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Cognitive defusion for reducing distressing thoughts in adults with autism

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ABSTRACT

Background: Cognitive fusion occurs when people over-identify with their thoughts, leading to a strong emotional response and a narrowed behavioral repertoire. Cognitive defusion (CD) is a technique used in acceptance and commitment therapy (ACT) to teach people how to pay attention to the process of thinking, thereby reducing the negative effect of over-identification and allowing people to behave in more adaptive ways. CD has been widely studied in neurotypical (NT) samples, but there is little research on cognitive fusion and related interventions for people diagnosed with autism (AS).

Method: Sixty-eight adult participants (AS group $n = 27$; NT group $n = 41$) answered questionnaires measuring psychological distress and dispositional levels of cognitive fusion. In a lab setting, participants next identified a personal distressing thought, then were randomized into a brief (5-minute) cognitive defusion technique or an equally-brief active distraction technique. Before and after the intervention, participants completed measures assessing the believability of their distressing thought and how much discomfort the thought caused.

Results: The AS group reported higher overall trait levels of cognitive fusion than the NT group. Cognitive fusion was moderately- to strongly-related with psychological distress in both participant groups. The brief interventions worked equally well in immediately reducing thought believability and thought discomfort for AS and NT groups.

Conclusions: The current study provides support for cognitive fusion as a contributing factor to the psychological distress experienced by people with AS, and that a brief intervention technique can effectively reduce fusion at least in an immediate context. More work is needed to explore the specific short-term and long-term efficacy for interventions aimed to reduce cognitive fusion.

1. Introduction

Adults diagnosed with autism (AS) experience elevated levels of psychiatric concern, and there is an urgent need to discover or adapt effective interventions for reducing cognitive and emotional distress (Buck et al., 2014; Joshi et al., 2013; Lugnegård, Hallerbäck, & Gillberg, 2011). In particular, adults with autism are frequently affected by high levels of inflexibility and rigidity, which are related to core symptoms of autism such an insistence on sameness and restricted/repetitive behaviors (RRBs), and also to associated symptoms of anxiety (Boulter, Freeston, South, & Rodgers, 2014; Rodgers, Glod, Connolly, & McConachie, 2012; Wigham, Rodgers, South, McConachie, & Freeston, 2015). Treatment approaches that directly address inflexibility may be especially helpful

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for adults with autism (Mazefsky & White, 2014; Rodgers, Herrema, Honey, & Freeston, 2018).

Mindfulness and acceptance based interventions (MABIs) have been quickly gaining traction as effective and empirically supported transdiagnostic treatments for depression, anxiety, and other psychiatric concerns (A-Tjak et al., 2015; Kuyken et al., 2015; Vøllestad, Nielsen, & Nielsen, 2012). Theoretically, MABIs train explicit skills which encourage simple observation and increased tolerance of uncomfortable rigid thoughts and behaviors, rather than trying to change them; and encourage more adaptive, flexible behavioral responses. Two widely used MABIS are Mindfulness Based Stress Reduction (MBSR; Kabat-Zinn, 1990) and Mindfulness Based Cognitive Therapy (MBCT; Williams, Teasdale, Segal, & Kabat-Zinn, 2007), both of which are often, but not necessarily, conducted in a group format and utilize various structured exercises. While there is much overlap between these two intervention packages, MBSR was originally developed for chronic illness and stress and emphasizes nonjudgmental awareness of the body (e.g. body scan, mindful yoga). MBCT was originally developed to treat depression and prevent relapse, and interventions tend to focus on assisting people in coping with dysfunctional cognitions. There is a small but growing body of literature showing that modified MBSR and MBCT interventions are both feasible and helpful in treating anxiety and mood disorders in AS samples (de Bruin, Blom, Smit, van Steensel, & Bogels, 2015; Kiep, Spek, & Hoeben, 2014; Sizoo & Kuiper, 2017; Spek, van Ham, & Nyklíček, 2013).

Acceptance and commitment therapy (ACT; Hayes, Strosahl, & Wilson, 2011) is a transdiagnostic MABI used in group or individual therapy aimed specifically at increasing psychological flexibility, or the ability to effectively change or persist in one's behavior in the service of living a meaningful life and accomplishing one's goals. Unlike other MABIS, the aim of ACT is not symptom improvement per say. Rather, ACT assists people in recognizing the negative effects of avoidance in their life, while providing tools to make meaningful life changes (e.g. identification of and commitment to one's values). There has been one study exploring the use of ACT for people with AS. Pahnke, Lundgren, Hursti, and Hirvikoski, (2014) conducted a pilot study examining a six-week ACT skills training group with teens and young adults administered as part of a weekly classroom curriculum compared to a wait-list control. At post-test, both teacher and self-report measures showed that students in the ACT group displayed significantly lower stress, hyperactivity, and emotional distress. Further, student self-report showed an increase in behaviors which were considered pro-social. Moreover, results were maintained at a two-month follow-up. Importantly, students had overall high satisfaction with the ACT treatment, with 93% reporting "high or very high" satisfaction (Pahnke et al., 2014).

