Affect Recognition in Adults with Attention-Deficit/Hyperactivity Disorder

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Abstract

Objective—This study compared affect recognition abilities between adults with and without Attention-Deficit/Hyperactivity Disorder (ADHD).

Method—The sample included 51 participants (34 men, 17 women) divided into 3 groups: ADHD-Combined Type (ADHD-C; $n = 17$), ADHD-Predominantly Inattentive Type (ADHD-I; $n = 16$), and controls ($n = 18$). The mean age was 34 years. Affect recognition abilities were assessed by the Diagnostic Analysis of Nonverbal Accuracy (DANVA).

Results—Analyses of Variance showed that the ADHD-I group made more fearful emotion errors relative to the control group. Inattentive symptoms were positively correlated while hyperactive-impulsive symptoms were negatively correlated with affect recognition errors.

Conclusion—These results suggest that affect recognition abilities may be impaired in adults with ADHD and that affect recognition abilities are more adversely affected by inattentive than hyperactive-impulsive symptoms.

Keywords

ADHD; adults; affect recognition; emotion; subtypes

Social missteps are common in individuals with ADHD, deleteriously affecting their interpersonal, academic, and professional lives. Understanding the factors that underlie these missteps is important conceptually and clinically. Both children and adults with ADHD have documented higher levels of impairment in terms of interpersonal and social functioning than those without ADHD (Hoza et al., 2005; Mannuzza & Klein, 2000; Owens, Hinshaw, Lee, & Lahey, 2009; Solanto, Pope-Boyd, Tryon, & Stepak, 2009). Impaired social abilities have been linked to difficulties in nonverbal communication in adults (Carton, Kessler, & Pape, 1999). Unlike verbal communication, nonverbal communication never stops; it is an ongoing and, typically, automatic process that has been posited to be a central factor in social success (Nowicki & Duke, 1992).

Neuroimaging studies have begun to shed light on the specific brain regions implicated in nonverbal affect recognition. Frontal regions (e.g., ventromedial prefrontal cortex,

dorsolateral prefrontal cortex) appear to be involved in processing emotional faces, along with the amygdala, insula, and fusiform gyrus (Phillips, Drevets, Rauch, & Lane, 2003; Sprengelmeyer, Rausch, Eysel, & Przuntek, 1998). Emotional prosody – the expression of emotion via linguistic intonation – appears to rely heavily on the right hemisphere, particularly the right inferior frontal cortex (Buchanan et al., 2000).

Several lines of evidence converge to give reason to suspect differences in affect recognition in adults with ADHD. First, differences in frontal regions and deficits in executive function have been found between adults with ADHD and comparisons (Boonstra, Oosterlaan, Sergeant, Buitelaar, 2005; Makris et al., 2007; Fassbender & Schweitzer, 2006), and frontal regions (e.g., orbitofrontal cortex) are implicated in facial and vocal affect recognition as well (Hornak et al., 2003). Second, there is evidence of emotion dysregulation in adults with ADHD (Reimherr et al., 2005). Third, some research has shown evidence of deficits in affect recognition in children with ADHD (e.g., Pelc, Kornreich, Foisy, & Dan, 2006), although findings have been somewhat mixed and stronger associations have been found linking nonverbal deficits to mood and anxiety disorders (Brotman et al., 2008; Easter et al., 2005; Lenti, Giacobbe, & Pegna, 2000; McClure, Pope, Hoberman, Pine, & Leibenluft, 2003; McClure et al., 2005).

Previously, poor affect recognition was thought to be characteristic of clinical disorders including mood disorders, anxiety disorders, and autism spectrum disorders. More recently, however, a number of studies have suggested that individuals with ADHD are often undistinguishable from peers with autism spectrum disorders in assigning emotion to facial expressions (Buitelaar, van der Wess, Swaab-Barneveld, & van der Gaag, 1999; Sinzig, Morsch, & Lehmkuhl, 2008; Downs & Smith, 2004). Children with ADHD appear to have particular difficulty recognizing negative emotions (Singh et al., 1998; Cadesky, Mota, & Schachar, 2000; Pelc et al., 2006; Williams et al., 2008). There is also evidence of altered neural signatures of emotional recognition in ADHD (Brotman et al., 2010), which, along with impaired recognition of fear and anger, is ameliorated with methylphenidate (Williams et al., 2008). Such deficits in affect recognition in ADHD appear to continue into adulthood (Cadesky et al., 2000; Rapport, Friedman, Tzelepis, & Van Voorhis, 2002), although, again, findings are mixed. Although not fully clear, some research has suggested that impairments in affect processing reflect problems with emotion recognition rather than impairments in underlying processes such as attention or impulsivity (Yuill & Lyon, 2007).

