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Young Children with Autism Spectrum Disorder Learning Emotion-Recognition from Animated Media Content

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Abstract

Research suggests children with Autism Spectrum Disorder (ASD) can learn emotion-recognition from media content such as Thomas the Tank Engine due to idiosyncrasies related to ASD. However, this author argues the way media is crafted is the key element in determining successful learning. To investigate this phenomenon, a survey of parents with children with ASD was conducted asking about their child's relationship with media, what has been most successful in their home, whether they have favorites, and whether they believe their children are learning emotions from media. The survey also asked about viewing and post-viewing behaviors. Results indicated parents believe their children have a special relationship with characters they cannot duplicate with people, with favorites including Dora the Explorer, Thomas the Tank Engine, and Mickey Mouse Clubhouse. Some parents saw better emotion-recognition after viewing. The most common behavior while viewing was "tuning out environmental distractors" and post-viewing was "repeating dialogue."

Keywords: Autism, emotions, learning from media, parents, young children

1. Introduction

The popular children's character Thomas the Tank Engine is beloved by young viewers and parents alike, but its value for children on the Autism spectrum may be greater than its creators ever expected. Research out of Cambridge University suggests that children ages 2-8 with Autism Spectrum Disorder (ASD) are learning emotion recognition skills from media content such as *Thomas the Tank Engine* (Baron-Cohen, 2008). However, indications that *Thomas* is helping children in this manner largely come from parental anecdotes, such as, "Thomas & Friends has definitely been one of the elements that has helped him to recognize human facial expressions and to label his own emotions," "He definitely uses the train faces to distinguish between different emotions. Thomas has helped him to get into the world of not just language but also how people feel," and "J couldn't talk about emotions unless it was through Thomas & Friends. When he was naughty he'd say he was like Diesel 10 and when we wanted to find out how he was feeling we'd ask him how he thought Thomas felt today" (Stirling, 2007, np). Observations such as these must be thrilling for parents who struggle every day when communicating with their children with ASD. Could *Thomas* and similar programs truly hold the key to augmenting executive functioning (EF) skills like mind-reading, empathy, and perspective-taking for children on the spectrum?

2. Review of the Literature

Whereas Baron-Cohen (2008) has not yet published causal or correlational data on *Thomas* and EF skills, he has put forth the Hyper-Systemizing Theory to explain the anecdotal evidence. As Baron-Cohen is an Autism researcher, his theory focuses on the abilities and challenges of the Autistic viewer, positing that the reason children learn from the program lies in idiosyncrasies related to ASD itself.

The current author, however, views this phenomenon from a cognitive load perspective, and couches the study of *Thomas's* usefulness in teaching EF skills in a new theoretical perspective with a focus on a cognitive capacity/multimedia learning. Thus, after a summary of ASD and EF deficits both theoretical perspectives are described below.

The Autism Spectrum and Executive Functioning Deficits

In 2013, the American Psychiatric Association (APA) updated their DSM-IV definition of ASD from a four-disorder diagnosis (autistic disorder, Asperger's disorder, childhood disintegrative disorder, and pervasive developmental disorder not otherwise specified) to a single "umbrella" disorder simply referred to as ASD in the new DSM-V (APA, 2013). Individuals diagnosed with ASD will still fall on a continuum, with some children displaying mild symptoms and others more severe.

According to the APA (2013), children diagnosed with ASD display several communication deficits. These children often respond inappropriately in conversations and tend to misread nonverbals, which greatly impairs their ability to make friends with peers and effectively communicate with adults. Haney (2013) explained that all children on the ASD spectrum display three core deficits including difficulty with socialization, deficits in communication (verbal and nonverbal), and "restrictive, repetitive, and stereotyped patterns of behaviors and interests" (p. 39).

