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Digital Media and Autism Spectrum Disorders: Review of Evidence, Theoretical Concerns, and Opportunities for Intervention

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Abstract

As the digital media landscape becomes more complex, individualized, and interactive, pediatric providers often find themselves asked to be the source of guidance for children with developmental and behavioral conditions such as autism spectrum disorder (ASD). In this Brief Report, we review the current literature that exists regarding traditional media (e.g., TV, video games) use in children with ASD. We then outline a conceptual framework to describe the interaction between ASD-specific developmental and behavioral vulnerabilities and aspects of new media (e.g., mobile devices, interactive apps, streaming video services) that could lead to problematic media use. This conceptual framework is then applied to clinical implications for how to prevent and manage problematic media usage in ASD, as well as how to use modern media as tools to support optimal development.

As the digital media landscape becomes more complicated, pervasive, and individualized, pediatric providers often find themselves the source of advice for families hoping to establish healthy media habits or address problematic media use. The new American Academy of Pediatrics (AAP) media guidelines released in 2016 provide guidance to pediatricians and families on how to balance media use with healthy behaviors, including making a family media use plan. At present there are no guidelines specifically for children with autism spectrum disorder (ASD) for helping them balance media with the social and play experiences they need to optimize their functioning. In this Brief Report, we review the limited research on media use and ASD, discuss theoretical reasons for concern for problematic media use in ASD, and outline relevant clinical interventional approaches. Addressing media use in children with ASD is especially important as technology design becomes more persuasive and habit-forming, which may uniquely interact with the social, communication, and behavioral characteristics of autism.

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Research Evidence: ASD and Media

Research evidence regarding associations between digital media use and several aspects of child development and behavior have been reviewed extensively by the AAP[1] and other childhood organizations,[2] but evidence regarding media use in children with ASD is more limited (see Stiller & Mößle 2018[3] for recent review). We review several studies here to illustrate some of the concepts important to clinical care.

The overall duration of traditional media use (such as TV and videos) may be no different in school-aged children who are typically developing (TD) compared to children with ASD. In a national survey of parents of school-aged children conducted by Montes and colleagues,[4] greater than half of participants reported more than two hours of screen media use per day, regardless of ASD status. Similarly, Gillette and colleagues[5] also found no difference between ASD and TD groups in parent-reported duration of media usage for children aged 10–17 years. Similar findings of no difference in duration of time spent with electronic media have been demonstrated in cohorts including young adults [6] and in studies comparing ASD children to their TD siblings.[7] While the data does not show a difference in overall usage time, it is clear that both school aged ASD and TD children spend more time in front of a screen than is recommended by the AAP.

However, differences in daily viewing duration have been demonstrated in younger cohorts. Chonchaiya et al [8]found that young children (mean age 2.5 years) in Thailand with ASD spent more time watching television per day than TD controls and children with non-ASD-related language delays. Additionally, in this study children with ASD began watching television an average of 6 months earlier than TD controls, prior to onset of language development. Although studies have shown a negative association between duration of time watching TV and development of language [9, 10] executive functioning,[11], and theory of mind [12] in TD toddlers and preschoolers, it is important to note that no studies have definitively linked early media use with onset of ASD. Rather, it is more likely that children with emerging social communication problems prefer object-based play, which includes TV and digital devices.

In studies focusing on media content rather than duration, differences in usage patterns between children with ASD and TD controls have been documented. Mazurek and Wenstrup [13] found that siblings with and without ASD spent similar time watching television, but the children with ASD spent more time playing video games than their TD siblings. Another survey of parents of boys with ASD, attention deficit hyperactivity disorder (ADHD), and TD showed higher rates of video game use in boys with ASD compared to TD peers.[14]

Research also suggests that differences in media usage by children with ASD have implications for health outcomes. In children with ASD and their TD peers, studies have shown that media use before bed is associated with impairments in sleep [15, 16] Sleep difficulties are already known to be more pronounced in children with ASD [17, 18] Both increased sleep onset latency as well as shorter duration of sleep have been documented in children with ASD when media is used as part of a bedtime routine. [19] Because poor sleep patterns have been shown to be predictive of future challenging daytime behaviors in

children and young adults with ASD, [20] bedtime media use may be an important target of behavioral interventions.

Survey research into physical activity has also demonstrated increased duration of sedentary activities - often spent engaging in screen media activities - in children with ASD compared to TD controls.[21] As with children without ASD, increased sedentary behaviors may be related to obesity and numerous associated negative health outcomes.

In summary, the majority of existing research on media use in children with ASD has been focused on traditional media forms such as television and video games; much less evidence is available regarding newer forms of media such as tablets or other forms of interactive technology. Below, we present a conceptual framework for how design features of newer forms of media may be especially engaging – in both negative and beneficial ways – for children with ASD.

