

# Emotion Regulation in Children and Adolescents With Autism Spectrum Disorder

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Emotion dysregulation is not a formal criterion for the diagnosis of autism spectrum disorder (ASD). However, parents and clinicians have long noted the importance of emotional problems in individuals with ASD (e.g. tantrums and “meltdowns”). In this study, 21 high-functioning children and adolescents with ASD and 22 age and gender group-matched typically developing (TD) controls completed a Reactivity and Regulation Situation Task. This task assesses emotional reactivity and spontaneous use of emotion regulation strategies (problem solving, cognitive reappraisal, avoidance, distraction, venting, suppression, and relaxation) in the context of age-appropriate ambiguous and potentially threatening negative scenarios. After the concept of cognitive reappraisal was explained, the scenarios were presented again to participants, and they were prompted to use this strategy. Results indicated that individuals with ASD exhibited the same level of reactivity to negative stimuli as TD participants. Furthermore, youth with ASD had a different emotion regulation profile than TD individuals, characterized by a less frequent use of cognitive reappraisal and more frequent use of suppression. When prompted to use cognitive reappraisal, participants with ASD were less able to implement reappraisal, but benefitted from this strategy when they were able to generate a reappraisal. Findings from this study suggest that cognitive reappraisal strategies may be useful to children and adolescents with ASD. Therefore, the development of treatment programs that focus on enhancing the use of adaptive forms of emotion regulation might decrease emotional problems and optimize long-term outcomes in youth with ASD. *Autism Res* 2015, 8: 9–18. © 2014 International Society for Autism Research, Wiley Periodicals, Inc.

**Keywords:** autism spectrum disorder; emotional reactivity; emotion regulation; cognitive reappraisal; suppression

## Introduction

Problematic emotional responses, such as tantrums and anger outbursts, are surprisingly common in individuals with autism spectrum disorder (ASD). Indeed, clinical reports and a few initial empirical studies provide evidence of severe impairments in emotional functioning among individuals with ASD [e.g. Laurent & Rubin, 2004; Mazefsky, Pelphrey, & Dahl, 2012; Mazefsky et al., 2013; Myles, 2003]. Interestingly, such dysfunctional emotional responses are not part of the formal definition or core features of ASD, which include deficits in social communication and interaction, as well as restricted and repetitive behaviors [American Psychiatric Association, 2013]. To better understand emotional problems in ASD, the present study was designed to examine the use and effectiveness of cognitive reappraisal, a generally adaptive emotion regulation strategy, in high-functioning chil-

dren and adolescents with ASD, compared with a group of typically developing (TD) participants.

## Research on Emotion Regulation

When individuals regulate their emotions, they are attempting to influence how they experience and/or express emotions [e.g. Gross, 1998; Gross & Thompson, 2007]. Emotion regulation abilities are crucial for optimal functioning and adaptive long-term outcomes because they enable appropriate responses in social interactions and facilitate the ability to cope with novel or changing situations and stimuli [Gross, 1998, 2007; Silk, Steinberg, & Morris, 2003].

Over the past decade, researchers have begun to characterize a number of emotion regulation strategies. These strategies differ in important ways, such as whether they influence the unfolding emotional response relatively

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early (i.e. antecedent-focused) or relatively late (i.e. response-focused) in the emotion-generative process. Cognitive reappraisal, an antecedent-focused regulation strategy, has been identified as particularly important for adaptive emotional functioning. It involves thinking about an event that has the potential to elicit an emotional response in a way that alters the event's emotional impact. Previous studies suggest that cognitive reappraisal is a strategy that is highly effective in downregulating negative emotions in TD individuals and predicts positive long-term outcomes [e.g. Bower et al., 2005; Gross, 2002]. Cognitive reappraisal has been found to be a key skill for optimizing emotional functioning [e.g. Gross & Thompson, 2007; Moore, Zoellner, & Mollenholt, 2008].

### *Emotion Dysregulation in ASD*

Problematic emotional behaviors including irritability, temper outbursts, aggression, and/or self-injurious behaviors are frequently observed in ASD [e.g. Geller, 2005; Lecavalier, Leone, & Wiltz, 2006; Lerner, Haque, Northrup, Lawer, & Bursztajn, 2012; Prizant & Laurent, 2011; Quek, Sofronoff, Sheffield, White, & Kelly, 2012]. Lecavalier et al. [2006] recently suggested that more than 60% of youth with ASD exhibit such behaviors. Additionally, individuals with ASD also experience elevated levels of anxiety and increased negative emotions [Capps, Kasari, Yirmiya, & Sigman, 1993; Joseph & Tager-Flusberg, 1997; Kasari & Sigman, 1997; Laurent & Rubin, 2004; Volkmar & Klin, 2003] that can contribute to intense feelings of distress. In combination with problematic emotional behaviors, elevated negative emotions may adversely impact daily functioning, quality of life, and long-term outcomes [see, for example, Cole & Michel, 1994; McLaughlin, Hatzenbuehler, Mennin, & Nolen-Hoeksema, 2011].

