AJSLP

Research Article

Speech-Language Dissociations, Distractibility, and Childhood Stuttering

Chagit E. Clark,[a] Edward G. Conture,[a] Tedra A. Walden,[a,b] and Warren E. Lambert[c]

Purpose: This study investigated the relation among speech-language dissociations, attentional distractibility, and childhood stuttering.
Method: Participants were 82 preschool-age children who stutter (CWS) and 120 who do not stutter (CWNS). Correlation-based statistics (Bates, Appelbaum, Salcedo, Saygin, & Pizzamiglio, 2003) identified dissociations across 5 norm-based speech-language subtests. The Behavioral Style Questionnaire Distractibility subscale measured attentional distractibility. Analyses addressed (a) between-groups differences in the number of children exhibiting speech-language dissociations; (b) between-groups distractibility differences; (c) the relation between distractibility and speech-language dissociations; and (d) whether interactions between distractibility and dissociations predicted the frequency of total, stuttered, and nonstuttered disfluencies.
Results: More preschool-age CWS exhibited speech-language dissociations compared with CWNS, and more boys exhibited dissociations compared with girls. In addition, male CWS were less distractible than female CWS and female CWNS. For CWS, but not CWNS, less distractibility (i.e., greater attention) was associated with more speech-language dissociations. Last, interactions between distractibility and dissociations did not predict speech disfluencies in CWS or CWNS.
Conclusions: The present findings suggest that for preschool-age CWS, attentional processes are associated with speech-language dissociations. Future investigations are warranted to better understand the directionality of effect of this association (e.g., inefficient attentional processes → speech-language dissociations vs. inefficient attentional processes ← speech-language dissociations).

The onset of childhood stuttering, typically between 2 and 4 years of age, coincides with significant and relatively rapid growth in children's phonology, vocabulary, morphology, and syntax (e.g., Bloodstein & Bernstein Ratner, 2008; Reilly et al., 2009; Yairi & Ambrose, 2013). Therefore, considerable attention has been paid to the relation between speech-language development and childhood stuttering (e.g., Anderson, 2007; Hakim & Ratner, 2004; Ntourou, Conture, & Lipsey, 2011; Richels, Buhr, Conture, & Ntourou, 2010; Seery, Watkins, Mangelsdorf, & Shigeto, 2007; Wagovich, Hall, & Clifford, 2009). Findings generally have shown that speech-language characteristics are related to instances, distribution, and loci of stuttering (e.g., Howell & Au-Yeung, 1995; Logan & Conture, 1997; Natke, Sandrieser, van Ark, Pietrowsky, & Kalveram, 2004; cf. Clark, Conture, Walden, & Lambert, 2013; Nippold, 2012). For example, children who stutter (CWS) tend to stutter on longer, more syntactically complex utterances (e.g., Buhr & Zebrowski, 2009; Howell & Au-Yeung, 1995; Logan & Conture, 1995, 1997; Melnick & Conture, 2000; Richels et al., 2010; Sawyer, Chon, & Ambrose, 2008; Yaruss, 1999; Zackheim & Conture, 2003). In addition, stuttering tends to increase "on function words [at the utterance-initial position] . . . across mean length of utterance (MLU) quartiles" (Richels et al., 2010, p. 325).

Empirical findings have also indicated that articulation, phonological, and language disorders are more prevalent among CWS than among children who do not stutter (CWNS; e.g., Arndt & Healy, 2001; Blood, Ridenour, Qualls, & Hammer, 2003; Yaruss, LaSalle, & Conture, 1998; cf. Nippold, 2001, 2004). Meta-analytical findings indicate that there are subtle but significant differences between the overall language abilities of CWS and CWNS (Ntourou et al., 2011). Some have reported that CWS exhibit significantly lower language performance compared with CWNS (e.g., Anderson & Conture, 2000, 2004; Bernstein Ratner & Silverman, 2000; Murray & Reed, 1977; Pellowski & Conture, 2005; Westby, 1974), whereas others have reported that CWS exhibit significantly greater language performance (e.g., Häge, 2001; Reilly et al., 2009, 2013; Watkins, 2005;

[a]Vanderbilt University, Nashville, TN
[b]Peabody College, Vanderbilt University, Nashville, TN
[c]Vanderbilt Kennedy Center, Nashville, TN
Correspondence to Chagit E. Clark: chagit.edery.clark@vanderbilt.edu

Editor: Krista Wilkinson
Associate Editor: Shelley Brundage
Received November 14, 2014
Revision received April 26, 2015
Accepted May 14, 2015
DOI: 10.1044/2015_AJSLP-14-0198

Disclosure: The authors have declared that no competing interests existed at the time of publication.

Watkins, Yairi, & Ambrose, 1999). However, some have reported no significant group differences in speech or language performance (e.g., Bernstein Ratner & Sih, 1987; Bonelli, Dixon, Bernstein Ratner, & Onslow, 2000; Clark et al., 2013; Nippold, Schwarz, & Jescheniak, 1991). Such differences in findings likely relate, at least in part, to between-studies differences in sample characteristics (e.g., age, gender, socioeconomic status [SES], and inclusion or diagnostic criteria), sample size (number of participants, ranging from seven to more than 100 per talker group), and methodologies (various formal or standardized vs. informal or nonstandardized indices of speech-language abilities).

Nevertheless, others have argued that mean speech-language differences between CWS and CWNS may not be as relevant to childhood stuttering as the congruence among subcomponents of their speech-language skills (Anderson & Conture, 2000; Anderson, Pellowski, & Conture, 2005; Coulter, Anderson, & Conture, 2009). Such incongruence—commonly labeled as *linguistic/language unevenness, imbalances, dyssynchronies, mismatches,* or *dissociations*—refers to any significant discrepancy in the development or performance of various subcomponents of speech-language planning and/or production. For example, some children might exhibit appreciably better expressive versus receptive language or better phonology versus expressive language. In the following section we further explore the concept of speech-language dissociations and their possible relation to childhood stuttering.

Speech-Language Dissociations

Speech-language dissociations are imbalances among subcomponents of speech-language planning and production. Such dissociations have been found among children with typical development as well as children with atypical development (e.g., late talkers, those with Williams syndrome) during early stages of language development (e.g., Bates, Bretherton, & Snyder, 1988; Bates, Dale, & Thal, 1995; Bates, Thal, Whitesell, Fenson, & Oakes, 1989; Hirsh-Pasek & Golinkoff, 1991). According to Anderson et al. (2005), speech-language dissociations

> "need not reflect a significant delay or disorder in one component of the system . . . . It is quite possible that dissociations could exist among components of the system even though the system is, overall, well within or even above normal limits" (p. 223).

Hall (2004) posited that "difficulties managing mismatches in language may lead to disruptions in fluency production" (p. 58). Indeed, empirical findings have shown that more preschool-age CWS tend to exhibit speech-language dissociations compared with their fluent peers, even in the absence of frank or clinically significant speech-language disorders (Anderson et al., 2005; Anderson & Conture, 2000; Coulter et al., 2009). It is interesting to note that there is no apparent pattern regarding the quality or type of dissociations. Thus, we speculate that the mere presence of speech-language dissociations might be more relevant to childhood stuttering than the quality or type of dissociations.

However, at least three issues raised by the above studies suggest that the mere presence of speech-language dissociations alone does not necessarily affect preschool-age children's speech fluency. The first issue relates to the fact that "some CWNS also exhibit dissociations in speech and language, and yet these children do not have fluency concerns" (Anderson et al., 2005, p. 246), a finding reported by other investigators as well (e.g., Boscolo, Bernstein Ratner, & Rescorla, 2002; Hall, 1996; Hall & Burgess, 2000; Hall, Yamashita, & Aram, 1993). The second issue relates to findings that CWS exhibit no apparent relation between speech-language dissociations and speech disfluencies (Anderson et al., 2005; Anderson & Conture, 2000; Coulter et al., 2009). The third issue relates to contradictory findings regarding CWNS. Some have reported that CWNS exhibiting linguistic dissociations tend to be highly disfluent (Boscolo et al., 2002; Hall, 1996, 1999; Hall & Burgess, 2000; Hall et al., 1993), whereas others have reported no apparent relation between such dissociations and measures of speech fluency exhibited by CWNS (Anderson et al., 2005; Anderson & Conture, 2000).

We speculated that at least one additional third-order variable (i.e., attention) underlies or contributes to the relation between speech-language dissociations and childhood stuttering. This speculation is consistent with Bates et al.'s (1989) account for the presence of linguistic dissociations, indicating that some language processes interact or are involved with other cognitive processes. Levelt (1983, 1989) has suggested that attention is one salient process involved in fluent speech-language production.[1] Thus, we propose that attentional processes may be one possible third-order variable that links speech-language dissociation and childhood stuttering. The focus on attention is motivated by empirical findings implicating the relevance of attention to (a) childhood stuttering (e.g., Bloodstein & Bernstein Ratner, 2008; Eggers, De Nil, & Van den Bergh, 2010, 2012; Embrechts, Ebben, Franke, & van de Poel, 2000; Felsenfeld, van Beijsterveldt, & Boomsma, 2010; Kraft, Ambrose, & Chon, 2014; Ntourou, Conture, & Walden, 2013) and (b) children's speech-language development or performance (e.g., Blair & Razza, 2007; Locke & Goldstein, 1973). The above findings are discussed in greater detail later, following a general discussion of attention.

Attentional Processes

Attentional processes encompass attention regulation, effortful control (EC; an attention-related construct), and various related networks (e.g., alerting, orienting, and executive attention; Rothbart, 2011; Rothbart & Rueda, 2005; Rueda et al., 2004; Rueda, Posner, & Rothbart, 2005),

[1]See Levelt (1983, 1989) and Levelt, Roelofs, and Meyer (1999) for a comprehensive description of how a person's attention and monitoring may be involved with his or her speech-language planning and production.

which significantly develop between 3 and 5 years of age (e.g., Berger, Kofman, Livneh, & Henik, 2007; Rothbart, 2011). Different theoretical frameworks and attentional constructs have been used to account for these various attentional processes (Buss & Plomin, 1975; Rothbart, 1981, 2011; Thomas & Chess, 1977, 1980). The present investigation focused on one attentional construct—distractibility—conceptualized and defined by Thomas and Chess (1977) as "the effectiveness of extraneous environmental stimuli in interfering with or in altering the direction of the [child's] ongoing behavior" (p. 22).

Distractibility is but one window into children's attentional processes. However, this window appears to be a reasonable, preliminary means through which to observe the relation among speech-language dissociations, attention, and childhood stuttering. Furthermore, at least one empirical study reported differences between the distractibility of CWS and CWNS (Anderson, Pellowski, Conture, & Kelly, 2003). Thus, we studied (a) whether children's distractibility (i.e., how easily extraneous stimuli divert or reallocate attention) might be associated with speech-language dissociations and (b) whether poor (i.e., too much or too little) distractibility in the presence of speech-language dissociations relates to children's speech (dis)fluency. Below we present evidence supporting the notion that attentional processes might be associated with speech-language development and childhood stuttering.

Attention and Speech-Language Development

Studies have generally shown an association between attention and various aspects of young children's speech-language abilities (e.g., Blair & Razza, 2007; Dixon & Shore, 1997; Dixon & Smith, 2000; Morales, Mundy, Delgado, Yale, Messinger, Neal, & Neal-Beevers, 2000; Morales, Mundy, Delgado, Yale, Neal, & Schwartz, 2000; Salley & Dixon, 2007; Slomkowski, Nelson, Dunn, & Plomin, 1992). For example, better attentional abilities have been found to be associated with better articulation (Locke & Goldstein, 1973) and language skills (e.g., Leve et al., 2013; Salley & Dixon, 2007) among infants, toddlers, and preschool-age children. In addition, findings reported by Millager, Conture, Walden, and Kelly (2014) may suggest a possible association between children's attention and their imbalanced performance (i.e., inconsistent response patterns) within one speech-language domain (i.e., intratest scatter). To our knowledge, there have been no published reports on the relation between the attentional processes of CWS or CWNS and their imbalanced performance across standardized speech-language measures (i.e., speech-language dissociations). Although such a relation could be inferred from the findings that attentional processes are associated with speech-language development, empirical exploration of this topic appears warranted.

Attention and Childhood Stuttering

Studies have shown a possible association between attention and the diagnosis of childhood stuttering (see the Appendix). Several researchers have compared the attentional processes of preschool-age CWS and CWNS using caregiver reports or various experimental paradigms, and findings have been inconsistent (Anderson et al., 2003; Eggers et al., 2010, 2012; Embrechts et al., 2000; Felsenfeld et al., 2010; Johnson, Conture, & Walden, 2012; Karrass et al., 2006; Schwenk, Conture, & Walden, 2007). Some have reported that CWS tend to be less distractible (e.g., Anderson et al., 2003) and exhibit poorer attention regulation compared with CWNS (e.g., Karrass et al., 2006), whereas others have reported no between-groups differences in attentional processes (e.g., Anderson & Wagovich, 2010). Such inconsistencies may relate to the methodological differences across studies (e.g., using various parent questionnaires vs. experimental paradigms), making it difficult to directly compare findings. Thus, further empirical study is warranted to better understand the association between attention and the diagnosis of childhood stuttering.

Some theorists have suggested a possible association between attention and stuttering behaviors (e.g., frequency of total, stuttered, and nonstuttered disfluencies; Levelt, 1983, 1989; Postma & Kolk, 1993; Vasiç & Wijnen, 2001). For example, Bloodstein and Bernstein Ratner (2008) hypothesized that stuttering frequency varies "with the amount of attention that stutterers give to their speech, [or] the cues that evoke stuttering" and that decreased stuttering is associated with "displacement of attention, or . . . 'distraction'" (pp. 267–268). Likewise, results of a computer simulation study suggest that increased stuttering is associated with overmonitoring or "too much attention" (Civier, Tasko, & Guenther, 2010). Although several investigators have studied the relation between attention and stuttering behaviors (e.g., frequency of disfluencies) in adults who do and do not stutter (e.g., Arends, Povel, & Kolk, 1988; Bosshardt, 2002; Bosshardt, Ballmer, & de Nil, 2002; Oomen & Postma, 2001; Vasiç & Wijnen, 2001), to our knowledge only two studies have empirically assessed the relation between attention and stuttering behaviors in preschool-age children (Kraft et al., 2014; Ntourou et al., 2013). Using parent questionnaires, Kraft et al. (2014) reported that the EC of preschool-age CWS is significantly predictive of and negatively correlated with stuttering severity.[2] These negative correlations indicate that CWS with poorer EC (associated with diminished attention regulation) tend to exhibit greater stuttering severity. These findings were taken to suggest that EC contributes to stuttering severity, and that perhaps CWS with elevated EC exhibit reduced stuttering behaviors because of their ability to flexibly focus and shift their attention, as well as inhibit or activate behavior. Using an experimental paradigm, Ntourou et al. (2013) reported that the longer CWS engaged in distraction behaviors (defined as diverting attention to something other than the experimental tasks; i.e., emotionally eliciting conditions), the less they stuttered during their narratives. This finding

[2]EC is a temperamental construct that includes attentional shifting, attentional focusing, inhibitory control, and perceptual sensitivity (e.g., Rothbart & Rueda, 2005).

suggests that the increased distractibility of CWS "facilitates their speech fluency . . . by diverting undue attention to or monitoring of their ongoing speech planning and production" (Ntourou et al., 2013, p. 270). Although these findings are intriguing, further study is warranted given that limited empirical investigations have assessed the relation between attention and stuttering behaviors of preschool-age CWS.

