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Managing Distressing Thoughts in Adults With and Without Autism: The Role of Cognitive Fusion and the Effectiveness of a Brief Defusion Intervention

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ABSTRACT

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In the tradition of acceptance and commitment therapy (ACT), cognitive fusion is a transdiagnostic risk factor and occurs when one becomes overly attached to or “caught up” in their thoughts, leading to a more narrowed behavioral repertoire and difficulty taking effective action in response to life’s demands. Cognitive defusion is ACT’s curative answer to fusion, and denotes the process of taking a step back, seeing thoughts as “simply thoughts,” thereby reducing the negative impact of distressing or anxiety-provoking thoughts. While these components have been widely studied in neurotypical (NT) samples, the purpose of this study was to extend findings to people diagnosed on the autism spectrum (AS). Specifically, this study aimed to examine the impact of cognitive fusion in this population and the effectiveness of a brief defusion technique.

Forty-two AS participants and fifty-five neurotypical participants were given a battery of questionnaires measuring psychological distress and dispositional levels of cognitive fusion. Participants were then randomized into either a brief cognitive fusion technique or a brief active distraction technique. In both conditions participants chose a distressing thought and rated it on a visual analogue scale (VAS) in terms of thought discomfort and believability. They were then read a rationale regarding their assigned technique, practiced the technique, and applied the technique to their chosen distressing thought. After the intervention participants immediately re-rated the thought on the same VAS. Throughout the study, participants’ heart rate and skin conductance were monitored to determine physiological effects of the conditions. Finally, a follow-up survey was sent at a one-week and two-week follow-up, where participants re-rated the believability and discomfort of their thoughts.

Results of this study showed that the AS group had higher overall levels of fusion than the NT group, and that fusion was moderately to strongly related to psychological distress in the AS group and the NT group. In terms of the intervention effects, all interpretation statements must be taken with caution, as there were significant pre-group differences despite randomization. Both defusion and distraction worked equally well in immediately reducing thought believability and thought discomfort for AS and NT groups. Furthermore, treatment effects were maintained at the two-week follow-up period for all groups except for the AS group in the defusion condition. There were no treatment effects for physiology. The current study provides evidence that cognitive fusion may be an important factor in the psychiatric comorbidity that people with AS experience, and a brief technique can be effectively used.

Keywords: autism spectrum disorder, cognitive defusion, acceptance and commitment therapy, mindfulness, thought believability

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Managing Distressing Thoughts in Adults With and Without Autism: The Role of Cognitive Fusion and the Effectiveness of a Brief Defusion Intervention

Autism Spectrum and Comorbid Psychological Distress

The life-time prevalence rate for people diagnosed with autism spectrum (AS) is around 1% (American Psychiatric Association, 2013; Lyall et al., 2017). AS is characterized by social and communication deficits, with accompanying repetitive or restrictive behavior and/or interests. In conjunction with these defining characteristics of AS, research has shown that people with AS tend to experience far greater levels of comorbid psychiatric concerns that neurotypical people (Buck et al., 2014; Joshi et al., 2013; Kerns et al., 2014; Lugnegård, Hallerbäck, & Gillberg, 2011; Spain et al., 2016). For instance, in a sample of 54 adults with ASD, Lugnegård et al. (2011) found that 70% had experienced an episode of major depression, 56% experienced at least one heterogeneous anxiety disorder, most common of which were generalized anxiety disorder and social phobia. These findings echo those of Buck et al. (2014), who re-assessed adults who were diagnosed with AS during a state-wide prevalence study in the 1980s. The sample included 129 adults presenting with a wide range of IQ scores. They found that at the time of the study, 73% of participants met criteria for at least one comorbid psychiatric disorder. Anxiety symptoms, measured by a semi-structured clinical interview developed for people with developmental disorders, were found to have the highest lifetime (52.7) and current (39.5) prevalence out of any disorder. In their sample, 12% of participants met criteria for current depression and 13% for a lifetime episode of depression.

Cognitive Behavioral Therapy in AS

Most of the extant research studies on interventions for comorbid psychological distress in AS have examined the effects of cognitive behavioral therapy (CBT). CBT is a widely used, evidenced-based psychological intervention that has been shown to be helpful in treating neurotypical adults with mood and anxiety disorders (Cuijpers et al., 2013; Hofmann & Smits, 2008). It employs various strategies such as psychoeducation, behavior tracking, cognitive restructuring, and exposure aimed at identifying and changing one's dysfunctional thoughts and behavior patterns (Barlow, 2014). However, most of the existing CBT studies utilizing samples diagnosed with AS have examined children or adolescents (Chalfant, Rapee, & Carroll, 2007; Lang, Regester, Lauderdale, Ashbaugh, & Haring, 2010; Vasa et al., 2014; Wood et al., 2009). There are very few adult studies in this area, and those which are published are difficult to generalize because of poor methodology and/or lack of randomized control trials (Binnie & Blainey, 2013; Langdon et al., 2016; Spain, Sin, Chalder, Murphy, & Happé, 2015; Weston, Hodgekins, & Langdon, 2016).

Importantly, of the few published adult CBT studies, many experimenters have deviated from traditional CBT protocols in service of adapting to the idiosyncratic characteristics of AS (Gaus, 2011; Kerns, Roux, Connell, & Shattuck, 2016). For instance, a systematic literature review of the effectiveness of CBT for adults with AS, Spain et al. (2015) examined 6 studies which used idiosyncratic adaptations to CBT. For example, they described studies increasing the number of sessions from the original protocols, incorporating more concrete and visual materials, utilizing longer experiential exercises, and engaging in more structured and directive approaches. There have been no studies systematically examining the effectiveness of these or other modifications of CBT in adult AS samples. Given the high rates of comorbidity in adults with

ASD and the dearth of high quality controlled studies, there is a clear need for more extensive research into the treatment of psychological distress in adults with AS.

Mindfulness and Acceptance-Based Interventions (MABIs)

As an alternative to traditional CBT, Mindfulness and Acceptance-Based Interventions (MABIs) have been quickly gaining traction as an effective and empirically supported treatment for heterogeneous anxiety and mood disorders in neurotypical people (A-Tjak et al., 2015; Dimidjian et al., 2016). The term mindfulness was defined by Kabat-Zinn (1990) as paying attention to the present moment in a non-judgmental and compassionate way. While definitions of mindfulness place heavy emphasis on awareness, interventions which highlight acceptance denote an approach of gentle allowance of all internal experience, while giving up the fight for control over aversive experiences like painful thoughts and feelings. While somewhat distinct, the constructs of mindfulness and acceptance overlap, as all mindfulness interventions contain a component of acceptance of internal experience, and all acceptance skills include mindfulness as a way to hold internal experience in gentle and kind awareness.

Like CBT, MABIs take into account the importance of both thoughts and behaviors. However, while CBT attempts to create positive change by teaching people how to control their thoughts and feelings, MABIs aim to change the context in which thinking and feeling occur. They utilize various tools and techniques to help people react to their internal experience in less aversive ways in order to behave more effectively (Arch & Craske, 2008; Hayes, Luoma, Bond, Masuda, & Lillis, 2006).

Some of the most prolific and well-researched MABIs include Acceptance and Commitment Therapy (ACT), Dialectical Behavior Therapy (DBT), Mindfulness Based Stress Reduction (MBSR), and Mindfulness Based Cognitive Therapy (MBCT; Hayes, Strosahl, &

Wilson, 2012; Kabat-Zinn, 1990; Linehan, 2015; Segal, Teasdale, Williams, & Gemar, 2002). While each of these therapy modalities differ slightly in theoretical stance, therapist role, and specific techniques, they all aim to increase one's mindfulness skills and acceptance of internal experience, allowing people to create distance from painful thoughts and feelings. When people are able to accept and make room for uncomfortable internal experiences, they are no longer bound to their strong emotions. This allows people to behave in more flexible and pragmatic ways.

There is reason to believe that MABIs may be an especially effective treatment for people with AS. Converging evidence suggests that the elevated levels of anxiety in AS are due to deficits in emotion regulation, or the ability to effectively cope with strong internal feelings in order to behave appropriately (Maisel et al., 2016; Mazefsky et al., 2013; Mazefsky & White, 2014; White et al., 2014). For instance, White et al. (2014) proposed that a combination of physiological, socio-cognitive, and neurobiological factors intrinsic to AS lead to an attenuated ability for them to cope with their emotions, which has a bi-directional relationship with increased anxiety and distress. Mennin & Fresco (2009) explained that MABIs are especially helpful in treating emotion regulation deficits, as they give people specific tools to help them experience their emotions in healthy ways without having to avoid uncomfortable thoughts and feelings. One particularly helpful tool MABIs offer is an increased ability to accept internal experience. Not only has acceptance of internal experience been shown to be a non-specific component of emotion regulation directly related to anxiety disorders (Mennin, McLaughlin, & Flanagan, 2009), but it is known to be an effective emotion regulation strategy overall in neurotypical populations (Dan-Glauser & Gross, 2015; Kohl, Rief, & Glombiewski, 2012; Roemer, Orsillo, & Salters-Pedneault, 2008). Furthermore, a recent study by Maisel et al. (2016)

showed that in addition to alexithymia (being unable to identify and delineate between different feelings), non-acceptance of inner experience plays a large role in the experience of anxiety for people with AS. Taken together, there is reason to believe that MABIs may help people with AS gain better emotion regulation skills and alleviate comorbid distress.

As noted, in addition to difficulties with internal acceptance, alexithymia has been thought to be highly related to emotional distress in both neurotypical (Berardis et al., 2008; Karukivi et al., 2010) and AS (Bird & Cook, 2013; Maisel et al., 2016) samples. Additionally, alexithymia appears to be more prevalent in people with AS compared to neurotypical populations (Berthoz, Lalanne, Crane, & Hill, 2013; Hill, Berthoz, & Frith, 2004). In fact, many of the extant models of emotion regulation deficits in people with AS posit that higher levels of alexithymia are one of the major contributors of emotion dysregulation for this population (Mazefsky & White, 2014; White et al., 2014). While no gold-standard treatment for alexithymia currently exists, a review of alexithymia interventions by Cameron, Ogrodniczuk, & Hadjipavlou (2014) noted that any treatment which increases awareness of emotions and physiological sensations, along with labeling and describing internal experience, is beneficial in assuaging alexithymia. MABIs may be particularly helpful in treating alexithymia, as they utilize many different mindfulness practices which train people to consciously focus their attention inside, observing all internal experience as it is. In support of this notion, increased levels of mindfulness have been shown to be related to decreased levels of reported alexithymia (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006; Veehof, Klooster, Taal, Westerhof, & Bohlmeijer, 2011).

In sum, it is likely that utilizing MABIs to increase acceptance and awareness of internal experiences will help people with AS regulate their emotions more effectively, thereby decreasing the comorbid psychiatric concerns which often occur along with the AS core symptoms. In fact, most of the current models of emotion dysregulation in AS recognize this and tentatively recommend the use of MABIs to help regulate emotions in this population (Mazefsky et al., 2013; Mazefsky & White, 2014). Moreover, Mazefsky & White (2014) noted that compared to other established treatments, MABIs might be particularly helpful for AS populations given the symptoms of inflexibility and rigidity which is inherent in the disorder. Instead of trying to change or arguing against inflexible and rigid thoughts and behaviors, MABIs teach explicit skills to simply observe these uncomfortable states in gentle awareness, while choosing to behave in more effective ways.

MABIs for Comorbid Symptoms in an AS population

Over the past decade, a nascent area of research has been accumulating empirical support showing the effectiveness of MABIs for people diagnosed with AS (Hwang & Kearney, 2013). One of the earliest studies in this area examined the utility of mindfulness training to reduce physical aggression in adolescents with AS (e.g., hitting, kicking, biting). Singh and colleagues (2011) conducted two multiple-baseline design studies, and found that teaching adolescents (utilizing one sample with high functioning autism and one sample with low functioning autism) to meditate on the soles of their feet while making room for uncomfortable feelings, drastically reduced the frequency of aggressive episodes. Moreover, for the high-functioning autism sample, a 4 year follow-up showed no episodes of physical aggression. For the lower functioning sample, a 3 year follow-up showed that the participants averaged only one episode of physical aggression per year (Singh, Lancioni, Manikam, et al., 2011; Singh, Lancioni, Singh, et al., 2011). These studies were some of the first to provide evidence that people with AS can acquire and effectively use mindfulness skills to cope with strong feelings.

