Expressive Language Intratest Scatter and Attention Problems of Preschool-age Children Who Stutter

Ryan A. Millager

Vanderbilt University

Author Note

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ABSTRACT

Purpose: The purpose of this study was to assess attention problems and intratest scatter (variability) of responses to standardized tests of expressive language by preschool-age children who do (CWS) and do not stutter (CWNS).

Method: Participants were 40 preschool-age CWS (30 males) and 46 CWNS (32 males). Between-group comparisons of attention were made using attention subscales of the *Child Behavior Checklist for Ages 1½ - 5* (CBCL; Achenbach & Rescorla, 2000). Likewise, between-group comparisons of intratest scatter were based on participant responses to the Expressive subtest of the *Test of Early Language Development – 3* (TELD-Exp; Hresko, Reid, & Hamill, 1999) and the *Expressive Vocabulary Test 2* (EVT-2; Williams, 2007). Furthermore, within-group assessment of the relation between CWS' scatter and their stuttering frequency was conducted.

Results: Results indicated no significant between-group differences in intratest scatter on the TELD-Exp and EVT-2, nor significant correlations between scatter and Attention Problems on the CBCL. Findings did indicate that for CWS, categorical scatter on the EVT-2 was positively correlated with their stuttering frequency.

Conclusions: Consistent with earlier findings, variability in speech-language performance appears to be related to CWS' stuttering, suggesting that perhaps some other underlying cognitive-linguistic variable (e.g., cognitive load) may be common to both variables and salient to a better understanding of developmental stuttering.

Children who stutter (CWS), when compared to children who do not stutter (CWNS), have been shown to differ with respect to attentional processes (Eggers, DeNil, & Bergh, 2010 & in press; Felsenfeld, van Beijsterveldt, & Boomsa, 2010; Heitmann, Asbjornsen, & Helland, 2004; Karrass et al., 2006). Moreover, Riley and Riley (2000) reported that pretreatment attentional difficulties were the single best predictor of poor fluency treatment outcomes for CWS, regardless of stuttering severity prior to treatment. Similarly, when monitoring the influence of attention-demanding cognitive processes on speech tasks, adults who stutter have shown greater sensitivity to interference than typically fluent adults (see Bosshardt, 2006). Foundas, Mock, Corey, Golub, and Conture (2012) found that adults who stutter were also less likely to experience benefits from wearing an altered auditory feedback device (i.e., SpeechEasy) if they scored within the clinically diagnosable range for disordered attention on a continuous performance test. Taken together, these findings suggest that differences in attentional processes are related to stuttering in both children and adults.

Interestingly, it has also been shown that CWS, when compared to CWNS, exhibit greater unevenness or dissociation on standardized measures of speech-language abilities (e.g., Anderson, Pellowski, & Conture, 2005; Coulter, Anderson, & Conture, 2009; Hall, 2004). These standardized measures require the individual taking the test to be able to adequately focus attention on specific items as well as to shift his or her attention from one test item to the next (Leonard, Weismer, Miller, Francis, Tomblin, & Kail, 2007). Therefore, if CWS' attentional resources are less robust than those of CWNS, it is possible that such differences may contribute to CWS' "uneven" performances on standardized measures of speech and language.

Such speculation regarding CWS is consistent with findings that children with specific language impairment (SLI) are also more likely to exhibit deficits in sustained attention, even in the absence of a clinically diagnosable attention disorder (Finneran, Francis, & Leonard, 2009;

Spaulding, Plante, & Vance, 2008). Discussing their findings, Spaulding et al. (2008) suggested that "differences in performance on tasks involving sustained selective attention may be, in part, a function of the task's demands on limited attentional resources" (pg. 29). It seems reasonable, therefore, to further assess the relation between attention problems and speech-language dissociations in CWS and CWNS, and whether possible between-group differences in this relation may help us better understand childhood stuttering.

Consistent with the above, Walden, Frankel, Buhr, Johnson, Karrass, and Conture (2012) recently reported a significant correlation between frequency of CWS' disfluency and expressive language unevenness, as measured by the presence of "scatter" on the expressive subtest of the *Test of Early Language Development – 3* (TELD-Exp; Hresko, Reid, & Hamill, 1999). Walden et al. (2012) operationalized scatter on the TELD-Exp as the presence of multiple basal runs of correct items separated by one or more incorrect items. Scatter has been broadly defined as an inconsistent pattern of response to items within a hierarchically organized test (Lezak, 1995), such that "a child who fails some easy items and then passes more difficult items may be considered to have intrasubtest scatter" (Dumont & Willis, 1995, pg. 272). Furthermore, there is some neuropsychological research suggesting that intratest scatter may be a valid measure of some attentional or cognitive constructs (see Godber, Anderson, & Bell, 2000).

Thus, there is some evidence that intratest scatter may be related to stuttering (Walden et al., 2012), with scatter speculated to be related to attentional constructs. Consequently, CWS' uneven performance on standardized tests of expressive language may have as much if not more to do with attention than speech-language processes, a hypothesis that would seem to be empirically testable. Moreover, it seems likely that scatter may emerge not only on the TELD-Exp, but on other tests of expressive language as well, such as the *Expressive Vocabulary Test 2* (EVT-2; Williams, 2007).

The present study was therefore designed to objectively assess attention problems as they may be related to intratest scatter of CWS and CWNS' responses to standardized tests of expressive language abilities. First, this study assessed whether CWS and CWNS differ in terms of clinically significant attention problems, based on the *Child Behavior Checklist for Ages 1 ½ - 5* (CBCL; Achenbach & Rescorla, 2000), a caregiver rating scale. It was hypothesized that the two groups would significantly differ in the CBCL's attention subscales, with CWS scoring higher than CWNS. Second, the study compared whether CWS and CWNS differ in terms of expressive intratest scatter on the TELD-Exp and EVT-2. It was hypothesized that CWS would exhibit significantly more intratest variability than CWNS on both measures. Third, the relation of intratest scatter to attention problems for both CWS and CWNS was assessed. It was hypothesized that higher attention deficit scores would be related to higher amounts of intratest scatter for both talker groups. Finally, within-group analyses were conducted relating intratest scatter scores to frequency of stuttering. The present writer hypothesized that there would be a positive correlation between CWS' scatter and their stuttering frequency.

