

# Developing Mirror Self Awareness in Students with Autism Spectrum Disorder

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**Abstract** A teaching methodology and curriculum was designed to develop and increase positive self-awareness in students diagnosed with autism spectrum disorders (ASD). Joint attention (JA) strategies were first utilized to directly teach students about reflected mirror images, and then subsequently, to indirectly teach students about their reflected image. Not only were Mirror Self Awareness Development (MSAD) JA activities initiated and preferred by students over non MSAD JA activities, they yielded a four step framework with which to measure increases in student self-awareness. While the focus of this study was to increase positive self-awareness in students with ASD, it may contribute to understanding the developmental stages of ‘Self’.

**Keywords** Autism spectrum disorder · Joint attention · Mirror self-awareness · Pronoun development · Self permanence · Video modeling

## Introduction

The word Autism is derived from the Greek word “autos,” meaning “self.” The term describes a condition in which a person withdraws from social interaction; hence, living in a world confined to ‘Self.’ Current definitional characteristics of Autism in the DSM-5 focus on an individual’s debilities with social interactions, however this may be

more representative of the ‘symptoms’ of Autism, rather than of Autism itself. If we more literally define “autism” from its root syntax, we would be forced to consider the condition of Autism as a form of “self-ism.” In fact, Autism could be viewed as an infirmity of the development of an individual’s ‘Self.’

Goals and Objectives of the Individual Education Plans of students with Autism often focus on increasing independent functioning, or activities of daily living (ADL) skills. Personal hygiene goals pertaining to washing hands, brushing teeth, washing/combing hair, and showering are pivotal life skills; however, these tasks are challenging when a student has no, or a limited, concept of ‘Self’. How could a student recognize that ‘their’ hands are dirty, their face needs to be washed, or their teeth need to be brushed—when they have no connection to, or recognition of ‘Self’? An important function of educators may be to facilitate a more tangible and/or positive construct of ‘Self’, before any increase in functional life skills, ADL skills, or social interaction and communication skills can be realized in students with autism spectrum disorders (ASD).

“Self-awareness and knowledge is not something that can simply be taught through direct instruction. Instead, students acquire this knowledge by interacting with their environment” (Wehmeyer and Shogren 2008, as cited in Simpson and Smith-Myles 2008, p. 455). If self-awareness is to be taught or cognitively restructured, an indirect means to teach ‘Self’ may be the most effective approach. Educators in this present study introduced a curriculum of instruction that utilized joint attention (JA) strategies, via reflected mirror images, to assist students in developing constructs of ‘Object’, ‘Other’ and subsequently ‘Self’.

While mirrors have been documented as measuring tools of students with and without ASD (Duval and Wicklund 1972; Gallup 1982; Spiker and Ricks 1984; Dawson and

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McKissick 1984; Rochat 2003), they have not readily been utilized by educators to facilitate JA in general, or in leading to the development of an awareness of ‘Self’, in particular. Mirror Self Awareness (MSA), is defined in this study as a student’s level of consciousness and perception while looking at mirror reflected images. Mirror Awareness of ‘Self’ was evidenced when students demonstrated an understanding of the triadic relationship of ‘Object’, ‘Other’ (through pronoun development), and then ultimately ‘Self’.

### Historical Perspectives of Self

In 1902, Cooley, theorized a “looking glass self” has three essential elements: the imagination of our appearance to the other person; the imagination of their judgment of that appearance; and a resulting feeling such as pride, or mortification (Cooley 1964, p. 184). George Herbert Mead stated the ‘Self’ is “not initially present at birth, and is something which has to be developed; self arises through the process of social experience and activity, and as a result of the relationship to that process as a whole and to the individuals within that process” (Mead 1962, p. 135). Duval and Wicklund (1972) advanced that self-awareness can be divided into two distinct classifications depending upon whether an individual’s attention and state of consciousness is directed internally or externally. One’s ‘Self’ is then developed through the individual’s process of being able to focus his/her attention both internally and externally, and both objectively and subjectively.

The implications of Cooley, Mead, and Duval and Wicklund are that the development of ‘Self’ is contingent upon the construct of ‘Other’. Therefore, students with Autism are at a distinct disadvantage for self-development, as their social withdrawal impedes the developmental experience of reasonably considering ‘Other’ in their self-awareness and recognition. This may lead to a negatively skewed view of ‘Self’, or even a non-awareness of ‘Self’ in students diagnosed with ASD.

### The Mirror, Self Recognition, and ASD

Historically, man’s sense of ‘Self’ and his relationship with the mirror has been inextricable intertwined. Jung’s view of ‘Self’ and psyche had strong attachment to the mirror, and its ability to reflect images. Joseph (1997) stated:

The psychical image of the mirror is an image par excellence of the core nature of psyche. The mirror is more than merely a metaphor for psyche; that is, the mirror is not just one way among many other equally good ways, of representing psyche. Rather, it is a primary symbol of psyche, in Jung’s precise sense,

namely a best possible representation of an otherwise unknown (and unknowable) reality (p. 140).

Jung considered the mirror as the quintessential tool to obtain knowledge of ‘Self’. According to Huskinson (2004), Jung understood that the mirror must be looked into in order to destroy error and illusion, thereby allowing one to arrive at a true genuine understanding and knowledge of self.