In the first randomized controlled trial of its kind, Spek, van Ham, & Nyklíček, (2013) examined the effectiveness of a modified version of Mindfulness-Based Therapy (MBT) for people with AS (MBT-AS). This study utilized therapists who were trained in MBT and who had extensive experience doing therapy with people diagnosed with AS. Modifications to MBT included giving participants extra time to do meditation practices, increasing the treatment protocol from 8 weeks to 9 weeks, and avoiding the use of abstract language (e.g., metaphors). The participants learned and practiced various experiential mindfulness exercises and learned how to use mindfulness to reduce stress. They found that compared to a control group, MBT-AS was effective in lowering depression, anxiety, and rumination, along with increasing positive affect, all with effect sizes ranging from moderate to large. Moreover, data from this study showed that a reduction in rumination was significantly related to lower anxiety and depression in people with AS. This supports the finding of (Jain et al., 2007) suggesting that rumination may serve as a possible mediator for comorbid symptomology, though this time using an AS sample.

Kiep, Spek, & Hoeben (2014) conducted a follow up study with 30 more AS participants who underwent MBT-AS to determine the stability of the therapeutic benefits over time. They found the same results as the original study, and also determined that the reductions in depression and anxiety lasted at least 9 weeks after treatment. However, these results must be interpreted cautiously, as there was no control group and levels of mindfulness were not objectively measured at any point during the study.

In a similar study, (de Bruin, Blom, Smit, van Steensel, & Bogels, 2015) utilized a group mindfulness intervention for 23 adolescents and young adults, along with a concurrent mindful parent training intervention for their parents. While the authors did not measure anxiety or stress specifically, participants showed lower levels of rumination and greater quality of life immediately after the intervention and at a 9 week follow-up. However, their reported trait worry and mindfulness skills did not show improvement. Parents of the participants in treatment reported an improvement in their child's social skills including social responsiveness, social motivation, communication, and social cognition. As with the previously described study, the investigators did not include a control group, and the results must be qualified accordingly. Importantly though, this study also showed high feasibility for mindfulness interventions in people with AS and their families, as attendance rates for the participants and their parents was excellent (almost 90%) and drop out was low. In a more recent study, Sizoo & Kuiper (2017) compared MBSR to traditional CBT in adults with autism, and found that both treatments were similarly effective in reducing anxiety and depressive symptoms at post-treatment and a 3-month follow-up.

While many different specific MABIs exist, acceptance and commitment therapy (ACT) may be especially helpful for people with autism. The goal of ACT is to increase psychological flexibility, or the ability for people to behave in effective ways regardless of their internal experience. It aims to increase psychological flexibility by teaching people a variety of mindfulness and acceptance skills, while emphasizing behavioral change (Hayes et al., 2012). Like other MABIs, ACT has been shown to be helpful in treating anxiety and mood disorders (Arch, Eifert, et al., 2012; A-Tjak et al., 2015; Powers, Zum Vorde Sive Vording, & Emmelkamp, 2009). Further, given the rigidity and restricted behavior often seen in AS, an intervention like ACT which aims to increase their behavioral flexibility and reduce rigidity may be especially warranted (Pahnke, Lundgren, Hursti, & Hirvikoski, 2014). Moreover, research has linked anxiety in AS to restricted/repetitive behaviors (Rodgers, Glod, Connolly, & McConachie, 2012; Wigham, Rodgers, South, McConachie, & Freeston, 2015), and targeting both of these difficulties with ACT may produce highly favorable outcomes.

In fact, there has been one study examining the effectiveness of ACT in teens and young adults. Pahnke et al., (2014) conducted a pilot study examining the success of a six week ACT skills training group administered as part of a weekly classroom curriculum. The investigators included 28 students in total who were enrolled in a special school for people diagnosed with high-functioning AS. The 15 students who received the intervention participated in a 40 minute ACT skills group twice per week, in addition to 6 to 12 minute daily mindfulness practices. The remaining 13 students were assigned to a wait-list control group where their classes did not include ACT or mindfulness. After the treatment was completed, both teacher and self-report measures showed that students in the ACT group displayed 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).

Components of MABIs: Cognitive Defusion for Psychological Distress

While there is increasing evidence that MABIs such as ACT will help reduce comorbid distress in people with AS, there are very few studies examining how effective specific components of MABIs are for AS populations. This is an important consideration, as it is necessary to modify existing interventions for specific difficulties in AS like rigidity, social deficits, and information processing irregularities (Gaus, 2011; Pahnke et al., 2014; Spain et al., 2015). Knowing the specific MABI skills or interventions which are especially helpful for people diagnosed with AS will increase efficiency and overall effectiveness of interventions.

One specific component of ACT with strong empirical support in neurotypical populations is treating cognitive fusion in order to increase one's behavioral repertoire and decrease their overall reactivity to negative thoughts (Hayes et al., 2012). Cognitive fusion occurs when people become caught up in their thoughts to the point where they are no longer able to receive effective feedback from their direct experience in the environment. In essence, people become "fused" with their thoughts, completely believing the stories their mind tells them while not being able to act in ways which are effective. For example, a common thought for people with depression is "I am worthless." When people are fused with this thought they believe it as reality, and begin behaving in ways which give evidence the thought. They may stop going to work or school, withdraw from social support, and engage in self-harm. This behavior further reinforces the thought of worthlessness, and the cycle of depression continues (Blackledge, 2007; Blackledge, 2015). Further, a growing body of evidence has strongly associated greater cognitive fusion with increased levels of psychological distress (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., 2012). At its core, CD aims to reduce the "context of literality" of thoughts (Blackledge, 2015). All CD skills aim to violate the ubiquitous conventions of language in order to allow people to see their thoughts in a different context, where they do not have to be taken as the literal truth. There are many ways to do this, including saying a thought out loud very slowly or very quickly, watching thoughts come and go from an observer perspective, singing the thoughts out loud to a favorite tune, and many more. Instead of viewing thoughts as directly reflecting reality, people can learn that thoughts are in actuality arbitrary verbal rules which don't necessarily have to be followed, and may even be the cause much distress and dysfunction when followed. Blackledge (2007) summarizes this succinctly by noting “defusion occurs when language use conventions are violated to the point that specific words or phrases lose their ability to make these words’ abstract referents psychologically present and appear to exert control over subsequent behavior” (p. 562). Basically, CD skills allow people to take a step back from their thoughts, thereby reducing their believability and impact, and allow people to behave in ways which were previously restricted (Blackledge, 2007; Blackledge, 2015; Snyder, Lambert, & Twohig, 2011). Moreover, CD has been shown to be a psychologically active component of ACT, with a meta-analysis showing a moderate effect size of .74 (Levin, Hildebrandt, Lillis, & Hayes, 2012).

Not only is CD an active and important component of ACT overall, but it may be especially helpful in the treatment of anxiety and mood disorders. By enabling people to neutrally observe their thoughts as private events separate from reality, it allows them to behave in ways which may have been previously constricted due to distress. For example, somebody with a fear of flying on an airplane may be too terrified to travel by air because they have the thought “there will be an accident.” By allowing the person to see their worry as simply an unhelpful thought, it can enable them to go on a plane even while the thought occurs.

There is growing evidence showing the important role of CD in treating psychiatric concerns. For instance, Arch, Wolitzky-Taylor, Eifert, & Craske (2012) conducted a randomized controlled trial for heterogeneous anxiety disorders and compared ACT vs CBT. They measured possible mediators of treatment (i.e., CD and anxiety sensitivity) every other session. Not only were both treatments efficacious in treating the anxiety disorders overall, they also both showed large effect sizes in the improvement of cognitive defusion and anxiety sensitive. Further, CD and anxiety sensitivity were shown to be significant mediators of reduced worry after both of the treatments. Interestingly, only CD was shown to mediate the secondary outcomes of quality of life, behavioral avoidance, and depression in both treatments. This high-quality study provides strong support for the important mediating role of CD in treating anxiety disorders. Furthermore, other studies have shown defusion interventions to be useful in reducing psychological distress and depressive symptoms (Hinton & Gaynor, 2010), performance anxiety (Juncos & Markman, 2015), and pain (Kohl et al., 2012).

Cognitive Defusion Technique: Semantic Satiation

Various CD techniques have been shown to be helpful in reducing thought believability. For example, studies have effectively taught people defusion by training them to see thoughts as unruly passengers on a bus (Masedo & Rosa Esteve, 2007), having people tell themselves "I know I am having the thought…" as a pre-fix to distressing thoughts (Healy et al., 2008), and using a variety of vocalization techniques (Hinton & Gaynor, 2010). However, the most widely studied defusion technique is a semantic satiation technique (Hayes et al., 2012). First proposed by Titchener (1916) and often referred to as "Titchener's repetition," the technique functions as an important defusion skill in ACT.

Outlined in ACT treatment protocols (Hayes et al., 2012), a short rationale is first given (e.g., describing how language can cause suffering when taken too seriously). Next, a client is asked to say the word "milk" and notice the perceptual cognitive connections they make (e.g., white, creamy, cold). The person then says the word "milk" out loud as quickly as they can for approximately 30 seconds. Throughout the exercise, people begin to notice that the meaning of the word phases out and the experience becomes about noticing the unconventional sounds of "milk" and what it physically feels like to say the word "milk" repeatedly. The goal of this exercise is to get people to understand that they attach arbitrary meaning to the thoughts they have, and that they don't have to necessarily "believe" their thoughts. The exercise is then use for any distressing thought a person may have. For example, a client with panic disorder who fears they will "go crazy" during a panic attack can practice this skill with the thought "crazy" or "panic." Semantic satiation acts as a defusion technique by disrupting the literality of language in two ways: it violates speech frequency parameters (i.e., people do not normally speak by saying one word over and over again) and it attends the person to the actual process of speaking (i.e., which people are usually completely unaware of) (Blackledge, 2015).

Some of the strongest research supporting semantic satiation as an effective defusion strategy comes from a series of studies conducted by Akihiko Masuda and colleagues (Masuda, Feinstein, Wendell, & Sheehan, 2010; Masuda, Hayes, Sackett, & Twohig, 2004; Masuda et al., 2009; 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 on the amount of emotional discomfort the words cause them and 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. 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, a well-established CBT treatment for thoughts. They also found the positive effects to have lasted at a 1 week follow-up.

Not only has semantic satiation shown to be an effective skill, but (Masuda et al., 2009) conducted a parametric analysis to determine the "dose" of semantic satiation which was needed for the most effective results. Their results suggested that emotional discomfort begins assuaging between 3 and 10 seconds, and believability between 20 and 30 seconds. This study also support the notion that thought believability and emotion discomfort are distinct thought processes.

Cognitive Defusion for AS

It is clear that MABIs are an effective treatment of psychological distress for neurotypical people, and a quickly growing field of research showing their effectiveness for populations with AS. Moreover, CD, an important component of ACT, is a psychologically active treatment which helps neurotypical people cope with anxiety and distress by reducing their thought believability and enabling them to behave in more flexible ways. There is strong rational for the use of CD in AS populations. First, AS is partially characterized by an insistence on sameness and restricted/repetitive behaviors (RRBs), which have been linked to anxiety and a fear of uncertainty (Boulter, Freeston, South, & Rodgers, 2014; Rodgers et al., 2012; Wigham et al., 2015). It has yet to be determined to what extent people with AS are fused with their thoughts, but the ubiquitous rigidity in AS could be related to a tendency for people with AS 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, it 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.

Moreover, unlike many traditional cognitive techniques, there are no complex steps or processes in defusion (e.g., estimating probability, replacing thoughts, identifying and changing thinking errors) which may be overwhelming or anxiety inducing themselves for people with AS. Similarly, it bypasses any rigidity of thinking which might occur when directly working with the content of thoughts. Defusion simply teaches people to step back and observe how their thoughts are not literal representations of the world, changing the context rather than content of thinking. Moreover, 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).

Current Study Rationale

To summarize, there is a dearth of research examining the effectiveness of interventions aimed at reducing comorbid psychological distress in adults diagnosed with AS. MABIs are a group of interventions which teach people mindfulness and acceptance skills to increase their behavioral repertoire by helping them react less aversively to disturbing thoughts and feelings. While there is evidence that MABIs are effective interventions for both people with and without AS, there has been no research examining the effectiveness and utility of specific MABI interventions for people with AS. CD skills are an important component of a widely used and empirically established MABI known as ACT. CD skills aim to teach people ways to gain distance from their anxious or distressing thoughts and take more effective action. There is evidence for the effectiveness and utility of many specific CD techniques in neurotypical populations, the most highly researched technique being semantic satiation, where a word is repeated out–loud many times until the word's arbitrary meaning is lost. However, there have been very few studies examining the effectiveness and usefulness of CD skills like semantic satiation in populations diagnosed with AS. This is a major gap in the AS treatment literature, as with the growing acceptability and use of MABIs in AS populations it is increasingly important to determine which specific components of these interventions are helpful for people with AS.

Current Study Goals

Due to the lack of research on cognitive defusion in people diagnosed with AS, there are two over-arching goals to the current study. First, while fusion to thoughts (increased believability and taking thoughts literally) clearly is associated with increased psychiatric concerns in neurotypical people, there is no research suggesting the prevalence or impact of cognitive fusion in AS populations. Therefore, the first goal is to determine how much cognitive fusion a group diagnosed with AS experiences compared to neurotypical group (NT), and to examine whether or not cognitive fusion in AS is related to greater psychological distress.