2. Method

2.1 Participants

Participants were monolingual speakers of English, including 40 children who stutter (CWS; 30 males and 10 females, M = 46.7 months, SD = 6.4) and 46 children who do not stutter (CWNS; 32 males and 14 females, M = 46.3 months, SD = 7.3). All participants were preschool-aged (3;0-5;3 years old), with no significant between-group differences in gender, χ^2 (1, N = 86) = 0.3, p = .58, nor in chronological age, t(84) = 0.26, p = .41.

Participants' data were collected as part of a large-scale empirical investigation of linguistic and emotional contributions to developmental stuttering (e.g., Arnold, Conture, Key,

& Walden, 2011; Coulter, Anderson, & Conture, 2009; Karrass et al., 2006; Walden et al., 2012). All were paid volunteers whose parents either learned of the study from an advertisement in a free, monthly parent magazine circulated throughout Middle Tennessee, were contacted from Tennessee State birth records, or were referred to the Vanderbilt Bill Wilkerson Hearing and Speech Center for speech evaluation. Informed consent by parents and assent by children were obtained.

The Hollingshead Four-Factor Index of Social Position (Hollingshead, 1975) was used in the present study to provide a descriptive/demographic measure classifying participants' socioeconomic status (SES). This index takes into account both parents' self-reported education levels, occupation, gender, and marital status. Possible scores range from 8 to 66, with a higher score indicating a higher SES.

2.2 Classification and Inclusion Criteria

To minimize the possibility that results may be confounded by clinically-significant speech-language-hearing deficits, all participants were administered standardized measures of articulation, expressive/receptive language skills, and hearing ability. Participants were consequently excluded from the study if they scored below the 16th percentile (i.e., one standard deviation below the mean) on any of the following: a.) *Peabody Picture Vocabulary Test – Fourth Edition* (PPVT-4; Dunn & Dunn, 2007), b.) *Expressive Vocabulary Test – 2* (EVT-2; Williams, 2007), c.) the receptive and expressive subtests of the *Test of Early Language Development – 3* (TELD-Rec and TELD-Exp, respectively; Hresko et al., 1999), and d.) "Sounds in Words" subtest of the *Goldman-Fristoe Test of Articulation-2* (GFTA-2; Goldman & Fristoe, 2000). Participants were also excluded from the study if unable to perform within normal limits on a bilateral pure-tone hearing screening (ASHA, 1990). Furthermore, participants were excluded from the present

investigation if they served as participants in the Walden et al. (2012) study, as hypotheses and findings overlap between the two studies.

A child was assigned to the CWS talker group if he or she met both of the following criteria, as determined by a speech-language pathologist's assessment of the first 300 words in an unstructured conversation sample: a) three or more stutterings (i.e., sound/syllable repetitions, sound prolongations, monosyllabic whole-word repetitions, and broken words) per 100 words of conversational speech (Conture, 2001), and b) a score of 11 or greater (i.e., severity of at least "mild") on the Stuttering Severity Instrument-3 (SSI-3; Riley, 1994). A child was assigned to the CWNS talker group if he or she a) exhibited two or fewer stutterings per 100 words of conversational speech (Zebrowski & Conture, 1989) and b) received a score of 10 or lower (i.e., severity of less than "mild") on the SSI-3.

2.3 Description of dependent variables: attentional processes

2.3.1 CBCL subscales of attention

Parents completed the *Child Behavior Checklist for Ages 1 ½ - 5* (CBCL; Achenbach & Rescorla, 2000), rating aspects of children's temperament and psychopathology. The CBCL is a standardized questionnaire that consists of 100 items, each rated on a 3-point scale (0 = *not true*, 1 = *somewhat or sometimes true*, 2 = *very often or often true*). The CBCL includes an Attention Problems subscale (one of seven "syndrome scales") and an Attention-Deficit/Hyperactivity Problems subscale (one of five "DSM-oriented" scales; Achenbach & Rescorla, 2000). These two subscales are respectively comprised of 5 and 6 items, including "can't concentrate," "quickly shifts," and "can't stand waiting." In a recent study looking at attention regulation in children who stutter, Felsenfeld, van Beijsterveldt, and Boomsa (2010) reported significant differences between highly

nonfluent children and typically fluent children on the Attention Problems subscale of a version of the CBCL for older children (ages 4-18).

2.3.2 Intratest scatter of expressive language

Overall expressive language skills were measured by standard scores on the TELD-Exp, and expressive vocabulary was measured by the EVT-2. Patterns of response within these (sub)tests were evaluated for variability, discussed below as *intratest scatter*. As described immediately below, two methods for evaluating intratest scatter were applied to participants' responses on the TELD-Exp and EVT-2.

The first, a *categorical* measure of scatter, was operationalized as the presence/absence of multiple basal runs of correct items separated by one or more incorrect items. This method divides participants into two groups, children with and children without scatter (Walden et al., 2012). The TELD-Exp has a basal rule of three correct consecutive responses, and the EVT-2 has a basal rule of five correct consecutive responses, defined by respective test-makers as psychometrically significant (Hresko et al., 1999; Williams, 2007). On the TELD-Exp, then, a child would be categorized as having scatter after scoring correctly on three consecutive items, missing one or two, and then accurately responding to another three consecutive items before later hitting ceiling (1, 1, 1, 0, 1, 1, 1, 0, 0, 0).

The second method of evaluating intratest scatter was an *ordinal* measure, a means of ranking participants' scatter scores by amount of response variability, or "scatter points." As defined by Dumont and Willis (1995) and Kaplan, Fein, Morris, & Delis (1991), scatter points signify the absolute difference between consecutive item scores on a test. On the TELD-Exp, for example, if a child passes the first three items and subsequently reaches the ceiling (1, 1, 1, 0, 0, 0), the child's scatter score would equal one (i.e., one change or shift from 1 to 0, or from 0 to 1).

If, however, a child passes the first three items and then fails the fourth item, passes the fifth and sixth, and only then reaches the ceiling (1, 1, 1, 0, 1, 1, 0, 0, 0), the scatter score would be three.

