8-2-2017

Rapid Automated Naming Performance of Young Spanish-English Speaking Children

Carla L. Wood
School of Communication Science and Disorders; Florida State University

Kristina N. Bustamante
School of Communication Science and Disorders; Florida State University

Lisa Fitton
University of South Carolina - Columbia, fittonl@mailbox.sc.edu

Dana M. Brown
School of Communication Science and Disorders; Florida State University

Yaacov Petscher
Florida Center for Reading Research, Flordia State University

Publication Info

Published in *Languages*, Volume 2, Issue 3, 2017, pages 13-.

languages

MDPI

Article

Rapid Automatic Naming Performance of Young Spanish–English Speaking Children

Carla L. Wood [1,*], Kristina N. Bustamante [1], Lisa M. Fitton [1], Dana M. Brown [1] and Yaacov Petscher [2]

1 School of Communication Science and Disorders; Florida State University, 201 W. Bloxham, Tallahassee, FL 32306, USA; knr15c@my.fsu.edu (K.N.B.); lmf11g@my.fsu.edu (L.M.F.); dmb14g@my.fsu.edu (D.M.B.)
2 Florida Center for Reading Research, 2010 Levy Ave., Suite 100, Florida State University, Tallahassee, FL 32310, USA; ypetscher@fcrr.org
* Correspondence: carla.wood@cci.fsu.edu; Tel.: +1-850-459-7088

Academic Editors: Maria del Carmen Parafita Couto, Usha Lakshmanan and Osmer Balam
Received: 20 May 2017; Accepted: 28 July 2017; Published: 2 August 2017

Abstract: The aim of this preliminary study was to examine the feasibility of a rapid automatic naming (RAN) task for young Spanish–English speaking dual language learners (DLLs) and to examine the relationship between children's performance on RAN and other standardized language and literacy assessments. A total of 275 Spanish–English speaking children in kindergarten and first grade attempted a RAN task and completed assessments of language and early literacy. Correlational analyses and quantile regression was conducted to examine relationships. Overall the RAN task was feasible for 74% (n = 203) of the DLLs; however, 42% of participants in kindergarten were unable to complete the task. There was a moderate positive correlation between RAN performance and standard scores in receptive vocabulary and letter identification, a small positive correlation with non-verbal intelligence, and no significant relationship with phonological awareness. There was a differential relation between RAN and English sentence imitation. The results support further consideration of RAN as a feasible and useful measure for young Spanish–English speaking DLLs.

Keywords: developmental assessment; early literacy; English as a second language

1. Introduction

Assessment practices for young Spanish–English speaking dual language learners (DLLs) is increasingly a priority area for educational personnel and researchers, due to the growing population of children in the United States who speak a language other than English. The estimated number of children from linguistic minority backgrounds enrolled in public schools in the United States increased from 4.1 million to 4.4 million between the 2002 and 2012 academic school years [1]. In addition to growing numbers of DLLs, there is a well-recognized need for increased progress monitoring of language and literacy development. The National Center for Education Statistics reported that English proficient speakers scored higher in reading than children learning English as a second language [2]. Children learning English as a second language show an achievement gap compared to English-proficient students [2]. Therefore, increased attention to the literacy needs of DLLs is warranted, particularly in the area of English language and literacy assessment.

Despite awareness of language and literacy needs, challenges persist in current assessment practices. Among these challenges, traditional literacy and achievement assessments have their foundation in research on monolingual English-speaking children [3]. Although monolinguals and DLLs may experience overlapping educational experiences, DLLs exhibit unique literacy and/or biliteracy development because of their knowledge of two languages [4,5]. Consequently, DLLs may differ in their responses to traditional language tests compared to monolinguals [6]. Another challenge in assessment practices is the diversity of the DLL population. The quantity and quality of English exposure may vary substantially among DLLs and within individual children's daily routine and school year [7]. Further research is required to better understand DLLs' performance in common language and literacy assessments.

1.1. Language Assessment for Dual Language Learners

Given the population of DLLs and potential differences in developmental trajectories for DLLs, the assessment of language skills is a priority area of interest for researchers and educational personnel. Assessment of DLL language skills is particularly challenging given the role of environmental language exposure in language specific tasks such as vocabulary in the first and second language. Recognizing that Spanish–English speaking DLLs enter kindergarten with different Spanish and English language experiences, there is a need to identify general language processing measures or quasi-universal tasks that are non-specific to a particular language, but may be used to assess a general language domain [8,9].

The theoretical basis for language-specific and language general knowledge is provided by Cummins' common underlying proficiency model [10], which is supported by factor analyses of language assessments [11,12]. In one such study, the task force of the Language Reading Research Consortium (LARRC) examined the Spanish and English language skills of 286 dual language learners in preschool [12]. The best-fitting model for the latent dimensionality of Spanish supported a single general language factor plus word knowledge and language knowledge. The authors interpreted the general language factor to represent aspects that are non-specific to Spanish or English, but rather shared in the child's overall representation of language or language processing. Similarly, Goodrich and Lonigan found general language and language-specific factors modeled children's phonological awareness and print awareness literacy skills [11]. More research is needed to identify assessment tools that capture or reflect this general language factor in young DLLs, which may also help to minimize cultural and linguistic biased assessment [13].

1.2. Rapid Automatic Naming

Among assessments, rapid automatic or automatized naming is one measure that has been associated with the identification of language learning disorders and reading outcomes [14–16]. Rapid automatic naming (RAN) refers to a task in which the examiner presents an individual with a series of pictures of commonly recognized symbols (e.g., objects, colors, numbers, letters). During the task, the examiner asks the child to label each symbol in the series as rapidly as possible, noting the amount of time the child requires [17,18]. The rate of naming, combined with accuracy, is used to compute a RAN score. The RAN score is thought to reflect the integration of a variety of skills including attention, perception, and cognitive–linguistic processing [19].

Although the construct validity has not been extensively examined for use with DLLs, numerous studies report significant relationships between RAN and reading for monolinguals. In the early school age years, the naming speed of colors predicts reading achievement, particularly for children in kindergarten and first grade [20–25]. In kindergarten, naming speed has been associated with letter identification and letter to sound association. Similarly, in first grade, naming speed has been associated with word recognition [21], also believed to be integral to reading. In Lervåg and Hulme's longitudinal study of the reading development of students from pre-literacy instruction through fourth grade [26], RAN was not only found to have high stability, but different RAN tasks (e.g., alphanumeric versus non-alphanumeric) had different relationships with factors in the model of reading performance at different time points. In a structural equation model from ten months prior to literacy instruction to three months post literacy instruction, non-alphanumeric RAN was the only naming task significantly predictive of text-reading fluency. However, from the three months post literacy instruction time point forward, alphanumeric RAN was the only naming task to significantly predict text-reading fluency. Alphanumeric RAN was predictive of reading fluency gains and reading fluency growth rates [26].

Given the predictive relationship between RAN and reading fluency, it is not surprising that RAN shows good construct validity in terms of differentiating children with and without language learning impairments. In previous studies, children with dyslexia generally demonstrate RAN performance that is more than one standard deviation below the norm, and RAN has differentiated children with typical and atypical oral language development [27–34].