Relational Frame Theory (RFT) is an evidence-based theory of cognition and language that underlies ACT. RFT researchers highlight the unique human ability to learn how to relate to any concept or idea in arbitrary ways (even if one has no direct experience with that stimuli). Furthermore, when people learn to associate two or more concepts (e.g., learning that a "cat" is a type of "animal"), we can learn novel responses to those concepts without ever having directly experienced them (this is called arbitrarily derived stimulus responses). For example, if a child develops a fear of dogs after being bitten, and the same child is later told that a "cat" is similar to a "dog" (i.e. both being house pets), the child may become scared of cats without ever having had direct experience with a cat. While this type of associative learning serves important survival functions, over-identification with these learned associations (coined "Cognitive Fusion" in ACT), can also lead to an unnecessarily narrowed behavioral repertoire (e.g., avoidance of all cats) and heightened distress (Blackledge, 2015; Törneke, Barnes-Holmes, & Hayes, 2010). In fact, empirical evidence from work with neurotypical samples has strongly associated greater cognitive fusion with increased psychological distress and behavioral inflexibility (Bardeen & Fergus, 2016; Berghoff, Forsyth, Ritzert, & Sheppard, 2014; Fergus, 2015; Gillanders et al., 2014; Herzberg et al., 2012).

ACT's answer to cognitive fusion is teaching people cognitive *defusion* (CD) skills (Hayes et al., 2011). At its core, CD aims to reduce the impact of these arbitrarily derived stimulus functions by teaching people to challenge conventions of language in order to relate to their thoughts in less rigid ways. From a RFT perspective, people can learn strategies to recognize times when they are over-identifying with thoughts that restrict their behavior, thereby increasing their behavioral repetoire and allowing them to choose more helpful behaviors (Blackledge, 2015). CD has been shown to be one psychologically active component of ACT (Levin, Hildebrandt, Lillis, & Hayes, 2012). The most widely studied CD intervention is semantic satiation, first proposed by Titchener (1916) and often referred to as "Titchener's repetition." Semantic satiation involves a person saying a painful or distressing thought out loud, repeatedly, as quickly as possible. Eventually, the meaning associated with the thought is lost, and people begin to learn that they attach arbitrary meaning to their thoughts.

Some of the strongest research supporting semantic satiation as an effective defusion strategy comes from a series of studies conducted by Masuda, Hayes, Sackett, and Twohig, 2004, 2009, Masuda, Feinstein, Wendell, & Sheehan, 2010; Masuda, Twohig et al., 2010). In the first study, Masuda et al. (2004) had participants come up with two negative self-referential thoughts and turn them into single words (e.g., "fat"). The participants then rated the thoughts on a scale of 0–100 regarding the amount of emotional discomfort the words cause them, and separately regarding the believability of the words. Using an alternating treatment design, the investigators found that the semantic satiation exercise was more successful in reducing thought believability and emotional discomfort than a distraction group and a thought control group. A parametric analysis to determine the "dose" of semantic satiation suggested two distinct processes that occur at different times: emotional discomfort begins diminishing between 3 and 10 s after the beginning of a satiation exercises, and thought believability diminishes between 20 and 30 s after starting (Masuda et al., 2009). These results have been replicated multiple times using group design studies, where semantic satiation has been shown to effectively alleviate emotional discomfort and believability of fearful or distressing thoughts compared to active and inactive control groups (Deacon, Fawzy, Lickel, & Wolitzky-Taylor, 2011; Mandavia et al., 2015; Masuda, Feinstein et al., 2010; Masuda, Twohig et al., 2010; Ritzert, Forsyth, Berghoff, Barnes-Holmes, & Nicholson, 2015). Deacon et al. (2011) provided evidence that a semantic satiation exercise was as effective in reducing distress and believability as a cognitive restructuring technique, which is a well-established cognitive behavioral therapy (CBT) treatment for distressing thoughts. They also found that positive effects persisted at a 1-week follow-up.

It has yet to be determined to what extent people with AS are fused with their thoughts, but frequent rigidity in AS could be related to a tendency for people to believe their thoughts to a much greater degree than neurotypical people. If this were the case,

cognitive fusion would lead them to react aversively to distressing thoughts, which would engender increased anxiety and an urge to behave in restricted and repetitive ways to cope with the anxiety. Preliminary evidence for this can be seen in a recent study showing that non-acceptance of internal experience (including thoughts and feelings), in addition to alexithymia (inability to describe emotions), largely mediated the relationship between autism symptoms and anxiety (Maisel et al., 2016). If people with AS tend to be more fused with their cognitions, defusion could be especially helpful in treating comorbid distress. In fact, a recent study utilizing two defusion techniques in verbal children diagnosed with AS suggested that, when combined with exposure therapy, defusion is quite helpful in reducing RRBs and other problematic behaviors (Eilers & Hayes, 2015). To date, however, there has been little other research concerning the use of defusion in AS samples. Our goals for this study were to understand the extent of cognitive fusion in AS, and the relationship between cognitive fusion and symptoms of emotional/cognitive distress; and to examine the effectiveness of a brief cognitive defusion exercise alongside another active distraction condition.

1.1. Study aims

1) Characterize the relationship between cognitive fusion (increased believability and taking thoughts literally) and psychiatric concerns in adults with AS. We hypothesize similar or stronger associations between cognitive fusion and anxiety, depression and stress in the AS compared to the NT group.
2) Compare the effectiveness and feasibility of two very brief interventions for reducing cognitive fusion in AS and NT participants. While both techniques have shown efficacy in previous studies with neurotypical samples, we hypothesize an interaction in that the cognitive defusion condition will be more effective than distraction for the AS group.

2. Methods

2.1. Participants

Participants were 17 years or older. IQ for all participants was in the average range or above (> 80) as measured by the Wechsler Abbreviated Scale of Intelligence, 2nd Edition (WASI-2; Wechsler, 2011). Participants in the AS group were recruited from existing research databases, referrals from a university counseling center, and flyers posted at a local intensive services program for adults with developmental disabilities. Diagnosis of AS according to DSM-5 criteria was made a clinician (author MS), who has been trained to research reliability in the Autism Diagnostic Observation Schedule, 2nd Edition (ADOS-2: Lord et al., 2012). All AS participants scored above autism spectrum cut-off scores on the ADOS, which was administered by MS or doctoral graduate students who have been trained in the ADOS and were closely supervised by MS. Participants in the NT group were university students recruited from an online system for course credit who reported no history of psychiatric or developmental disorders.