Although little is known about nonverbal affect recognition in adults with ADHD, it is clear that such abilities are important to success in multiple domains. Research has documented a positive association between the ability to accurately interpret nonverbal communication and social abilities (Nowicki & Mitchell, 1998), positive social behaviors (Izard et al., 2001), and academic competence (Izard et al., 2001). Studies exploring the possibility of affect recognition deficits in children with ADHD have tended to result in mixed findings with some revealing such deficits (Corbett & Glidden, 2000; Pelc et al., 2006; Hall, Peterson, Webster, Bolen, & Brown, 1999; Shapiro, Hughes, August, & Bloomquist, 1993), and others finding none (Cadesky et al., 2000; Sprouse, Hall, Webster, & Bolen, 1998). Even less clear is whether such deficits exist in adults with ADHD, particularly with respect to ADHD subtypes.

The goal of the present study was to examine differences in nonverbal affect recognition between adults with ADHD-Inattentive subtype (ADHD-I), adults with ADHD-Combined subtype (ADHD-C), and adult controls. Based on the small literature base that suggests that children with ADHD have difficulty with affect recognition, we expect that both the ADHD-I and ADHD-C groups will make more affect recognition errors than the control group. Given the paucity of research examining differences in affect recognition among ADHD

subtypes, we have little to base our hypotheses on in terms of ADHD subtype contrasts. However, because attending to affective stimuli seems to be an inherent component of making accurate interpretations and given that both the ADHD-I and ADHD-C groups have significant attentional deficits, we make the tentative hypothesis that the two groups will not differ.

Method

Participants

The sample consisted of a total of 51 adult participants: 16 ADHD-I, 17 ADHD-C, and 18 controls. Thirty-four men and 17 women participated. The mean age was 33.8 years, with an average Full Scale IQ (FSIQ) of 117.6. Table 1 provides age, education, and FSIQ data by group. The three groups did not differ significantly in any of these areas.

Recruitment and Screening

Participants were recruited from a university-based adult ADHD clinic and local advertisements. Following a description of the study and its associated risks, each participant gave written informed consent for a protocol approved by the Human Investigations Committee.

All participants completed the Adult ADHD DSM-IV Current-Self, Retrospective-Self Rating Scales (Murphy & Barkley, 1995; see Table 1 for mean ratings), Current-Other, Retrospective-Other ADHD DSM-IV Rating Scales (Murphy & Barkley, 1995) the Symptom Checklist–90, Revised (SCL-90-R; Deragotis, 1986), a semi-structured interview based on the DSM-IV criteria for ADHD (Barkley & Murphy, 2005) and a structured psychiatric interview (Mini-SCID for DSM-IV; First, Gibbon, & Spitzer, 1996) to screen for psychiatric conditions. Participants were also administered the Wechsler Adult Intelligence Scale–3rd Edition (WAIS-III; Wechsler, 1997) to screen for intellectual function as measured by the FSIQ. Academic achievement was measured by the Reading, Spelling, and Arithmetic subtests of the Wide Range Achievement Test–3rd Edition (WRAT-3; Wilkinson, 1993). Participants were considered to have a learning disability (LD) if their standard score on any WRAT-3 subtest was 20 points below their FSIQ score.

To determine inclusion for the study, the initial step to confirm the presence for either subtype of ADHD required significant symptom reports on the ADHD Self Rating Scale with ratings of a 2 (frequent) or 3 (very frequent) on the appropriate scale(s) for either subtype for 6 or greater symptoms. The next step required a review of ratings from spouses/ friends and parents/grandparents/older siblings on the Other ADHD Rating Scale. Investigators only retained volunteers with third party rating scales corroborating impairment. Third, the investigators used results from the semi-structured DSM-IV ADHD interview reviewing the criteria for ADHD-I and ADHD-C to assess for inclusion criteria. The rating scale and interview results with information derived from the personal information questionnaire, mini-SCID and SCL-90R were then used to determine whether current symptom impairment was present in two or more settings, had a clinically significant impact on social, occupational, and/or vocational functioning and could not better be accounted for by another mental disorder. Participants meeting these criteria were considered eligible for inclusion as ADHD participants in the study.