The Present Study: Speech-Language Dissociations, Attention, and Childhood Stuttering

The preceding review provided empirical evidence for possible associations between (a) stuttering and speech-language, (b) attention and speech-language, and (c) attention and stuttering. We propose that an association exists among the three—that is, that there is a relation among inefficient use (exerting too much or too little) of attentional resources, dissociations across speech-language abilities, and childhood stuttering. To our knowledge, no published studies have explored this topic.

Thus, the present study examined relations among speech-language dissociations, distractibility, and childhood stuttering in preschool-age CWS and CWNS. This was accomplished by first addressing between-groups differences in speech-language dissociations and distractibility (Hypotheses 1 and 2, respectively) and then addressing within-group relations among speech-language dissociations, distractibility, and speech fluency (Hypotheses 3 and 4).

The first hypothesis predicted that more CWS than CWNS exhibit dissociations. Findings supporting the first hypothesis would suggest that an association exists between childhood stuttering and speech-language dissociations, thus confirming previous findings using different samples. The second hypothesis predicted that CWS exhibit poorer distractibility scores compared with CWNS. Findings supporting the second hypothesis should help clarify whether more or less distractibility is associated with childhood stuttering (see the *Attentional Processes* section and the Appendix). The third hypothesis predicted that a relation exists among children's distractibility scores, speech-language dissociations, and the diagnosis of stuttering (i.e., CWS vs. CWNS). Findings supporting the third hypothesis should help clarify whether CWS and CWNS exhibit different relations between distractibility and frequency of speech-language dissociations. The fourth hypothesis predicted that distractibility moderates the relation between speech-language dissociations and speech disfluencies (i.e., frequency of total, stuttered, and non-stuttered disfluencies). Findings supporting the fourth hypothesis should determine whether speech-language dissociations in the presence of poor (i.e., too much or too little) distractibility affect the frequency of children's speech disfluencies. The present findings should help clarify whether distractibility moderates or is associated with the relation between speech-language dissociations and childhood stuttering.

Method

Participants

Participants included 202 monolingual, English-speaking preschool-age children (ages 3;0–5;11 [years;months])—82 CWS (65 boys, 13 girls; *M* age = 46.68 months, *SD* = 9.04) and 120 CWNS (59 boys, 61 girls; *M* age = 49.23 months, *SD* = 9.0). Data were previously collected as part of an ongoing series of empirical investigations of linguistic and emotional associates of childhood stuttering conducted by Vanderbilt University's Developmental Stuttering Project (e.g., Arnold, Conture, Key, & Walden, 2011; Choi, Conture, Walden, Lambert, & Tumanova, 2013; Clark, Conture, Frankel, & Walden, 2012; Johnson, Walden, Conture, & Karrass, 2010; Jones et al., 2014; Millager et al., 2014; Richels et al., 2010; Walden et al., 2012). Children were paid volunteers whose caregivers learned of the study from (a) a free monthly parent magazine circulated throughout middle Tennessee, (b) a local health care provider, or (c) self- or professional referral to the Vanderbilt Bill Wilkerson Hearing and Speech Center for an evaluation. Informed consent by parents and assent by children were obtained. The institutional review board at Vanderbilt University approved the procedures.

Classification and Inclusion Criteria

Participants were classified as CWS if they both (a) exhibited three or more stuttered disfluencies (SDs; i.e., sound or syllable repetitions, sound prolongations, or single-syllable whole-word repetitions) per 100 words of conversational speech (Conture, 2001; Yaruss, 1998) and (b) scored 11 or greater (i.e., severity of at least mild) on the Stuttering Severity Instrument–Third Edition (SSI-3; Riley, 1994). Participants were classified as CWNS if they both (a) exhibited two or fewer SDs per 100 words of conversational speech and (b) scored 10 or lower on the SSI-3 (i.e., severity of less than mild).[3] Children were unclassifiable if talker group membership was ambiguous on the basis of the following criteria: (a) if the child both exhibited two or fewer SDs per 100 words and scored 11 or greater on the SSI-3 or (b) if the child both exhibited three or more SDs per 100 words and scored 10 or lower on the SSI-3. Data from unclassifiable children were excluded from the final data corpus (see the Final Data Corpus section). All included CWS and CWNS had no known or reported hearing, neurological, psychological, developmental, or behavioral disorders (e.g., attention-deficit/hyperactivity disorder). Furthermore, included participants were required to have

[3]The SSI-3 does not include a *no stuttering* category; the lowest stuttering severity category on the SSI-3 is *very mild,* which corresponds to a total score of 10 or below. Thus, there could be some overlap between CWS and CWNS who fall under this category. To minimize such potential overlap, only children who scored 11 or above on the SSI-3 and exhibited three or more SDs per 100 words were classified as CWS. Only children who scored 10 or below on the SSI-3 and exhibited fewer than three SDs per 100 words were classified as CWNS.

complete data for all standardized speech-language tests as well as complete data for the Distractibility subscale of the Behavioral Scale Questionnaire (BSQ; McDevitt & Carey, 1978). To minimize the possibility that the present results may be confounded by clinically significant speech-language deficits, participants were required to score within normal limits on the standardized speech-language measures (i.e., at or above the 16th percentile).

Final Data Corpus

The initial cohort consisted of 257 children, nine of whom were removed because they were unclassifiable (see the Classification and Inclusion Criteria section). Of the remaining 248 children, 13 were excluded because one or more of their standardized speech or language scores were missing, and an additional 23 children were excluded because of missing distractibility data on the BSQ. Of the remaining 212 children, 10 were excluded because they exhibited speech-language scores below the 16th percentile or approximately 1 *SD* below the mean. These procedures resulted in 202 participants (82 CWS, 120 CWNS) being analyzed in the present study.

Standardized Measures of Speech and Language Abilities

Four standardized speech-language tests assessed participants' articulation, receptive and expressive vocabulary, and language abilities. Each measure is described in the sections below.

Measure of Speech Sound Articulation Abilities

The norm-referenced Sounds in Words subtest of the Goldman-Fristoe Test of Articulation–Second Edition (GFTA-2; Goldman & Fristoe, 2000) assessed participants' spontaneous articulation of consonant sounds in response to pictures. Higher standard scores indicate better articulation abilities. The GFTA-2 was standardized on 2,350 participants between ages 2;0 and 21;11. It has a reliability of $\alpha = .94$ for boys and men and $\alpha = .96$ for girls and women and a test–retest reliability of $\alpha = .98$ for sounds across initial, medial, and final positions.

Measures of Receptive and Expressive Vocabulary Skills

The Peabody Picture Vocabulary Test–Third Edition (PPVT-3; Dunn & Dunn, 1997) and the Expressive Vocabulary Test (EVT; Williams, 1997) measured participants' receptive and expressive vocabulary skills, respectively. Higher scores on each test suggest better receptive and expressive vocabulary skills. These measures were standardized on 2,725 participants between ages 2.5 and 90 years. The PPVT-3 and EVT have internal consistencies of $\alpha = .95$ and test–retest reliabilities of $\alpha = .92$ and $\alpha = .84$, respectively.

Measures of Receptive and Expressive Language Abilities

The Test of Early Language Development–Third Edition (TELD-3; Hresko, Reid, & Hammill, 1999) Receptive and Expressive subtests measured participants' language comprehension and oral communication, respectively, through a variety of tasks (e.g., follow directions, identify correctness of grammatical structures, answer questions, and generate complex sentences). Higher scores on the TELD-3 suggest better language skills. The TELD-3 was standardized on 2,217 children between ages 2;0 and 7;11. It has a coefficient $\alpha = .92$ and test–retest reliability of $\alpha = .87$ for both subtests combined.

Measurement of Speech Fluency

Participants' speech fluency was measured with respect to frequency, type, and severity of stuttering, as described below. Values were derived from a 300-word conversational speech sample obtained through child–examiner free play and the SSI-3.

Types of Disfluencies

Participants' speech disfluencies were categorized as stuttered or nonstuttered. SDs include sound and syllable repetitions (e.g., "s-s-s-sorry"), single-syllable whole-word repetitions (e.g., "the-the-the"), and sound prolongations (e.g., "ssssorry").[4] Nonstuttered disfluencies (NSDs) include interjections (e.g., "um"), phrase repetitions (e.g., "I want to I want to"), and revisions (e.g., "I'm going to the store the restaurant").

Frequency of Total Disfluencies, SDs, and NSDs

Frequency of total disfluencies (TD) was calculated by dividing the total number of all speech disfluencies (stuttered plus nonstuttered) by the total number of words produced (TW). Frequency of SDs was calculated by dividing the total number of SDs by the TW. Frequency of NSDs was calculated by dividing the total number of NSDs by the TW.

Stuttering Severity

Participants' stuttering severity was determined by the SSI-3, a criterion-referenced measure assessing stuttering frequency, duration, and physical concomitants. Examiners adhered to the administration procedures stipulated in the test manual.

[4]According to the SSI-3 manual, single-syllable whole-word repetitions produced "without tension are not counted as stuttering. Repetition of one-syllable words may be stuttering if the word sounds abnormal (e.g., shortened, prolonged, staccato, tense); however, when these single-syllable words are repeated but are otherwise spoken normally, they do not qualify as stuttering" (Riley, 1994, p. 4). Thus, in the present study, only perceptually "abnormal (shortened, prolonged, staccato, tense, etc.)" single-syllable whole-word repetitions were counted as SDs. Perceptually effortless, nontense repetitions of single-syllable whole words, such as those produced for emphasis (e.g., the child says, "It was a *big, big* dog," while gesturing how large the dog was), were not counted as SDs or NSDs and were excluded from the fluency data. Other stuttering classification schemes, some of which exclude whole-word repetitions from the SD category, have been reportedly used when assessing older, school-age children and adults who stutter (e.g., Howell, Bailey, & Kothari, 2010; Jiang, Lu, Peng, Zhu, & Howell, 2012).

Measure of Attentional Distractibility

The BSQ is a 100-item parent questionnaire that assesses temperamental characteristics of 3- to 7-year-old children along nine dimensions: (a) activity level, (b) adaptability, (c) approach–withdrawal, (d) mood, (e) intensity, (f) distractibility, (g) attention span and persistence, (h) sensory threshold, and (i) rhythmicity (McDevitt & Carey, 1978). This instrument requires parents to rate how frequently they observe given behaviors in their children (1 = *almost never,* 6 = *almost always*). The BSQ was normed on a relatively large sample of children (175 boys, 175 girls) and has excellent test–retest (α = .89) and split–half (α = .84) reliabilities on the basis of samples of 53 and 350 children, respectively.

For the present study, participants' distractibility was measured using the 10-item Distractibility subscale of the BSQ, which has a test–retest reliability of α = .82 and split–half reliability of α = .70.[5,6] This subscale measures how easily extraneous stimuli divert a child's attention from a particular task or behavior (BSQ sample item: "The child stops an activity because something else catches his or her attention"). As in Anderson et al.'s (2003) study, raw distractibility scores were converted to *z* scores. Greater or positive *z* scores suggest that the child is more easily distracted by irrelevant stimuli. In contrast, lower or negative distractibility *z* scores suggest that the child is less easily distracted by irrelevant stimuli.

Measures of Speech-Language Dissociations

The present study replicated correlation-based analytical methods (Anderson et al., 2005; Bates, Appelbaum, Salcedo, Saygin, & Pizzamiglio, 2003; Coulter et al., 2009) to identify the presence of speech-language dissociations among preschool-age CWS and CWNS. This four-step procedure was chosen for its stringent criteria for assessing true dissociations. Such criteria "tend to be more conservative than methods which assume independence [among measures] (i.e., the latter identify fewer cases as 'dissociated')" (Bates et al., 2003, p. 1148), thus reducing the risk of false positives (i.e., detecting dissociations by chance) and false negatives (i.e., missing true dissociations). False positives are especially salient to the present study because speech-language measures tend to be highly correlated (see Table 1), although not necessarily reflecting true dissociations.[7] Below is a description of this four-step procedure and the three measures resulting from this procedure: (a) number of children exhibiting dissociations, (b) number of dissociations, and (c) magnitude of dissociations. See Figure 1 for an illustration of this procedure (including a scatter plot, density ellipsoid, and linear fit line) using data from the present study.

Measures of Speech-Language Dissociations: Correlation-Based Procedure

Step 1: Transform standard scores into z *scores.* Participants' standard scores on each of the five speech-language (sub)tests (i.e., GFTA-2, PPVT-3, EVT, TELD-3 Receptive, and TELD-3 Expressive) were transformed to *z* scores representing the number of *SD*s from the mean. For example, children received a *z* score of 0 if they scored at the mean on a standardized speech-language test. Those who scored 1 *SD* above the mean on the standardized test received a *z* score of +1. Those who scored 1 *SD* below the mean on the standardized test received a *z* score of −1.

Step 2: *Run correlations and create scatter plots.* Ten separate correlations were applied to participants' *z* scores —one for each combination or pair of speech-language measures: (a) PPVT-3 versus EVT, (b) PPVT-3 versus GFTA-2, (c) PPVT-3 versus TELD-3 Receptive, (d) PPVT-3 versus TELD-3 Expressive, (e) TELD-3 Receptive versus TELD-3 Expressive, (f) EVT versus TELD-3 Receptive, (g) EVT versus TELD-3 Expressive, (h) GFTA-2 versus EVT, (i) GFTA-2 versus TELD-3 Receptive, and (j) GFTA-2 versus TELD-3 Expressive. For each correlation, scatter plots with linear fits were generated to illustrate the association among speech-language scores.

Step 3: Superimpose density ellipses on the scatter plots. For each correlation, density ellipses were constructed and superimposed on the scatter-plots. Ellipses were first created for CWNS using a confidence interval (CI) of 95% and were then applied to the data for CWS. Thus, the 95% of cases falling within the ellipses represent the "typical" population (i.e., on the basis of CWNS exhibiting the typical relation between speech-language measures) and were the basis for comparing the presence of dissociations between CWS and CWNS.[8] Visual inspection of the scatter plots with density ellipses helped identify the outliers. Outliers represent the 5% of participants who fall outside of the ellipses, exhibiting potential dissociations between two speech-language measures (Bates et al., 2003; Saygin, Dick,

[5]The 10-item Attention Span/Persistence subscale of the BSQ was not analyzed in the present study given its poor internal consistency using present data (α = .53), which is roughly consistent with McDevitt and Carey (1978; α = .6).

[6]Comparable psychometric properties for the Distractibility subscale have been reported elsewhere for both typical (Baydar, 1995; McDevitt & Carey, 1996) and atypical (Hepburn & Stone, 2006) populations.

[7]The statistical procedure developed by Bates et al. (2003) "takes the means and standard deviations of the population into account, along with the correlation between behavioral measures [i.e., the relation among the standardized speech-language measures] . . . . If the correlation between two measures is low, then there will be little difference in outcomes between this correlation technique and those that assume measurement independence. [However] if the correlation between two measures is high, as is often the case with speech-language measures, then this correlation-based technique will increase the probability of finding dissociations that may be of interest theoretically" (Anderson et al., 2005, p. 224).

[8]"The probability of a proposed dissociation in a single clinical population can be evaluated by comparing the clinical population with a normal control population on several behavioral measures (Bates et al., 2003)" (Anderson et al., 2005, p. 221).

