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Experience Sampling of Positive Affect in Adolescents with Autism: Feasibility and Preliminary Findings

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Abstract

Background—Experience sampling is a powerful method for obtaining ecologically valid data from research participants in real-world contexts. Given the urgent need for innovative and sensitive outcome measures in autism spectrum disorder (ASD) research, the present study sought to examine the feasibility of using experience sampling of positive affect and behavior in adolescents with ASD.

Method—Nineteen high functioning adolescents with ASD and 20 sex and age matched controls completed smartphone- and Qualtrics® -based experience sampling of positive affect and behavior six times over four days.

Results—Adherence was excellent: adolescents with ASD completed 85% of the assessments, compared to 93% in controls, and response rates were not impacted by age or IQ. Groups did not differ in positive affect overall or as a function of activities, nor did groups differ in the proportion of assessments completed during social or nonsocial activities. However, groups did differ in the proportion of assessments completed during preferred activities.

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Conclusions—Results suggest that smartphone- and Qualtrics® -based experience sampling with high functioning adolescents with ASD is feasible and captures real-world behaviors that would not be possible using laboratory-based measures.

Keywords

Autism spectrum disorder; experience sampling; positive affect; restricted interests

Introduction

Nearly all questionnaire-based autism spectrum disorder (ASD) research measures are laboratory-based caregiver-report or self-report instruments. Experience sampling is a method for obtaining subjective information in a natural setting that is useful for gathering information about context-dependent states (Stone & Shiffman, 2002). Experience sampling offers new methods to examine social-affective functioning in ASD with strong ecological validity because data are collected in real-time during naturalistic behaviors. Additionally, there is an urgent need for novel, sensitive, and standardized outcome measures in ASD treatment studies (Vivanti, Prior, Williams, & Dissanayake, 2014; Warren et al., 2011), and the high ecological validity of experience sampling suggests that this method may have the potential to be a sensitive ASD treatment outcome measure.

Experience sampling has been used in a number of psychiatric contexts as well as with pediatric and severely mentally ill populations (aan het Rot, Hogenelst, & Schoevers, 2012; Granholm, Ben-Zeev, Fulford, & Swendsen, 2013; Marhe, Waters, van de Wetering, & Franken, 2013; Shiffman, Stone, & Hufford, 2008; Silk, Steinberg, & Morris, 2003; Tan et al., 2012). Experience sampling also offers relatively increased ecological validity relative to laboratory measures and is thus a natural complement to laboratory-based studies (Myin-Germeys et al., 2009; Shiffman et al., 2008; Stone & Shiffman, 2002). For example, experience sampling leads to less underreporting of mood fluctuations (Piasecki, Hufford, Solhan, & Trull, 2007), and experience sampling of mood has very good temporal stability and internal consistency (Larson, 1989). Experience sampling is particularly valuable for gathering information about states and behaviors that may be context-dependent, such as affect (Moskowitz & Young, 2006), and the accessibility of smartphones and freely-available survey software has made experience sampling a valuable method to collect self-report data in naturalistic contexts.

Though there is little ASD research that has used experience sampling, there are a number of factors that suggest that experience sampling may be a particularly suitable assessment method for ASD research. First, the accessibility of smartphones and survey software makes experience sampling accessible to most researchers and families. Second, experience sampling via smartphones may be well suited for older children and adolescents given the high use of smartphones by this age group (nearly 70% of 10 year olds use smartphones daily (Rice et al., 2014)). Finally, experience sampling via smartphones may be ideal for adolescents with ASD given this population's strengths in using technology (Klin, McPartland, & Volkmar, 2005) and the preference for screen media over other leisure activities for individuals with ASD (Shane & Albert, 2008).