A core deficit in socialization is typically one of the earliest indicators of ASD. Diagnosed children show atypical development in early childhood with joint attention, social referencing, and symbolic and pretend play, three key EF skills. Dawson et al. (2004) explained that joint attention involves gazing and pointing and typically begins in infancy; it is foundational when engaging in shared experiences. Social referencing involves looking to others' emotions first to gather information about current events before acting (Dickstein & Park, 1988). Difficulty with joint attention, social referencing, and the engagement with pretend play diminishes a child's ability to engage in what is termed social reciprocity, often resulting in rejection and alienation from peers (Haney, 2013). "Theory of mind," (TOM) sometimes called "mindblindedness" is also a core deficit where socialization is concerned. TOM refers to the ability to understand the mental state of someone else and virtually "engage in a form of mind reading" (Durand, 2005, p. 92). When this perspective-taking ability is lacking, social relationships are difficult to maintain.

Deficits in overt verbal and nonverbal communication also hinder children with ASD. These children often have difficulty maintaining eye contact and accurately using and regulating nonverbal signals such as facial expressions, postures, gestures, and body language. They also struggle with "social and emotional reciprocity" and often fail to understand the give-and-take of social relationships (Haney, 2013, p. 42). Spoken language can also appear later than with non-ASD children, which results in difficulty initiating and sustaining conversation (Christopher, Sears, Williams, Oliver, & Hersh, 2004). Children with ASD can also be overly reliant on routine. They can become intensely focused on minutiae or inappropriate items, and are highly sensitive to any change to their immediate environment (APA, 2013). Many children with ASD prefer objects to people and display restrictive interests that are atypically intense in focus (such as only playing with trains, talking about trains, drawing trains, etc., for several months) (Heflin & Aliamo, 2007).

2.1 Can Children with ASD Learn from Media?

Research on Bandura's (1977) Social Learning Theory (SLT) has established that children can effectively learn via observation, and they demonstrate such knowledge via imitation/modeling behavior. Video modeling appears to be beneficial for teaching skills to children with ASD (raisingchildren.net, 2022); research has documented the successful acquisition of vocalization and communication skills, (Charlop & Walsh, 1986; Charlop & Milstein, 1989), social and play skills (D'Ateno, Mangiapanello, & Taylor, 2003; Taylor, Levin, & Jasper, 1999; Wert & Neisworth, 2003), academics (Kinney, Vedora, & Stromer, 2003; Schaeffer, Hamilton, & Johnson, 2016) and adaptive behavior (Shipley-Benamou, Lutzger, & Taubman, 2002).

Perhaps most crucial to the current project, however, are the studies pointing to successful imitative learning from video of emotion processing (Corbett, 2003) and perspective taking (Charlop-Christy & Daneshvar, 2002; LeBlanc, Coates, Daneshvar, Charlop-Christy, Morris, & Lancaster, 2003) by children with ASD. Corbett (2003) used a case study approach with an 8-year old Autistic child to help him read four emotions: happy, sad, angry, and afraid. The child observed videotaped scenes of typically-developing peer models every day, five days per week, over a period of two months.

After each session, a therapist would ask him to identify how the child in the video was feeling and offer praise if correct. Then the therapist would role-play with the child to act out the emotion. The child quickly mastered "happy," eventually mastering the others. Corbett (2003) saw a 51% increase in facial expression identification between pretest and posttest, a moderate improvement in identification of emotional tone in speech, and no change in perception of gestures. These results show promise for the potential of learning emotions from media.

Both Charlop-Christy and Daneshvar (2002) and LeBlanc et al. (2003) used video modeling to teach perspective-taking to three children with ASD. After viewing video of familiar adults performing perspective-taking tasks, and explaining their thought processes and repeating correct responses, all six children from both studies displayed an understanding of perspective-taking immediately after viewing. Charlop-Christy and Daneshvar (2002) explained these results in terms of stimulus overselectivity: video modeling is thought to help compensate for this overselectivity because the camera zooms in closely on only the relevant information, so the child viewer's attention is highly engaged and focused only on those relevant cues. Whereas these studies are almost two decades old, they are still being used as the "gold standard" when caring for children with ASD (see for example, Model Me Kids, LLC, 2022).