Potential control and ADHD participants were excluded for the following reasons: Any clinically significant chronic medical conditions, intellectual disability (FSIQ < 75), clinically unstable psychiatric conditions (psychosis, criminality, suicidal behaviors), bipolar disorder, obsessive-compulsive disorder, current major depressive episode, drug or alcohol abuse or dependence within one year preceding the study, and/or current use of

antipsychotic medication. During the screening process, some participants with ADHD were identified with LDs (two ADHD-C, three ADHD-I), dysthymia (two ADHD-I), anxiety disorder not otherwise specified (one ADHD-C), major depressive disorder (in full remission; two ADHD-C), and/or alcohol dependence (in full remission; one ADHD-C, one ADHD-I). None of the control participants were positive for LDs. Participants taking psychostimulants agreed to take a "medication vacation" for at least 24 hours before testing to eliminate the impact of psychostimulant medications on task performance. A licensed, Ph.D.-level psychologist reviewed all interview information, rating scales and test records to determine eligibility for the study. Note that all control participants were required to complete the same diagnostic procedure to rule out the presence of ADHD or other psychiatric or LDs.

Affect Recognition Measures

The primary measure of interest was the Diagnostic Analysis of Nonverbal Accuracy (DANVA; Nowicki & Duke, 1994). The DANVA assesses nonverbal facial and vocal affect recognition skills. Facial affect decoding skills are measured via a series of 24 photos of adult faces representing four emotions (happy, sad, angry, fearful) at two intensity levels (low, high). Participants view each photo for no more than 5 seconds and then are asked whether the facial expression depicted is happy, sad, angry, or fearful. The examiner notes the response, and then proceeds to the next photo stimulus. The internal consistency of the DANVA adult facial stimuli ranges from an alpha of .78 to .90 (Nowicki & Carton, 1993). Test-retest reliability as reported by Nowicki and Carton (1993) was .84 over a two-month period and scores on the DANVA have been correlated with other well-established measures assessing similar constructs (Nowicki & Duke, 1994). Items that comprise this measure were selected based on ratings from a normative sample (as opposed to, for example, anatomical features), potentially strengthening the generalizability of this measure to everyday life.

Vocal affect decoding skills are measured on the DANVA via a series of 24 audio-taped recordings of a sentence spoken in a happy, sad, angry, or fearful tone at two different levels of intensity. Participants listen to each recorded version of the sentence and then identify the vocal affect as happy, sad, angry, or fearful. The internal consistency of the vocal affect stimuli is .75 among middle-aged adults (Baum, Diforio, Tomlinson, & Walker, 1995). The test-retest reliability over a six-week period among college students is reported at .83 (Nowicki, 1995).

Participants obtain scores based on the number of errors in the facial and vocal channels as well as a total score for the number of errors across the two channels. In addition, scores are calculated for the number of errors within the four affect categories and at the two intensity levels (high, low). Primary outcome variables for the purposes of this study include the total number of affect recognition errors for each emotion separately across both channels combined, and the total number of affect recognition errors in the facial and vocal channels separately, collapsing across emotion.

Data Analytic Plan

All statistical analyses were performed with SPSS for Macintosh, Version 16. We note at the outset the exploratory nature of this study. Further, because of the small sample size and low associated power, multivariate analysis of variance was not practical. Thus, we performed analyses of variance (ANOVAs) for each DANVA outcome variable, starting with each affect category (happy, sad, angry, fearful), then total errors in the facial channel, and finally total errors in the vocal channel, using diagnostic subgroup (ADHD-I, ADHD-C and control) as a fixed factor. Tukey's post hoc correction for multiple comparisons was

employed to examine subgroup contrasts. Following the ANOVAs, regression analyses in which the continuous variables of ADHD symptomatology (inattentive, hyperactive-impulsive) were used to test for relationships between severity of ADHD symptomatology and affect decoding ability variables. In the regression models, we entered self-rated scores of inattention in Step 1 and self-rated scores of hyperactivity-impulsivity in Step 2. In all analyses, the significance level was set at .05. We emphasize effect sizes, calculated as Cohen's *d*.

Results

One-way ANOVAs on each of the DANVA variables produced significant main effects for Fearful Affect Errors, $F(2, 48) = 4.12$, $p = .022$. Post hoc tests using Tukey's correction for multiple comparisons revealed that the ADHD-I group made significantly more errors than did the control group ($p = .018$). The ADHD-I and ADHD-C groups did not differ ($p = .151$), nor did the ADHD-C and control groups ($p = .629$). Means, *SD*s, and effect sizes are presented in Table 2, and were of medium to large size with respect to these significant subgroup contrasts. In general, effect sizes were relatively larger for non-significant ADHD-I versus control group contrasts than any other subgroup contrasts.