2.4 Description of dependent variables: stuttering frequency

Frequency of stuttering was calculated as the mean number of stutterings per 100 words of conversational speech, as collected during the first 300 words of an unstructured conversation with the experimenter (Conture, 2001). Overall stuttering severity was also assessed by the Stuttering Severity Instrument-3 (SSI-3; Riley, 1994), which additionally considers physical concomitants and stuttering duration.

2.5 Procedure

Caregivers were interviewed for relevant information regarding family's SES, history of speech-language disorder, as well as concerns about their children's speech-language abilities. Caregivers also completed the CBCL during this time. Another examiner administered standardized tests of speech and language to the participant, as well as bilateral pure tone screenings and unstructured conversation. As mentioned above, results of this conversation were used to help determine each participant's talker group membership.

2.6 Pre-analytic and analytic considerations

Pre-analytic assessment, by means of histograms, indicated normality of distribution for standard scores on all tests of receptive and expressive language (i.e., TELD-Rec, TELD-Exp, PPVT-4, EVT-2). Similar assessment indicated non-normality of distribution for standard scores and measurements of demographics (i.e., SES and age), speech sounds (i.e., GFTA-2), fluency (i.e., SSI scores, stuttering frequency), and attention (i.e., CBCL subscales, categorical scatter, ordinal scatter). For those variables with normal distribution, appropriate parametric statistics were employed (e.g., independent samples t-test, etc.). Conversely, for those variables without normal distribution, appropriate nonparametric statistics were employed (e.g., Mann-Whitney

U test, Spearman's rho, etc.). Unless otherwise stated, all statistical analyses were performed with *IBM SPSS Statistics* software (SPSS Inc., 2010).

2.7 Inter- and intra-judge measurement reliability for intratest scatter and stuttering

Approximately twenty percent of the total final data corpus of each talker group (eight age-matched CWS and nine age-matched CWNS) was selected at random to assess inter- and intra-judge reliability for measurements of stuttering and intratest scatter.To assess inter-judge measurement reliability for stuttering frequency, the present author's measurements of the reliability sample were compared with those of other lab members (four trained graduate students of speech-language pathology). Comparison among the coders' assessments of stuttering frequency indicated strong inter-judge reliability, as determined by a Spearman's rank-order correlation, ranging from $\rho = .76$ to $\rho = .85$, mean $\rho = .81$. Comparison of the present author's initial measurements with subsequent re-measurements, taken at least one month later, also indicated strong intra-judge reliability, $\rho = .88$.

To assess the inter-judge reliability of the present author's intratest scatter measurements (categorical and ordinal), another speech-language pathology graduate student was trained to serve as a reliability coder for measurements of categorical and ordinal scatter in the reliability sample. The reliability coder was blind to talker group. Comparison between the present writer and the reliability coder's measurements for intratest scatter (average of results for TELD-Exp and EVT-2) indicated strong inter-judge reliability for categorical scatter, mean $\rho = .95$, and ordinal scatter, mean $\rho = .94$. Comparison of the present author's initial scatter measurements with subsequent re-measurements, taken at least one month later, also indicated strong intra-judge reliability for categorical scatter, mean $\rho = .89$, and categorical scatter, mean $\rho = .99$.

3. Results

3.1 Descriptive and demographic information

3.1.1 SES and demographics

Parents of most participants (N = 77, 90% of total participants) provided SES information using the Four-Factor Index of Social Status (described above; Hollingshead, 1975). Based on calculated family averages for these SES scores (see Table 1), there was no significant difference between CWS (M = 42.7, SD = 12.3) and CWNS (M = 44.9, SD = 10.5), $U(86) = 647.5$, $p = .34$, d = -0.19.

Participants' race was also obtained via parental interview. CWS and CWNS participants identified as follows: Caucasian (N = 41), African-American (N = 10), multi-racial (N = 1), and no response provided (N = 34).

3.1.2 Stuttering/speech disfluencies

As expected based on aforementioned exclusionary criteria, results of a Mann-Whitney U test (see Table 1) indicated that CWS (M = 8.6, SD = 4.9) exhibited significantly greater stuttering frequency than CWNS (M = 1.3, SD = 0.7), $U(86) = 0.00$, $p < .001$, d = 2.09. Likewise, Mann-Whitney U test results, $U(86) = 0.00$, $p < .001$, d = 2.7, indicated that CWS (M = 18.9, SD = 5.8) scored significantly higher on the SSI-3 than CWNS (M = 7.1, SD = 1.9).

3.1.3 Speech and language abilities

As indicated in Table 1, there were no significant between-group differences for the GFTA-2, EVT-2, PPVT-4, TELD-Rec, and TELD-Exp standardized tests of speech and language.

TABLE 1 ABOUT HERE

3.2 Group differences in attention

3.2.1 CBCL subscales (Attention Problems and Attention-Deficit/Hyperactivity Disorder)

The two subscales for attention deficits on the CBCL (Attention Problems and Attention-Deficit/Hyperactivity Disorder), which share a number of test items, were found to be significantly correlated for this sample as indicated by a Spearman's rho analysis, $\rho = .84$, $p < .001$. Because of this high correlation, the present study only utilized the empirically-derived Attention Problems subscale, a measure of attention thought to be reliable as well as independent of clinical diagnosis (Achenbach & Rescorla, 2000).

To assess hypothesis #1 (i.e., CWS would exhibit significantly higher attentional problems than CWNS), results of a Mann-Whitney U test indicated no significant differences between talker groups on the CBCL's Attention Problems subscale, $U(86) = 770$, $p = .63$, $d = 0.04$, indicating lack of support for hypothesis #1. However, for all children (CWS + CWNS), a significant effect on the CBCL's Attention Problems subscale was noted for gender, $U(86) = 478$, $p = .03$, $d = 0.34$, with males ($M = 2.3$, $SD = 1.8$) having higher CBCL scores than females ($M = 1.3$, $SD = 1.4$) relative to attention problems, a finding consistent with other studies (e.g., Eisenberg et al., 2001, Gaub & Carlson, 1996).

3.2.2 Measures of intratest scatter

To asses hypothesis #2 (i.e., CWS would exhibit significantly greater intratest scatter than CWNS), categorical and ordinal measures[1] of scatter were assessed separately for the TELD-Exp and the EVT-2.