Only a few studies have evaluated experience sampling in ASD. Cordier and colleagues (2014) used experience sampling to identify the contexts and content of daily life in a small sample (n=6) of children with high functioning ASD using an iPod Touch. They reported descriptive analyses of the quality of experiences and corresponding emotions in everyday social interactions in ASD, however children without ASD were not included in this study. Similarly, Chen and colleagues (2014; 2013) investigated the feasibility of experience sampling in small samples of individuals with and without high functioning ASD (n=6 and n=4, respectively), and found acceptable response rates and response validity for seven surveys administered over seven consecutive days. Finally, Khor and colleagues (2014) used experience sampling across two weeks in adolescents with high-functioning ASD to evaluate stress and coping and reported moderate compliance with the experience sampling protocol as well as moderate concurrent validity with retrospective measures of coping. They also found that similarities between child-reported and parent-reported variables of behavior and emotional difficulty provided promising evidence of the ability of high functioning adolescents with Autism Spectrum Disorders to report on internal states.

In this study, experience sampling of positive affect and behavioral context were examined in high functioning adolescents with ASD (i.e., characterized by average IQ scores). Although research on affective experience in ASD has focused primarily on negative affect (e.g., White et al., 2014; Yirmiya, Kasari, Sigman, & Mundy, 1989), the recent emphasis on understanding motivational aspects of ASD has focused research attention on positive affect given its relevance for the social motivational deficits that characterize the disorder (Chevallier, Kohls, Troiani, Brodkin, & Schultz, 2012; Dawson, Webb, & McPartland, 2005). Additionally, theories that focus on impaired motivational systems in ASD have begun to examine behaviors related to restricted interests, a core symptom of ASD (American Psychiatric Association, 2013), because of converging lines of evidence that ASD is characterized by increased positive affect while processing stimuli related to restricted interests (Cascio et al., 2014; Sasson, Dichter, & Bodfish, 2012; K. K. Watson et al., 2015).

The primary goal of this study was to establish the feasibility of experience sampling of positive affect in high functioning adolescents with ASD. Accessibility was emphasized when developing to the experience sampling protocol to ensure that promising findings would be replicable in a diverse range of settings. Our secondary goals were to use experience sampling to investigate (1) differences in positive affect and behavioral context in ASD; (2) the relative proportions of time individuals with ASD were engaged in various activities related to preferred activities, and (3) whether the social context of sampling (i.e., if participants were alone or with other people) differentially influenced positive affect in ASD.

Methods

Participants

Twenty-two adolescents with ASD and 20 controls between 9 and 19 years old consented to a protocol approved by the local human investigations committee at UNC-Chapel Hill. Groups were recruited to be matched on age, gender distribution, and IQ. Three adolescents with ASD withdrew before completing any assessments, citing conflicts with their schedules

in two cases and unspecified reasons in the third case. Thus, the final sample was 19 adolescents with ASD and 20 typically developing controls. Adolescents with ASD were recruited via the Autism Subject Registry maintained through the Carolina Institute for Developmental Disabilities. Typically developing controls were recruited via an email listserve at UNC-Chapel Hill.

Inclusion criteria were as follows. Control participants scored below the recommended cutoff of 15 on the Social Communication Questionnaire, an ASD screening measure (Mulligan, Richardson, Anney, & Gill, 2009). ASD participants had clinical diagnoses of ASD that were confirmed by the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000), administered by trained research staff with established research reliability supervised by a licensed clinical psychologist using standard cutoffs. Because Module 3 and Module 4 were used (Module 3: 9 participants, Module 4: 10 participants), calibrated severity scores were calculated from raw ADOS scores to obtain a dimensional measure of ASD symptom severity across modules (Gotham, Pickles, & Lord, 2009; Hus & Lord, 2014). ASD participants were also administered the restricted, repetitive behaviors items only from the Autism Diagnostic Interview-Revised (ADI-R; Lord, Rutter, & Le Couteur, 1994) and were not asked to stop any psychosocial or medication interventions during their participation in the study.