2.2. Measures

The *Depression Anxiety and Stress Scale-21* (DASS-21; P.F. Lovibond & Lovibond, 1995,1995b) is a 21-item Likert-type questionnaire with separate 7-item scales designed to discriminate between the constructs of depression, anxiety, and negative affect/stress. The DASS-21 and its subscales have consistently been shown to have excellent psychometric properties including high Cronbach's alpha scores, excellent discriminant and convergent validity, good test-retest reliability, and a valid three-factor structure (Antony, Bieling, Cox, Enns, & Swinson, 1998; Brown, Chorpita, Korotitsch, & Barlow, 1997; Clara, Cox, & Enns, 2001; Crawford & Henry, 2003; Lovibond, 1998; P.F. Lovibond & Lovibond, 1995,1995b; Norton, 2007). In the current study, Cronbach's alpha was .88 for the AS group and .89 for the NT group.

The *Autism Spectrum Quotient* (AQ; Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001) is a widely used, 50–item questionnaire with good psychometric properties that asks participants to indicate the extent to which they can identify with statements describing behaviors and attitudes that reflect core facets of the AS phenotype. In the current study, Cronbach's alpha was .89 for the AS group and .80 for the NT group.

The *Cognitive Fusion Questionnaire* (CFQ; Gillanders et al., 2014) was developed as a broad measure of cognitive fusion. It assesses cognitive fusion as a unidimensional construct where higher scores represent more cognitive fusion and lower scores represent less cognitive fusion. The CFQ has good psychometric properties within neurotypical samples, with a 4-week test-retest reliability of $r = .81$ in a community sample, excellent internal consistency (ranging from .88 to .93 in samples), convergent validity, and divergent validity (i.e., no significant correlation with socially desirable responding), Solé et al. (2015) found that a Catalan version of the CFQ maintained a one-factor solution and good psychometric capabilities in an adolescent sample, and the authors noted how the simplicity and brevity of the CFQ was a major strength which allowed it to be translated to this younger sample. In the current study Cronbach's alpha was .88 for the AS group and .84 for the NT group.

The *Believability of Anxious Feelings and Thoughts Questionnaire* (BAFT: Herzberg et al., 2012) was developed as a more distinct measure of cognitive fusion specifically concerning anxiety provoking thoughts. The BAFT was developed and validated on both a healthy college sample and a clinically anxious community sample. The BAFT was developed and validated on both a healthy college sample and a clinically anxious community sample. For both samples it showed strong internal consistency, excellent convergent validity, sensitivity to treatment effects, incremental validity in predicting anxiety sensitivity, and an acceptable 12-week test-retest reliability ($r = .77$). Moreover, the BAFT total score was supported by confirmatory factor analyses in both samples (Herzberg et al., 2012). In the current study, Cronbach's alpha was .90 for the AS group and .92 for the NT group.

Subjective Measures: To assess subjective thought believability and discomfort, participants were shown a Visual Analogue Scale

from 0 to 100 before and after the intervention (Supplemental Data, Fig. 1). While this approach has been commonly used in similar defusion studies, no psychometric data has been reported (Deacon et al., 2011; Mandavia et al., 2015; Masuda, Feinstein et al., 2010; Masuda, Twohig et al., 2010; Ritzert et al., 2015). In the current study, Cronbach's alpha for believability was .77 for AS and .79 for NT, and for discomfort was .62 for AS and .69 for NT. At the end of the study we also collected subjective feasibility ratings from participants, where they completed a 7-point Likert-scale (ranging from "Strongly Disagree" to "Strongly Agree") about the intervention's perceived effectiveness, ease of use, understandability, and the likelihood they will use it again. It is important to interpret these findings with caution, as this has not been a psychometrically validated measure.

2.3. Procedure

This study was designed to compare a *cognitive defusion* technique to an *active neutral distraction* technique, an evidence-based technique which involves direct instruction of a participant to distract themselves with a neutral (i.e. neither positive nor negative) stimulus. This study obtained ethical approval from the university Institutional Review Board (IRB) in line with principles of the Declaration of Helsinki. Signed informed consent was provided by all participants. All scripts, and examples of rating scales, are available in the Supplemental Data that accompanies this manuscript.

Participants completed the online questionnaire battery while visiting the lab during data collection as part of a larger study. Once questionnaires were completed, participants engaged in the intervention portion of the study. The *thought identification*, *thought rating*, and *defusion* procedures closely followed those outlined in the defusion studies by Masuda et al. (2004), 2009, Masuda, Feinstein et al., 2010; Masuda, Twohig et al., 2010) and Deacon et al. (2011). The *distraction* condition was based off procedures outlined in previous emotion regulation research (Gross, 2015; Mandavia et al., 2015; Webb, Miles, & Sheeran, 2012).

Participants, regardless of condition, first engaged in the *thought identification* process. They were given a handout of 15 common distressing thoughts as visual examples, then instructed to come up with a highly distressing or anxiety provoking thought which they often experience (e.g., "I am ugly"). Participants entered their chosen specific thought into the computer in front of them, then were instructed to re-state the thought as a one word summary (e.g. "ugly") and also enter this one-word thought into the computer. Finally, they were asked to rate their full thought based on how *believable* it was and how much *discomfort* it causes them in the moment, using a 100-mm Likert-style visual analogue scale (VAS) also presented on the computer.