Relatively few studies have examined emotion regulation in ASD, but available evidence suggests high levels of disturbances in this domain [Jahromi, Meek, & Ober-Reynolds, 2012; Konstantareas & Stewart, 2006; Laurent & Rubin, 2004; Lecavalier et al., 2006; Lerner et al., 2012; Quek et al., 2012; Rieffe et al., 2011]. For example, studies have suggested that individuals with ASD use adaptive emotion regulation strategies, such as goal-directed behaviors or social support seeking, less effectively compared with a control group [Jahromi et al., 2012]. Instead, individuals with ASD rely on maladaptive or idiosyncratic strategies [see also Laurent & Rubin, 2004], such as avoidance and venting [Jahromi et al., 2012] or defense and crying [Konstantareas & Stewart, 2006]. In addition, eye contact avoidance in ASD has been suggested to be a coping mechanism used to avoid a heightened emotional response associated with eye contact [Dalton et al., 2005]. This is consistent with

Samson, Huber, and Gross's [2012] recent study suggesting that adults with ASD use cognitive reappraisal less frequently than their TD counterparts, but use more expressive suppression, which is considered maladaptive in the long term if it is the only available regulatory strategy. This pattern persisted even when controlling for differences in emotional reactivity and labeling.

### *The Present Study*

The goal of the present study was to gain a better understanding of emotion regulation in children and adolescents with ASD. While initial findings from a self-report study provided evidence suggesting that adults with ASD use cognitive reappraisal less frequently than TD adults [Samson et al., 2012], little is known about the use and efficacy of cognitive reappraisal in children and adolescents with ASD. Late childhood and adolescence are both critical phases for the development of emotion regulation skills. During these stages, individuals acquire a broad repertoire of emotion regulation strategies, including adaptive strategies such as problem solving and cognitive reappraisal. As development continues through these stages, the strategies acquired may be used more flexibly and may be tailored to situational requirements [Compas, Connor-Smith, Saltzman, Thomsen, & Wadsworth, 2001; Gross, 1999; McRae et al., 2012; Silvers et al., 2012].

Using the Reactivity and Regulation Situation Task [Carthy, Horesh, Apter, Edge, & Gross, 2010], we examined spontaneous and cued cognitive reappraisal in high-functioning children and adolescents with ASD and TD controls. We also measured the extent to which reappraising a potentially threatening situation yielded a reduction in levels of experienced negative emotion (reappraisal efficacy). By utilizing stimuli that resemble real-life situations in childhood and adolescence, we were able to elicit real-time emotional activation in order to provide quantitative and qualitative assessments of individual differences in emotional reactivity and regulation. We hypothesized that compared with TD participants, (a) individuals with ASD would be equally affected by the emotional stimuli. We also anticipated that participants with ASD would exhibit a different emotion regulation profile. Specifically, we predicted that relative to TD participants, individuals with ASD would (b) make less spontaneous use of cognitive reappraisal; (c) be less able to use cognitive reappraisal when prompted; and (d) be less effective at downregulating their negative emotions using cognitive reappraisal.

## **Method**

### *Participants*

Only participants able to complete the experimental procedures were included (one ASD participant was not

**Table 1. Sample Characteristics**

	ASD		TD		Statistics
	M (SD)	M (SD)	M (SD)	M (SD)	
N	21	22			
Male/female	18/3	16/6			ns. <sup>a</sup>
Age	12.71 (3.62)	13.00 (2.99)			$t(41) = -0.28$ , ns.
FSIQ	103.33 (15.33)	112.59 (11.54)			$t(41) = -2.24$ , $P < 0.05$

Notes. FSIQ, full-scale intelligence quotient; ASD, participants with autism spectrum disorder; SD, standard deviation; TD, typically developing participants.

