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Emotional Understanding in School-Aged Children with Fetal Alcohol Spectrum Disorders: A Promising Target for Intervention

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Abstract

Background—Children with fetal alcohol spectrum disorders (FASD) are at high risk for secondary conditions, including mental health difficulties. Data on both children with typical development and other clinical conditions suggest that limited emotional understanding (EU) raises risk for psychopathology, but little is known about EU in FASD.

Objective—Determine if EU is a reasonable treatment target for children with FASD.

Methods—56 children (6–13 years) with FASD completed the Kusche Affective Interview-Revised, a verbal interview measure of EU.

Results—Children showed striking delays in EU (2–5 years delay) relative to published normative data, despite mean IQ (IQ=94.56) within normal limits. Individual variability was considerable even after accounting for age and verbal IQ.

Conclusions—Despite variability in individual differences, treatments targeting EU may benefit children with FASD as components within a comprehensive, tailored intervention focused on child self-regulation and caregiver behavior management.

Keywords

fetal alcohol spectrum disorders; emotional understanding; prenatal alcohol exposure; neurodevelopmental disorders; intervention; fetal alcohol syndrome

Introduction

Active case ascertainment studies estimate 2–5 percent of U.S. school-aged children have neurodevelopmental difficulties associated with prenatal alcohol exposure (PAE)[1]. Although

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there is considerable individual variability, common areas of impairment include general intellectual functioning, learning and memory, executive functioning, social communication, and adaptive and behavioral functioning[2–3]. Individuals with fetal alcohol spectrum disorders (FASD) have high rates of secondary conditions such as mental health problems and school disruption[4], and data are needed to empirically identify targets for preventive intervention. The influence of childhood emotional and social functioning, including the important construct of emotional understanding (EU), on adult mental health and life outcomes is well documented in normative and atypically developing populations[5–6]. To determine if EU is a reasonable treatment target in FASD, this study aimed to characterize EU among school-aged children with FASD.

Emotional Understanding

EU is defined as the conscious knowledge about emotional processes and how they work[7–8]. EU involves recognition of emotions in oneself and others, understanding of causes and consequences of emotions, awareness of situational display rules for emotions, and knowledge of strategies to regulate or cope with emotions. In normative populations, EU follows a clear developmental trajectory that is linked with advances in biological, cognitive, and social maturation (for reviews see[7–10]). At age 2 years, children can typically recognize some basic emotions and are beginning to use emotion words. Children become more adept across the preschool years at recognizing emotions and talking about their feelings. The ability to express a basic understanding of the causes, cues, and consequences associated with emotions in oneself and others also begins to emerge during the preschool period and matures throughout childhood. During elementary school, children develop an understanding of the simultaneity of emotions and recognize the ability to feel multiple emotions directed toward a single target. They also learn cultural display rules for emotions, and how to change or hide emotions. Children's knowledge of strategies to regulate and cope with emotions progresses from a reliance on external strategies (e.g., changing external situation, seeking adult support) to an increase in reflective internal strategies (e.g., redirecting thoughts, reinterpreting the situation).

Not surprising given the developmental progression of EU, studies with community samples consistently find significant associations between EU and child age[9,11–14]. Documentation of gender effects has been less consistent. Although several reviews have concluded that boys and girls do not differ in their capacity to understand emotions[9–10], some studies have found gender-related differences in EU[12,15–16]. When found, these gender effects generally suggest girls have better developed EU than boys.

Despite clear age-related trends in EU, significant variability exists in the ages at which children develop specific aspects of EU. Several studies have documented continuity in individual differences in EU across time[16–17]. Individual (e.g., verbal IQ, language skills) and family-level (e.g., attachment, emotion socialization) factors have been found to predict individual differences in EU[14,18].

In atypical populations, such as children with developmental disabilities or behavioral disorders, there is limited research on the developmental progression of EU. What is generally known is that these child populations have underdeveloped EU relative to typically

developing peers[8]. Understanding the adverse impact on EU is important for designing effective interventions in these clinical populations.

EU in Children with FASD

Highlighting the need for the current study, EU has received very limited investigation in FASD. Studies have largely focused on simpler EU aspects of emotion recognition based on facial processing, prosody, and body positioning and movement[19–21]. Findings are mixed and likely related (at least in part) to specific task features or task complexity. For example, children with FASD could match pictures of different emotions on simple tasks, but had more difficulty with cross-modality matching of visual emotional expressions and verbally-presented emotion words[19]. Children with FASD displayed more errors in emotion recognition on facial and prosody tasks when stimuli were derived from adult, but not child, actors[20]. No differences in facial emotion recognition were found when children with PAE were compared with mental-aged matched controls[21].