The ASD and the control groups completed the Social Responsiveness Scale (SRS; Constantino & Gruber, 2002), a dimensional measure of overall ASD symptom severity, the Repetitive Behavior Scale-Revised (RBS-R; Bodfish, Symons, & Lewis, 1999), a dimensional measure of repetitive behavior symptoms in ASD, the Kaufman Brief Intelligence Test (KBIT; Kaufman, 1990), and the Interests Scale (Bodfish, 2004; Turner-Brown, Lam, Holtzclaw, Dichter, & Bodfish, 2011), a checklist that describes typical childhood interests and open-ended questions to identify a child's primary interest or hobby and any associated functional impairments with strong internal consistency (Cronbach's alpha = .81; Turner-Brown et al., 2011). Participant characteristics are provided in Table 1, which illustrates that groups did not differ in terms of age, $t(37)=.64$, $p=.53$, *Cohen's d* = 0.14, or intelligence quotient (IQ) scores, $t(37)=1.62$, $p=.11$, *Cohen's d* = 0.49. Seventy-seven percent of the sample was Caucasian, 15% were African American, 3% were Asian, and 5% identified as “other.”

Procedure

Measures & Materials

The experience sampling protocol used the Positive and Negative Affect Scale for Children (PANAS-C; Laurent et al., 1999). The PANAS-C was developed as a child version of the original PANAS, which was designed to measure positive and negative affect in relation to the tripartite model of emotion (Clark & Watson, 1991), and the current study focuses only on the 15 positive affect items from the PANAS-C. Positive affect is a broad affective dimension characterized by feelings of enthusiasm and energy in response to one's environment (D. Watson, Clark, & Tellegen, 1988). The PANAS–C was developed to measure affect in youth, has favorable psychometric properties across clinical and nonclinical samples (Chorpita & Daleiden, 2002; Hughes & Kendall, 2009), and has been

used in prior experience sampling studies of affect in youth (Forbes et al., 2009; Silk et al., 2011). The PANAS-C asks respondents to rate how much they feel like each of 30 different emotion words (e.g., *interested, joyful*) using a 5-point Likert scale, and yields a total positive affect score (higher numbers denote higher positive affect).

To facilitate understanding among participants with ASD, two alterations were made to the PANAS-C. First, the Likert scale anchors were modified to decrease language complexity. The original PANAS-C anchors are “Very slightly,” “A little,” “Moderately,” “Quite a bit,” and “Extremely.” These were changed to “Not at all,” “A little,” “Some,” “Quite a bit,” and “A lot.” Additionally, visual supports were added to the Likert scale anchors. An example item from the modified PANAS-C is presented in Figure 1. The PANAS-C was administered by Qualtrics ®, a web-based survey research software package which has been approved by our institutional review board for collection and storage of Private Health Information (PHI). This tool easily allows for surveys to be optimized for use on a range of smartphone platforms[1]. Results of only the positive affect subscale are reported here.

Experience Sampling Procedure

Participants came to the Carolina Institute for Developmental Disabilities to complete diagnostic and questionnaire measures. At the end of this visit, a research staff member explained the experience sampling procedure to each participant and his or her caregiver(s). Participants and their caregivers confirmed that they would have access to a smartphone or computer during the periods of time when they would be contacted. Participants were shown screenshots of what text message prompts would look like and completed a practice administration with the support of a research staff member. During this time, research staff reviewed each item from the PANAS-C. Items that were unclear to participants were further explained and comprehension was confirmed using a “teach-back” method wherein participants would explain the meaning of the word back to research staff.

Participants received text messages that were automatically generated by a HIPPA-compliant Outlook Exchange email system. Text messages included their ID number and a web link to access the smartphone-compatible Qualtrics® survey, and participants were instructed to complete the survey as soon as possible after receiving the text message. Two participants who did not have text messaging enabled on their cell phones received telephone calls to prompt them to complete the surveys.

Each survey began with three open-ended context questions: (1) Where are you? (2) What are you doing? and (3) Whom are you with? These were followed by the PANAS-C. Participants received six automated text message prompts over the course of four days: one on Friday afternoon, two on Saturday, two on Sunday, and one on Monday afternoon. Research staff members and caregivers agreed on acceptable time windows for assessments (e.g., Friday between 3:00 pm and 6:00 p.m.) that would not interfere with school or academic tasks and that would be during times that they were engaged in typical free-time activities. Consistent with signal scheduling methods used in previous momentary sampling

[1]Please contact mosner@email.unc.edu to receive a copy of the Qualtrics ® survey used in this study.

