	95.6	7.3	91.1-100.0
	4	96.3	5.6	91.4-100.0	90.0	14.4	77.4-100.0	93.1	10.8	86.4-99.8
	All	97.6	3.3	94.7-100.0	94.8	4.1	91.2-98.4	96.2	3.8	93.8-98.6
14	2	100.0	—	—	98.8	2.8	96.4-100.0	99.4	2.0	98.2-100.0
	3	95.6	4.6	91.6-99.6	98.9	2.5	96.7-100.0	97.2	3.9	94.8-99.6
	4	98.8	2.8	96.4-100.0	93.8	14.0	81.5-100.0	96.3	9.9	90.2-100.0
	All	98.0	2.4	95.9-100.0	97.2	5.2	92.6-100.0	97.6	3.9	95.2-100.0
16	2	100.0	—	—	100.0	—	—	100.0	—	—
	3	100.0	—	—	97.8	3.0	95.2-100.0	98.9	2.3	97.5-100.0
	4	95	11.2	85.2-100.0	93.8	8.8	86.1-100.0	94.4	9.5	88.5-100.0
	All	98.4	3.6	95.2-100.0	97.2	3.3	94.3-100.0	97.8	3.3	95.8-99.9
6-8	2	96.3	6.0	92.6-100.0	99.4	2.0	98.2-100.0	97.8	4.7	95.7-99.9
	3	91.1	7.0	86.8-95.4	90.0	7.3	85.5-94.5	90.6	7.0	87.5-93.7
	4	82.5	13.4	74.2-90.8	80.0	12.8	72.1-87.9	81.3	12.8	75.7-86.9
	All	90.0	5.7	86.5-93.5	89.8	5.5	86.4-93.2	89.9	5.4	87.5-92.3
10-12	2	98.1	5.9	94.4-100.0	99.4	2.0	98.2-100.0	98.8	4.3	96.9-100.0
	3	91.7	13.9	83.1-100.0	88.9	12.8	81.0-96.8	90.3	13.1	84.6-96.0
	4	88.8	14.4	79.9-97.7	90.6	10.7	84.0-97.2	89.7	12.4	84.3-95.1
	All	92.8	10.2	86.5-99.1	92.8	5.6	89.3-96.3	92.8	8.0	89.3-96.3
14-16	2	100.0	—	—	99.4	2.0	98.2-100.0	99.7	1.4	99.1-100.0

Age	Syllables	Male M	SD	95% CI	Female M	SD	95% CI	Both M	SD	95%CI
4	1	85.0	7.0	82.7-90.7	85.0	7.0	78.9-91.1	85.0	6.6	80.9-89.1
	2	80.0	9.4	66.2-89.8	85.0	12.7	73.9-96.1	82.5	10.9	75.7-89.3
	3	73.6	16.9	52.9-78.5	74.3	8.9	66.5-82.1	73.9	12.7	66.0-81.8