But there is limited understanding of more complex aspects of EU in FASD. Two studies found children with FASD manifested poorer knowledge of display rules than did typically developing children or children with attention deficit hyperactivity disorder (ADHD)[19,22]. Both studies used a task involving brief vignettes in which the main character hides their true emotions and the child has to indicate the character's feelings using a set of feeling faces. Also, children with FASD had lower scores than typically developing peers on child and parent questionnaires assessing empathy, suggesting greater difficulty understanding the emotions of others[22]. Females in both groups tended to have higher empathy scores based on parent and self-report. Neither study attempted to explore EU in more depth. Thus, little is known about other aspects of EU at this more complex level in the clinical population of FASD.

Current Study

The primary aim of this study was to fulfill this important knowledge gap, and to describe in more detail understanding and reasoning about emotions among children with FASD. Children with FASD were hypothesized to show delays in EU relative to published normative data. Older age, stronger verbal skill, and a history of fewer psychosocial stressors were expected to significantly predict better EU.

Methods

Participants

Fifty-six children (ages 6–13) with FASD and their primary caregivers were recruited from FASD diagnostic clinics in Washington State as part of a treatment study of the Families Moving Forward (FMF) Program[23]. Study inclusion criteria were an FASD diagnosis based on the 4-Digit FASD Diagnostic Code[24] and verbal IQ greater than 70. Children were excluded if they had another birth defect associated with cognitive impairment, behavior problems thought to require more intensive intervention (e.g., serious fire-setting), or insufficient time living with that caregiver (<4 months or not expected to remain >1.5 years). Of participants, 53.6% (30) were assigned to pilot or full versions of FMF intervention. The

remainder received the community standard of care. Given the nature of the study, there was no additional comparison group.

Procedures

The University of Washington Human Subjects Division approved all study procedures. Participants provided written informed consent/assent. Primary variables for the current study were collected at the second post-intervention follow-up time point, approximately 17.64 months post-baseline. Child EU was not directly targeted by the caregiver-focused FMF Program and not expected to change as a result of FMF Program participation. Intervention and control groups did not significantly differ on study variables (p's >.05).

Measures

EU was measured by the Kusche Affective Inventory-Revised (KAI-R[25]), as part of a larger test battery. The KAI-R is a verbal interview designed to assess children's experience with and reasoning about emotions[25]. Standard procedures are used to deliver the interview, and all interviewers were carefully trained in use of the interview. All interviews were recorded and then transcribed verbatim. Responses were scored by coders trained in the use of the detailed KAI-R coding system, which is largely based on a Piagetian developmental framework proposed by Carroll and Steward[11]. This system assigns children's EU responses along a 4-point hierarchy based on the child's developmental level of reasoning (see Table 1).

These developmental levels of EU are strongly correlated with developmental levels from standard Piagetian cognitive tasks (particularly those involving classification and conservation), even after accounting for age and level of receptive vocabulary[11]. Two trained coders reviewed each transcript independently and final scores were determined by consensus. Inter-rater reliability was acceptable; the mean intraclass correlation across coded items contributing to scores used in analyses was 0.83 (range 0.62–0.94).

Table 2 provides details on the EU variables selected for this study. Children's response patterns across individual questions in the KAI-R were examined within aspects of EU. When individual items were highly correlated within an area (e.g., recognizing sad and mad emotion cues in oneself), scores were averaged to create one composite score for that area. When variables were not highly correlated (e.g., simultaneous experience of emotions), individual variables were analyzed separately. A total of seven EU variables were examined in analyses.

Because the KAI-R requires verbal responses, the Vocabulary Score from the Kaufman Brief Intelligence Test (K-BIT[26]; administered at baseline) was included and examined in analysis. A descriptive variable summarizing occurrence of nine psychosocial stressors during the child's lifetime was also assessed via caregiver report and a Cumulative Psychosocial Risk Score (possible range 0–9) was created by summing (yes=1, no=0): child neglect, parent divorce, parent separation, living with a parent with substance abuse, violence towards the child, death of a parent, separation from a parent, living in poverty, and living in a home with little developmental stimulation.