The standard measure of mirror self-recognition began with placing a dot of rouge on the brow of one eye and the top half of the opposite ear of a chimpanzee (see Gallup 1970), and then on the nose of children (see Lewis et al. 1989). If the chimpanzee, and later children, were observed to touch the rouge while looking in the mirror at their reflected image, they were assumed to have self-awareness.

Spiker and Ricks (1984) tested 52 children with Autism for visual self-recognition, based upon the rouge test of mirror self-recognition developed by Gallup. Out of the 52 children, 36 or 69 % showed evidence of mirror self-recognition, and 16 or 31 % “failed to give clear indications of recognizing their mirror images” (p. 214). Although Spiker and Ricks reported that language development and the severity of language impairment appeared to be the major factor in the ability to recognize one’s self or not, they cautioned “one cannot equate failure to show evidence of visual self recognition (performance) with a lack of visual self recognition (competence)” (p. 221).

Asendorpf et al. (1996) also reported difficulties with relying on the rouge test as the exclusive litmus test of self-awareness. They found that some subjects, identified to have self-awareness, did not touch or remove the rouge from their faces. It appears that solely relying on the identification of ‘Self’ through the classic rouge mirror test is problematic.

Dawson and McKissick (1984) examined the relationship of imitation and object permanence, to self-recognition in 15 children with Autism using a variation of the Gallup rouge test. They reported 11 participants (73 %) exhibited evidence of visual self-recognition however, only 8 individuals, or 53 % showed a high level of imitation ability. All 11 individuals exhibiting visual self-recognition also had high levels of object permanence. Dawson and McKissick also noted, “it is important to keep in mind that the rouge experiment measures only one aspect of emerging self awareness, visual self recognition” (p. 393).

Although not defined in their study, Dawson and McKissick’s methodology incorporated a JA strategy in determining object permanence. Children were encouraged to find a partially covered object, and were socially reinforced “with clapping or praise when he or she searched for the object” (p. 387). In the present study, JA activities

were not utilized to test object permanence, rather, educators used JA activities to measure and develop MSA, ultimately leading to a sense of ‘self permanence’. Self permanence would then be defined as the awareness and recognition that one continues to exist independently, and apart from, their reflected mirror image.

### Joint Attention and ASD

Joint Attention is an individual’s ability to use “gestures and eye contact to coordinate attention with another person in order to share the experience of an interesting object or event” (Mundy et al. 1994). In JA, individuals socially “initiate” others to pay attention to the same stimuli, as each individual follows the social gestures of the other. It is precisely this “triadic attention”, between ‘Self’, ‘Other’ and ‘Object’ (Leekam et al. 2000), that makes JA a powerful intervention strategy in the development of ‘Self’.

Social interaction, language, and theory of mind are all developmentally linked and positively correlated with an individual’s ability to engage in JA. Consequently, deficits in JA and in developing theory of mind, are now recognized as a descriptors of individuals with autism. A study by Kasari et al. (2006) examined the role of JA as a treatment methodology for children with Autism, finding that the group of children that received JA strategies increased their social responsiveness, and were more likely to initiate future JA responses with their mothers, in their mother–child relationships.

While it is difficult to pinpoint the exact moment that JA develops, behavior manifestations of JA have been reported to emerge within the first 6 months of age, (D’Entremont et al. 1997; Farroni et al. 2002; Morales et al. 1998) and continue to develop through at least 3 years of age (Adamson et al. 2004; Carpenter et al. 1998, as cited in Mundy et al. 2007). Murray et al. (2008) reported that JA typically develops before an infant is 12 months and is well established by 18 months of age.

Charman (2003) studied the association of JA and social communication abilities of infants with autism and pervasive developmental disorder at 20 months, and then again when those infants were 42 months; finding that JA was positively correlated with language gains and social communication (p. 8). Quinsay (2012) also reported “joint attention is a necessary precursor skill for language and social-cognitive development” (p. 1). It is the “shared attention and communicative reference of joint attention behavior that is early evidence for an infant’s emerging understanding of others as intentional agents, and this mental state of shared attention may be a precursor to understanding Theory of Mind” (Tomasello 1995, as cited in Charman 2003, p. 6).

### Pronouns and the Development of Self

Pronoun development and development of self are inter-related. As pronoun development occurs, there is an incremental and simultaneous increase in the awareness of self. Owens (2008) stated subjective pronouns, such as *he*, *she*, and *they*, are acquired before objective pronouns, such as *him*, *her*, and *them*. Subjective pronouns are followed by the development of possessive pronouns, such as *his*, *her*, and *their*, and finally, around age five, reflexive pronouns, such as *himself*, *herself*, and *themselves* appear (p. 255). A similar pattern in pronoun development was reported by Rossetti (1990), finding typically developing children referring to their self by name from 21 to 24 months of age. Pronouns such as *me*, *my*, *mine* also develop at that time. By 27–30 months of age, a typically developing child uses *I*, *me*, and *mine*, and reportedly understands pronoun usage from 22 to 28 months of age. It is common for children at this stage to use the word “*mine*” in reference to their toys, drinks, or food, and they are typically able to recognize their image in the mirror as “*me*” (Rosetti 1990, as cited in Harrington 2012).

First person I/You pronoun reversal (referring to oneself in third or second person pronoun) difficulties have been recognized as descriptors of individuals with ASD (Bartak and Rutter 1974; Fay 1979; Kanner 1944; as cited in Volkmar et al. 2005, p. 256). Harrington (2012) asserted that pronoun reversal in individuals with ASD is directly related to echolalia. Harrington contended that individuals with ASD often use echolalic speech, and therefore, refer to themselves as they have heard others speak of them (ex. third person pronoun)—and repeat back what someone has said. For example, an adult might ask “Are you hungry Bob”? and the child responds “Bob is hungry” (p. 1).