Second, other than helping children with AS cope with RRBs (Eilers & Hayes, 2015), the effectiveness of cognitive defusion techniques have not been directly examined in AS populations. Given that previous research has shown that semantic satiation is an effective defusion skill in helping neurotypical people reduce their thought believability and discomfort compared to both no-treatment and active control conditions (Deacon et al., 2011; Mandavia et al., 2015; Masuda, Feinstein, et al., 2010; Masuda et al., 2004; Masuda, Twohig, et al., 2010; Ritzert et al., 2015), the current study will compare this intervention to a distraction-based control condition to determine if semantic satiation is similarly effective for people with AS. Gross (2015) describes distraction as the process of a person shifting their attention from one situation or stimuli to another. Typically, this includes somebody in a state of distress redirecting their focus to a less threatening stimulus. Specifically, the current study utilizes *active neutral distraction,* an evidence-based technique which involves direct instruction of a participant to distract themselves with a neutral (i.e. neither positive nor negative) stimulus. In a meta-analysis, this type of brief treatment had a significant effect size of d=.38 across 20 studies (Webb, Miles, & Sheeran, 2012), and there are many studies showing that active distraction is a helpful brief intervention in reducing psychological distress (Huffziger & Kuehner, 2009; Smoski, LaBar, & Steffens, 2014; Wade, George, & Atkinson, 2009).

In the current study, we chose to compare cognitive defusion to an active distraction condition, rather than to a no treatment control, for several reasons. First, there is converging evidence that for neurotypical samples, semantic satiation is more beneficial than no treatment control conditions in managing distressing thoughts, and at least similarly effective to other active treatment conditions (Deacon et al., 2011; Masuda, Feinstein, et al., 2010; Masuda et al., 2004; Masuda, Twohig, et al., 2010; Ritzert et al., 2015). 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. This enabled us to have more participants per group, retaining more statistical power for our analyses. 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.

The current study will also measure the level of physiological arousal (heart rate and skin conductance) participant's experience throughout both conditions (CD vs distraction) to examine their effect on participant's state-anxiety levels. Finally, a previous study has found that reductions in thought discomfort and believability engendered by CD are maintained for up to one week (Deacon et al., 2011). The current study will attempt to measure longer-lasting effects of CD by conducting both a 1-week and 2-week follow-up assessment.

Aims of the Current Study

Aim 1. Determine to what degree people with AS are fused with their thoughts compared to neurotypical people.

Hypothesis 1. People with AS will have slightly higher levels of cognitive fusion than neurotypical people, due to the rigidity and inflexible that is prevalent with AS.

Aim 2. Determine to what degree cognitive fusion predicts anxiety in both groups (AS and NT).

Hypothesis 2. In both groups (AS and NT), cognitive fusion will have a moderately-strong inverse relationship with psychological distress (i.e. depression, anxiety, stress, and total distress)

Aim 3. To determine whether semantic satiation is similarly effective in reducing thought believability and discomfort of distressing thoughts in people with AS compared to an active thought distraction control condition.

Hypothesis 3. CD will be similarly effective in reducing thought believability and discomfort of distressing thoughts in both groups (AS and NT).

Aim 4. To determine how CD and a distraction-based control will affect physiological arousal (measured by heart rate variability and skin conductance) for both groups (AS vs NT).

Hypothesis 4. Given extant research that CD tends to be more effective in reducing thought believability and discomfort than comparison conditions, it is hypothesized that the CD condition will show a greater decrease in physiological arousal than the distraction condition for both groups (AS and NT). Moreover, it is hypothesized that CD will be similarly effective for both groups.

Aim 5. To determine if CD skills have longer-term effects in reducing thought believability and discomfort of distressing thoughts in both groups (AS and NT)

Hypothesis 5. Participants who receive CD in both groups will show attenuated thought believability and discomfort after a one-week and two-week follow-up.

Method

Participants

Demographics of the AS and NT group can be found in Table 1. All participants were at least 17 years old and were given the Wechsler Abbreviated Scale of Intelligence, 2nd Edition (WASI-2; Wechsler, 2011) to establish IQ of at least 80. There were 42 participants with AS included in the study (27 were male). AS participants were recruited from existing 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 by an expert clinician and all AS participants scored above autism spectrum cut-off scores on the Autism Diagnostic Observation Schedule (ADOS; Lord et al., 2000) administered by research-reliable raters. Participants with AS were not excluded based on psychiatric comorbidity. One participant in the AS group could not think of a distressing thought during the experimental portion of the study, and the associated data was not included in those analyses. There were 55 NT participants including in this study (41 were male). NT participants were healthy university students recruited from an online system for course credit who reported no history of psychiatric, developmental disorders, or neurological concerns. There was little ethnic diversity in the current sample, where about 95% of participants in both groups identified as Caucasian.

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

General Study Procedure

This study obtained approval from Brigham Young University's (BYU) Institutional Review Board before recruitment or randomization began. Prospective participants were emailed a link to an online consent form and short survey through Qualtrics software (Qualtrics, Provo, UT). Those meeting eligibility were scheduled for an appointment to the research laboratory at

BYU's MRI Research Facility. A small portion of the AS participants (*n*=3) were seen at local school for students with AS.

After reviewing and signing a hard copy of the consent form with participants, the experimenter attached BioNomadix wireless system with a MP150 base unit from BioPac Systems Inc. (Santa Barbara, CA, USA) to measure participant physiological response throughout the study protocol. Heart rate was measured using the photoplethysmogram (PPG; BN-PULSE-XDCR, BioPac Systems Inc., USA) attached to the index finger, with an amplifier bandpass filter set to 0.5hz to 3hz. Electrodermal activity (EDA; BN-EDA-LEAD2, BioPac Systems Inc., USA) was measured by leads attached to two electrodes with isotonic gel located on the middle and ring fingers, with a bandpass filter set to 3hz. All channels had a sampling rate of 1000hz. Physiological data was recorded and cleaned using Acqknowledge version 4.4.2 (BioPac Systems Inc., USA) according to manufacturer guidelines. While data was collected continuously throughout the experiment, the study utilized E-Prime software 2.0 (Psychology Software Tools, Pittsburgh, PA) to mark specific events for analyses. These events included two neutral baselines, the stressful event of choosing a negative thought, pre- and post- ratings of the thought, and use of the assigned intervention. To get a baseline reading of physiology, participants proceeded to read an article about Stonehenge or the Pyramids of Giza for 5 minutes. The articles were counterbalanced for participants between baseline and recovery.

After having the Bionomadix equipment attached to their fingers and reading the neutral article (e.g., about Stonehenge or the Pyramids of Giza) to attain a physiological baseline, participants completed a battery of questionnaires utilizing Qualtrics software on a computer screen located in front of them. Given that the questionnaires measuring cognitive fusion have never been used in a sample of people with AS, experimenters tracked any questions participants asked about the measures which might indicate confusion or a lack of understanding regarding the question content. Moreover, if participants had any general inquiries about specific questions on these measures, the experimenter instructed them to "answer the best you can." If participants inquired about the context of the question (e.g., they note that the answer "depends" on the specifics of their situation in some way), experimenters responded by telling them "the question is asking about on average, or what is most typical." Experimenters answered participant questions in this standardized way in order to limit confounds.

Once questionnaires were completed, participants engaged in the intervention portion of the study. It is important to note that the thought identification process, thought rating process, and defusion condition were closely based off of procedures outlined in the defusion studies by Masuda & colleagues (Masuda, Feinstein, et al., 2010; Masuda et al., 2004; Masuda et al., 2009; Masuda, Twohig, et al., 2010) and Deacon et al. (2011), whereas the distraction condition was based off of procedures outlined in (Mandavia et al., 2015) and emotion regulation literature (Gross, 2015; Webb et al., 2012) .

First, participants engaged in the thought identification process, where they were told to come up with a highly distressing or anxiety provoking thought which they often experience (e.g. "I am ugly"; See Appendix A for the script). They were given a handout of 15 common distressing thoughts as visual examples (See Appendix B for the handout). Once a specific thought was chosen, they were asked to enter it on the computer in front of them. They were then instructed to re-state the thought as one word (e.g. "ugly") and also enter this one-word thought on 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. These ratings were taken on 100-

mm Likert-style visual analogue scales (VAS) presented on the computer in front of them (see Appendix C for an example of the VAS).

Next, participants were randomized into either the defusion or distraction condition. Similar to extant semantic satiation research, both were designed to take the same amount of time (i.e., approximately 5 minutes) and both included the use of the word “milk” as the primary training tool for the intervention. Additionally, both the defusion and the distraction conditions were designed to have 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.

Defusion condition. See Appendix D for a full script of the defusion condition. Participants were first told 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 they could for 30 seconds along with the experimenter, and to “notice what happens.” After 10 and 20 seconds 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 distressing thoughts, and were reminded of the one word-thought they had come up with. They then repeated the exercise with their targeted thought for 30 seconds, again being reminded to speak “louder” and “faster” after 10 and 20 seconds.

Thought distraction condition. See Appendix E for the full script of the 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 (see Appendix F). They were 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 seconds 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 seconds, again being reminded to "pay attention to the shapes" at 10 and 20 seconds.

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 on a 7-point Likert-scale (ranging from "Strongly Disagree" to "Strongly Agree") about the interventions perceived effectiveness, ease of use, understandability, and the likelihood they will use it again. Finally, participants read a neutral article about either Stonehenge or the construction of the pyramids of Giza for 5 minutes (which were counterbalanced between recovery and baseline) to gain a recovery state for physiology measurements. At 1-week and 2-weeks post-intervention, participants were emailed a link to an online Qualtrics survey asking them to re-assess the believability and discomfort of the original distressing thought they had chosen. The survey reminded them of their thought, and utilized the same VAS scale. Finally, participants were asked how often they practiced their assigned technique over the last week on a 5-point Likert scale (ranging from "Never" to "Always").

Measures

The *Autism Spectrum Quotient* (AQ; Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001) is a 50–item questionnaire 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. It has been used as a dimensional measure of AS-symptoms in clinical populations and in the general public, and is demonstrated to be sensitive to subclinical AS symptoms.

The *Depression Anxiety and Stress Scale-21* (DASS-21; S.H. Lovibond & P.F. Lovibond, 1995) is a questionnaire designed to distinctly discriminate between the constructs of depression, anxiety, and stress. It was created using a subset of the original 42-item DASS scale to serve as a shorter and more efficient measure of specific psychopathology (Antony, Bieling, Cox, Enns, & Swinson, 1998; S.H. Lovibond & P.F. Lovibond, 1995). The DASS-21 includes 21 items which ask participants the extent to which various statements apply to them over the previous week (e.g. "I found it hard to wind down"). Each question is rated on a 4-point Likert scale from 0 ("did not apply to me") to 3 ("applied to me very much or most of the time"). The total score of the DASS-21 can be used as a measure of general psychological distress, or scores can be broken down into three subscales, each made up of 7 items: anxiety, depression, and 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. Moreover, these psychometric capabilities of both the original DASS and the DASS-21 have been replicated in a variety of samples, including clinical, non-clinical, and different racial groups (Antony et al., 1998; Brown, Chorpita, Korotitsch, & Barlow, 1997; Clara, Cox, & Enns, 2001; Crawford & Henry, 2003; Lovibond, 1998; P.F. Lovibond & S.H. Lovibond, 1995; Norton, 2007).

As with most widely used measures, neither the DASS nor the DASS-21 has ever been validated in a large sample of people diagnosed with AS. However, there is support that either can be effectively used with this population. For instance, Maddox & White (2015) used the DASS-21 to show that people with AS scored much higher than neurotypical controls, but similarly to neurotypical people who have social anxiety disorder. Similarly, McGillivray & Evert (2014b) used the DASS as an outcome measure in a group CBT study for treating psychopathology in young adults with AS. They were able to show reductions in stress and depression based off the DASS. Finally, another study by McGillivray & Evert (2014a) found that people with AS scored higher than neurotypical norms on all three subscales of the DASS, which corroborated with extant literature that people with AS present with higher rates of anxiety and depression than neurotypical people (Lugnegård et al., 2011; Mazefsky et al., 2013).

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 (i.e., increased cognitive defusion). The CFQ has a total of 7-items where participants read statements and decide how true each statement is about themselves. Each question is rated on a 7-point Likert scale ranging from 1 (“never true”) to 7 (“always true”). The CFQ was initially developed and validated by Gillanders et al. (2014) in a series of studies involving over 1800 participants and diverse samples. Gillanders et al. (2014) provided supported for the unidimensional nature of the CFQ among different samples through confirmatory factor analysis. Moreover, the CFQ was shown to have excellent psychometric properties, 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). Further, the CFQ was shown to have incremental validity in predicting depression and distress in three separate samples, along with being sensitive to change when a subsection of participants underwent an ACT intervention (Gillanders et al., 2014). While still nascent, there is a quickly growing bodily of research suggesting that the CFQ may be a particularly useful and valid tool in measuring cognitive fusion (McCracken, DaSilva, Skillicorn, & Doherty, 2014; Romero-Moreno, Marquez-Gonzalez, Losada, Gillanders, & Fernandez-Fernandez, 2014; Solé et al., 2015).

