HHS Public Access

Author manuscript

Acta Neuropsychol. Author manuscript; available in PMC 2017 December 04.

Published in final edited form as:

Acta Neuropsychol. 2004 ; 2(1): 70–85.

Conversational fluency and executive function in adolescents with conduct disorder

Lyn S. Turkstra, **Tracy Fuller**, **Eric Youngstrom**, **Kristen Green**, and **Elizabeth Kuegeler**

Case Western Reserve University, Cleveland, Ohio, USA

SUMMARY

Background—EF impairments are known to occur among adolescents with conduct disorder (CD) but their influence on communication ability is not well-understood. The purpose of this study was to relate scores on a clinical EF questionnaire to performance on a communication task. Extemporaneous conversation was chosen as the target task, because it places a high demand on EFs and it is a critical medium for adolescent social development.

Material and Methods—The participants were 18 incarcerated adolescents with conduct disorder (I-CD), 12 incarcerated adolescents without CD (I-NCD), and 26 typically developing (TD) non-incarcerated adolescents. Participants completed the Self-Report form of the Behavior Rating Inventory of Executive Function (BRIEF) and extemporaneous conversations.

Results—The I-CD and I-NCD groups produced four times more dysfluencies in conversation than the TD group. There was also a significant group effect on BRIEF subscores for executive memory (TD vs. I-CD), but not for planning and organization. Fluency data correlated significantly with BRIEF scores for executive memory, and the combination of fluency and BRIEF data accounted for 65% of the variance in group membership between TD adolescents and their incarcerated peers, regardless of CD diagnosis.

Conclusions—BRIEF scores seem to be related to performance on communication tasks relevant for adolescents in daily living. Our results also revealed very high dysfluency rates among incarcerated juveniles. The EF and conversation measures differentiated incarcerated vs. non-incarcerated juveniles, but were less sensitive to CD.

Keywords

verbal communication; incarcerated juvenile; self-rating; cognition

INTRODUCTION

Tests of executive functions (EFs) may be used to predict behavior outside of clinical settings, but the validity of many EF measures for this purpose has not been established (Sbordone 1996; Stuss & Alexander 2000). This may be due in part to the fact that "executive function" is not a unitary construct (Mesulam 2002), but rather, as Stuss and

Correspondence to: Dr. Lyn Turkstra, Department of Communicative Disorders, University of Wisconsin-Madison Goodnight Hall, 1975 Willow Drive-Madison WI 53706, USA-PHONE: (+1 608) 262-7583, FAX: (+1 608) 262-6466, lsturkstra@wisc.edu.

Alexander proposed (Stuss & Alexander 2000), a family of processes "which converge on the general concept of control functions" (p. 289). Thus, attempts to link scores on a global EF measure to performance in a specific activity in daily living may be unrealistic. Alternatively, individual EF sub-processes may be correlated with different elements of task performance. For example, Burgess and colleagues (Burgess et al. 1998) found that responses on a questionnaire of EFs in daily living could be described by three underlying cognitive factors: Inhibition, intentionality (e.g., planning and decision-making), and executive memory. Burgess et al. found that questionnaire responses on these three factors differentially correlated with standardized test scores from a battery of EF tests. Thus, it was possible to identify different EF sub-processes using formal tests, and relate these test scores to clusters of behaviors in everyday living.

In addition to predicting behavior outside of clinical settings, the assessment of EF sub-processes is important for intervention planning. The umbrella term of EFs includes functions as diverse as self-regulation (Barkley 1997, see also review in Ylvisaker & Feeney 2002), humor, self-awareness, and the use of strategies to aid learning and recall (Stuss & Alexander 2000). There may be a tendency to think of patients with frontal lobe dysfunction – developmental or acquired - as impaired in all of these functions. In fact, individuals are likely to be as heterogeneous in frontal lobe functions as they are in frontal neuroanatomy (Stuss & Alexander 2000). Each individual will present with a unique profile of strengths and weaknesses, and a test of EFs that permits the evaluation of sub-processes may help tailor intervention to that person's individual needs.

Although the measurement of EF sub-processes may be desirable, the instruments available for this purpose have several limitations. First, many EF tests were designed for other purposes (Stuss & Alexander 2000). Individuals with EF impairments may have coexisting cognitive and perceptual deficits, which confound the interpretation of results of "borrowed" tests. For example, discourse macrostructure is considered to reflect frontal dysfunction in children with TBI (e.g. Chapman et al. 1992), but the typical elicitation task is story retelling, which may make memory demands that confound the interpretation of EF contributions. A second limitation of existing measures is that evaluation in clinical settings does not capture the challenges of real-world settings, in part because of the support provided by the examiner and environment (Ylvisaker & Szekeres 1989a). Thus, even the most reliable clinical EF measure may not predict performance in the fluid and unstructured contexts of daily life. A third limitation peculiar to children is that adult models of EF assessment may not apply to developing nervous systems (see discussion in Gioia et al. 2002). Although developmental models of EFs have been proposed (e.g. Anderson, Levin, & Jacobs 2002; Dennis 1991) and predictions based on these models have been tested empirically (e.g. Dennis et al. 1998; Dennis et al. 1996; Dennis et al. 2001), this information is just beginning to be translated into standardized assessment.

