Research Article

Academic Developmental Stages for HFA and LFA Mandarin-English Speakers: Four Case Studies

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Abstract

Little information is available regarding the early academic skills among individuals with autism. The purpose of this investigation is to report the profile of autism behaviors, related strengths, and academic performances of four individuals with ASD (i.e., two with HFA and two with LFA) using the *Academic Developmental Stages* Profile, a measure designed to assess writing, reading, and math skills. The results proved the usefulness of the profile as a valid measurement for depicting the academic development in younger children with ASD.

Keywords: ASD; LFA; HFA; AcDS; CADS

Introduction

Academics and ASD

Little has been reported about the academic achievement of Higher Functioning ASD (HFA) and Lower Functioning ASD (LFA) [1-3]. One investigation by [1] presented an evaluation approach called the *Academic Developmental Stages for HFA and LFA (AcDS)* that assessed the reading, writing, and math abilities among younger Chinese students with ASD below age 7 years. The purpose of this investigation, therefore, was to investigate the academic developmental stages among four younger Chinese-American students with ASD: two who presented with HFA and two with LFA.

Academic Developmental Stages (AcDS)

Hao and Layton [1] have reported on the reading, writing, and math skills among a group of Chinese children with Higher Functioning Autism (HFA) and Lower Functioning Autism (LFA). Both groups were matched by age to a group of children who were typically developing or children with intellectual disabilities. Their results indicated that both the HFA and LFA groups performed similar to their control groups on most academic areas. Furthermore, the LFA group performed similar to the HFA group in basic academic skills, but they were approximately one year behind on writing skills. As part of the investigation, an academic profile was developed by the investigators, which they called, *Academic Developmental Stages for HFA and LFA (AcDS)*.

The *AcDS* is a profile that contains emerging or acquired basic academic skills across three age groups: 36-47 months, 48-59 months, and 60-72 months. There are twelve different academic areas included in the profile (Figures 1-4). These include measures of reading, writing, and math; however, the application or the scoring of the AcDS was not reported in children with ASD. The investigators recommended that the profile should be applied to both HFA and LFA individuals in order to determine its validity and usefulness.

Reading

Reading requires a student to be able to identify a word either by sounding it aloud (i.e., encoding or word attack skills) or by sight-word reading (i.e., recognizing the Gestalt or entire word) [4]. To be successful on the first task, the reader must know the alphabet and sounds for the alphabet (phonics), such as the letter 'b' sounds like "bah." Some students with ASD, but not all, are successful readers using this approach [5]. A second approach to reading is being able to understand what is being read; this entails understanding the single word, the sentence, or the paragraph. Included in this is the understanding of the theme of the entire story. Reading for comprehension is a tricky task in that the student needs to express what they understood from the passage; this requires speaking, social interaction with adults, as well as making decisions on a paper-pencil task. For instance, it has been reported that social communication skills in children with ASD influences reading comprehension [6], which are difficult concepts for most individuals with ASD [3,6,7]. Therefore, it is difficult to know whether the individual with ASD is having trouble comprehending the reading material or just unable to explain what they had read.

Writing

Writing is a higher literacy skill: it requires integrating speech expression with reading comprehension (i.e., both encoding and comprehension), which are both necessary in the process of writing. If the individual has trouble expressing his/her ideas, writing then becomes problematic. Furthermore, not knowing the alphabet and sounds of letters is a disadvantage for spelling and writing words. Most reported investigations have found greater deficiencies in writing skills than in other areas of academics among students with ASD [8,9].

Math

Several areas are subsumed in the basic understanding of math skills. These include identification of numbers, grouping of sets, adding and subtracting, as well as problem solving. Problem solving requires a higher level of reading, as addressed above, along with the executive function of reasoning and planning. For instance, the following math problem requires knowing the terms "left" and "altogether", as well as understanding addition and making appropriate choices.