The videos used in these studies were specifically crafted to be instructional and children viewed them under controlled conditions devoid of any extraneous visual and auditory stimuli. However, most programming to which children are exposed is animated entertainment, viewed in non-controlled, often chaotic settings. So, the question remains: can we be confident that entertainment programming not specifically crafted for an ASD audience will provide appropriate video models to encourage the learning of EF skills like emotion-reading and TOM? This survey of parents begins to address this question.

2.2 Hyper-systemizing Theory

As noted above, Baron-Cohen's (2008) work on hyper-systemizing is not media-centric in its approach, but his ideas about the core difficulties experienced by children with ASD must be a part of the conversation. Hyper-systemizing theory suggests that individuals with ASD have an incredibly strong drive to systemize. Through a system, and learned rules of cause and effect, the human brain observes an input and makes a prediction of the potential output based on probability (Baron-Cohen, 2008). These observations lead to the identification of laws. Baron-Cohen (2008) explained, "Systems that are 100% lawful have zero variance, or only 1 degree of freedom, and can therefore be predicted (and controlled) 100%" (p. 66). When the variance is wider, as in a social interaction, there is an increase in degrees of freedom and a decrease in predictability. Lawful predictably is significant to individuals with ASD because of their "need for sameness" or "resistance to change" (Kanner, 1943). They do not do as well in a more variable, social situation.

Baron-Cohen's (2008) hyper-systemizing theory proposes that every human brain has a systemizing mechanism (SM). Each individual, dependent upon mental ability, has this mechanism set at a different "level" ranging from level 1, which is characterized by little or no desire to systemize, to level 8, which shows a strong affinity for lawful, systematic change and an intolerance to hasty, unpredictable change (Baron-Cohen et al., 2005). ASD individuals generally operate on a relatively high systemizing level (6-8), whereas most neurotypical people have a limited attraction to lawful systemizing and operate on level 2 or 3. Furthermore, the higher the SM level, the lower one's ability to generalize (Baron-Cohen et al., 2005). In addition, there are two types of change: agentive and non-agentive. Baron-Cohen et al. (2005) explained, "If an object change is perceived to be self-propelled, the brain interprets the object as an agent, with a *goal*" (p. 3). In contrast, a non-agentive change is not self-propelled, but uses systemizing processes to search for structure (Baron-Cohen et al., 2005).

The actual process of systemizing involves five phases: analysis, operation, repetition, law derivation, and confirmation/disconfirmation (Baron-Cohen et al., 2005). Phase 1, analysis, focuses on observing inputs and outputs (instruments that create change). Phase 2, operation, centers on performing an operation on the input and observing the change on the output. Phase 3, repetition, performs the same operation multiple times to test the established pattern of the input and output. Phase 4, dictated law derivation, references the law derived from the observed change (i.e., if X, then Y). The final phase, confirmation/disconfirmation, suggests that "if the same pattern of input-operation holds true for all instances, the law is retained" (Baron-Cohen et al., 2005, p. 5). If the pattern is different, phases 2-5 are repeated, and the law is revised.

So why is hyper-systemizing important to this project? Baron-Cohen and his colleagues have used the knowledge that preschool children with ASD are hyper-systemizers to create a series of DVDs called "The Transporters" to teach emotion recognition (Baron-Cohen, Golan, Chapman, & Granader, 2007). The logic is that children with autism tend to avoid looking at the human face, and thus find it difficult to understand why faces "move" the way they do. The inability to read others' emotions then impairs successful socialization. But since researchers know that these hyper-systemizers are looking for "rules" and patterns first and foremost, the characters in the DVDs play off their fascination with things like rotating wheels, spinning tops, rotating fans, and mechanical, lawful motion and include vehicles that run on tracks or lines (such as trains). Each of these toy characters has an animated human face, and the episodes focus on 15 human emotions: happy, sad, angry, afraid, excited, disgusted, surprised, tired, unfriendly, kind, sorry, proud, jealous, joking, and ashamed. Baron-Cohen et al. (2007) reported that after four weeks of watching the videos 15 minutes per day, children with ASD ages two to eight caught up with neurotypically-developing children of the same age in their performance on emotion-recognition tasks. This has important implications for the viability of *Thomas* to do the same. However, Baron-Cohen and colleagues explained their results only in terms of hyper-systemizing. The current author agrees that the systemizing aspect most assuredly plays a role, but believes that there is more to the process. The style in which the material is presented plays a crucial role as well.