Participants were randomized into either the *defusion* (Def) or *distraction* (Dis) condition. Similar to extant semantic satiation research, both conditions were designed to take the same amount of time (approximately 5 min) and both included the use of the word "milk" as the primary training tool for the intervention. The Def and Dis conditions likewise had the same structure and the same order of components (i.e., pre-intervention thought rating phase, rationale, practice phase, intervention phase, post-intervention thought rating phase). The following two sections outline the two conditions in more detail.

2.3.1. Defusion condition

Participants were first educated that thoughts cause anxiety and distress when people allow themselves to believe a thought is literally true. The importance of stepping back and seeing realistic thoughts as "simply thoughts" was emphasized. Next, participants were instructed to say the word "milk" out loud and to note the various perceptual qualities which emerge (e.g., "cold," "creamy," "white"). To practice, participants were instructed to repeat the word "milk" out-loud, repeatedly, as quickly as possible for 30 seconds along with the experimenter, and to "notice what happens." After 10 and 20 s the experimenter instructed them to speak "louder" and "faster." After briefly describing their experience with the exercise, participants were informed that this skill can be used for reducing distressing thoughts and were reminded of their previously-identified, one-word distressing thought. Participants then repeated the satiation exercise with their targeted thought for 30 s, again being reminded to speak "louder" and "faster" after 10 and 20 s.

2.3.2. Thought distraction condition

Participants were first read a rationale explaining that thoughts are the cause of behaviors and feelings, and that becoming overwhelmed by negative thoughts is at the root of suffering. It was suggested that an effective way to stop this suffering is by distracting oneself away from their negative thoughts and onto something less threatening. Next, participants were instructed to say the word "milk" out loud and to note various perceptual qualities which emerge (e.g., "cold," "creamy," "white"). To practice, participants were given a handout with two simple geometric shapes and instructed to say the word "milk" one time, and then "not think about anything related to milk" and instead pay attention to the picture of the shapes. At 10 and 20 s the experimenter instructed them to "pay attention to the shapes." After briefly describing their experience with the exercise, participants were informed that this skill can be used for distressing thoughts and were reminded of the one word thought they initially chose. They then repeated the exercise with their chosen word for 30 s, again being reminded to "pay attention to the shapes" at 10 and 20 s.

2.3.3. Intervention follow-up

Immediately after completing the assigned exercise, participants were reminded of the full negative thought they originally chose and asked to re-rate the thought believability and discomfort on the same VAS. Similar to Masuda, Feinstein et al. (2010), participants also completed four feasibility ratings.

2.4. Data analysis plan

All analyses were conducted with Stata IC version 14.2 (StataCorp, 2015). Data was inspected for outliers and normality, and

outliers were fenced above and below two times the interquartile range of the median. Some variables were shown to be non-normal, and were transformed accordingly for the appropriate parametric analyses (scores are shown in the tables are raw scores). All analyses using transformed data were also run with non-transformed variables and found analogous results. To look at basic differences between groups and conditions, *t*-tests were used for normally distributed continuous variables, chi-square tests for categorical variables, and Mann-Whitney U tests for ordinal variables or variables that did not meet the assumption of normality after transformation. To examine relationships between variables, Spearman's correlations were utilized with Bonferroni adjustments. Cohen's *d* effect sizes were calculated for the pre-post effects of intervention within groups. According to Cohen (1988) guidelines, .2 denotes a small effect, .5 a medium effect, and .8 a large effect. Within group effect sizes were calculated with GPower (Faul, Erdfelder, Lang, & Buchner, 2007). Wilcoxon Rank-Sum Tests were utilized to explore the feasibility and effectiveness ratings of the interventions between groups and conditions.

The analyses examining intervention effectiveness (i.e., Def and Dis) were conducted using mixed effects modeling. This approach is recommended for repeated measures studies, as they permit subjects to be measured at different time points, and have no restrictive assumptions regarding correlation patterns (Gueorguieva & Krystal, 2004). Further, these models allow more powerful exploration as they can adjust for individual differences (Winter, 2013). In the current study, maximum likelihood estimation was used to model behavioral data separately *thought believability* and *thought discomfort* as dependent variables. Both models included three fixed effects: time (pre-test and post-test), condition (defusion and distraction), and group (AS and NT). A random effect for subject was included, allowing the model to take into account individual differences by assuming random intercepts. In both models, main effects of the three fixed effects were examined in addition to interactions among them. Post hoc tests of simple effects were conducted using Bonferroni adjustments.

3. Results

3.1. Sample characteristics and dispositional group differences

As seen in Table 1, the only significant between-groups difference in demographics was for age, where the AS group was slightly older than the NT group. In line with data from previous studies, the AS group reported significantly more autism symptoms, anxiety, depression, and stress. As hypothesized, the AS group reported significantly more cognitive fusion than the NT group. Differences

Table 1
Sociodemographic Information, Means, and Standard Deviations Compared Across Groups.

