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Immersive and Maladaptive Daydreaming and Divergent Thinking in Autism Spectrum Disorders

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Abstract

Little is known about the internal mental experiences of individuals with ASD. While some research suggests a limited capacity for imagination, other studies show heightened interest in fantasy and unique forms of creative thinking in ASD. This study explored daydreaming experiences in adults with ASD, with a focus on immersive daydreaming and its relation to divergent thinking abilities. Individuals with and without a diagnosis of ASD were surveyed on their daydreaming habits and completed a divergent thinking task. Experiences of immersive daydreaming were identified in 42% of adults with ASD and were related to broad ASD traits in those without a diagnosis of ASD. However, ASD diagnosis was unrelated to originality of divergent thinking, which was negatively associated with immersive daydreaming. Moreover, daydreaming experiences in ASD were diverse. A more nuanced understanding of the mental experiences in ASD may assist in the development of interventions and support for this population.

Keywords

daydreaming, imagination, creativity, autism

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The core symptoms and features of autism spectrum disorders (ASD) are well documented, including difficulties with social functioning, communication, and the presence of restricted interests and repetitive behaviors (American Psychiatric Association, 2013). However, little is known about the lived internal mental experiences of individuals with ASD. Some research indicates that there are limitations of imaginative thinking and creativity in ASD (Craig & Baron-Cohen, 1999). On the other hand, adolescents and adults with ASD often show a certain proclivity for fantasy, such as a strong interest in science-fiction and fantasy media genres, comic books, fantasy role-playing, and video games (Gutermuth Anthony et al., 2013; Mazurek & Wenstrup, 2013; Rozema, 2015). Although the reasons for these interests are unclear, researchers have suggested that this reflects unique creative capacities in ASD (Fein, 2015; Visuri, 2017). Visuri argues that most investigations of imagination and creativity in ASD have used paradigms that rely on interpersonal skills and limited creativity constructs. When exploring more subjective individual experiences of imagination, Visuri demonstrated the generation of rich creative content by individuals with ASD. Much of this content is in the form of imagined fantasy realities and daydreaming. The current study is the first to systematically explore the quality and content of daydreaming in ASD, focusing on unique immersive daydreaming experiences, and the link between daydreaming and creative thinking in ASD.

Immersive daydreaming refers to intense absorption in elaborate mental fantasy scenarios, stories, and worlds (West & Somer, 2019). Typical forms of daydreaming often involve creative and fantastical themes (Singer, 1975); however, immersive daydreaming is described as more vivid and enduring than typical daydreaming. For instance, individuals who experience immersive daydreaming report that their daydreams involve detailed narratives and alternate realities that they have been developing for many years (Somer, 2002). Immersive daydreaming may represent an extreme in a continuum of daydreaming experiences. While immersive daydreaming may be a positive and creative mental activity for some, its highly rewarding nature may be problematic for others. A dysfunctional form of this activity has been identified in numerous studies, known as maladaptive daydreaming (Bigelsen & Schupak, 2011; Somer, 2002; Somer et al., 2016). Maladaptive daydreaming is associated with both social and emotional difficulties (Greene et al., 2020; Somer & Herscu, 2017; West & Somer, 2019). Immersive and maladaptive daydreaming may provide an opportunity for individuals to escape such challenges and retreat into a more ideal and controllable reality. As such, this activity may be compelling for individuals with ASD who face similar challenges.

Imagination and Creativity in ASD

Deficits in imagination and related constructs, such as pretend play and theory of mind, are documented in ASD (Craig & Baron-Cohen, 1999; Rutherford & Rogers, 2003; Scott, 2013). However, more recent research contradicts these findings, demonstrating

a degree of complexity and nuance in these capacities among individuals with ASD (Best et al., 2015; Visuri, 2017). For instance, recent research showed heterogeneity in theory of mind capacity among individuals with ASD, such that significant portions of individuals performed similar to typical groups, while others did not (Rosello et al., 2020). Theory of mind ability is thought to be tightly linked with imagination abilities (e.g., Giminez-Dasi et al., 2016). Moreover, studies suggest that individuals with ASD may have a stronger tendency to use mental imagery to process information, such as comprehending sentences and solving perceptual puzzles (Kana et al., 2006; Soulieres et al., 2011). Mental imagery is thought of as an important building block to imagination and daydreaming (Singer, 1975).

Imagination and creativity in ASD may be less constrained by social norms. Visuri (2017) theorized that the tasks used to measure creativity and imagination rely on inter-subjective and shared creative concepts which fail to capture *intra*subjective forms of creative capacity that may be present in ASD. Participants in Visuri's study reported that imaginary experiences allowed them to be creative and process information in a mental space that is removed from the pressures of real social interactions and expectations. Fantastical immersive daydreaming may offer a safe and predictable space to explore emotions, social scripts, and identity while exercising intrasubjective creativity (Visuri, 2017). Moreover, fantasy role-play activities appear to be an effective method of delivering psychotherapy for adolescents and young adults with ASD (Fein, 2015). Social comparisons can influence an individual's perception of their creative abilities; Jankowska et al. (2019) found that self-reported creative abilities were negatively related to ASD traits, while more objective creative measures were positively related to ASD traits.

Creativity can be measured in many ways; one common approach is to test divergent thinking, the ability to produce many unique ideas from one central idea (Guilford, 1967). For instance, the Alternate Uses Test asks participants to think of as many unusual uses as they can for common objects, such as a paperclip (Guilford, 1967). Some research has shown that adults with ASD produce fewer unique ideas in the Alternate Uses Test compared to individuals with typical development. These studies show that individuals with ASD instead excel at *convergent* thinking, the ability to converge many ideas into one central theme or pattern (Abu-Akel et al., 2020; Claridge & McDonald, 2009). However, studies vary in scoring the Alternate Uses Test, and response *originality* can be confounded by *fluency*; the number of responses can disproportionately impact the originality score (Reiter-Palmon et al., 2019). Individuals with ASD often struggle with verbal fluency (Pastor-Cerezuela et al., 2016) and may produce fewer responses; fluency and originality should ideally be evaluated independently. Studies have shown that controlling for fluency, individuals with ASD produce ideas that are more original than those of typically developing individuals (Best et al., 2015; Liu, et al., 2011). Best et al. (2015) speculated that individuals with ASD are less reliant on semantic associations when completing the Alternate Uses Test, and therefore produce more original and novel ideas.