While the CFQ has not yet been used in a population with AS, 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. These qualities may also enable the CFQ to be effectively utilized with participants who have AS, as they may be less likely to become overwhelmed or confused by the question content.

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 instructions ask participants to imagine that each question is a thought which has occurred and to answer how valid or believable that thought would be to them. It consists of 16 items each rated on a 7-point Likert scale from 1 (“not at all believable”) to 7 (“completely believable”). 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).

Similar to the CFQ, studies have recently been emerging which support the use of the BAFT in anxiety intervention research. For instance in a recent randomized controlled trial, Gloster et al. (2015) examined the effectiveness of an ACT intervention for people with panic disorder and/or agoraphobia who had received a state-of-the-art treatment in the past which was unsuccessful. While the ACT intervention was shown to be generally helpful in reducing participant anxiety, the outcome measure with the largest effect size was change in BAFT scores between the group who received ACT and the control group. Similarly, a recent single subject design study examining the effectiveness of a 10 session ACT intervention for the treatment of music performance anxiety showed a drastic reduction in the participant's BAFT score going from 77 and ending at 16 at the one month follow-up (a normative score on the BAFT from a different sample in this study was M=50.10, SD=16.88). It is clear that the BAFT is an instrument which is sensitive to change and an important tool in the measurement of cognitive fusion.

Data Analysis Plan

All analyses were conducted with Stata IC version 14.2 (StataCorp, 2015). The data was inspected for outliers and normality. All 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. All analyses using transformed data were also run with non-transformed variables and found analogous results. For ease of interpretation, all results shown in the tables are non-transformed means and standard deviations. 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 variables that did not meet the assumption of normality after transformation or that were ordinal. 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's (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) from paired *t*-tests or Wilcoxon sign rank tests.

The analyses examining intervention effectiveness (i.e. defusion and distraction) were conducted using mixed effects modeling. This approach is recommended for repeated measures studies, as they do not require repeated data for every subject, 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, two models were run for the behavioral data using maximum likelihood estimation, one examining *thought believability* as the dependent variable and one examining *thought discomfort*. Both models included three fixed effects: time (pre-test, post-test, week-one follow-up, two-week follow-up), 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.

Two other mixed effects models were run for the physiology data, one examining heart rate as the primary outcome variable and the other examining skin conductance. Physiology data was collected for 30 seconds at four time points while the participants were at the laboratory: a) in the middle of the 5 minute baseline task (i.e. participants reading a neutral article), b) immediately after participants came up with a distressing thought, c) immediately after engaging in the intervention, and d) in the middle of the 5 minute recovery task (reading a final neutral article). One benefit of mixed effects models was that instead of averaging the data for the 30 seconds, we were able to treat each moment of data collection as a separate time point, allowing us to better capture within subject variance. Therefore, in addition to utilizing a random effect for subject, we included a random effect for slope in the model. This allows the model to take into account change over time for each subject (Winter, 2013). Tests of model fit using Bayesian Information Criterion (BIC) and Akaike Information Criterion (AIC) showed that including a random effect of slope improved overall model fit (Müller, Scealy, & Welsh, 2013). Finally, as with the behavioral data, all main effects and interactions were explored and follow-up tests utilized Bonferroni adjustments.

Results

Sample Characteristics and Dispositional Group Differences

Demographic differences and differences between AS and NT groups can be found in Table 1. The only significant demographic difference between groups was age, where the AS group was slightly older than the NT group. Corroborating with extant research, the AS group reported significantly more autism symptoms, anxiety, depression, and stress. In accordance with this study's hypothesis, the AS group reported significantly more cognitive fusion than the NT group.

Differences between conditions for the AS group can be found in Table 2. Despite randomization, AS participants in the distraction condition (AS-Dis) reported significantly higher depression and cognitive fusion than AS participants in the defusion condition (AS-Def). AS-Dis had near significantly greater overall distress and stress levels than AS-Def (both with p=.06).

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

	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

Finally, AS-Dis had significantly greater FIQ than AS-Def (106.52 and 115.24, respectively). Unlike the AS group, there were no significant differences between NT participants in the defusion group (NT-Def) and those in the distraction group (NT-Dis; see Table 3).

Table 3. *Means and Standard Deviations Compared Across Conditions for NT Group*

	Defusion (*n* = 28)		Distraction (*n* = 27)	
Measure	Mean	(SD)	Mean	(SD)
Age	21.36	(1.83)	21.37	(2.36)
Range	18-26		17-27	
FIQ	109.07	(8.39)	111.52	(10.41)
Range	94-129		89-129	
AQ	15.32	(5.24)	17.37	(6.49)
Range	7-28		6-40	
DASS-T	18.43	(12.09)	18.74	(11.86)
Range	0-44		2-44	
DASS-A	3.00	(3.29)	3.85	(4.00)
Range	0-12		0-14	
DASS-D	6.07	(5.03)	5.41	(4.14)
Range	0-16		0-16	
DASS-S	9.07	(4.60)	9.93	(6.38)
Range	0-16		0-22	
CFQ	21.36	(4.68)	22.00	(6.48)
Range	11-32		10-35	
BAFT	51.25	(15.16)	51.63	(18.90)
Range	18-75		22-82	

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; Wilcoxon Rank Sum test was used for age and DASS-A. Independent t-tests were used for all other variables. DASS-D, DASS-T, and AQ were non-normal, and thus transformed for the analyses. For all variables, non-transformed raw-scores are reported in the table. No test was significant.

Spearman's correlations separated by group and for both groups combined can be found in Table 4. All measures were associated in the expected directions. Of particular interest, it appeared that for both AS and NT groups, higher cognitive fusion was moderately to strongly related to anxiety, depression, and stress, with especially strong associations with overall distress. Associations remained significant when looking at the AS and NT groups combined. This not only corroborates extant research showing the importance of cognitive fusion in the experience of psychopathology, but extends these findings to a group with high functioning autism.

Table 4. *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

When completing the cognitive fusion questionnaires, neither group appeared to have difficulty understanding the items. One AS participant asked for clarification about a CFQ question, and one AS and two NT participants asked for clarification about a BAFT question. While there were slight differences between groups, both the AS and NT participants appeared to find both interventions similarly effective, easy to understand, useful, and reported that they would use it again (see Table 5). Of note, for the NT group only, participants reported practicing the distraction condition to a greater extent compared to the defusion condition at both follow-up points.

Table 5. *Means and Standard Deviations of Feasibility and Practice Ratings Compared by Group and Condition*

	ASD Def (*n*=21)	ASD Dist (*n*=21)	NT Def (*n*=28)	NT Dist (*n*=27)
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)
Week 1 Practice	.80 (.95)	1.19 (1.08)	[c].46 (.74)	[c]1.19 (1.17)
Week 2 Practice	.75 (1.07)	1.25 (1.21)	[D].32 (.56)	[D]1.40 (1.04)

Note: Def = Cognitive Defusion; Dist = Distraction; 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; Wilcoxon Rank-Sum Tests were used to determine significant differences between groups and conditions. Corresponding small letters indicate significant differences between conditions in a single group (e.g. did the ASD group rate defusion as more effective than distraction). Corresponding small numbers indicate significant differences on the same condition between two groups (e.g. did the ASD group rate defusion as more effective than the NT group).

Mixed Effect Modeling of Behavioral Data

To test assumptions of the mixed model as recommended by Winter (2013), residual plots were visually inspected. There were no apparent deviation 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 et al., 2013; Winter, 2013). Extant 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, Feinstein, et al., 2010; Masuda et al., 2009; 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 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. Moreover, the trend of results were highly similar in both models.

For follow-up data at week one, total missingness (including low scores initially dropped) comprised of two observations for AS thought discomfort, four for AS thought believability, nine for NT thought discomfort, and four for NT thought believability. For week two, total missingness included three for AS thought discomfort, four for AS thought believability, 13 for NT discomfort, and eight for typical believability. Data was determined to be Missing at Random (MAR) as evidenced by no significant correlations between variable's missing data and other study variables.

Thought Believability as the Outcome Variable

Primary findings. A mixed effects model using thought believability as the outcome variable showed a significant main effect for time (χ^2 (3, N=97) = 69.92, p<.0001) and diagnosis (χ^2(1, N=97) = 8.67, p<.01), and a significant three way interaction for time by condition by diagnosis (χ^2(3, N=97) = 9.29, p<.05; see Figure 1). These findings were further explored as follows. First, when exploring the main effect of time, participants in each group showed a significant reduction in thought believability from pre-test to post-test (AS-Def=- 22.10, AS-Dis=-12.83, NT-Def=-15.89, NT-Dis=-17.25) with medium to large effect sizes (see Table 6). This suggests that both interventions were immediately effective in reducing thought believability for AS and NT participants. Results also showed that AS-Dis, NT-Dis, and NT-Def maintained a significant reduction in thought believability from pre-test to week-two follow-up (-21.39, -13.90, -13.58, respectively). In contrast, AS-Def's initial improvement in thought believability was not maintained to the follow-up points, and this group showed an increase in thought believability from post-test to week-two follow-up (+14.39).

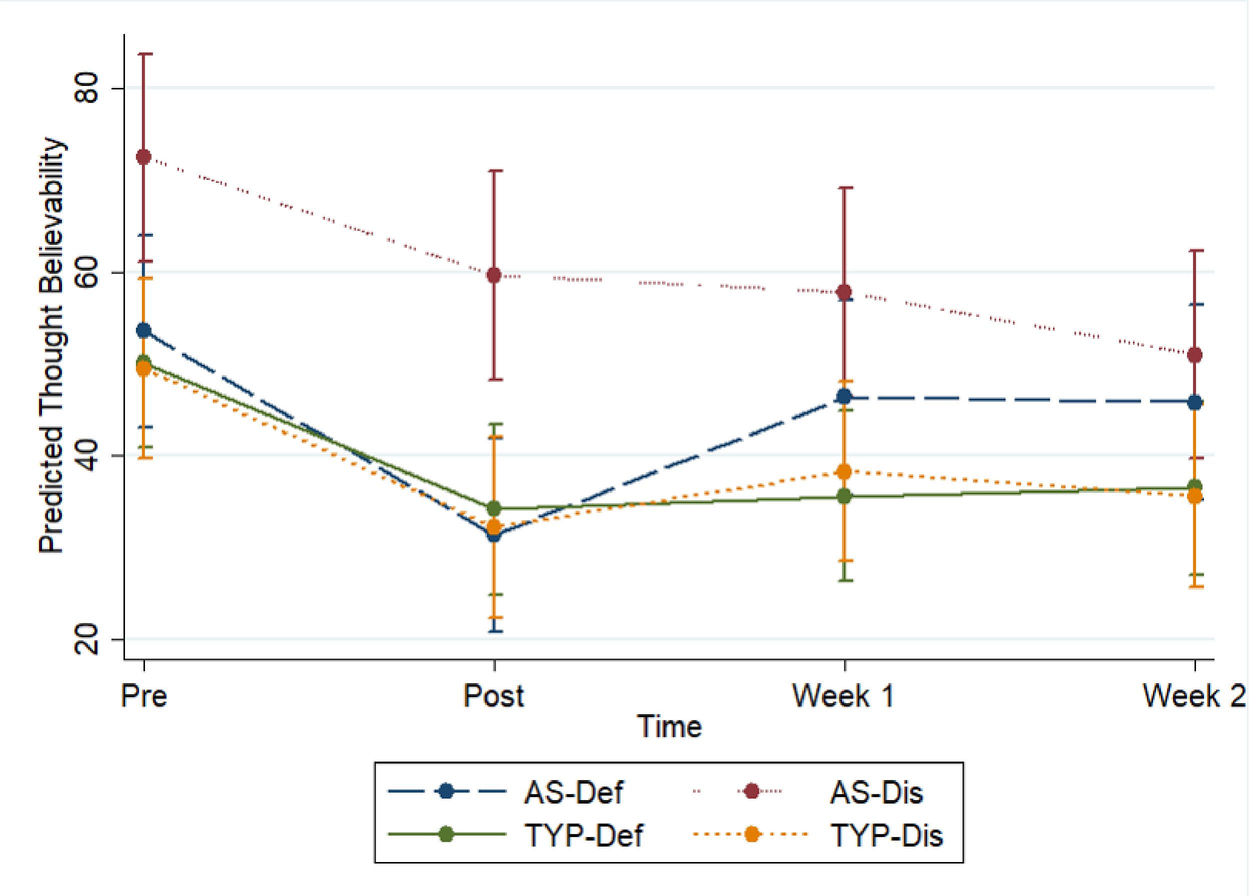

Figure 1. Depiction of a mixed effects model showing predicted change in thought believability for each time point. Error bars represent 95% confidence intervals.