Table 1. Pearson product–moment correlations across speech-language domains for preschool-age children who stutter (CWS; n = 82; 65 boys, 17 girls) and children who do not stutter (CWNS; n = 120; 59 boys, 61 girls).

Speech-language domain	r value (p value) CWS	r value (p value) CWNS
Vocabulary		
PPVT-3 vs. EVT	.540* (< .001)	.604* (< .001)
Language		
TELD-3 Receptive vs. TELD-3 Expressive	.430* (< .001)	.427* (< .001)
Language and vocabulary		
TELD-3 Expressive vs. PPVT-3	.388* (< .001)	.377* (< .001)
TELD-3 Expressive vs. EVT	.476* (< .001)	.488* (< .001)
TELD-3 Receptive vs. PPVT-3	.388* (< .001)	.339* (< .001)
TELD-3 Receptive vs. EVT	.505* (< .001)	.381* (< .001)
Articulation and vocabulary		
GFTA-2 vs. PPVT-3	.176 (.176)	.251* (.006)
GFTA-2 vs. EVT	.122 (.272)	.333* (< .001)
Articulation and language		
GFTA-2 vs. TELD-3 Receptive	.144 (.193)	.327* (< .001)
GFTA-2 vs. TELD-3 Expressive	.414* (< .001)	.348* (< .001)

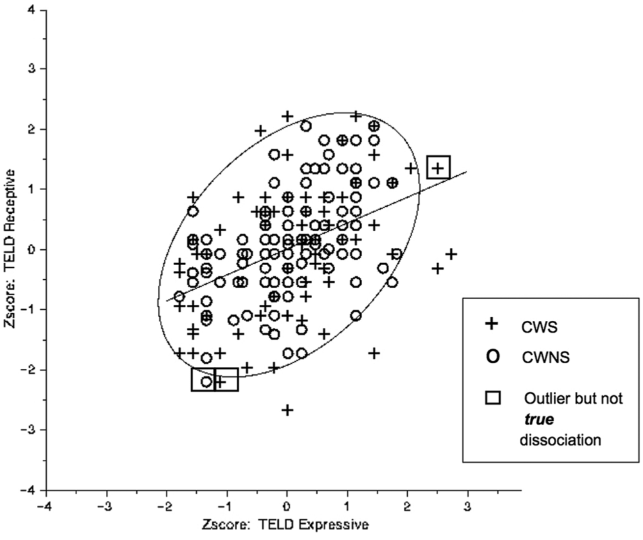
Note. PPVT-3 = Peabody Picture Vocabulary Test–Third Edition; EVT = Expressive Vocabulary Test; TELD-3 = Test of Early Language Development–Third Edition; GFTA = Goldman-Fristoe Test of Articulation–Second Edition.

*Asterisks indicate significant p values.

Wilson, Dronkers, & Bates, 2003). It is important to note that not all outliers represent true dissociations.

Step 4: Identify true dissociations. To quantify true dissociations, participants were required to meet both of the following criteria (Anderson et al., 2005; Bates et al., 2003; Coulter et al., 2009): (a) fall outside the correlation ellipsoid (i.e., the 5% of outliers) and (b) exhibit at least "1 *SD* difference between the two measures" (Coulter et al., 2009, p. 262). Thus, children with true dissociations represent extreme cases in which Y is abnormally low for X, even if they perform near or above the group mean (i.e., within or above the normal limits) on both measures (Bates et al., 2003).

Figure 1. Sample relation between two speech-language measures (i.e., Test of Early Language Development–Third Edition [TELD-3] Receptive and Expressive) using Bates et al.'s (2003) correlation-based method. Scatter plot and density ellipsoid are based on data from the present study. CWS = children who stutter; CWNS = children who do not stutter.



Measures of Speech-Language Dissociations

The above procedures produced three measures of linguistic dissociations: (a) number of children exhibiting dissociations, (b) number of dissociations, and (c) mean magnitude of dissociations. For both number of children exhibiting dissociations and number of dissociations, we categorized dissociations into three types: (a) total, (b) language only, and (c) speech-language only. *Total dissociations* refers to all of the dissociations exhibited in speech and/or language (sub)domains. *Language-only dissociations* refers to dissociations in the vocabulary and language (sub)tests (i.e., PPVT-3, EVT, TELD-3 Receptive, and TELD-3 Expressive). *Speech-language–only dissociations* refers to dissociations in articulation versus vocabulary and/or articulation versus language (sub)tests (i.e., GFTA-2 vs. PPVT-3, EVT, and TELD-3 Receptive and Expressive).

Number of children exhibiting dissociations served as a general index of the presence or absence of speech-language dissociations—that is, how many CWS and CWNS did and did not exhibit true dissociations across subcomponents of their speech-language abilities. As previously mentioned, this measure was separated into three categories (total, language only, and speech-language only), allowing us to assess the number of children exhibiting specific types of dissociations.

Number of dissociations served as an index of the frequency of dissociations and is specific only to children with dissociations. As previously mentioned, this measure was separated into three categories (total, language only, and speech-language only), allowing us to assess the number of dissociations children exhibited per category.

Mean magnitude of dissociations served as an index of how largely dissociated children's abilities are in speech-language subtests or domains. This measure was derived as follows: After converting participants' standard speech-language scores into *z* scores, difference scores (henceforth referred to as *z score differences*) were calculated by subtracting *z* scores in each of the 10 pairs of speech-language measure (e.g., PPVT-3 vs. EVT; TELD-3 Receptive vs. TELD-3 Expressive). For example, a child with a *z* score of +1 on the PPVT-3 and −1 on the EVT received a *z* score difference of 2 between these two measures. Thus, each child had a total of 10 *z* score differences—one for each pair of speech-language subtests. Participants' mean magnitude of dissociations was calculated by averaging their absolute value of *z* score differences across all 10 combinations of speech-language measures.[9] For example, a child with a *z* score difference of 2 between the TELD-3 Receptive and the TELD-3 Expressive, a *z* score difference of 1 between the PPVT-3 and the EVT, and a *z* score difference of 5 between the GFTA-2 and the EVT (i.e., [2 + 1 + 5]/3) will have a mean magnitude of dissociations of 2.67 across these domains.

Procedures

Parent Interview

Parents completed the BSQ prior to their interview at Vanderbilt University's Developmental Stuttering Lab. Information was obtained regarding family history of speech-language and fluency disorders as well as caregivers' concerns about their children's speech-language abilities (for this interview process, see Conture, 2001). In addition, participants' SES data were gathered.

SES data were classified using the Hollingshead Four-Factor Index of Social Position (Hollingshead, 1975), a measure based on the U.S. Census. This index takes into account both parents' educational levels, occupation, gender, and marital status. SES scores range from 8 to 66, with higher scores representing a higher SES.[10] A score of 8 reflects the lowest possible level of occupational status (e.g., dishwashers) and education (less than seventh grade), whereas a score of 66 reflects the highest level of occupational status (e.g., aeronautical engineer) and educational level (graduate education). See Richels, Johnson, Conture, and Walden (2013) for further information regarding the possible association of SES, parental education, and childhood stuttering.

Child Testing

Testing was conducted in a laboratory environment. While one examiner conducted the parent interview, another engaged the child in conversation during free play, from which measures of speech fluency were obtained (see the *Measurement of Speech Fluency* section). Participants were then administered the GFTA-2, PPVT-3, EVT, and TELD-3 to assess their articulation, receptive and expressive vocabulary, and receptive and expressive language, respectively. Examiners adhered to the administration procedures stipulated in the test manuals. Standardized testing was followed by the administration of bilateral, pure-tone, and tympanometric hearing screenings. All audiometric equipment was routinely calibrated.

Although testing procedures might have introduced an element of fatigue to some of the tests administered later (e.g., TELD-3), these procedures were constant for all participants in both talker groups. Furthermore, our experience using these standardized tests with preschool-age children has shown that the above procedures maximize the chance that the greatest number of preschool-age children will complete all speech-language testing. Perhaps more children complete this testing procedure because it begins with a relatively simple task (i.e., conversation during free play), which gradually increases in complexity (i.e., from single-word picture-naming [GFTA-2] to more complex language elicitation [TELD-3]), and ends with another simple task (i.e., a hearing screening requiring children to raise a hand when they hear a beep).

Data Analyses

Talker Group Characteristics

Speech fluency characteristics. Prior to testing the main hypotheses, generalized linear models (GLMs; Nelder & Wedderburn, 1972) assessed differences between CWS and CWNS in speech fluency (i.e., SSI-3 scores and frequency of SDs, NSDs, and TDs).[11] GLM was chosen because the present study's speech disfluency data followed a negative binomial distribution (similar to Clark et al., 2013, and Tumanova, Conture, Walden, & Lambert, 2014).[12] See Gardner, Mulvey, and Shaw (1995) for more detailed statistical illustrations and explanations of GLM and negative binomial distributions.

Age, gender, SES, and speech-language characteristics. A series of analyses was performed to describe the age, gender, SES, and speech-language characteristics of the CWS and CWNS samples. With the exception of gender, all

[9]Note that the denominator was fixed (i.e., 10) for all children, representing the 10 combinations of speech-language measures. This was also done for children exhibiting fewer than 10 dissociations across the speech-language measures.

[10]Weighted family SES scores were calculated by multiplying the occupation scale score by a weight of 5 and the education scale score by a weight of 3 (Hollingshead, 1975).

[11]Generalized linear models allow one to analyze dependent variables that follow various distributions (e.g., binary, Poisson, or negative binomial), including count data that are not normally distributed (Nelder & Wedderburn, 1972). According to Gardner et al. (1995), "The GLM should not be confused with the general linear model [i.e., ANOVA] described by Cohen (1968) . . . . The latter statistical model is a generalization of multivariate and univariate regression with normally distributed errors" (p. 395).

[12]Nonnormality of distribution was determined by graphical descriptive analysis of the data (i.e., histogram) as well as results of the Shapiro–Wilk test of normality ($p < .001$ for all disfluency measures). Negative binomial is a type of a Poisson regression with overdispersion (e.g., a long right-hand tail).

of the sample characteristics followed normal distributions and allowed for parametric assessment.

A chi-square analysis assessed between-groups gender differences (given the nonnormal categorical nature of the data). A series of analyses of variance (ANOVA) assessed between-groups differences regarding other sample characteristics (e.g., age, SES, TELD-3). Because multiple significance tests may yield false (i.e., significant) results by chance, a bootstrap resampling with replacement procedure (Efron, 1993) was used for multiple tests, with a familywise false discovery rate of $p < .05$ (Benjamini & Hochberg, 1995; Hochberg, 1988). Resampling makes no assumptions about normality or independence. This was done using SAS PROC MULTTEST (Westfall, Tobias, & Wolfinger, 1999). Characteristics that significantly differed between the groups were included as covariates or factors in subsequent statistical models.

Hypotheses

Hypothesis 1: More preschool-age CWS exhibit speech-language dissociations compared with CWNS. To test the first hypothesis, a chi-square analysis assessed between-groups differences in the number of children exhibiting dissociations—that is, whether significantly more CWS than CWNS exhibited dissociations among subcomponents of their speech-language skills. Three ancillary analyses related to Hypothesis 1 were performed only for children who exhibited one or more speech-language dissociations: (a) age and gender differences in speech-language dissociations, (b) between-groups differences in the number of dissociations, and (c) between-groups differences in the mean magnitude of dissociations. Nonparametric procedures were used for the ancillary analyses given the nonnormal distribution of the dependent variables (e.g., gender, number and magnitude of dissociations) and to account for the relatively small samples of CWS and CWNS exhibiting dissociations. Chi-square analyses examined between-groups gender differences; a Mann–Whiney *U* test assessed between-groups differences in chronological age and magnitude of dissociations; and GLMs for negative binomial distributions assessed between-groups differences in number of dissociations.

Hypothesis 2: CWS exhibit poorer distractibility compared with CWNS. To test the second hypothesis, an ANOVA assessed between-groups distractibility differences. Talker group characteristics that significantly differed between CWS and CWNS were included in the model as covariates or factors to account for competing explanations for present results.

Hypothesis 3: Distractibility is associated with speech-language dissociations. To test the third hypothesis, Spearman's rank correlations were used to determine whether participants' distractibility scores were associated with measures of speech-language dissociations (i.e., magnitude of dissociations as well as frequency of total, speech-language–only, and language-only dissociations; see the *Measures of Speech-Language Dissociations* section). Separate within-group correlations were conducted for (a) CWS only who exhibited at least one dissociation and (b) CWNS only who exhibited at least one dissociation. Between-groups comparisons assessed whether the talker groups significantly differed in their respective correlations. These comparisons were done by Fisher's *r*-to-*z* transformations (Preacher, 2002) and visual inspection of the standard error bars surrounding each of the correlations (Cumming & Finch, 2005).[13] Between-groups differences were considered significant if Fisher's *r*-to-*z* transformation resulted in *z* scores greater than $|1.96|$ (Preacher, 2002) and if there was no overlap between the standard error bars surrounding the correlations of the two groups (Cumming & Finch, 2005).[14]

Hypothesis 4: Distractibility moderates the relation between speech-language dissociations and speech fluency. To test the fourth hypothesis, GLMs for negative binomial distributions assessed whether interactions between children's distractibility and frequency of dissociations predict the frequency of SDs, NSDs, and/or TDs. Talker group characteristics that significantly differed between CWS and CWNS were included in the statistical model.

For the above analyses, estimates of effect size were expressed in partial eta squared (η_p^2), Spearman's rho (ρ), beta weights (β), *d,* or *w* (Cohen, 1988, 1992), depending on the statistical procedure used. Recommended interpretations for the effect sizes were assumed (i.e., $d = 0.2$, 0.5, and 0.8 for small, medium, and large effects, respectively; $\eta_p^2 = .01$, .06, and .14 for small, medium, and large effects, respectively; $w = .1$, .3, and .5 for small, medium, and large effects, respectively; Cohen, 1973, 1988, 1992; Ferguson, 2009; UCLA Statistical Consulting Group, n.d.; Volker, 2006). Where possible, a 95% CI for each effect size is reported "to indicate the precision of estimation of the effect size" (American Psychological Association, 2010, p. 34). Analyses were performed in JMP Version 10 (Sall, Creighton, & Lehman, 2005) and SPSS Version 21.0.

Statistical Power

A Cohen-based power analysis (Cohen, 1988, 1992) was performed using PASS software (Hintze, 2008) for two-groups comparisons (i.e., Hypotheses 1 and 2). Power was evaluated by estimating the minimum detectable effect size (Kraemer, Mintz, Noda, Tinklenberg, & Yesavage, 2006). Traditional criteria were assumed ($p < .05$; two tailed; power = 80%; and Cohen's effect size guidelines, e.g., $d = 0.2$, 0.5, and 0.8 for small, medium, and large effects, respectively).

The results of the power analysis indicated that between-groups analyses (i.e., hypotheses 1 and 2) with two groups

[13]See Cumming and Finch (2005) for a detailed explanation of "inference by eye" to interpret between-groups differences in CIs and standard error bars on graphical illustrations.

[14]"For a comparison of two independent [samples], $p < .05$ when the gap between the standard error bars is at least about the size of the average standard error—that is, when the proportion gap is about 1 or greater . . . . In addition, $p < .01$ when the proportion gap is about 2 or more" (Cumming & Finch, 2005, p. 177).