Data Analysis

Descriptive statistics were calculated to characterize EU. Age effects were examined by correlation analysis and by comparing the mean age for children attaining each developmental level of EU with published data from a normative sample[11]. Differences were also examined by sex and FASD diagnosis (FAS/pFAS vs. other FASD diagnosis). Diagnostic subgroups were compared because the field of FASD has, in some studies, detected a difference between subgroups of children sufficiently affected to show central nervous system (CNS) dysfunction plus characteristic facial dysmorphology vs. those who show only evidence of CNS dysfunction and typical morphology. Correlations between EU, verbal skills, and a Cumulative Psychosocial Risk Score were also examined. Correlations of ±.3 or higher represent medium effects.

Results

Participant Demographics

Approximately half the sample was male (51.8%, n=29) with mean age of 10.16 years (SD=2.05) at this data collection timepoint. Racial/ethnic background was diverse. Using these demographic categories, the sample was: 51.8% White/Non-Hispanic (n=29), 3.6% White/Hispanic (n=2), 7.1% African American (n=4), 3.6% Native Ancestry (n=2), and 33.9% multiracial (n=19). At this study time point, 10.8% (n=6) of children lived with: a biological parent, 16.1% (n=9) relatives, 8.9% (n=5) non-relative foster care, and 50% (n=28) adopted (non-relative)[a] . Average gross household income was $66,249 (SD= $51,260, range $10,000-$250,000). Thirteen children (23.2%) had fetal alcohol syndrome (FAS) or partial FAS (pFAS). The sample had a mean Cumulative Psychosocial Risk Score of 5.25 (SD=2.32, range 0–9).

EU in Children with FASD

For most EU indices, on average, these school-aged children were functioning at preoperational to transitional levels of developmental understanding (see Table 3 for distributions). Children had the most difficulty expressing their understanding that multiple emotions can be experienced simultaneously, emotions can be hidden, and that all emotions are ok to experience. These items are more complex and require relatively greater verbal expression of concepts. Children had relatively better understanding that people can change their feelings, and slightly more than half articulated self-reflective strategies involving thinking or doing something to change one's feelings.

Age significantly correlated with only two of seven indicators of EU: recognizing emotion cues in oneself (r=.45, p=.001) and others (r=.45, p=.001). Age was not related to items assessing understanding that emotions can be experienced simultaneously (sad/happy: r=.15, p=.262; sad/mad: r=.24, p=.078), can be changed (r=.22, p=.112), can be hidden (r=.15, p=.30), or that all emotions are ok to have (r=.08, p=.581). Mean ages were calculated for each developmental level of EU and compared to normative data[11] (see Table 4). Inspection of

[a]Two children with missing placement data were living with relatives at baseline.

age means and ranges at each developmental level within the FASD group highlights wide individual variability among children with FASD.

No significant differences were identified by sex (p's>.05). Effect sizes for sex comparisons were generally small (cohen's d's range: 0.04–0.38). EU did not differ by whether children had an FAS/pFAS diagnosis (p's>.05, d's range 0.05–0.41). As expected, verbal IQ significantly correlated with EU variables that all emotions are ok to have (r=.31, p=.022) and the simultaneous experience of sad/happy emotions (r=.30, p=.026). Children with higher verbal IQ demonstrated a higher level of emotion reasoning for these more abstract aspects of EU. No aspects of EU were significantly correlated with the Cumulative Psychosocial Risk Score (r's range .01–.15, p's>0.05).

Individual differences were examined in more depth to see if patterns emerged to better characterize this group of children, and thus shed light on how to customize or target EU treatment. Response patterns across EU variables and relevant demographics (e.g., age, IQ, linguistic abilities) were carefully visually inspected for each child. At the broadest level of exploration, this sample of school-aged children with FASD and relatively intact cognitive function included a relatively large number at the "below preoperational" level (coded 0) for the more complex aspects of EU. It was notable that only 12 (21.4%) children in the entire sample did not give a single "below preoperational" response across the 7 EU variables. In effect, then, only about one-fifth of the group showed better EU. The verbal IQ skills of these 12 children were all broadly within the average range. However, a sizeable percentage of children who scored in the "below preoperational" level on one or more EU variables also had average or above average verbal skills.