<sup>a</sup>On the basis of a Fisher's exact test, two-tailed.

included because he could not respond to any of the questions). Twenty-one individuals with ASD and 22 individuals with TD participated in the study. Table 1 presents sample characteristics. The two groups did not differ in gender and age (age range within each group: 8–20 years), but TD participants scored higher on full-scale intelligence quotient (FSIQ) (FSIQ range for individuals with ASD: 80–129; FSIQ range for TD participants: 92–133). The sample consisted of 68.3% Caucasian, 2.4% Mexican, 9.8% Chinese, 4.9% Indian, 2.4% Southeast Asian, 7.3% other, and 4.9% declined to answer. No group difference was observed when comparing Caucasians with all other ethnicities (70% of individuals with ASD and 66.7% of TD participants were Caucasian,  $X^2(1) = 0.05$ ,  $P = 0.82$ ). For ASD participants, the diagnosis of autism was established through expert clinical evaluation (J.M.P. and A.Y.H.) based on the Diagnostic and Statistical Manual of Mental Disorders-IV-TR (DSM-IV-TR) and confirmed with the Autism Diagnostic Interview-Revised (ADI-R) and Autism Diagnostic Observation Schedule [ADOS; Lord et al., 2000; Lord, Rutter, & Le Couteur, 1994]. The ADI-R is administered to the parent and consists of 88 items that are informed by the International Classification of Diseases (ICD-10) and Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) diagnostic criteria for autistic disorder. The ADOS is a semi-structured instrument that allows assessment of children through behavioral observations during specific play, social, and language tasks [Lord et al., 2000]. Children with secondary autism related to a specific etiology (e.g. tuberous sclerosis, Fragile X) were excluded, as were potential subjects with evidence of genetic, metabolic, or infectious disorders.

TD controls were recruited through advertisements in areas that were comparable with the socioeconomic status of the ASD participants. TD participants were screened using face-to-face evaluations [Kiddie-Schedule for Affective Disorders and Schizophrenia for School-Aged Children-Present and Lifetime Version (K-SADS PL); Kaufman et al., 1997], telephone interviews, and observation during psychometric tests. The Kiddie-Schedule

for Affective Disorders and Schizophrenia for School-Aged Children (K-SADS) is a semi-structured diagnostic interview designed to assess current and past episodes of psychopathology in adolescents according to Diagnostic and Statistical Manual of Mental Disorders-III-R (DSM-III-R) and DSM-IV criteria. Exclusion of control subjects was also based on medical and psychiatric history.

Participants with a FSIQ < 70 were excluded from the study. Cognitive functioning was assessed using the Stanford-Binet, 5th edition [SB5; Roid, 2003]. This study was approved by Stanford University's Institutional Review Board. Written informed consent was obtained from parents, and assent was obtained from all participants.

#### Reactivity and Regulation Situation Task

To assess emotional reactivity and regulation in children and adolescents with and without ASD, we adapted the Reactivity and Regulation Situation Task [Carthy et al., 2010]. In this task, participants are asked to consider 16 ambiguous scenarios designed to elicit negative emotional reactions experienced in daily life. Scenarios are presented on the computer, and each scenario is one or two sentences long and written in the second person singular ("you"). Topics include family situations (e.g. "Your parents tell you they want to talk to you about something important"), social relationships and interactions (e.g. "You see a bunch of your classmates hanging out and you want to join them; when you come closer you hear them laughing"), academic performance (e.g. "Your teacher asks to see you after class"), or feeling physically uncomfortable (e.g. "You are walking down the street and a stranger approaches you"). We adapted the original task—which was developed under the supervision of one of the co-authors—in two ways. First, the task was translated from Hebrew to English by a PhD level experimenter who was bilingual and fully familiar with details of the procedures. Second, because the task was originally designed for children, a small number of scenarios were adapted for adolescents (see Appendix). This adaptation was made after some adolescents received the child version of the task (see limitation section).

The task consisted of two blocks. The first block began with two practice trials, followed by 16 real trials. For each trial, participants were instructed to read out loud a sentence and to think about the situation as though it were happening at that very moment. They were then instructed to "[d]escribe the first thought that comes into your mind." The experimenter recorded participants' initial responses. Participants were then asked to rate "[f]o what extent to you feel tense/worried?" A 1 = "not at all" to 5 = "very much" scale was used, with circles of increasing size and redness, such that 5 was represented as a large,

bright red unhappy face. Subsequently, participants were then presented with the question, "What would you do to calm yourself down?"; and again their responses were recorded verbatim.

The second block began with an explanation and examples of cognitive reappraisal. Cognitive reappraisal was introduced as an emotion regulation strategy by describing in very simple language how people are able to change their emotions by changing the way they think about what is happening or has happened to them. The words "think differently" were used instead of "cognitive reappraisal" to facilitate participants' understanding. Then, a few example scenarios were presented (e.g. "Today you are sick but that means you can stay home and do things you don't usually have time for."). The participants had the opportunity to practice "thinking differently" to decrease their anxiety and fears. Once the participant was able to verbalize his/her understanding of this process and was able to provide an example for cognitive reappraisal, he/she was instructed to implement this new strategy for each of the scenarios he/she was affected by (rating >1) during the first exposure, and in the same order as in Block One ("Can you think about this situation in a different way so that it appears less worrisome/scary?"). After each reappraisal, the participant was asked again how negative he/she felt (from 1 = "not at all" to 5 = "very much") and the same 1–5 rating scale of red circles of increasing size was presented. Participants rated their negativity following their cognitive reappraisals and *not* on their initial reaction to the situation. For those scenarios that were rated as "not at all" worrisome (i.e. rating of 1) in the first exposure, the participant was not asked to reappraise. All reappraisals and ratings were documented by the experimenter. There were two different versions of each, the child and adolescent versions, with two different randomizations of the orders in which the stimuli were presented to the participants. The duration of the task varied between 30 and 45 min.