	ASD (n = 42)		NT (n = 55)	
	N (%)		*N* (%)	
Male	27	(64.29)	41	(74.55)
African American	1	(2.38)	0	(0)
Caucasian	40	(95.24)	52	(94.55)
Hispanic	1	(2.38)	1	(1.82)
Other	0	(0)	2	(3.63)
	Mean	(SD)	Mean	(SD)
*Age	24.36	(6.18)	21.36	(2.08)
Range	18-41		17-27	
IQ	110.88	(13.00)	110.27	(9.43)
Range	82-133		89-129	
**AQ	28.93	(7.83)	16.33	(5.92)
Range	11-44		6-40	
**DASS-T	39.05	(19.25)	18.58	(11.87)
Range	6-84		0-44	
**DASS-A	10.19	(6.49)	3.42	(3.64)
Range	0-26		0-14	
**DASS-D	12.52	(8.79)	5.75	(4.51)
Range	2-38		0-16	
**DASS-S	16.33	(9.05)	9.49	(5.51)
Range	0-34		0-22	
**CFQ	30.29	(7.56)	21.67	(5.59)
Range	15-47		10-35	
**BAFT	69.98	(17.63)	51.44	(16.94
Range	40-108		18-82	

Note: IQ = Intelligence Quotient; AQ = Autism Spectrum Quotient; DASS-T = Total Distress; DASS-A = Anxiety; DASS-D = Depression; DASS-S = Stress; CFQ = Cognitive Fusion Questionnaire; BAFT = Believability of Anxious Thoughts and Feelings; Chi-Square tests were used for race and gender and the Wilcoxon Rank Sum test for age. All DASS subscales were non-normal, and thus transformed for independent samples t-tests. Wilcoxon Rank Sum test was used for the DASS-A, as it remained non-normal.

* p value < .05.

** p value < .0001.

Table 2
Means and Standard Deviations Compared Across Conditions for AS Group Only.

	Defusion (n = 21)		Distraction (n = 21)	
Measure	Mean	(SD)	Mean	(SD)
Age	24.48	(5.28)	24.24	(7.09)
Range	18-37		18-41	
FIQ*	106.52	(13.41)	115.24	(11.25
Range	82-130		95-133	
AQ	28.00	(7.96)	29.86	(7.78)
Range	11-41		14-44	
DASS-T	33.52	(18.59)	44.57	(36.05)
Range	6-70		14-84	
DASS-A	10.29	(6.67)	10.10	(6.46)
Range	2-24		0-26	
DASS-D*	9.52	(7.64)	15.52	(8.99)
Range	2-30		2-38	
DASS-S	13.71	(8.95)	18.95	(8.57)
Range	0-34		4-32	
CFQ**	26.76	(7.02)	33.81	(6.47)
Range	15-42		18-47	
BAFT	69.10	(17.63)	70.86	(15.21)
Range	40-108		48-104	

Note: IQ = Intelligence Quotient, AQ = Autism Spectrum Quotient, DASS-T = Total score, DASS-A = Anxiety, DASS-D = Depression, DASS-S = Stress, CFQ = Cognitive Fusion Questionnaire, BAFT = Believability of Anxious Thoughts and Feelings. Wilcoxon Rank Sum test was used for age. Independent t-tests were used for all other variables. DASS-D was non-normal, and thus transformed for the analyses. For all variables, non-transformed raw-scores are reported in the table.

* p value < .05.

** p value < .001.

were also examined between conditions. There were no significant differences between the NT group assigned to the defusion condition (NT-Def) and for the NT group assigned to the distraction condition (NT-Dis) on any measure. For the AS group, participants randomly assigned to the distraction condition (AS-Dis) seemed to be somewhat more distressed than the participants assigned to the defusion condition (AS-Def) (see Table 2).

Spearman's correlations, separated by group, are reported in Table 3. All measures were associated in the expected directions, i.e., higher cognitive fusion was significantly and positively correlated with anxiety, depression, and stress. This was true for AS and NT separately and for the combined sample.

3.2. Mixed effect modeling of behavioral data

As recommended by Winter (2013), residual plots were visually inspected to test assumptions of the mixed model. There were no apparent deviations from homoscedasticity or normality. Further, P-values of likelihood ratio tests and both Bayesian Information Criterion (BIC) and Akaike Information Criterion (AIC) showed benefits of the model (Müller, Scealy, & Welsh, 2013; Winter, 2013). Previous defusion studies examining semantic satiation have often dropped data of participants who had a low pre-thought ratings, as there would be little room for change (Masuda et al., 2009; Masuda, Feinstein et al., 2010; Masuda, Twohig et al., 2010). In the current study, thought rating data at post-test and both follow-ups were dropped if pre-thought ratings were 1.5 standard deviations

Table 3
Spearman Correlations.

	ASD (n = 42)		NT (n = 55)		Combined (n = 97)	
	CFQ	BAFT	CFQ	BAFT	CFQ	BAFT
AQ	.26	.12	.38	.41*	.57****	.51****
DASS-T	.70****	.63***	.58****	.45*	.76****	.64****
DASS-A	.38	.61***	.50**	.45*	.61****	.64****
DASS-D	.57**	.35	.47**	.39	.61****	.48****
DASS-S	.68****	.59***	.56***	.37	.70****	.55****

Note: AQ = Autism Spectrum Quotient, DASS-T = Total Distress; DASS-A = Anxiety; DASS-D = Depression; DASS-S = Stress; CFQ = Cognitive Fusion Questionnaire; BAFT = Believability of Anxious Thoughts and Feelings.

* p value < .05.

** p value < .01.

*** p value < .001.

**** p value < .0001.

below the mean for thought believability (scores below 11 were dropped) or thought discomfort (scores below 19 were dropped). For thought believability, three AS participant ratings were dropped and four NT participant ratings were dropped. For thought discomfort, one AS participant rating was dropped and eight NT participant ratings were dropped. When models with and without the dropped data were compared, dropping the low ratings improved model fit according to BIC and AIC. However, the trend of results was highly similar in both models.