2.3 Cognitive Capacity Models and Multimedia Learning

To move beyond the systemizing explanation, the author looked to the media and communication literature for theories that seek to provide a more media-based explanation for why some material is more accessible to children with ASD. Ideally, an appropriate theoretical framework would account for the cognitive capacity of the viewers and how that affects their ability to learn from media. In 2015, AUTHOR created a "hybrid theory of cognitive capacity and multimedia learning by high-systemizers" (p. 23) in which elements from four theories focusing on working memory and the limitations of the cognitions of the viewers were combined: Cognitive Load Theory (CLT) (Sweller, 1988), Limited Capacity Model of Motivated Mediated Message Processing (LC4MP) (Lang, 1992), Capacity Model (Fisch, 2004), and the Cognitive Theory of Multimedia Learning (CTML) (Mayer, 2001).

The basic premise is that to make a mediated character accessible to children with ASD, content creators must keep things simple. CLT focuses on schemas and "germane cognitive load," reminding content creators to limit extraneous or supplementary information when crafting educational media content. Second, the LC4MP outlines the encoding, storage, and retrieval processes that continuously compete for a viewer's fixed pool of total mental resources, and highlights the importance of forming links between existing knowledge and new material. Third, the Capacity Model's contribution of "narrative distance" reminds researchers and content creators how crucial it is that the narrative and instructional content be closely intertwined if child viewers have any chance of learning the educational lessons presented. And lastly, the CTML's "multimedia principle" posits that viewers learn more deeply from words *and* pictures than from words alone.

Keeping in mind that the viewers under study are children with ASD and are most likely high systemizers, Baron-Cohen's work tells us that if content creators can make the learning of emotions systematic in some way, these children have a greater chance of learning the material. So, for example, if the content contained in *Thomas* is germane to the emotion-recognition lesson, makes it easy for viewers to link what they are learning to material they already know, keeps a small narrative distance in the storyline, and presents relevant material in both words and pictures, this "hybrid theory" predicts that the program can successfully utilize the capacity of working memory to teach emotion recognition to children with ASD.

2.4 Research Questions

Obviously, *Thomas* gives researchers a place to begin investigating this phenomenon, as there is a plethora of anecdotal evidence from parents that this particular program was helpful in teaching emotion recognition. But the potential also exists for other programs with similar cognitive requirements to "teach" children with ASD. Is this ostensible effect limited to *Thomas*, or do parents of children with ASD see this behavior in other media contexts? If so, are there some commonalities among these "favorites" that are predicted by the literature/theory? Thus, RQ1: What do parents with children on the Autism spectrum report about their child's relationship with media? And RQ2: What program/character has been most successful in their home (i.e., was there a show that "worked" best)?

Actual viewing behaviors that can indicate engagement with the mediated content are also of interest, as they speak to the cognitive load issue. Thus, RQ3: What behaviors do you observe in your child with ASD that indicate engagement with the content or characters?

And lastly, as *Thomas the Tank Engine* is the program specifically anecdotally noted by parents as most influential regarding children with ASD and emotion recognition, RQ4: What do these parents think about *Thomas's* ability to help children learn EF skills?

3. Methodology

This online survey of parents with children who have been diagnosed with ASD was launched via Qualtrics.

3.1 Sampling

A snowball sampling method was used to circulate the link to the Qualtrics survey. Social media was used to recruit parents who have children with ASD. The researcher posted the link to her Facebook and Twitter accounts and encouraged others to share it. Because the sample is limited to parents with children diagnosed with ASD, various Autism support groups were also contacted online via their social media accounts and asked if they would post the link to their followers.