In this study, self-ratings of two EF sub-processes were compared to performance on a communication task in daily living. The EF sub-processes were identified using a novel EF measure, the Behavior Rating Inventory of Executive Function, Self-Report Form for adolescents (BRIEF, Gioia et al. 2000b), which was designed to capture the behavior of children and adolescents in everyday life contexts. The authors' hypothesis was that

responses on the BRIEF would be related to verbal fluency in extemporaneous conversation, a measure selected to capture elements of EF in daily communication.

The BRIEF, originally developed for children (Gioia et al. 2000a), is a standardized questionnaire that asks about an examinee's behavior over the preceding six months in several domains of EF, including working memory, inhibition, shifting behaviors, completing tasks, and organizing oneself and one's possessions. Scores on the Parent Report form of the BRIEF discriminated typically developing children from those with reading disorders, attention deficit/hyperactivity disorder, traumatic brain injury, or autistic spectrum disorders (Gioia et al. 2002). Given its basis in observation of daily behavior, the BRIEF was considered to be more likely than laboratory-generated EF tests to have predictive value for behaviors beyond clinical settings. In addition, the BRIEF factor structure suggested two distinguishable EF factors that could be characterized as reflecting intentionality vs. executive memory and inhibition, similar to the factors of Burgess et al. (1998).

The investigators compared BRIEF scores to measures of conversational dysfluency. Conversational fluency is an aspect of communication that is thought to reflect EFs such as organization and planning (Chapman et al. 1992; Coelho, Liles, & Duffy 1994; VanLeer & Turkstra 1999), and executive memory (German & Simon 1991). Dysfluencies in conversational discourse may be defined as "disturbances in the flow of information that result from any one of a number of language and non-language behaviors that impair continuity of language sequencing and information content" (Shadden 1998: 52). While such disturbances are present to some extent in the conversation of all speakers, the nature and degree of disruption may differentiate normal speakers from those with communication disorders (Shadden 1998). In addition, conversational fluency may be related to listener burden, which in turn may affect the listener's willingness to engage in conversation with a dysfluent speaker. Thus an understanding of conversational dysfluency has both clinical and social implications.

The participants in the study were typically developing adolescents and their peers with a diagnosis of Conduct Disorder (CD). CD is defined as "a repetitive and persistent pattern of behavior in which the basic rights of others or major age-appropriate societal norms or rules are violated" (DSM-IV 1994). It is diagnosed in approximately 9 percent of boys and 2-9 percent of girls under the age of 18 years in the United States (Ford-Martin 1999). The diagnosis requires the presence within the preceding six months of clinically significant impairments in social, academic, or occupational functioning, related to antisocial behavior (DSM-IV 1994).

The CD group was selected for comparison because EF impairments have been identified in several studies of children and adults with CD (Clark, Prior, & Kinsella 2000; Giancola & Mezzich 2000; Teichner & Golden 2000; Toupin et al. 2000). This population was also of interest because previous investigators have reported differences on standardized language tests between children with CD and their typically developing peers (Berger 2000; Giancola & Mezzich 2000; Wilson & Hernstein 1985), and these differences were found to be mediated by executive function deficits (Giancola & Mezzich 2000). That is, children with CD may have communication problems related to executive dysfunction. This has

significant implications for their ability to express and defend themselves in social, academic, and judicial settings. From a public health perspective, individuals in this group tend to be refractory to conventional intervention (judicial or rehabilitative), and a greater understanding of their EF strengths and limitations could lead to improved treatment approaches (Paschall & Fishbein 2002).

The CD participants in this study were incarcerated juveniles. As EF impairments have been found in incarcerated individuals regardless of the diagnosis of CD (Teichner & Golden 2000), the study included a comparison group of incarcerated adolescents without a CD diagnosis. As differences in demographic variables may differentiate incarcerated from non-incarcerated juveniles (e.g. the population at the facility from which participants were recruited was over 90% African American, with a majority of males), and because age was a factor in scores on the Parent Report Form of the BRIEF for younger children (Gioia et al. 2000a), the incarcerated and non-incarcerated groups were matched as closely as possible for age, race, and sex.

To summarize, the study hypotheses were that:

1. self-reports of EF in daily living, as measured by BRIEF scores, would be significantly related to measures of conversational dysfluency in adolescents with and without a diagnosis of CD;
2. adolescents with a diagnosis of CD would be more dysfluent than their typically developing peers, and also would have lower self-ratings of executive function on the BRIEF;
3. differences between CD and non-CD groups would outweigh differences due to incarceration.