2. Theoretical Framework

We employed the double deficit hypothesis to frame our understanding of the predicted relationship between children's RAN skills and performance on language and literacy tasks. The double deficit hypothesis of reading disability posits that subtypes of reading disorders exist, such that reading disabilities may be primarily attributed to phonological deficits, deficits underlying naming speed processes, or a combination of both phonological deficits and naming speed deficits [16,35]. A deficit in either phonological skills or naming speed is thought to result in a less severe form of reading disability than a combined deficit. While tasks such as rhyming, alliteration, categorization, phoneme blending, segmentation, elision, and nonword repetition (NWR) measure phonological skill [33,36–39], rapid automatic naming (RAN) is the primary measure of naming speed. There exists some controversy regarding the theoretical explanations for the relationship between naming speed and reading [40], with differing key constructs thought to underly the relationship including phonological awareness [41], orthographic processing [42], and general cognitive processing or executive function [43]. Mounting evidence suggests that RAN is a separate predictor from phonological tasks, predicting literacy aspects such as reading speed and word identification above and beyond the variance predicted by phonological measures [16]. In a one-way ANOVA followed-up with Tukey (HSD) pairwise comparisons, Spanish-speaking children with a double-deficit scored lower than children with a phonological deficit, who scored lower than children with only a RAN deficit on a RAN-objects task ($F(2, 28) = 4.76$, $p < 0.05$). In multiple stepwise regression models, Lopez Escribano found that RAN uniquely predicted 50% of variance in reading speed after controlling for orthographic choice and reading disability status in one model and word reading and reading status in another model [35].

The double deficit hypothesis has been researched with RAN in the assessment battery of monolingual children who speak English, Finnish, Hungarian, Portuguese, German, Dutch, Spanish, or French [19,33,44,45] (for a review see [16]). In dyslexic Spanish-speaking second graders, children who scored low on RAN performed worse on measures of reading speed and orthographic processing than peers matched for phonological skill [46]. Thus when controlling for phonological measures, RAN independently contributed to the variance in reading and orthography [46]. Plaza and Cohen modeled literacy achievement in French-speaking first graders using a hierarchical analysis of time to accuracy ratios for processing tasks and found phonological and naming speed tasks to be separate, important predictors of reading ability [33]. Moreover, phonological and naming speed were the most influential of four predictors. Variables accounting for a visual cognitive component of reading (visual code matching and visual attention) were cancelled out when RAN was entered into the model or did not contribute to the model [33].

2.1. Relationship between Rapid Automatic Naming and Performance on Emergent Literacy

Multiple studies have highlighted a relationship between RAN and performance on language and literacy tasks [47–49]; however, there is no consensus regarding which skills are tasked in RAN measures [40]. Vocabulary, memory, speed of lexical access, verbal fluency, and phonological processing are among reported significant correlations highlighted in the existing literature. As such, RAN may be viewed as a general nonspecific domain task, meaning that it is not heavily influenced by exposure and experience to any one specific language, but instead captures general language or general cognitive processing skills. Other studies propose RAN naming tasks as tasking both general and domain-specific knowledge such as orthographic recognition [50]. Mixed findings in the previous literature were reviewed to add clarity and illuminate the gaps in available funds of knowledge on RAN.

Findings of research studies such as those of Bowers [42], Bowers and Wolf [51] and Bowers and Swanson [52] have shown that phonological processing tasks predicted word and non-word reading but do not adequately predict word and text speed. Naming speed predicted accuracy and latency for word identification, expressiveness, and speed reading text messages [53]. Bowers found unique contributions to oral reading and to word identification accuracy for regular and irregular words by both variables [42]. Naming speed was the only variable that contributed to speed of reading measures and phonological decoding was the only variable that contributed to comprehension [16].

Wolf et al. examined the relationship between phonological awareness and naming speed in children with severe language disorders [54]. The authors found that the phonological measures contributed the most variance to word attack measures while naming speed contributed the most variance to word identification. Similarly, Manis et al. also assessed whether or not phonemic awareness and naming speed have specific and/or shared variance using reading tasks [55]. The results revealed that both naming speed and phonological variables predicted distinct variance in each reading measure. In orthographic variables, naming speed accounted for more variance in the tasks that were solely orthographic than the phonological variable and a slight difference of variance in tasks that included both orthographic and phonological components such as word identification [16]. Additional support is provided by the results of Torgesen et al. [41], who examined whether or not RAN makes a distinct contribution to describing the improvement of orthographic reading skills between the 2nd and 4th grade and the 3rd and 5th grades. The findings revealed that phonemic awareness explained a small but significant amount of variance in 4th grade word recognition above the variance that includes 2nd grade word recognition.

2.2. Need for Additional Studies of Rapid Automatic Naming with Spanish–English speaking Dual Language Learners

There are notably few studies examining the use of RAN as an assessment tool for dual language learners, specifically Spanish–English DLLs. Based on findings of studies on linguistic processing, it might be expected that response time in RAN tasks may be slowed for young DLLs by the need to suppress their first language in naming basic object [56]. Lexical retrieval in Spanish–English speaking bilinguals may affect naming latency and accuracy in various RAN tasks equally; however, other researchers have pointed out that bilinguals may be more affected in the retrieval of low-frequency words compared to high-frequency words [13,57]. In this case, tasks involving letters or numbers may be expected to be more efficient and feasible for school-age DLLs, given that instruction in numbers and letters has occurred with English as the language of instruction. Conclusions cannot be drawn from the existing literature base given that very few RAN studies include Spanish–English DLLs. In response to the gaps in the literature, one of the key aims of the current project as a preliminary study was to expand the knowledge base related to the RAN skills of young Spanish–English speaking DLLs relative to their performance in other language and literacy assessments.

2.3. Research Aims

Given the remaining gaps in the knowledge of the relationship between RAN and performance in language and literacy measures for DLLs, the current preliminary study explored the following research aims.

1. Is RAN a feasible task for kindergarten and first grade Spanish–English speaking DLLs who may have limited English skills?
2. What is the average RAN performance of Spanish–English speaking DLLs in kindergarten and the first grade by types of symbols (numbers/letters and colors/objects)?
3. What is the relationship between RAN and children's performance in standardized language and literacy assessments for Spanish–English speaking DLLs?

3. Method

The investigators collected data for the current study as part of a package of baseline assessment measures administered in a larger grant-funded research project supported by the Institute of Education Sciences, U.S. Department of Education, that focused on developing a vocabulary intervention for English learners in kindergarten and the first grade. The current project used extant baseline data from all three years of the development project. The study procedures were reviewed and approved by the university's committee on research involving human subjects (HSC#: 2016.18265). The current project partnered with eight elementary schools in Florida and Kansas. Teachers distributed consent forms to parents to review and approve. Researchers contacted parents who had provided signed consent for their children to participate.

3.1. Participants

Participants were recruited through cooperating kindergarten and first grade teachers. Teachers sent home study information with students of families who reported Spanish to be spoken in the home and met the school's criteria as an English learner. The participant pool consisted of 275 participants who attempted the RAN test, comprised of 141 boys (51%) and 134 girls (49%). There were 128 participants in kindergarten and 147 participants in the first grade. Participants in kindergarten and the first grade did not differ in terms of gender, primary language, free/reduced lunch, or ethnicity (gender: χ^2 (1) = 0.052, p = 0.819; primary language: χ^2 (4) = 7.84, p = 0.098; free/reduced lunch: χ^2 (2) = 0.438, p = 0.803; ethnicity: χ^2 (1) = 0.233, p = 0.630). Based on information provided by parents, 94% of participants were eligible for free lunches and 4% were eligible for reduced lunches. None of the participants had any identified sensory impairments or other identified disorders. Additional demographic information about the participating children per grade is provided in Table 1.

Table 1. Participant demographics.