(N = 202; 82 CWS, 120 CWNS) using a standardized outcome (M = 0, SD = 1) could detect effects as small as Cohen's d = 0.4 *SD*s with 80% power. Thus, the present study was sufficiently powered to detect small to medium effects (Cohen, 1992).

Interjudge Reliability for Measurement of Speech Disfluencies

Intraclass correlation coefficients (McGraw & Wong, 1996; Shrout & Fleiss, 1979) using the absolute agreement criterion assessed interjudge agreement for SDs, NSDs, and TDs. Four examiners trained in assessing stuttering measured disfluencies in real time while watching randomly selected video-recorded speech samples (obtained during child–clinician conversations in free play).

Assessment of interjudge agreement was based on approximately 16% (n = 32; 14 CWNS, 18 CWS) of participants' video-recorded, 300-word conversational speech samples. Intraclass correlation coefficients ranged from .95 to .97 (M = .96), with average measures of .989, p < .001, for identification of SD; from .82 to .89 (M = .86), with average measures of .955, p < .001, for identification of NSD; and from .94 to .97 (M = .96), with average measures of .987, p < .001, for identification of TD. The above reliability values exceed the popular criterion of .7 (Yoder & Symons, 2010).

Results

Talker Group Characteristics

Table 2 shows participants' age, gender, SES, and speech-language and fluency characteristics.

Speech Fluency Characteristics

As would be expected on the basis of talker group classification, preschool-age CWS, compared with CWNS, exhibited significantly more TDs, Wald $\chi^2(1, 200) = 56.18$, p < .001, $\beta = -1.098$, and SDs per 100 words, Wald $\chi^2(1, 200) = 167.97$, p < .001, $\beta = -1.975$. Consistent with these findings, CWS exhibited significantly higher mean scores on the SSI-3, Wald $\chi^2(1, 200) = 46.09$, p < .001, $\beta = -1.016$. There was no significant group difference in NSDs per 100 words. All of the above β values (i.e., an estimate of effect size) for speech disfluencies indicated strong effects, with the exception of NSD, with a β value of −0.286, which is "minimum [but] 'practically' significant . . . for social science data" (Ferguson, 2009, Table 1).

Age, Gender, and SES Characteristics

No between-groups differences were found for chronological age (p = .051, η_p^2 = .019; p = .26, bootstrapped) or SES (p = .579, η_p^2 = .002; p = .995, bootstrapped). Thus, further consideration for these characteristics did not appear warranted. There was a moderate between-groups gender effect, $\chi^2(1) = 18.621$, p < .001, w = .304, indicating that the sample consisted of more boys who stutter than girls who stutter (CWS = 17 girls, 65 boys; CWNS = 61 girls, 59 boys). Gender differences are expected because more boys stutter than girls (Bloodstein & Bernstein Ratner, 2008, Table 3-1). Thus, gender was included as a factor in subsequent statistical models to account for its possible effects on present results.

Speech and Language Characteristics

Using the bootstrap resampling with replacement procedure (Efron, 1993; see the *Talker Group Characteristics* section), no between-groups speech and language differences reached significance (*p*s ranged from .012 to .578; bootstrapped *p*s ranged from .071 to .995). In addition, the effect sizes were small, with η_p^2 ranging from .002 to .031. Therefore, these between-groups speech and language differences did not appear to warrant further consideration.

Hypothesis 1: Between-Groups Differences in the Number of Participants Exhibiting Speech-Language Dissociations

A 2 × 2 chi-square tested the first hypothesis—that is, significantly more preschool-age CWS than CWNS exhibit dissociations among subcomponents of their speech-language skills. Chi-square categories included CWS who do (n = 23) and do not (n = 59) exhibit dissociations and CWNS who do (n = 18) and do not (n = 102) exhibit dissociations. Findings supported the first hypothesis, with significantly more CWS (n = 23 out of 82; 28%) exhibiting total speech-language dissociations compared with their CWNS peers (n = 18 out of 120; 15%), $\chi^2(1) = 5.127$, p = .024, w = .159, 95% CI [0.021, 0.291]. There were, however, no significant between-groups differences in the number of participants exhibiting language-only (p = .238) or speech-language–only (p = .057) dissociations. Table 3 shows between-groups differences in the number of children exhibiting dissociations across speech-language (sub)domains. Three ancillary analyses related to Hypothesis 1 were conducted only for children who exhibited one or more speech-language dissociations (23 CWS, 18 CWNS).[15]

Differences in Age and Gender

The first analysis involved age and gender differences relative to speech-language dissociations. The findings indicated no significant differences in chronological age (in months) between CWS (*Mdn* age = 44 months) and CWNS (*Mdn* age = 48.5 months) who exhibited at least one dissociation, U = 150.50, p = .201, r = .20, 95% CI [−0.115, 0.478]. Regarding gender differences in dissociations, 17.65% (three out of 17) of female CWS and 13.11% (eight out of

[15]Ancillary analyses were limited to this sample to better understand the characteristics of children who exhibited dissociations. Therefore, children who did not exhibit dissociations were excluded from these comparisons.

Table 2. Age, gender, socioeconomic status, and speech-language and fluency characteristics of preschool-age children who stutter (CWS; n = 82; 65 boys, 17 girls) and children who do not stutter (CWNS; n = 120; 59 boys, 61 girls).

Variable	*M* (*SD*) CWS	*M* (*SD*) CWNS	*F* (*df*)	Wald χ^2 (*df*)	*p* (bootstrapped)[a]	η_p^2	β
Chronological age (months)	46.68 (9.04)	49.23 (9.01)	3.87 (1, 200)		.051 (.260)	.019	
Gender[b]					< .001*		
Socioeconomic status[c]	44.04 (12.38)	45.00 (11.46)	0.309 (1, 192)		.579 (.995)	.002	
Speech fluency measure							
Total disfluencies (%)	13.10 (5.39)	4.37 (2.61)		56.18 (1, 200)	< .001*		−1.098
Stuttered disfluencies (%)	8.94 (5.19)	1.24 (0.76)		167.97 (1, 200)	< .001*		−1.975
Nonstuttered disfluencies (%)	4.16 (2.58)	3.13 (2.35)		3.65 (1, 200)	.056		−0.286
SSI-3 total score	18.94 (5.54)	6.86 (1.98)		46.09 (1, 200)	< .001*		−1.016
Speech-language measures							
GFTA-2	109.35 (9.27)	110.43 (10.13)	0.583 (1, 200)		.446 (.970)	.003	
PPVT-3	114.20 (12.42)	115.89 (12.33)	0.917 (1, 200)		.340 (.919)	.005	
EVT	114.54 (13.58)	119.06 (11.60)	6.435 (1, 200)		.012 (.071)	.031	
TELD-3 Receptive	118.63 (14.46)	120.88 (11.40)	1.521 (1, 200)		.219 (.765)	.008	
TELD-3 Expressive	111.16 (15.17)	112.22 (11.78)	0.310 (1, 200)		.578 (.995)	.002	

Note. As described in the Method section, analyses of variance assessed between-groups differences in chronological age, socioeconomic status, and standardized measures of language (e.g., TELD-3, PPVT-3, EVT); a chi-square assessed between-groups gender differences; and generalized linear models assessed between-groups speech fluency differences (i.e., SSI-3 scores as well as frequency of stuttered, nonstuttered, and total disfluencies). Therefore, Wald χ^2 and β values were applicable only to the speech fluency measures; *F* and η_p^2 values are not applicable. SSI-3 = Stuttering Severity Instrument–Third Edition; GFTA-2 = Goldman-Fristoe Test of Articulation–Second Edition; PPVT-3 = Peabody Picture Vocabulary Test–Third Edition; EVT = Expressive Vocabulary Test; TELD-3 = Test of Early Language Development–Third Edition.

[a]As described in the Method section, a bootstrap resampling procedure was used when appropriate to control for false discovery rates. [b]A chi-square analysis assessed between-groups gender differences, which provided frequencies of boys and girls per talker group, rather than *M, SD,* or *F*. As discussed in the Method and Results sections, chi-square results indicated that the present sample consisted of more boys who stutter than girls who stutter (CWS = 17 girls, 65 boys; CWNS = 61 girls, 59 boys), $\chi^2(1) = 18.621$, $p < .001$, $w = .304$. Such findings are expected given the gender differences in childhood stuttering (i.e., more boys than girls stutter). [c]Socioeconomic status information was available for 194 of the 202 total participants (114 CWNS, 80 CWS).

*$p \le .05$.

61) of female CWNS exhibited dissociations, and 30.77% (20 out of 65) of male CWS and 16.95% (10 out of 59) of male CWNS exhibited dissociations. When considering only participants with at least one dissociation (23 CWS, 18 CWNS), there was a medium to large gender effect, with significantly more boys (20 CWS, 10 CWNS) than girls (three CWS, eight CWNS) exhibiting dissociations, $\chi^2(1) = 5.072$, $p = .024$ ($p = .036$, Fisher's exact test), $w = .352$, 95% CI [0.050, 0.595]. Caveats related to findings of between-groups gender differences are considered in the Discussion section.

Differences in Number of Dissociations

The second ancillary analysis involved between-groups differences in the number of dissociations exhibited only by children with one or more speech-language dissociations (see Table 4 for raw number of outliers and dissociations). Gender was included as a factor to account for its possible effect on between-groups differences in number of dissociations. For children exhibiting dissociations, there were no significant between-groups differences in number of total, $p = .742$, $\beta = 0.137$, 95% CI [−0.68, 0.95]; language-only, $p = .754$, $\beta = 0.144$, 95% CI [−0.76, 1.04]; or speech-language–only, $p = .831$, $\beta = 0.105$, 95% CI [−0.86, 1.07], dissociations. In addition, no gender effects were found for total, $p = .644$, $\beta = -0.217$, 95% CI [−1.14, 0.70]; language-only, $p = .338$, $\beta = -0.521$, 95% CI [−1.59, 0.55]; or speech-language–only, $p = .841$, $\beta = 0.108$, 95% CI [−0.95, 1.17], dissociations. Table 5 provides results pertaining to group differences in the number of dissociations exhibited by children with dissociations.

Differences in Magnitude of Dissociations

The third ancillary analysis involved between-groups differences in mean magnitude of dissociations only for children exhibiting one or more speech-language dissociations. There were no significant differences in the mean magnitude of dissociations exhibited by CWS ($n = 23$, mean z score difference = 0.59, $SD = 0.39$, range = 0.04–2.11, $Mdn = 0.71$) and CWNS ($n = 18$, mean z score difference = 0.51, $SD = 0.53$, range = 0.02–1.16, $Mdn = 0.30$), $U = 168$, $p = .306$, $r = .326$, 95% CI [0.020, 0.576]. There was, however, a small to moderate gender effect for magnitude. Girls ($n = 11$) had a larger mean magnitude of dissociations ($M = 0.83$, $SD = 0.58$, range = 0.16–2.11, $Mdn = 0.76$) compared with boys ($n = 30$, $M = 0.46$, $SD = 0.36$, range = 0.02–1.16, $Mdn = 0.42$); $U = 94$, $p = .037$, $r = .138$, 95% CI [−0.177, 0.426].

In summary, more preschool-age CWS exhibited overall dissociations compared with CWNS. For children

Table 3. Number (%) of preschool-age children who stutter (CWS; n = 82) and children who do not stutter (CWNS; n = 120) who exhibited speech-language dissociations.

	Total dissociations[a]			Language-only dissociations[b]			Speech-language–only dissociations[c]		
Variable	**Total**	**CWS**	**CWNS**	**Total**	**CWS**	**CWNS**	**Total**	**CWS**	**CWNS**
Frequency	41/202 (20.3%)	23/82 (28.1%)	18/120 (15%)	32/202 (15.8%)	16/82 (19.5%)	16/120 (13.3%)	26/202 (12.9%)	15/82 (18.3%)	11/120 (9.2%)
χ^2 (*df*)		5.127 (1)			1.395 (1)			3.618 (1)	
p		.024*			.238			.057	
w		.159			.083			.134	

[a]The total number of children who exhibited dissociations across all speech and/or language (sub)domains. Note that some children exhibited multiple dissociations across domains. Thus, the same children may overlap in the language-only and speech-language–only dissociations. [b]The number of children who exhibited dissociations across the vocabulary and language (sub)tests (i.e., Peabody Picture Vocabulary Test–Third Edition, Expressive Vocabulary Test, Test of Early Language Development–Third Edition Receptive, and Test of Early Language Development–Third Edition Expressive). [c]The number of children who exhibited dissociations across the articulation versus vocabulary and/or articulation versus language (sub)tests (i.e., Goldman-Fristoe Test of Articulation–Second Edition vs. Peabody Picture Vocabulary Test–Third Edition, Expressive Vocabulary Test, and Test of Early Language Development–Third Edition Receptive and Expressive).

*$p \leq .05$.

Table 4. Number of outliers and dissociations across speech-language domains for preschool-age children who stutter (CWS; n = 82; 65 boys, 17 girls) and children who do not stutter (CWNS; n = 120; 59 boys, 61 girls).

Speech-language domain	Outliers[a] (*n*)		Dissociations[b] (*n*)		Type of dissociation (*n*)	
	CWS	CWNS	CWS	CWNS	CWS	CWNS
Vocabulary						
PPVT-3 vs. EVT	4	6	2	3	PPVT-3 > EVT (2)	PPVT-3 > EVT (2) PPVT-3 < EVT (1)
Language						
TELD-3 R vs. TELD-3 E	9	2	7	1	TELD-3 R > TELD-3 E (3) TELD-3 R < TELD-3 E (4)	TELD-3 R < TELD-3 E (1)
Language and vocabulary						
TELD-3 E vs. PPVT-3	7	3	5	3	TELD-3 E > PPVT-3 (2) TELD-3 E < PPVT-3 (3)	TELD-3 E > PPVT-3 (1) TELD-3 E < PPVT-3 (2)
TELD-3 E vs. EVT	6	4	4	1	TELD-3 E > EVT (3) TELD-3 E < EVT (1)	TELD-3 E > EVT (1)
TELD-3 R vs. PPVT-3	9	8	7	6	TELD-3 R > PPVT-3 (3) TELD-3 R < PPVT-3 (4)	TELD-3 R < PPVT-3 (6)
TELD-3 R vs. EVT	5	9	2	7	TELD-3 R > EVT (2)	TELD-3 R > EVT (3) TELD-3 R < EVT (4)
Articulation and vocabulary						
GFTA-2 vs. PPVT-3	6	8	5	6	GFTA-2 < PPVT-3 (5)	GFTA-2 < PPVT-3 (6)
GFTA-2 vs. EVT	5	6	4	4	GFTA-2 > EVT (1) GFTA-2 < EVT (3)	GFTA-2 > EVT (1) GFTA-2 < EVT (3)
Articulation and language						
GFTA-2 vs. TELD-3 R	8	6	8	5	GFTA-2 > TELD-3 R (3) GFTA-2 < TELD-3 R (5)	GFTA-2 > TELD-3 R (1) GFTA-2 < TELD-3 R (4)
GFTA-2 vs. TELD-3 E	5	5	4	4	GFTA-2 < TELD-3 E (4)	GFTA-2 < TELD-3 E (4)
Total	64	57	48	40		

Note. PPVT-3 = Peabody Picture Vocabulary Test–Third Edition; EVT = Expressive Vocabulary Test; TELD-3 R = Test of Early Language Development–Third Edition Receptive; TELD-3 E = Test of Early Language Development–Third Edition Expressive; GFTA-2 = Goldman-Fristoe Test of Articulation–Second Edition.