MATERIAL AND METHODS

Participants

The participants were 18 incarcerated adolescents with a diagnosis of Conduct Disorder (I-CD group), 12 incarcerated adolescents with no diagnosis of CD (I-NCD group), and 26 typically developing adolescents (TD group). Participant demographic characteristics are summarized in Table 1. The I-CD and I-NCD group members were incarcerated at a minimum-security detention center, in which most residents were convicted of drug-related offenses. The diagnosis of CD was based on the results of the Computer-Assisted SCID II (CASII) structured clinical interview for DSM-IV axis II personality disorders, administered by research assistants under the supervision of authors Youngstrom and Green. The TD group members were recruited from area schools and community sources as part of a larger study of social communication in adolescents.

Participants in all three groups were required to have no history of special education services or diagnosis of language or learning disability or mental retardation. This was determined by a review of academic records (for I-CD and I-NCD participants) or parent report (for TD participants). Participants were further required to have no neurological or psychiatric disorder affecting cognitive function, other than the CD diagnosis. Participants in the TD

group represented a range of sociodemographic backgrounds, including urban and suburban settings, with parent occupations encompassing the range of scores on the Hollingshead Four Factor Index of Occupations (Hollingshead 1975), from Unemployed or Menial Service Workers to Major Professionals. Parent employment information was not available for the I-CD and I-NCD groups, although socioeconomic status would be expected to be lower in an incarcerated sample (Wilson & Hernstein 1985), a factor that will be considered further in the discussion.

As there were fewer African American males in the TD population from which the study group was drawn, it was not possible to match four of the I-CD and I-NCD Group males. To maximize the sample size, these unmatched African American males were retained.

Tasks

Conversation Task—Each participant engaged in an extemporaneous conversation on a topic of his or her choice for 1-3 minutes. If the participant did not generate a topic, he or she was offered a choice of topics identified by adolescent focus group participants in prior research (Turkstra 2000). These topics included music, movies, and sports. For the TD participants, the partner was a peer (n = 19), or student or faculty researcher (n = 7). For the I-CD and I-NCD participants, the partner was always a student researcher. The conversations of TD participants were videotaped and the conversations of I-CD and I-NCD participants were audiotaped, for later analysis.

BRIEF—The BRIEF (Gioia et al. 2000a) was designed to function as both a screening measure and a component of a more extensive neuropsychological assessment of EFs. Gioia and colleagues originally designed the BRIEF to be completed by parents and teachers of children, and it was standardized on 1419 parents of children in diverse socioeconomic groups and geographical settings. Scores were stable over several weeks in both normal and clinical populations (Gioia et al. 2000b). The BRIEF was adapted by its authors to permit self-assessment of executive function by adolescents (Gioia et al. 2000a). The standardized Self-Report BRIEF currently is in press, and a research version was used in the present study. The investigators provided respondents with a scoresheet listing all questions, and asked participants to indicate whether each statement on the questionnaire never, sometimes, or often applied to them over the past six months. The items included questions such as, “I get caught up in details and miss the big picture,” “I have good ideas but cannot get them on paper,” “I interrupt others,” “I make careless errors,” and “I forget what I am doing.”

Procedure

Typically developing adolescents who chose to participate, or their parents (for minor participants), completed a consent process approved by the relevant institutions (e.g., their school, the University Institutional Review Board, the correctional facility). For the incarcerated juveniles, the institution acted in loco parentis to provide informed consent, as approved by the Institutional Review Board of the University Hospitals of Cleveland Research Institute and the administration of the juvenile facility. Each adolescent in the TD group was paid $10 per hour of participation. In keeping with the policies of the detention

facility, I-CD and I-NCD group participants were not paid for their participation, but received a soda and a chocolate bar to thank them for their time.

Participants in the TD group completed the BRIEF questionnaire individually during the course of their participation in the larger study. Participants in the incarcerated groups completed the BRIEF in groups of four to eight. The investigators gave each participant a questionnaire form, and asked him or her to follow along and indicate a response while the examiner read each statement aloud. All participants completed the conversation task individually. The order of tasks was randomized.

For all participants, code names were used to protect their privacy. These codes were separated from participant identifying information, and the names of the incarceration facility and participating schools and community institutions are not stated here.

Data Analysis

The conversations were transcribed orthographically and then divided into T-units. A T-unit was defined as a main clause and its subordinates (Scott 1988). A main clause that began with a coordinating conjunction (e.g., “and”, “or”) was considered a separate T-unit rather than a dependent clause of the preceding T-unit. If the coordinated clause included a co-referential subject deletion, the utterance still was considered a T-unit as long as it contained a main clause including a predicate (e.g., “I got sent here (1) / and have to stay in for two months (2)”).