	Kindergarten (*n* = 128)		**1st Grade (*n* = 147)**	
	n	**M (SD)**	***n***	**M (SD)**
Age (months)	128	66.30 (4.27) (60–83)	147	79.17 (5.04) (72–98)
	n	%	*n*	%
Gender	128	100	147	100
Male	64	50	77	52
Female	64	50	70	48
Reported Primary Language	56	44	107	73
Spanish	22	39	49	46
Both	27	48	55	51
English	7	13	3	3
Free/Reduced Lunch	88	69	112	76
Free	84	95	104	93
Reduced	3	3	4	4
Ethnicity	55	43	107	73
Hispanic/Latino	54	98	106	99
Declined to report	1	2	1	1

Not all families responded to requests for demographic information. M = mean; SD = standard deviation.

All participants attended schools in which English was the primary language of instruction. All partnering schools (n = 8) were considered to be low socioeconomic schools in terms of serving a high percentage (78–97%) of children eligible for free or reduced lunch (refer to Table 2).

Table 2. Description of participating schools.

	n	School Population [1]	% F/R Lunch [2]	% Hispanic in School	% F/R Lunch in District	% Hispanic in District	% EL in District	White–Hispanic Gap [3]
School A	32	362	82	52	83.1	19.2	6.2	0.229 (SE = 0.161)
School B	32	145	99	93.3	39.1	25.9	12.2	0.708 (SE = 0.036)
School C	12	1042	86	63	51.9	31.4	11.3	0.614 (SE = 0.009)
School D	21	358	82	51.7	31.1	19.0	8.3	0.774 (SE = 0.014)
School E	48	1250	78	62.6	83.0	45.3	28.8	0.255 (SE = 0.016)
School F	44	907	82	52	51.9	31.4	11.3	0.614 (SE = 0.009)
School G	23	944	94	53	65.9	67.6	19.6	0.516 (SE = 0.009)
School H	6	258	77	25	83.1	19.2	6.2	0.229 (SE = 0.161)

n Refers to number of participants in the current study attending each school. District-level data was retrieved from the Stanford Education Data Archive [58]. [1] School Population represents the total number of children enrolled in the elementary school. [2] F/R Lunch reflects the percentage of the school population that receives free or reduced lunch. [3] White–Hispanic Gap reflects the achievement gap between average performances in state English language arts assessment for Hispanic students compared to White students in the district. Reported in standard deviations (see [58]). SE: standard error.

3.2. Family Characteristics

After consent forms were returned, heritage Spanish speakers who were graduate students or advanced undergraduates majoring in the School of Communication Science and Disorders called parents to collect information during a telephone interview. The bilingual phone interviewers followed the parents' lead and responded in either Spanish or English depending on parents' language use. Investigators followed a script for the phone interview, collecting demographic data from 216 families, 79% of all participants. Information regarding parents' level of education, Spanish and English use in the household, and country of origin was collected to better understand language input and dialectal features of in participants' home language environments. Approximately half of the mothers were unemployed (56%) and the majority reported family childcare as a primary responsibility. Fathers' occupations were in skilled (49%) and unskilled labor (47%), commonly reporting positions in construction and lawn care. Parents reported that they had less than a high school education (63%), originated from Mexico (45%) or Guatemala (18%), and spoke Spanish alone as the primary household language (59%). Less frequently identified origins included El Salvador (10%), Cuba (9%), and Honduras (3%). Fewer than three families reported the following countries as their country of birth: the United States, Puerto Rico, Dominican Republic, Colombia, Uruguay, Peru, and Venezuela. Additionally, in 10% of families, parents in the same family reported different countries of origin (e.g., a mother from Mexico and a father from El Salvador). Table 3 provides a detailed description of participant family characteristics by grade.

Table 3. Characteristics of participant families.

	Kindergarten (*n* = 128) *n*%		1st Grade (*n* = 147) *n*%	
Country of Origin	56	44	107	73
Mexico	23	41	51	48
Guatemala	11	20	19	18
Other	16	28	29	26
Primary Household Language	55	43	107	73
Spanish	30	55	66	62
English	1	2	5	5
Both	24	43	36	33
Mother's Education	53	41	102	69
Beyond high school	6	11	16	16
High school/GED	21	40	25	24
Some high school	4	7	17	17
Less than high school	22	42	44	43

Table 3. *Cont.*

	Kindergarten (*n* = 128) *n*%		1st Grade (*n* = 147) *n*%	
Father's Education	46	36	99	67
Beyond high school	2	4	7	7
High school/GED	14	30	19	19
Some high school	10	22	21	21
Less than high school	20	44	52	53
Mother's Occupation	54	42	100	68
Professional	0	0	3	2
Skilled Labor	4	7	11	11
Unskilled Labor	21	39	29	29
Unemployed	29	54	57	57
Father's Occupation	48	38	91	62
Professional	0	0	2	2
Skilled Labor	19	40	49	54
Unskilled Labor	25	52	40	44
Unemployed	4	8	0	0

Not all the families responded to all the demographic questions and therefore the total differs across categories. GED: General Educational Development test of the American Council on Education.

3.3. Measures

3.3.1. Rapid Automatic Naming

The RAN subtest of the *Woodcock Reading Mastery Tests* (WRMT-III; [59]) was administered to assess RAN skills. Consistent with other tests of RAN, the subtest included RAN for numbers, letters, pictures, and colors [17]. Following the standard procedures for administering and scoring the WRMT-III subtest, the two subtests with the highest performance were recorded as the raw score used for calculating the standard score. The alternate-form correlation reliability coefficient for object plus color naming is 0.83 on Forms A and B for kindergarten. The alternate-form correlation reliability coefficient for number plus letter naming is 0.88 on Forms A and B for kindergarten, first, and second grades.

3.3.2. Reading Readiness

The *Woodcock Reading Mastery Tests*, Third Edition (WRMT-III; [59]) was administered in the fall of the school year. The test was not administered at all schools due to restrictions on assessment time; however, it was included in the battery whenever possible due to the theoretical framework suggesting RAN is a separate predictor from phonological awareness [16]. The WRMT-III is a set of tests for measuring oral language and academic achievement, normed on individuals 4–79 years old. The test was evaluated on a normative sample of 3360 individuals (including 2600 school age participants) in 45 states in the United States. Phonological awareness (PA), RAN, and letter identification (LI) subtests were administered. Phonological awareness subtest tasks included first and last sound matching, rhyming, blending, and deletion. Split-half reliability for each subtest on Form A are as follows for kindergarten: 0.91 for LI, 0.92 for PA, and 0.83 for RAN. For first grade, split-half reliability for each subtest on Form A are 0.69 for letter identification, and 0.91 for phonological awareness. Internal consistency for the average total reading cluster is 0.97.

3.3.3. Nonverbal Intelligence

The *Primary Test of Nonverbal Intelligence* (PTONI; [60]) was used to assess nonverbal reasoning. Children were required to identify a picture that does not belong within an array as items increase in difficulty. The PTONI's average reliability alpha coefficient is 0.93.

3.3.4. Receptive Vocabulary

The *Peabody Picture Vocabulary Test*, Fourth Edition (PPVT-4; [61]) was used to assess English receptive vocabulary. The task requires children to identify the picture of a word spoken by the examiner within a field of four pictures. The PPVT-4's average test–retest reliability is 0.93. The *Test de Vocabulario en Imágenes Peabody* (TVIP; [62]) was used to assess Spanish receptive vocabulary. Reliability coefficients per age group ranged from 0.93 to 0.94 (ages 5 through 8 years and 11 months).