Regression analyses, presented in Table 3, were conducted to test for significant associations between degree of inattentive and hyperactive-impulsive symptoms and affect decoding accuracy. For the primary DANVA outcome variables, the regression for Sad Affect Errors was statistically significant, $R^2 = .10$, $p = .014$. The standardized regression coefficients for both inattentive and hyperactive-impulsive scores were statistically significant. Interestingly, hyperactive-impulsive symptoms were associated with fewer errors, $\beta = -.53$, $p = .014$, with the negative β indicating that as hyperactive-impulsive symptoms increase, Sad Affect Errors decrease. Inattentive symptoms were associated with more errors, $\beta = .54$, $p = .011$.

Overall, the significant ANOVAs revealed that the ADHD-I group made more errors than the control group on the Fearful Affect DANVA variable, collapsing across channels. The ADHD-I and ADHD-C groups did not differ on any variables, nor did the ADHD-C and control groups. The regression analyses indicated that dimensional measures of both inattentive and hyperactive-impulsive symptoms explained a significant proportion of the variance in Sad Affect Errors. Inattentive symptoms were associated with more affect recognition errors while hyperactive-impulsive symptoms were associated with fewer affect recognition errors.

Discussion

Although the literature base is small (and mostly in children), several studies have suggested that individuals with ADHD have difficulty accurately identifying affect. We predicted that both the ADHD-I and ADHD-C groups would make more affect recognition errors than the control group and that both the ADHD-I and ADHD-C groups would not differ in terms of affect recognition errors. Our hypotheses were partially confirmed, with Fearful Affect Errors more common in the ADHD-I group compared to the control group, but there were no significant differences between the ADHD-C and control groups or between the ADHD-I and ADHD-C groups. The lack of significant differences between the ADHD-C and control groups may be due to reduced statistical power to detect differences, given effect sizes.

The present findings are partly in line with findings in the child ADHD literature, which has shown that children with ADHD have decreased recognition in anger and fear facial expressions (Singh et al., 1998; Cadesky et al., 2000; Pelc et al., 2006; Williams et al., 2008), although the ANOVAs in the present study were only significant for Fearful Affect.

A recent study of youth with ADHD, bipolar disorder and severe mood dysregulation indicated that while children with ADHD showed no differences in behavioral performance on the task compared to controls or the other groups, they did demonstrate hyperactivity in the amygdala when making subjective fear ratings of neutral faces (Brotman et al., 2010) suggesting that neural functioning may be altered for emotion processing even when behavioral differences are not evident.

Although non-significant, the effect sizes for ADHD versus comparison group contrasts in the vocal channel were medium to large. This is consistent with neuroimaging findings that suggest that adults with ADHD may process information in more visual and less auditory ways (Schweitzer et al., 2000), which could result in more errors to auditory information but less to visual information. Although this work was not done with emotionally-relevant tasks, other research has shown that the right hemisphere is intricately involved in processing emotional prosody (Buchanan et al., 2000; Ross, Thompson, & Yenkosky, 1997), and abnormalities in the right hemisphere have been associated with social skills deficits, nonverbal learning disabilities, and ADHD (Schrimsher, Billingsley, Jackson, & Moore, 2002; Semrud-Clikeman & Hynd, 1990; Weintraub & Mesulam, 1983). Social skills deficits are also common in ADHD (Wheeler Maedgen & Carlson, 2000), and some have suggested that "social inattention" – or difficulty attending to social cues – may be an additional feature of ADHD. In addition, it has been posited that ADHD is associated with risk for social comprehension deficits, particularly in those with atypical right hemisphere morphology (Miller, Miller, Bloom, Hynd, & Craggs, 2006). Thus, there is some evidence for abnormal right hemisphere functioning in ADHD (Hale, Bookheimer, McGough, Phillips, & McCracken, 2007; Swartwood, Swartwood, Lubar, & Timmermann, 2003), and clear evidence for the importance of the right hemisphere in emotional prosody.

The regression analyses proved significant for Sad Affect Errors. These findings are again in line with some of the child literature showing that children with ADHD exhibit decreased emotion recognition abilities (Williams et al., 2008). These regression findings also expand the ANOVA findings by suggesting that not only are ADHD symptoms associated with errors in recognizing fearful affect, they are also associated with errors in recognizing sad affect.