Table 6. *Post-Hoc Results Over Time for Thought Believability with Bonferroni Corrections*

	Contrast	Z	P	95% CI	*d*
ASD					
Defusion					
Pre to Post	-22.10	-4.94	<.001	-33.89, -10.30	.86
Pre to Week 1	-7.18	-1.58	.69	-19.17, 4.81	.31
Pre to Week 2	-7.70	-1.69	.54	-19.69, 4.29	.27
Post to Week 1	14.92	3.28	.006	2.93, 26.90	.63
Post to Week 2	14.39	3.17	.009	2.41, 26.38	.73
Week 1 to Week 2	-.52	-.11	1.00	-12.70, 11.65	.08
Distraction					
Pre to Post	-12.83	-2.66	.047	-25.58, -.09	.76
Pre to Week 1	-14.67	-3.04	.014	-27.41, -1.92	1.07
Pre to Week 2	-21.39	-4.43	<.001	-34.13, -8.64	1.05
Post to Week 1	-1.83	-.38	1.00	-14.58, 10.91	.09
Post to Week 2	-8.56	-1.77	.459	-21.30, 4.19	.35
Week 1 to Week 2	-6.72	-1.39	.984	-19.47, 6.02	.40
NT					
Defusion					
Pre to Post	-15.89	-4.03	<.001	-26.30, -5.48	.85
Pre to Week 1	-14.48	-3.67	.001	-24.89, -4.08	.56
Pre to Week 2	-13.58	-3.31	.006	-24.39, -2.76	.61
Post to Week 1	1.41	.36	1.00	-9.00, 11.81	.07
Post to Week 2	2.31	.56	1.00	-8.51, 13.13	.11
Week 1 to Week 2	.90	.22	1.00	-9.91, 11.72	.14
Distraction					
Pre to Post	-17.25	-4.12	<.001	-28.29, -6.21	1.19
Pre to Week 1	-11.21	-2.68	.044	-22.25, -.17	.47
Pre to Week 2	-13.90	-3.28	.006	-25.09, -2.71	.60
Post to Week 1	6.04	1.44	.89	-5.00, 17.08	.26
Post to Week 2	3.35	0.79	1	-7.84, 14.54	.16
Week 1 to Week 2	-2.69	-0.63	1	-13.88, 8.50	.24

Additionally, when considering the main effect for diagnosis, post-hoc testing showed that overall, the AS group tended to report greater thought believability than the NT group (see Table 7).

Table 7. *Differences in Believability by Diagnosis with Bonferroni Corrections*

	Contrast	Z	P	95% CI
Defusion at Pre-Test	-3.45	-.48	1	-22.94, 16.04
Defusion at Post-Test	2.76	.39	1	-16.73, 22.24
Defusion at Week 1	-10.75	-1.50	1	-30.36, 8.86
Defusion at Week 2	-9.33	-1.29	1	-29.17, 10.52
Distraction at Pre-Test	-22.89	-3.00	.022	-43.77, -2.01
Distraction at Post-Test	-27.31	-3.58	.003	-48.19, -6.42
Distraction at Week 1	-19.43	-2.54	.088	-40.31, 1.45
Distraction at Week 2	-15.40	-2.01	.357	-36.37, 5.57

Note: This table compares believability scores for AS vs NT across time points and conditions. Negative scores indicate higher AS believability, whereas positive indicate higher NT believability.

Three way interaction. Next, the three-way interaction was explored. A three-way interaction implies that a two-way interaction varies across levels of a third variable (UCLA: Statistical Consulting Group, n.d.). In the current study, this suggests that thought believability varied over time depending on the condition (DEF vs DIS), which further varied whether somebody was in the AS or NT group. While a three-way interaction was not originally hypothesized by the authors, in examining the full mixed effects model results in Figure 1 and the post-hoc results in Table 6, it appeared that this interaction involved thought believability for AS-Dis, NT-Dis, and NT-Def remaining either stable or trending downwards from post-test to week-two follow-up, while the AS-Def group deteriorated and had a significant increase in thought believability after post-test.

To further test the above explanation of the three-way interaction, a series of two-way mixed effects models were conducted to examine the specific rates of change (i.e. two-way interaction terms) from post-test to week-one and week-two follow-up points. The first set of models looked at the post-test to follow-up differences between defusion and distraction for the AS group by itself (AS-Def vs AS-Dis) and for the NT group by itself (NT-Def vs NT-Dis). For the AS group only, there was a significant interaction for time by condition (χ^2 (2, N=39) =

14.46, *p*<.001), showing that people in the AS group who received defusion deteriorated faster over time compared to people in the AS group who received distraction (see Figure 2). In contrast, when looking the NT group only, there was no significant interaction (see Figure 2). This shows that regardless of what intervention the NT participants received, their thought believability remained similarly reduced over time.

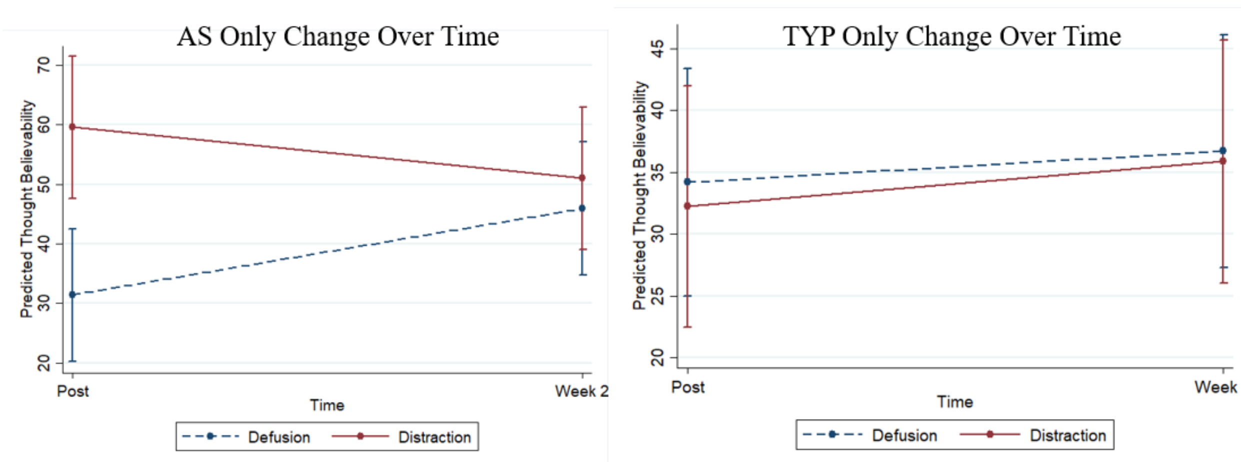

Figure 2. Mixed effects model showing change in believability from post-test to week-2 follow-up for the AS group only and for NT group only. Error bars represent 95% confidence intervals.

While the above models showed a significant interaction when comparing the interventions for the AS group and no interaction when comparing them for the NT group, it was also important to determine if there was an interaction when directly comparing AS to NT. Therefore, the second set of mixed effects models looked at the differences between the AS group and NT group for defusion by itself (AS-Def vs NT-Def) and for distraction by itself (AS-Dis vs NT-Dis) from post-test to week-two follow-up.

Similar to the findings above, the model comparing AS-Def to NT-Def found a significant interaction of diagnosis by time (χ^2 (2, N=44) = 7.79, p<.05; see Figure 3). This shows that defusion lead to an increase in thought believability over time for participants in the AS group compared to participants in the NT group. The model comparing AS-Dis to NT-Dis found no significant interaction, showing that both AS and NT participants responded similarly to the distraction intervention (see Figure 3). In sum, this set of two-way mixed effects models offers strong evidence that the AS-Def group had an increase in thought believability after post-test compared to all other comparison groups.

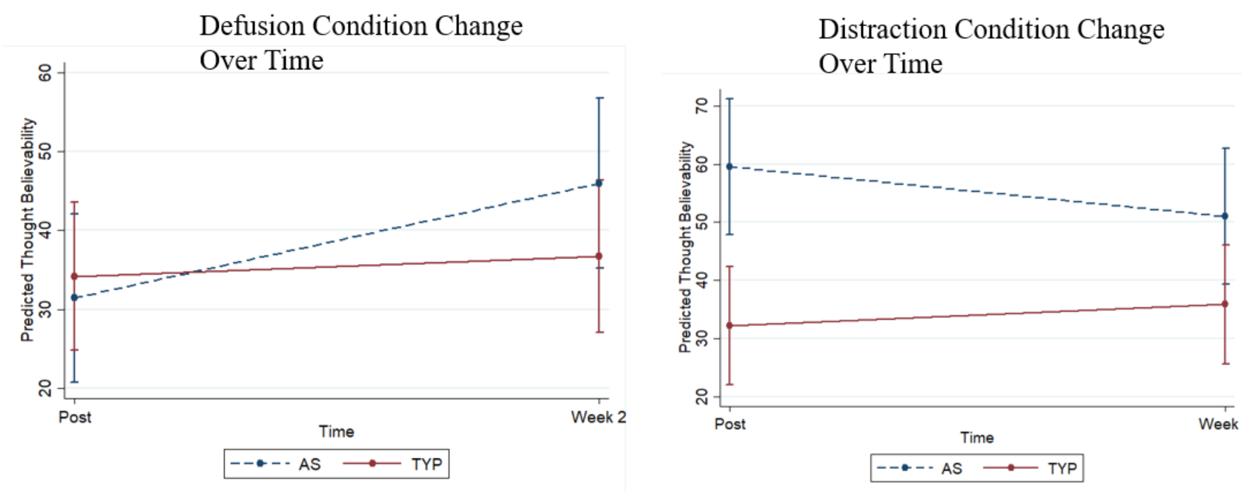

Figure 3. Predicted change in thought believability from post-test to week-2 follow-up for AS-Def and NT-Def only and for AS-Dis and NT-Dis only. Error bars represent 95% confidence intervals.

Combining groups by diagnostic status. A final mixed effect model was run to explore the effects of the interventions combined for AS (AS-Com) compared to NT (NT-Com). There was a main effect for time (χ^2 (3, N=97) = 66.93, p<.0001) and diagnosis (χ^2 (1, N=97) = 7.41, p<.01), and no significant interaction terms (see Figure 4).

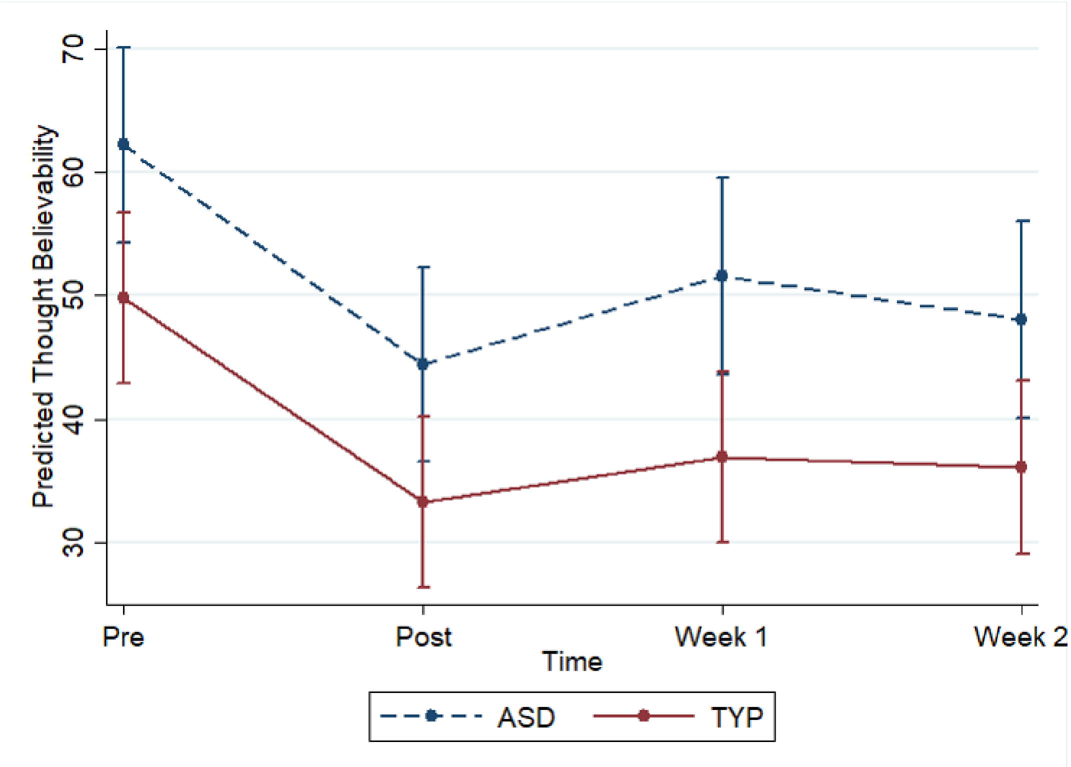

Figure 4. Predicted thought believability over time with combined conditions. Error bars represent 95% confidence intervals.