Divergent thinking may be related to a tendency to engage in fantastical immersive daydreaming in ASD. Presumably, the generation of unique fantasy worlds and scenarios relies on divergent thinking ability. Several studies show that divergent thinking is related to pretend play in childhood, which resembles immersive daydreaming in its reliance on the imagination of alternate realities (for a review, see Russ & Wallace, 2013). Fantasy daydreaming has been linked to creative behaviors, along with absent-mindedness (Zedelius et al., 2021). However, in the same study, daydreaming was not related to divergent thinking. Zedelius and colleagues themselves note the limitations with their implementation of the Alternate Uses Test, such that they did not specifically prompt for creative ideas and their time limit for each question (90 s) was shorter than the usual 2–3 min; responses typically become more unique as the time interval progresses (Silvia et al., 2008). Moreover, our construct of immersive daydreaming is distinct from the more typical style of fantasy daydreaming targeted in Zedelius et al.'s study. A higher degree of vividness, elaborateness, and immersion involved in immersive daydreaming may be related to more unique creative thinking. The link between immersive daydreaming and divergent thinking is unknown. Immersive daydreaming is related to lower levels of creative productivity (West & Somer, 2019); however, this finding may be explained by the preference for fantasizing over the engagement in real-life performance, rather than reflecting diminished creative thinking.

Aims and Hypotheses

This project aimed to explore immersive daydreaming experiences in ASD, and to shed light on how divergent thinking abilities are related to these experiences. We further aimed to give a general profile of the quality and content of daydreaming in ASD, particularly comparing individuals with and without maladaptive daydreaming tendencies, and with and without ASD. As there are no validated measures of the broader construct of immersive daydreaming, our analyses focus primarily on maladaptive daydreaming, since this is considered a dysfunctional form of immersive daydreaming. We hypothesized that maladaptive daydreaming would be related to ASD traits and divergent thinking originality. In a sample of individuals without a diagnosis of ASD selected from online maladaptive daydreaming communities, we expected that ASD traits and divergent thinking originality would predict maladaptive daydreaming tendencies while controlling for demographic variables.

In a sample of adults with a diagnosis of ASD, we expected that originality in divergent thinking would predict maladaptive daydreaming while controlling for demographic variables. We also controlled for symptoms of attention deficit hyperactivity disorder (ADHD), given the comorbidity of ADHD with both ASD and maladaptive daydreaming (Antshel et al., 2016; Theodor-Katz, 2019). Finally, we expected that individuals with ASD or maladaptive daydreaming would score higher on the originality of

their responses in the divergent thinking task compared to individuals with neither condition; individuals with *both* ASD and maladaptive daydreaming experiences would score the highest on the originality of divergent thinking. In contrast, the fluency of responses in the divergent thinking task would be lower for all individuals with ASD compared to those without ASD, regardless of daydreaming experiences. We also explored daydream content, daydream identities, reasons for daydreaming, and triggers of daydreaming. While it was expected that daydream qualities would differ between maladaptive and non-maladaptive daydreamers, we had no specific hypotheses regarding the types of differences, as well as the differences between those with ASD and those without ASD. These hypotheses were pre-registered on OSF (https://osf.io/9nkyr/), where the data and analyses are also available for download.

Method

Participants

Daydreaming Community Sample. Participants were recruited via advertisements on online forums and websites related to maladaptive and immersive daydreaming, including Reddit, Facebook groups, and the International Consortium for Maladaptive Daydreaming Research. A total of 544 participants (395 females, 101 males, 48 other) completed an online survey (a further 65 participants were removed from analyses for incomplete surveys). Participants were fluent English speakers and older than 18 years ($M = 25$ years, $SD = 8$). Participants were from 61 different countries, mostly North America (39%) and UK/Europe (27%). Most participants (99%) had completed at least a secondary school education, and 50% of the sample reported having a psychiatric diagnosis. Participation was voluntary and anonymous; participants did not receive any compensation.

ASD Sample. A second sample of participants was recruited via Simons Foundation Powering Autism Research for Knowledge (SPARK), an online research collaborative of participants with professional ASD diagnoses. Individuals over the age of 18 years who were living independently were invited to participate in the study. A total of 223 individuals completed the survey (data from a further 31 participants were removed for incomplete surveys). Of these, 123 were female (90 male, 10 other), mean age was 34 years ($SD = 12$), and 98% had completed secondary school or above. The sample was predominantly Caucasian (83%; 10% multi-race), 55% were employed, and 50% were single. All participants in this sample had received a diagnosis of ASD (48% Asperger's Syndrome; 39% ASD; 6% autism; 6% PDD-NOS) by either a clinical psychologist, paediatrician, or a team of qualified professionals; the age of diagnosis ranged from 22 months old to 66 years old ($M = 22$; $SD = 16$). Participants in this sample received $15 for participation. Ethical approval for the study was obtained from the Institutional Review Board at the University of XXX*[masked for review]*.

Measures

The following definition of daydreaming was presented at the beginning of the survey, as follows:

> Here, we define daydreaming as fantastical mental images and visual stories/narratives that are not currently part of your life. By "fantastical" we mean that the content of the experience is remarkable, bizarre, or unrealistic in some way. We are not referring to acts such as reminiscing about past events, mentally preparing for future activities such as a meeting with your boss, or thinking about your "to-do" list.
>
> Examples of daydreams: hanging out with a favorite celebrity, winning a gold medal in the Olympics (unless you are an Olympic athlete), telling off your boss after winning the lottery, living in a parallel fantasy world, imagining violent, scary, or tragic events that have never happened to you, engaging in heroic or rescue actions, etc. Any daydreams involving fictional characters or plots should also be included.

Immersive Daydreaming. The 16-item Maladaptive Daydreaming Scale (MDS-16; Somer et al., 2016) was used to measure immersive daydreaming, as maladaptive daydreaming is theorized to fall under the broader construct of immersive daydreaming, for which no direct measures are currently available (West & Somer, 2019). Individuals who score high on the MDS-16 experience pathological degrees of immersive daydreaming. Therefore, our interpretations regard this extreme form of immersive daydreaming. The well-studied MDS-16 questions individuals on the extent to which they experience certain features of maladaptive daydreaming (e.g., compulsion to daydream, motor movements associated with daydreaming, distress, or impairment caused by daydreaming). Participants responded using a scale from 0% (*never*) to 100% (*extremely frequent*), with 10% increments. Total scores were averaged across items, with higher scores indicating higher degrees of maladaptive daydreaming experiences and features. An average score of 40 or above across all items has been shown to have good sensitivity (95%) and specificity (89%) for identifying maladaptive daydreamers based on self-identification with the condition (Somer et al., 2017). The MDS-16 has demonstrated good criterion-related validity via correlation with measures of fantasy-proneness, $r = .58$, $p = .01$, and excellent internal consistency, $\alpha = .95$, and test-retest reliability, $r = .92$. Internal consistency in this study was very good ($\alpha = .87$).