The most notable finding from the regression analyses was the significant and *positive* standardized β for inattentive symptoms and the significant and *negative* β for hyperactive-impulsive symptoms with respect to Sad Affect Errors. These results support the ANOVAs in highlighting the link between inattention and nonverbal decoding deficits. This finding makes some sense, given that individuals with more symptoms of inattention are likely more inattentive and passive in social situations and may have a greater deficiency in social knowledge than those with ADHD-C or more hyperactive-impulsive symptoms (Wheeler Maedgen & Carlson, 2000). It may be that individuals with more severe inattentive symptoms are not attending properly to take in appropriate social cues when in social situations, have less experience in social interactions, and/or more experience in less successful interactions due to a more passive and inattentive nature. The present findings could reflect the idea that the deficits in the ADHD-I group were related mainly to an attention problem and not an underlying deficit in emotional processing, although previous research in children suggests that impairments in affect processing remained even after controlling for factors such as attention (Yuill & Lyon, 2007). Whether there are continuities between such findings in children with ADHD and adults with ADHD remains unclear.

The statistically significant and negative β for hyperactive-impulsive symptoms is curious, indicating that DANVA errors decrease as hyperactive-impulsive symptoms increase. Why this should be the case is not clear. The adults in this study were quite high functioning (i.e.,

intellectually strong, no major psychiatric comorbidity); perhaps the participants with more hyperactive and impulsive symptoms are more frequently engaged in social relationships and have learned to compensate for weaknesses in social situations by attending more carefully to cues from others. Future research could test younger participants to determine if age is a factor, with compensation developing with maturity. Subsequent research with a larger and more heterogeneous sample could also test if the lack of severe comorbidity, general social functioning and intellectual ability might also be playing a role in our findings.

Taken together, the ANOVA and regression results link inattentive symptoms with affect decoding deficits and provide some evidence of linking ADHD with deficits in fearful affect recognition specifically. However, our results differ from those in the literature in that, in our study, the most striking nonverbal affect recognition impairments were found in the ADHD-I group or associated with symptoms of inattention. Although interesting, this finding is in need of replication. The existing literature, although limited and conflicting, note deficits in children with the ADHD-C or ADHD-HI subtypes relative to controls, which differ from the ADHD-I group in their hyperactive-impulsive symptoms (Corbett & Glidden, 2000; Pelc et al., 2006). Further research is needed to clarify whether both children and adults with ADHD exhibit affect decoding deficits and, if so, whether the deficits depend on ADHD subtype, or if dimensional measures of ADHD symptomatology provide more useful information in regards to affect recognition deficits.

This study had several limitations. Namely, the study sample was small and highly intelligent (mean FSIQ of 118). Both factors raise questions regarding the generalizability of the findings. The small sample size, particularly in regards to the size of each group, also reduced the statistical power of the analyses. Although current comorbidity was minimal in the study sample, it deserves mention as a potential confounding factor. This is a criticism common in the ADHD literature but difficult to address given the practical constraints of time and sample size. Previous studies in the affect decoding literature suggest that including a separate LD group may be critical to gaining a clearer understanding of deficits in ADHD vs. LD vs. ADHD/LD groups. Future studies in adults with ADHD would also benefit from including a clinical control group to provide a more critical test of how sensitive the various measures are to ADHD deficits specifically; such work is beginning to emerge in the child literature. Another limitation of this study was that the investigators were not blind to the potential group status (i.e., ADHD or control) of the participants. Because of these cautions, this work is viewed as preliminary and in need of cross-validation.

Continued research across the lifespan in ADHD is important to document the developmental trajectory of the disorder. This includes neuroimaging studies to identify the neural mechanisms underlying potential deficits in affect recognition in these populations. Such work could have implications for treatments aimed at improving social interactions in individuals with ADHD. Research should also focus on refining the diagnostic criteria for ADHD subtypes, and perhaps shift to more dimensional measures of ADHD symptomatology. The constantly changing classification system for ADHD across the various revisions of the DSM is evidence that this disorder has been a challenge for researchers to conceptualize, especially in adults.