With regards to the main effect for time, post hoc testing showed that both groups had a reduction in thought believability from pre-test to post-test (AS-Com = -17.82, NT-Com = -16.53; see Table 8).

Table 8. *Post-Hoc Results Over Time for Thought Believability Using Combined Groups with Bonferroni Corrections*

	Contrast	Z	P	95% CI
AS-Combined				
Pre to Post	-17.82	-5.29	<.001	-26.71, -8.93
Pre to Week 1	-10.67	-3.14	.01	-19.64, -1.71
Pre to Week 2	-14.16	-4.17	<.001	-23.12, -5.19
Post to Week 1	7.15	2.10	.21	-1.82, 16.12
Post to Week 2	3.66	1.08	1.00	-5.30, 12.63
Week 1 to Week 2	-3.48	-1.02	1.00	-12.52, 5.56
NT-Combined				
Pre to Post	-16.53	-5.61	<.001	-24.30, -8.76
Pre to Week 1	-12.94	-4.39	<.001	-20.71, -5.17
Pre to Week 2	-13.75	-4.54	<.001	-21.73, -5.77
Post to Week 1	3.59	1.22	1.00	-4.18, 11.36
Post to Week 2	2.78	0.92	1.00	-5.20, 10.76
Week 1 to Week 2	-0.81	-0.27	1.00	-8.79, 7.18

Moreover, thought believability remained significantly lower for both groups from pre-test to week-one follow-up (AS-Com = 10.67, NT-Com = 12.94) and from pre-test to week-two follow-up (AS-Com= -14.16, NT-Com = -13.75). Post-hoc testing for the main effect of diagnosis showed that overall, ASD-Com had higher thought believability than NT-Com (see Table 9).

Table 9. *Differences in Thought Believability by Diagnosis Using Combined Groups with Bonferroni Corrections*

	Contrast	Z	P	95% CI
Pre-Test	-12.43	-2.32	.08	-25.82, .97
Post-Test	-11.14	-2.08	.15	-24.53, 2.26
Week 1	-14.69	-2.73	.03	-28.13, -1.25
Week 2	-12.02	-2.22	.11	-25.57, 1.53

Note: This table compares believability scores for AS vs NT across different time points. Negative scores indicate higher AS believability, whereas positive indicate higher NT believability.

Pre-test to post-test differences for AS and NT. Overall, results from the full mixed model above show that both interventions were similarly effective at reducing thought believability in the short-term, and only the ASD-Def group showed no longer-term improvement. It is important to note that semantic satiation is often considered to be most useful as a quick experiential exercise to allow people to experience defusion, to be followed by more extensive exercises which clients can practice at home (Masuda, Feinstein, et al., 2010; Masuda, Twohig, et al., 2010). Therefore in the current study, there is special interest in examining the pre-test to post-test results more specifically. Moreover, post-hoc results showed that the thought reduction in AS-Def was nearly doubled that of AS-Dis (AS-Def=- 22.10, AS-Dis=-12.83; see Table 6).

To explore how condition affected change from pre-test to post-test in more depth, two mixed models were run examining a time by condition interaction for AS only and for NT only. There was no significant interaction for either group, suggesting that defusion and distraction worked similarly for both the AS and NT participants. It is important to note that AS-DIS appeared to have a higher baseline of thought believability than AS-Def. In fact, the full-mixed effects model showed that at pre-test, AS-Dis had rated their thoughts 18.87 points higher than AS-Def (see Table 10).

Table 10. *Differences in Believability by Condition with Bonferroni Corrections*

	Contrast	Z	P	95% CI
ASD at Pre-Test	18.87	2.40	.13	-2.65, 40.38
ASD at Post-Test	28.13	3.58	<.01	6.61, 49.64
ASD at Week-1	11.38	1.44	1.00	-10.25, 33.00
ASD at Week-2	5.18	0.65	1.00	-16.45, 26.80
NT at Pre-Test	-.57	-0.08	1.00	-19.36, 18.21
NT at Post- Test	-1.94	-0.28	1.00	-20.72, 16.85
NT at Week-1	2.70	0.39	1.00	-16.09, 21.49
NT at Week-2	-.89	-0.13	1.00	-20.02, 18.24

Note: This table compares believability scores for Defusion vs Distraction across different time points and diagnostic group. Negative scores indicate higher defusion believability, whereas positive indicate higher believability for distraction

With the conservative Bonferroni corrections this was not significant, but when run without the corrections it became significant (p=.02, CI [3.45, 34.29]). Additionally, as shown in Table 2, on the questionnaires the AS-Dis group reported significantly higher depression and cognitive fusion, with a trend towards higher overall psychological distress and stress than AS-Def. Thus, despite random assignment, AS-Dis appears to have more psychological concerns than AS-Def group, making direct comparison of interventions for the AS group difficult. While it appears that defusion and distraction similarly reduced thought believability for the AS group, these results must be interpreted cautiously.

Pre-test to post-test exploratory analyses. Finally, a set of exploratory analyses were run to determine whether pre-test scores influenced how each group immediately responded to the interventions (i.e. the rate of change from pre-test to post-test). To do this, each questionnaire was entered into the mixed effect model one at a time as a covariate. Since the condition x time interaction is the treatment effect, a significant three-way interaction with condition x time x covariate denoted that the questionnaire did influence the rate of change differentially between conditions. In the current study the DASS-A, DASS-T, BAFT, and AQ were shown to affect pre-test to post-test change for the NT group. No questionnaire was shown to affect change for the AS group.

Mixed effects modeling was then used to predict how NT participants in each condition would respond to low, medium, and high scores (which were based on each questionnaires range, mean, and SD) on the DASS-A, DASS-T, BAFT, and AQ. For every questionnaire a clear pattern emerged, where distraction appeared to be more effective than defusion in reducing thought believability at higher levels of reported symptoms (see Table 11 and Figure 5 for the predicted pre-test to post-test differences in each condition for participants who scored in varying symptom ranges on each questionnaire).

Table 11. *Pre-Test to Post-Test Differences at Varying Levels of Covariates for NT Group*

	Contrast	Z	*P*	95% CI
Thought Believability				
DASS-A				
Defusion at 0	-22.72	-5.64	<.001	-30.63, -14.82
Distraction at 0	-13.85	-3.07	<.01	-22.69, -5.01
Defusion at 5	-11.47	-3.33	.001	-18.23, -4.71
Distraction at 5	-17.93	-5.59	<.001	-24.21, -11.65
Defusion at 10	-.22	-0.03	.98	-13.82, 13.39
Distraction at 10	-22.01	-3.99	<.001	-32.82, -11.19
DASS-T				
Defusion at 0	-26.26	-4.83	<.001	-36.92, -15.59
Distraction at 0	-11.51	-1.90	.06	-23.40, .38
Defusion at 20	-15.01	-4.99	<.001	-20.91, -9.12
Distraction at 20	-17.50	-5.52	<.001	-23.72, -11.28
Defusion at 40	-3.77	-0.62	.54	-15.72, 8.18
Distraction at 40	-23.49	-3.64	<.001	-36.14, -10.84
BAFT				
Defusion at 20	-28.89	-4.21	<.001	-42.34, -15.44
Distraction at 20	-10.55	-1.75	.08	-22.37, 1.27
Defusion at 50	-16.43	-5.47	<.001	-22.31, -10.54
Distraction at 50	-16.98	-5.34	<.001	-23.21, -10.75
Defusion at 80	-3.97	-0.62	.54	-16.52, 8.59
Distraction at 80	-23.41	-4.12	<.001	-34.56, -12.27
AQ				
Defusion at 0	-40.24	-4.38	<.001	-58.25, -22.22
Distraction at 0	-17.34	-1.98	<.05	-34.53, -.15
Defusion at 20	-8.63	-2.20	<.05	-16.33, -.93
Distraction at 20	-17.24	-5.19	<.001	-23.75, -10.72
Defusion at 40	22.98	1.62	.12	-4.87, 50.82
Distraction at 40	-17.14	-1.57	.12	-38.51, 4.24

Note: Significance denotes a significant change from pre-test to post-test.

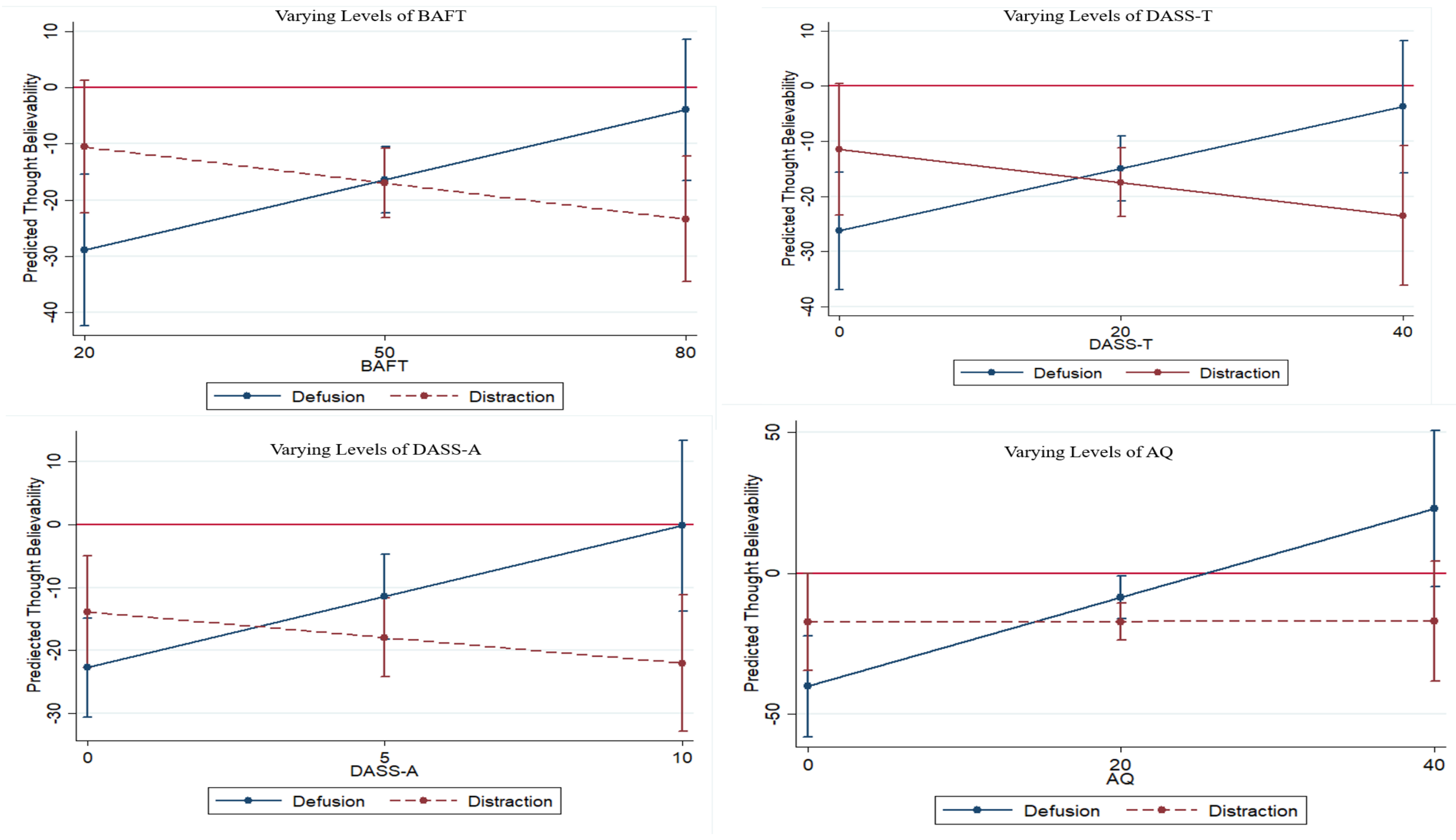

Figure 5. Pre-test to post-test change in thought believability for the NT group at varying levels of the BAFT, DASS-T, DASS-A, and AQ. Error bars represent 95% confidence interval.

For instance, defusion and distraction worked similarly for participants who scored low on the DASS-A. However, distraction was more effective for participants who scored high on the DASS-A. A series of chi-square analyses were also run to test for significance and confirmed these results (see Table 12). It is important to note that defusion worked significantly better than distraction at reducing thought believability for participants who scored in the low-range of the BAFT and trended in that direction for participants who scored in the low range of the DASS-T, though chi-square tests showed that it did not quite reach significance (see Table 12).