Participants in the TD group produced longer conversations on more topics than those in the I-CD Group and I-NCD Groups. Therefore, only the first topic of conversation was used for all participants. The transcribed conversations were analyzed for three types of dysfluencies, defined according to the following criteria of Dollaghan and Campbell (1992):

- *Repetitions.* A repetition was defined as the exact duplication of a linguistic unit of any length, from a word to an entire clause, with no other utterances besides fillers [such as um or uh] allowed in between. For example, the T-unit “he said he said I could go to the store” contains the repeated unit, “he said”.
- *Revisions.* Revisions were defined as reliably recognizable modifications of a T-unit already produced by the speaker. The revision may be to correct an error or to add, delete, or change information. An example is the following T-unit: “My dad comes to see me once every two weeks every three weeks.” The phrase “every two weeks” was revised to “every three weeks”.
- *Orphans.* Orphans were defined as units that had no reliably identifiable relationship to other units. For example, in the utterance, “I saved up in / all my money”, “in” is an orphan. An orphan also may be an entire abandoned train of thought, such as in the following utterance: “I wanted to / we’re watching a movie later.” In this case, “I wanted to” is an orphan.

Scoring reliability for conversation measures

Inter-rater reliability was calculated by having a second rater segment 10% of the transcripts into T-units and analyze verbal disruptions for these transcripts. Reliability was calculated as percent agreement between the two raters. T-unit segmentation reliability was computed according to the guidelines of Hux et al. (1997), using the following formula: (number of segmentation agreements/(number of segmentation agreements + number of segmentation disagreements)) × 100.

Statistical Analysis

The number of dysfluencies was calculated by summing for each participant. This total was divided by the number of T-units to yield the number of dysfluencies per T-unit. In a previous study, conversations with non-peer (i.e. researcher) partners had higher coherence ratings than those with peer partners, in part because researcher partners tended to ask more direct questions and therefore provided more structure for responses (Turkstra 2001). As TD Group members had both peer and non-peer partners whereas all I-NCD and I-CD Group members had non-peer partners, the potential effects of conversation partner on fluency were first evaluated by performing a t-test comparing the two TD subgroups. The TD group members with peer partners produced significantly more dysfluencies, $t(24) = 3.02$, $p = .0059$. As this was in the opposite direction of the study hypothesis (that is, CD group members had non-peer partners and therefore would have a fluency advantage), any statistically significant results would be in spite of this difference.

The BRIEF responses were converted to numeric data (Never = 1, Sometimes = 2, Often = 3), and scores for item clusters were derived in accordance with the test authors' instructions. The nine item clusters were: Emotional Control, Inhibition, Cognitive Flexibility, Shift, Working Memory, Planning and Organization, Organization of Materials, Self-Monitoring, and Task Completion. To minimize the number of analyses and maximize statistical power, a principal components analysis (Floyd & Widaman 1995) was used to summarize the relations among the nine BRIEF item clusters and generate summary scores. The analysis was based on BRIEF responses from the 26 TD group members and 50 typically developing adolescents who participated in previous research by the first author and met the same criteria for inclusion as those in the present study. Multiple decision rules informed the choice of the number of components to retain, including the rule of scree plot and eigen values greater than one, as well as the two most accurate algorithms, the Minimum Average Partials (MAP) and Parallel Analysis (PA) methods (O'Connor 2000; Zwick & Velicer 1986). To test the hypothesis that BRIEF scores would predict dysfluency, dysfluency rates per T-unit were regressed on component scores representing the two BRIEF factors.

In a preliminary analysis, the authors evaluated the ability of EF and dysfluency rates to discriminate youths with vs. without conduct disorder using forward entry stepwise logistic regression. Similarly, the authors used stepwise logistic regression to test whether EF and dysfluency made unique contributions to the prediction of incarceration.

RESULTS

Scoring eeliability

Inter-rater agreement for T-unit segmentation was 85%. Agreement for dysfluency identifications was 81%. These were considered acceptable.

Fluency

The fluency data are summarized in Table 2. There was a main effect of Group on the number of dysfluencies per t-unit, $F(2, 53) = 3.69$, $p < .05$, and no effect of partner, $F(1,53) = .51$, $p > .05$. Overall, adolescents in the two incarcerated groups produced approximately four times more dysfluencies than their non-incarcerated peers. Sheffé post-hoc analysis revealed that the TD group was significantly different from both the I-NCD and I-CD groups, and there was no significant difference between the two incarcerated groups.

BRIEF

BRIEF cluster scores for the three groups are shown in Table 3. The item groupings on the BRIEF were highly correlated and could be summarized into one or two global scores. MAP, the scree plot, and the Kaiser criterion (eigenvalues > 1) suggested a two-component solution, and Glorfeld's extension of PA suggested a one-factor solution (Glorfeld 1995). Promax rotation of the two component solution produced an interpretable pattern matrix, with the two factors correlating at $r = .53$. Multiple decision rules supported a two factor solution, and the BRIEF developers also reported a two factor solution in the standardization sample for the Teacher and Parent Report version of the BRIEF (Gioia et al. 2000a). Therefore, the two-factor solution was used in subsequent analyses. The first factor included the following item clusters: Emotional Control, Cognitive Flexibility, Shifting, Planning and Organization, Organization of Materials, and Task Completion. This factor may generally be characterized as representing abilities related to the flexible planning and execution of tasks. The second factor included item clusters for Inhibition, Working Memory, and Self-Monitoring, and could be generally characterized as representing ongoing control of memory and performance, similar to what Burgess et al. (1998) referred to as executive memory. The factor loadings for the two-factor solution are presented in Table 4, and are based on a PROMAX rotation of a principal axis factor extraction (Gorsuch 1983).