1. John has 8 balloons but 2 flew away. How many does he have

Figure 1: Standard scores for CADS Domains.
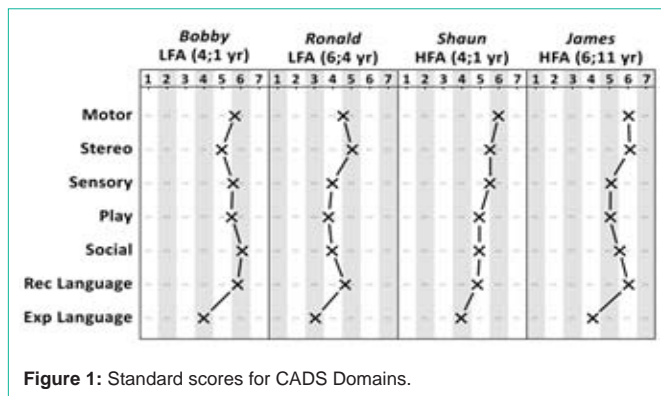
left?

2. Mary found 6 spiders in the yard. John found 4 more. How many spiders are there altogether?

Most individuals with ASD have been reported to be somewhat successful in math areas of counting and simple calculations, but less successful in math problem-solving skills [1-3,9,10].

Present study

The purpose of the current investigation was to clinically test the application of the *AcDS* among four younger Mandarin-English speaking students with ASD. Individual reports are provided on their autism profile (e.g., related strengths, and performances on the *AcDS*). Relationships between the individual areas of autism (i.e., motor skills, sensory skills, stereotype behaviors, play skills, social skills, receptive language, and expressive language) and the performances on the *AcDS* were also examined.

Methods

Participants

Four bilingual Mandarin-English speaking students with ASD were included in the study. For purposes of confidentiality, no real names are reported in the study. All participants were being seen for individual speech-language therapy in a University clinic or in a private clinic. Participants were selected because they were bilingual Chinese-English speakers, assumed to present with autism, had no other known diagnosis, and were male clients.

To be considered HFA for this study, the individual had to be present with a deficit in social communication, be verbal, demonstrate difficulties in initiating social interactions, demonstrate unsuccessful responses to social overtures by others, and be capable of interaction in society with minimal support. The person also had to be assessed on the *CADS* (see description below) [11] and determined to be "mild" in autism (Table 1) below. To be considered LFA, the individual had to be minimally verbal, demonstrate severe impairments in social interaction, frequently fixate on rituals and repetitive behaviors, and had to require substantial support in order to function in society. In addition, the person was assessed by the *CADS* [11] and found to be "moderate" or "severe" in autism (Table 1) below.

Chinese Autism Diagnostic Scale (CADS)

The *Chinese Autism Diagnostic Scale (CADS)* [11] was designed and developed on Mandarin speaking individuals across seven domains (Figure 1). Three Domains, (i.e., Play, Social Interactive, and Receptive Language), were designed to evaluate social-interactive behaviors [12]. Three other domains (i.e., Motor behaviors, stereotypic behaviors, and Sensory behavior) evaluated the area of repetitive/restrictive behaviors [12]. The remaining domain, Expressive Language, evaluated the use of language. Of the seven areas, six are considered core areas (i.e., 6-Core behaviors: Motor, Sensory, Stereotype, Play, Social, and Receptive Language). The English version of the *CADS* was used for the current investigation. A trained professional speech-language pathologist administered the *CADS*, with a parent to assist in the assessment and to translate the information when needed.

Students

Student 1: The youngest, Bobby, was 4; 1 years-old male who spoke both Mandarin and English. His mother reported that Bobby is, "Not talkative around peers; however, at home he often verbally communicates and may screech loudly if he is unhappy." Her concerns for Bobby are in his ability to follow directions, interact with peers, make eye contact, and express his wants and needs. Bobby attends a bilingual preschool twice a week and receives speech-language therapy. Based on his autism diagnostic scores (Table 1) below, he presents with severe autism and is Considered Lower-Functioning (LFA).