3.3. Thought believability

3.3.1. Primary findings

A mixed effects model using thought believability as the outcome variable showed a significant main effect for time (χ^2 (1, $N = 90$) = 71.78, $p < .0001$), diagnosis ($\chi^2(1, N = 90) = 8.57$, $p < .01$), condition ($\chi^2(1, N = 90) = 6.54$, $p < .05$), and a significant two way interaction for diagnosis by condition ($\chi^2(1, N = 90) = 8.11$, $p < .01$). When exploring the main effect of time, participants in each group showed a significant reduction in thought believability from pre-test to post-test with medium to large effect sizes (see Fig. 1and Table 4). This suggests that both interventions were immediately and similarly effective in reducing thought believability for AS and NT participants (Table 4).

The main effects for diagnosis and condition, in addition to the interaction between these two variables, were examined using post-hoc testing. As highlighted in Fig. 1, the interaction effect showed that AS-Dis reported significantly elevated thought believability at pre-test and post-test compared to other groups. The finding that AS-Dis had significantly higher baseline thought believability was surprising given that all groups were randomly assigned, and likely relates to Table 2 showing AS-Dis group had elevated depression and general cognitive fusion scores compared with AS-Def. Therefore, results concerning thought believability must be interpreted cautiously.

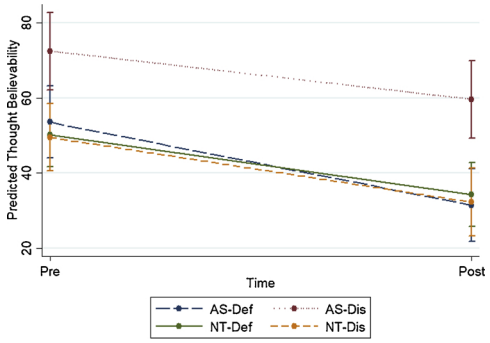

Fig. 1. Depiction of a mixed effects model showing predicted change in thought believability. Error bars represent 95% confidence intervals.
Note. AS-Def = AS in Defusion; NT-Def = NT in Defusion; AS-Dis = AS in Distraction; NT-Dis = NT in Distraction

3.4. Thought discomfort

3.4.1. Primary findings

A mixed effects model using thought discomfort as the outcome variable showed a significant main effect for time (χ^2 (1, $N = 88$) = 146.09, $p < .0001$) and diagnosis ($\chi^2(1, N = 88) = 4.50$, $p < .05$). As depicted in Fig. 2, participants in each group showed a significant reduction in thought discomfort from pre-test to post-test (AS-Def = - 28.35, AS-Dis = -24.33, NT-Def = -21.39, NT-Dis = -29.38; see Table 5) with large effect sizes. This suggests that as with thought believability, both interventions were immediately effective in reducing thought discomfort for both AS and NT participants. Concerning the main effect of diagnosis, post-hoc testing showed one significant group difference, in that AS-Dis reported greater thought discomfort (by 17.39 points) than NT-Dis ($\chi^2(1, N = 88) = 8.62$, $p < .05$) at post-test.

Finally, results from the feasibility and effectiveness ratings administered after the interventions were explored. All participants appeared to find the interventions effective, easy to understand, useful, and reported that they would use it again (see Table 6). There were several small but significant differences found. For instance, AS-Def reported perceiving the intervention as more effective than

Table 4
Pre-Test to Post-Test Differences for Thought Believability with Bonferroni Corrections.

	Contrast	Z	P	95% CI	*d*
AS-Def	−22.10	−5.37	< .001	−30.15, -14.04	.86
AS-Dis	−12.83	−2.89	< .01	−25.58, -.09	.76
NT-Def	−15.89	−4.38	< .001	−22.99, -8.78	.85
NT-Dis	−17.25	−4.49	< .001	−24.79, -9.71	1.19

Note. AS-Def = AS in Defusion; NT-Def = NT in Defusion; AS-Dis = AS in Distraction; NT-Dis = NT in Distraction.

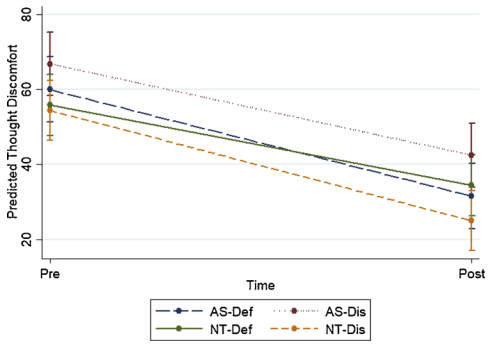

Fig. 2. Depiction of a mixed effects model showing predicted change in thought discomfort. Error bars represent 95% confidence intervals.
Note. AS-Def = AS in Defusion; NT-Def = NT in Defusion; AS-Dis = AS in Distraction; NT-Dis = NT in Distraction

Table 5
Pre-Test to Post-Test Differences for Thought Discomfort with Bonferroni Corrections.

	Contrast	Z	P	95% CI	*d*
AS-Def	−28.35	−6.33	< .001	−37.12, -19.58	1.08
AS-Dis	−24.33	−5.57	< .001	−32.90, -15.77	1.09
NT-Def	−21.39	−5.12	< .001	−29.57, -13.21	1.33
NT-Dis	−29.38	−7.19	< .001	−37.38, -21.37	1.75

Note. AS-Def = AS in Defusion; NT-Def = NT in Defusion; AS-Dis = AS in Distraction; NT-Dis = NT in Distraction.

the AS-Dis group. As-Def also reported being more likely to use the intervention compared to NT-Def. NT-Dis noted a higher ease of use and understanding of the intervention than AS-Dis. Finally, NT-Dis reported being more likely to use the intervention again than the NT-Def group.