There was no significant difference among the three groups in total BRIEF scores, $F(2,53) = 1.05$, $p = .36$, or in scores for the first factor, $F(2, 53) = 1.79$, $p = .18$. There were, however, significant differences in scores on the second factor, $F(2,53) = 3.81$, $p = .03$. A Bonferroni post-hoc analysis revealed significant differences between the TD and I-CD groups only.

Executive function vs. conversational fluency

The regression model relating BRIEF factor scores to dysfluencies was significant, $F(2,53) = 6.17$, $p = .004$, although the model accounted for a relatively small percent of variance (16%). The executive memory factor contributed significantly to the model, $t = -3.46$, $p = .001$; the factor related to planning and execution did not contribute significantly, $t = 1.46$, $p = .15$.

A logistic regression analysis revealed that the combination of dysfluency and BRIEF data significantly discriminated between those with a diagnosis of CD and their peers without CD, chi-squared (3) = 18.72, p = .0003, with significant contributions of dysfluencies and the executive memory BRIEF factor. The model accounted for 27% of the variance in group membership. As the major group differences in fluency and BRIEF data were between incarcerated vs. non-incarcerated juveniles rather than between those with and without a CD diagnosis, the data were re-analyzed using those two groups. Again, the combination of dysfluency and BRIEF scores discriminated between the two groups, chi-squared (3) = 49.92, p = .0000. There were significant contributions of both dysfluencies and the planning and execution factor, and the EF factor approached significance (p = .07). The model accounted for 65% of the variance in group membership, with an 88% correct classification rate when applied retrospectively.

DISCUSSION

The goals of the present study were to determine whether

1. conversational dysfluencies would be associated with self-ratings of EF;
2. adolescents with conduct disorder would show greater dysfluencies and lower self-ratings of EF in daily living than would a comparison group of non-CD adjudicated peers;
3. adjudicated adolescents with CD would show greater dysfluency than their adjudicated peers without a CD diagnosis.

The study hypotheses were supported in part. BRIEF scores were correlated with conversational dysfluency in this sample of adolescents, but the percent of variance accounted for was relatively small. Adolescents with a diagnosis of CD were significantly less fluent than their typically developing peers, and also rated themselves as poorer in executive function on some measures. These differences, however, were confounded by incarceration, as incarcerated juveniles were less fluent and had lower self-reported executive function abilities than their non-incarcerated peers, regardless of the diagnosis of CD.

The ability to generate mathematically and conceptually distinguishable EF sub-scores was useful in between-group comparisons and in the evaluation of EF effects on conversational fluency. While the BRIEF total score did not differentiate among the three groups of participants, the subscore related to planning and execution differed significantly among groups. Although this was primarily due to differences between typically developing adolescents and incarcerated adolescents with a CD diagnosis, inspection of the average cluster scores in Table 3 reveals that overall the data were as one might expect, with the scores of incarcerated juveniles without a CD diagnosis falling between those of adolescents with CD and their non-incarcerated peers. Significant differences may have emerged in a larger sample.

In regard to EF-fluency relationships, the results suggested that self-reported working memory, inhibition, and self-monitoring – a group of factors that may be conceptualized as

"executive memory" – were more related to the maintenance of a fluent conversation than were EF skills related to planning and organization. On the surface, this may seem counterintuitive, as planning might appear to be the most likely contributor to smooth verbal production. It must be noted, however, that planning is evaluated on the BRIEF at the macroscopic level (e.g. event planning), whereas the type of planning that underlies word choice in extemporaneous conversation is at the microscopic level (e.g., the moment-to-moment selection of appropriate words based on the speaker context, prior information, and future demands). This level of organization may be more likely to be influenced by working memory and inhibition. The relationship between executive function scores and conversational measures could be strengthened by adding items more closely related to communication in daily living (e.g., "I'm always mixing up words and having to change what I'm saying.") to the BRIEF.

The most striking finding in the study was the dysfluency of the incarcerated juveniles. The children and adolescents in this study were often in contexts in which verbal agility was required to successfully avoid future adjudication. These included peer contexts (e.g. full participation in group activities at the detention facility, negotiation of peer conflicts), employment settings, school, and judicial contexts (e.g. defending themselves and accounting for their behavior). Whereas their typically developing peers were producing, on average, one revision, repetition, or orphan every 10 T-units, the incarcerated individuals were dysfluent approximately every second T-unit. Consider the following example, in which dysfluencies are noted with underlining and t-unit boundaries are indicated by forward slashes (/):

> "When I was younger I used to play football for the [team name] / and every like every Sunday my father / we had games / and every Sunday my father wake me up early in the morning / and we'd go get / eat the / we'd go out to breakfast."