Student 2: The second student, Shaun, was also 4; 1 years old and speaks both Mandarin and English. Mandarin is his first language, but since 2-years of age he has been learning English. He attends an English only preschool and a bilingual preschool twice a week: he receives speech-language therapy through the bilingual preschool. His mother reported that Shaun is fluent in Mandarin and uses 3-5 word sentences in English. He demonstrates some echolalia but does not use stereotyped speech. The mother's primary concern is Shaun's inability to play and socially interact with peers. According to his autism diagnostic scores (Table 1) below, he presents with mild autism and is considered Higher-Functioning (HFA).

Student 3: The third student, Ronald, was a 6; 4 years-old male who speaks both Mandarin and English at home. Mandarin is the primary spoken language. Ronald speaks mainly English because he attends an inclusive English-speaking classroom and receives private speech therapy with English being emphasized. Ronald has better comprehension skills than oral expression. Although Ronald is able to imitate oral-words, he lacks most social-skills and spontaneous initiations. He says "hi" when entering a room, and "bye" when leaving, if prompted. At home, it is reported that he sometimes uses the carrier phrase "I want + item" when requesting something. He can read words but lacks reading comprehension skills. He also has limited math skills. He receives speech therapy services at school and through a private clinic. Based on his autism diagnostic scores, he presents with severe autism and is considered Lower-Functioning (LFA) (Table 1) below.

Student 4: The fourth student, James, was a 6; 11 years-old male at the time of the evaluation. James attends an inclusive public school classroom where only English is spoken. Both Mandarin and English are spoken in the home, but Mandarin is the primary spoken language. James understands Mandarin but does not speak it. He is verbal and speaks only English. James receives speech therapy both at school and

Table 1: Individual converted scores for CADS 6-Core Domain, DSM-V Social Interaction/Communication category, DSM-V Stereotype behaviors category, and CADS Expressive Language Domain for three subjects with ASD.

Subject	Age in months	CADS 6-Core	DSM-V Social Interaction/ Communication	DSM-V Stereotyped behaviors	CADS Expressive language	Total	CADS level
Bobby	49	2	2	3	4	11	Severe
Ronald	76	3	3	3	4	13	Severe
Shaun	49	2	2	1	1	6	Mild
James	83	2	2	1	2	7	Mild

1=mild, 2=moderate, 3=moderate-severe, 4=severe; Totals: 0-2 not autism; 3-4 unlikely autism; 5-7 mild autism; 8-10 moderate autism; 11-16 severe autism.
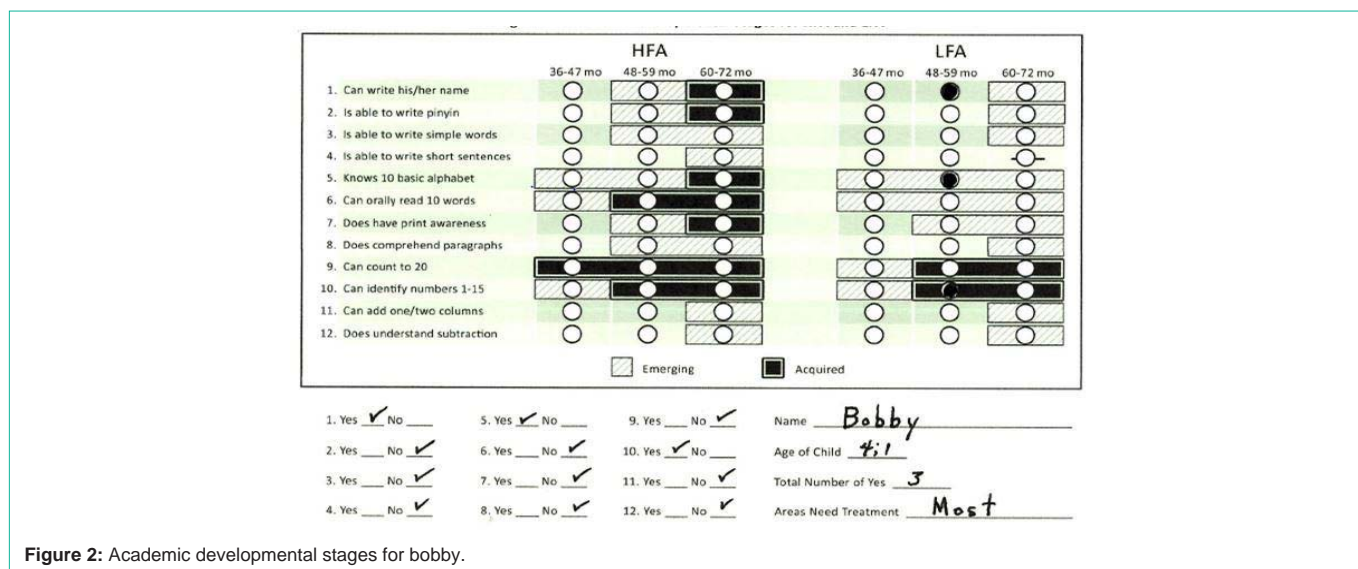