[a]Outliers represent the 5% of participants who fall outside of the ellipses, exhibiting *potential* dissociations between two speech-language measures. [b]Dissociated cases are those that (a) fall outside the density ellipses and (b) exhibit at least "one standard deviation difference between the two measures" (Coulter et al., 2009, p. 262).

Table 5. Number, mean and range of speech-language dissociations exhibited by preschool-age children with dissociations (23 children who stutter [CWS], 18 children who do not stutter [CWNS]).

Variable	Total dissociations[a]			Language-only dissociations[b]			Speech-language–only dissociations[c]		
	Total	CWS	CWNS	Total	CWS	CWNS	Total	CWS	CWNS
Frequency	88	48	40	48	27	21	40	21	19
M (*SD*)	2.15 (1.15)	2.09 (1.12)	2.22 (1.22)	1.17 (0.86)	1.17 (0.98)	1.17 (0.71)	0.98 (1.11)	0.91 (1.00)	1.06 (1.26)
Range	1–5	1–4	1–5	0–3	0–3	0–3	0–4	0–4	0–4
Wald χ^2		.109			.098			.046	
df		(1, 38)			(1, 38)			(1, 38)	
p		.742			.754			.831	
β		.137			.144			.105	

Note. Number of dissociations refers to the number of data points that met the dissociation criteria (i.e., fell outside the density ellipses and exhibited at least 1-*SD* difference between the speech-language measures). Children may exhibit one or more instances of dissociations across speech-language (sub)domains.

[a]The total number of dissociations across speech-language (sub)domains. [b]The number of dissociations across the vocabulary and language (sub)tests (i.e., Peabody Picture Vocabulary Test–Third Edition, Expressive Vocabulary Test, Test of Early Language Development–Third Edition Receptive, and Test of Early Language Development–Third Edition Expressive). [c]The number of dissociations across the articulation versus vocabulary and articulation versus language (sub)tests (i.e., Goldman-Fristoe Test of Articulation–Second Edition vs. Peabody Picture Vocabulary Test–Third Edition, Expressive Vocabulary Test, and Test of Early Language Development–Third Edition Receptive and Expressive).

with at least one dissociation, there were no significant talker group differences in number or magnitude of dissociations. More boys than girls had dissociations, and girls exhibited a greater mean magnitude of dissociations compared with boys.

Hypothesis 2: Between-Groups Differences in Distractibility Scores

We used an ANOVA to test the second hypothesis—that preschool-age CWS exhibit poorer distractibility scores on the BSQ compared with CWNS. This model included gender and a Talker Group × Gender interaction to account for possible gender effects on group distractibility differences.

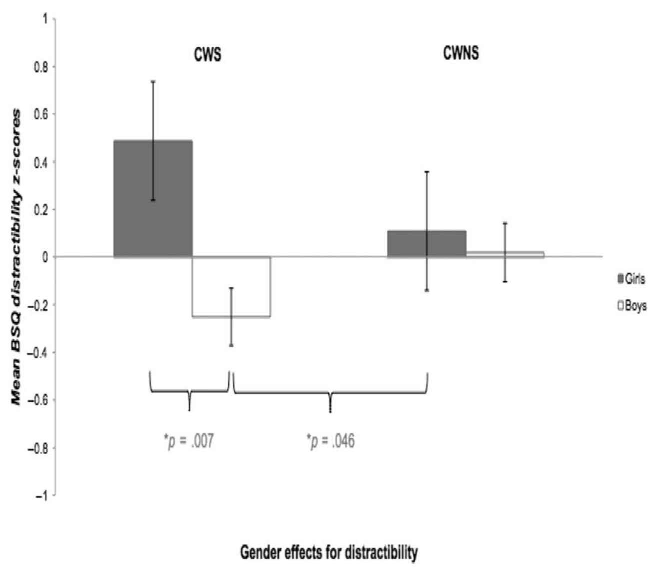
The findings did not confirm this hypothesis, indicating no significant overall group differences between the BSQ distractibility scores of CWS (mean *z* score = −0.098, *SD* = 1.02) and CWNS (mean *z* score = 0.065, *SD* = 0.99), $F(1, 198) = 1.945$, $p = .165$, $\eta_p^2 = .010$, $d = 0.1998$, 95% CI [−0.0817, 0.4813]. There was, however, a significant gender effect for distractibility, $F(1, 198) = 6.548$, $p = .011$, $\eta_p^2 = .032$, $d = 0.3698$, 95% CI [0.0843, 0.6553], with boys scoring significantly lower (*M* = −0.123, *SD* = 0.961)—suggesting less distractibility—than girls (*M* = 0.192, *SD* = 1.042). Furthermore, there was a significant Talker Group × Gender interaction, $F(1, 198) = 4.012$, $p = .047$, $\eta_p^2 = .020$, $d = 0.287$, 95% CI [0.0048, 0.5692]. Male CWS scored significantly lower on the distractibility measure (*M* = −0.251, *SD* = 0.968)—suggesting less distractibility—than both female CWS (*M* = 0.487, *SD* = 1.028), *p* = .007, *d* = −0.7528, 95% CI [−1.299, −0.2066], and female CWNS (*M* = 0.109, *SD* = 1.039), *p* = .046, *d* = −0.3589, 95% CI [−0.7111, −0.0067]. No distractibility differences were found between male CWNS (*M* = 0.019, *SD* = 0.941) and female CWNS, *p* = .62, *d* = −0.0907, 95% CI [−0.4488, 0.2674]; male CWS and male CWNS, *p* = .118, *d* = −0.2826, 95% CI [−0.6368, 0.0715]; or female CWS and female CWNS, *p* = .188, *d* = 0.3646, 95% CI [−0.176, 0.9052]. As shown in Figure 2, preschool-age male CWS were found to be significantly less distractible compared with female CWS and female CWNS.

Hypothesis 3: Association Between Speech-Language Dissociations and Distractibility

We used Spearman's rho correlations to test the third hypothesis—that a significant relation exists between children's distractibility scores and measures of speech-language dissociations (i.e., magnitude of dissociations; frequency of total, speech-language–only, and language-only dissociations). Correlations were conducted only for children with at least one dissociation (CWS = 23, CWNS = 18).

Consistent with this hypothesis, for CWS exhibiting dissociations (*n* = 23) there were significant inverse associations between children's distractibility and frequency of total dissociations, ρ = −.433, *p* = .039, 95% CI [−0.717, −0.025], and speech-language–only dissociations, ρ = −.417,

Figure 2. Mean [standard error] *z* scores on the Distractibility subscale of the Behavioral Style Questionnaire for preschool-age children who stutter (CWS; *n* = 82) and preschool-age children who do not stutter (CWNS; *n* = 120).

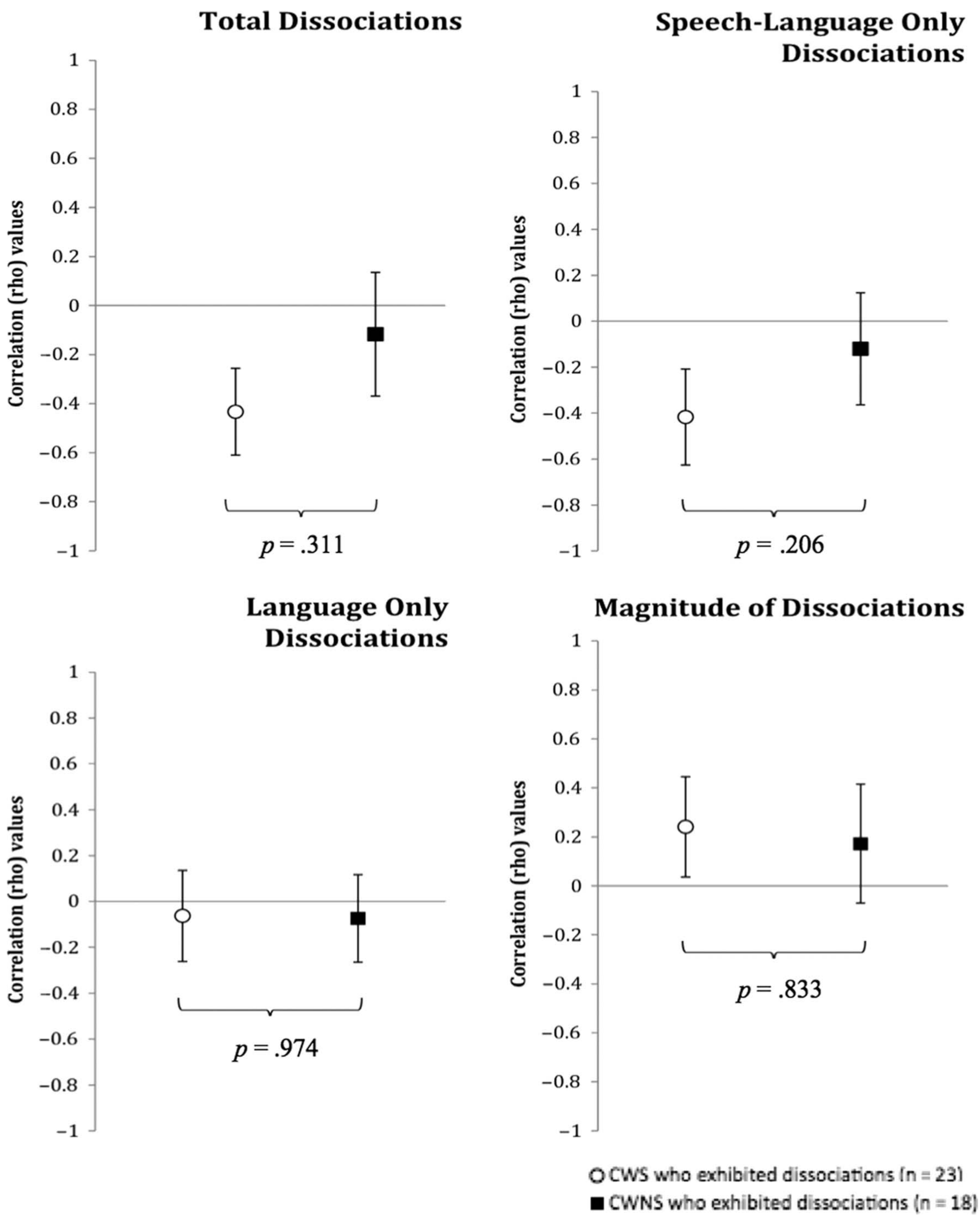


p = .048, 95% CI [−0.708, −0.006].[16] In other words, for preschool-age CWS exhibiting dissociations, less distractibility was associated with increased frequency of total and speech-language–only dissociations. However, there were no significant associations between CWS's distractibility scores and the magnitude of their dissociations, ρ = .241, *p* = .268, 95% CI [−0.19, 0.594], or frequency of their language-only dissociations, ρ = −.063, *p* = .776, 95% CI [−0.463, 0.359]. Likewise, for CWNS exhibiting dissociations (*n* = 18), there were no significant associations between distractibility and measures of dissociations, with ρ values ranging from −.12 to .172, associated *p* values ranging from .496 to .770, and 95% CI ranging from [−0.321, 0.591] to [−0.523, 0.407].

To test whether there were significant differences between CWS's and CWNS's correlations, we performed Fisher's *r*-to-*z* transformations (Preacher, 2002) and visually inspected the overlap between the standard error bars surrounding each group's correlations (Cumming & Finch, 2005). As shown in Figure 3, although two of the correlations for CWS were significant (between distractibility and frequency of total and speech-language–only dissociations), the error bars surrounding these correlations overlapped with those of CWNS. There were overlapping error bars surrounding CWS's and CWNS's correlations between distractibility and frequency of language-only dissociations and between distractibility and magnitude of dissociations. Overlapping error bars indicate nonsignificant differences between CWS's and CWNS's correlations, consistent with Fisher's *r*-to-*z*

[16]It should be noted that negative or lower BSQ scores suggest less distractibility.

Figure 3. Correlational (ρ) values and standard error bars illustrating the association between distractibility *z* scores and frequency of total, speech-language–only, and language-only dissociations and magnitude of dissociations for preschool-age children who stutter (CWS; n = 23) and preschool-age children who do not stutter (CWNS; n = 18) who exhibited at least one dissociation.



transformation findings (z scores ranged from −1.265 to 0.032, and associated p values ranged from .206 to .9742).

Hypothesis 4: Distractibility Moderates the Relation Between Speech-Language Dissociations and Speech Fluency

We used GLMs to assess the fourth hypothesis—that interactions between distractibility and speech-language dissociations predict fluency breakdowns. GLMs were conducted only for children with at least one dissociation (CWS = 23, CWNS = 18). The dependent variables were frequency of TDs, SDs, and NSDs. The independent variables were children's distractibility scores and frequency of total dissociations. Gender was included as a factor in each of the models to account for its possible effect.

The findings indicated that neither CWS's nor CWNS's frequency of disfluencies was predicted by their distractibility scores, frequency of speech-language dissociations, gender, or Distractibility × Dissociation interactions. For CWS, p values for TDs ranged from .448 to .888, associated β values ranged from −0.106 to 0.087, and 95% CIs ranged from [−0.32, 0.50] to [−1.78, 0.79]. For CWNS, p values for TDs ranged from .353 to .996, associated β values ranged from −0.385 to 1.006, and 95% CIs ranged from [−0.50, 0.50] to [−1.12, 3.13]. For CWS, p values for SDs ranged from .353 to .997, associated β values ranged from −0.614 to 0.158, and 95% CIs ranged from [−0.43, 0.43] to [−1.91, 0.68]. For CWNS, p values for SDs ranged from .688 to .984, associated β values ranged from −0.068 to −0.239, and 95% CIs ranged from [−0.41, 0.56] to [−0.93, 1.4]. For CWS, p values for NSDs ranged from .227 to .745, associated β values ranged from −0.597 to 0.249, and 95% CIs ranged from [−0.16, 0.65] to [−1.54, 1.10]. For CWNS, p values for NSDs ranged from .128 to .865, associated β values ranged from −0.717 to 1.821, and 95% CIs ranged from [−0.62, 0.50] to [−0.53, 4.17]. Thus, findings did not support hypothesis 4; distractibility did not moderate the relation between children's speech-language dissociations and their speech disfluencies.

Discussion

Summary of Main Findings

The present study resulted in four main findings. First, more preschool-age CWS exhibited speech-language dissociations compared with CWNS. Second, male CWS scored significantly lower on the BSQ Distractibility subscale —suggesting that they are less distractible—compared with female CWS and female CWNS. Third, for CWS but not CWNS, distractibility scores were associated with frequency of total and speech-language–only dissociations. Fourth, neither CWS's nor CWNS's frequency of TDs, SDs, or NSDs was predicted by their distractibility scores, frequency of speech-language dissociations, or Distractibility × Dissociation interactions. Implications of these findings are discussed below.