### Data Reduction and Analysis

The Reactivity and Regulation Situation Task provides indices for emotional reactivity (average ratings, as well as percentage of how often individuals were affected by the scenarios, i.e. ratings >1), percentage of spontaneous use of different emotion regulation strategies (see categories below), percentage of using cognitive reappraisal after having been prompted (in scenarios they were affected at first exposure, i.e. rating >1), and efficacy of cognitive reappraisal (percent reduction of negative emotions after participants were able to use cued reappraisal compared with the reactivity rating of the scenarios in block 1, i.e. rating >1, this controlled for emotional reactivity during first exposure).

In order to analyze the emotion regulation strategies, qualitative analyses were conducted. These included the first thoughts and the spontaneous use of emotion regulation strategies. The statements were categorized into the following categories based on the process model of emotion regulation [Gross, 1998, 2007], the paper by Carthy et al. [2010], and initial attempts to categorize the types of spontaneous emotion regulation strategies: (a) avoidance (e.g. "I will run away," "I will not go there"); (b) problem solving (e.g. "I will call my mom and tell her I'm not well"); (c) distraction (e.g. "I distract my mind with animals and books"); (d) cognitive reappraisal (e.g. "I convince myself that she is fine," "I think differently about it"); (e) suppression (e.g. "I hold it in"); (f) venting (e.g. "I will cry"); (g) relaxation (e.g. "I am taking a deep breath"); (h) no regulation ("I just wait," "I don't know what to do"); and (i) not codeable (if the participant's response was unclear or unrelated to the question or situation). In the rare situations a participant mentioning two different strategies, the first one was taken into account for the coding.

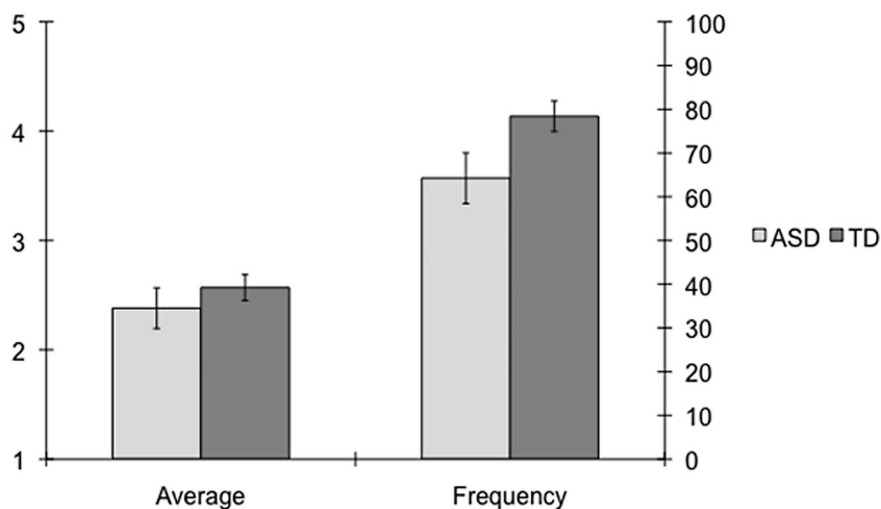
Scoring was done by two raters who were blind to the participant's diagnosis, age, and gender. One rater coded all the participant's comments, while the second rater coded those of 20 participants that were randomly chosen to compute inter-rater reliability. Disagreements were resolved by discussion, which resulted in a final score used for analyses. The average inter-rater reliability for all categories was satisfactory (Cohens Kappa,  $\kappa = 0.83$ , ranging from 0.69 to 1.00).

Given differences in FSIQ between groups, we used analysis of covariances (ANCOVAs) with FSIQ as a covariate to test for group differences in emotional reactivity (average ratings, average frequency of being affected by the scenarios), as well as in the use and efficacy of cued cognitive reappraisal. A repeated measures ANCOVA with FSIQ as a covariate was used to test for group differences in the spontaneous use of different strategies between ASD and TD participants (i.e. emotion regulation profile). Finally, all the analyses were conducted with emotional reactivity as an additional covariate to control for uninstructed emotional reactivity at first exposure (except of the efficacy of cued reappraisal because this index already controlled for reactivity).