Figure 2: Academic developmental stages for bobby.

through a private speech therapist. His mother attends all the private therapy sessions, where she assists by speaking Mandarin to him when needed. James has excellent reading skills, both sight-word reading and reading comprehension. He also has good math skills but limited problem-solving skills. James presents with immediate and delayed echolalia, with the latter being more common. He has improved in his social-skills over the past year, and now acknowledges others when entering a room, takes turns, interacts with peers, and uses eye contact. Based on his autism diagnostic scores, he is considered to have mild autism or Higher-Functioning (HFA) (Table 1) below.

Procedure

As can be seen in (Figure 1), scores are plotted for each of the seven domains obtained by the *CADS* per participant. The domain standard scores range from 1-7 with 1 being the lowest possible score and 7 being the highest score.

Scoring for level of Autism

Individual behavior-items are assigned levels of involvement in (Table 1). A score of 0 indicates no problem of autism, 1 for symptoms of autism sometimes present, and 2 for symptoms of autism frequently present. On a few items, there are only two choices: either 0 for no problem or 2 for symptoms frequently present.

On the *CADS*, the 6-Core behaviors are grouped into two basic categories as recommended in the [12]. The Social Interactive/ Communicative category includes three *CADS* Domains: Play, Social, and Receptive Language. The Repetitive/Restrictive Stereotype

category includes other *CADS* Domains: Motor, Sensory, and Stereotype behaviors.

Scoring for the level of autism, therefore, consists of using the scaled scores from the *CADS'* 6-Core individual domains, along with the Social Interaction/Communicative category overall scores, the Repetitive/Restrictive Stereotype category overall scores, plus the single Expressive Domain score (Table 1). According [1], the total scaled scores on the above measures, determines a likeliness of ASD diagnosis and the severity of ASD (Table 1): that is, a combined score of 0-2 is considered to be "not autism", a combined score of 3-4 is considered "unlikely" autism, a combined score of 5-7 is considered "mild" autism, a combined score of 8-10 is considered "moderate" autism, and a combined score of 11-12 is considered "severe" autism. The results for each student are shown in (Table 1).

Therefore, our student, Bobby, had a total score of 11 indicating a CADS' level of severe autism, Ronald had a total score of 13 indicating a CADS' level of severe autism, Shaun had a total score of 6 indicating a CADS' level of mild autism, and James had a total score of 7 indicating a CADS' level of mild autism.