4. Discussion

4.1. Intervention effects

The most important finding of the current study showed that a brief cognitive defusion technique and a brief active distraction technique were similarly effective in immediately reducing thought believability and thought discomfort in both groups with moderate to large effect sizes. This finding extends a body of research from neurotypical adults, showing the utility of semantic satiation and active distraction interventions to a sample of adults with autism who have average cognitive and language ability.

An unexpected result of the current study was that active distraction worked as well as cognitive defusion in reducing thought believability for both groups. While active distraction has been shown to be a helpful way to cope with distressing thoughts (Dörfel et al., 2014; Wade, George, & Atkinson, 2009; Webb et al., 2012), its theorized mechanism of action in the emotion regulation literature is very different than defusion. In active distraction, the goal is to limit the cognitive processing of unpleasant stimuli by focusing on an unrelated stimulus, therefore allowing one to have more neutral thoughts (Sheppes et al., 2014). In contrast, it seems as though defusion would more directly impact one's thought believability, as the goal is to reduce the impact of arbitrarily derived stimulus functions by bringing awareness to process of thinking (Blackledge, 2015). Some previous research has shown equivocal findings with regards to distraction-type interventions compared to MABI type- interventions. For instance, there are some studies showing distraction being similarly effective in reducing psychological distress (Wade et al., 2009) and thought believability

Table 6
Means and Standard Deviations of Feasibility Ratings.

	AS-Def	AS-Dis	NT-Def	NT-Dis
Effective	[b]5.48 (1.08)	[b]4.52 (1.54)	4.68 (1.44)	5.37 (1.33)
Use Again	[3]5.38 (1.43)	4.81 (1.63)	[a] [3]4.35 (1.59)	[a]5.56 (1.15)
Understand	6.48 (.87)	[2]6.38 (.74)	6.39 (1.10)	[2]6.74 (.66)
Ease	5.76 (1.14)	[1]4.86 (1.93)	6.00 (1.61)	[1]5.93 (1.33)

Note. Effective = "I found this strategy effective"; Use Again = "I will use this strategy again"; Understand = "I found this strategy easy understand"; Ease = "I found this strategy easy to use". AS-Def = AS in Defusion; NT-Def = NT in Defusion; AS-Dis = AS in Distraction; NT-Dis = NT in Distraction.
Corresponding small letters and numbers indicate significant differences between groups (AS vs NT) or intervention conditions (Defusion vs Distraction).

(Masuda, Twohig et al., 2010), while others have found that it is less helpful (Mandavia et al., 2015; Masuda, Feinstein et al., 2010). Considering research showing that distraction reduces the short-term impact of strong emotions (Sheppes, Suri, & Gross, 2015; Verduyn, Van Mechelen, & Tuerlinckx, 2011), it may be that distraction temporarily disrupts the effects of derived stimulus functions, leading to less emotional distress in the moment. This could lead people to seeing their originally distress thought as less threatening than originally thought, and therefore less believable., While more research is needed in this area, this can be seen as another example of how RFT can explain similar effects of two distinct interventions (semantic satiation and distraction) (Arch et al., 2012).

4.2. Trait cognitive fusion in AS and NT

As expected, the AS group had higher levels of trait cognitive fusion than the NT group on two distinct measures. One important diagnostic feature of AS is behavioral rigidity (American Psychiatric Association, 2013), which can include insistence on sameness, difficulty switching tasks, and difficulty with changes to routine (Geurts, Corbett, & Solomon, 2009; Van Eylen et al., 2011). Fusion to thoughts is conceptualized as a core component to inflexible behavior, where people's behavioral repertories are limited based on their history of arbitrarily applicable relational responding, rather than their direct experience (Blackledge, 2015). Inflexible behavior in AS has been previously explained in terms of atypical neurological function (Uddin et al., 2015), higher order anxiety processing (South, Newton, & Chamberlain, 2012), and atypical sensory function (Wigham et al., 2015). The current study suggests that another contributing factor could be elevated levels of cognitive fusion.

4.3. Cognitive fusion associations with psychological distress

While extant research is clear that higher levels of fusion are related to many indicators of psychological distress, including behavioral flexibility (Bardeen & Fergus, 2016; Gillanders et al., 2014; Herzberg et al., 2012), this is the first study to extend these findings to a sample of adults with AS. Similar to the NT group, measures of cognitive fusion in the AS group had moderate to strong negative associations with measures of anxiety, depression, stress, and total psychological distress. Given that cognitive fusion has been shown to be an important factor in the treatment of anxiety and depressive disorders in neurotypical people (Arch et al., 2012; Gloster et al., 2015; Hinton & Gaynor, 2010), findings from the current study provide a rationale for the continued examination of MABIs such as ACT to treat comorbid psychopathology in people with high functioning AS.

4.4. Cognitive fusion as an emotion regulation deficit

Findings from this study fit into the growing body of literature showing that the high rates of associated psychopathology in AS (e.g., anxiety and depression) are due to deficits in emotion regulation, stemming from an interaction of neurobiological, social, developmental, and behavior factors that are specific to AS (Mazefsky & White, 2014; White et al., 2014). Given the current results that the AS group had higher cognitive fusion than the NT group, it appears as though people with AS may be more negatively impacted by arbitrarily-derived stimulus functions compared to neurotypical people, which may contribute to both inflexible behavior and elevated emotional distress. One possible explanation of this is that people with AS tend to have difficulty with flexible thinking and conceptual learning (D. L. Williams, Mazefsky, Walker, Minshew, & Goldstein, 2014; D. L. Williams, Minshew, & Goldstein, 2015), which could make it difficult for them to unlearn negative or maladaptive arbitrary relations that they had previously made. While it is important to note that this has not been looked at empirically, these findings do corroborate Mazefsky and White's (2014) assertion that MABIs may be a helpful emotion regulation treatment for people with AS.