Overall, our results are suggestive of difficulties in recognizing fearful affect in those with ADHD-I, and that symptoms of inattention are associated with increased errors in recognizing sad affect, whereas hyperactive-impulsive symptoms are associated with fewer errors. However, no differences emerged between the ADHD-C and control groups, nor did they emerge between the ADHD-C and ADHD-I groups. Thus, affect recognition deficits

were certainly not found unanimously in the ADHD groups, suggesting a more nuanced view of affect recognition deficits in adults with ADHD. Although our findings should be interpreted with caution given the small sample size and highly intelligent sample, this study provides preliminary evidence for some affect recognition deficits in adults with ADHD and suggests that inattention may be particularly relevant to such deficits.

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Table 1

Participant Characteristics

Variable	ADHD-C		ADHD-I		Control		F(2, 48)	p
	M	SD	M	SD	M	SD		
Age	33.35$_a$	11.45	36.44$_a$	10.73	31.94$_a$	7.70	0.88	0.423
Education (years)	16.32$_a$	3.40	15.28$_a$	2.18	16.97$_a$	2.19	1.74	0.187
FSIQ	114.18$_a$	8.29	116.31$_a$	14.38	121.89$_a$	11.70	2.05	0.140
IA Score	20.41$_a$	3.99	20.00$_a$	3.95	1.83$_b$	1.25	183.54	0.000
HI Score	19.00$_a$	4.09	9.31$_b$	2.89	2.06$_c$	1.66	137.37	0.000
Total Score	39.41$_a$	6.60	29.31$_b$	5.08	3.89$_c$	2.30	240.65	0.000

Note. ADHD-C = Attention-Deficit/Hyperactivity Disorder-Combined Type, ADHD-I = Attention-Deficit/Hyperactivity Disorder-Inattentive Type, FSIQ = Full Scale IQ, IA = inattentive, HI = hyperactive-impulsive.

Means in the same row that do not share subscripts differ at $p < .05$ by Tukey post hoc comparisons.

Table 2

DANVA Variables by Diagnostic Subgroup

Variable	A. ADHD-C (*n* = 17)		B. ADHD-I (*n* = 16)		C. Control (*n* = 18)		*p*	Cohen's *d*[a]		
	M	*SD*	*M*	*SD*	*M*	*SD*		A–B	A–C	B–C
Happy Errors	2.24	1.48	2.19	1.22	2.22	1.44	0.995	0.04	0.01	−0.02
Sad Errors	1.47	1.33	2.25	1.95	1.33	1.19	0.180	−0.47	0.11	0.57
Angry Errors	2.12	1.58	2.06	1.06	2.22	1.40	0.941	0.04	−0.07	−0.13
Fearful Errors	3.06	1.52	4.13	2.09	2.56	1.15	0.022	−0.59	0.37	0.93
Facial Channel Errors	2.94	1.09	3.63	2.31	2.94	1.30	0.390	−0.38	0.00	0.37
Vocal Channel Errors	5.94	2.59	7.00	2.42	5.39	1.61	0.116	−0.42	0.26	0.78

Note. DANVA = Diagnostic Analysis of Nonverbal Accuracy.

Cohen's *d* reflects contrast of first-lettered subgroup versus second-lettered subgroup, with positive values reflecting greater deviance in the first subgroup.

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Table 3

Regression Analyses for DANVA Variables

	R	ΔR²	Sig. F Change	Standardized β	t	Sig.
Happy Errors						
Step 1: IA scores	0.01	0.00	0.995	−0.02	−0.10	0.918
Step 2: HI scores	0.02	0.00	0.936	0.02	0.08	0.936
Sad Errors						
Step 1: IA scores	0.14	0.02	0.326	0.54	2.63	0.011
Step 2: HI scores	0.37	0.12	0.014	−0.53	−2.56	0.014
Angry Errors						
Step 1: IA scores	0.06	0.00	0.659	−0.11	−0.51	0.615
Step 2: HI scores	0.08	0.00	0.772	0.07	0.29	0.772
Fearful Errors						
Step 1: IA scores	0.22	0.05	0.125	0.47	2.20	0.033
Step 2: HI scores	0.30	0.04	0.132	−0.33	−1.53	0.132
Facial Channel Errors						
Step 1: IA scores	0.00	0.00	0.994	0.25	1.13	0.265
Step 2: HI scores	0.21	0.04	0.143	−0.32	−1.49	0.143
Vocal Channel Errors						
Step 1: IA scores	0.22	0.05	0.130	0.46	2.16	0.036
Step 2: HI scores	0.30	0.04	0.140	−0.32	−1.50	0.140

Note. IA = inattentive, HI = hyperactive-impulsive