Academic Developmental Stages for HFA and LFA

The *Academic Developmental Stages for HFA and LFA (AcDS)* [1] includes 12 specific areas of academic skills within three domains: reading, writing, and math. The *AcDS* was developed by [1] to represent the "emerging" and "acquired" skills for both HFA and LFA (Figures 2-4). The *AcDS* was administered initially on a
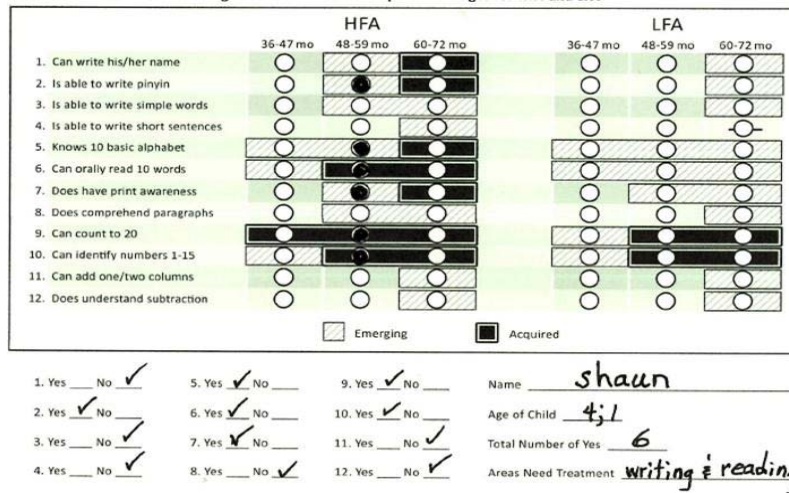
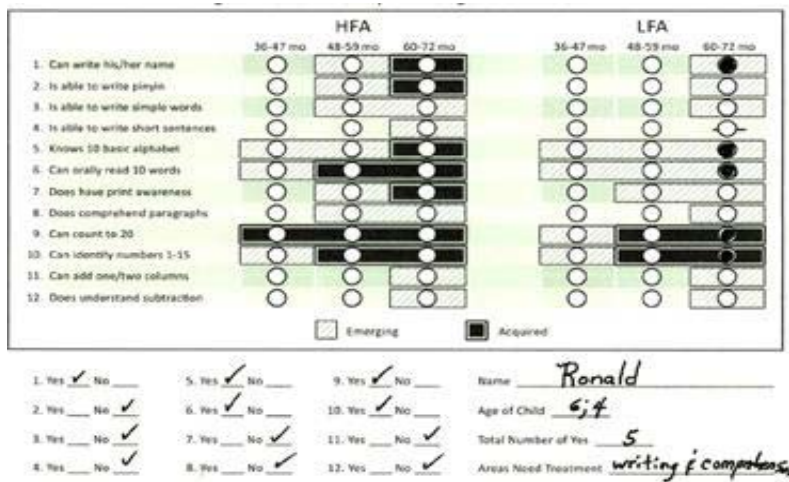**Figure 3:** Academic developmental stages for Shaun.

Figure 4: Academic developmental stages for Ronald.

Mandarin speaking population that included LFA (n=86), HFA (n=39), Typically Developing (TD) (n = 69), Language Impaired (LI) (n=11), and Intellectual Disabilities (ID) (n=15). Age ranges were from 38-72 months. Academic skills were compared across all groups for reliability, validity, and psychometric measures [1].

The skills were divided across: 1) Reading domain (four skills: basic alphabet, sight word reading, print awareness, comprehension of short paragraphs); 2) Writing domain (four skills: writing pinyin letters, simple words, sentences to dictation); and 3) Math domain: (four skills: counting to 20, identification of numbers 1-15, adding two columns, and simple subtraction). Scoring for each skill included a score of 2 when the child mastered the skill tested, a score of 1 when the child had partially acquired the skill tested, and a score of 0 when the child had not clearly demonstrated the skill tested.

Further scoring for the "emerging" and "acquired" levels incorporates the individual item scores of 2 or 2+1, in which [1] determined, from age-group performances, two levels of achievement: "emerging" level and "acquired" level. The "emerging" level indicated when an age group had either mastered or partially mastered the specific skill tested. To determine "emerging", the authors used a cut-off score of 25% of the population who scored either a 1 or a 2 on that item. The "acquired" was more restrictive in that a cut-off score of 50% of the population scored a 2 on that item, which means at least half of individuals with ASD at the specific age group had mastered the specific skill tested.

Each case study was administered the AcDS by a trained professional speech-language pathologist (Figures 2-5), with parent or caregiver being present to assist in the assessment. Testing was completed in a single setting or over a two-day period. Confirmation of the scoring was provided by the parent or caregiver.

Results

Bobby

Figure 1 shows the *CADS* seven domain scores for Bobby, age 4; 1 years. As can be seen from the figure, Bobby had strengths in the areas of motor, play, social skills, and receptive language. His areas

Table 2: Academic areas emerging and acquiring for the four students.