[1] It will be recalled that *categorical* scatter was defined as the presence of multiple basal runs of correct items separated by one or more incorrect items. Likewise, *ordinal* scatter was defined as "scatter points," or the total of differences between consecutive item scores on a test.

Categorical scatter.

Figures 1 illustrates the percentage of categorical scatter found in each talker group. Categorical scatter was analyzed with a Pearson chi-square test. There were no significant between-group differences in categorical scatter on the TELD-Exp, χ^2 (1, N = 86) = 1.9, p = .16, nor on the EVT-2, χ^2 (1, *N* = 86) = 2.6, p = .11.

Ordinal scatter.

Figure 2 illustrates each talker group's mean ordinal scatter. To assess ordinal scatter between groups, Mann-Whitney U tests were performed for the TELD-Exp and EVT-2, U(86) = 899, p = .85, *d* = -0.03 and U(86) = 910, p = .93, *d* = -0.03, respectively. Results indicated no significant between-group differences. Hence, hypothesis #2 was not supported for categorical and ordinal scatter.

It should be noted, however, that this study's power to reject a false null hypothesis may be considered relatively low (i.e., 1 − β = 0.61), as assessed by *G*Power* freeware (Erdfelder, Faul, & Buchner, 1996). To increase power to at least a "medium" effect size (*d* = 0.5), 1 − β = 0.80, *d* = 0.5, this study would have required *N* ≥ 134 (see Cohen, 1992).

FIGURES 1 AND 2 ABOUT HERE

3.3 Correlational analyses

3.3.1 Attention versus intratest scatter

To assess hypothesis #3 (i.e., higher attention problems would be related to higher amounts of intratest scatter in both talker groups), categorical and ordinal measures of scatter on the TELD-Exp and EVT-2 were assessed separately with respect to CBCL Attention Problem

scores. Nonparametric point biserial analysis was utilized for categorical scatter, and Spearman's rho correlation analysis was used for ordinal scatter. Results (see Table 2) indicated no significant relations between measures of intratest scatter and attention, a result which was inconsistent with hypothesis #3.

*** TABLE 2 ABOUT HERE ***

3.3.2 Stuttering versus intratest scatter

To assess hypothesis #4 (i.e., greater stuttering would be related to higher amounts of intratest scatter), categorical and ordinal measures of scatter on the TELD-Exp and EVT-2 were assessed separately with respect to stuttering in CWS. Nonparametric point biserial analysis was utilized for categorical scatter, and Spearman's rho correlation analysis was used for ordinal scatter. For CWS, results (see Table 3) revealed a significant positive relation ($\rho = .33$, $p = .04$) between total number of stutterings and categorical scatter on the EVT-2, providing support for hypothesis #4. Stuttering severity, as measured by the SSI, was marginally significantly correlated to categorical scatter on the EVT-2, $\rho = .28$, $p = .08$. No other significant relationships were found between measures of intratest scatter and attention.

TABLE 3 ABOUT HERE

3.3.3 Ancillary scatter analyses

In order to investigate the possible relation of overall speech-language performance to intratest scatter, categorical and ordinal measures of scatter on the TELD-Exp and EVT-2 were

assessed separately with respect to the standard scores on each test. Nonparametric point biserial analysis was utilized for categorical scatter, and Spearman's rho correlation analysis was used for ordinal scatter. Although results (see Table 4) revealed a significant positive correlation between scatter and TELD-Exp standard scores for CWS and not CWNS, a Fisher transformation did not reveal significant difference between the two groups' correlations for categorical nor ordinal scatter, $Z = 0.66$, $p = .51$, and $Z = 1.65$, $p = .10$, respectively.

To also examine the likelihood of intratest scatter relating to the number of items given for each test, correlation analyses were additionally performed between scatter scores and total number of items administered per test. Results (see Table 4) revealed significant positive correlations between number of items administered and all ordinal scatter scores (for both CWS and CWNS), as well as with categorical scatter on the TELD-Exp.

TABLE 4 ABOUT HERE

4. Discussion

The present investigation resulted in two main findings. The first main finding was a non-significance of between-group differences for intratest scatter on the TELD-Exp and the EVT-2, as well as a lack of significant correlation between scatter and attention problems scores. The second main finding revealed that, for CWS, categorical intratest scatter on the EVT-2 was significantly correlated with stuttering frequency, as well as marginally significantly correlated with their stuttering severity. Further discussion of these and other findings follows immediately below.

4.1 No significant between-group differences in scatter or correlations with attention scores

The first main finding indicated no significant between-group differences in intratest scatter on either test of expressive language, despite hypotheses to the contrary. Likewise, scatter was not found to be significantly correlated with attention problems scores. There are at least two likely reasons for these null findings; first, it may be that the methods of operationalizing intratest scatter in the present study did not adequately capture broad trends and significant patterns in each child's responses. Using a similar measure of ordinal scatter ("scatter points") on the WAIS-R, Godber, Anderson, and Bell (2000) also found no significant difference between children with and without cranial irradiation treatment. Given findings of a significant relationship between stuttering frequency and scatter on the EVT-2 (discussed below), however, present methods appear to be at least approaching a valid quantification of scatter in CWS. Discrepancies such as these may highlight the need to better understand and standardize intratest scatter.

Second, it may be that the two talker groups truly do not meaningfully differ on intratest scatter on the TELD-Exp and EVT-2, possibly due to the psychometric properties of the tests. Both the TELD-Exp and EVT-2 have many different types of test items, and children are not timed or pressured to perform at any particular rate during administration. As such, attention problems may not greatly impact children's performance, particularly in a way that would result in consistent patterns of scatter. The TELD-Exp consists of a particularly varied sequence of both semantic and syntactic items, alternating from confrontation naming tasks, to sentence repetition tasks, to grammatical completion tasks, to other various expressive language tasks. And although the EVT-2 only targets semantic knowledge, it presents a variable sequence of prompts, progressing from the more straightforward, "What do you see?" to questions like "What's another word for 'printing'?" Although these variable test items would seem to actually

stress processes of attention focusing and attention shifting, the absence of a test-related time pressure could obscure the impact of attentional difficulties. Perhaps scatter would be better examined on a more homogenous, continuous, and rapidly-changing task, such as the Conners' Continuous Performance Test (Conners & MHS Staff, 2000) or the Attention Network Test (Fan, McCandliss, Sommer, Rz, & Posner, 2002).