3.2 Survey Instrument

The questionnaire contains both closed- and open-ended questions. Questions for parents centered on their child with ASD and their ability to read others' emotional states. Items included, "Does your child have difficulty understanding emotions? Can you recall any incidents that stemmed from a lack of understanding of someone's feelings/emotions (including your own)?" and "Would you consider using media (TV, DVDs, video games, apps, computer games, etc.) to help your child with emotion recognition?" Additional questions were specific to their child's relationship with media, such as, "Have you ever noticed your child responding to television/DVD content in a way that is different from how they respond to other people? Please explain." and if yes, "How old was your child when you noticed this?," "Was there a show(s) that "worked" the best?," "Why do you think it "worked" for your child? Was there something about the content or how the content was presented that appealed to your child?"

To address RQ3 about viewing behaviors, Shane and Albert's (2008) Likert-type questions were adopted, asking parents first if they observed any of the following behaviors while their child was watching TV (never, occasionally, frequently): Verbal imitation, physically approached screen, imitate movements on screen, tune out environmental distractors, act out the scene, recreate scene with props, attend to remote or electronics more than the program, attend to written language on screen more than the show, repeatedly view and play selected shows/scenes, and tolerates a device turned off. Parents were also asked about their child's behavior after exposure to the content. Using the same Likert scale options, behaviors included: Sing or hum songs from preferred programs, repeat dialogue, imitate part of shows alone, re-enact scenes with toys/props, and reproduces written language

To begin exploring RQ4 about Thomas, parents were also asked, "If there was a TV show available to you that claimed to help your child learn emotions/feelings and what they mean, would you be interested in hearing more about it?" and "How likely would you be to show this program to your child?" Thomas was introduced at the end of the questionnaire (before demographics), and parents were asked, "Are you familiar with the children's program *Thomas the Tank Engine*?," "Has your child ever watched this program? If yes, did your child appear to enjoy it?," and "Did you ever notice your child learning anything from this program? Please explain."

Demographic questions regarding gender, age, race/ethnicity, income, and education of parents, and number, ages, and genders of children (both ASD and non-ASD) were included at the end of the instrument.

4. Results

Twenty-one parents began the survey, but only 11 online surveys were completed. However, as this research is exploratory, the results presented here can inform the larger conversation about ASD and learning from media.

Ninety-three percent (n= 13) of parents who began the survey indicated that their child had difficulty understanding emotions, and can recall specific incidents that stemmed from a lack of understanding of another's emotions. All parents indicated that they would consider using media to help their children with emotion recognition.

Open-ended questions asked parents if they had ever noticed their child responding to media content in a way that is different than how they interact with people. Most parents indicated their children appeared to engage more with the media content than people. Example responses included, "My son will hyper focus on TV," "With people my daughter is very shy and poor eye contact. She is very engaging and verbal when watching her favorite television show or dvd," and "he can empathize with TV characters, especially animated ones." Specific shows mentioned as favorites included: *Dora the Explorer, Thomas the Tank Engine, My Little Ponies, Pokemon, Paw Patrol, Mickey Mouse Clubhouse, Looney Tunes,* and *Bubble Guppies*. One parent even explained, "She responds best to animated and children's films. She watches them intently and could tell me if a character was sad or happy and why. While shows with 'real' people that are age appropriate, she doesn't identify the emotions of those people." When asked about why certain programs seem to "work" for their children, parents specifically mentioned machines, trains, and spinning wheels; extreme facial features of the characters; songs and musical components; and the simplicity of the images and language.

Parents were asked 10 questions regarding behaviors their children perform while watching media content, and rated them on a Likert scale where 1 = never, 2 = rarely, 3 = occasionally, 4 = frequently, and 5 = very frequently. Means and standard deviations are reported in Table 1. The most common behavior reported was that their child tuned out environmental distractors (i.e., overly-focused on the content), $M = 4.55$, $SD = 1.21$. The least common behavior reported was their child attending to the written language on the screen more than the show content itself ($M = 2.18$, $SD = .98$).