Mobile, On-Demand, and Interactive Media: Theoretical concerns

The unique cognitive and behavioral features of children with ASD, combined with the high degree of content tailored to the specific interests of the individual in modern media (i.e., through search algorithms or browser/app-based data collection), potentially make for a perfect storm for problematic media use habits. Problematic media use has been defined in many ways,[22] but generally occurs when media use starts to displace sleep and other healthy behaviors; interrupts homework or academic functioning; or becomes compulsive or excessive in duration. The clinical features of ASD that might contribute to problematic media use include social communication deficits and tendency toward solitary play and restricted interests; sensory differences; executive functioning weaknesses; and contextual factors such as parent stress (See Table 1).

Social Communication Deficits, Solitary Play, and Restricted Interests.

Because social information is challenging for children with ASD to process in a dynamic fashion, they may prefer solitary play or develop restricted interests in more predictable objects such as particular toys, TV or storybook characters, or topics. Modern media has the capability to be highly personalized to a child's individual interests, making restricted content (e.g., YouTube videos on favorite topics or toy unwrapping, streaming episodes of favorite shows on autoplay) easily accessible to children. Machine learning algorithms embedded in many streaming video or search features provide users with suggestions similar to their prior behaviors, which means that children with ASD will be offered the same restricted themes and topics, rather than the broadening range of ideas they need for mental flexibility and creative play.

Sensory Differences.

Children with ASD process sensory information in a different manner such that they may tend to seek out media content that is more visually intense (i.e., sensory-seeking) or calming (i.e., sensory-avoidant, to control their sensory experience through interaction with predictable media rather than unpredictable social or environmental stimuli). Some children with ASD have stronger visual-perceptual abilities than language, and prefer processing

information in visual form, which makes digital media even more appealing and intuitive to them. Many online games or other digital media have attention-grabbing interactive feature that, to many parents, may appear to sustain a child with ASD's attention for extended periods of time. In reality, this rapidly changing visual environment is likely fulfilling a sensory-seeking need, or allowing children to withdraw from unpredictable social stimuli, but are not requiring that children use top-down executive control mechanisms for sustaining attention. Programs and apps that are labeled as "educational" – and marketed to parents eager to build their child's tech-savviness – are actually often heavily loaded with such gamified interactive elements, which can distract children from the content's true learning goals and objectives.[23] Children with ASD may be particularly unable to filter out this extra sensory information and integrate and learn from interactive media meaningfully.

However, sensory-seeking media use can sometimes result in viewing highly arousing or violent content with vivid imagery. A survey of parents and adolescents with ASD found that video and computer games categorized as "action games" were most commonly used.[24] However, most children do not have the emotional maturity to fully understand violent gaming content, which has been associated with lower user empathy in prior studies.[25]

Weaker Executive Functioning/Self-Monitoring.

Children with ASD have weaker executive functions, and struggle more to use metacognition to generate a cohesive explanation of their experiences. Research suggests that, in order to avoid the habit-forming or persuasive design effects of modern media, users need to develop the meta-cognition to understand when their behavior is being manipulated.[26] However, children with ASD have more difficulty with self-monitoring and awareness of their cognitive and emotional reactions, and therefore may have a particularly difficult time building awareness of how their attention or behavior is being influenced by "likes," tokens, or other well-described persuasive design practices.[27] In addition, young adults with weaker executive functioning tend to prefer media multitasking and media forms that help maintain their attention through audiovisual effects and novelty; they therefore do not get as many offline experiences that are thought to improve executive functions such as exercise or unstructured play. This displacement concern is also relevant because interactive media and video games are highly reinforcing, and therefore may be experienced as more satisfying to children with developmental differences who struggle with other experiences (e.g., communication, social interactions, physical play due to coordination deficits).

High Parenting Stress.

Parenting children with ASD is associated with high parent stress levels.[28] Research suggests that parents with low perceived control over parenting who have toddlers with social-emotional delays are more likely to use mobile media as a calming strategy or to keep the household quiet,[29] which may apply to families raising a child with ASD as well. The highly preferred nature of media in children with ASD make it an easily accessible tool during times of stress, which can have both positive and negative outcomes, depending how much parents rely on media to calm children in times of distress, rather than using parent-mediated approaches known to improve child ASD symptoms over time.[30] Difficulties in

transitioning between activities may also make it more difficult to stop bouts of media use when used as a calming tool.

Knowledge of these features of ASD that make media use so appealing, yet also problematic, can be applied to help families learn how to productively integrate media into their everyday life.

Clinical Implications

Research on digital media use in children (with and without ASD) is commonly focused on negative implications and health outcomes associated with its use. However, opportunities remain for parents to become proactive purveyors of media by focusing on the following areas: using media as a tool; sharing media; and teaching persuasion-savviness.

Using media as a tool.

Advancements in technology have dramatically affected the ways in which families are able to use media. Instead of simply a passive viewing experience, families are now able to truly interact with different media platforms, offering an opportunity to use medial as a tool to help impact areas of challenge in children with ASD such as impairments in social interactions and language. Videochat programs and applications offer opportunities to connect meaningfully with family and friends on a more frequent basis. Parents can use personal media devices to help create Social Stories, an evidence-based visual approach to help children with new experiences and situations.[31] Of course, tablets and other personal media devices can be used as assistive/augmentative communication devices. However, it is important to remind parents that children with ASD learn best from people, not from technology, and that any new skills learned through media may not generalize to the child's everyday behavior.