Pronoun reversals however, are not contingent upon the presence of echolalia. Many individuals with ASD without echolalia refer to themselves in the third person. Conversely, some individuals with ASD with echolalia refer to themselves in the first person pronoun. It is more likely that an individual with ASD, with or without echolalia, will have difficulty with pronoun development due to their inability to develop a sense of who they are, having not acquired constructs of ‘Object’ and ‘Other’, and then consequently, ‘Self’. As per Cooley, Mead, and Wicklund; the construct of other has to be developed, prior to developing the construct of ‘Self’.

There is empirical evidence that individuals with Autism have difficulty with pronoun reversals, and developing a construct of self. In their study of neural brain physiology, Mizuno et al. (2011) also found that limbic system function was significantly different/lower in individuals with high functioning Autism. Mizuno et al. (2011) reported this was characteristic of “an atypical understanding of the social

world because deictic shifting (from other to oneself) is embedded in understanding the self and other-relationship, requiring the recognition of the self's stance relative to the other's existence" (p. 12). Pronoun reversals may "reflect a disturbed processing of the understanding of self and other in the reciprocal relationship, rather than a semantic error to adjust pronominal forms (Mizuno et al. 2011, p. 12).

## Method

### Participants

Convenience sampling of six adolescents (one female, five males) from two ASD self-contained high school classrooms in a suburban Florida city participated in the study. The female's chronological age (CA) was 16 years, and the CAs of the males were 15, 16, 17, 19, and 21 years respectively. All parents of participants gave informed, written consent for their children to take part in the study, and releases were also obtained with respect to photographic materials.

An IQ assessment of participants was not conducted. All participating students were previously identified by their respective Elementary Schools as having ASD, and had been placed in self-contained classrooms due to significant cognitive impairment. Each student met the following criteria for participation in statewide alternative assessment testing (FLDOE, Assessment Participation Checklist, July 2010).

- The student has a significant cognitive disability;
- The student is unable to master grade-level, general state content standards even with appropriate and allowable instructional accommodations, assistive technology, or accessible instructional materials;
- The student participates in a curriculum based on sunshine state standard access points for all academic areas;
- The student requires extensive direct instruction in academics based on access points in order to acquire, generalize and transfer skills across settings.

Student cognitive complexity levels, as defined by the FLDOE alternate assessment, indicated the following: Student B and E at the participatory level (skills at a beginning academic awareness level, such as recognizing parts of a whole or recognizing a letter or number); Students A, C, D, and F at the supported level (skills that require identifying, recalling, or performing basic academic skills, such as reading words or solving simple math problems); and there were no students at the independent level (skills that require organizing, comparing, and analyzing, such as identifying the main idea of a story or solving more complex math problems).

### Materials

#### Dry Erase Colored Markers

#### Dry eraser

12" × 12" dry erase Whiteboard (framed with one inch of gray duct tape: W-Board)

12" × 12" mirrored tile (framed with one inch of gray duct tape: M-Board)

#### Duct tape

11" × 8.5" slanted acrylic easel holder/copy holder

24" × 36" fixed vertical mirror (Vertical M-Board)

Student's individual visual schedule including task and activity pictures

#### Velcro Dots

Picture Cards (5" × 8" language cards—photos and words for developing basic vocabulary skills by north star).

### Procedure

The procedures in this study evolved from an effort to assist students with ASD in meeting Independent Functioning, ADL, and personal hygiene IEP goals. A four-stage paradigm was introduced to measure the effectiveness of self-awareness instructional techniques for students with ASD, and six students were individually guided through a matrix of JA curriculum activities that utilized mirror reflected images. The mirror provided a unique learning instrument that facilitated each student's ability to join constructs of 'Object', 'Other', and then ultimately 'Self'.

Before initiating the JA matrix of activities, each student was positioned in front of the vertical mirror for a single trial, to determine baseline MSA. Although each participant's previous experience and exposure to mirrors and reflected images was not ascertainable, the baseline determination of MSA was a reliable indicator of the student's current level of self-awareness.

Each student's reaction to the mirror, and reflected images of 'Object' (picture cards), 'Other', and 'Self' was observed and recorded. Students were then assigned a corresponding baseline level of MSA as outlined in Fig. 5.

### Level of Mirror Self Awareness (MSA)

- Mirror aversion—an unwillingness (or unawareness) to engage with mirror reflected images;
- Mirror object identification—ability to correctly identify objects by their mirror reflected images;
- Mirror self identification (MSI)—ability to correctly identify 'Other' and 'Self' by their mirror reflected images in third and second person pronoun syntax;

- Mirror self recognition (MSR)—ability to correctly identify their mirror reflected image of ‘Self’ in first person pronoun syntax.

### *Mirror Self Awareness Development*

Within this study, MSA was developed along four distinct stages of reflected image awareness, based upon the triadic features of joint attention recognition of object, other, and self. Each individual student was guided through the Mirror Self Awareness Development (MSAD) Joint Attention Intervention Matrix (see Table 1). The JA activities included picture card identification; Dolch word identification; word writing of picture card images; names of siblings, peers, teachers, and

pro-nouns; and picture card image reflecting. For example, students were asked “what is this?” (reflected image of object-picture card), “who is this/that?” (reflected image of ‘Other/Self’). Each joint attention activity was timed, and continued for up to 20 min. Student time on task was observed and recorded and students were closely monitored throughout each JA activity for indirect mirror eye contact with ‘Other’ (teachers), and direct mirror eye contact with their ‘Self’.