3.3.5. Sentence Imitation

Research assistants administered the sentence repetition task from the morphosyntax subtest of the *Bilingual English and Spanish Assessment* (*BESA*) in English [63]. The *BESA* is an assessment measure designed for Latino children 4–7 years of age, in which the examiner presents 7–14 word sentences individually and the child is asked to repeat the sentence verbatim [63]. Targeted grammatical words within the sentence are scored and not every word in the sentence is used in deriving a score on the subtest. Targeted grammatical items are comprised of a variety of grammatical forms including relative clauses (e.g., *who is a doctor),* irregular past tense, auxiliaries, articles, inverted copulas and auxiliaries, infinitives, subordinating conjunctions (e.g., because), subject pronouns, possessive pronouns, past tense, "wh" question forms, and conditionals.

3.4. Procedures

Graduate and undergraduate students in Communication Science and Disorders employed as research assistants completed training on the standard procedures for administering the language and literacy assessments. Upon completion of the training, the research assistants had an opportunity to observe experienced examiners. The research assistants administered language and literacy assessments individually to children in their schools during the months of September and October. The order of test administration was randomized across participants. Research assistants scored the assessments following the standard protocol for each test. Three separate assistants scored each test independently (three times total) to ensure accuracy. Any conflicting scores were examined by the project coordinator or team leader to resolve any discrepancies in scoring.

4. Analyses

To address the first and second research questions, frequency and descriptive data were examined. To address the feasibility of RAN as an assessment tool for young DLLs, the children's performance on the WRMT-III RAN subtest was categorized as either a) complete administrations, or b) administrations including excessive errors. Administrations with excessive errors (i.e., four or more naming errors on any task) did not meet criteria for the test to be a valid indicator of rapid automatic naming. The children's mean scores and standard deviations were examined for each pair of subtests, objects and colors or numbers and letters. To determine average RAN performance by grade, means and standard deviations were obtained for the participants scores in the RAN subtest. Descriptive statistics were examined overall and by grade, and comparisons between the groups were made using independent sample *t*-tests.

For the third research question, correlation coefficients were first obtained to examine the relation between RAN performance and scores on the standardized assessments of language and literacy. Quantile regression was then used to test the relations between RAN and the two measures of English language and literacy, conditional on points of the language measure distribution other than the mean. While standard correlation coefficients provide an overall estimate of the relation between two variables of interest, the resulting estimate may conceal a relation that changes based on the performance of either of the variables [64,65]. Quantile regression allows for the examination of the correlation between the variables at different points on the distribution, or quantiles, without paring the individuals' data in a way that diminishes overall power [64]. This approach was employed for the present research to allow for more fine-grained analysis of the concurrent criterion validity of RAN.

5. Results

5.1. Descriptive Statistics

To address the first research question, relating to the feasibility and utility of the RAN task for young DLLs, we examined descriptive statistics for each grade. Of the 275 participants who were administered the WRMT-III RAN task, 203 had complete administrations that could be scored. The remaining 72 (26.2%) participants had administrations including excessive naming errors, resulting in a null score. Of these 72 children, 54 (75.0%) were in kindergarten and 18 (25.0%) were in first grade. Within the grade, 54 of the 128 total kindergarten participants (42%) were unable to complete the task; however only 18 of the 147 first grade participants (12%) were unable to complete the task. Table 4 provides descriptive information for participants based on their completion of the RAN task.

To address the second research question, we examined descriptive data for the average RAN performance by grade and type of symbols (e.g., colors/objects or letters/numbers). Overall, the participants achieved the highest score for RAN on the objects and colors task, with a mean standard score of 97.26 (SD = 13.73). The difference was not significant, however $t(201) = 0.16$, $p = 0.600$. For participants who achieved their highest score on the numbers and letters task, the mean standard score was 96.14 (SD = 12.09). Notably, a total of 84 participants received their highest score from the objects and colors task, while a total of 119 participants received their highest score from the numbers and letters task.

The examination of task performance by grade revealed that for the Spanish–English DLLs in kindergarten, more children achieved their highest standard score for the objects and colors task ($n = 41$) compared to the numbers and letters task ($n = 32$). Children received similar scores for the two tasks, with a mean of 95.07 (SD = 10.70) for objects and colors and a mean of 95.41 (SD = 11.55) for numbers and letters. Among the first-grade participants, more children achieved their highest standard score for the numbers and letters task ($n = 87$) compared to the objects and colors task ($n = 43$). First grade DLLs similarly did not exhibit significantly different standard scores on the two tasks, $t(128) = 1.06$, $p = 0.293$. The mean score for objects and colors among first graders was 99.35 (SD = 15.96) and for numbers and letters it was 96.41 (SD = 12.34). Overall performance on all assessment measures is provided in Table 4. No statistically significant differences in the WRMT-III RAN standard score were observed between the two grades $t(201) = -1.23$, $p = 0.220$.

Finally, we examined relationships between RAN and children's performance on standardized language and literacy assessments. DLL correlations revealed significant relations between participants' raw scores on the WRMT-III RAN and those attained for WRMT-III letter identification ($r = 0.34$, $p = 0.001$), PPVT-4 ($r = 0.34$, $p < 0.001$), TVIP ($r = 0.32$, $p < 0.001$), and PTONI ($r = 0.25$, $p < 0.001$). The relation observed between RAN and WRMT-III phonological awareness was not significant ($r = 0.19$, $p = 0.108$). The correlation between all the variables of interest by grade are provided in Table 5.

Table 4. Children's performance in language and literacy assessment measures.

	Children with RAN			Children Unable to Complete RAN			Full Sample		
Measure	***n***	**Raw M (SD)**	**SS M (SD)**	***n***	**Raw M (SD)**	**SS M (SD)**	***n***	**Raw M (SD)**	**SS M (SD)**
Age (mos)	203	74.76 (7.73)		72	68.71 (6.88)		275	73.18 (7.96)	
RAN	203	19.83 (7.12)	96.61 (12.78)				203	19.83 (7.12)	96.61 (12.78)
Vocabulary									
PPVT-4	201	79.69 (21.89)	85.10 (13.11)	68	52.37 (25.82)	71.19 (14.5)	269	72.78 (25.80)	81.59 (14.75)
TVIP	170	27.82 (19.61)	80.03 (17.02)	51	26.98 (18.20)	83.91 (19.60)	221	27.63 (19.26)	81.09 (17.78)
Nonverbal Intelligence									
PTONI	200	32.59 (11.10)	93.13 (19.22)	71	24.63 (10.60)	88.07 (18.23)	271	30.50 (11.49)	91.79 (19.06)
Reading									
WRMT-LI	96	15.45 (3.28)	97.24 (12.72)	32	9.25 (6.37)	82.47 (15.68)	128	13.90 (5.02)	93.55 (14.91)
WRMT-PA	75	20.72 (6.68)	95.40 (16.86)	15	18.33 (8.40)	91.13 (25.06)	90	20.32 (7.00)	94.69 (18.38)
Readiness	74		95.86 (14.67)				74		95.86 (14.67)

PPVT = *Peabody Picture Vocabulary Test-Fourth* [61]. TVIP = *Test de Vocabulario en Imágenes Peabody* [62]. PTONI = *Primary Test of Nonverbal Intelligence* [60]; WRMT-LI = *Woodcock Reading Mastery Test—Letter Identification* [59]. WRMT-PA = Woodcock Reading Mastery Test—Phonological Awareness [60]. RAN = Rapid Automatic Naming subtest of WRMT [59].