The sense of presence in daydreaming scale (SPD; Somer et al., 2016) was used as a secondary proxy measure for immersive daydreaming. This scale includes six questions designed to capture the immersive quality of the daydreaming experience, adapted from prior measures of presence in virtual reality (Slater et al., 1998). Participants rated their sense of presence in their most vivid daydream over the past two weeks, on a 7-point Likert scale. Total scores were averaged across items, with

higher scores indicating a higher sense of presence. The internal consistency of the measure in our study was good ($\alpha = .79$).

ASD Traits. The Autism Spectrum Quotient (AQ; Baron-Cohen et al., 2001) measured the level of autism traits among participants in the daydreaming community sample. The AQ consists of 50 statements intended to reflect the presence of an autism-like trait (e.g., "I tend to notice details that others do not"), half of which are reverse scored (e.g., "I find social situations easy"). The measure has good validity and reliability for measuring autism traits among neurotypical individuals (Baron-Cohen et al. 2001; Hoekstra et al. 2008) and has been used extensively to study autism traits in neurotypical samples (see Ruzich et al. 2015 for a review). Participants indicate the extent to which they agree with each statement on a 4-point response scale, with 1 indicating "*definitely agree*" and 4 indicating "*definitely disagree*". Each item is scored from one to four, with possible total scores ranging from 50 to 200; higher scores indicate higher levels of autism traits. The AQ has been shown to have good internal consistency ($\alpha > .63$), and good test-retest reliability ($r = .70$). The AQ successfully discriminates between groups of individuals who would be expected to differ in their level of autism traits, such as males versus females, STEM experts versus experts of human sciences, and individuals with versus without a diagnosis of ASD (Baron-Cohen et al., 2001).

Divergent Thinking. Divergent thinking was assessed with two commonly used tasks: alternate uses (Guilford, 1967) and instances (Wallach & Kogan, 1965). These two tasks have demonstrated the highest reliability compared to a range of divergent thinking tasks (Silvia et al., 2008), and were easily transferred to an online format. The alternate uses task required participants to think of alternate uses for two common objects (brick, paperclip), while the instances task required participants to think of two instances of a given characteristic (things that are round, things that are loud). Silvia et al. (2008) found that the wording of task instructions impacted responses, such that participants instructed to give as many responses as they could have a higher number of responses, whereas those instructed to give unusual responses had more original responses. To explore the capacity for unusual creative ideas in ASD and immersive daydreaming, we chose to focus on the originality of divergent thinking responses in this study, and thus emphasized originality in task instructions. The instructions for the tasks were: "For this task, you should write down all of the original and creative [uses for/instances of] [a *object*/things that are *characteristic*] that you can think of. Certainly, there are [common, unoriginal ways to use a *object*/some obvious things that are *characteristic*]; for this task, write down all of the unusual, creative, and uncommon [uses/instances] you can think of. You'll have two minutes." Participants were given two minutes to respond; Benedek et al. (2013) found that this time interval was optimal for balancing the time demands involved in the generation of creative ideas while maintaining a manageable scoring load.

Responses were scored by the first author and two trained assistants for originality and fluency (number of responses). We largely followed the scoring methods outlined by

Reiter-Palmon et al. (2019). Participants with fewer than three responses on a given item were removed from that item before scoring. Further, inadequate responses were removed before scoring; inadequate responses included alternate uses that could apply to any object (e.g., "draw it"), incomplete or nonsensical responses (e.g., "clothes" for uses for a brick, or "dancers" for things that are round), responses that did not follow the instructions correctly (e.g., listing uses of round objects instead of instances), and within-person repetitions. Repetitions included lists of responses from one category (e.g., listing various structures you could build with bricks, or listing several types of sports balls for things that are round). When determining the appropriateness of responses, two scorers independently scored the same 15% of responses for a single item and compared scores. This process continued in 10% increments until a reliability estimate of $k > .80$ was achieved for all items. Valid responses were then evaluated to ensure succinctness and consistency (i.e., to account for different ways of portraying the same meaning).

For originality scoring, each response was assigned a score based on the percentage of other participants in the sample who gave the same response (5 = 0%; 4 = 1–3%; 3 = 4–6%; 2 = 7–9%; 1 = 10–12%; 0 = 13% +). This scoring system yielded the most normal distribution in our data compared to the more conservative or liberal allocation of scores per percentage, and has been described as more objective than asking for ratings of creativity (Silvia et al., 2008). Benedek et al. (2013) discussed the confound of fluency, or the unequal number of responses across participants, which can inflate or reduce originality scores depending on whether scores are summed or averaged. These authors and others argue in favor of a "top responses" method, in which a select number of the most original responses count toward the originality score; restricting the originality scores to the top 3–6 responses per person, per item, resulted in the most valid scores. Thus, we selected the top 3 responses for each item and averaged the scores of these across items per participant. Participants with less than 50% of data across all four items were removed. Fluency was scored by counting the number of valid responses per item and averaging across the four items.

Attention Deficits. ASD participants completed the Adult ADHD Self-Report Scale (ASRS-v1.1) to screen for ADHD symptoms. The ASRS-v1.1 consists of 18 questions based on the DSM-IV-TR criteria for ADHD (e.g., "How often do you have trouble wrapping up the final details of a project, once the challenging parts have been done?"). Participants respond on a 5-point scale (0 = "*never*"; 4 = "*very often*") and each item is assigned one point if the response constitutes the presence of an ADHD symptom and zero points if it does not. Item points are summed to obtain a total score ranging from 0–18. The measure has demonstrated strong internal consistency ($\alpha = .63$-$.72$) and test-retest reliability ($r = .58$-$.77$) as successfully identifying individuals with a clinical diagnosis of ADHD (AUC = .90; Kessler et al., 2007). A large population-based study showed that the average score on the ASRS-v1.1 among non-diagnosed adults in the US was 2 (Adler et al., 2018). In the current study, internal consistency was very good ($\alpha = .81$).