ASD research (Khor et al., 2014), this pseudo-random sampling strategy was chosen to be minimally disruptive of school schedules and to capture participants when they were in less structured environments.

Data Analysis

For all analyses, effect sizes are reported using *Cohen's d*, for which 0.8, 0.5, and 0.2 are typically interpreted as a large, moderate, and small effect sizes (Cohen, 1988; Durlak, 2009).

Reliability Estimates of the Experience Sampling Procedure—We report split-half reliability with Spearman-Brown adjustment and Cronbach's alpha for the ASD group, for the control group, and for both groups combined.

Behavioral context—For control participants, responses from the Interests Scale were used to identify a participant's preferred activity or hobby, termed their “primary interest”. For ASD participants, information from the Interests Scale, combined with responses from the Restricted Behavior subscale of the RBS-R (items 40-43) and the unusual preoccupations (item 67) and circumscribed interests (item 68) items from the ADI-R were used to identify each participant's restricted interest. Representative primary interests for the control group include reading, video games, and sports; representative restricted interests in the ASD group are video games, military information, and watching cartoon episodes in sequence.

Social Context—Information about whom participants were with at the time of each assessment was used to categorize activities as either social or nonsocial. Social activities included being with friends, family, or both parents. Nonsocial activities included assessments when the participant reported being alone or with one parent (the age range of participants made it likely that they may be accompanied by one parent for purely supervision or transportation purposes).

Responses were also categorized into various activity types to provide more comprehensive descriptions real-world behavior in adolescents with ASD, relative to their typically developing peers. Participant responses to the open-ended context question “What are you doing?” were categorized as belonging to one of the following activity types: technology (e.g., watching television, playing video games), meal (e.g., eating, having dinner), academic (e.g., doing homework), recreation (e.g., playing sports), or chore (e.g., doing yardwork).

Results

Feasibility

Each participant was asked to complete six assessments, resulting in a possible total of 234 assessments. Participants completed 208 of those surveys, yielding an 89% overall response rate. The ASD group completed 97/114 (85%) of the assessments and the control group complete 111/120 (93%) of the assessments, a significant difference (z-test comparing proportions =2.19, p=.024, *Cohen's d* =0.09). Pearson correlations between age and IQ and the proportion of surveys completed across or within groups were not significant (r's<.25,

p's>.16, *Cohen's d* <0.063). The average response rate in the ASD group was 85% and the average response rate in the control group was 92.5%.

Reliability

Across all six momentary sampling measures of positive affect, within the ASD group Cronbach's alpha = 0.88 and split-half reliability = 0.87. Within the control group, Cronbach's alpha = 0.67 and split-half reliability = 0.56. Across both groups, Cronbach's alpha = 0.81 and split-half reliability = 0.75.

Positive Affect

Figure 2 illustrates mean positive affect in both groups overall, when participants reported being engaged in social and nonsocial activities, and when participants reported engaging in restricted interest (for the ASD group) and primary interest (for the control group) activities. A 2 (Group: ASD, Control) × 4 (Condition: Overall, Social, Nonsocial, Primary or Restricted Interest) mixed ANOVA revealed a main effect of Condition, multivariate $F(3,35)=7.19$, $p=.0006$, but no Group*Condition interaction, $F(3,35)=1.5$, $p=.23$, or main effect of Group, $F(1,37)=0.25$, $p=.62$. Exploratory between groups t-tests for each level of Condition revealed that there were no significant group differences in positive affect for any condition, *t*'s<.35, *p*'s>.70, *Cohen's d*s <0.01.

Behavioral Context during Assessments

The left side of Figure 3 illustrates mean percentages of time that participants were engaged in activities that involved technology, meals, academics, recreation, and chores. Groups did not differ in the percentage of time engaged in any of these activities, *t*'s(37) < 1.60, *p*'s>.10, *Cohen's d*s <0.15. The right side of Figure 3 illustrates the mean percentages of time that participants were engaged in social, nonsocial, or restricted interest (for the ASD group) and primary interest (for the control group) activities. The figure illustrates that groups did not differ in the percentage of time engaged in social or nonsocial activities, *t*'s(37) < 1.65, *p*'s>.10, *Cohen's d*s <0.2. However, groups did differ in the amount of time spent in restricted interest or primary interest activities, $t(37)=2.59$, $p=.01$ *Cohen's d*=0.32.