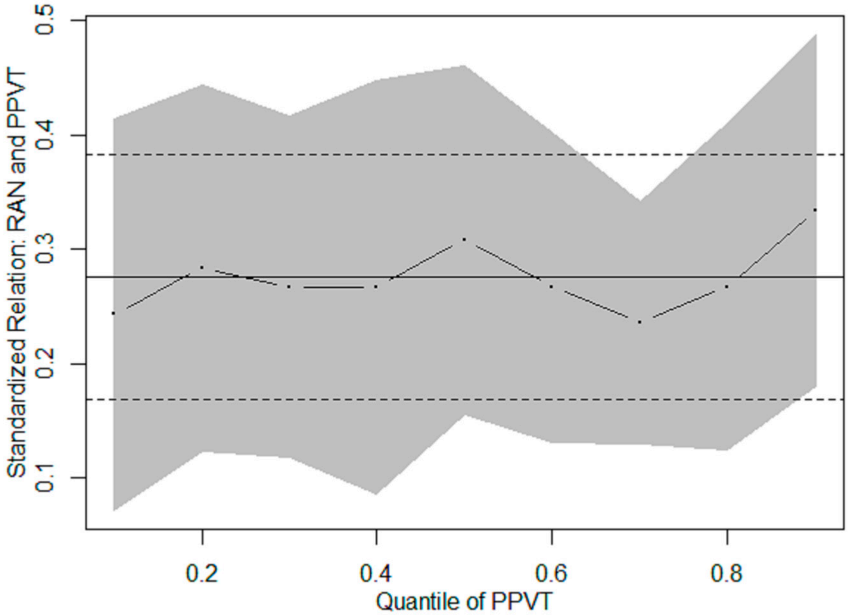
Table 5. Relationships between RAN and raw scores on language, early literacy and non-verbal intelligence measures.

	1	**2**	**3**	**4**	**5**	**6**	**7**
1. RAN	---	0.202	0.001	0.260 **	0.049	0.237 **	0.105
2. Letter ID	0.295	---	0.154	0.191	0.227	0.078	−0.075
3. PA	0.062	0.316	---	0.367 **	0.109	0.190	0.424 **
4. PPVT	0.023	0.475 **	0.440 **	---	0.065	0.286 **	0.413 **
5. TVIP	0.281 *	0.296	−0.102	−0.126	---	−0.011	0.107
6. PTONI	0.196	0.478 **	0.553 **	0.504 **	0.005	---	0.356 **
7. Sentence Repetition (English)	0.019	0.131	0.528 *	0.579 **	−0.338 **	0.347 **	---

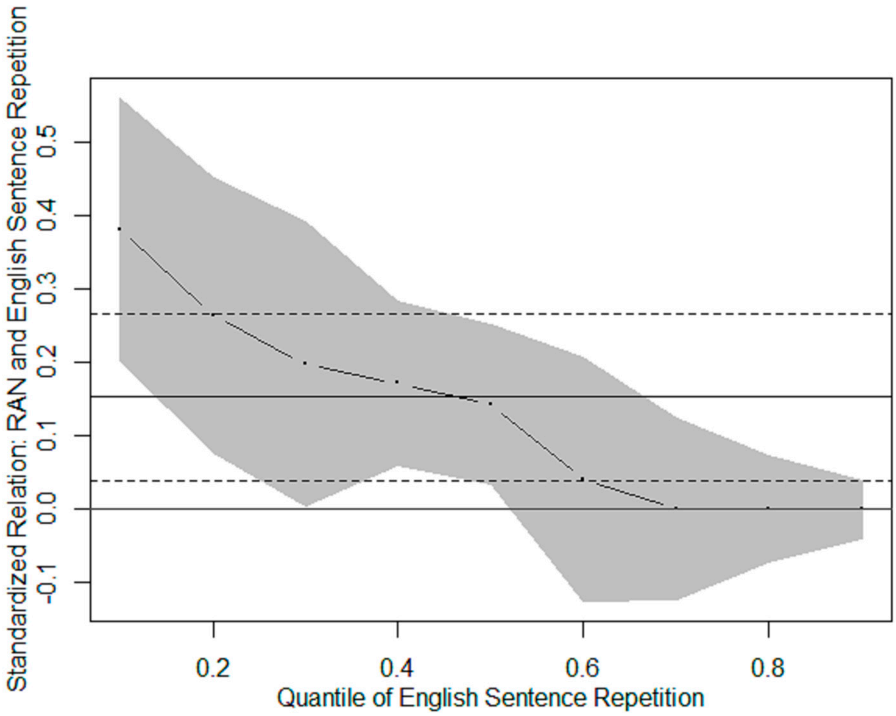
* $p < 0.05$, ** $p < 0.01$. All values were rounded to the hundredth place. Numbers in gray in the lower left area below the dashes represent the correlations for kindergarten participants and the bold represent correlations for first grade participants. Sentence Repetition of the *Bilingual English and Spanish Assessment* (*BESA*) [63].

5.2. Quantile Regression

Results from the quantile regression revealed that the relation between RAN and PPVT-4 scores remained relatively even across the distribution of the PPVT-4. As shown in Figure 1a, the OLS (ordinary least squares) correlation was observed at 0.28. The range of relations observed across the 0.10 through 0.90 quantiles was 0.25 to 0.32. Limited variability occurred across quantiles.



(a)



(b)

Figure 1. Quantile regression results for the relation between Rapid Automatic Naming (RAN) and *Peabody Picture Vocabulary Test-Fourth* (PPVT) **(a)** and English Sentence Repetition **(b)**.

RAN and English sentence repetition, however, demonstrated a differential relation conditional on English sentence repetition. Overall, a weak positive correlation was noted between the two variables. At the lower end of the distribution of English sentence repetition, the observed relation was notably larger (at the 0.10 quantile, 0.38) compared to the upper end of the distribution (at the 0.60 quantile and above, <0.05). That is, for DLLs with lower scores on English sentence repetition a stronger positive relation between RAN and English sentence repetition was observed. For children above the 0.60 quantile, the relation neared zero. In other words, for children with poor performance in English sentence repetition, RAN was an adequate predictor of performance. For children with average or above average English sentence repetition performance, RAN was a poor predictor. Figure 1b displays this finding.

6. Discussion

6.1. Key Findings

This preliminary study examined the feasibility of a RAN task for young Spanish–English speaking DLLs and the relationship between RAN and participants' performance in standardized language assessment measures. Findings indicated that a RAN task was feasible for the majority of young DLLs, particularly for those in the first grade; however, it should be noted that a sizeable group of children of each age were not able to complete the RAN task. On average, DLLs scored within the typical range on the RAN task compared to norms. Children tended to show slightly higher scores on colors–objects in kindergarten and letters–numbers in the first grade; however the overall mean scores were not significantly different between tasks. For the full sample, RAN scores were moderately positively correlated with letter identification, English receptive vocabulary, and Spanish receptive vocabulary. The relation between RAN and English receptive vocabulary was stable for DLLs with varying scores on receptive vocabulary. RAN also exhibited a small positive correlation with nonverbal intelligence and English sentence repetition. Interestingly, the relation between RAN and English sentence repetition was stronger for children with lower sentence repetition scores and minimal for children with higher sentence repetition scores. No significant correlation was observed between RAN and English phonological awareness.

6.2. Interpretation and Comparison to Previous Findings

6.2.1. Feasibility of RAN for young DLLs

The finding that 74% of DLLs were able to complete the RAN with sufficient speed and accuracy to calculate a standard score was considered to be somewhat positive support for the feasibility of RAN tasks for young DLLs. Most of the unsuccessful participants (i.e., those who made too many naming errors or took too long) were in kindergarten, suggesting RAN tasks are feasible for the majority of DLLs in the first grade, but further consideration of the appropriateness of RAN for DLLs in kindergarten is warranted. Given that 42% of kindergarten DLLs were unable to complete the task successfully, additional studies may be needed to explore adaptations (or accommodations and modifications) for kindergarten DLLs to complete RAN tasks successfully.