Parents were also asked to distinguish the frequency of five post-viewing behaviors from the during-viewing behaviors using the same Likert scale. Means and standard deviations are reported in Table 2. After viewing, the most frequent behavior reported was "repeats dialogue" ($M = 3.82$, $SD = 1.17$) and the least common behavior was "reproduces written language" ($M = 1.82$, $SD = .87$).

Although statistical analysis of such a small sample size is not appropriate, cross tabs of behaviors indicated that there may be some significant relationships among a few variables once the sample is larger. The "difficulty understanding emotions" variable was related to the "tune out environmental distractors while viewing" variable ($X^2 = 11$, $df = 4$, $p = .03$). The "act out the scene while viewing" variable was related to the "recreate scene with props while viewing" variable ($X^2 = 28.72$, $df = 16$, $p = .03$). The "act out the scene while viewing" variable was related to the "imitate parts of the show after viewing" variable ($X^2 = 26.35$, $df = 16$, $p = .05$). Lastly, there is an indication that there may also be a relationship between "repeatedly view selected scenes/shows" variable and the "imitate parts of the show after viewing" variable, as it approached significance ($X^2 = 25.76$, $df = 16$, $p = .06$).

Specifically concerning the program *Thomas the Tank Engine*, all parents reported familiarity with the show, 64% reported their child had viewed the program, and 75% reported their child enjoyed it. An open-ended question asked if parents ever noticed their child learning anything from this program. Five out of the seven parents who chose to answer this question indicated that they observed some learning. Examples included "was obsessed with the turning of the wheels" and "yes, the sing along song," and one parent elaborated, "He started to listen to music because of the theme song. He asked questions about the situations the characters were in. The first show he really got involved in. He talked about the characters and what they said, how they felt, what they did. He would ask why they didn't do something else or why they said something."

5. Discussion

Obviously, given the sample size, these results are merely informational. However, the direction in which these results point appears promising. Regarding RQ1 (What do parents with children on the Autism spectrum report about their child's relationship with media?), both open- and closed-ended questions yielded responses indicating that children with ASD are engaging with media content in several ways, including repetition of dialogue, imitation of on-screen actions, and recall of program content. Parents specifically mentioned music seemed to appeal to their children, and the simplicity of programs like *Dora the Explorer* and *Thomas the Tank Engine* where the characters narrate their actions most likely added to the appeal. Several parents also noted that the fact their child did not have to make eye contact with these characters (the way they must in real life) made it more likely that their child would engage with the content.

The second research question asked parents what program or character had been most successful or "worked best" for their child with ASD. Interestingly, all of the programs mentioned by parents were animated. And although programs like *Dora the Explorer* and *Mickey Mouse Clubhouse* feature characters who break the "fourth wall" and directly address the audience, looking them in the eye, children with ASD still seem to be interacting with them. This shows promise for animated characters having the ability to communicate with children with ASD where face-to-face intervention fails.

To address the cognitive load issue, a scale developed by Shane and Albert (2008) helped answer the third research question, which asked parents what behaviors they observe in their children that indicate engagement with the content while viewing. The most common viewing behavior was that children appeared to tune out all other environmental distractions. In fact, one parent called it "hyper focus." This type of focus could help children with ASD block out distractions while viewing, which may give them a better chance for learning. Corbett (2003) supports this notion. In a series of case studies Corbett (2003) reported that the use of video modeling with children on the Autism spectrum resulted in the acquisition, maintenance, and generalization of the behaviors or skills they were attempting to teach, even with children considered very low functioning. He determined that using video modeling captivates these children with ASD by focusing their attention on relevant stimuli, and speculated that the features of autism "such as selective attention, preference for visual stimuli, repetitive behavior and avoidance of face-to-face attention, may actually be capitalized on while using video modeling" (p. 6). So it appears that parental anecdotes may be supported by the research.