### *Mirror Image Desensitizing Strategies*

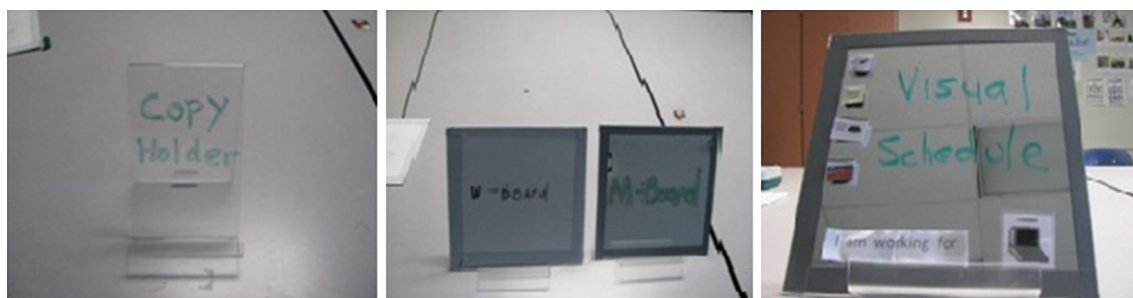
The goal of the first stage of MSAD was to have students become comfortable with reflected mirror images as they worked on routine tasks. After determining baseline MSA,

**Table 1** Mirror Self Awareness Development joint attention activity intervention matrix

Stage	Student baseline (MSA) JA activity	Completion	Pronoun development	Mirror image awareness			
				Object identification	Other identification	Self identification	Self recognition
	Male A (MSR)						
1	Visual schedule	Yes	N/A	Yes	N/A	Yes	Yes
2	Picture card identification	N/A	N/A	N/A	N/A	N/A	N/A
3	Word identify/writing	Yes	Yes	N/A	Yes	Yes	Yes
4	Picture card reflecting	Yes	Yes	Yes	Yes	Yes	Yes
	Male B (MA)						
1	Visual schedule	Yes	N/A	Yes	N/A	N/A	N/A
2	Picture card identification	Yes	Yes	Yes	N/A	N/A	N/A
3	Word identify/writing	Yes	Yes	N/A	Yes	Yes	No
4	Picture card reflecting	Yes	Yes	Yes	Yes	Yes	No
	Male C (MA)						
1	Visual schedule	Yes	N/A	Yes	N/A	N/A	N/A
2	Picture card identification	Yes	N/A	Yes	N/A	N/A	N/A
3	Word identify/writing	Yes	Yes	N/A	Yes	Yes	No
4	Picture card reflecting	Yes	Yes	Yes	Yes	Yes	No
	Female D (MSR)						
1	Visual schedule	Yes	N/A	Yes	N/A	N/A	N/A
2	Picture card identification	Yes	N/A	Yes	Yes	Yes	Yes
3	Word identify/writing	Yes	Yes	Yes	N/A	Yes	Yes
4	Picture card reflecting	Yes	Yes	Yes	Yes	Yes	Yes
	Male E (MOI)						
1	Visual schedule	Yes	N/A	Yes	N/A	N/A	N/A
2	Picture card identification	Yes	N/A	Yes	Yes	N/A	N/A
3	Word identify/writing	Yes	Yes	Yes	N/A	Yes	No
4	Picture card reflecting	Yes	Yes	Yes	Yes	Yes	No
	Male F (MSI)						
1	Visual schedule	Yes	N/A	Yes	N/A	N/A	N/A
2	Picture card identification	Yes	N/A	Yes	Yes	N/A	N/A
3	Word identify/writing	Yes	Yes	Yes	N/A	Yes	Yes
4	Picture card reflecting	Yes	Yes	Yes	Yes	Yes	Yes

Student progression through the stages JA activities was recorded for activity completion and pronoun development





**Fig. 1** Set up of copy holder, W-Board\_M-Board, and visual schedule

the next step incorporated desensitizing students to having the 12" × 12" mirror in proximity. The 12" × 12" mirrored tile (M-Board) and 12" × 12" dry erase whiteboard (W-Board) was placed in each student's copy holder, in front of each student on their desk/work station.

Students initially performed daily work station activities in front of their M-Board in the afternoon for 3 days, and then both morning and afternoon for 7 days (total of two school weeks). Students were shown how to place the W-board in front of the M-Board so that if they became uncomfortable with the M-Board (or their reflection), they were able to place the W-Board directly in front of the M-Board—in essence, they were able to turn off their reflected image.

All students routinely followed visual schedules, and this familiarity naturally led to a further desensitization to the proximity of the M-Board and any reflected images. The student's usual visual schedule was replicated on the M-Board, with tasks vertically placed on the left side of the M-Board (see Fig. 1 for set up of copy holder, W-Board\_M-Board, and visual schedule). The words "I am working for \_\_\_\_" (picture of chosen reward) was at the bottom of the task board. All pictures and words were adhered to the mirror reflective surface, with Velcro dots.