## Results

### Preliminary Analyses

Analyses of gender, age, and FSIQ revealed that these factors did not interact with group, except for a group  $\times$  gender effect for "not codeable" ( $F(1, 40) = 5.77$ ,  $P < 0.05$ ), and a group  $\times$  FSIQ effect on the use of spontaneous reappraisal ( $F(1, 40) = 6.42$ ,  $P < 0.05$ ). Because we found few effects for gender and age, only FSIQ was included as a covariate in primary analyses given the



**Figure 1.** Intensity of emotional reactivity and frequency of scenarios with >1 intensity ratings in autism spectrum disorder (ASD) and typically developing (TD) participants. Average emotional reactivity based on negativity ratings (from 1 = “not at all” to 5 = “very much”). Average frequency in percent of being affected = ratings >1 out of 16 scenarios.

observed group effect for this variable. The two orders and versions of the task did not have an effect on the reactivity and regulation variables. The age of the children that were presented the child version ( $n = 30$ ) was on average 11.87 (standard deviations ( $SD$ ) = 2.98). The age of participants that were presented the the adolescent version ( $n = 13$ ) was on average 15.15 ( $SD = 2.82$ ). None of the variables (except age:  $F(1, 42) = 11.38, P < 0.01$ ) differed across the two versions.

In order to assess whether the use of language was different in the two groups, verbosity was analyzed. Word frequency for the first and second block of the experiment was taken into account for group comparisons. In the first block, individuals with ASD used 176.48 ( $SD = 67.05$ ) words on average, while TD participants used 189.90 ( $SD = 40.00$ ) words. The groups did not differ significantly ( $F(1,42) = .64, P = 0.43$ ). In the second block, individuals with ASD used significantly less words ( $M = 89.62, SD = 46.68$ ) than TD participants ( $M = 126.91, SD = 49.60, F(1,42) = 6.41, P = 0.015$ ). However, after correcting for the number of scenarios in which the participants were affected, the groups did not differ anymore because the participants were instructed to reappraise only when he or she was affected at the first exposure to the scenario ( $M_{ASD} = 10.21, SD = 5.92, M_{TD} = 9.98, SD = 2.70, F(1,42) = .03, P = 0.87$ ).

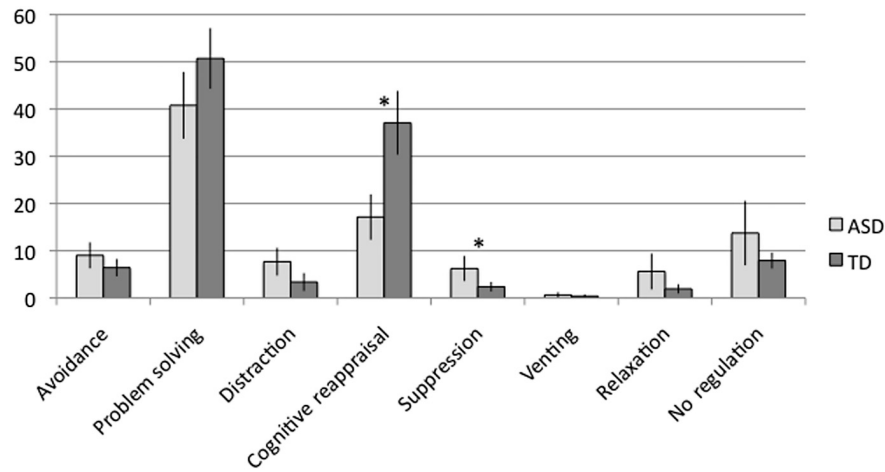
#### Group Differences in Emotional Reactivity

Average ratings over the 16 scenarios were computed, as well as how frequently the participants indicated that they were affected by rating the scenarios higher than 1. Using FSIQ as a covariate, individuals with ASD ( $M = 2.38, SD = 0.79$ ) did not differ in the average nega-