Table 12. *Chi-Square Tests for Rate of Change Differences Between Conditions at Varying Levels of Covariates for NT Group*

	Contrast	Chi-Square Test	95% CI
Thought Believability			
DASS-A = 0	8.87	χ^2 (1, *N*=51) = 2.15, *p*=.14	-2.99, 20.73
DASS-A = 5	-6.46	χ^2 (1, *N*=51) = 1.88, *p*=.17	-15.69, 2.77
DASS-A=10	-21.79	χ^2 (1, *N*=51) = 6.04, *p*<.05	-39.16, -4.41
DASS-T = 0	14.75	χ^2 (1, *N*=51) = 3.28, *p*=.07	-1.22, 30.72
DASS-T = 20	-2.49	χ^2 (1, *N*=51) = .32, *p*=.57	-11.05, 6.08
DASS-T = 40	-19.72	χ^2 (1, *N*=51) = 4.93, *p*<.05	-37.12, -2.32
BAFT = 20	18.34	χ^2 (1, *N*=51) = 4.03, *p*<.05	.44, 36.24
BAFT = 50	-.55	χ^2 (1, *N*=51) = .02, *p*= .90	-9.12, 8.01
BAFT = 80	-19.45	χ^2 (1, *N*=51) = 5.16, *p*<.05	-36.23, -2.66
AQ = 0	22.90	χ^2 (1, *N*=51) = 3.25, *p*=.07	-2.00, 47.80
AQ = 20	-8.61	χ^2 (1, *N*=51) = 2.80, *p*=.09	-18.69, 1.48
AQ = 40	-40.11	χ^2 (1, *N*=51) = 5.02, *p*<.05	-75.21, -5.01

Note: Negative contrast denotes that distraction reduced thought believability more than defusion. Positive contrast denotes that defusion reduced thought believability more than distraction.

Thought Discomfort as the Outcome Variable

Primary findings. A mixed effects model using thought discomfort as the outcome variable showed a significant main effect of time (χ^2 (3, *N*=97) =146.03 , *p*<.0001) and a significant interaction of diagnosis by condition (χ^2 (1, *N*=97) =4.67 , *p*<.05). As depicted in Figure 6, 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 13) 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. Further, results showed that all groups (AS-Def, AS-Dis, NT-Def, NT-Dis) maintained a significant reduction in thought believability from pre-test to week-two follow-up (-19.82, -21.45, -12.24, -24.38, respectively).

Table 13. *Post-Hoc Results Over Time for Thought Discomfort with Bonferroni Corrections*

	Contrast	Z	P	95% CI	*d*
ASD					
Defusion					
Pre to Post	-28.35	-6.07	<.001	-40.68, -16.02	1.08
Pre to Week 1	-19.08	-4.02	<.001	-31.61, -6.54	.77
Pre to Week 2	-19.82	-4.17	<.001	-32.35, -7.28	.72
Post to Week 1	9.27	1.95	.306	-3.26, 21.81	.46
Post to Week 2	8.53	1.80	.435	-4.00, 21.07	.32
Week 1 to Week 2	-.74	-.15	1.00	-13.48, 12.00	.06
Distraction					
Pre to Post	-24.33	-5.33	<.001	-36.37, -12.30	1.09
Pre to Week 1	-16.90	-3.71	.001	-28.94, -4.87	.97
Pre to Week 2	-21.45	-4.63	<.001	-33.67, -9.22	.97
Post to Week 1	7.43	1.63	.621	-4.61, 19.46	.32
Post to Week 2	2.89	.62	1	-9.34, 15.11	.07
Week 1 to Week 2	-4.54	-.98	1	-16.76, 7.68	.20
NT					
Defusion					
Pre to Post	-21.39	-4.91	<.001	-32.89, -9.89	1.33
Pre to Week 1	-12.91	-2.96	.018	-24.41, -1.41	.64
Pre to Week 2	-12.24	-2.68	.044	-24.27, -.21	.59
Post to Week 1	8.48	1.95	.311	-3.02, 19.98	.41
Post to Week 2	9.15	2.01	.269	-2.88, 21.18	.43
Week 1 to Week 2	.67	.15	1.00	-11.36, 12.70	.12
Distraction					
Pre to Post	-29.38	-6.88	<.001	-40.63, -18.12	1.75
Pre to Week 1	-19.66	-4.54	<.001	-31.09, -8.24	.89
Pre to Week 2	-24.38	-5.55	<.001	-35.96, -12.79	.95
Post to Week 1	9.71	2.24	.149	-1.71, 21.13	.47
Post to Week 2	5.00	1.14	1.00	-6.59, 16.58	.24
Week 1 to Week 2	-4.71	-1.07	1.00	-16.38, 6.95	.34

The two-way interaction shows that beginning at baseline and over all subsequent time points, the AS-Dis group tended to report higher thought discomfort than NT-Dis, while AS-Def and NT-Def reported similar levels of thought discomfort (see Table 14 and Figure 6).

Table 14. *Differences in thought discomfort by diagnosis with Bonferroni corrections*

	Contrast	Z	P	95% CI
Defusion at Pre	-4.12	-.63	1.00	-22.15, 13.90
Defusion at Post	2.83	.43	1.00	-15.19, 20.86
Defusion at Week 1	2.04	.31	1.00	-16.14, 20.22
Defusion at Week 2	3.45	.51	1.00	-15.09, 21.99
Distraction at Pre	-12.35	-1.92	.44	-29.96, 5.27
Distraction at Post	-17.39	-2.70	.056	-35.01, .23
Distraction at Week 1	-15.10	-2.33	.159	-32.84, 2.63
Distraction at Week 2	-15.28	-2.32	.161	-33.26, 2.71

Note: Negative contrast denotes ASD is elevated. Positive contrast denotes NT is elevated

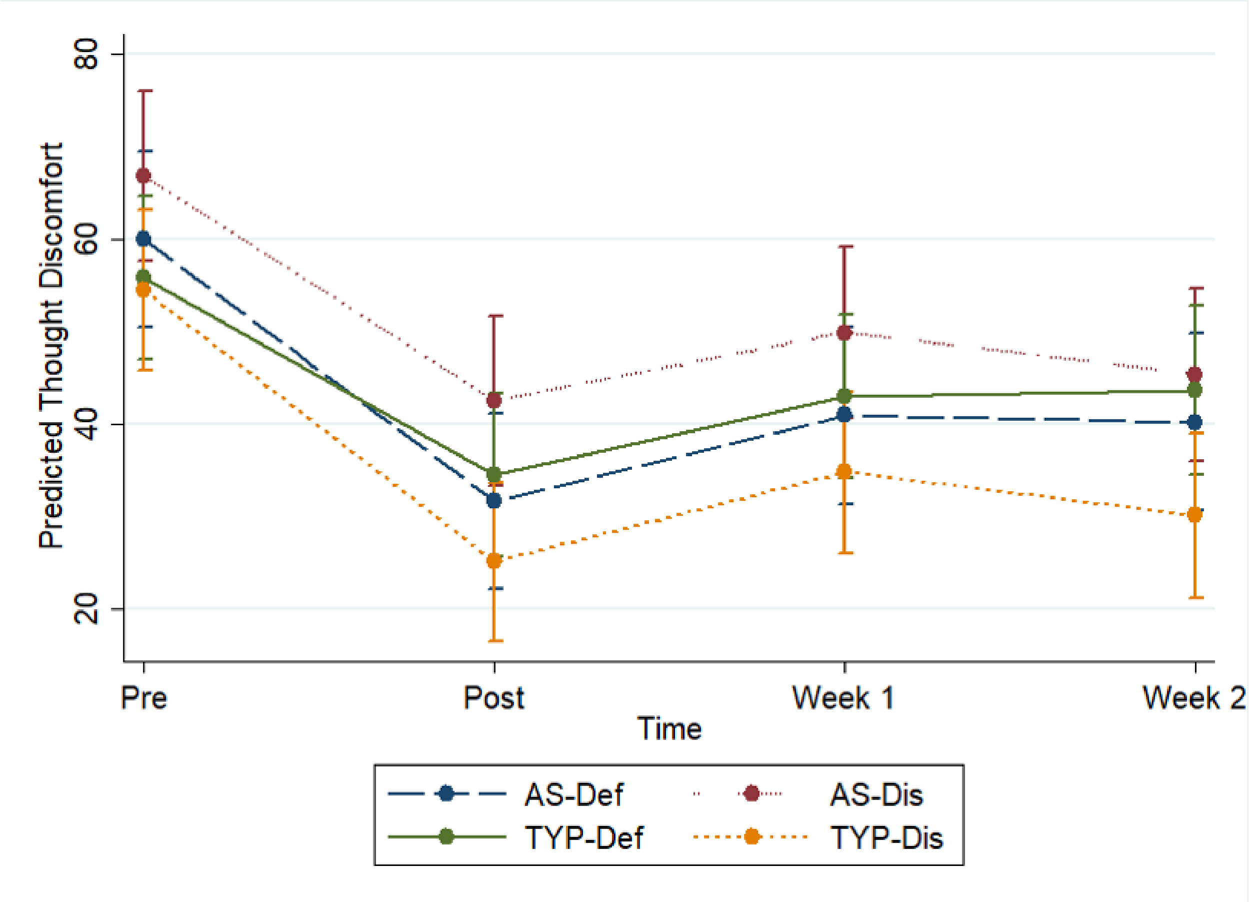

Figure 6. Depiction of a mixed effects model showing predicted change in thought discomfort for each time point. Error bars represent 95% confidence intervals.

Combining groups by diagnostic status. A mixed effect model was run to explore the effects of the interventions combined for AS (AS-Com) compared to NT (NT-Com). There was a main effect for time (χ^2 (3, N=97) = 144.12, p<.0001) and a close to significant main effect for diagnosis (χ^2 (1, N=97) = 3.54, p=.06). There were no significant interaction terms (see Figure 7).

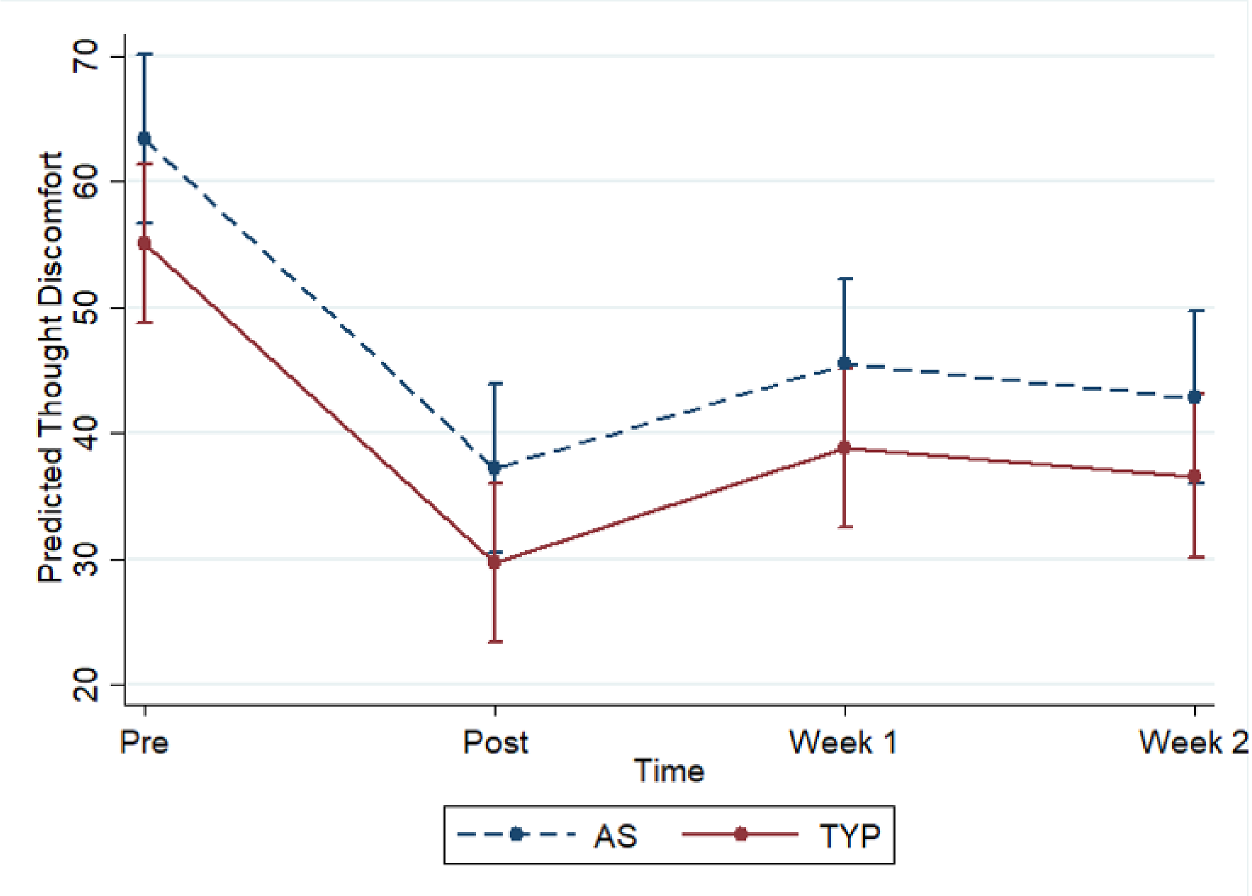

Figure 7. Predicted thought discomfort over time with combined conditions. Error bars represent 95% confidence intervals

With regards to the main effect for time, post hoc testing showed that both groups had a significant reduction in thought discomfort from pre-test to post-test (AS-Com = -26.29, NT-Com = -25.47; see Table 15).