Between-Groups Differences in Speech-Language Dissociations

The first main finding indicated that more preschool-age CWS exhibited speech-language dissociations compared with CWNS: Twenty-eight percent of preschool-age CWS exhibited speech-language dissociations compared with 15% of their fluent peers—a roughly 2:1 ratio that is comparable to that reported by Anderson et al. (2005; 35.6% CWS, 17.8% CWNS) and Coulter et al. (2009; 25% CWS, 12.5% CWNS). Although the present study assessed CWS at one point in time—some CWS will persist whereas others will recover from stuttering—it is interesting to observe that the percentages of preschool-age CWS exhibiting dissociations are roughly similar to those of stuttering persistence (e.g., Yairi & Ambrose, 1999). One might speculate that an association exists between the continued presence of speech-language dissociations and stuttering persistence. Such speculations are consistent with Hall's (1996) findings, which suggested a possible association between the continuation of speech-language dissociations—from preschool through 9 years of age—and the continuation of fluency breakdowns for children with language disorders. The results of future longitudinal studies of CWS and CWNS with typical development—from preschool through the school-age years—should enhance our understanding of the possible role that speech-language dissociations play in the persistence of childhood stuttering.

Related to the first main finding, one ancillary result indicated that significantly more boys (20 CWS, 10 CWNS) exhibited dissociations compared with girls (three CWS, eight CWNS). When considering the total sample (124 boys, 78 girls) from which the dissociated sample (30 males, 11 females) was obtained, 24% of boys (30 out of 124) compared with 14% of girls (11 out of 78) exhibited dissociations. Considering each talker group separately, 30.77% of male CWS (20 out of 65) versus 17.65% of female CWS (three out of 17) had dissociations, whereas only 16.95% of male CWNS (10 out of 59) versus 13.11% of female CWNS (eight out of 61) had dissociations. There are at least two alternative explanations for these findings. The first explanation suggests that perhaps gender differences within the sample of children with dissociations reflect gender differences associated with the total sample from which they were taken (see Table 2). The second explanation suggests that perhaps more boys than girls tend to exhibit speech-language dissociations. Such gender differences relative to speech-language dissociations might be associated with reports that girls generally exhibit better developed language abilities compared with boys (e.g., Blair, Granger, & Peters Razza, 2005; Bornstein, Hahn, & Haynes, 2004; Leve et al., 2013). Perhaps better developed speech-language abilities reflect more congruence or evenness among speech-language (sub)domains. This speculation awaits future empirical study.

Between-Groups Differences in Distractibility

The second main finding indicated that although there were no overall group differences in distractibility, there was a significant Talker Group × Gender interaction, with preschool-age male CWS exhibiting less distractibility than female CWNS and female CWS. The nonsignificant overall group differences in distractibility are consistent with findings reported by some researchers (e.g., Anderson & Wagovich, 2010; Eggers et al., 2010) but not others (e.g., Anderson et al., 2003; Karrass et al., 2006). Perhaps such equivocal findings relate to between-studies differences in methodology (e.g., caregiver reports vs. experimental paradigms). Ntourou et al. (2013) proposed that caregiver reports represent children's overall abilities to regulate their emotions, whereas direct observation and/or experimental procedures capture children's regulatory attempts as they occur. Dixon and Smith (2000) suggested that parent questionnaires "tap into some aspects of temperament that are reflected by the children's own behavior . . . which are not necessarily reflected by laboratory-based observations of temperament" (p. 420). Thus, caregiver questionnaires and experimental paradigms may tap into different attentional constructs or processes (e.g., distractibility, attention span and persistence, shifting, or focusing).

Despite the finding of no overall between-groups differences in distractibility, a significant Talker Group × Gender interaction indicated that preschool-age male CWS were significantly less distractible than female CWNS and female CWS. Such findings are consistent with those of Anderson et al. (2003), which indicated that preschool-age CWS were more likely to be rated by parents as being less distractible than CWNS. Anderson et al.'s sample of less distractible CWS comprised mostly boys (81% of the total CWS sample).

It is interesting to note that meta-analytical results of 189 empirical studies (Else-Quest, Hyde, Goldsmith, & Van Hulle, 2006) indicated that girls tend to exhibit "an overall better ability . . . to regulate or allocate their attention" compared with boys (p. 61). Rothbart (2011) suggested that too much or too little self-regulation could be problematic, especially when it "is used to develop rigid and inflexible responses that protect the child from information or experience" (p. 234). On the basis of this suggestion, both too much and too little distractibility—but not necessarily clinically significant or disordered levels of distractibility—may represent less effective or flexible forms of attention. However, it is unclear what constitutes "too much" or "too little" distractibility. Perhaps subtle mean score differences in distractibility, as opposed to clinically significant attentional disorders associated with hyper- or hypodistractibility, are especially problematic during rapidly changing situations (e.g., speech-language processing, planning, or production). Such subtle yet less effective forms of attention could relate or contribute to difficulties some children have with establishing normally fluent speech. Indeed, the present findings suggest that male CWS exhibit subtle yet significantly less distractibility than female CWS.

Perhaps less distractibility among preschool-age male CWS plays a role in stuttering persistence, whereas more distractibility among female CWS somehow aids or plays a role in their recovery. Such speculation is worthy of further investigation given that boys are at greater risk for persistence (Yairi & Ambrose, 2005). In addition, less distractibility exhibited by some male CWS might affect therapeutic outcome. For instance, "a child who is minimally distractible may be relatively impervious to environmental suggestions to change . . . from a speech-language pathologist, making it more difficult to successfully and quickly change his/her behavior" (Anderson et al., 2003, p. 1229). This speculation is similar to that of Rothbart (2011) regarding too much or too little self-regulation "protect[ing] the child from information or experience" (p. 234). Thus, some preschool-age male CWS may be too focused on, and less able to shift their attention away from, their speech errors or disfluencies. Such sustained focus could exacerbate stuttering. The above speculations seem worthy of further empirical investigation given their theoretical and clinical salience.

Association Between Distractibility and Speech-Language Dissociations

The third main finding indicated that for CWS exhibiting dissociations, less distractibility was associated with increased frequency of total and speech-language–only dissociations. Although within-group correlations were significant for CWS but not for CWNS, the results of Fisher's *r*-to-*z* transformations and visual inspection indicated no significant differences between the correlations (see Figure 3). Disparate findings regarding within-group versus between-groups correlations challenge a precise understanding of the relation between distractibility and speech-language dissociations and call for further empirical study. Nevertheless, the current preliminary findings suggest a possible association between less distractibility and increased speech-language dissociations among preschool-age CWS. One explanation for this association is related to Rispoli and Hadley's (2001) and Levelt's (1983) models of speech-language production.

In brief, Rispoli and Hadley (2001) theorized that overt speech disfluencies are associated with glitches or errors that progress or propagate throughout the speech-language subprocessors (i.e., the conceptualizer, formulator, and articulator). These relatively subtle glitches may be associated with temporal misalignments or incongruities in speech-language. In addition, according to Levelt's (1983) speculation, a speaker's monitoring system is alerted upon error detection, which could result in the creation of new or adjusted instructions for error repair.

Applying the above speculations to the present findings, if speech-language dissociations are associated with more glitches and errors, then the monitoring or attentional systems of CWS may be more frequently alerted for repairs, requiring them to make greater use of their attentional resources. In other words, CWS may exert greater attentional vigilance (i.e., becoming less distractible) to detect and repair errors as well as anticipate possible future errors.

Relation Among Speech-Language Dissociations, Distractibility, and Speech Fluency

The fourth main finding indicated that for preschool-age CWS and CWNS, distractibility, speech-language dissociations, and distractibility × dissociation did not predict frequency of disfluencies. Nonsignificant Distractibility × Dissociation effects suggest that children's distractibility does not moderate the relation between their speech-language dissociations and speech disfluencies. One possible explanation for these findings relates to the variable nature of stuttering (e.g., Johnson, Karrass, Conture, & Walden, 2009; Silverman, 1971; Yaruss, 1997). A speech sample from a single point in time may not accurately represent the central tendency of a child's stuttering frequency. Therefore, it may be difficult to adequately assess the relation among distractibility, speech-language dissociations, and speech disfluencies when the latter is based on a measure of stuttering frequency from one point in time. Future investigations of this topic might consider using multiple speech samples across contexts, speakers, and situations (e.g., Ingham & Riley, 1998; Yaruss, 1997).

It is interesting to note that the present findings, which are based on caregivers' reports, differ from Ntourou et al.'s (2013) findings on behavioral observations. Ntourou et al. found an association between CWS's stuttering frequency and distractibility, whereas present findings showed that children's distractibility did not predict their speech disfluencies. Likewise, the present findings, which were based on speech-language dissociations (i.e., imbalanced performance *across* standardized measures), differed from those that were based on a different methodology—that is, intratest scatter (i.e., imbalanced performance *within* a standardized language test). Previous findings showed stuttering frequency to be significantly associated with CWS's intratest scatter on the Expressive Vocabulary Test–Second Edition (Millager et al., 2014) and the TELD-3 Expressive (Walden et al., 2012). In contrast, present findings indicated that children's speech-language dissociations did not predict their speech disfluencies. Perhaps these differing findings relate to between-studies differences in measures (e.g., caregiver report vs. behavioral observations; intratest scatter vs. speech-language dissociations across standardized tests) as well as statistical analyses (e.g., negative binomial GLM vs. correlational analyses).

Caveats

One limitation of the present study is the possibility that speech-language dissociations may be an index of or proxy for attention. Consistent with this notion, Millager et al. (2014) found a positive correlation between intratest scatter (i.e., imbalanced performance within language measures) and the number of test items on a measure of expressive language. Such findings suggest that intratest scatter might be affected by other testing-related variables (e.g., participants' fluctuating levels of attention while being tested). Future empirical studies might consider assessing whether children's speech-language dissociations are also associated with similar testing effects on attention.

A second limitation of the present study is that children's distractibility was assessed by means of a parent questionnaire, a method that has been questioned by some (e.g., Kagan, 1998) but advocated by others (e.g., Bates et al., 1995). Bates et al. (1995) argued that "parents have a far larger dataset than researchers or clinicians can ever hope to assemble; it is also far more representative of the child's ability, as it is based on the child's behavior in a wide range of situations" (p. 3). Likewise, Henderson and Wachs (2007) suggested that although "parent report measures do contain some subjective parental components, available evidence indicates that these measures also contain a substantial objective component that does accurately assess children's individual characteristics" (p. 402). Nevertheless, perhaps a multimethod approach using various measures (e.g., caregiver questionnaires and experimental paradigms such as the Traditional and Affect Cueing Tasks [Johnson et al., 2012] or the Attention Network Test [Eggers et al., 2012]) would provide a more comprehensive assessment of children's attentional processes.

Last, inferences and interpretations regarding gender effects should be made with caution, given the relatively small sample of female CWS in this study. Such an unequal ratio of boys who stutter to girls who stutter is expected in this population (e.g., Yairi & Ambrose, 2013). However, further investigations using larger samples of female CWS and/or more balanced gender ratios may better determine whether more preschool-age male CWS exhibit speech-language dissociations and less distractibility compared with female CWS.

Conclusions

The present investigation empirically studied the relation among speech-language dissociations, attention, and childhood stuttering. The findings indicated that more preschool-age CWS—in particular, boys—exhibit speech-language dissociations compared with their normally fluent peers and that for CWS there is a relation between greater attention (i.e., less distractibility) and speech-language dissociations. The latter result suggests that underlying variables, such as less distractibility, are involved in speech-language dissociations for at least a subgroup of preschool-age CWS. Given the present methodology (e.g., parent questionnaires and correlational analyses), it is difficult to determine the directionality of effect—that is, whether ineffective distractibility caused, resulted from, or simply co-occured with CWS's speech-language dissociations (see Conture, Kelly, & Walden, 2013, for a similar discussion about directionality of effect regarding temperament and speech-language disorders). Nevertheless, the present findings emphasize the importance of studying associations and interactions among multiple variables (e.g., dissociations across several speech-language domains in addition to distractibility) and their possible relation to childhood stuttering.

Overall, the findings suggest that distractibility and speech-language dissociations are associated with the diagnosis of childhood stuttering (CWS vs. CWNS). However, given that dissociations and distractibility did not predict children's frequency of speech disfluencies, how these variables contribute to the behaviors of childhood stuttering (e.g., stuttering frequency) remains unclear. Perhaps additional variables tie together attentional processes, speech-language dissociations, and childhood stuttering. Whatever the case, our further understanding of such variables and their relations to childhood stuttering must await future empirical study.

Acknowledgments

This work was supported in part by National Institute on Deafness and Other Communication Disorders Grants 5R01DC000523-18 and 5R01DC006477-03 (awarded to Edward G. Conture), the National Center for Research Resources (awarded to Edward G. Conture), CTSA Grant 1 UL1 RR024975 (awarded to Vanderbilt University with Edward G. Conture as P.I.), a Vanderbilt University Discovery Grant (awarded to Edward G. Conture), and the National Stuttering Association's Canadeo Family Research Award (awarded to Chagit Edery Clark). The research reported herein does not reflect the views of the National Institutes of Health, the National Institute on Deafness and Other Communication Disorders, Vanderbilt University, or the National Stuttering Association. We thank James Bodfish and Robin Jones for reviews of earlier drafts of this article as well as Julie Anderson for her input at the initial stages of this study. We also extend our sincere appreciation to the participants and their families, who made this study possible.

References

American Psychological Association. (2010). *Publication manual of the American Psychological Association* (6th ed.). Washington, DC: Author.

Anderson, J. D. (2007). Phonological neighborhood and word frequency effects in the stuttered disfluencies of children who stutter. *Journal of Speech, Language, and Hearing Research, 50,* 229–247.

Anderson, J. D., & Conture, E. G. (2000). Language abilities of children who stutter: A preliminary study. *Journal of Fluency Disorders, 25,* 283–304.

Anderson, J. D., & Conture, E. G. (2004). Sentence-structure priming in young children who do and do not stutter. *Journal of Speech, Language, and Hearing Research, 47,* 552–571.

Anderson, J. D., Pellowski, M., & Conture, E. G. (2005). Linguistic variables in childhood stuttering: Speech-language dissociations. *Journal of Fluency Disorders, 30,* 219–253.

Anderson, J. D., Pellowski, M. W., Conture, E. G., & Kelly, E. M. (2003). Temperamental characteristics of young children who stutter. *Journal of Speech, Language, and Hearing Research, 46,* 1221–1233.

Anderson, J. D., & Wagovich, S. A. (2010). Relationships among linguistic processing speed, phonological working memory, and attention in children who stutter. *Journal of Fluency Disorders, 35,* 216–234.

Arends, N., Povel, D. J., & Kolk, H. (1988). Stuttering as an attentional phenomenon. *Journal of Fluency Disorders, 13,* 141–151.

Arndt, J., & Healy, E. C. (2001). Concomitant disorders in school-age children who stutter. *Language, Speech, and Hearing Services in Schools, 32,* 68–78.

Arnold, H. S., Conture, E. G., Key, A. P., & Walden, T. (2011). Emotional reactivity, regulation and childhood stuttering: A behavioral and electrophysiological study. *Journal of Communication Disorders, 44,* 276–293.

Bates, E., Appelbaum, M., Salcedo, J., Saygin, A. P., & Pizzamiglio, L. (2003). Quantifying dissociations in neuropsychological research. *Journal of Clinical and Experimental Neuropsychology, 25,* 1128–1153.

Bates, E., Bretherton, I., & Snyder, L. (1988). *From first words to grammar: Individual differences and dissociable mechanisms.* New York, NY: Cambridge University Press.

Bates, E., Dale, P. S., & Thal, D. (1995). Individual differences and their implications for theories of language development. In P. Fletcher & B. MacWhinney (Eds.), *The handbook of child language* (pp. 96–151). New York, NY: Blackwell.