Exploratory Daydreaming Questions. Given the lack of prior research on daydreaming in ASD, exploratory questions were included to understand daydream qualities in ASD (immersive and non-immersive), in comparison to individuals without ASD. These questions probed the level of detail in daydreams, ranging from 0 (*very basic details, basic conversations or events*) to 10 (*Extremely detailed, with deep plots, complex characters and backgrounds*); the degree to which daydreams are based on real-life or made-up (0 = "*everything in my daydreams is based on real-life*"; 10 = "*everything in my daydreams is made-up*"); the extent to which daydreams involve various identities (*being yourself – your real-life identity; imagining you are a "better version" of yourself; imagining you are someone else that you know in real life; imagining you are someone who is famous in real life; imagining you are someone entirely made-up*); and the degree of violent or tragic themes. Participants were asked to select their top three reasons for daydreaming and their top three situations or triggers for daydreaming; lists were developed based on previous research on maladaptive daydreaming (Somer et al., 2016). Finally, participants were asked to write as briefly as possible the most common theme of their daydream content.

Procedure

Participants in the daydreaming community sample followed a link in online advertisements to the survey within Qualtrics. Participants read and agreed to the consent form before proceeding with the survey. Participants in the ASD sample were sent an initial invitation to participate, and those who expressed interest were sent the consent form. In both cases, the consent form included a basic description of the study aims, eligibility requirements, expected completion time, confidentiality of data, risks and benefits, their right to not answer questions or withdraw at any time without penalty, and contact information for both the primary researcher and the institutional review board. Participants indicated their consent by checking a box, which stated that they agreed to participate, and continuing the study. Following consent, participants followed a link to complete the online survey in their own time within the SPARK online system. All participants completed the measures in a fixed order, beginning with demographic information and self-report scales, followed by the divergent thinking task, and finishing with exploratory daydreaming questions. At the end of the survey, participants were asked to indicate how seriously they took the survey (seriously; somewhat; not at all). Those who reported not taking the survey seriously were removed from the analysis.

Data Analysis

The assumptions of multicollinearity, normality of residuals, and homoscedasticity of data were confirmed by inspecting correlations, the p-p plot, and the scatterplot of the residuals. Partial correlational analyses tested the relationships between maladaptive

daydreaming symptoms, sense of presence in daydreaming, ASD traits (daydreaming community sample only), ADHD symptoms (ASD sample only), diagnostic age (ASD sample only), and divergent thinking originality and fluency while controlling for demographic variables (age, gender, level of education, and psychiatric diagnoses) within each sample of participants.

For the daydreaming community sample, a hierarchical multiple linear regression analysis was conducted with demographic variables entered at step 1, and AQ score and divergent thinking originality entered at step 2; maladaptive daydreaming scale score was the outcome variable. An additional hierarchical multiple linear regression analysis was conducted with the same predictors and sense of presence in daydreaming as the outcome variable.

For the ASD sample, a hierarchical multiple linear regression analysis was conducted with demographic variables and ADHD symptoms entered at step 1, and divergent thinking originality entered at step 2; maladaptive daydreaming scale score was the outcome variable. An additional hierarchical multiple linear regression analysis was conducted with the same predictors and sense of presence in daydreaming as the outcome variable.

Group Comparisons. Subsets of participants were selected from each population, based on scores on the maladaptive daydreaming scale (MDS-16), to form four distinct groups; scores above 40 on the MDS-16 were considered to reflect pathological immersive daydreaming experiences. These groups included individuals who had a diagnosis of ASD and experienced maladaptive daydreaming (**ASD + MD**), individuals with ASD who did not experience maladaptive daydreaming (**ASD-only**), individuals without a diagnosis of ASD who experienced maladaptive daydreaming (**MD-only**), and individuals who did not have either ASD or maladaptive daydreaming (**Typical**). Fifty-six individuals from the daydreaming community sample scored below 40 on the MDS-16 and formed the Typical group, therefore the other three groups were selected to match this sample size. A multivariate analysis of covariance (MANCOVA) was conducted to compare groups on divergent thinking originality and fluency, controlling for age, gender, education, and psychiatric diagnoses. Significant main effects were followed-up with independent-samples t-tests to compare pairs of groups, adjusted for false discovery rate (FDR) to account for multiple comparisons using the Benjamini-Hochberg method (Benjamini & Hochberg 1995).

Test assumptions were met for all group comparison analyses: the absence of outliers was determined by observing no values more than three times the interquartile range, normal distribution of scores within groups was observed by skewness and kurtosis values lying within -2 to $+2$, and homogeneity of variances was confirmed with Levene's tests. It is important to note that divergent thinking originality was re-scored for group comparisons such that scores were relative to the participants included in the analysis across the four groups, rather than scores being relative to each population

(i.e., each response was assigned a score based on the percentage of participants who gave that same response across the four groups).

Finally, exploratory daydreaming questions were examined to gain a deeper understanding of daydream qualities between groups. These questions were expected to differ between maladaptive and non-maladaptive daydreaming groups, however, the nature of the differences in daydreaming content is unclear, as well as the differences between those with and without ASD. Ratings on questions regarding daydream detail, degree of made-up content, imaginary identities, and degree of violent or tragic content were compared between groups using independent-samples t-tests, adjusted for FDR (Benjamini & Hochberg 1995). The top three reasons for daydreaming and triggers of daydreaming, along with common themes of daydream content, were compared by observing frequencies.

Results

Descriptive Statistics

In the daydreaming community sample, 479 participants (88%) scored above the cutoff for probable maladaptive daydreaming (>40) on the maladaptive daydreaming scale (MDS-16). In the ASD sample, 93 participants (42%) scored above the cutoff for probable maladaptive daydreaming. Descriptive statistics are displayed in Table 1. In the daydreaming community sample, 47 participants did not give enough valid responses on the divergent thinking task, while 31 participants in the ASD sample did not give enough valid responses on this task. Therefore, data from 497 participants from the daydreaming community sample, and 192 participants from the ASD sample, were included in analyses of divergent thinking.

Table 1. Descriptive Statistics.