Exploring more closely, no clear patterns could be identified between the two subsets of children who gave "below preoperational" responses and those who did not. It was only when the number of "below preoperational" level responses across the 7 EU variables was examined that some patterns emerged. Children in this sample gave a mean of 1.64 (SD=1.34, range 0–6) "below preoperational" responses. The number of "below preoperational" responses was significantly correlated with verbal IQ scores (r=−.28, p=.034), with children with lower verbal IQ giving a greater number of "below preoperational" responses across items. Age (r=−.24, p=.069) and FAS/pFAS diagnosis (r=.24, p=.071) approached significance. Sex and history of psychosocial stressors did not correlate (p's > .10) with the number of "below preoperational" responses across EU variables. Thus, while many children in the sample tended to give "below preoperational" responses on the more complex items of EU (simultaneous experience of emotions, can hide emotions), the children who gave a greater number of "below preoperational" responses, including on more concrete items, tended to have relatively lower IQ, younger age, and have FAS/pFAS.

Discussion

Similar to other populations at risk for psychopathology[8], current findings reveal delays in EU among children with FASD. Compared to normative data[11], children with FASD performed, on average, a striking 2 to 5 years behind chronological age expectations. Delays are notable given the overall average IQ in this sample and exclusion of children with

intellectual disability. Results are also somewhat surprising in highlighting individual variability in EU largely independent of age, sex, diagnosis on the fetal alcohol spectrum, history of psychosocial stressors, and, for some aspects, verbal skill. Only subtle associations with age, verbal IQ, and FASD diagnosis can be discerned among children performing at the lower levels of EU. EU treatment appears likely to be useful across the range of children in the FASD clinical population.

Findings of delayed EU are consistent with deficits in affect recognition and display rule understanding found in prior FASD research[19,20,22]. Results fit with and extend existing neuropsychological and language data, as across studies children with FASD have struggled more with tasks of increasing complexity, requiring higher levels of abstract reasoning, or cross-modality comparison. This is consistent with theory suggesting that children with FASD experience a core deficit in complex information processing[2].

Prior research on PAE found emotion recognition skills commensurate with mental age[21]. Yet in current data only a few aspects of EU were positively correlated with verbal skill. Even after accounting for chronological age and verbal skill, this study revealed considerable individual variability in EU. This fits with the often-seen uneven skill development among children with FASD. This emphasizes the importance of accurate EU assessment and adjusting expectations for this outcome domain, as with others, among children in this clinic population based on level of functioning rather than chronological age, verbal skill, or IQ.

Implications for Intervention

Current findings support EU as a potential treatment target for children with FASD. There are existing intervention programs that involve concrete visual materials and role-play practice through games and exercises with well-documented effects on EU and other socio-emotional outcomes, such as Promoting Alternative THinking Strategies[27] and others[28]. These may help children with FASD, but adaptation of existing curricula or format will often be necessary for optimal impact given these children's neurodevelopmental disabilities[29–30]. For instance, special emphasis on carefully structured practice, repetition beyond what might seem necessary given a child's intellectual level or age, and carefully planned work on generalization of new skills are vital, as children with FASD have difficulty translating knowledge into action[30–31].

Given the well-documented self-regulation and behavior problems of children with FASD[32], EU interventions will likely be most effective when integrated into comprehensive programming that includes child skills training in calming and self-regulation, coupled with guidance in behavior management. Parent behavioral consultation programs, such as the FMF Program[23,31], could be paired with child-focused training in EU and self-regulation to support skill acquisition and positive behavior. Comprehensive FASD-informed care such as this must often also have a trauma focus, given high rates of psychosocial adversity in this population. Yet clinicians must specifically account for these children's often limited recognition of their own and others' emotions, and difficulty generating self-reflective strategies to change feelings and behavior. These are skills often expected to be intact when using trauma-focused treatment, so providers may have to modify their clinical approach.

Limitations

The current study was part of a treatment trial that did not incorporate a typically developing control group, limiting comparisons that could be made to the use of existing published data. Although the sample was demographically diverse, most children had clinically significant behavior problems and those with intellectual disabilities were purposefully excluded. Therefore, the data range may have been restricted in some ways and generalizability of findings possibly reduced (although behavioral difficulties are common in the FASD population[33]).

As with most clinically ascertained FASD samples, information on early childhood risk and protective factors is limited. Although, EU was not related to the Cumulative Psychosocial Risk Score in the current study, it is possible other indices of psychosocial risk (e.g., more precise indicators of attachment, quality of early caregiving relationships) would be more sensitive predictors of individual differences in EU. PAE is a confirmed teratogen, but likely just one of the multiple complex risk factors contributing to child emotional development. As with risk, detailed information on protective factors (e.g., early intervention) experienced by children and families in this sample could not be known with precision.