One key difference between CD and traditional cognitive techniques is that CD does not have to require complex steps or processes (e.g., estimating probability, replacing thoughts, identifying and changing thinking errors), which may be overwhelming or themselves anxiety-inducing for people with AS. Similarly, it bypasses any rigidity of thinking which might occur when directly working with the content of thoughts. In the simplest terms, defusion provides an opportunity for people to become aware of many ways in which language impacts our behavior. While there is research showing that some people with AS have difficulty with flexibility of thinking (Williams et al., 2015), cognitive defusion may be particularly helpful, as it can be taught in an experiential way rather than through abstract or metaphorical language. There are many different cognitive defusion techniques which are modifiable to one's idiosyncratic symptoms, which is especially important when working with AS populations (Gaus, 2011). For example, one widely used defusion technique involves having people say a distressing or anxiety provoking thought in a silly voice, possibly from a cartoon character they particularly enjoy. This allows people to see the often-comical nature of taking one's thoughts too seriously. An intervention like this may be particularly helpful to a person with AS who has a particularly strong interest in a cartoon or movie character. The use of CD skills in general for people with AS is supported by the high feasibility and low dropout rates reported by extant MABI studies for people with AS (de Bruin et al., 2015; Eilers & Hayes, 2015; Pahnke et al., 2014).

4.5. Limitations and future directions

There are several important limitations to this study. The largest limitation is the lack of a no-treatment control group. Although there is extensive support for the short term effectiveness of these two interventions, there was no condition to control for placebo or demand characteristics (Deacon et al., 2011; Mandavia et al., 2015; Masuda et al., 2004; Masuda, Feinstein et al., 2010; Masuda, Twohig et al., 2010; Ritzert et al., 2015; Wade et al., 2009; Webb et al., 2012). Given the extant evidence for semantic satiation, the complexities of recruiting participants diagnosed with AS, and the decision to include a NT group in the current study, we decided

that it would be a more efficient use of resources to leave out a no-treatment control and instead directly compare semantic satiation to another active condition. Moreover, considering the high comorbidity rates in people diagnosed with AS, we had ethical concerns regarding having this group undergo a no-treatment control condition. However, this limitation should add a layer of caution to the interpretation of study results. Additionally, as with many studies utilizing samples with people with AS, none of the questionnaires except for the AQ has been psychometrically validated in large samples of people with AS.

Another major limitation of the current study was that the AS group showed elevated levels of psychological distress compared to the NT group. Thus, differences in outcome may be attributed to the higher levels of distress in AS, rather than AS per se. It will be important for future research to utilize matched NT samples with similar levels of reported psychological distress. This study utilized cognitively able participants with IQ scores > 80. It is unknown if individuals with AS and lower cognitive abilities would also reported elevated levels of cognitive fusion, or if cognitive defusion would be as helpful in reducing thought believability. Furthermore, despite randomization into groups, the AS-Dis group had higher pre-intervention distress than the AS-Def group. This makes comparison of the differential effects between interventions more difficult for the AS sample. It will be important for future studies to consider stratified randomization to avoid important pre-intervention differences.

An important limitation regarding generalizability of the findings is that experimenters in the current study applied only one defusion intervention (e.g. semantic satiation) to participants. This likely differs from how therapists would use defusion in clinical practice, where clinicians can offer a “menu” of various defusion techniques. This allows clients to experiment with a variety of techniques and to find the ones that work best for them. Future studies should consider ways to offer participants a greater variety of choices in defusion interventions. Likewise, clinicians from any range of theoretical backgrounds may find active neutral distraction useful by using it to teach AS clients a simple and intuitive way to manage acutely distressing thoughts (Sheppes et al., 2014). Moreover, while several studies utilizing neurotypical samples show that a brief semantic satiation technique can have long lasting benefits, long term effects of defusion techniques in people with AS has not been studied, and there is a need for more research in this area (Deacon et al., 2011; Tyndall, Papworth, Roche, & Bennett, 2017). It is important to note that previous research does show that MABIs administered in full treatment packages can have long-lasting benefits for people with AS, though it is uncertain if short-term single session techniques would show similar results (Kiep et al., 2014; Sizoo & Kuiper, 2017). Furthermore, MABI’s such as ACT tend to emphasize the importance of skills acquisition by having client’s practice techniques they learn (Harris, 2009; Parsons, Crane, Parsons, Fjorback, & Kuyken, 2017), and it is likely that this applies to people with AS in addition to neurotypical people. However, there is no research on whether people with AS require more intensive or longer duration practice than NT people to gain the same benefits. The current study suggest that both groups likely have similar response to the same dose of treatment, but this will have to be further explored.

5. Implications

Our data indicate that both defusion and distraction tasks may be clinically indicated for managing distressing thoughts in AS individuals, at least in-the-moment during therapy sessions. Specifically, we have shown that people with AS and understand the rationale of defusion and benefit from experiential practice. After such initial interventions, clinicians could proceed by engaging in more extensive interventions aimed at reducing the impact of negative thoughts and increasing behavioral flexibility (e.g. more comprehensive defusion or mindfulness exercises) and at helping clients to practice such interventions on an ongoing basis to reduce distress in everyday life. It is important to note that while both distraction and defusion can be helpful brief interventions to alleviate distress associated with a specific thought, they will be most effectively used within a multidimensional treatment package such as ACT or CBT.

Conflicts of interest

All authors declare that there are no conflicts of interest.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.rasd.2018.12.005.

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