		Mean (*SD*)
MD symptoms (MDS-16); 0–100	DC sample	61.1 (17.7)
	ASD sample	36.4 (21.4)
Presence in daydreaming; 1-7	DC sample	4.4 (1.2)
	ASD sample	3.6 (1.5)
ASD traits (AQ); 50–200	DC sample	126.6 (19.3)
ADHD symptoms (ASRS- v1.1); 0-18	ASD sample	10.0 (4.2)
DT originality; 0-5	DC sample	3.4 (0.8)
	ASD sample	3.5 (0.9)
DT fluency	DC sample	6.8 (2.6)
	ASD sample	6.0 (2.4)

MD = Maladaptive Daydreaming; DC = Daydreaming Community; ASD = Autism spectrum Disorder; ADHD = Attention Deficit Hyperactivity Disorder; DT = Divergent Thinking; SD = Standard Deviation.

Correlations

Maladaptive daydreaming symptoms were positively correlated with a sense of presence in daydreaming in both samples. However, a sense of presence in daydreaming was not related to divergent thinking originality or fluency. In the daydreaming community sample, maladaptive daydreaming symptoms were positively correlated with broad ASD traits, and *negatively* correlated with divergent thinking, both originality, and fluency. ASD traits were not associated with divergent thinking originality or fluency. In the ASD sample, maladaptive daydreaming symptoms and a sense of presence in daydreaming were positively correlated with ADHD symptoms. Divergent thinking originality and fluency were not correlated with any other measures, except diagnostic age; diagnosis of ASD at an older age was associated with higher divergent thinking abilities. Correlations are displayed in Table 2.

Daydreaming Community Sample: Regression Analyses

Step 1 of the model was significant, $R^2 = .04$, $F(4, 492) = 5.1$, $p < .001$, with age being a significant negative predictor of MDS-16 scores, $\beta = -.20$, $p < .001$; younger age predicted higher degrees of maladaptive daydreaming. After accounting for this effect, step 2 of the model was significant, $R^2_{change} = .04$, $F_{change}(2, 490) = 9.4$, $p < .001$. The AQ score predicted MDS-16 score, $\beta = .16$, $p < .001$, such that stronger ASD traits were associated with higher degrees of maladaptive daydreaming. Divergent thinking originality negatively predicted MDS-16 score, $\beta = -.10$, $p = .03$, such that lower divergent thinking originality corresponded to higher degrees of maladaptive daydreaming.

In predicting sense of presence in daydreaming, step 1 of the model was not significant, $R^2 = .005$, $F(4, 492) = 0.7$, $p = .63$. Step 2 of the model was also not significant, $R^2_{change} = .008$, $F_{change}(2, 490) = 1.9$, $p = .15$; neither ASD traits or divergent thinking originality were significant predictors of sense of presence in daydreaming.

ASD Sample: Regression Analyses

Step 1 of the model for predicting MDS-16 scores was significant, $R^2 = .23$, $F(5,189) = 11.5$, $p < .001$, with ADHD symptoms (ASRS-v1.1) explaining a significant portion of the variance in MDS-16 scores, $\beta = .48$, $p < .001$. After accounting for this effect, step 2 of the model was not significant, $R^2_{change} = .001$, $F_{change}(1, 188) = 0.2$, $p = .62$; divergent thinking originality did not predict of MDS-16 score.

In predicting sense of presence in daydreaming, step 1 of the model was significant, $R^2 = .17$, $F(5, 186) = 7.5$, $p < .001$, with ADHD symptoms (ASRS-v1.1) explaining a significant portion of the variance in sense of presence, $\beta = .37$, $p < .001$. After accounting for these effects, step 2 was not significant, $R^2_{change} = .001$, $F_{change}(1, 185) = 0.2$, $p = .64$; divergent thinking originality was not a predictor of sense of presence in daydreaming.

Table 2. Pearson's Partial Correlations, Controlling for age, Gender, Education, and Psychiatric Diagnoses.

		Presence in daydream	ASD traits	ADHD symptoms	Diagnostic age	DT originality	DT fluency
DC sample	MD symptoms	.46**	.15**	–	–	−.12*	−.14*
	Presence in daydream	–	.07	–	–	−.01	.01
	ASD traits	–	–	–	–	−.07	−.05
	DT originality	–	–	–	–	–	.58**
ASD sample	MD symptoms	.68**	–	.43**	−.08	.10	.02
	Presence in daydream	–	–	.34**	.05	.04	.07
	ADHD symptoms	–	–	–	−.10	.12	.10
	Diagnostic age	–	–	–	–	.19*	.20*
	DT originality	–	–	–	–	–	.56**

DC = Daydreaming Community; ASD = Autism spectrum Disorder; MD = Maladaptive Daydreaming; DT = Divergent Thinking; ADHD = Attention Deficit Hyperactivity Disorder.
* p <.05; ** p <.001

Group Comparisons

Results of the MANCOVA comparing groups on divergent thinking originality and fluency, controlling for demographic variables, showed a significant main effect of divergent thinking fluency. However, divergent thinking originality was not significantly different between groups. Follow-up comparisons showed that the ASD-only group had lower fluency than the two non-ASD groups (MD-only and Typical), and equal fluency to the ASD + MD group. The typical group had higher fluency than both ASD groups (ASD + MD and ASD-only), and equal fluency to the MD-only group. The two maladaptive daydreaming groups (ASD + MD and MD-only) had equal fluency. See Table 3 for statistics and Figure 1 for a visual depiction of group differences.

Exploratory Data

Descriptive statistics for exploratory daydreaming questions for both full samples are presented in Table 4.

Differences between the four smaller subgroups revealed that the ASD-only group scored lower than all other groups on daydream detail, degree of made-up content, imagining an ideal self, imagining someone made-up, and degree of violent/tragic daydreams, ts > 2.1, ps <.05. Daydream detail was higher in the MD-only group than the Typical group, $t = 2.2$, $p = .03$; otherwise, daydream detail and degree of made-up content did not differ among groups, ts < 1.9, ps >.06. Both the ASD + MD and ASD-only groups were more likely to daydream about their real selves than the MD-only group, ts > 3.2, ps <.002, while ASD + MD were more likely to imagine an ideal self than the Typical group, $t = 2.6$, $p = .01$. ASD + MD were also more

Table 3. Group Comparisons of Both Autism spectrum Disorder and Maladaptive Daydreaming (ASD + MD), ASD-Only, MD-Only, and Neither Condition (Typical), on Divergent Thinking (DT) Originality and Fluency Measures.