6.2.2. Relationship with English Vocabulary

The finding that children's RAN performance showed a significant, moderate correlation with performance on standardized measures of receptive vocabulary in English and Spanish was interesting. This result could be argued to support the case for RAN being a language-general task. The correlation coefficients were moderate and positive, suggesting a similar relation between RAN and both English and Spanish receptive vocabulary. Additionally, quantile regression revealed that the relation between RAN and English receptive vocabulary was not moderated by the level of English word knowledge. In other words, DLLs with a low English vocabulary had a tendency to perform poorly on RAN with similar magnitude of relation as DLLs with a high English vocabulary had a tendency to have high RAN scores. This relational stability could be interpreted as substantiating the view that RAN reflects general language ability. Underlying English vocabulary skills relate to RAN performance (thought to affect speed of word retrieval and accuracy) for all levels of vocabulary knowledge among DLLs. Furthermore, the consistency of the relationship with vocabulary supports the utility of RAN as a tool for use with DLLs of varying English lexical abilities.

6.2.3. Relationship to Sentence Imitation

The relation between RAN and English sentence imitation was observed to be differential for DLLs with varying levels of English sentence repetition performance. Lower English sentence repetition scores were associated with lower RAN scores, but higher English sentence repetition scores were not significantly related to RAN scores. This finding seems to suggest that the RAN task is a more general cognitive–linguistic processing task and not a domain-specific language task with regard to English morphosyntactic skills for DLLs [19,39]. The English sentence repetition task was designed to be an indicator specifically of English grammatical knowledge for DLLs [66]. Lower levels of English sentence repetition, however, have been identified as more closely related to general language skills [67,68], similar to RAN [16,19]. The results suggest that, at higher levels of English sentence repetition ability, children's scores are indicative of an underlying ability that differs from that measured by RAN.

Importantly, specific grammatical skills (such as those targeted by the English sentence repetition task) are not believed to relate strongly to RAN performance (e.g., [26,69]). This hypothesis is substantiated by the current finding that children with high RAN scores were not significantly more likely to demonstrate high scores on the morphosyntactic task. Although the nature of the relationship cannot be derived conclusively from this preliminary study, the differential relation between sentence repetition and RAN supports the notion that the two tasks are measures of different underlying constructs, with RAN potentially tasking general cognitive language processing speed.

6.3. Theoretical Considerations

Given that RAN performance is believed to be the product of the synchronous execution of multiple cognitive and linguistic skills [19,39], it is not surprising that significant correlations were observed between RAN and measures of language and literacy. The fact that children's performance on RAN related more strongly to receptive vocabulary than to the morphosyntactic task seems to support that lexical skills associated with naming and word retrieval are associated with the construct underlying RAN performance. The lack of significant relations between phonological awareness and RAN may be thought to substantiate the double deficit hypothesis, with the skills indicated by RAN not being fully encompassed within phonological awareness tasks [16].

6.4. Limitations

Due to the use of extant data, we were limited in the nature of available assessment data. It would have been interesting to have included a global, comprehensive reading achievement score or performance data from state assessments to consider predictive relationships to an outcome variable. Also noted among the limitations is the use of one measure per construct. Only one assessment tool per construct (i.e., phonological awareness) was administered, due to time demands and the need to limit assessment time to minimize missed instruction time. Additionally, there was missing data on several assessments since some schools imposed restrictions on the number of assessments.

Given the research design, a causal relationship between factors cannot be derived from the data. Although the RAN scores showed a positive significant association with vocabulary skills in the children's first and second languages, the nature of the relationship cannot be fully understood from this preliminary study. Additionally, recognizing that RAN involves the synchronous execution of multiple cognitive and linguistic skills [19,39], it is impossible to identify the critical skill responsible for the significant relationship observed. In other words, it is possible that short-term memory or visual spatial processing alone account for the relationship observed, but this cannot be concluded from the current study.

6.5. Implications

The finding that the majority of young DLLs in this study were able to complete the RAN task reaching the scoreable criteria for the number of errors and speed, suggests that it is a feasible task for young DLLs particularly in the first grade, despite some DLLs having limited vocabulary. However, modifications may need to be further explored for DLLs in kindergarten. Future studies are needed to identify effective adaptations, such as additional rehearsal and practice items. The finding that RAN is positively associated with receptive English vocabulary performance supports the relevance of RAN in school-age language and literacy assessment batteries. The combination of RAN and other language and literacy measures may be useful in assessment batteries of language and literacy performance.

7. Recommendations for Future Studies

Future studies are needed to examine the stability of RAN scores across the school year and the test–retest reliability for Spanish–English speaking DLLs to further examine the utility for progress monitoring. Further, recognizing the interplay between languages for DLLs, future studies are needed to further examine the relationship between children's first language skills and RAN performance, as well as differences in trends for children with varying language backgrounds, such as children with high dominance in their first language compared to balanced bilinguals. Such comparisons may be beneficial in providing insights into the potential role of first language interference or the effect of suppression on the speed of RAN in English. Additionally, it would be interesting for future studies to include Spanish–English speaking children with language learning impairments. Although this study did not include students identified with language learning disorders, to further explore the use of RAN in assisting with differential diagnosis, it would be interesting to replicate with a group of dual language learners identified with reading and language learning disorders. It would also seem interesting to include a short-term memory assessment in future studies to help differentiate the component of RAN that may explain the relationship to language and literacy performance.

Acknowledgments: The research reported here was supported by the Institute of Education Sciences, U.S. Department of Education, through Grant R305A130460 to Florida State University. The opinions expressed are those of the authors and do not represent views of the Institute or the U.S. Department of Education. The authors are grateful for the work of graduate and undergraduate students in the School of Communication Science and Disorders who contributed to the feasibility of the project through data collection, data entry, and management.

Author Contributions: Carla L. Wood conceived and designed the study and contributed to writing the paper; Kristina N. Bustamante, Lisa M. Fitton, and Dana M. Brown contributed to data management and writing; and Yaacov Petscher analyzed the data and contributed to writing the paper.

Conflicts of Interest: The authors declare no conflict of interest. The funding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

References

1. Kena, G.; Musu-Gillette, L.; Robinson, J.; Wang, X.; Rathbun, A.; Zhang, J.; Wilkinson-Flicker, S.; Barmer, A.; Dunlop Velez, E. *The Condition of Education 2015*; NCES 2015-144; U.S. Department of Education: Washington, DC, USA, 2015. Available online: https://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2015144 (accessed on 6 July 2016).
2. Kena, G.; Hussar, W.; McFarland, J.; de Brey, C.; Musu-Gillette, L.; Wang, X.; Zhang, J.; Rathbun, A.; Wilkinson-Flicker, S.; Diliberti, M.; et al. *The Condition of Education 2016*; NCES 2016-144; U.S. Department of Education: Washington, DC, USA, 2016. Available online: https://nces.ed.gov/pubs2016/2016144.pdf (accessed on 6 July 2016).
3. Everatt, J.; Smythe, I.; Ocampo, D.; Gyarmathy, E. Issues in the assessment of literacy-related difficulties across language backgrounds: A cross-linguistic comparison. *J. Res. Read.* **2004**, *27*, 141–151. [CrossRef]