4.2 CWS' correlation between stuttering frequency and categorical scatter on the EVT-2

The second main finding indicated that although mean scatter scores did not broadly differentiate the two talker groups (see above), categorical scatter on the EVT-2 was significantly positively related to stuttering frequency within the CWS group. A similar finding revealed stuttering severity to be nearly significantly correlated with scatter as well. Increased scatter may reflect subtle disturbances in CWS' developing speech-language systems, with more frequent stuttering associated with greater vulnerabilities in the ongoing accuracy of expressive language performance. Consistent with this speculation, Ntourou et al. (2011) have suggested that, "when planning/formulating sentences, CWS may experience subtle but important difficulties in quickly and efficiently encoding and retrieving lexical items" (p.174). These difficulties may manifest as intratest scatter in a testing context, and be associated with instances of stuttering in a conversational context.

Note that Walden et al. (2012) also found stuttering frequency to be correlated with categorical scatter, albeit on the TELD-Exp. Those findings were not replicated here, with significant correlations found only on the EVT-2. The present study found the amount of scatter in both talker groups to be much greater on the EVT-2 (see Figures 1 and 2), as the EVT-2 has a higher ceiling requirement of five items (rather than three), and is normed for a much broader age range than the TELD-Exp. Nevertheless, these equivocal findings warrant additional research on scatter in preschool CWS.

4.4 General discussion

As indicated by Dumont and Willis (1995), intratest scatter must be interpreted cautiously, and should not be the sole basis for clinical decision-making. Ancillary analyses for both talker groups revealed a strong positive correlation between intratest scatter and overall number of items administered during testing, indicating that scatter scores may be confounded by other variables (such as testing age, test form, and/or individual ability; see Godber, Anderson, & Bell, 2000). Other means for assessing scatter may be preferred; for example, analyzing responses to the TELD-Exp specifically by semantic and syntactic items to identify possible dissociations of language domains. It is also possible that a longitudinal, rather than cross-sectional, study of scatter and stuttering may better reveal expressive language variability with respect to CWS and CWNS' development. Other aspects of speech and language may also be considered (e.g., receptive language), as performance on these tests should also be impacted by attention processes.

Additionally, the fact that no correlations were observed between intratest scatter and attention may indicate the need for a different and/or more sensitive measure of attention, as the CBCL is designed to identify clinically significant behavior, rather than more subtle variations in attentional processes (Achenbach & Rescorla, 2000). Some findings suggest that CWS' attentional abilities are, on average, about 0.5 standard deviations below the population mean—significantly below CWNS—yet within normal limits with respect to clinical concern (e.g., Felsenfed et al., 2010). In the present study, however, CWS and CWNS did not significantly differ on the Attention Problems scale of the CBCL, further suggesting the need to develop and utilize an instrument more comprehensively targeting the theoretical construct of attention regulation.

4.5 Caveats

Although no significant between-group differences were found in age or gender, these variables may have had a subtle and confounding impact that was not assessed with this study's analytical procedures. Also, total number of items administered was found to be correlated with intratest scatter, suggesting that participants' testing age and overall test scores may also have had a confounding impact on findings. For example, younger children may reach ceiling in fewer items than an older child, with more opportunity for scatter in those children responding to more items. As such, future studies should consider scatter in relation to the quantity/quality of specific items that children respond to. Moreover, this study's sample size (N = 86) had a relatively low Power ($1 - \beta = 0.61$), indicating an increased probability of Type II error.

4.6 Conclusions

Findings from the present study indicate that intratest scatter on standardized tests of speech and language may be a viable means for considering CWS and CWNS with respect to developmental stuttering in preschoolers, with CWS' stuttering found to be significantly correlated to scatter on a test of expressive language. Findings are taken to support the importance of attentional and cognitive-linguistic processes to childhood stuttering and are consistent with other findings in this area. Variability in speech-language performance, whether measured by dissociation (e.g. Coulter, Anderson, & Conture, 2009) or intratest scatter (e.g., Walden et al., 2012), appears to be related to CWS' speech disfluencies. It may be that such findings are related to some additional underlying cognitive-linguistic variable, such as cognitive load, which may be common to both stuttering and scatter. By continuing to pursue these interconnected processes in young CWS and CWNS, we hope to further our understanding of developmental stuttering.

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TABLES AND FIGURES

Table 1

Demographic and descriptive information for preschool-age children who stutter (CWS) and children who do not stutter (CWNS).

	CWS (*N*=40)		CWNS (*N*=46)		Sig. Δ
	M	*SD*	*M*	*SD*	*(CWS vs. CWNS)*
Individual differences					
Age (months)	46.7	6.4	46.3	7.3	p=.41
SES (4-factor score)	42.7	12.3	44.9	10.5	p=.34
Speech fluency					
Mean # stutterings	8.6	4.9	1.3	0.7	p<.001*
SSI Total	18.9	5.8	7.1	1.9	p<.001*
Speech-language abilities					
TELD-Exp	107.3	13.7	111.5	11.3	p=.62
TELD-Rec	114.1	13.5	120.1	13.1	p=.35
GFTA-2	106.6	10.4	109.0	12.1	p=.22
PPVT-4	109.5	12.3	114.2	11.3	p=.65
EVT-2	112.6	11.8	118.9	10.8	p=.71
Attentional abilities					
CBCL Attention Problems	2.03	1.7	1.95	1.9	p=.63
CBCL Attention-Deficit / Hyperactivity Disorder	4.03	2.6	3.59	2.7	p=.36

Note: SES = socioeconomic status; TELD-Exp and TELD-Rec = Test of Early Language Development 3 – Expressive and Receptive subtests, respectively; GFTA-2 = Goldman-Fristoe Test of Articulation 2; PPVT-4 = Peabody Picture Vocabulary Test 4; EVT-2 = Expressive Vocabulary Test 2; CBCL = Childhood Behavior Checklist.

*=significant at 0.05 level of confidence.

Table 2

Spearman's rho correlation coefficients for categorical scatter, ordinal scatter, and attention.