Students were instructed to check their work schedule on the M-Board (steering them to their reflected image), and encouraged to complete their assigned work tasks in front of their M-Board. As with the initial desensitization to the M-Board, if students became uncomfortable with their task schedule, they could cover the schedule with the W-Board. The M-Board, with the visual picture schedule, and W-Board remained on student's desks throughout the intervention.

### *Mirror Image Object Identification*

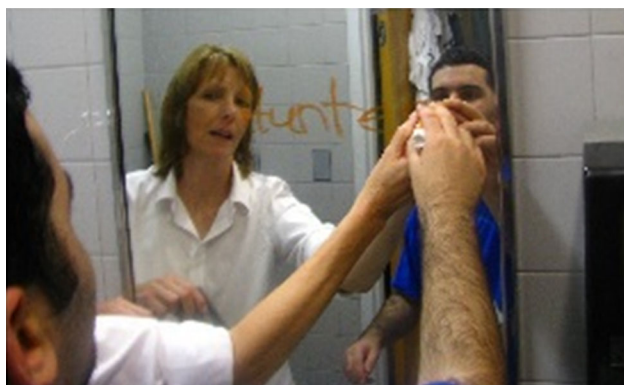
The goal of the second stage of MSAD was to have students correctly identify the reflected picture card images of objects. This stage incorporated each individual student being brought to the vertical mirror (that was at eye level for both student and teacher). As Teacher One positioned

herself beside the student in front of the mirror, with both the student and Teacher One facing the mirror; Teacher Two was located three feet behind them and recorded the names of the objects/pictures, and observations of student responses. The student was actively engaged by Teacher One in choosing to identify the reflected image of the picture card held by Teacher One. The student was then asked a series of questions designed to establish the concept of 'this' and 'that' as prerequisite for pronoun development; for example, "is this a cow?", "is that a cow or pig?".

The next segment of stage two was to involve the student holding an individual picture card in front of them, reflecting the image of the picture card into the mirror. The student was asked demonstratives such as ("What is this?" and "What is that?") to identify the reflected image of the picture card and the engage with the teacher in writing the name of the object (ex "rabbit", "Lets write rabbit, r-a-b-b-i-t on the mirror"). This procedure was followed for each of ten subsequent picture cards, or until there was a breakdown in JA.

The Mirror Joint Attention strategies within this stage incorporated demonstratives (ex. "What is this?") previously identified by Diessel (2003), to be effective in developing JA, and the emergence of grammar. Diessel (2003) stated joint attention has received a great deal of consideration from psychology and philosophy; however, the role of joint attention in the development of language and language acquisition has "largely been ignored by linguistics" (p. 464). Diessel purported that demonstratives (words that denote location—*this, that, these, those*) "play a foundational role in establishing and creating a focus of joint attention" (p. 464).

The student was asked to identify reflected images of picture cards held by Teacher Two, who was positioned behind the student facing the mirror. The student was then instructed not to turn their body to look directly at the picture card behind them; rather, they were directed to identify the image of the picture card that was reflected in the mirror. The student was engaged by Teacher One in writing (hand over hand if necessary) the name of the reflected image of the picture on the mirror, at the student's eye level, just under the image of the picture (Fig. 2).



**Fig. 2** Indirect eye contact after identifying picture cards

### *Mirror Image ‘Other’ Attention: Mirror ‘Self’ Identification (MSI)*

The goal of the third stage of MSAD was to have students make indirect eye contact with ‘Other’ (Teacher One) as the student developed proper pronoun syntax. Through identification of reflected picture card images of objects, the stages of pronoun development proceeded from third person (he, she, it, they, them or formal name), to second person (you), and finally first person (I, me, we, us). This third stage also focused on having the student’s viewpoint at eye level with Teacher One, thereby enabling indirect mirror eye contact between student and Teacher One to occur in an innocuous way.

Teacher One chose ten Dolch words that the student was familiar with, and wrote them on the vertical mirror one at a time with a dry erase marker. The student, in unison with Teacher One, observed and verbalized each word with Teacher One. For example, “bird, b-i-r-d, bird”, for each of the ten words. Teacher One actively engaged the student’s mirror image, and encouraged the student to make eye contact, and communicate with Teacher One’s reflected image.

Within this third stage of MSAD word writing JA strategies were employed to differentiate ‘Other’ and then ‘Self’. This stage was designed to develop third person (he, she, him, her), and then second person (you) pronoun mastery. The student was advised that the names of people they knew would be written on the mirror. Teacher One stated “Your name is Bob, lets write B-o-b”. The student was encouraged to generate free association, and subsequently, articulate the names of people they knew including; siblings, teachers, and peers that they would like to write on the mirror. Indirect eye contact with the student’s reflected image was held, as the student wrote the names of people on the mirror.

This present study utilized a student’s ability to accurately communicate first person pronouns, as confirmation



**Fig. 3** Pronoun and ‘Self’ development

of their recognition of their reflected image, as their ‘Self’. Figure 3 illustrates the process of beginning instruction for pronoun and development of ‘Self’. While maintaining eye contact with the reflected image of the student, Teacher One stated, “Your name is Bob”, B-o-b, while she pointed toward the student’s reflected image, that’s you. “My name is Chris, that’s me”, as the teacher touched her hand to her chest. Students were asked to identify their self/image and the teacher’s reflected image by name and appropriate pronoun syntax, while student eye contact was held with Teacher One. Correct student responses during JA activities confirmed student progression through the three stages of pronoun development.