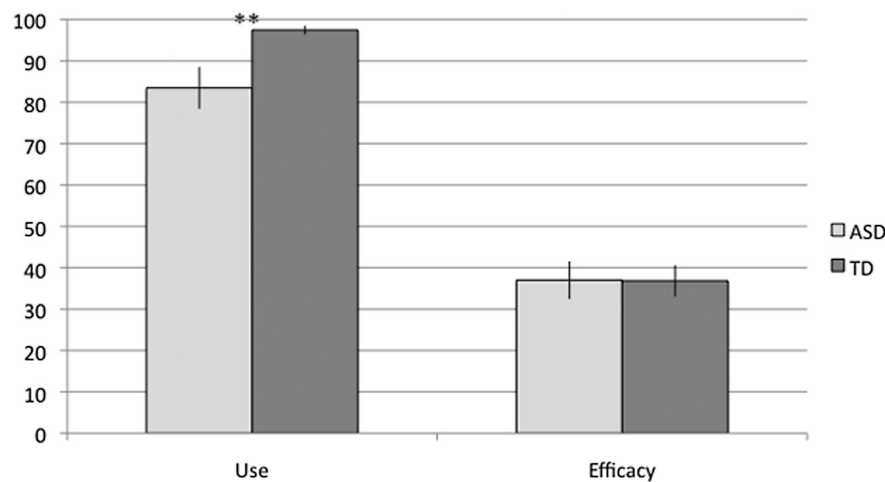
tive emotional reactivity compared with TD participants ( $M = 2.57, SD = .55; F(2, 37) = 2.00$ , non significant, *ns.*). In addition, individuals with ASD ( $M = 64.24, SD = 24.61$ ) did not differ on how frequently they were affected by the scenarios (i.e. rated the scenario >1) compared with TD participants ( $M = 78.41, SD = 16.33; F(2, 37) = 2.67, ns.$ , see Fig. 1).

#### Group Differences in Spontaneous Emotion Regulation

To assess group differences in spontaneous emotion regulation, average percentages in the use of each regulation strategy were calculated for scenarios in which the participants were emotionally affected. The 2 (group)  $\times$  8 (strategy) repeated measures ANOVA with FSIQ as covariate yielded a significant interaction effect ( $F(7,280) = 2.20, P < 0.05$ ). As shown in Figure 2, follow-up ANCOVAs with FSIQ as a covariate revealed that ASD participants used less cognitive reappraisal ( $M_{ASD} = 17.14\%, SD = 20.47; M_{TD} = 37.10\%, SD = 31.71; F(2,39) = 4.01, P < 0.05$ ), but more suppression ( $M_{ASD} = 6.24\%, SD = 11.28; M_{TD} = 2.39\%, SD = 4.76; F(2,39) = 3.78, P < 0.05$ ) compared with TD participants. Furthermore, ASD participants displayed “not codeable” responses more frequently than TD ( $M_{ASD} = 11.66\%, SD = 11.11; M_{TD} = 2.67\%, SD = 4.75; F(2,37) = 7.03, P < 0.01$ ). The other strategies yielded no significant differences (avoidance ( $M_{ASD} = 9.04\%, SD = 11.70; M_{TD} = 6.43\%, SD = 8.63$ ); problem solving ( $M_{ASD} = 40.80\%, SD = 30.00; M_{TD} = 50.72\%, SD = 30.08$ ); distraction ( $M_{ASD} = 7.69\%, SD = 12.46; M_{TD} = 3.38\%, SD = 8.90$ ); venting ( $M_{ASD} = 0.62\%, SD = 2.62; M_{TD} = 0.38\%, SD = 1.78$ ); relaxation ( $M_{ASD} = 5.63\%, SD = 16.16; M_{TD} = 1.93\%, SD = 4.58$ ); no regulation ( $M_{ASD} = 13.75\%, SD = 11.09; M_{TD} = 7.93\%, SD = 7.90$ ).



**Figure 2.** Spontaneous use of emotion regulation for autism spectrum disorder (ASD) and typically developing (TD) participants (in percent). \* $P < 0.05$ .



**Figure 3.** Use and efficacy of cued cognitive reappraisal in autism spectrum disorder (ASD) and typically developing (TD) participants. Use = percentage of times participants were able to generate cognitive reappraisals for scenarios that were rated  $>1$  during first exposure. Efficacy = percent reduction of negative emotions after participants were able to use cued reappraisal (difference scores between first and second exposure for scenarios in which participants were affected, i.e. that were rated  $>1$ ). \*\* $P < 0.01$ .

Additional analyses revealed that these effects were evident even if emotional reactivity was included as an additional covariate. The interaction of group  $\times$  strategy ( $F(7,273) = 2.28, P < 0.05$ ), and group differences in reappraisal ( $F(3,42) = 4.75, P < 0.01$ ) suppression ( $F(3,42) = 3.37, P < 0.05$ ) as well as the noncodeable responses ( $F(3,42) = 6.04, P < 0.01$ ) were still significant even controlling for emotional reactivity in block 1.

#### Group Differences in the Use and Efficacy of Cued Reappraisal

ASD participants were able to come up with a reappraisal strategy in fewer of the scenarios than TD participants, as revealed by an ANCOVA with FSIQ as a covariate

( $M_{ASD} = 83.47\%$ ,  $SD = 21.48$ ;  $M_{TD} = 97.47\%$ ,  $SD = 4.89$ ,  $F(2,40) = 5.50, P < 0.01$ ). However, if the participants were able to generate a cognitive reappraisal, individuals with ASD and TD equally benefitted from this strategy ( $M_{ASD} = 36.99\%$ ,  $SD = 19.41$ ;  $M_{TD} = 36.84$ ,  $SD = 17.76$ ;  $F(2,40) = .22, ns.$ , see Fig. 3). Furthermore, when emotional reactivity was included as an additional covariate, the two groups still differed significantly in cued reappraisal ( $F(3,39) = 3.85, P < 0.05$ ).