4. Branum-Martin, L.; Mehta, P.D.; Carlson, C.D.; Francis, D.J.; Goldenberg, C. The nature of Spanish versus English language use at home. *J. Educ. Psychol.* **2014**, *106*, 181–199. [CrossRef]
5. Castilla-Earls, A.P.; Restrepo, M.A.; Perez-Leroux, A.; Gray, S.; Holmes, P.; Gail, D.; Chen, Z. Interactions between bilingual effects and language impairment: Exploring grammatical markers in Spanish-speaking bilingual children. *Appl. Psycholinguist.* **2016**, *37*, 1147–1173. [CrossRef] [PubMed]
6. Bedore, L.; Peña, E. Assessment of bilingual children for identification of language impairment: Current findings and implications for practice. *Int. J. Biling. Educ. Biling.* **2008**, *11*, 1–29. [CrossRef]
7. Hoff, E.; Core, C.; Place, S.; Rumiche, R.; Señor, M.; Parra, M. Dual language exposure and early bilingual development. *J. Child Lang.* **2012**, *39*, 1–27. [CrossRef] [PubMed]
8. Boerma, T.; Blom, E. Assessmen of bilingual children: What if testing in both languages is not possible? *J. Commun. Disord.* **2017**, *66*, 65–76. [CrossRef] [PubMed]
9. Boerma, T.; Chiat, S.; Leseman, P.; Timmermeister, M.; Wijnen, F.; Blom, E. A quasi universal nonword repetition task as a diagnostic tool for bilingual children learning Dutch as a second language. *J. Speech Lang. Hear. Res.* **2015**, *58*, 1747–1760. [CrossRef] [PubMed]
10. Cummins, J. The role of primary language development in promoting educational success for language minority students. In *Schooling and Language Minority Students: A Theoretical Framework*; Leyba, C., Ed.; California State University: Los Angeles, CA, USA, 1994; pp. 3–49.
11. Goodrich, M.; Lonigan, C. Language-Independent and language-specific aspects of early literacy: An evaluation of the Common Underlying Proficiency model. *J. Educ. Psychol.* **2017**. [CrossRef]
12. Language and Reading Research Consortium. The dimensionality of Spanish in young Spanish-English dual language learners. *J. Speech Lang. Hear. Res.* **2015**, *58*, 754–766. [CrossRef]
13. Edmonds, L.A.; Donovan, N.J. Item level psychometrics and predictors of performance for Spanish/English bilingual speakers on An Object and Action Naming Battery. *J. Speech Lang. Hear. Res.* **2012**, *55*, 359–381. [CrossRef]
14. Denckla, M.B.; Rudel, R.G. Naming of object-drawing by dyslexic and other learning disabled children. *Brain Lang.* **1976**, *3*, 1–15. [CrossRef]
15. Denckla, M.B.; Rudel, R.G. Rapid 'automatized'naming (RAN): Dyslexia differentiated from other learning disabilities. *Neuropsychologia* **1976**, *14*, 471–479. [CrossRef]
16. Wolf, M.; Bowers, G.B.; Biddle, K. Naming-Speed processes, timing, and reading: A conceptual review. *J. Learn. Disabil.* **2000**, *33*, 387–407. [CrossRef] [PubMed]
17. Denckla, M.B.; Rudel, R. Rapid "automatized" naming of pictured objects, colors, letters and numbers by normal children. *Cortex* **1974**, *10*, 186–202. [CrossRef]
18. Wolf, M.; Denckla, M.B. *RAN/RAS: Rapid Automatized Naming and Rapid Alternating Stimulus Tests*; Pro-Ed: Austin, TX, USA, 2005.
19. González-Garrido, A.A.; Gómez-Velázquez, F.R.; Zarabozo, D.; Ruiz-Villeda, B.A.; de la Tuya, J.M. Rapid automatized naming and lexical decision in children from an electrophysiological perspective. *Clin. EEG Neurosci.* **2011**, *42*, 14–23. [CrossRef] [PubMed]
20. Badian, N. Do dyslexic and other poor readers differ in reading related cognitive skills? *Read. Writ.* **1994**, *6*, 45–63. [CrossRef]
21. Blachman, B.A. Relationship of rapid naming ability and language analysis skills to kindergarten and first-grade reading achievement. *J. Educ. Psychol.* **1984**, *76*, 610–622. [CrossRef]
22. Cornwall, A. The relationship of phonological awareness, rapid naming, and verbal memory to severe reading and spelling disability. *J. Learn. Disabil.* **1992**, *25*, 532–538. [CrossRef] [PubMed]
23. Felton, R.H.; Brown, I.S. Phonological processes as predictors of specific reading skills in children at risk for reading failure. *Read. Writ.* **1990**, *2*, 39–59. [CrossRef]
24. Mann, V.A.; Ditunno, P. Phonological deficiencies: Effective predictors of future reading problems. In *Perspectives on Dyslexia: Vol. 2: Cognition, Language, and Treatment*; Pavlides, G., Ed.; J. Willy & Sons: Chichester, UK, 1990; pp. 105–131.
25. Wolf, M.; Bally, H.; Morris, R. Automaticity, retrieval processes, and reading: A longitudinal study in average and impaired readers. *Child Dev.* **1986**, *57*, 988–1000. [CrossRef] [PubMed]
26. Lervåg, A.; Hulme, C. Rapid automatized naming (RAN) taps a mechanism that places constraints on the development of early reading fluency. *Psychol. Sci.* **2009**, *20*, 1040–1048. [CrossRef] [PubMed]