Conclusions and Future Directions

For children with FASD, the current study documents striking delays in EU. Data support the need for interventions targeting EU in this clinical population. These interventions will likely be most effective when parent- or teacher-assisted to support initial learning and skill generalization. Additional research on EU is required to understand more completely how personal- and family-level factors contribute to individual differences among children with FASD. Larger studies could examine relationships of EU with other factors, such as verbal IQ and FASD diagnosis, in more depth. Longitudinal studies are vital to reveal developmental trajectories of EU, and relationships with later social and lifestyle problems. The ultimate goal is to develop targeted early intervention to prevent or reduce high rates of debilitating secondary conditions.

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Table 1

Coding Scheme for Developmental Levels of Reasoning for KAI-R Variables.

Level	Response characteristics	Piagetian developmental level
0	• Vague or unclear • Inappropriate • Responds, “I don’t know”	Below Preoperational
1	• Characterized by exclusive use of idiosyncratic and particularistic elements • No sense of internal feeling or generalization	Preoperational
2	• Characterized by use of actions/behaviors/expressions • Responses may be more elaborate and thoughtful but do not convey any sense of inner processing of emotions	Transitional
3	• Incorporate multiple elements with relations classified and/or ordered coherently • Include reference to a self-reflective inner state • Can include both generalizations and particulars • Can take more than one perspective	Concrete Operations

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Table 2

Details on the Variables from the Kusche Affective Inventory – Revised Selected for the Current Study

Area	Item	Coding	Examples
Recognizing Emotional Cues – **SELF**	• How do you know when you are feeling SAD? • How do you know when you are feeling MAD or angry?	• Individual responses categorically coded within each emotion. • Summary scores created for each emotion based on the levels of reasoning described in Table 1. • Summary scores for SAD and MAD were averaged to create ONE TOTAL SCORE.	• When somebody hit me (Level 1). • When I have a frown on my face and I cry (Level 2). • My face gets really red and I feel like I am going to explode inside (Level 3).
Recognizing Emotional Cues – **OTHER**	• How do you know when other people are feeling SAD? • How do you know when other people are feeling MAD or angry?	• Individual responses categorically coded within each emotion. • Summary scores created for each emotion based on the levels of reasoning described in Table 1. • Summary scores for SAD and MAD were averaged to create ONE TOTAL SCORE.	• When someone breaks their toys (Level 1). • They stomp their feet and yell (Level 2). • When someone makes fun of them – I know I would feel sad if that happened to me (Level 3).
Sad/Happy Simultaneous Emotions	• Can someone feel SAD and HAPPY at the very same time?	• Child's response was coded either Level 0 (emotions cannot be simultaneous), Level 1 (emotions are sequential or directed simultaneously at different targets), Level 2 (emotions are simultaneous but not elaborated), Level 3 (emotions can be simultaneous at the same target).	• Sad when he broke my plane, then happy he got in trouble (Level 1). • Like when I got 2nd place at the swim meet (Level 2). • Happy I got a new dog, but sad it wasn't the color I wanted (Level 3).
Sad/Mad Simultaneous Emotions	• Can someone feel SAD and MAD at the very same time?	• Child's response was coded either Level 0 (emotions cannot be simultaneous), Level 1 (emotions are sequential or directed simultaneously at different targets), Level 2 (emotions are simultaneous but not elaborated), Level 3 (emotions can be simultaneous at the same target).	• Sad when I didn't get to watch my favorite show then mad when my mom sent me to my room (Level 1). • Yes, like when my friend pushed me (Level 2). • Yes, I was sad and mad when she told the other girls not to talk to me. And the sadder I got the more angry I felt (Level 3).
Emotions Can be Hidden	• Can you HIDE your feelings? • If YES, HOW can you do that?	• Child's response was coded based on the levels of reasoning described in Table 1. • Children indicating that feelings cannot be hidden were coded at Level 0.	• Hide under the table so you don't get in trouble (Level 1). • Just stop so nobody will know, like stop crying (Level 2).