		M	*SD*	*F*	η_p^2	Comparisons	*t*
DT originality				1.8	.16		
	1. ASD + MD	3.6	0.8			*NS*	
	2. ASD-only	3.3	0.9				
	3. MD-only	3.6	0.8				
	4. Typical	3.7	0.9				
DT fluency				5.3*	.07		
	1. ASD + MD	6.0	2.5			2 < 3; 4	> 3.9**
	2. ASD-only	5.3	2.1			4 > 1; 2	> 2.5*
	3. MD-only	7.0	2.4			1 = 2; 3	< 2.1
	4. Typical	7.3	2.8			3 = 4	0.5

* p <.05; ** p <.001.

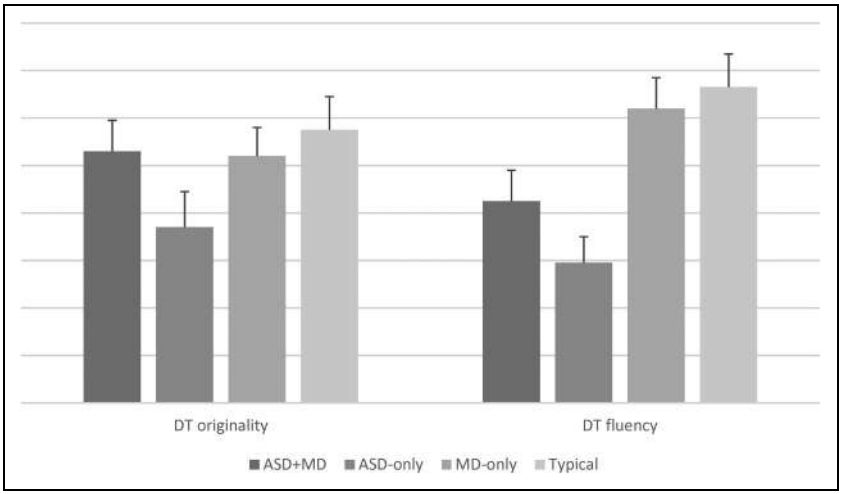

Figure 1. Divergent Thinking (dt) Originality and Fluency Scores for Groups of Both Autism Spectrum Disorder and Maladaptive Daydreaming (ASD + MD), ASD-only, MD-only, and Neither Condition (Typical).

Table 4. Descriptive Statistics for Exploratory Daydreaming Questions for the Daydreaming Community (DC) Sample and Autism spectrum Disorder (ASD) Sample.

Measure (scale: 0–10)	Sample	*M*	*SD*
Daydream detail	DC sample	7.9	2.2
	ASD sample	5.9	3.1
Made-up content	DC sample	6.1	2.5
	ASD sample	4.2	2.9
Self-identity	DC sample	3.1	3.2
	ASD sample	5.1	3.2
Ideal self-identity	DC sample	6.4	3.7
	ASD sample	5.6	3.5
Known other identity	DC sample	0.8	1.9
	ASD sample	1.9	2.8
Famous identity	DC sample	1.9	3.1
	ASD sample	2.1	2.9
Made-up identity	DC sample	5.2	4.0
	ASD sample	3.6	3.5
Violence/tragedy	DC sample	5.4	2.9
	ASD sample	3.8	3.0

likely than all other groups to daydream about someone that they knew and someone famous, *t*s > 2.1, *p*s <.04. MD-only did not differ from typical on daydream identities, *t*s < 1.4, *p*s >.16. ASD + MD and MD-only were more likely to have violent or tragic daydreams than ASD-only and Typical, *t*s > 2.9, *p*s <.005. See Figure 2 for group differences.

Regarding the reasons for daydreaming, ASD + MD, MD-only, and Typical all reported their top three reasons as enjoyment, boredom, and to not feel alone. The ASD-only group also rated boredom as a top reason, however, they did not rate enjoyment as highly and instead indicated that they daydream to process information or for no reason. All four groups cited similar triggers for daydreaming, with the highest rated triggers being music, being alone, or being in bed. Upon inspecting and categorizing daydream themes, it appeared that the ASD + MD, MD-only, and Typical groups most often mentioned themes related to achievement and recognition, and fantasy or fiction. The MD-only and Typical groups also commonly reported themes related to companionship, while the ASD + MD and ASD-only groups commonly reported themes related to an ideal life. In contrast to the other three groups, several individuals from the ASD-only group reported having no daydreams at all.

Discussion

This study aimed to explore daydreaming habits in ASD and determine the relationship between ASD, immersive daydreaming, and divergent thinking. In a sample of

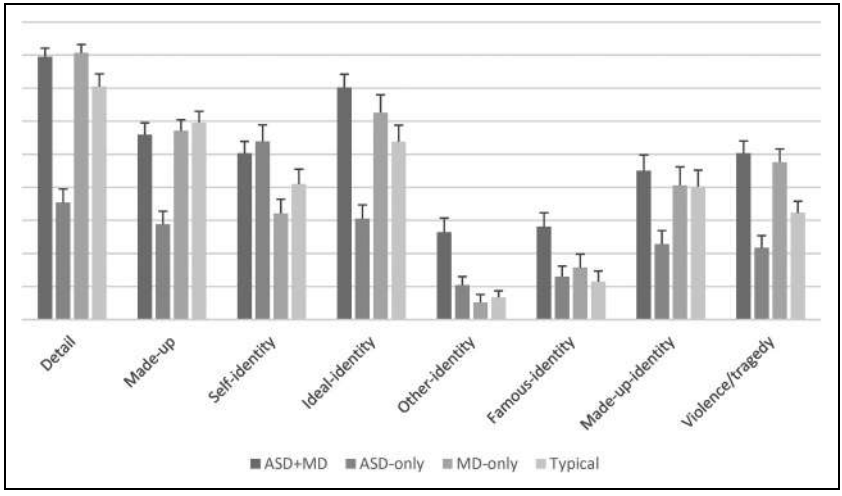

Figure 2. Average scores on Exploratory Daydreaming Questions for the Groups with Both Autism Spectrum Disorder and Maladaptive Daydreaming (ASD + MD), ASD-only, MD-only, and Typical.

individuals recruited from online daydreaming forums, who did not have a diagnosis of ASD, broad ASD traits predicted maladaptive daydreaming, as expected. Age also predicted maladaptive daydreaming in this sample, in line with previous research showing that maladaptive daydreaming is more common in younger adults (Bigelsen et al., 2016; Mariani et al., 2021; Musetti et al., 2021;). This activity may decrease as life demands increase. In a sample of adults with a confirmed diagnosis of ASD, 42% reported experiences consistent with maladaptive daydreaming. In line with Visuri (2017), these results suggest that ASD is associated with engagement in rich mental narratives and contradict research suggesting limited imaginary capacities in ASD (e.g., Craig & Baron-Cohen, 1999).