The first dysfluency is a repetition of "every," and the second and third are revisions. The revision of "every Sunday my father" may have been made to provide more context information to the listener (the team's Sunday games would set the stage for his father waking him up on Sundays), and the revision of "go get" and "eat the" may be indications of word-finding difficulty.

In the next example, the speaker is re-telling a movie plot. Although there are only two revisions and one repetition, they are at key points in the narrative in terms of their potential to distract the listener from the main idea:

> "It's about um this lady and her um boyfriend / they was going on a hunt / well not a hunting but a vacation / they was on vacation from their jobs / and she had / her um boss had called her back to come / so she was flying back / and the um pilot had crashed / it was it was a rainy day / the pilot had crashed / and they was stuck on this one island."

It is noteworthy that the speaker attempts 11 t-units to communicate four main elements of the story:

1. a woman and her boyfriend are on vacation from work;

2. the woman's boss asks her to fly back to work;
3. because of bad weather the plane she was taking crashes on an island;
4. she and the pilot are stranded.

Two of the 11 t-units may have been necessitated by the dysfluencies. The first is the statement that "they was on vacation from their jobs", which may have served the purpose of reiterating that it was not a hunting trip. The second is the repetition that the "pilot had crashed," which may have been made because the earlier statement that the pilot had crashed was made before specifying that it was a rainy day (i.e. justifying the crash). Thus, dysfluency may have both local effects – e.g. distracting the listener at the moment the dysfluency is produced – and "downstream" effects on other elements of discourse.

Executive function skills accounted for a portion of the difference in dysfluency between the incarcerated and non-incarcerated groups, evidenced by the correlation between BRIEF scores and fluency data, but other factors also may have contributed. One potential influence might be performance pressure associated with participation in the study, given the fact that adults often evaluate the performance of incarcerated juveniles. Although this may not be ruled out, there are several factors that make it unlikely. First, individuals in the CD group were on average less fluent than their incarcerated peers without CD. If performance anxiety were a factor, one might expect the adolescents with CD to be less anxious and therefore more fluent, based on their clinical characteristics. Second, it could be argued that typically developing participants would also be subject to performance anxiety, particularly as they were videotaped rather than audiotaped, as the incarcerated juveniles were. Third, there were no behavioral indications that the incarcerated adolescents were more anxious than the non-incarcerated group. In fact, several of the incarcerated participants spontaneously shared information about personal events and feelings that one might not expect if they feared evaluation. A more likely explanation of the effect of incarceration is that it is a surrogate marker for socioeconomic status, which in turn may be related to education and verbal skills. The lack of access to socioeconomic information limits interpretation of the study results, and in future research the effects of education and general verbal ability should be distinguished from those of executive function, to more clearly reveal the relationship between executive function and measures of daily communication performance.

In a preliminary retrospective analysis, the combination of EF and dysfluency scores was a significant predictor of both CD and incarceration. For the latter, scores on these two measures accounted for a substantial portion of group membership. As noted above, however, dysfluency may have been a surrogate marker for other factors. These factors should be considered in a future prospective study, as the findings could have an impact on decisions such as eliminating summer educational programs at the facility studied here.

CONCLUSIONS

In summary, scores on a novel EF test were significantly related to verbal fluency in a type of communication that is relevant to adolescents in daily living, providing preliminary evidence of the predictive validity of the BRIEF as a standardized EF measure. The ability to generate sub-scores was an advantage, as only some aspects of EF were related to verbal

performance. It should be noted, however, that EF test scores accounted for a relatively small percent of variance in verbal performance; factors such as intelligence and education also may have played a significant role and should be included in future studies.

Consistent with previous studies of EFs in adjudicated youth, the BRIEF and conversation measures differentiated incarcerated adolescents from their community-dwelling peers. It was, however, less sensitive to the diagnosis of CD. This may be attributable to the sample size, as scores of incarcerated non-CD participants tended to fall between those of the other two groups.

In addition to the results related to EF, a noteworthy outcome of the study was the finding of relatively high verbal dysfluency rates in a group of incarcerated juveniles. This has implications for their ability to speak for themselves in institutional settings. It was also of interest that the combination of dysfluency data and EF scores was a significant predictor of group membership. Future research should further explore the factors underlying this dysfluency and consider its impact on outcome for these at-risk youth.

Acknowledgments

This project was supported by the Howard Hughes Medical Institute, and by Grant DC-00163 from the National Institute on Deafness and Other Communication Disorders of the National Institutes of Health to Dr. Turkstra, and a grant from the Schubert Center for Child Development to Dr. Youngstrom. The authors wish to thank the staff and residents of the community juvenile detention facility for their assistance and participation in the study, and Daniel Fogerty for his assistance with data analysis.

References

Anderson, V., Levin, HS., Jacobs, R. Executive functions after frontal lobe injury: A developmental perspective. In: Stuss, DT., Knight, RT., editors. Principles of Frontal Lobe Function. New York: Oxford University Press; 2002. p. 504-527.