Students were guided through the three stages of pronoun development, by first establishing proper use of ‘this’ or ‘that’ for image/object identification. Students were then sequentially directed through a series of questions to confirm the student’s ability to properly utilize pronoun syntax. Questions such as ‘Who is that?’ and ‘What is his name?’ were used to substantiate third person pronoun mastery.

After students established matching third person pronouns to their respective images, the last segment of the third stage instructed students to hold picture cards, in a way so that Teacher Two, standing three feet behind the student and within range of the student’s visual field, could see the card’s reflected image. Teacher Two’s comments included specific instruction to the student; for example, “Hold that cat so I can see it” and questions such as “Can you see the cat’s reflection in the mirror”, and “Who would you like to erase the words on the mirror, ‘Me’ or ‘You’?”. Students were positively reinforced for appropriate responses, and corrected for improper use of pronouns. For example, if student chose ‘Me’ to erase the words on the mirror and handed the eraser to Teacher Two, the student was guided back through the series of questions and JA activities previously used to teach stage one (“this, that”) and stage two (“My name is..., your name is...”) of pronoun development.

It is presumed that students began to connect the cause (moving the card), and the effect on the card's reflected image during this third stage of pronoun development; thus demonstrating an awareness and understanding of the relationship between the 'Object's' reflected image (virtual), and the 'Object's' image itself (real). It was also during this stage that highly personalized comments and questions were posed to the student to reinforce second and third person pronouns. The student was asked "What color are my eyes?" "My eyes are green". "What color are your eyes?" "Your eyes are brown". This stage was critical as students began to understand that the image reflected in the mirror, was in fact, the reflected image of their 'Self'.

#### *Mirror 'Self' Recognition (MSR)*

The goal of the fourth and final stage of MSAD was to have the student identify their mirror reflected image in first person pronoun syntax. It was within this stage of MSR that the student was instructed to stand alone, with each teacher positioned to ensure that their reflected image was not within the student's mirror view. The student was given a picture card and prompted to hold and identify the picture on the picture card, from the card's reflected image (Fig. 4).

After the student identified the picture, they were asked a series of questions to ascertain their understanding of first person pronoun. For example, "Who is holding the picture of the cat?" and "Who (reference to student) is wearing the blue shirt?" Responses in the first person, such as "That's me", "Me" or "I am" were indicative of 'Self' recognition (MSR) and positive indicators that the student could both internally and externally direct his attention on 'Self'. Responses such as "Bob", "Him", or "He" indicated the student had not mastered first person pronoun, and 'self-awareness' was limited to 'Self' identification (MSI) suggesting the student was unable to direct his attention both internally and externally on 'Self'.



**Fig. 4** Making eye contact with reflected self image

## Results

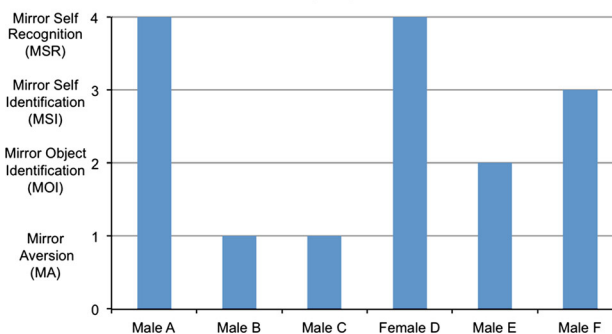
Student baseline MSA assessments (Fig. 5) indicated two males (B, C) had mirror aversion (MA), as evidenced by their refusal to engage with any aspect of the M-Board and/or the vertical mirror. Both the female (D) and one male (A) were able to recognize their reflected image as their 'Self' (MSR) and when asked "who is that?" both students referred to themselves within the first person ("me"). Although the female recognized her reflected image as herself, her eye contact and facial expression with her reflected image was exaggerated, over animated, and socially inappropriate.

One male (E) was able to correctly identify reflected images of objects; however he had difficulty recognizing the reflected image of himself (MSI). The remaining male (F) identified himself in third person, using his proper name "Frank" to identify himself, rather than "that's me" or "I".

Table 1 outlines the Mirror Self Awareness Joint Attention Activities utilized, and how the JA framework related to student MSA development. The baseline MSA level of male students A and F, and female student D signified that they had knowledge of their reflected image. Students A and D exhibited MSR, and student F demonstrated MSI—referring to his reflected image by proper name.

All students completed JA activities of visual schedule, picture cards, word identification/writing, and picture card reflecting. Students A, F and D also completed Art drawings in the mirror, and students D and F completed basic math questions with Teacher One on the M-Board. Figure 6 illustrates that four students (B, C, E, and F) showed increases in MSA, as they progressed through MSAD JA activities. Both students A and D became more socially appropriate after MSAD JA activities were introduced. Eye contact and facial expressions became less exaggerated, less animated, and more situationally appropriate.