	4	47.8	22.6	19.5-61.7	58.9	16.8	44.2-73.6	53.3	19.7	41.1-65.5
	All	66.7	11.6	49.1-74.0	72.1	11.2	62.3-81.9	69.4	11.1	62.5-76.3
6	1	88.3	7.5	81.7-94.9	88.3	9.5	80.0-96.6	88.3	8.1	83.3-93.3
	2	92.0	10.4	82.9-100.0	91.0	2.2	89.0-92.9	91.5	7.1	87.1-95.9
	3	80.0	11.2	70.2-89.8	81.4	8.5	74.0-88.9	80.7	9.4	74.9-86.5
	4	66.1	16.0	52.1-80.1	65.0	4.2	61.3-68.7	65.6	11.1	58.7-72.5
	All	78.3	10.8	68.8-87.8	78.1	4.5	74.2-82.0	78.2	7.8	73.4-83.0
8	1	75.0	28.3	50.2-100.0	88.3	9.5	80.0-96.6	81.7	21.1	68.6-94.8
	2	96.0	4.2	92.3-100.0	92.0	2.7	89.6-94.4	94.0	3.9	91.6-96.4
	3	87.9	8.6	80.4-95.4	90.0	8.1	82.9-97.1	88.9	8.0	83.9-93.9
	4	71.7	7.2	65.4-78.0	66.7	12.6	55.7-77.7	69.2	10.0	63.0-75.4
	All	81.9	7.6	75.2-88.6	81.5	7.3	75.1-87.9	81.7	7.0	77.4-86.0
10	1	86.7	7.5	80.1-93.3	91.7	0.0		89.2	5.6	85.7-92.7
	2	91.0	4.2	87.3-94.7	92.0	7.6	85.3-98.7	91.5	5.8	87.9-95.1
	3	91.4	6.0	86.1-96.7	82.1	9.1	74.1-90.1	86.8	8.8	81.4-92.3
	4	72.2	20.4	54.3-90.1	66.7	7.6	60.0-73.4	69.4	14.8	60.2-78.6
	All	83.5	10.2	74.6-92.4	79.6	6.5	73.9-85.3	81.6	8.3	76.5-86.7
12	1	91.7	10.2	82.8-100.0	91.7	5.9	86.5-96.9	91.7	7.9	86.8-96.6
	2	97.0	4.5	93.1-100.0	96.0	4.2	92.3-100.0	96.5	4.1	94.0-99.0
	3	92.1	6.9	86.1-98.2	92.9	4.4	89.0-96.8	92.5	5.4	89.2-95.9
	4	80.0	7.7	73.3-86.8	75.0	8.6	67.5-82.5	77.5	8.1	72.5-82.5
	All	88.5	5.0	84.1-92.9	86.7	4.5	82.8-90.6	87.6	4.6	84.8-90.5