Area	Item	Coding	Examples
	• If NO, WHY NOT?		• When you can't laugh out loud, you can laugh inside (Level 3).
Emotions Can be Changed	• Can feelings CHANGE? • OK, suppose you were feeling upset, could your feelings CHANGE? • Tell me what would happen to make your feelings change	• Child's responses were coded based on the levels of reasoning described in Table 1. • Responses across questions were aggregated and the ONE TOTAL SCORE reflects the highest level response.	• By somebody spending the night (Level 1). • Just forget about it (Level 2). • If I'm sad and I do something I like, it makes my feelings change (Level 3).
All Emotions Are Ok to Have	• Are all feelings OK to have? • IF YES, Why? How do you know that? • IF NO, Why not?	• Child's response was coded based on the levels of reasoning described in Table 1.	• They just are – my teacher told me (Level 1). • If you don't have any feelings you can't share them with anybody (Level 2). • You have to have feelings, no matter what kind of feelings they are (Level 3).

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Table 3

Developmental Levels of Emotional Understanding in School-Aged Children with Fetal Alcohol Spectrum Disorders

Developmental Level	Emotion cues in self	Emotion cues in others	Sad/Happy simultaneous[a]	Sad/Mad simultaneous[a]	Emotions can change[a]	Emotions can be hidden[a]	All emotions are ok[a]
Level 0 – % [n]	5.4 [3]	5.4 [3]	46.4 [26]	41.1 [23]	7.1 [4]	42.9 [24]	19.6 [11]
Level 1: Preoperational - % [n]	21.4 [12]	25.0 [14]	23.2 [13]	14.3 [8]	21.4 [12]	12.5 [7]	50.0 [28]
Level 2: Transitional – % [n]	58.9 [33]	69.6 [39]	17.9 [10]	28.6 [16]	17.9 [10]	33.9 [19]	7.1 [4]
Level 3: Concrete Operations - % [n]	14.3 [8]	0.0 [0]	12.5 [7]	14.3 [8]	51.8 [29]	7.1 [4]	19.6 [11]
Median	2.00	2.00	1.00	1.00	3.00	1.00	1.00
Mean [Standard Deviation]	2.07 [0.75]	1.78 [0.49]	0.96 [1.08]	1.16 [1.13]	2.16 [1.01]	1.06 [1.05]	1.28 [1.02]

Note.

[a]Total percentages do not add up to 100%; interview was terminated early for a very few children due to child fatigue or frustration levels.

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Table 4

Mean Age for School-Aged Children with Fetal Alcohol Spectrum Disorders at Each Developmental Level of Emotion Understanding in Comparison with Published Normative Data

Developmental Level -Mean age [standard deviation] ***(age range)***	**Normative data for age**[a]	**Emotion cues in self**	**Emotion cues in others**	**Sad/Happy simultaneous**	**Sad/Mad simultaneous**	**Emotions can change**	**Emotions can be hidden**	**All emotions are ok**
Level 0	-	9.86 [2.14] *(7.58–11.83)*	8.50 [2.74] *(6.33–11.58)*	9.78 [2.24] *(6.33–13.08)*	9.44 [2.14] *(6.33–12.50)*	7.10 [0.58] *(6.33–7.58)*	10.01 [2.29] *(6.33–13.25)*	10.16 [2.48] *(6.33–13.08)*
Level 1: Preoperational	5.1	8.35 [1.96] *(6.33–11.58)*	9.01 [2.09] *(6.33–12.50)*	10.50 [1.84] *(7.66–13.25)*	9.49 [1.97] *(7.50–12.83)*	10.58 [2.11] *(6.33–13.25)*	8.86 [2.33] *(6.33–11.83)*	9.81 [1.97] *(6.41–12.91)*
Level 2: Transitional	6.8	10.41 [1.86] *(7.16–13.08)*	10.60 [1.85] *(7.00–13.25)*	9.52 [1.99] *(6.41–12.08)*	11.49 [1.55] *(8.16–13.25)*	9.95 [2.38] *(6.41–13.08)*	10.45 [1.61] *(7.85–13.08)*	11.36 [2.41] *(7.85–13.25)*
Level 3: Concrete Operations	8.3	11.40 [1.72] *(8.33–13.25)*	-	11.26 [1.72] *(8.83–12.91)*	9.66 [1.94] *(6.33–12.50)*	10.32 [1.84] *(7.00–12.91)*	11.14 [2.38] *(7.66–12.83)*	10.30 [2.05] *(7.41–12.91)*

Note.

[a]Carroll & Steward, 1984; standard deviations not reported.