Divergent Thinking

Contrary to our expectations, divergent thinking was associated with lower levels of maladaptive daydreaming in the daydreaming community sample and did not predict daydreaming measures in the ASD sample. Literature on the psychology of fiction claims that story creation relies on structures that align with our human tendencies to order events and adhere to the rules of cause and effect (Oatley, 2012). This theory suggests that the creation of stories is not an unconstrained generative process, it is structured and systematic. Oatley argues that recognisable patterns in narratives are necessary if those stories are to be psychologically meaningful. While most typical forms of daydreaming or mind wandering are thought of as being unconstrained thought (McMillan et al., 2013), maladaptive daydreaming is unique in that it involves detailed narratives that endure over long periods (Somer, 2002). Maladaptive daydreaming may follow the rules of narrative fiction; maladaptive daydreamers report that their daydreams involve characters and plots, are often based on pieces of fiction, and often incorporate common themes of fiction, such as heroism (Bigelsen & Schupak, 2011; Somer et al., 2019). Therefore, we suggest that maladaptive and immersive daydreaming requires the ability to apply and adapt existing narrative schemas and structures within one's imagination. Divergent thinking is not required for, and can perhaps be incompatible with, this process.

Maladaptive daydreaming may involve a fixation on a narrow range of fantasy scenarios. We call for further research to explore the idea that there may be limited amounts of novel content and ideas generated in maladaptive daydreaming. West and Somer (2019) argued that their finding of reduced creative productivity was due to the time spent immersed in daydreams. However, this finding might also be attributed to a limited capacity for divergent thinking that may be required for other creative endeavours. Literature on maladaptive daydreaming also suggests that daydreaming themes may serve as a compensatory process driven by underlying emotional needs, rather than a creative process (Greene et al., 2020; Sandor et al., 2021; Somer & Herscu, 2017).

Two caveats to these interpretations include that divergent thinking is one subtype of creativity, which we measured with just one type of task. Additionally, non-pathological forms of immersive daydreaming may differ from maladaptive daydreaming in relation to creative ability. Therefore, we cannot conclude that immersive daydreaming does not involve creative processes, particularly since the generation of vivid mental imagery is an act of creativity itself. Additional research is also needed to explore the possibility that immersive daydreaming involves heightened *convergent* thinking ability. This idea is plausible since the individual stories may be formed by drawing from multiple existing narratives. Moreover, Kanter (1982) found that a higher frequency of daydreaming was related to *visual* divergent thinking tasks, rather than verbal divergent thinking. Kanter suggested that frequent daydreamers have a heightened capacity for divergent thinking in the generation of unique imagery, rather than words. The Alternate Uses Test, used in the current study, is a heavily verbal task. Future research should also aim to explore the possibility that immersive daydreaming is related to visual divergent thinking.

We hypothesized that divergent thinking originality would be related to ASD traits, and that individuals with ASD (regardless of daydreaming experiences) and those with maladaptive daydreaming (regardless of ASD status) would have higher divergent thinking originality compared to individuals with either condition. Moreover, we expected that individuals who had both ASD and maladaptive daydreaming would score the highest on originality. Contrary to hypotheses, divergent thinking measures were not associated with ASD traits and originality did not differ between groups. The existing data on divergent thinking capacity in individuals with ASD or ASD traits is mixed (Abu-Akel et al., 2020). Our findings of no relationship between divergent thinking and ASD traits do not support those of Best et al. (2015) and Liu et al. (2011) but are consistent with findings reported by Abu-Akel et al. (2020) and Zabelina et al. (2014). The results suggest that, while the ability to generate unique ideas was not enhanced in ASD, it was not impaired, either. Given the link between creative thinking and theory of mind, these findings support research showing that many individuals with ASD perform similarly to typical controls on theory of mind tasks (Rosello et al., 2020). However, in line with our predictions, we found that fluency of responses on the divergent thinking tasks was reduced in the ASD groups. This finding is consistent with previous work and likely reflects general impairments in verbal fluency (Best et al., 2015; Pastor-Cerezuela et al., 2016).

Some researchers have suggested that unique thinking in ASD manifests as *convergent*, rather than divergent thinking (Abu-Akel et al., 2020; Claridge & McDonald, 2009). That is, individuals with ASD are better able to form associations and draw unique conclusions from a set of ideas, rather than generate a range of ideas from a limited source. Established processing styles in ASD may be more conducive to convergent thinking, such as local processing and pattern recognition (Happe & Vital, 2009). It is possible that repetitive tendencies often seen in ASD may manifest as obsessive fantasizing about a limited range of scenarios, albeit detailed. Various

sources of information, such as existing fiction, may be funnelled into this obsession. Divergent thinking, on the other hand, has been related to schizotypal traits and not ASD traits (Abu-Akel et al., 2020). Since schizotypal traits involve disorganised thinking, this finding further attests to the notion that divergent thinking fosters less structured idea generation and may not allow the conditions necessary for well-structured fantasy generation. Further research should aim to explore whether convergent thinking is associated with immersive daydreaming in ASD. If convergent thinking is involved in immersive daydreaming, this may explain why individuals with ASD engage in this activity.

Given the proportion of adults with ASD who reported maladaptive daydreaming experiences, it seems that our data support Visuri's (2017) assertion that we should focus on intrasubjective forms of creativity in ASD. The reliance on structure for effective narrative may explain these experiences in ASD, as well as the broader interest in fiction and fantasy found among adults with ASD (Mazurek et al., 2013; 2015; Rozema, 2015). The preference for structure and systematic thinking may deem the adoption of narrative scripts within imagination particularly attractive to some individuals with ASD. However, as a need for structure and systemizing is fairly universal among individuals with ASD, it remains unclear from our data why some individuals with ASD have such rich imaginary experiences, while others have limited daydreaming. This could be related to differences in theory of mind ability (Rosello et al., 2020). Moreover, it could be that fantasy constitutes the object of restricted interests for some individuals. Future research is needed to explore the factors which differentiate these experiences in ASD.