Barkley, RA. ADHD and the nature of self-control. New York, New York: The Guildford Press; 1997.

Berger M. The nonuse of figurative language in conduct-disordered adolescents. Dissertation Abstracts International: Section B: The Sciences and Engineering. 2000; 60(11-B):5762.

Burgess PW, Alderman N, Evans J, Emslie H, Wilson BA. The ecological validity of tests of executive function. Journal of the International Neuropsychological Society. 1998; 4:547–558. [PubMed: 10050359]

Chapman SB, Culhane KA, Levin HS, Harward H, Mendelsohn D, Ewing-Cobbs L, et al. Narrative discourse after closed head injury in children and adolescents. Brain and Language. 1992; 43:42–65. [PubMed: 1643511]

Clark C, Prior M, Kinsella GJ. Do executive function deficits differentiate between adolescents with ADHD and oppositional defiant/conduct disorder? A neuropsychological study using the Six Elements Test and Hayling Sentence Completion Test. Journal of Abnormal Child Psychology. 2000; 28(5):403–414. [PubMed: 11100915]

Coelho, CA., Liles, BZ., Duffy, RJ. Cognitive framework: A description of discourse abilities in traumatically brain-injured adults. In: Bloom, RL.Obler, LK.DeSanti, S., Ehrlich, JS., editors. Discourse analysis and applications. Hillsdale, New Jersey: Lawrence Erlbaum Associates, Inc; 1994. p. 95-110.

Dennis M. Frontal lobe function in childhood and adolescence: A heuristic for assessing attention regulation, executive control, and the intentional states important for discourse. Developmental Neuropsychology. 1991; 7(3):327–358.

Dennis M, Barnes M, Wilkinson M, Humphreys RP. How children with head injury represent real and deceptive emotion in short narratives. Brain and Language. 1998; 61:450–483. [PubMed: 9570873]

Dennis M, Barnes MA, Donnelly RE, Wilkinson M, Humphreys RP. Appraising and managing knowledge: Metacognitive skills after childhood head injury. Developmental Neuropsychology. 1996; 12(1):77–103.

Dennis M, Purvis K, Barnes MA, Wilkinson M, Winner E. Understanding of literal truth, ironic criticism, and deceptive praise following childhood head injury. Brain and Language. 2001; 76(2): 1–16. [PubMed: 11161351]

Dollaghan CA, Campbell TF. A procedure for classifying disruptions in spontaneous language samples. Topics in Language Disorders. 1992; 12(2):56–68.

DSM-IV. Diagnostic and Statistical Manual of Mental Disorders. Fourth. Washington, D.C: American Psychiatric Association; 1994.

First, MB., Gibbon, M., Spitzer, RL., Williams, JBW., Benjamin, LS. Computer-Assisted SCID II (CAS II) Computer Program. North Tonawanda, NY: Multi-Health Systems; 1997.

Floyd FJ, Widaman KF. Factor analysis in the development and refinement of clinical assessment instruments. Psychological Assessment. 1995; 7:286–299.

Ford-Martin PA. Gale Encyclopedia of Medicine: Conduct Disorder. 1999; 2002

German DJ, Simon E. Analysis of children's word-finding skills in discourse. Journal of Speech and Hearing Research. 1991; 34:370–382.

Giancola PR, Mezzich AC. Executive cognitive functioning mediates the relation between language competence and antisocial behavior in conduct-disordered adolescent females. Aggressive Behavior. 2000; 26(5):359–375.

Gioia, GA., Isquith, PK., Guy, SC., Kenworthy, L. Behavior Rating Inventory of Executive Function. Odessa, FL: Psychological Assessment Resources, Inc; 2000a.

Gioia GA, Isquith PK, Guy SC, Kenworthy L. Behavior Rating Inventory of Executive Function: Self-report version for adolescents and adults. 2000b Unpublished.

Gioia GA, Isquith PK, Kenworthy L, Barton RM. Profiles of everyday executive function in acquired and developmental disorders. Child Neuropsychology. 2002; 8(2):121–137. [PubMed: 12638065]

Glorfeld LW. An improvement on Horn's parallel analysis methodology for selecting the correct number of factors to retain. Educational and Psychological Measurement. 1995; 55(3):377–393.

Gorsuch, RL. Factor Analysis. Second. Hillsdale, NJ: Erlbaum; 1983.

Hollingshead, AB. Four factor index of social status. New Haven, Connecticut: Yale University; 1975.

Hux K, Sanger D, Reid R, Maschka A. Discourse analysis procedures: Reliability issues. J Commun Disord. 1997; 30:133–150. [PubMed: 9100128]

Mesulam, MM. The human frontal lobes: Transcending the default mode through contingent encoding. In: Stuss, DT., Knight, RT., editors. Principles of Frontal Lobe Function. New York: Oxford University Press; 2002. p. 8-30.