#### Discussion

In this study, we found significant differences in the spontaneous emotion regulation profile of high-functioning

children and adolescents with ASD, compared with TD participants, as reflected in the less frequent use of cognitive reappraisal, but more frequent use of suppression. Moreover, individuals with ASD had greater difficulty generating cognitive reappraisals, even after being prompted to use this strategy. We had expected individuals with ASD to be less effective in downregulating their emotions when implementing cognitive reappraisal. However, compared with TD participants, they seemed to benefit from cognitive reappraisal to a similar extent when able to implement this strategy. These findings underline crucial differences in the cognitive reappraisal ability of ASD vs. TD participants, even when controlling for uninstructed emotional reactivity, and dovetail nicely with previous self-report findings in adults [Samson et al., 2012].

#### *Explaining Differences in Emotional Reactivity and Regulation*

One noteworthy feature of our findings is that individuals with ASD were affected by the emotion-eliciting scenarios to the same degree as TD participants. This might seem puzzling given that it is often reported that individuals with ASD have increased levels of negative affect [Capps et al., 1993; Joseph & Tager-Flusberg, 1997; Kasari & Sigman, 1997; Samson et al., 2012]. While the scenarios implemented in the present study were previously used and validated [Carthy et al., 2010], it might be possible to induce even stronger emotional reactions in individuals with ASD if the stimulus materials were tailored to the individual's specific negative emotional triggers. Frequently, situations that are novel, difficult to anticipate, and involving unexpected changes (e.g. going to unfamiliar places, meeting unfamiliar people) seem to induce strong negative emotions in individuals with ASD.

Why might individuals with ASD have more difficulty than TD in *generating* cognitive reappraisal strategies? This might be related to a decreased ability to describe and identify emotions and decreased insight into more complex emotional processes [i.e. alexithymia; Capps, Yirmiya, & Sigman, 1992; Losh & Capps, 2006], as well as the tendency to perseverate, which was recently studied in relation to emotion dysregulation [Mazefsky et al., 2012]. Difficulty in interrupting or inhibiting maladaptive behaviors and negative emotions in ASD might also increase the tendency to exhibit exaggerated negative emotions and associated behaviors [Mazefsky et al., 2012]. However, in prior work, differences in alexithymia [i.e. difficulty to identify and describe own emotions, see Berthoz & Hill, 2005] did not fully explain differences in cognitive reappraisal [Samson et al., 2012]. Therefore, other impaired processes in ASD, such as cognitive linguistic processes [e.g. Losh & Capps, 2006], executive functions/cognitive flexibility/imagination ability [e.g.

Jahromi, Bryce, & Swanson, 2013], or perspective taking/theory of mind [Samson et al., 2012] might also hamper the successful generation of cognitive reappraisals.

#### *Treatment Implications*

It is striking that individuals with ASD, similar to neurotypicals, derive benefits when they are capable of generating a cognitive reappraisal strategy. This finding has important implications for the development of new interventions for ASD. It can also be seen as a confirmation of several treatment programs that target "metacognitive" emotion regulation strategies [Social Communication, Emotional Regulation, and Transactional Support, SCERTS model, Prizant, Wetherby, Rubin, Laurent, & Rydell, 2006] or "thinking tools" that are trained to improve modification of maladaptive thinking [see Scarpa & Reyes, 2011; Sofronoff, Attwood, Hinton, & Levin, 2007]. Although the participants with ASD demonstrated deficiencies in generating cognitive reappraisals, our results suggest that they are able to improve their generation of adaptive emotion regulation strategies. After being prompted to use cognitive reappraisals, ASD participants were able to increase the number of reappraisals used in response to the emotion eliciting stimuli (although to a limited extent, compared with TD participants). These observations are very informative because, if replicated, they might be seen as a key component of treatment programs that aim to improve emotion regulation in individuals with ASD [e.g. Scarpa & Reyes, 2011; Sofronoff et al., 2007].