14	1	93.3	7.0	87.2-99.4	88.3	4.6	84.3-92.3	90.8	6.2	87.0-94.6
	2	99.0	2.2	97.1-100.0	98.0	4.5	94.1-100.0	98.5	3.4	96.4-100.0
	3	93.6	5.3	89.0-98.3	92.1	6.9	86.1-98.2	92.9	5.8	89.3-96.5
	4	76.7	13.4	65.0-88.5	83.3	7.1	77.1-89.5	80.0	10.7	73.4-86.6
	All	88.3	5.7	83.3-93.3	89.6	4.2	85.9-93.3	89.0	4.8	86.0-92.0
16	1	96.7	4.6	92.7-100.0	95.0	4.6	91.0-99.0	95.8	4.4	93.1-98.5
	2	97.0	2.7	94.6-99.4	98.0	2.7	95.6-100.0	97.5	2.6	95.9-99.1
	3	99.3	1.6	97.9-100.0	95.0	4.8	90.8-99.2	97.1	4.1	94.6-99.6
	4	89.4	6.6	83.6-95.2	84.4	6.7	78.5-90.3	86.9	6.8	82.7-91.1
	All	94.8	2.6	92.5-97.1	91.7	2.9	89.2-94.2	93.2	3.0	91.3-95.1
6-8	1	81.7	20.7	68.9-94.5	88.3	9.0	82.7-93.9	85.0	15.9	78.0-92.0
	2	94.0	7.7	89.2-98.8	91.5	2.4	90.0-93.0	92.8	5.7	90.3-95.3
	3	83.9	10.3	77.5-90.3	85.7	9.1	80.1-91.3	84.8	9.5	80.6-89.0
	4	68.9	12.1	61.4-76.4	65.8	8.9	60.3-71.3	67.4	10.4	62.8-72.0
	All	80.1	9.0	74.5-85.7	79.8	6.0	76.1-83.5	79.9	7.4	76.7-83.1

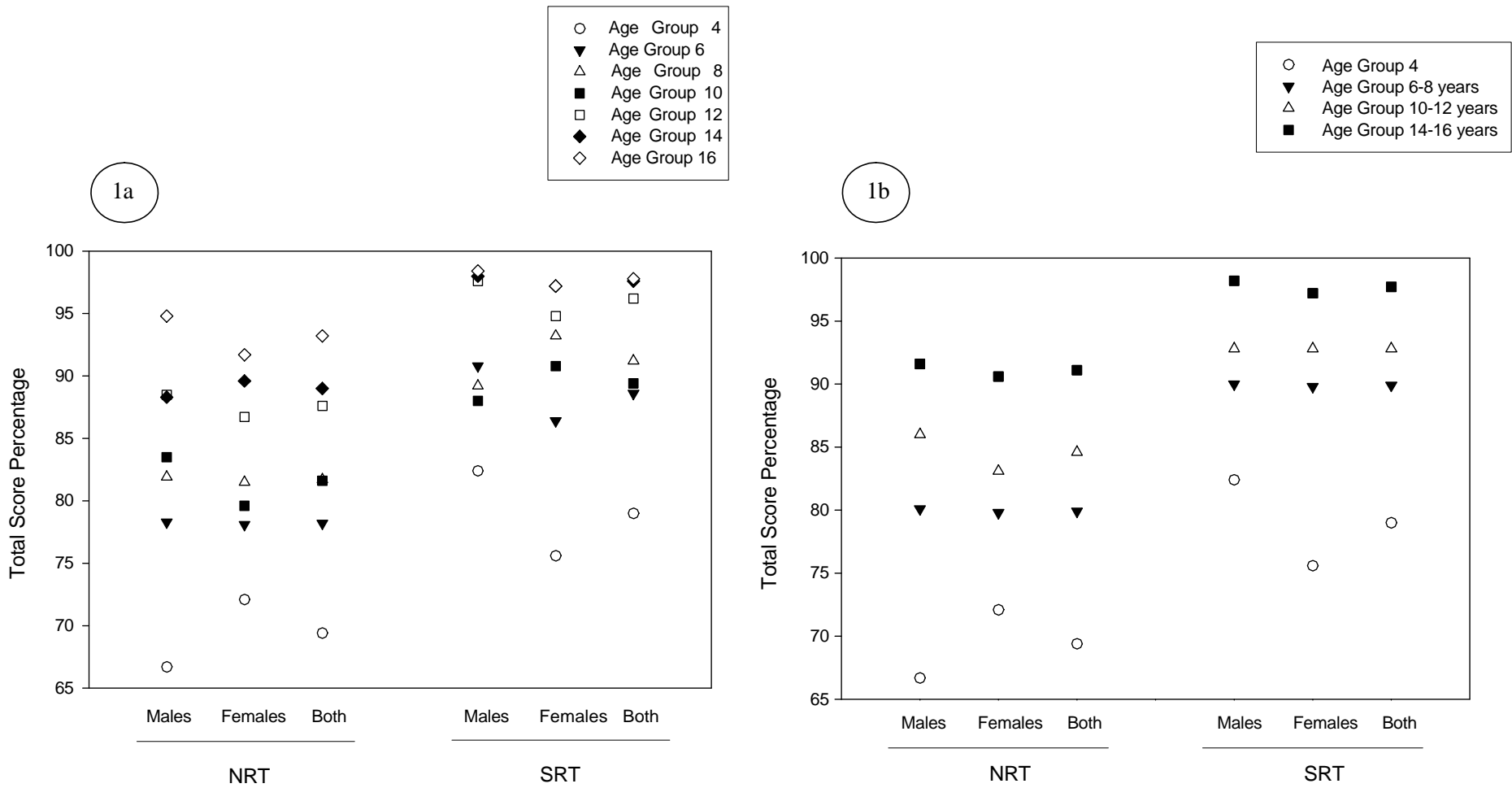|									
3	96.4	4.8	93.4-99.4	93.6	3.8	90.0-97.2	95.0	5.4	92.6-97.4
4	83.1	12.0	75.7-90.5	83.9	6.5	79.9-87.9	83.5	9.4	79.4-87.6
All	91.6	5.4	88.3-95.0	90.6	3.6	88.4-92.8	91.1	4.5	89.1-93.1

Figure 1. Total NRT and SRT percentage scores for developmental comparison groups. Figure 1a displays scores for males, females, and combined males-females in each of the 7 age groups. Figure 1b shows collapsed data by age groups, including 4, 6-8, 10-12, and 14-16 years.