Discussion

The primary purpose of this study was to establish the feasibility of experience sampling methods using smartphones and Qualtrics ® web-based survey software in adolescents with high functioning ASD. The secondary goal of this study was to use experience sampling methods to investigate positive affect and behavior in naturalistic contexts in adolescents with ASD. Feasibility was excellent: the ASD group completed 85% of the assessments while the control group completed 93% of surveys, and the age and IQ of participants in this high functioning sample did not influence the proportion of surveys completed, suggesting that this methodology is suitable for higher functioning adolescents with ASD.

Groups did not differ in positive affect overall, when engaged social or nonsocial activities, or when engaged in their preferred activities (restricted interests for the ASD group and primary interests for the control group). Equivalent positive affect during preferred activities

confirms prior caregiver-based reports that typically developing and ASD groups do not differ in interests in preferred activities (Turner-Brown et al., 2011). The finding of equivalent positive affect in social contexts is somewhat surprising; the social motivation hypothesis of ASD suggests that individuals with ASD derive decreased pleasure from social experiences (Chevallier et al., 2012). However, not all studies of reward-based responses to social stimuli in ASD have yielded consistent results (see K. K. Watson et al., 2015 for a review). Additionally, Chen and colleagues (2015) reported that individuals with high functioning ASD were more likely to be self-determined while engaging in "solitary/parallel leisure" as well as "social activities" than when engaged in other types of activities, and Chen and colleagues (2016) reported that "solitary/parallel leisure" and "social activities" were positively associated with interest and enjoyment in individuals with high functioning ASD. These studies dovetail with the present finding of equivalent positive affect in social contexts. Finally, although ASD has been found to be characterized by deficits in social motivation (i.e., social "wanting"), evidence of differences in social hedonic responses (i.e., social "liking") is more equivocal (see Kohls, Chevallier, Troiani, & Schultz, 2012 for a review). In the present study, experience sampling of positive affect may reflect social liking rather than social wanting which may account for the lack of group differences in this measure.

Groups did not differ in the percentage of time engaged in social or nonsocial activities, nor in the percentage of time engaged in various classes of behaviors (technology, meals, etc.). However, groups did differ in the percentage of time engaged in preferred activities (restricted interests in the ASD group and primary interests in the control group). This finding is consistent with the defining features of restricted interests in ASD, namely that they are intense and pervasive (American Psychiatric Association, 2013), as well as prior reports that restricted interests in ASD are more interfering than are primary interests in typically developing individuals (Turner-Brown et al., 2011). This finding, combined with the finding that groups did not differ in the percentage of time engaged in nonsocial activities, speaks to the importance of incorporating research questions that address behaviors in the context of restricted interests in ASD specifically, which may reflect a specific class of nonsocial activities in ASD with etiologic relevance. Experience sampling may prove particularly beneficial in this regard due to the fact that good temporal stability and ecological validity are crucial to truly capturing context-dependent behavior or emotional response related to engagement in individual restricted interests.

Several limitations of the present study should be noted. The sample size was relatively small and only high functioning adolescents were included. Future studies should also address the impact of psychiatric comorbidities on positive affect in ASD. Although groups did not differ statistically in IQ, the effect size for IQ differences was moderate; even though IQ was not related to the dependent measures of interest, future work in this area should aim to more closely match groups with respect to IQ. Additionally, the psychometric properties of the PANAS-C have not been evaluated in ASD, and thus the validity of this measure in this population cannot be firmly established although in this initial study reliability estimates for the experience sampling procedure were acceptable. Participants were contacted only six times over the course of four days, a relatively small number of contacts for an experience sampling study, and thus it is possible that these results were not truly representative of

experienced positive affect. Future research should explore the feasibility of denser sampling approaches. Moreover, multilevel modeling analyses that examine person-specific changes over time are often used to analyze experience sampling datasets. Similar to prior initial studies of experience sampling in ASD (Chen et al., 2014; Chen et al., 2013; Cordier et al., 2014; Khor et al., 2014), we did not analyze our data in this way because of the suboptimal sample size for such an approach (Maas & Hox, 2005), and future studies with larger samples should evaluate the impact of multilevel modeling approaches to data analysis[2].