Interestingly, previous research has suggested that the ability to generate cognitive reappraisal strategies may be linked to perspective taking abilities, executive functioning, and cognitive linguistic abilities [e.g. Jahromi et al., 2013; Losh & Capps, 2006; Samson et al., 2012]. This association is critical because it means that interventions that are developed to target cognitive reappraisal may have the additional benefit of improving emotion regulation abilities among individuals with ASD as well as providing potential benefits in other domains such as social interaction and communications. This is particularly important in light of the limited availability of effective interventions to target emotional disturbances and consequently core features of ASD because existing psychotropic medications, such as atypical antipsychotics, lead to considerable side effects and have limited effects on social and communication impairments [Doyle & McDougle, 2012; Polite & McDougle, 2014].

#### *Limitations and Future Directions*

Our findings shed important new light on the ability of individuals with ASD to use and benefit from cognitive reappraisal. However, there were several limitations in the current study that are important to note.

First, the present study used written hypothetical scenarios to induce negative emotions. Although this is a well validated set of stimuli previously used in clinical contexts [Carthy et al., 2010], this task has certain limitations. Because this task involves reading and language, as well as perspective taking abilities, it might be difficult for some individuals with ASD to picture themselves in the situations described in the scenarios. Additionally, some reports suggest that individuals with ASD tend to think in pictures rather than in words [e.g. Grandin, 1995], which may have impacted the accessibility of the written scenarios. While verbosity did not differ by group, future studies should use material that can be processed via other sensory channels, such as visual material. Additionally, future studies should focus on emotion regulation strategies that require fewer language abilities. Using language-independent stimuli and regulation strategies may also allow researchers to examine emotion regulation in lower-functioning individuals with ASD. In general, the conclusions drawn from this study may not be generalizable to lower-functioning children and adolescents with ASD.

A second important limitation is that the dependent measures were all self-report measures. It is true that these measures were obtained in the content of an engaging emotion-eliciting task. However, future studies on emotion dysregulation should include more objective measures, such as autonomic and brain measures. This could be done using autonomic psychophysiology or functional magnetic resonance imaging.

A third limitation is the absence of a control task. This limits our ability to draw strong conclusions as to whether the deficits we observed in ASD participants were specific to emotion regulation per se. In future studies, it might be helpful to include a control task that is comparable in difficulty with cognitive reappraisal, but not related to emotions. A control condition also might help assess effects of habituation (e.g. a condition in which participants would not have been instructed to reappraise but just rate emotional stimuli during a second exposure). Because most of our participants were able to reappraise during a second exposure to the stimulus, we were not able to address the impact—if any—of habituation.

A fourth limitation is that we introduced the adolescent version of the task—which differs from the child version only in three scenarios—only after we had already run some adolescents with the child version. Although on average, the two groups differ in their age; in both groups, the age range is 8–20 years.

A fifth limitation is that although we controlled for cognitive functioning (FSIQ), the present study did not link difficulties in emotion regulation to core features of autism, such as social and communication difficulties, repetitive behaviors, or sensory sensitivities. Previous research has provided some evidence for a link between

emotion regulation difficulties and social competences [i.e. prosocial peer engagement, see Jahromi et al., 2013]. In addition, other studies discuss possible associations with perseveration [Mazefsky et al., 2012] or perspective taking abilities and theory of mind [Samson et al., 2012]. Future studies with a larger sample size are required to examine the associations between emotion dysregulation and core features, as well as potential causal links.

These limitations, notwithstanding the present study, help to clarify the emotion regulation profiles of individuals with ASD. Our focus here was primarily on cognitive reappraisal, and future tasks should broaden the focus to other emotion regulation strategies that might be beneficial for individuals with ASD. It is crucial to learn more about how individuals with ASD implement and benefit from other emotion regulation strategies, such as problem solving or cognitive distraction. This has particular relevance for less cognitively challenging strategies that may be used by lower-functioning individuals with ASD.

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## Appendix

### Scenarios

*Items that were adapted for adolescents are in parentheses.*

1. Your mom tells you that she needs to go to the doctor for a checkup.
2. On the way to school, your stomach starts to feel weird.
3. You are walking in the street and a car slows down next to you.
4. Your parents are about to go out to an event in the city. (You are about to go study abroad for 6 months).
5. You see a bunch of your classmates playing and you want to join them. When you come closer, you hear them laughing.
6. Your mom was supposed to be home, but she is late. (Your boyfriend/girlfriend was supposed to call you but he/she did not).
7. Your teacher asks to see you after class.
8. You enter a store and the employee stares at you.
9. Your father tells you unexpectedly that he has to travel out of the country tomorrow.
10. You hear a knock on the door and when you open it, you see a person you do not know.
11. You are in a group. People are introducing themselves, and now it is your turn to introduce yourself.
12. Your teacher returns a test and says that your score was surprising.
13. Your parents tell you they want to talk to you about something important.
14. You just got a test and you start reading the questions.
15. You wake up at night and hear a noise in the hallway.
16. You are about to go out somewhere with a lot of people. (You are about to go out somewhere with a lot of people you just met).