Subject	Items not present at age level			Items acquired at age level
Bobby	*Reads 10 words		*Knows 10 basic alphabet	**Identifies # 1-15
LFA	*Print awareness	Writes his name		
48-59 months	**Counts to 20			
Shaun	*Writes his name		*Writes pinyin	**Reads words
HFA	*Writes simple words		*Knows 10 basic alphabet	**Counts to 20
48-59 months	*Comprehends paragraph		*Print awareness	**Identifies # 1-15
Ronald	*Writes pinyin		*Writes his name	**Counts to 20
LFA	*Writes words		*Knows alphabet	**Identifies # 1-15
60-72 months	*Print awareness		*Reads words	
	*Comprehends paragraph			
James	**Writes pinyin		*writes words	**Writes his name
HFA	*Comprehends paragraph		*Writes short sentences	**Knows 10 basic alphabet
60-72 months			*Addition	**Reads words
			*Subtraction	**Print awareness
				**Counts to 20
				**Identifies # 1-15

(Number of items appropriate per age level: LFA 48-59 months=5 items; HFA 48-59 months=9 items; LFA 60-72 months=11 items; HFA 60-72 months=12 items)
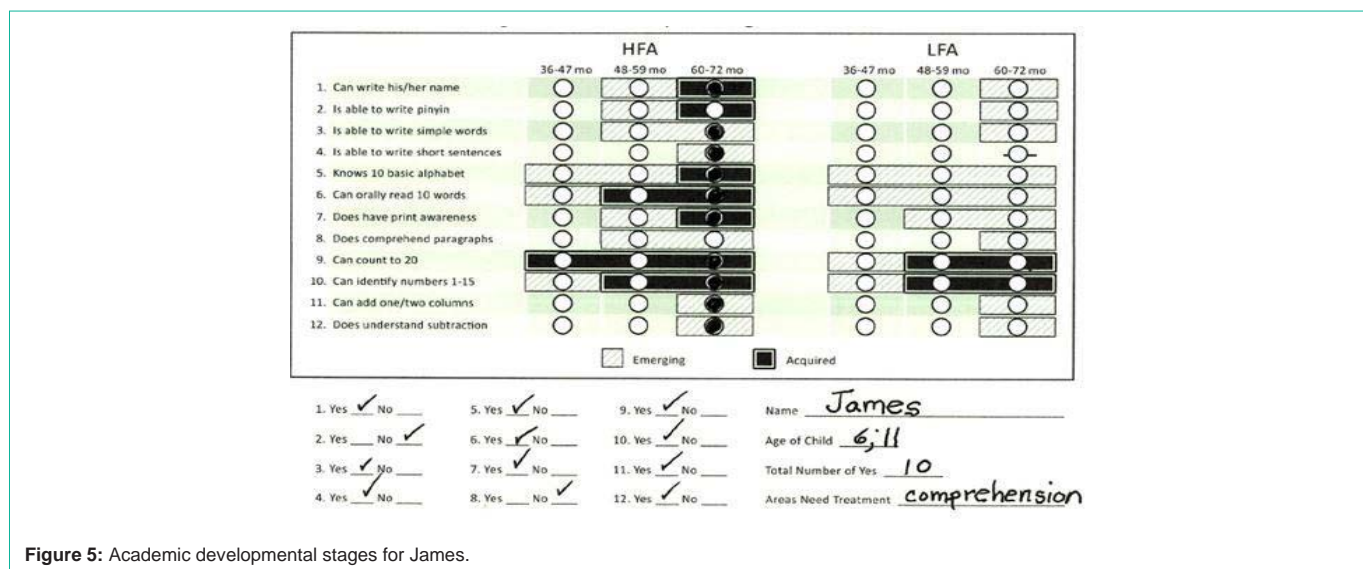*Emerging item for Age Level, **Acquired item for Age Level

Figure 5: Academic developmental stages for James.

of weakness were in stereotypic behaviors, sensory behavior and expressive language. Furthermore, his areas of strength and weakness are confirmed in (Table 1) where his 6-Core Domain score was a 2 (i.e., moderate level); his DSM-V Social Interaction/Communication and Stereotype behavior score was also a 2 (i.e., moderate level); and his weakest was expressive language at a score of 4 (severe level). These scores combined total 11 points, indicating that Bobby is considered "severe" autism, or LFA. Bobby, therefore, appears to have good play, social and receptive language skills but weaker motor and expressive language skills.