The final research question was specific to *Thomas the Tank Engine*, as it is the program specifically noted by parents in previous literature as most influential regarding children with ASD and emotion recognition. What do these parents think about *Thomas's* ability to help children learn EF skills? All of the parents in this study were familiar with the program and the majority of their children appeared to enjoy it. Some parents explained that the only effect they saw from the show was an appreciation for machines, trains, and spinning wheels, which speaks directly to Baron-Cohen's (2008) hyper-systemizing theory. However one parent noted that this was *the* show her son connected with. He got involved with the characters, asking questions about how they felt and what they did. This parent appeared to believe in *Thomas*'s ability to help her child learn emotions, but she was the only parent to specifically speak to that issue. It is encouraging, however, that parents noted other programs they *did* believe helped their child learn emotion recognition, such as *Bob the Builder* and *Dora the Explorer*.

Charlop-Christy and Deneshvar (2002) explained that using video modeling with children with ASD is successful because it compensates for "stimulus overselectivity" by using features such as zooming in on relevant cues to focus attention on specific information (p. 16). And even if the ASD child viewer does engage in overselectivity, the only cues to select are relevant to the lesson. This explanation for the success of video modeling is reminiscent of the ideas presented in both the LC4MP and the Capacity Model, which encourage content creators to simplify the video material and ensure that the narrative and educational content a closely intertwined. However, the videos used by Charlop-Christy and Deneshvar (2002) and others are specifically crafted to teach a skill or behavior in an experimental setting. If creators of popular animated programs can follow suit, these children have the best chance of learning relevant skills from their content as well.

Both Charlop-Christy and Deneshvar (2002) and Schreibman (1988) also believed that using video modeling is successful because watching a television program or DVD is a highly self-reinforcing activity. As the parents in this study revealed, their children often repeat dialogue from their favorite shows or recreate scenes they love. Schreibman (1988) explained that when children with ASD become preoccupied with favorite lines or viewing the same parts of a program repeatedly, watching television shows or DVDs is intrinsically and automatically reinforcing. Again, this increases the likelihood of learning from the content.

As this project currently stands, there appears to be some hope that programs such as *Thomas* can indeed engage children with ASD and begin to teach them basic skills toward emotion recognition. All indications are that parents notice their children interacting with popular media in ways they cannot, or will not, engage with other people. The ultimate goal of the project is to garner enough evidence via survey to craft an experimental study to capture this type of engagement and learning in popular media franchises like *Thomas the Tank Engine*, especially considering that many of these programs are available for free to parents in the US on PBS stations nationwide and through local libraries. Such a free resource that can improve a child's understanding of emotion and other executive functioning skills should be widely communicated to parents of children with ASD.

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Table 1. Mean Scores of Behaviors Displayed by Children with ASD While Viewing

Behavior	Mean	Standard Deviation
Verbal imitation	3.36	1.29
Physically approach screen	3.91	1.04
Imitate movements on screen	3.36	1.21
Tune out environmental distractors	4.55	0.69
Act out the scene	3.18	1.47
Recreate scene with props	2.45	1.29
Attend to remote or electronics more than the program	2.73	1.27
Attend to written language on screen more than the program	2.18	0.98
Repeatedly view & play selected show/scene	3.82	1.40
Tolerates a device turned off	2.45	1.21

Likert scale: 1 = never, 2 = rarely, 3 = occasionally, 4 = frequently, 5 = very frequently

Table 2. Mean Scores of Behaviors Displayed by Children with ASD After Viewing

Behavior	Mean	Standard Deviation
Sing or hum songs from preferred programs	3.36	1.29
Repeat dialogue	3.82	1.17
Imitate part of show (alone)	3.09	1.22
Re-enact scenes with toys/props	2.27	1.10
Reproduce written language	1.82	0.87

Likert scale: 1 = never, 2 = rarely, 3 = occasionally, 4 = frequently, 5 = very frequently