Bates, E., Thal, D., Whitesell, K., Fenson, L., & Oakes, L. (1989). Integrating language and gesture in infancy. *Developmental Psychology, 25,* 1004–1019.

Baydar, N. (1995). Reliability and validity of temperament scales of the NSLY child assessments. *Journal of Applied Developmental Psychology, 16,* 339–370.

Benjamini, Y., & Hochberg, Y. (1995). Controlling the false discovery rate: A practical and powerful approach to multiple testing. *Journal of the Royal Statistical Society B, 57,* 289–300.

Berger, A., Kofman, O., Livneh, U., & Henik, A. (2007). Multidisciplinary perspectives on attention and the development of self-regulation. *Progress in Neurobiology, 82,* 256–286.

Bernstein Ratner, N., & Sih, C. C. (1987). The effects of gradual increases in sentence length and complexity on children's disfluency. *Journal of Speech and Hearing Disorders, 52,* 278–287.

Bernstein Ratner, N., & Silverman, S. W. (2000). Parental perceptions of children's communicative development at stuttering onset. *Journal of Speech, Language, and Hearing Research, 43,* 1252–1263.

Blair, C., Granger, D., & Peters Razza, R. (2005). Cortisol reactivity is positively related to executive function in preschool children attending Head Start. *Child Development, 76,* 554–567.

Blair, C., & Razza, R. P. (2007). Relating effortful control, executive function, and false belief understanding to emerging math and literacy ability in kindergarten. *Child Development, 78,* 647–663.

Blood, G. W., Ridenour, V. J., Jr., Qualls, C. D., & Hammer, C. S. (2003). Co-occuring disorders in children who stutter. *Journal of Communication Disorders, 36,* 427–448.

Bloodstein, O., & Bernstein Ratner, N. (2008). *A handbook on stuttering.* Clifton Park, NY: Thomson/Delmar.

Bonelli, P., Dixon, M., Bernstein Ratner, N., & Onslow, M. (2000). Child and parent speech and language following the Lidcombe Programme of early stuttering intervention. *Clinical Linguistics & Phonetics, 14,* 427–446.

Bornstein, M. H., Hahn, C. S., & Haynes, O. M. (2004). Specific and general language performance across early childhood: Stability and gender considerations. *First Language, 24,* 267–304.

Boscolo, B., Bernstein Ratner, N., & Rescorla, L. (2002). Fluency of school-aged children with a history of specific expressive language impairment: An exploratory study. *American Journal of Speech-Language Pathology, 11,* 41–49.

Bosshardt, H. G. (2002). Effects of concurrent cognitive processing on the fluency of word repetition: Comparison between persons who do and do not stutter. *Journal of Fluency Disorders, 27,* 93–114.

Bosshardt, H. G., Ballmer, W., & de Nil, L. F. (2002). Effects of category and rhyme decisions on sentence production. *Journal of Speech, Language, and Hearing Research, 45,* 844–857.

Buhr, A., & Zebrowski, P. (2009). Sentence position and syntactic complexity of stuttering in early childhood: A longitudinal study. *Journal of Fluency Disorders, 34,* 155–172.

Bush, A. L. (2006). Effects of childhood stuttering on attention regulation in emotionally arousing situations. *Vanderbilt Undergraduate Research Journal, 2,* 1–14.
Buss, A. H., & Plomin, R. (1975). *A temperament theory of personality development*. Hoboken, NJ: Wiley InterScience.
Choi, D., Conture, E. G., Walden, T. A., Lambert, W., & Tumanova, V. (2013). Behavioral inhibition and childhood stuttering. *Journal of Fluency Disorders, 38,* 171–183.
Civier, O., Tasko, S. M., & Guenther, F. H. (2010). Overreliance on auditory feedback may lead to sound/syllable repetitions: Simulations of stuttering and fluency-inducing conditions with a neural model of speech production. *Journal of Fluency Disorders, 35,* 246–279.
Clark, C. E., Conture, E. G., Frankel, C. B., & Walden, T. A. (2012). Communicative and psychological dimensions of the KiddyCAT. *Journal of Communication Disorders, 45,* 223–234.
Clark, C. E., Conture, E. G., Walden, T. A., & Lambert, W. E. (2013). Speech sound articulation abilities of preschool-age children who stutter. *Journal of Fluency Disorders, 38,* 325–341.
Cohen, J. (1968). Multiple regression as a general data-analytic system. *Psychological Bulletin, 70,* 426–443.
Cohen, J. (1973). Eta-squared and partial eta-squared in fixed factor ANOVA designs. *Educational and Psychological Measurement, 33,* 107–112.
Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.
Cohen, J. (1992). A power primer. *Psychological Bulletin, 112,* 155–159.
Conture, E. G. (2001). *Stuttering: Its nature, diagnosis, and treatment*. Boston, MA: Allyn & Bacon.
Conture, E. G., Kelly, E. M., & Walden, T. A. (2013). Temperament, speech and language: An overview. *Journal of Communication Disorders, 46,* 125–142.
Coulter, C., Anderson, J. D., & Conture, E. G. (2009). Childhood stuttering and dissociation across linguistic domains: Replication and extension. *Journal of Fluency Disorders, 34,* 257–278.
Cumming, G., & Finch, S. (2005). Inference by eye: Confidence intervals and how to read pictures of data. *American Psychologist, 60,* 170–180.
Dixon, W., & Shore, C. (1997). Temperamental predictors of linguistic style during multiword acquisition. *Infant Behavioral Development, 20,* 99–103.
Dixon, W., & Smith, P. (2000). Links between early temperament and language acquisition. *Merrill–Palmer Quarterly, 46,* 417–440.
Dunn, L., & Dunn, L. (1997). *Peabody Picture Vocabulary Test–Third Edition*. Circle Pines, MN: AGS.
Efron, B. T. R. (1993). *An introduction to the bootstrap*. Boca Raton, FL: Chapman & Hall/CRC.
Eggers, K., De Nil, L. F., & Van den Bergh, B. R. (2010). Temperament dimensions in stuttering and typically developing children. *Journal of Fluency Disorders, 35,* 355–372.
Eggers, K., De Nil, L., & Van den Bergh, B. R. (2012). The efficiency of attentional networks in children who stutter. *Journal of Speech, Language, and Hearing Research, 55,* 946–959.
Else-Quest, N. M., Hyde, J. S., Goldsmith, H. H., & Van Hulle, C. A. (2006). Gender differences in temperament: A meta-analysis. *Psychological Bulletin, 132,* 33–72.
Embrechts, M., Ebben, H., Franke, P., & van de Poel, C. (2000). Temperament: A comparison between children who stutter and children who do not stutter. In H. G. Bosshardt, J. S. Yaruss, & H. F. M. Peters (Eds.), *Proceedings of the Third World Congress on Fluency Disorders: Theory, research, treatment, and self-help* (pp. 557–562). Nijmegen, the Netherlands: University of Nijmegen Press.
Fan, J., McCandliss, B. D., Sommer, T., Raz, A., & Posner, M. I. (2002). Testing the efficiency and independence of attentional networks. *Journal of Cognitive Neuroscience, 14,* 340–347.
Felsenfeld, S., van Beijsterveldt, C., & Boomsma, D. (2010). Attentional regulation in young twins with probable stuttering, high nonfluency, and typical fluency. *Journal of Speech, Language, and Hearing Research, 53,* 1147–1166.
Ferguson, C. J. (2009). An effect size primer: A guide for clinicians and researchers. *Professional Psychology: Research and Practice, 40,* 532–538.
Gardner, W., Mulvey, E. P., & Shaw, E. C. (1995). Regression analyses of counts and rates: Poisson, overdispersed Poisson, and negative binomial models. *Psychological Bulletin, 118,* 392–404.
Goldman, R., & Fristoe, M. (2000). *Goldman-Fristoe Test of Articulation–Second Edition*. Circle Pines, MN: AGS.
Häge, A. (2001). Is there a link between the development of cognitive-linguistic abilities in children and the course of stuttering? In H. G. Bosshardt, J. S. Yaruss, & H. F. M. Peters (Eds.), *Proceedings of the Third World Congress on Fluency Disorders: Theory, research, treatment, and self-help* (pp. 190–194). Nijmegen, The Netherlands: University of Nijmegen Press.
Hakim, H. B., & Ratner, N. B. (2004). Nonword repetition abilities of children who stutter: An exploratory study. *Journal of Fluency Disorders, 29,* 179–199.
Hall, N. E. (1996). Language and fluency in child language disorders: Changes over time. *Journal of Fluency Disorders, 21,* 1–32.
Hall, N. E. (1999). Speech disruptions in pre-school children with specific language impairment and phonological impairment. *Clinical Linguistics & Phonetics, 13,* 295–307.
Hall, N. E. (2004). Lexical development and retrieval in treating children who stutter. *Language, Speech, and Hearing Services in Schools, 35,* 57–69.
Hall, N. E., & Burgess, S. D. (2000). Exploring developmental changes in fluency as related to language acquisition: A case study. *Journal of Fluency Disorders, 25,* 119–141.
Hall, N. E., Yamashita, T. S., & Aram, D. M. (1993). Relationship between language and fluency in children with developmental language disorders. *Journal of Speech and Hearing Research, 36,* 568–579.
Henderson, H. A., & Wachs, T. D. (2007). Temperament theory and the study of cognition–emotion interactions across development. *Developmental Review, 27,* 396–427.
Hepburn, S. L., & Stone, W. L. (2006). Using Carey Temperament Scales to assess behavioral style in children with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 36,* 637–642.
Hintze, J. (2008). PASS 2008 [Computer software]. Kaysville, UT: NCSS Statistical Software.
Hirsh-Pasek, K., & Golinkoff, R. M. (1991). Language comprehension: A new look at some old themes. In N. A. Krasnegor, D. M. Rumbaugh, R. L. Schiefelbusch, & M. Studdert-Kennedy (Eds.), *Biological and behavioral determinants of language development* (pp. 301–320). New York, NY: Psychology Press.
Hochberg, Y. (1988). A sharper Bonferroni procedure for multiple significance testing. *Biometrika, 75,* 800–803.
Hollingshead, A. (1975). *Four factor index of social status*. Unpublished manuscript, Yale University, New Haven, CT.
Howell, P., & Au-Yeung, J. (1995). Syntactic determinants of stuttering in the spontaneous speech of normally fluent and stuttering children. *Journal of Fluency Disorders, 20,* 317–330.
Howell, P., Bailey, E., & Kothari, N. (2010). Changes in the pattern of stuttering over development for children who recover or persist. *Clinical Linguistics & Phonetics, 24,* 556–575.

Hresko, W., Reid, D., & Hammill, D. (1999). *Test of Early Language Development–Third Edition*. Austin, TX: Pro-Ed.
Ingham, J. C., & Riley, G. (1998). Guidelines for documentation of treatment efficacy for young children who stutter. *Journal of Speech, Language, and Hearing Research, 41,* 753–770.
Jiang, J., Lu, C., Peng, D., Zhu, C., & Howell, P. (2012). Classification of types of stuttering symptoms based on brain activity. *PLOS ONE, 7*(6), e39747.
Johnson, K. N., Conture, E., & Walden, T. (2012). Efficacy of attention regulation in preschool-age children who stutter: A preliminary investigation. *Journal of Communication Disorders, 45,* 263–278.
Johnson, K. N., Karrass, J., Conture, E. G., & Walden, T. (2009). Influence of stuttering variation on talker group classification in preschool children: Preliminary findings. *Journal of Communication Disorders, 42,* 195–210.
Johnson, K. N., Walden, T. A., Conture, E. G., & Karrass, J. (2010). Spontaneous regulation of emotions in preschool children who stutter: Preliminary findings. *Journal of Speech, Language, and Hearing Research, 53,* 1478–1495.
Jones, R., Buhr, A., Conture, E., Walden, T., Porges, S., & Tumanova, V. (2014). Autonomic activity of preschool-age children who stutter. *Journal of Fluency Disorders, 41,* 12–31.
Kagan, J. (1998). Biology and the child. In W. Damon & N. Eisenberg (Eds.), *Handbook of child psychology: Vol. 3. Social, emotional and personality development* (5th ed., pp. 177–235). New York, NY: Wiley.
Karrass, J., Walden, T., Conture, E., Graham, C., Arnold, H., Hartfield, K., & Schwenk, K. (2006). Relation of emotional reactivity and regulation to childhood stuttering. *Journal of Communication Disorders, 39,* 402–423.
Kraemer, H. C., Mintz, J., Noda, A., Tinklenberg, J., & Yesavage, J. A. (2006). Caution regarding the use of pilot studies to guide power calculations for study proposals. *Archives of General Psychiatry, 63,* 484–489.
Kraft, S. J., Ambrose, N., & Chon, H. C. (2014). Temperament and environmental contributions to stuttering severity in children: The role of effortful control. *Seminars in Speech and Language, 35*(2), 80–94.
Leve, L. D., DeGarmo, D. S., Bridgett, D. J., Neiderhiser, J. M., Shaw, D. S., Harold, G. T., . . . Reiss, D. (2013). Using an adoption design to separate genetic, prenatal, and temperament influences on toddler executive function. *Developmental Psychology, 49,* 1045–1057.
Levelt, W. J. (1983). Monitoring and self-repair in speech. *Cognition, 14,* 41–104.
Levelt, W. J. (1989). *Speaking: From intention to articulation*. Cambridge, MA: MIT Press.
Levelt, W. J., Roelofs, A., & Meyer, A. S. (1999). A theory of lexical access in speech production. *Behavioral and Brain Sciences, 22*(1), 1–38.
Locke, J. L., & Goldstein, J. I. (1973). Children's attention and articulation. *Language and Speech, 16,* 156–168.
Logan, K. J., & Conture, E. G. (1995). Length, grammatical complexity, and rate differences in stuttered and fluent conversational utterances of children who stutter. *Journal of Fluency Disorders, 20,* 35–61.
Logan, K. J., & Conture, E. G. (1997). Selected temporal, grammatical and phonological characteristics of conversational utterances produced by children who stutter. *Journal of Speech, Language, and Hearing Research, 40,* 107–120.
McDevitt, S. C., & Carey, W. B. (1978). The measurement of temperament in 3–7 year old children. *Journal of Child Psychology, 19,* 245–253.
McDevitt, S. C., & Carey, W. B. (1996). *Manual for the Behavioral Style Questionnaire*. Scottsdale, AZ: Behavioral-Developmental Initiatives.
McGraw, K. O., & Wong, S. P. (1996). Forming inferences about some intraclass correlation coefficients. *Psychological Methods, 1,* 30–46.
Melnick, K. S., & Conture, E. G. (2000). Relationship of length and grammatical complexity to the systematic and nonsystematic speech errors and stuttering of children who stutter. *Journal of Fluency Disorders, 25,* 21–45.
Millager, R., Conture, E., Walden, T., & Kelly, E. (2014). Expressive language intratest scatter of preschool-age children who stutter. *Contemporary Issues in Communication Science and Disorders, 41,* 110–119.
Morales, M., Mundy, P., Delgado, C., Yale, M., Messinger, D., Neal, R., & Neal-Beevers, A. R. (2000). Responding to joint attention across the 6- through 24-month age period and early language acquisition. *Journal of Applied Developmental Psychology, 21,* 283–298.
Morales, M., Mundy, P., Delgado, C., Yale, M., Neal, R., & Schwartz, R. (2000). Gaze following, temperament and language development in 6-month-olds: A replication and extension. *Infant Behavior and Development, 23,* 231–236.
Murray, H. L., & Reed, C. G. (1977). Language abilities of preschool stuttering children. *Journal of Fluency Disorders, 2,* 171–176.
Natke, U., Sandrieser, P., van Ark, M., Pietrowsky, R., & Kalveram, K. T. (2004). Linguistic stress, within-word position, and grammatical class in relation to early childhood stuttering. *Journal of Fluency Disorders, 29,* 109–122.
Nelder, J. A., & Wedderburn, R. W. M. (1972). Generalized linear models. *Journal of the Royal Statistical Society A, 135,* 370–384.
Nippold, M. A. (2001). Phonological disorders and stuttering in children: What is the frequency of co-occurrence? *Clinical Linguistics & Phonetics, 15,* 219–228.
Nippold, M. A. (2004). Phonological and language disorders in children who stutter: Impact on treatment recommendations. *Clinical Linguistics & Phonetics, 18,* 145–159.
Nippold, M. A. (2012). Stuttering and language ability in children: Questioning the connection. *American Journal of Speech-Language Pathology, 21,* 183–196.
Nippold, M. A., Schwarz, I. E., & Jescheniak, J. (1991). Narrative ability in school-age stuttering boys: A preliminary investigation. *Journal of Fluency Disorders, 16,* 289–308.
Ntourou, K., Conture, E. G., & Lipsey, M. W. (2011). Language abilities of children who stutter. *American Journal of Speech-Language Pathology, 20,* 163–180.
Ntourou, K., Conture, E. G., & Walden, T. A. (2013). Emotional reactivity and regulation in preschool-age children who stutter. *Journal of Fluency Disorders, 38,* 260–274.
Oomen, C. C., & Postma, A. (2001). Effects of time pressure on mechanisms of speech production and self-monitoring. *Journal of Psycholinguistic Research, 30,* 163–184.
Pellowski, M. W., & Conture, E. G. (2005). Lexical priming in picture naming of young children who do and do not stutter. *Journal of Speech, Language, and Hearing Research, 48,* 278–294.
Postma, A., & Kolk, H. (1993). The covert repair hypothesis: Prearticulatory repair processes in normal and stuttered disfluencies. *Journal of Speech, Language, and Hearing Research, 36,* 472–487.
Preacher, K. J. (2002). Calculation for the Test of the Difference Between Two Independent Correlation Coefficients [Computer software]. Retrieved from http://quantpsy.org