Figure 2 & Table 2 shows Bobby's performance on the *AcDS*

profile. Three items were not present for Bobby's age level. These include not being able to read 10 words, no print awareness, and not being able to count to 20. He was, fortunately, able to write his name at the "emerging" age for that item, suggesting that Bobby is advanced in this skill compared to other LFA children. Knowing the alphabet occurred at the "emerging" age, again suggesting that Bobby is a the typical developing age for this skill compared to other LFA children; and he was able to identify numbers at the "acquired" for his age and level of autism, suggesting that this skill was mastered.

In summary, The additional scoring by the *AcDS* provides

more information to Bobby's profile as a social-communicator and educational learner. Clearly, Bobby is falling behind in some areas of basic academics, which without the *AcDS* profile would not have been identified. Together, then, the scores on the *CADS* and the *AcDS* provide a comprehensive profile of Bobby's strengths and needs.

In addition to his good *CADS* scores in social behavior, play skills, and receptive language, Bobby appears to have some knowledge of the alphabet and identification of numbers, but also has difficulty in reading sight words, understanding print awareness, and counting.

Shaun

Figure 1 shows the *CADS* seven domain scores for Shaun, age 4; 1 years, who is considered to be mild autism or HFA (Table 1). His profile on the *CADS* is relatively flat for the 6-Core areas of motor, stereotypic behaviors, sensory behaviors, play skills, social skills, and receptive language; but his expressive language skills fell more than 1 standard deviation below the mean. (Table 1) confirms his overall skills, with his 6-Core behaviors score being a 2 (i.e., moderate level), and his DSM-V Social Interaction/Communication and Stereotyped behavior scores were a 2 and 1 respectively. These combined scores total 6, indicating that Shaun has "mild" autism, or HFA. Shaun, therefore, appears to have good play, social interaction, and receptive language skills but weak expressive language skills.

Figure 3 & Table 2 shows Shaun performance on the *AcDS* profile. Shaun was not able to: write his name, write simple words, nor comprehend paragraphs…these skills were expected for his age and level of autism. He was, however, successful at the "emerging" level on: writing pinyin, knowing the basic alphabet, and has print awareness; and he had "acquired" skills of reading words, counting to 20, and identifying numbers [1-12].

In summary, his overall skills were good on the *AcDS* but he does needs assistance in writing simple words, writing sentences, and in reading comprehension. Shaun is also behind age level in expressive language, which was noted on his *CADS* scores as well as on the *AcDS* profile.

Ronald

Figure 1 also contains the individual *CADS* domain scores for Ronald, age 6; 4 years.. As can be seen, Ronald's overall scores are lower than those of Bobby and Shaun, who were younger, and James, who was approximately Ronald's same age.

Within Ronald's *CADS* performance scores, stereotype behaviors were his best area, followed by motor skills, and receptive language. The areas of sensory skills and social skills were quite similar and slightly below his best performance areas. His lowest areas were play skills and expressive language skills. Thus, Ronald appears to have better motor, sensory and receptive language skills, but weaker play and expressive language.

Figure 3 & Table 2 show Ronald's performance on the *AcDS*. Unfortunately, Ronald was unsuccessful on four areas: writing pinyin, writing simple words, print awareness, and comprehending paragraphs, which are considered "emerging" items for his age. He was also successful at the "emerging" level on three items: writing his name, knowing the alphabet, and reading simple words. Furthermore, he was successful at the "acquired" level on counting to 20 and identifying numbers [1-12].