	CBCL Attention Problems Subscale		
	CWS	CWNS	CWS + CWNS
TELD-Exp			
Categorical scatter, ρ (p)	-.24 (.14)	.21 (.20)	-.01 (.93)
Ordinal scatter, ρ (p)	-.15 (.37)	.004 (.98)	-.08 (.50)
EVT-2			
Categorical scatter, ρ (p)	.04 (.82)	.19 (.25)	.13 (.25)
Ordinal scatter, ρ (p)	.22 (.17)	.14 (.39)	.17 (.13)

Note: CWS = children who stutter; CWNS = children who do not stutter; TELD-Exp = Test of Early Language Development 3 – Expressive subtest; EVT-2 = Expressive Vocabulary Test 2.

Table 3

Spearman's rho correlation coefficients between measures of scatter (categorical and ordinal) and measures of stuttering severity and stuttering frequency.

	Measures of Stuttering	
	SSI score	**Mean # stutterings**
TELD-Exp		
Categorical scatter, ρ (p)	.01 (.94)	-.12 (.44)
Ordinal scatter, ρ (p)	-.05 (.78)	-.03 (.87)
EVT-2		
Categorical scatter, ρ (p)	.28 (.08)	.33 (.04)*
Ordinal scatter, ρ (p)	.02 (.89)	-.02 (.91)

Note: CWS = children who stutter; TELD-Exp = Test of Early Language Development 3 – Expressive subtest; EVT-2 = Expressive Vocabulary Test 2.

*Significant at 0.05 level of confidence.

Table 4

Nonparametric point biserial and Spearman's rho correlation coefficients for TELD-Exp and EVT-2 categorical scatter, ordinal scatter, and standard scores.

	TELD-Exp Standard Score		TELD-Exp # of Items Administered	
	CWS	CWNS	CWS	CWNS
TELD-Exp				
Categorical scatter, ρ (p)	.41 (.009)**	.28 (.06)	.45 (.005)**	.39 (.01)**
Ordinal scatter, ρ (p)	.51 (.001)**	.19 (.20)	.79 (<.001)**	.69 (<.001)**
	EVT-2 Standard Score		**EVT-2 # of Items Administered**	
	CWS	CWNS	CWS	CWNS
EVT-2				
Categorical scatter, ρ (p)	-.07 (.65)	.09 (.57)	.29 (.09)	.14 (.35)
Ordinal scatter, ρ (p)	.31 (.049)*	.45 (.002)**	.72 (<.001)**	.53 (<.001)**

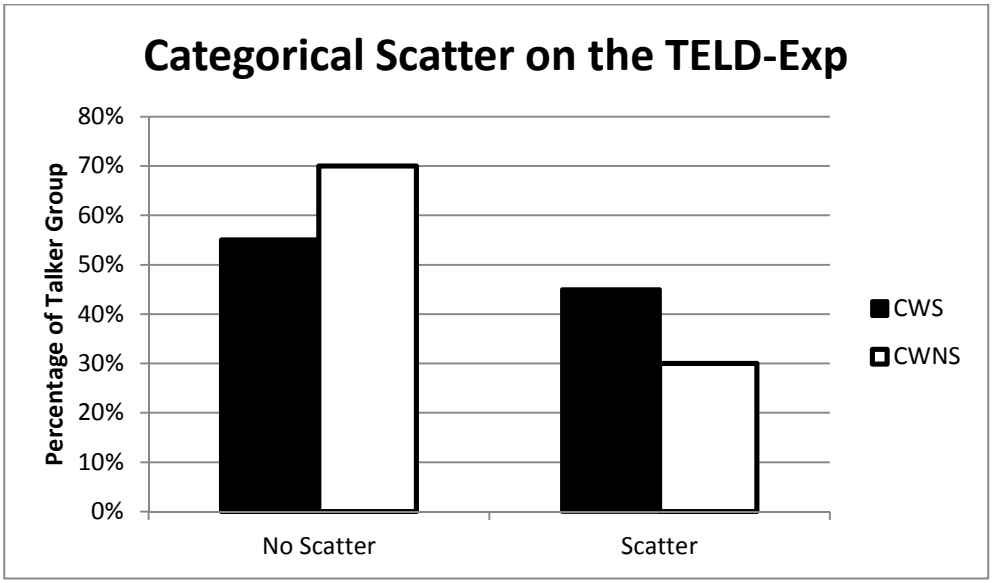
Note: CWS = children who stutter; CWNS = children who do not stutter; TELD-Exp = Test of Early Language Development 3 – Expressive subtest; EVT-2 = Expressive Vocabulary Test 2.

*Significant at 0.05 level of confidence. **Significant at 0.01 level of confidence.

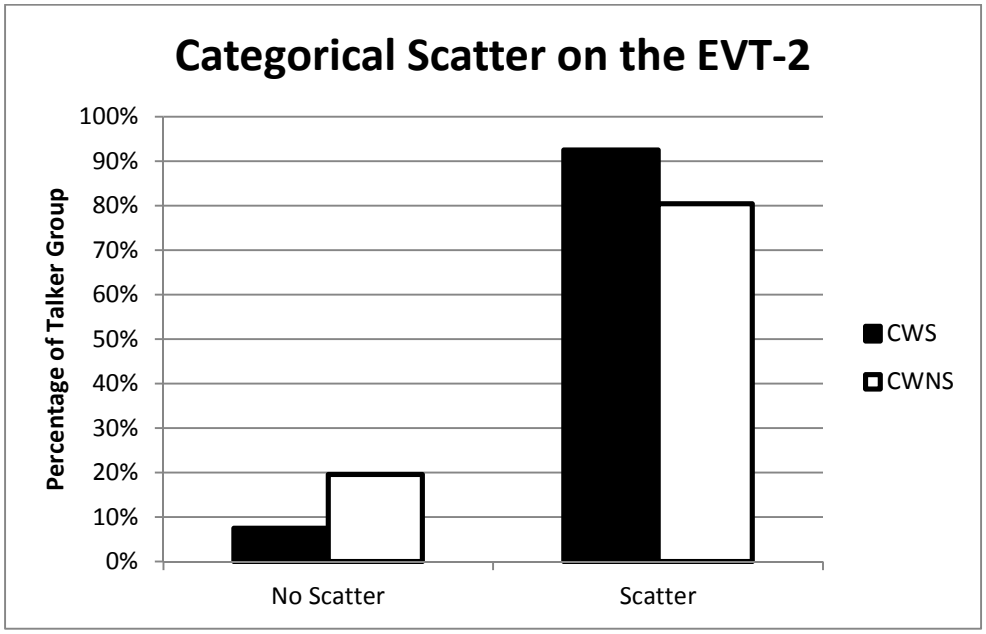
Figure 1

Percentage of talker group with categorical scatter on (A) the Test of Early Language Development 3 – Expressive subtest (TELD-Exp) and (B) the Expressive Vocabulary Test – 2 (EVT-2).