Putnam, S. P., & Rothbart, M. K. (2006). Development of short and very short forms of the Children's Behavior Questionnaire. *Journal of Personality Assessment, 87*(1), 102–112.

Reilly, S., Onslow, M., Packman, A., Cini, E., Conway, L., Ukoumunne, O. C., . . . Wake, M. (2013). Natural history of stuttering to 4 years of age: A prospective community-based study. *Pediatrics, 132,* 460–467.

Reilly, S., Onslow, M., Packman, A., Wake, M., Bavin, E., Prior, M., . . . Ukoumunne, O. (2009). Predicting stuttering onset by the age of 3 years: A prospective, community cohort study. *Pediatrics, 123,* 270–277.

Richels, C., Buhr, A., Conture, E., & Ntourou, K. (2010). Utterance complexity and stuttering on function words in preschool-age children who stutter. *Journal of Fluency Disorders, 35,* 314–331.

Richels, C., Johnson, K., Conture, E., & Walden, T. (2013). Socioeconomic status, parental education, vocabulary and language skills of children who stutter. *Journal of Communication Disorders, 46,* 361–374.

Riley, G. D. (1994). *Stuttering Severity Instrument for children and adults* (3rd ed.). Austin, TX: Pro-Ed.

Rispoli, M., & Hadley, P. (2001). The leading-edge: The significance of sentence disruptions in the development of grammar. *Journal of Speech, Language, and Hearing Research, 44,* 1131–1143.

Rothbart, M. K. (1981). Measurement of temperament in infancy. *Child Development, 52,* 569–578.

Rothbart, M. K. (2011). *Becoming who we are: Temperament and personality in development*. New York, NY: Guilford Press.

Rothbart, M. K., Ahadi, S. A., Hershey, K. L., & Fisher, P. (2001). Investigations of temperament at three to seven years: The Children's Behavior Questionnaire. *Child Development, 72,* 1394–1408.

Rothbart, M. K., & Rueda, M. R. (2005). The development of effortful control. In U. Mayr, E. Awh, & S. W. Keele (Eds.), *Developing individuality in the human brain: A tribute to Michael I. Posner* (pp. 167–188). Washington, DC: American Psychological Association.

Rueda, M. R., Fan, J., McCandliss, B. D., Halparin, J. D., Gruber, D. B., Lercari, L. P., & Posner, M. I. (2004). Development of attentional networks in childhood. *Neuropsychologia, 42,* 1029–1040.

Rueda, M. R., Posner, M. I., & Rothbart, M. K. (2005). The development of executive attention: Contributions to the emergence of self-regulation. *Developmental Neuropsychology, 28,* 573–594.

Sall, J., Creighton, L., & Lehman, A. (2005). *JMP start statistics: A guide to statistics and data analysis using JMP and JMP IN software*. Cary, NC: SAS Institute.

Salley, B. J., & Dixon, W. E., Jr. (2007). Temperamental and joint attentional predictors of language development. *Merrill–Palmer Quarterly, 53,* 131–154.

Sawyer, J., Chon, H., & Ambrose, N. G. (2008). Influences of rate, length, and complexity on speech disfluency in a single-speech sample in preschool children who stutter. *Journal of Fluency Disorders, 33,* 220–240.

Saygin, A. P., Dick, F., Wilson, S. W., Dronkers, N. F., & Bates, E. (2003). Neural resources for processing language and environmental sounds: Evidence from aphasia. *Brain, 126,* 928–945.

Schwenk, K., Conture, E., & Walden, T. (2007). Reaction to background stimulation of preschool children who do and do not stutter. *Journal of Communication Disorders, 40,* 129–141.

Seery, C. H., Watkins, R. V., Mangelsdorf, S. C., & Shigeto, A. (2007). Subtyping stuttering II: Contributions from language and temperament. *Journal of Fluency Disorders, 32,* 197–217.

Shrout, P. E., & Fleiss, J. L. (1979). Intraclass correlations: Uses in assessing rater reliability. *Psychological Bulletin, 86,* 420–428.

Silverman, E. M. (1971). Situational variability of preschoolers' disfluency: Preliminary study. *Perceptual & Motor Skills, 33,* 1021–1022.

Slomkowski, C. L., Nelson, K., Dunn, J., & Plomin, R. (1992). Temperament and language: Relations from toddlerhood to middle childhood. *Developmental Psychology, 28,* 1090–1095.

Thomas, A., & Chess, S. (1977). *Temperament and development*. New York, NY: Brunner/Mazel.

Thomas, A., & Chess, S. (1980). *The dynamics of psychological development*. New York, NY: Brunner/Mazel.

Tumanova, V., Conture, E. G., Walden, T. A., & Lambert, E. W. (2014). Speech disfluencies of preschool-age children who do and do not stutter. *Journal of Communication Disorders, 49,* 25–41.

UCLA Statistical Consulting Group. (n.d.). *Introduction to SAS*. Retrieved from http://www.ats.ucla.edu/stat/stata/faq/effectsize.htm

Van den Bergh, B. R., & Ackx, M. (2003). Een Nederlandse versie van Rothbarts "Children's Behavior Questionnaire" [A Dutch version of Rothbarts "Children's Behavior Questionnaire"]. *Kind en Adolescent, 24*(2), 53–57.

Vasiç, N., & Wijnen, F. (2001, August 29–31). *Stuttering and speech monitoring*. Paper presented at the International Speech Communication Association (ICSA) Tutorial and Research Workshop (IRTW) on Disfluency in Spontaneous Speech (DiSS), Edinburgh, United Kingdom.

Volker, M. A. (2006). Reporting effect size estimates in school psychology research. *Psychology in the Schools, 43,* 653–672.

Wagovich, S. A., Hall, N. E., & Clifford, B. A. (2009). Speech disruptions in relation to language growth in children who stutter: An exploratory study. *Journal of Fluency Disorders, 34,* 242–256.

Walden, T. A., Frankel, C. B., Buhr, A. P., Johnson, K. N., Conture, E. G., & Karrass, J. M. (2012). Dual diathesis-stressor model of emotional and linguistic contributions to developmental stuttering. *Journal of Abnormal Child Psychology, 40,* 633–644.

Watkins, R. (2005). Language abilities of young children who stutter. In E. Yairi & N. Ambrose (Eds.), *Early childhood stuttering: For clinicians by clinicians* (pp. 235–252). Austin, TX: Pro-Ed.

Watkins, R., Yairi, E., & Ambrose, N. G. (1999). Early childhood stuttering III: Initial status of expressive language abilities. *Journal of Speech, Language, and Hearing Research, 42,* 1125–1135.

Westby, C. E. (1974). Language performance of stuttering and nonstuttering children. *Journal of Communication Disorders, 12,* 133–145.

Westfall, P., Tobias, R., & Wolfinger, R. D. (1999). *Multiple comparisons and multiple tests using the SAS system*. Cary, NC: SAS Institute.

Williams, K. T. (1997). *Expressive Vocabulary Test*. Circle Pines, MN: AGS.

Yairi, E., & Ambrose, N. G. (1999). Early childhood stuttering I: Persistency and recovery rates. *Journal of Speech, Language, and Hearing Research, 42,* 1097–1112.

Yairi, E., & Ambrose, N. G. (2005). *Early childhood stuttering for clinicians by clinicians*. Austin, TX: Pro Ed.

Yairi, E., & Ambrose, N. (2013). Epidemiology of stuttering: 21st century advances. *Journal of Fluency Disorders, 38,* 66–87.

Yaruss, J. S. (1997). Clinical implications of situational variability in preschool children who stutter. *Journal of Fluency Disorders, 22,* 187–203.

Yaruss, J. S. (1998). Real-time analysis of speech fluency: Procedures and reliability training. *American Journal of Speech-Language Pathology, 7,* 25–37.

Yaruss, J. S. (1999). Utterance length, syntactic complexity, and childhood stuttering. *Journal of Speech, Language, and Hearing Research, 42,* 329–344.
Yaruss, J. S., LaSalle, L. R., & Conture, E. G. (1998). Evaluating stuttering in young children: Diagnostic data. *American Journal of Speech-Language Pathology, 7,* 62–76.
Yoder, P., & Symons, F. (2010). *Observational measurement of behavior*. New York, NY: Springer.
Zackheim, C. T., & Conture, E. G. (2003). Childhood stuttering and speech disfluencies in relation to children's mean length of utterance: A preliminary study. *Journal of Fluency Disorders, 28,* 115–142.

Appendix A (p. 1 of 2)

Summary of Studies Assessing Attentional Differences Between Children Who Do and Do Not Stutter

Table A1. Summary of empirical studies using caregiver reports to assess between-groups (children who stutter [CWS] vs. children who do not stutter [CWNS]) differences in attention.

		Participants			
Study	**Caregiver measure**	**CWS (*n*)**	**CWNS (*n*)**	**Age range (years;months)**	**Findings[a]**
Anderson et al. (2003)	BSQ	31	31	3;0–5;4	• CWS exhibited lower scores on the Distractibility subscale. • Between-groups differences approached significance, with CWS exhibiting higher scores on the Attention Span/ Persistence subscale.
Anderson & Wagovich (2010)	CBQ-SF	9	14	3;6–5;2	• No group differences were found on the Attention Focusing subscale.
Eggers et al. (2010)	CBQ-D	58	58	3;4–8;11	• CWS exhibited lower attention shifting scores compared with CWNS. • No group differences were found on the Attention Focusing subscale.
Embrechts et al. (2000)	CBQ	38	38	3;0–7;8	• CWS exhibited lower focusing scores compared with CWNS.
Karrass et al. (2006)	Modified BSQ[b]	65	56	3;0–5;11	• CWS exhibited lower attention regulation scores compared with CWNS.

Note. BSQ = Behavioral Style Questionnaire (McDevitt & Carey, 1978); CBQ-SF = Children's Behavior Questionnaire–Short Form (Putnam & Rothbart, 2006); CBQ-D = Dutch version of the Children's Behavior Questionnaire (Van den Bergh & Ackx, 2003); CBQ = Child Behavior Questionnaire (Rothbart, Ahadi, Hershey, & Fisher, 2001).

[a]Attention shifting and attention focusing are the attentional constructs or processes conceptualized by Rothbart (2011) that could be measured using various versions of the CBQ. *Attention focusing* refers to the "tendency to maintain attentional focus upon task-related channels" (p. 52). *Attention shifting* refers to the ability to transfer attentional focus from one activity or task to another. [b]Karrass et al. (2006) used a modified version of the BSQ, from which a measure of attention regulation was derived. These authors reported that comparisons were made between the derived measures of attention regulation and another well-known measure of attention—the CBQ. Findings indicated that the "BSQ attention regulation was associated with CBQ attention shifting, $r(34) = .67$, $p < .001$" (p. 409). Therefore, this derived measure of attention regulation related to attention shifting.

Appendix A (p. 2 of 2)

Summary of Studies Assessing Attentional Differences Between Children Who Do and Do Not Stutter

Table A2. Summary of empirical studies that used experimental paradigms to assess between-groups (children who stutter [CWS] vs. children who do not stutter [CWNS]) differences in attention.

		Participants			
Study	**Experimental attention task or measure**	**CWS**	**CWNS**	**Age range (years;months)**	**Findings**
Bush (2006)	• Frequency and latency of looks away from the computer monitor during narratives • Frequency and latency of off-topic statements during narratives	15	17	3;0–5;7	• CWS exhibited slower and less frequent looks away from stimuli compared with CWNS. • No group differences were found in frequency of or latency to first off-topic statements.
Eggers et al. (2012)	Performance on a computerized Attention Network Test[a]	41	41	4;0–9;0	• CWS exhibited lower orienting network scores compared with CWNS. • No group differences were found for the alerting or executive control networks.
Johnson et al. (2012)	Speed and accuracy of nonspeech reaction time (i.e., button pushing) during traditional and affect-cueing tasks[b]	12	12	3;0–5;11	No group differences were found.
Ntourou et al. (2013)	Frequency of distraction behaviors[c]	18	18	3;0–5;11	No group differences were found.
Schwenk et al. (2007)	• Frequency and duration of attention shifts from task to camera movements • Latency of attention shifts (i.e., reaction time) between onset of camera movement and onset of attention shift to look at the camera	18	18	3;0–5;11	• CWS exhibited a greater frequency of looks per camera movements. • No group differences were found in duration of looks (attention shifts) at the camera following its movement. • CWS exhibited slower reaction times compared with CWNS.

[a]The Attention Network Test (Fan, McCandliss, Sommer, Raz, & Posner, 2002) is a computerized instrument designed to measure the attentional networks of “alerting, orienting, and executive control in adults and in children” (Eggers et al., 2012, p. 947). [b]Both traditional and affect-cueing tasks require “disengaging attention from focal point, shifting attention to [un]cued location, and [re]engaging attention to stimulus” (Johnson et al., 2012, p. 265). However, affect-cueing tasks immediately follow instructions designed to influence participants’ emotionality. For further review, see Johnson et al. (2012). [c]Distraction behaviors were defined as “the diversion of attention to something other than the . . . [experimental] tasks” (Ntourou et al., 2013, p. 266).