The Nature of Daydreaming in ASD

Our additional exploratory questions give some insight into the nature of daydreaming experiences in ASD. These data suggest that daydreaming experiences are heterogeneous among adults with ASD, such that some experience pathological degrees of immersive daydreaming, while others have more limited experiences than even typical daydreaming. ASD participants who experienced maladaptive daydreaming appeared similar to maladaptive daydreamers who don't have ASD, with respect to the degree of detail and made-up content (not based on reality) of their daydreams, the degree to which they imagined a better version of themselves, and the degree of violent or tragic content in their daydreams. In contrast, ASD participants who did not engage in maladaptive daydreaming were lower than all other participants, including typical, on all these measures. Individuals with both ASD and maladaptive daydreaming were also more likely than all others to daydream about people they knew and about famous people. However, these identities were relatively low in this group compared to imagining ideal selves and made-up identities.

All ASD participants reported daydreaming about their real selves a greater amount than participants without ASD. Individuals with ASD may be more likely to daydream

about their real selves due to a need for familiar structures, or a need to mentally process their experience of self and compensate for lost opportunities in real-life. The ASD participants also differed on their reported reasons for daydreaming; maladaptive daydreamers fantasized mostly for the purpose of enjoyment, to relieve boredom, and to not feel alone. These reasons for daydreaming mirrored those reported by participants without ASD. On the other hand, the top reason for daydreaming among individuals with ASD without maladaptive daydreaming was to process information. This suggests that the limited daydreaming in some individuals with ASD may contain more practical rather than fantastical content, which aligns with research showing that individuals with ASD are more likely to use mental imagery to process information and solve problems (Kana et al., 2006; Soulieres et al., 2011). The top immediate causes for daydreaming included music, being alone, and being in bed. While listening to music was demonstrated as a trigger and enhancer of maladaptive daydreaming (Somer et al., 2016), it appears that music is also a trigger for daydreaming among those without maladaptive daydreaming. Research has shown that music listening while mind wandering evokes positive emotions and thought content (Taruffi, 2021). Therefore, for individuals who do not engage in maladaptive levels of daydreaming, music may enhance the positive and beneficial aspects of daydreaming activities.

Daydream themes were reasonably uniform across participants, ASD participants without maladaptive daydreaming reporting fewer themes of achievement and recognition, fantasy, and fiction. All ASD participants reported fewer themes related to companionship and more themes depicting an ideal life. This finding suggests that the daydreams of individuals with ASD may be less social and more focused on personal perspectives. However, several individuals with ASD reported that they do not daydream at all. Individuals from this group conform to the common view of limited imaginative capacities in ASD (Craig & Baron-Cohen, 1999). However, the portion of ASD participants who did experience maladaptive daydreaming contradicts this view. Factors that underly distinct daydreaming experiences among individuals with ASD are unclear. We explored the possibility that this variance could be related to diagnostic age. However, diagnostic age did not correlate with maladaptive daydreaming and instead was linked to divergent thinking abilities. We found that ADHD symptoms related to maladaptive daydreaming amongst the ASD sample. Indeed, ADHD has been previously associated with maladaptive daydreaming (Theodor-Katz, 2019). Future research should explore whether attention deficits contribute to distinct daydreaming experiences in ASD.

Other psychopathological phenomena may explain immersive daydreaming tendencies in ASD, such as overlapping features of ASD and schizophrenia. Research shows a degree of comorbidity between ASD and schizophrenia, as well as associations between ASD traits and schizotypal traits (Chisholm et al., 2015; Cochran et al., 2013). A large portion of the research suggests that ASD is only related to the negative features of schizophrenia, such as social withdrawal, and are incompatible with regard

to the positive features (Zhou et al., 2019). For example, ASD involves hyper-focus of attention, whereas schizotypy involves hyper-switching of attention (Abu-Akel et al., 2018; Zhou et al., 2019). ASD and psychotic-affective conditions are also usually conceived as opposites regarding imagination, with heightened imagination and fantasy-proneness in psychotic-affective conditions (Crespi et al., 2016; Sanchez-Bernardos & Avia, 2006). However, there is some mixed evidence suggesting there may be associations between ASD and positive schizotypal traits (Barneveld et al., 2011). Perhaps the mixed findings reflect a unique intersection in which a subset of individuals with ASD align with both positive and negative features of schizophrenia, while others only relate to the negative symptoms. This subset may overlap to some degree with the subset of individuals with ASD who experience immersive daydreaming.

Some authors have theorized that the overlap in ASD traits and schizotypal traits may be explained by common deficits in self-consciousness (Tordjman et al., 2019). Specifically, both ASD and schizophrenia involve alterations in body concept and self/non-self differentiation (Haag et al., 2010; Tordjman & Maillhes, 2009). Correspondingly, neuroscientific evidence show that brain regions involved in self/other distinctions and social processing are implicated in both ASD and schizophrenia (Nakagawa & Chinba, 2016; Radeloff et al., 2014). Tordjman et al. (2019) suggest that a failure in the construction of the self underlies the social deficits and other challenges seen in both schizophrenia and ASD. It is possible that this deficit of self-consciousness also contributes to the conditions required for immersive daydreaming, such that there may be reduced constraints on self-embodiment, allowing a more immersive experience of imagined selves. Immersive daydreaming in ASD may also serve as an attempt to establish a more defined sense of self by mentally exploring social and identity-related scripts.

ASD is not a homogeneous condition, and unique subsets of individuals with ASD have been identified in the literature. For instance, intellectual functioning is highly varied in ASD and may relate to diverging daydreaming experiences. It is noteworthy that factors related to the mental health and cognitive profiles of the participants across the different groups in the current study may have introduced some confounds to the current results. Future research should explore such factors in greater depth to gain further understanding of the heterogeneity of daydreaming experiences in ASD, and how these experiences compare to other groups. Factors to explore may include the severity of ASD symptoms, intellectual functioning, fantasy-proneness, and other mental health factors including self-concept, dissociation and schizotypy.

We note that the lack of a direct measure of immersive daydreaming as a construct is a significant limitation in the current study. While we theorize that our findings extend to the broader construct of immersive daydreaming, the associations of study variables with a measure of maladaptive daydreaming may be attributed to the maladaptive components of this behaviour. Therefore, replication of this study with a validated measure of immersive daydreaming is warranted. Finally, Fein (2015) and Visuri (2017) suggest that fantasy and imagination could have implications for social and emotional

learning in ASD. Further research should also aim to determine the potential benefits and consequences of immersive daydreaming in ASD.

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