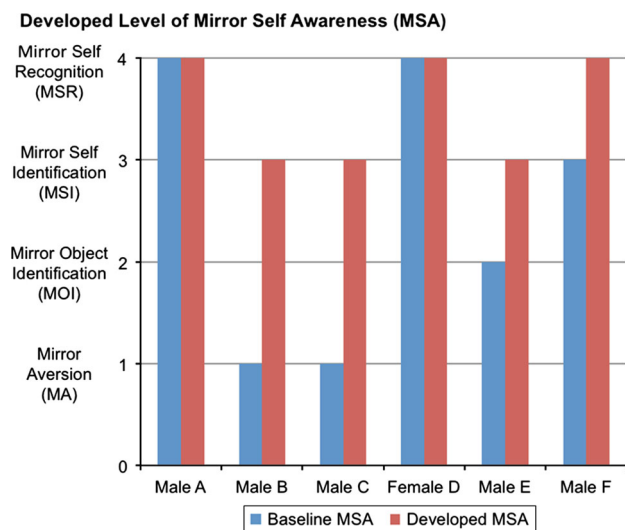
**Baseline Level of Mirror Self Awareness (MSA)**



**Fig. 5** Student baseline of mirror self-awareness

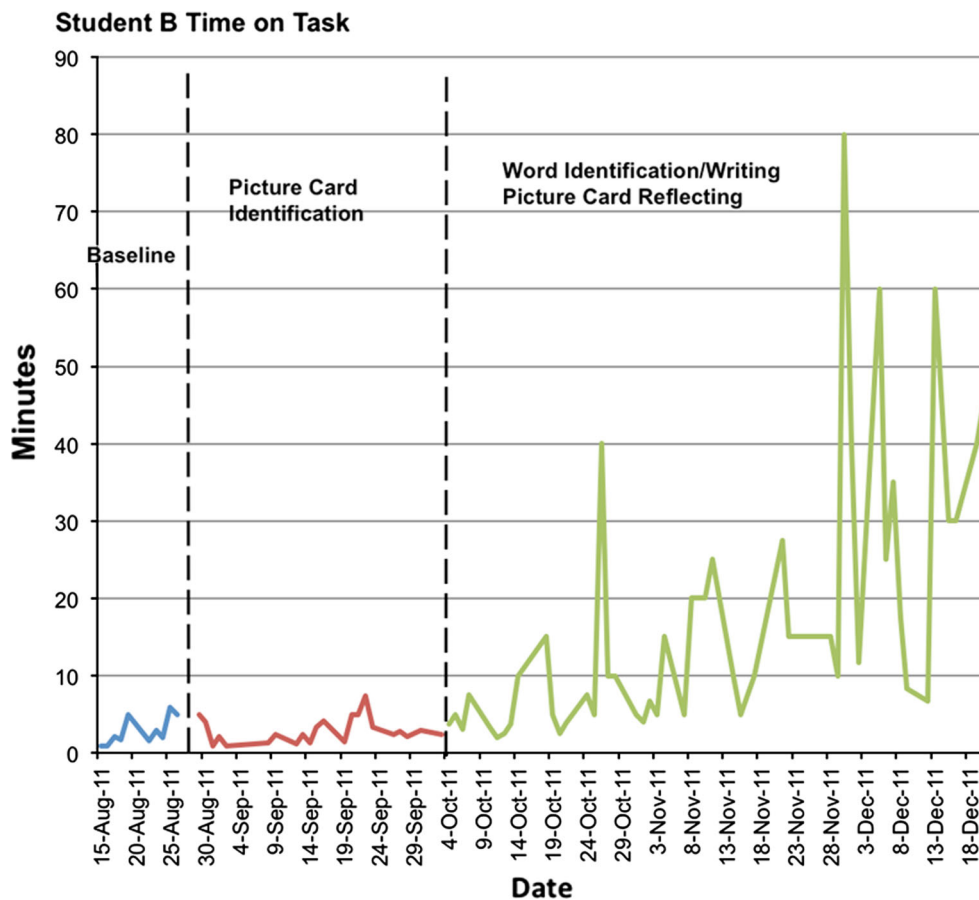


Student C was initially unaware and oblivious to the function and very presence of a mirror. He was observed to stand in front the vertical mirror, unaware that his image or any other image could be, or was reflected. Student E was able to initially identify reflected images of objects; however, he did not recognize himself, having



**Fig. 6** Student mirror self-awareness before and after joint attention matrix activities

**Fig. 7** Student B increased his ability to stay on task during routine classroom academic assignments, as he progressed through the MSD JA matrix



what could be termed as ‘Self Blindness’. Student E’s developed level of MSA was increased to where he could identify himself in the third person (when the teacher asked “Who is that”, the student’s response was “Evan”). Student E had the most difficulty with first person pronoun development.

Although student F was very comfortable with engaging in MSAD JA activities, and readily made indirect eye contact with ‘Other’ and direct eye contact with his ‘Self’ reflected image, baseline MSA indicated that was unable to identify himself in the first person. Student F enjoyed completing additional curriculum including; basic math problems, artwork, and word activities on the vertical mirror surface. Over the course of the study, Student F developed MSR, as evidenced by referring to his reflected image in the first person with responses of “That’s me” to questions such as “Who is that?”.

The baseline of student B was a severe aversion to any mirror, or any reflected mirror images. While all students made gains in the amount of time they engaged in MSAD JA activities; student B, the lowest academically functioning student, made significant gains in the amount of time he was able to remain on MSAD JA, and other routine academic tasks; after Picture Card MSAD JA activities were introduced (Fig. 7). Student B increased his time on task from less

than 5 min (over the course of completing one assigned academic activity) to a high of 80 min total (over the course of completing three academic activities). Student B's MSA progression was the most dramatic, moving from complete MA to MSI over a 6 week period. He became desensitized to, and overtly comfortable with his proximity to the both the M-Board and vertical mirror, and was able to correctly and consistently identify reflected 'Object' images, make eye contact with his and 'Other's' reflected image, and developed pronoun syntax of 'Other' and 'Self'.