(A)



(B)

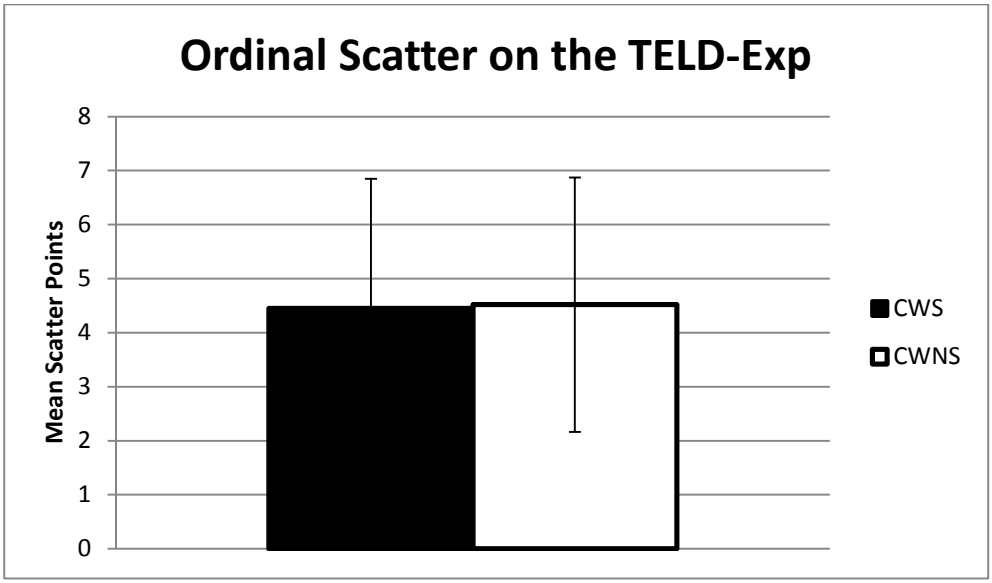


Note: CWS = children who stutter; CWNS = children who do not stutter.

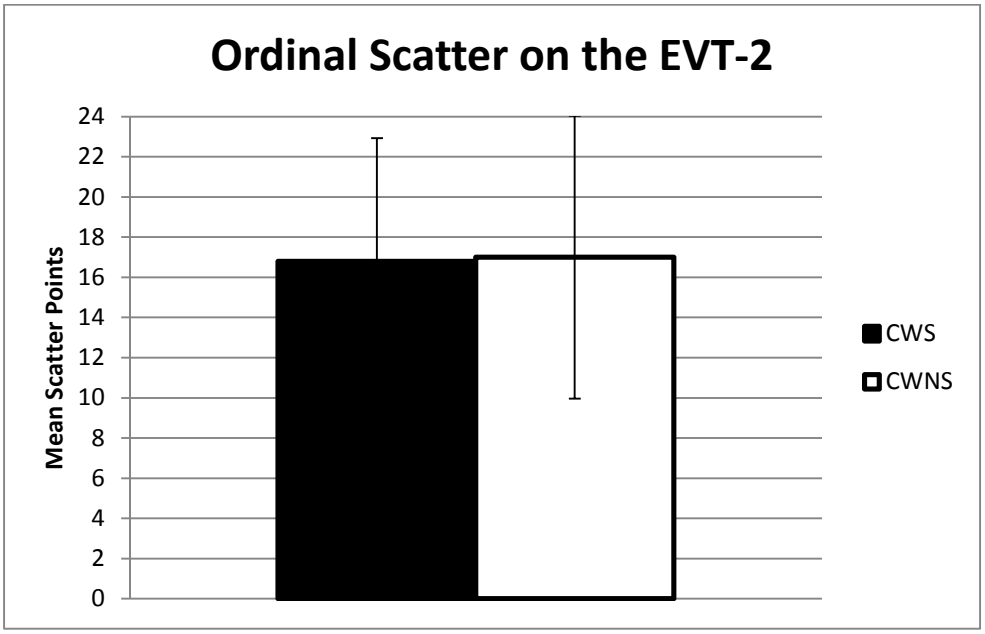
Figure 2

Mean ordinal scatter with standard deviations on (A) the Test of Early Language Development 3 – Expressive subtest (TELD-Exp) and (B) the Expressive Vocabulary Test – 2 (EVT-2).

(A)



(B)



Note: CWS = children who stutter; CWNS = children who do not stutter.

APPENDIX A

Correlations among dependent and related variables for all participants (*N* = 86; Table A1), for CWS (*N* = 40; Table A2), and for CWNS (*N* = 46; Table A3).

Table A1

Correlations (Spearman's rho or point biserial) among dependent and related variables for all participants.