O'Connor BP. SPSS and SAS programs for determining the number of components using parallel analysis and Velicer's MAP test. Behavior Research Methods, Instruments & Computers. 2000; 32(3):396–402.

Paschall MJ, Fishbein DH. Executive cognitive functioning and aggression: A public health perspective. Aggression and Violent Behavior. 2002; 7:215–235.

Sbordone, RJ. Ecological validity: Some critical issues for the neuropsychologist. In: Sbordone, RJ., Long, CJ., editors. Ecological validity of neuropsychological tests. St. Lucie Press; 1996. p. 15-41.

Scott, CM. Spoken and written syntax. In: Nippold, MA., editor. Later language development: ages nine through nineteen. Austin, TX: Pro-Ed; 1988. p. 49-95.

Shadden, BB. Sentential/surface-level analysis. In: Cherney, LR.Shadden, BB., Coelho, CA., editors. Analyzing discourse in communicatively impaired adults. Gaithersburg, MD: Aspen Publishers, Inc; 1998.

Stuss DT, Alexander MP. Executive functions and the frontal lobes: A conceptual view. Psychological Research. 2000; 63:289–298. [PubMed: 11004882]

Teichner G, Golden CJ. The relationship of neuropsychological impairment to conduct disorder in adolescence: A conceptual review. Agression and Violent Behavior. 2000; 5(6):509–528.

Toupin J, Dery M, Pauze R, Mercier H, Fortin L. Cognitive and familial contributions to conduct disorder in children. Journal of Child Psychology and Psychiatry and Allied Disciplines. 2000; 41(3):333–344.

Turkstra L. Should my shirt be tucked in or left out? The communication context of adolescence. Aphasiology. 2000; 14(4):349–364.

Turkstra L. Partner effects in adolescent social communication. Journal of Communication Disorders. 2001; 34:151–162. [PubMed: 11322565]

VanLeer E, Turkstra L. Effect of narrative elicitation procedure on cohesion and coherence in traumatically brain-injured adolescents. Journal of Communication Disorders. 1999; 32:327–349. [PubMed: 10498013]

Wilson, JQ., Hernstein, RJ. Crime and human nature. New York: Simon and Schuster; 1985.

Ylvisaker M, Feeney T. Executive functions, self-regulation, and learned optimism in pediatric rehabilitation: A review and implications for intervention. Pediatric Rehabiliation. 2002; 5(2):51–70.

Ylvisaker M, Szekeres SF. Metacognitive and executive impairments in head-injured children and adults. Topics in Language Disorders. 1989a; 9(2):34–49.

Zwick WR, Velicer WF. Comparison of five rules for determining the number of components to retain. Psychological Bulletin. 1986; 99:432–442.

Table 1

Demographic information for typically-developing adolescents (TD Group), incarcerated adolescents with conduct disorder (I-CD Group), and incarcerated adolescents with no conduct disorder (I-NCD Group)

	TD Group *n*=26	I-CD Group *n*=19	I-NCD Group *n*=12
Males:Females	15:11	12:7	7:5
African-AmericarvCaucasian	13:13	10:9	9:3
Mean age (years, months)	15,9	15,9	15,9
Age range (years, months)	13,4-18,7	12,4-17,9	14,2-17,4

Table 2

Conversational fluency data for the TD, I-NCD and I-CD Groups (data are group averages)

	TD Group *n*=26	**I-CD Group *n*=19**	**I-NCD Group *n*=12**
Total T-units	20.42	12.50	14.05
Total dysfluencles	2.19	4.83	6.21
Dysfluencies per T-unit	0.11	0.42	0.45
Repetitions	0.50	1.92	2.32
Revisions	0.81	2.25	1.74
Orphans	0.88	0.92	1.37

Table 3

Group means for typically developing adolescents (TD Group) and incarcerated adolescents with a diagnosis of conduct disorder (I-CD Group) or without a diagnosis of conduct disorder (I-NCD Group)

	TD ***n*=26**	**I-NCD** ***n*=12**	**I-CD** ***n*=18**
Emotional Control	1.70	1.79	1.95
Inhibition	1.70	1.71	1.78
Cognitive Flexibility	1.62	1.80	1.86
Shift	1.57	1.83	1.89
Working Memory	1.69	1.43	1.47
Planning and Organization	1.65	1.72	1.78
Organization of Materials	1.48	1.69	1.77
Self-Monitoring	2.00	1.63	1.74
Task Completion	1.53	1.58	1.86

Table 4

Factor loadings for BRIEF clusters (clusters loading on each factor are indicated in boldface type)

	Factor 1	Factor 2
Emotional Control	**.80**	−.04
Inhibition	.27	**.58**
Cognitive Flexibility	**.75**	.18
Shift	**.96**	−.28
Working Memory	−.11	**.94**
Planning and Organization	**.55**	.20
Organization of Materials	**.38**	.33
Self-Monitoring	−.11	**.74**
Task Completion	**.46**	.31