Although there are numerous studies in which high functioning individuals with ASD have reported affective states using self-report instruments (e.g., Sasson et al., 2012; Tseng et al., 2014; White et al., 2014), another potential limitation of the present study is the long-standing issue of the validity of self-report of affective states in ASD (Berthoz & Hill, 2005; Kaat & Lecavalier, 2015), and future research that addresses the correspondence between self- and caregiver-report indices of positive affect in ASD will be needed to address this issue. We highlight in this regard, however, that the ASD and control groups in this study showed relatively equivalent levels of positive affect, suggesting that the ASD group understood the meaning of PANAS-C items (although this observation is clearly not sufficient to establish the validity of self-reported positive affect in the ASD group, which should be addressed in future studies). Finally, despite its methodological strengths, experience sampling must be applied and interpreted with caution if certain parameters related to identifying the sampled construct are not met (see Hurlburt & Heavey, 2015 for a review).

Implications

The present study indicates that experience sampling is feasible in adolescents with high functioning ASD and may be implemented using smartphones and commercially available web-based survey software. Given these promising initial findings, future work evaluating the validity and reliability of experience sampling of affect in ASD is warranted. Additionally, there is an urgent need for novel, sensitive, and standardized treatment outcome measures in ASD (Vivanti et al., 2014; Warren et al., 2011), and the high ecological validity of experience sampling methods may ultimately provide a viable and sensitive treatment outcome measure in ASD treatment research. If future studies continue to support the feasibility and reliability of experience sampling approaches, it may represent not only a novel method to assess symptom profiles and potentially response to novel treatments in ASD, but also a novel way for practitioners to assess the impact of interventions that target affect that is easy to implement and ecologically valid.

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Highlights

- We present a preliminary report of smartphone-based experience sample in adolescents with autism.
- Adherence was excellent and response rates were not impacted by age or IQ.
- Groups did not differ in positive affect overall or as a function of activities.
- Groups differed only in the proportion of assessments completed during restricted interests behaviors.
- Results suggest that experience sampling in autism is feasible and highly informative.

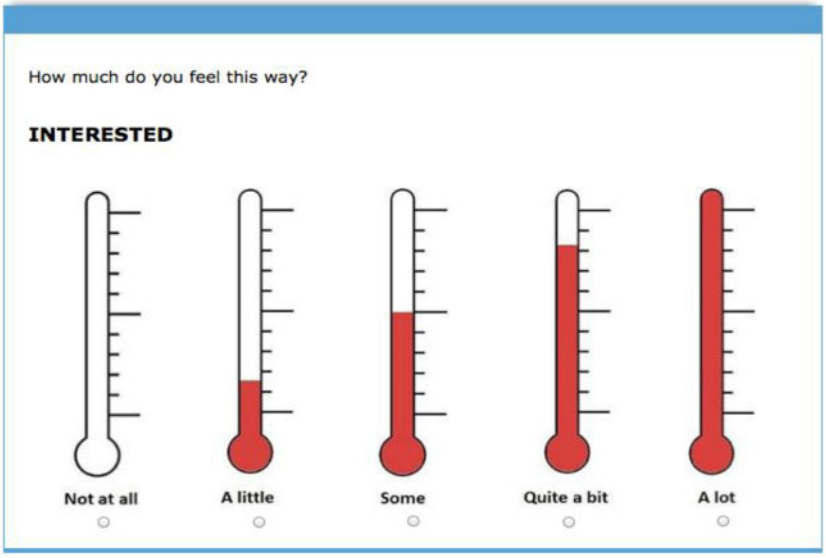

Figure 1.
Verbal anchors and visual supports used for PANAS-C items.