	Age (months)	SSI score	Mean # stutterings	CBCL Attn. Prob.	TELD-Exp Cat. Scat.	TELD-Exp Ord. Scat.	TELD-Exp Stand. Score	TELD-Exp # items	EVT-2 Cat. Scat.	EVT-2 Ord. Scat.	EVT-2 Stand. Score	EVT-2 # items
Age (months)		.11	.06	-.04	-.09	-.19	-.35**	-.16	-.01	.03	-.21	-.08
SSI score	.11		.94**	.04	.11	-.03	-.25*	-.12	.19	.04	-.37**	-.11
Mean # stutterings	.06	.94**		.05	.09	.02	-.23*	-.09	.16	.06	-.35**	-.13
CBCL Attention Problems score	-.04	.04	.05		-.01	-.07	.001	-.15	.13	.17	-.04	.01
TELD-Exp Categorical Scatter	-.09	.11	.09	-.01		.32**	.30**	.42**	.03	-.02	.06	.18
TELD-Exp Ordinal Scatter	-.19	-.03	.02	-.08	.32**		.34**	.73**	.03	.07	.25*	.17
TELD-Exp Standard Score	-.35**	-.25*	-.23*	.001	.30**	.34**		.62**	.05	.16	.56**	.43**
TELD-Exp # items given	-.16	-.12	-.09	-.15	.42**	.73**	.62**		.08	.07	.42**	.39**
EVT-2 Categorical Scatter	-.01	.19	.16	.13	.03	.03	.05	.08		.05	-.03	.11
EVT-2 Ordinal Scatter	.03	.04	.06	.17	-.02	.07	.16	.07	.05		.36**	.53**
EVT-2 Standard Score	-.21	-.37**	-.35**	-.04	.06	.25*	.56**	.42**	-.03	.36**		.53**
EVT-2 # items given	-.08	-.11	-.13	.01	.18	.17	.43**	.39**	.11	.53**	.53**	

Note: CWS = children who stutter; CWNS = children who do not stutter; SSI = Stuttering Severity Instrument – 3; CBCL = Childhood Behavior Checklist; TELD-Exp = Test of Early Language Development 3 – Expressive subtest; EVT-2 = Expressive Vocabulary Test 2

**Significant at 0.01 level of confidence.

Table A2

Correlations (Spearman's rho or point biserial) among dependent and related variables for CWS.

	Age (months)	SSI score	Mean # stutterings	CBCL Attn. Prob.	TELD-Exp Cat. Scat.	TELD-Exp Ord. Scat.	TELD-Exp Stand. Score	TELD-Exp # items	EVT-2 Cat. Scat.	EVT-2 Ord. Scat.	EVT-2 Stand. Score	EVT-2 # items
Age (months)		.09	.08	-.06	-.17	-.10	-.26	-.13	-.21	-.19	-.18	-.24
SSI score	.09		.88**	.04	.01	-.05	-.28	-.14	.28	.02	-.42**	-.16
Mean # stutterings	.08	.88**		.14	-.12	-.03	-.27	-.18	.33*	-.02	-.48**	-.17
CBCL Attention Problems score	-.06	.04	.14		-.24	-.15	.02	-.29	.04	.22	.05	.17
TELD-Exp Categorical Scatter	-.17	.01	-.12	-.24		.44**	.41**	.45**	.07	-.10	.14	.20
TELD-Exp Ordinal Scatter	-.10	-.05	-.03	-.15	.44**		.51**	.78**	.19	.10	.39*	.41*
TELD-Exp Standard Score	-.26	-.28	-.27	.02	.41**	.51**		.69**	.11	.24	.56**	.62**
TELD-Exp # items given	-.13	-.14	-.17	-.29	.48**	.78**	.69**		.07	.03	.47**	.50**
EVT-2 Categorical Scatter	-.21	.28	.33*	.04	.07	.19	.11	.07		.29	-.07	.15
EVT-2 Ordinal Scatter	-.19	.02	-.02	.22	-.10	.10	.24	.03	.29		.31*	.71**
EVT-2 Standard Score	-.18	-.42**	-.48**	.05	.14	.39*	.57**	.47**	-.07	.31*		.67**
EVT-2 # items given	-.24	-.16	-.17	.17	.20	.41*	.62**	.50**	.15	.65**	.67**	

Note: CWS = children who stutter; CWNS = children who do not stutter; SSI = Stuttering Severity Instrument – 3; CBCL = Childhood Behavior Checklist; TELD-Exp = Test of Early Language Development 3 – Expressive subtest; EVT-2 = Expressive Vocabulary Test 2

*Significant at 0.05 level of confidence. **Significant at 0.01 level of confidence.

Table A3

Correlations (Spearman's rho or point biserial) among dependent and related variables for CWNS.

	Age (months)	SSI score	Mean # stutterings	CBCL Attn. Prob.	TELD-Exp Cat. Scat.	TELD-Exp Ord. Scat.	TELD-Exp Stand. Score	TELD-Exp # items	EVT-2 Cat. Scat.	EVT-2 Ord. Scat.	EVT-2 Stand. Score	EVT-2 # items
Age (months)		.16	-.01	-.05	-.05	-.24	-.46**	-.17	.08	.19	-.16	.03
SSI score	.16		.69**	-.08	-.08	-.02	-.03	-.13	-.02	.17	-.16	.05
Mean # stutterings	-.01	.69**		-.14	-.04	.14	.05	.02	-.13	.23	-.04	-.01
CBCL Attention Problems score	-.05	-.08	-.14		.21	.004	-.04	.02	.19	.14	-.09	-.09
TELD-Exp Categorical Scatter	-.05	-.08	-.04	.21		.23	.28	.37*	-.03	.08	.17	.19
TELD-Exp Ordinal Scatter	-.24	-.02	.14	.004	.23		.19	.67**	-.06	.03	.10	-.05
TELD-Exp Standard Score	-.46**	-.03	.05	-.04	.28	.19		.55**	.08	.07	.46**	.20
TELD-Exp # items given	-.17	-.13	.02	.02	.37*	.67**	.55**		.10	.10	.33*	.27
EVT-2 Categorical Scatter	.08	-.02	-.13	.19	-.03	-.06	.08	.10		-.06	.09	.14
EVT-2 Ordinal Scatter	.19	.17	.23	.14	.07	.03	.07	.10	-.06		.45**	.44**
EVT-2 Standard Score	-.16	-.16	-.04	-.09	.17	.10	.46**	.33*	.09	.45**		.38*
EVT-2 # items given	.03	.05	-.01	-.01	.19	-.05	.20	.27	.14	.44**	.38*	

Note: CWS = children who stutter; CWNS = children who do not stutter; SSI = Stuttering Severity Instrument – 3; CBCL = Childhood Behavior Checklist; TELD-Exp = Test of Early Language Development 3 – Expressive subtest; EVT-2 = Expressive Vocabulary Test 2

*Significant at 0.05 level of confidence. **Significant at 0.01 level of confidence.