## Discussion

Mirror understanding and its relation to the development of self and pronouns in general, and ASD specifically, is not clearly or readily defined in the current literature. The present study outlined how the mirror can assist educators of students with ASD to introduce joint attention activities—leading to measurable increases in student self-awareness, as aligned with pronoun development.

Out of the six students that participated in this study, two students progressed from Mirror Self Aversion (unwillingness or unawareness to engage with mirror reflected images), to MSI (when asked "Who is that", they both referred to themselves in third person pronouns, by their given names, ex. "Bob"). One of those two students, (Student B) dramatically increased his ability to remain on task, as his level of self awareness increased. One student moved from Mirror Object Identification (ability to identify reflected images of pictures), to MSI, and one student increased their MSA, from MSI to MSR (when asked "Who is that", they referred to their self in the first person pronoun "that's me"). Two students maintained their levels of MSA at MSR.

Apart from increasing self-identification and self-recognition, this study's MSAD JA strategies also proved to be highly engaging (for both teacher and student), and highly preferred by all students. When offered the choice between a mirrored surface (M-Board/vertical mirror), or a non-mirrored surface (W-Board) to complete JA activities, each student consistently chose the mirrored surface. Moreover, students more readily engaged in and preferred to complete tasks in front of their M-Board, rather than in front of their W-Board. The MSAD JA curriculum implemented in this study was 'teacher friendly', inexpensive, and easily incorporated into students daily classroom activities.

## Applicability to Video Modeling

Several studies suggest that video modeling (VM) is a highly effective strategy in teaching various skills to

students with ASD. VM has been defined as an intervention involving "a child watching videotapes of positive examples of adults, peers, or him-or herself engaging in a behavior that is being taught" (Delano 2007, p. 33). VM is classified in two general categories: "Other as Model" or "Self as Model" as follows:

- "Other as Model"—Student watches a video of an adult or a peer engaged in a targeted behavior. After observing the video, the student is encouraged to replicate the targeted or modeled behavior of 'Other'. As teachers use VM they label the targeted behavior, making third person pronoun comments such as "look, what 'he' is doing".
- "Self as Model"—Student watches an edited video of him/herself performing a targeted behavior. After observing the video, the student is encouraged to replicate the targeted or modeled behavior of himself/herself. In this VM procedure, teachers use first and second person pronoun dialog such as "look at what 'you' are doing", in an effort to have the student understand that it is their 'Self' ('that's me, I am doing that, I can do that').

While VM is considered an effective means to teach social skills, it has not been found to be universally beneficial for all students with ASD. Perhaps VM is not as effective for individuals lacking basic constructs of 'Other' and/or 'Self'. This may suggest that the development and awareness of the permanence of one's Self, (understanding that one exists apart from a video image), or 'Self permanence', may be a critical factor in successful VM intervention techniques.

## Possible Relevance to Neuroplasticity

Differences and difficulties in the ability of individuals with ASD to develop a sense of 'Self' have neurobiological underpinnings. Components of the Limbic system (precuneus, insula and amygdala) have been related to concepts of self, self awareness, and JA. Mizuno et al. (2011) found the precuneus was related to aspects of 'self', and the 'anterior insula' is linked with 'self-awareness' while Rosenberg and MacMaster (2009) reported that the amygdala supports JA.

Studies have shown there are Limbic system differences in individuals with ASD, particularly as these differences are related to the amygdala and engaging in JA. Mosconi et al. (2009) found the amygdalae in individuals with ASD were enlarged. Schumann et al. (2004) reported the amygdalae of toddlers with Autism were 17 % larger than those without Autism. Toddlers with Autism also had the most difficulty in establishing JA.

Differences in the amygdala could also contribute to the difficulty some individuals with ASD have in engaging in

JA, and in developing a sense of self. JA may be requisite to developing a construct of self, due the triadic nature of its processes as they relate to ‘Object’, ‘Other’, and ‘Self’. Non-traditional JA activities, such as mirror awareness activities, may be suited to targeting Limbic system function (amygdala, precuneus, and anterior insula) in students with ASD, and thus assist in developing the construct of self.

Hamann et al. (2002) found the amygdala was activated in positive emotional reactions as measured with positron emission tomography (PET). Although this present study is limited in that it did not measure student brain function, some aspect of neuroplasticity (change in structure and function of neurons or pathways) may have occurred. Student preferences to engage in JA activities, coupled with increases in MSA suggest that a positive emotional reaction could have occurred, and that some aspect of the amygdala or the limbic system of students may have been affected—assisting toward the development of self.

### Concluding Thoughts

The implications of this study may open new areas of research including: What role does mirror interaction have in affecting ‘self-development’? What are the social and communicative interrelationships between JA, pronoun acquisition, and self awareness, in students with ASD? Could JA mirror activities affect the development of the amygdala, precuneus, and anterior insula/insula? Can changes in self awareness be neurologically mapped and empirically correlated to the Limbic system? How does the development of self-awareness in students with ASD differ from other students? Questions posed also point to the need for additional research into the construct of ‘Object’ as it relates to JA, the construct of ‘Other’ as it relates to developing ‘Theory of Mind’, and the construct of Self permanence as it relates to a ‘Theory of Self’.

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