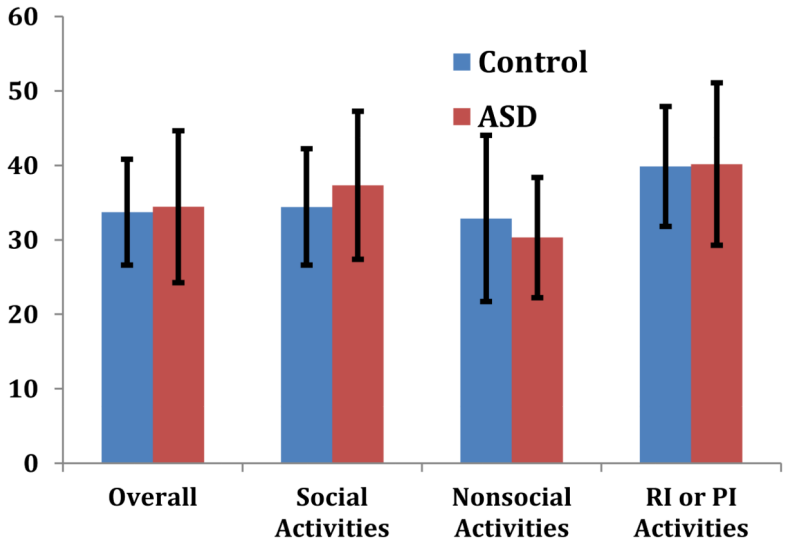

Figure 2.

Mean levels of positive affect reported by both groups overall, as well as in the context of social, nonsocial, and restricted interests (in the ASD group) or primary interests (in the control group) activities. Note that restricted interest and primary interest activities may be either social or nonsocial. Error bars represent standard errors of the mean.

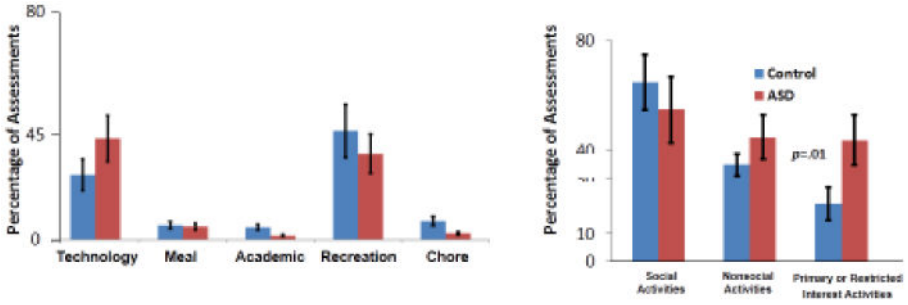

Figure 3.

Left: The percentage of time participants in both diagnostic groups reported being engaged in activities related to technology, meals, academics, recreation, and chores at the time of experience sampling data collection. **Right**: The percentage of time participants in both diagnostic groups reported being engaged in social, nonsocial and restricted interest (in the ASD group) and primary interest (in the control group) activities at the time of experience sampling data collection. Error bars represent standard errors of the mean.

Table 1
Participant Characteristics (Means and standard deviations)

	ASD (*n*=19)	Control (*n*=20)
Age	14.11 (3.3)	14.5 (2.0)
%Male	74%	80%
ADOS Total Score	13.2 (3.1)	
ADOS Calibrated Severity Score [a]	9.52 (1.81)	.
SRS Total Score [*]	76.36 (7.26)	57.7 (3.66)
RBS-R Total Score [*]	28.42 (15.38)	0.91 (1.52)
Full Scale IQ	102.21 (15.10)	109.50 (14.62)

Note.

[*] $p < .0005$.

ASD = autism spectrum disorder.

[a] Calculated from raw Autism Diagnostic Observation Schedule (ADOS) scores (Gotham et al., 2009; Hus & Lord, 2014). SRS= Social Responsiveness Scale (Constantino & Gruber, 2002), RBS-R= Repetitive Behavior Scale-Revised (Bodfish et al., 1999), IQ = Intelligence Quotient from the Kaufman Brief Intelligence Test (KBIT).