Ronald, therefore, had better receptive language skills, on the *CADS*, and did well on the AcDS in knowing the alphabet, sight words, counting, and identifying numbers, all of which could be regarded as memory-recall tasks. Conversely, his poorer performances were in social skills, play behaviors, and expressive language on the *CADS,* and were accompanied by poorer performances on writing words, print awareness, reading comprehension. In other words, these academic tasks require some aspect of expressing ones ideas and thoughts, which demonstrates an area of weakness.

James

Figure 1 further shows the *CADS* domain scores for James, age 6-11 years. It is apparent that James performed as well or better than the other three students on all seven domains did. For instance, his 6-Core domain behaviors (i.e., motor skills, stereotype behaviors, sensory behavior, play skills, social behavior, and receptive language skills) were all excellent (Table 1). Only his expressive language skills were significantly below his other areas. James is considered mild-autism or HFA.

On James' *AcDS* profile, he was successful on 10 out of 12 academic areas (Figure 5). He successfully "acquired" six items: writing his name, knowing the alphabet, reading 10 words, print awareness, counting to 20, and identifying numbers [1-12]. He successfully had four "emerging" skills: writing simple words, writing short sentences, adding and subtracting. The two areas he was less successful completing were writing pinyin, as expected, and comprehending paragraphs (i.e., James is a good reader but performs poorly on reading comprehension skills, as mentioned earlier).

His poor reading comprehension skills may be due to his inability to grasp the meaning of text or it may be related to his inability to demonstrate expressive language skills, in which he exhibits difficulty expressing what he had just read. It is apparent that James' receptive language skills, as assessed by the *CADS*, is good; this infers that he has the basic capability to understand the written text and, therefore, should be a successful reader. However, his expressive language skills appear to be affecting his ability to explain what he has read.

In summary, James' ability on the *CADS* related well to his performance on the *AcDS* in those good social skills, play skills, and receptive language skills meant good writing, math, and reading skills. His inadequacy in expressive language may have carried over to his poorer reading comprehension skills.

Discussion

The purpose of the current study was to validate the *AcDS* [1], an academic profile for young Mandarin-English children with HFA and LFA. The investigators recommended that the profile should be applied to both younger HFA and LFA individuals in order to determine its validity and usefulness. To achieve this goal, four young Chinese, Mandarin-English speaking boys with HFA/LFA were assessed by the *CADS* [11] and on the *AcDS* [1]. Two of the boys were considered severe-autism and LFA, and two were considered mild-autism and LFA.

The findings on the *AcDS* support its value as an extension to the *CADS* profile for the four case studies. That is, for all four Mandarin-

English students, the *AcDS* added to the *CADS* profile by showing the areas of strength and weakness in three general academic areas. For instance, for Bobby, nearly all academic areas were in need of assistance; for Shaun his areas of need included writing and reading comprehension; whereas for Ronald his academic areas of need included writing and reading; and finally for James his area of need was reading comprehension. Thus, the *AcDS* was a useful clinical instrument that provided additional information to each student's behavior skills. This indicates the *AcDS* should be part of a comprehensive evaluation.

The instrument also validated its usefulness by determining the strengths and weaknesses obtained by a general autism diagnostic test like the *CADS* [11], in which the scores on the *CADS* related clearly to performances on the *AcDS*.

Although it was not the purpose of the study to compare performance on the *AcDS* across levels of autism, it is important to note that the instrument was successful in describing academic areas for both HFA and LFA Mandarin-English speaking individuals with autism. The *AcDS* was designed for both levels [1]. The current findings demonstrated that both younger and older Mandarin-English speaking individuals with ASD, either HFA or LFA, were successful on some of the reading, writing, and math areas suggesting that the *AcDS* is a reasonable instrument to use with younger individuals with autism.

The current investigation contributes to the literature by demonstrating how the *AcDS* adds to the performance of HFA and LFA in the area of academic achievement.

Future investigations are needed to assess the test-retest reliability of the *AcDS* as well as inter-examiner reliability with English speaking students with ASD. Although the *AcDS* was useful for the four individuals in the current study, it is recommended that the *AcDS* should be administered to a larger sample of younger and older individuals for construct and discriminant validity (both Mandarin-English and English only speakers).

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