It is important for parents to be proactive in diversifying their child's experience with technology so as to avoid having the child get stuck in a "loop" of merely watching content related to a preferred character. Expanding media use to include activities such as programs to teach computer coding languages, or creating videos, music, or art can help make media a productive activity of shared enjoyment between parent and child.

Due to the numerous reasons already mentioned, media devices are a powerful reinforcer and are often used as a go-to calming tool in times of stress. Although use of media as an immediate reinforcer has become more common, this approach has not been formally studied. Anecdotally, some therapists and teachers report that use of tablets or smartphones as an immediate reinforcer can create challenges when trying to transition the child back to therapy tasks. Some parents use media as a longer-term reinforcer (e.g., earning more minutes of weekend media use), or at the end of the day when all responsibilities (e.g., homework, chores) and play opportunities have been completed. In general, it may be helpful to counsel parents to use media like a "stim" toy reinforcer: intentionally, and for brief, specific ways, with parent monitoring.

Shared media use.

Many parents state that complete elimination of media is not a realistic option for them,[32] but as media use becomes more handheld and individualized, it also becomes more of a solitary activity. The AAP guidelines recommend more shared media use among family members, which allows more monitoring of content and helping children process what they view. Limited amounts (i.e., 1 hour/day) of videogaming can be a shared social activity for children with ASD and siblings or peers. Even when children with ASD are viewing content that is highly preferred, there are opportunities to make the experience productive from shared viewing. First, humorous media acts as a source of shared enjoyment with children. In addition, the content in educational media can act as a stimulus for conversation, play, or knowledge after turning off the program. If the media content is low-quality, not age-appropriate, or if violence, stereotypes, or strong themes are encountered, the parent has an opportunity to turn this into a teaching experience and restrict that content moving forward.

Modeling from television shows with preferred characters may be helpful in learning adaptive behaviors and new skills. Prosocial modeling of behavior by TV characters has long been known to improve children's behavior,[33] and this applies to children with ASD as well. Two 5-year-old boys with ASD showed improved ability in the skills of trying a new food and of stopping play time after video modeling from the PBS show *Daniel Tiger's Neighborhood*.[34]

Teaching tech-savviness and safety.

The AAP recommends that, from an early age, parents try to act as their child's 'media mentor' so that children will come to parents when needing help with social media, uncomfortable interactions, or interpreting online misinformation. As noted above, children with ASD will need more oversight to help them understand persuasive design and to self-regulate their own media use. Parents can role model tech-savviness by questioning advertising, showing children how to resist the persuasive intent of digital products (e.g., by turning off autoplay), and teaching children about the ways technology is designed to be "sticky" and keep users' attention for as long as possible. In particular, parents should be urged to be skeptical of marketing claims that devices are "educational," as children with ASD need more practice with social emotional skills that cannot be taught with a device.

Conclusion

We have outlined a conceptual framework hypothesizing that children with ASD are at increased risk of problematic media use with portable and interactive media devices due to features of ASD that make this type of media highly appealing. A limited body of research has examined traditional media use in children with ASD, but there is a paucity of research looking at the specific use of mobile devices by children with ASD. Based on our conceptual framework, we recommend three main areas of future research. First, we recommend research directed toward better understanding of how the specific developmental and behavioral vulnerabilities of ASD interact with children's media use habits over time. Second, investigation is needed into which aspects of mobile/interactive media use can be most easily used as a tool to support prosocial functioning, and which contribute most to

problematic displacement of sleep, exercise, homework, or play. Lastly, clinical research should examine of how media can be used as an effective positive reinforcer and method for reducing sensory overload, without becoming the child's preferred play or coping strategy. Clinically, we suggest that the AAP guidelines are appropriate for children with different developmental and behavioral characteristics, but providers may need to ask more about the child's specific relationship with media, to tailor advice with the goal that media use becomes a productive, but not dominant part of everyday life.

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Table 1:

Conceptual framework for problematic interactions between characteristics and contextual factors of autism spectrum disorder and modern digital media

ASD-Related Characteristics/Contextual Factors	Media Characteristic
Social communication deficits	More predictable content and interactivity than interpreting human social information
Restricted interests	Highly personalized, restricted content; endless supply of videos/information
Sensory differences (seeking and avoidant)	High visual or auditory salience, gamified interactive elements, satisfying sensory experience
Executive functioning/self-monitoring weaknesses	Persuasive design acts on more subconscious habits/rewards; media multitasking is more common in young adults with executive functioning weaknesses
Low satisfaction from other activities	Highly rewarding; provides feeling of power and control/wish fulfillment
High parenting stress	Effective behavior reinforcement tool in keeping children occupied and calm; portable and instantly accessible (with both positive and negative consequences, depending on displacement of other activities or parent coping)