27. Ackerman, P.T.; Dykman, R.A. Phonological processes, confrontational naming, and immediate memory in dyslexia. *J. Learn. Disabil.* **1993**, *26*, 597–609. [CrossRef] [PubMed]
28. Badian, N.A. Phonemic awareness, naming, visual symbol processing, and reading. *Read. Writ. Interdiscip. J.* **1993**, *5*, 87–100. [CrossRef]
29. De Groot, B.J.; Van den Bos, K.P.; Van der Meulen, B.F.; Minnaert, A.E. Rapid naming and phonemic awareness in children with reading disabilities and/or specific language impairment: Differentiating Processes? *J. Speech Lang. Hear. Res.* **2015**, *55*, 1538–1548. [CrossRef] [PubMed]
30. Denckla, M.B. Color-naming defects in dyslexic boys. *Cortex* **1972**, *8*, 164–176. [CrossRef]
31. Fawcett, A.J.; Nicolson, R.I. Naming speed in children with dyslexia. *J. Learn. Disabil.* **1994**, *27*, 641–646. [CrossRef] [PubMed]
32. Korhonen, T.T. The persistence of rapid naming problems in children with reading disabilities: A nine-year follow-up. *J. Learn. Disabil.* **1995**, *28*, 232–239. [CrossRef] [PubMed]
33. Plaza, M.; Cohen, H. Influence of auditory–verbal, visual–verbal, visual, and visual–visual processing speed on reading and spelling at the end of Grade 1. *Brain Cognit.* **2005**, *57*, 189–194. [CrossRef] [PubMed]
34. Wimmer, H. Characteristics of developmental dyslexia in a regular writing system. *Appl. Psycholing.* **1993**, *14*, 1–33. [CrossRef]
35. López-Escribano, C. Training Reading Fluency and Comprehension of Spanish Children with Dyslexia. In *Reading Fluency*; Khateb, A., Bar-Kochva, I., Eds.; Springer International Publishing: Cham, Switzerland, 2016; pp. 141–161.
36. Catts, H.W.; Adlof, S.M.; Hogan, T.P.; Weismer, S.E. Are specific language impairment and dyslexia distinct disorders? *J. Speech Lang. Hear. Res.* **2005**, *48*, 1378–1396. [CrossRef]
37. Conti-Ramsden, G.; Durkin, K. Phonological short-term memory, language and literacy: Developmental relationships in early adolescence in young people with SLI. *J. Child Psychol. Psychiatry* **2007**, *48*, 147–156. [CrossRef] [PubMed]
38. Gorman, B.K. Relationships between vocabulary size, working memory, and phonological awareness in Spanish-speaking English language learners. *Am. J. Speech-Lang. Pathol.* **2012**, *21*, 109–123. [CrossRef]
39. Rispens, J.; Baker, A. Nonword repetition: The relative contributions of phonological short-term memory and phonological representations in children with language and reading impairment. *J. Speech Lang. Hear. Res.* **2012**, *55*, 683–694. [CrossRef]
40. Kirby, J.R.; Georgiou, G.K.; Martinussen, R.; Parrila, R. Review of research: Naming speed and reading—From prediction to instruction. *Read. Res. Q.* **2010**, *45*, 341–362. [CrossRef]
41. Torgesen, J.K.; Wagner, R.K.; Rashotte, C.A. Prevention and remediation of severe reading disabilities: Keeping the end in mind. *Sci. Stud. Read.* **1997**, *1*, 217–234. [CrossRef]
42. Bowers, P.G. Tracing symbol naming speed's unique contributions to reading disabilities over time. *Read. Writ.* **1995**, *7*, 189–216. [CrossRef]
43. Kail, R.; Hall, L.K. Speed of processing, naming speed, and reading. *Dev. Psychol.* **1994**, *30*, 949–954. [CrossRef]
44. Wimmer, H.; Mayringer, H.; Raberger, T. Reading and Dual-Task Balancing Evidence against the Automatization Deficit Explanation of Developmental Dyslexia. *J. Learn. Disabil.* **1999**, *32*, 473–478. [CrossRef] [PubMed]
45. Ziegler, J.C.; Bertrand, D.; Tóth, D.; Csépe, V.; Reis, A.; Faísca, L.; Blomert, L. Orthographic depth and its impact on universal predictors of reading a cross-language investigation. *Psychol. Sci.* **2010**, *21*, 551–559. [CrossRef] [PubMed]
46. López Escribano, C. Evaluation of the double-deficit hypothesis subtype classification of readers in Spanish. *J. Learn. Disabil.* **2007**, *40*, 319–330. [CrossRef] [PubMed]
47. Norton, E.S.; Wolf, M. Rapid automatized naming (RAN) and reading fluency: Implications for understanding and treatment of reading disabilities. *Annu. Rev. Psychol.* **2012**, *63*, 427–452. [CrossRef] [PubMed]
48. Powell, D.; Stainthorp, R.; Stuart, M. Deficits in orthographic knowledge in children poor at rapid automatized naming (RAN) tasks? *Sci. Stud. Read.* **2014**, *18*, 192–207. [CrossRef]
49. Rodríguez, C.; van den Boer, M.; Jiménez, J.E.; de Jong, P.F. Developmental changes in the relations between RAN, phonological awareness, and Reading in Spanish children. *Sci. Stud. Read.* **2015**, *19*, 273–288. [CrossRef]

50. Neuhaus, G.F.; Swank, P.R. Understanding the relations between RAN letter subtest components and word reading in first-grade students. *J. Learn. Disabil.* **2002**, *35*, 158–174. [CrossRef] [PubMed]
51. Bowers, P.G.; Wolf, M. Theoretical links among naming speed, precise timing mechanisms and orthographic skill in dyslexia. *Read. Writ.* **1993**, *5*, 69–85. [CrossRef]
52. Bowers, P.G.; Swanson, L.B. Naming speed deficits in reading disability: Multiple measures of a singular process. *J. Exp. Child Psychol.* **1991**, *51*, 195–219. [CrossRef]
53. Young, A.; Bowers, P.G. Individual difference and text difficulty determinants of reading fluency and expressiveness. *J. Exp. Child Psychol.* **1995**, *60*, 428–454. [CrossRef]
54. Wolf, M.; O'rourke, A.G.; Gidney, C.; Lovett, M.; Cirino, P.; Morris, R. The second deficit: An investigation of the independence of phonological and naming-speed deficits in developmental dyslexia. *Read. Writ.* **2002**, *15*, 43–72. [CrossRef]
55. Manis, F.R.; Doi, L.M.; Bhadha, B. Naming speed, phonological awareness, and orthographic knowledge in second graders. *J. Learn. Disabil.* **2000**, *33*, 325–333. [CrossRef] [PubMed]
56. Kohnert, K.J.; Bates, E.; Hernandez, A.E. Balancing bilinguals: Lexical-semantic production and cognitive processing in children learning Spanish and English. *J. Speech Lang. Hear. Res.* **1999**, *42*, 1400–1413. [CrossRef] [PubMed]
57. Gollan, T.H.; Montoya, R.I.; Fennema-Notestine, C.; Morris, S.K. Bilingualism affects picture naming but not picture classification. *Mem. Cognit.* **2005**, *33*, 1220–1234. [CrossRef] [PubMed]
58. Reardon, S.F.; Kalogrides, D.; Ho, A.; Shear, B.; Shores, K.; Fahle, E. Standford Educational Data Archive, 2016. Stanford Digital Repository. Available online: https://purl.stanford.edu/db586ns4974 (accessed on 31 July 2017).
59. Woodcock, R.W. *Woodcock Reading Mastery Tests, Third Edition (WRMT)*; Pearson: San Antonio, TX, USA, 2011.
60. Ehrler, D.J.; McGhee, M.L. *Primary Test of Nonverbal Intelligence (PTONI)*; Clocktower Hill Research and Publishing Group, LLC: Austin, TX, USA, 2008.
61. Dunn, L.M.; Dunn, L.M. *Peabody Picture Vocabulary Test-Fourth*; American Guidance Service: Circle Pines, MN, USA, 2007.
62. Dunn, L.; Lugo, S.; Padilla, R.; Dunn, L. *Test de Vocabulario en Imágenes Peabody. [Peabody Picture Vocabulary Test]*; American Guidance Service: Circle Pines, MN, USA, 1986.
63. Peña, E.D.; Gutiérrez-Clellen, V.F.; Iglesias, A.; Goldstein, B.A.; Bedore, L.M. *Bilingual English Spanish Assessment (BESA)*; AR-Clinical Publications: San Diego, CA, USA, 2013.
64. Petscher, Y. Do our means of inquiry match our intentions? *Front. Psychol.* **2016**, *7*. [CrossRef] [PubMed]
65. Petscher, Y.; Logan, J.A.R.; Zhou, C. Extending conditional means modeling: An introduction to quantile regression. In *Applied Quantitative Analysis in Education and Social Sciences*; Petscher, Y., Schatschneider, C., Compton, D.I., Eds.; Routledge: New York, NY, USA, 2013; pp. 3–33.
66. Peña, E.D.; Gutiérrez-Clellen, V.; Iglesias, A.; Goldstein, B.; Bedore, L.M. *BESA: Bilingual English Spanish Assessment Manual*; AR-Clinical Publications: San Rafael, CA, USA, 2014.
67. Archibald, L.M.D.; Joanisse, M.F. On the sensitivity and specificity of nonword repetition and sentence recall to language and memory impairments in children. *J. Speech Lang. Hear. Res.* **2009**, *52*, 899–914. [CrossRef]
68. Stokes, S.F.; Wong, A.M.Y.; Fletcher, P.; Leonard, L.B. Nonword repetition and sentence repetition as clinical markers of SLI: The case of Cantonese. *J. Speech Lang. Hear. Res.* **2006**, *49*, 219–236. [CrossRef]
69. De Jong, P.F. What discrete and serial rapid automatized naming can reveal about reading. *Sci. Stud. Read.* **2011**, *15*, 314–337. [CrossRef]