Table 15. *Post-Hoc Results Over Time for Thought Discomfort Using Combined Groups with Bonferroni Corrections*

	Contrast	Z	P	95% CI
Group				
AS-Combined				
Pre to Post	-26.29	-7.99	<.001	-34.98, -17.61
Pre to Week 1	-17.92	-5.40	<.001	-26.68, -9.17
Pre to Week 2	-20.65	-6.17	<.001	-29.47, -11.82
Post to Week 1	8.37	2.52	.07	-.38, 17.13
Post to Week 2	5.64	1.69	.55	-3.18, 14.47
Week 1 to Week 2	-2.73	-.81	1.00	-11.62, 6.17
NT-Combined				
Pre to Post	-25.47	-8.28	<.001	-33.58, -17.36
Pre to Week 1	-16.31	-5.27	<.001	-24.48, -8.14
Pre to Week 2	-18.53	-5.81	<.001	-26.95, -10.12
Post to Week 1	9.16	2.96	<.05	.99, 17.33
Post to Week 2	6.93	2.17	.18	-1.48, 15.35
Week 1 to Week 2	-2.22	-.70	1.00	-10.67, 6.22

Moreover, thought discomfort remained significantly lower for both groups from pre-test to week-one follow-up (AS-Com = -17.92, NT-Com = -16.31) and from pre-test to week-two follow-up (AS-Com = -20.65, NT-Com = -18.53). Post-hoc testing for the near-significant main effect of diagnosis showed that overall, ASD-Com tended to have higher thought discomfort than NT-Com (see Table 16).

Table 16. *Differences in thought discomfort by diagnosis using combined groups with Bonferroni corrections*

	Contrast	Z	P	95% CI
Pre-Test	-8.33	-1.77	.31	-20.08, 3.42
Post-Test	-7.51	-1.60	.44	-19.26, 4.24
Week 1	-6.72	-1.42	.62	-18.56, 5.11
Week 2	-6.22	-1.29	.79	-18.25, 5.81

Note: This table compares discomfort scores for AS vs NT across different time points. Negative scores indicate higher AS discomfort, whereas positive indicate higher NT discomfort.

Pre-test to post-test differences for AS and NT. Overall, results from the full mixed model above show that both interventions were similarly effective at reducing thought discomfort immediately and over a two-week follow-up period. As with thought believability, the current study aimed to specifically explore if there were differences between condition for AS group and for the NT group. Two mixed models were run examining a time by condition interaction for AS only and for NT only. There was no significant interaction for either group, suggesting that defusion and distraction worked similarly for both the AS and NT participants. However, as noted before, comparison of AS-Dis and AS-Def must be done with caution due to the AS-Dis group appearing more symptomatic from baseline.

Pre-test to post-test exploratory analyses. Similar with the outcome variable of thought believability, a set of exploratory analyses were run to determine whether pre-test scores influenced how each group immediately responded to the interventions (i.e. the rate of change of thought discomfort from pre-test to post-test). In the current study varying levels of DASS-D, DASS-T, and FIQ were shown to affect pre-test to post-test change for the ASD group (see Table 17 and Figure 8).

Table 17. *Pre-Test to Post-Test Differences at Varying Levels of Covariates for AS Group*

	Contrast	Z	*P*	95% CI
Thought Discomfort				
DASS-D				
Defusion at 5	-35.50	-6.05	<.001	-47.00, -24.00
Distraction at 5	-18.58	-2.46	<.05	-33.36, -3.79
Defusion at 20	-13.16	-1.58	.11	-29.48, 3.17
Distraction at 20	-26.78	-4.94	<.001	-37.41, -16.15
Defusion at 35	9.18	.53	.60	-24.68, 43.04
Distraction at 35	-34.98	-2.97	<.01	-58.04, -11.93
DASS-T				
Defusion at 10	-40.86	-4.84	<.001	-57.41, -24.31
Distraction at 10	-14.93	-1.42	.16	-35.57, 5.71
Defusion at 40	-25.48	-4.83	<.001	-35.82, -15.14
Distraction at 40	-23.09	-4.55	<.001	-33.03, -13.15
Defusion at 70	-10.09	-0.91	.36	-31.84, 11.65
Distraction at 70	-31.25	-3.71	<.001	-47.78, -14.72
FIQ				
Defusion at 90	-14.49	-1.84	.07	-29.88, .91
Distraction at 90	-39.21	-3.27	<.01	-62.74, -15.69
Defusion at 110	-32.55	-6.20	<.001	-42.83, -22.27
Distraction at 110	-27.42	-5.17	<.001	-37.82, -17.02
Defusion at 130	-50.61	-4.60	<.001	-72.18, -29.05
Distraction at 130	-15.63	-1.95	.05	-31.35, .09

Note: Significance denotes a significant change from pre-test to post-test.

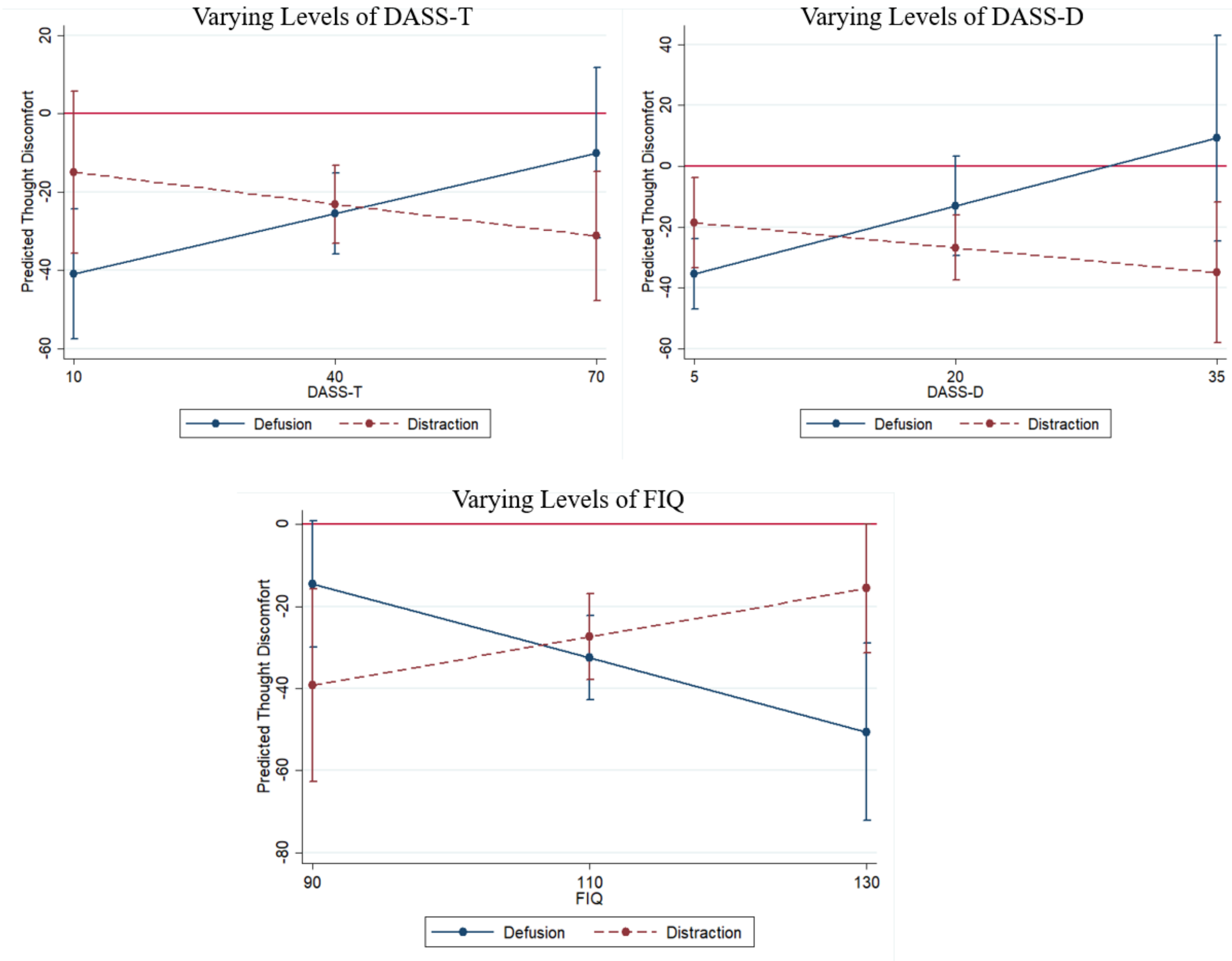

Figure 8. Pre-test to post-test change in thought believability for the AS group at varying levels of the DASS-T, DASS-D, and FIQ. Error bars represent 95% confidence interval.

No questionnaire was shown to affect rate of change for the NT group. For both the DASS-D and DASS-T, defusion was more effective at reducing thought discomfort for participants who reported low levels of symptoms, while distraction worked better for those that reported high levels. Interestingly, defusion appeared to reduce thought discomfort more effectively for AS participants who had higher FIQ scores. A series of chi-square analyses were also run to test for significant differences between conditions (see Table 18).

Table 18. *Chi-Square Tests for Rate of Change Differences Between Conditions at Varying Levels of Covariates for AS Group*

	Contrast	Chi-Square Test	95% CI
Thought Discomfort			
DASS-D=5	16.92	χ^2 (1, *N*=41) = 3.13, *p*=.08	-1.81, 35.65
DASS-D=20	-13.62	χ^2 (1, *N*=41) = 1.88, *p*=.17	-33.10, 5.86
DASS-D=35	-44.16	χ^2 (1, *N*=41) = 4.47, *p*<.05	-85.13, -3.20
DASS-T = 10	25.93	χ^2 (1, *N*=41) = 3.69, *p*=.05	-.53, 52.39
DASS-T = 40	2.39	χ^2 (1, *N*=41) = .11, *p*=.74	-11.95, 16.73
DASS-T = 70	-21.15	χ^2 (1, *N*=41) = 2.30, *p*=.13	-48.47, 6.16
FIQ = 90	-24.73	χ^2 (1, *N*=41) = 2.97, *p*=.08	-52.84, 3.39
FIQ = 110	5.13	χ^2 (1, *N*=41) = .47, *p*=.49	-9.50, 19.75
FIQ = 130	34.98	χ^2 (1, *N*=41) = 6.60, *p*<.05	8.29, 61.67

Note: Negative contrast denotes that distraction reduced thought discomfort more than defusion. Positive contrast denotes that defusion reduced thought discomfort more than distraction.

Physiology

All physiology data was visually examined for quality of data and outliers. Skin conductance data was square root transformed before analyses (Braithwaite, Watson, Jones & Rowe 2013). Data for 2 AS participants were dropped due to experimenter error, where markers were not placed to denote beginning and end of tasks. Heart rate data was dropped for 2 AS participants and 1 NT participant due to Bionomadix signal drop-out leading to flat or sporadic readings. Skin conductance data was dropped for 3 AS participants and 6 NT participants for the same reason. Similar to the mixed models for the behavioral data, assumptions of the mixed models examining physiology were tested as recommended by Winter (2013), and residual plots were visually inspected. There were no apparent deviations from homoscedasticity or normality. Moreover, P-values of likelihood ratio tests and both Bayesian Information Criterion (BIC) and Akaike Information Criterion (AIC) showed benefits of the model (Müller et al., 2013; Winter, 2013).

It is important to note that after all data was collected, the researchers discovered a confound in the design of the current study regarding the physiological data. The defusion condition required participants to become more physiologically active (i.e. repeating words out loud) compared to the distraction condition (i.e. staring at a picture). Therefore, the involvement of the task itself may have systematically affected skin conductance and heart rate, leading the current study to be highly cautious of making interpretations regarding differences between conditions. However, this study can more confidently offer insight into the physiological differences between the two groups on the same condition (e.g. AS-Dis vs NT-Dis, AS-Def vs NT-Def).

Heart Rate as the Primary Outcome Variable

Primary findings. A mixed effects model for heart rate (see Figure 9) showed only a main effect for diagnosis (χ^2 (1, N=92) =83.81 , p<.0001), with no significant interaction terms (see Table 19 for heart rate change over time). Post hoc testing showed that at nearly all time points, the AS group overall (both conditions) had significantly elevated heart rate compared to the NT group (see Table 20).

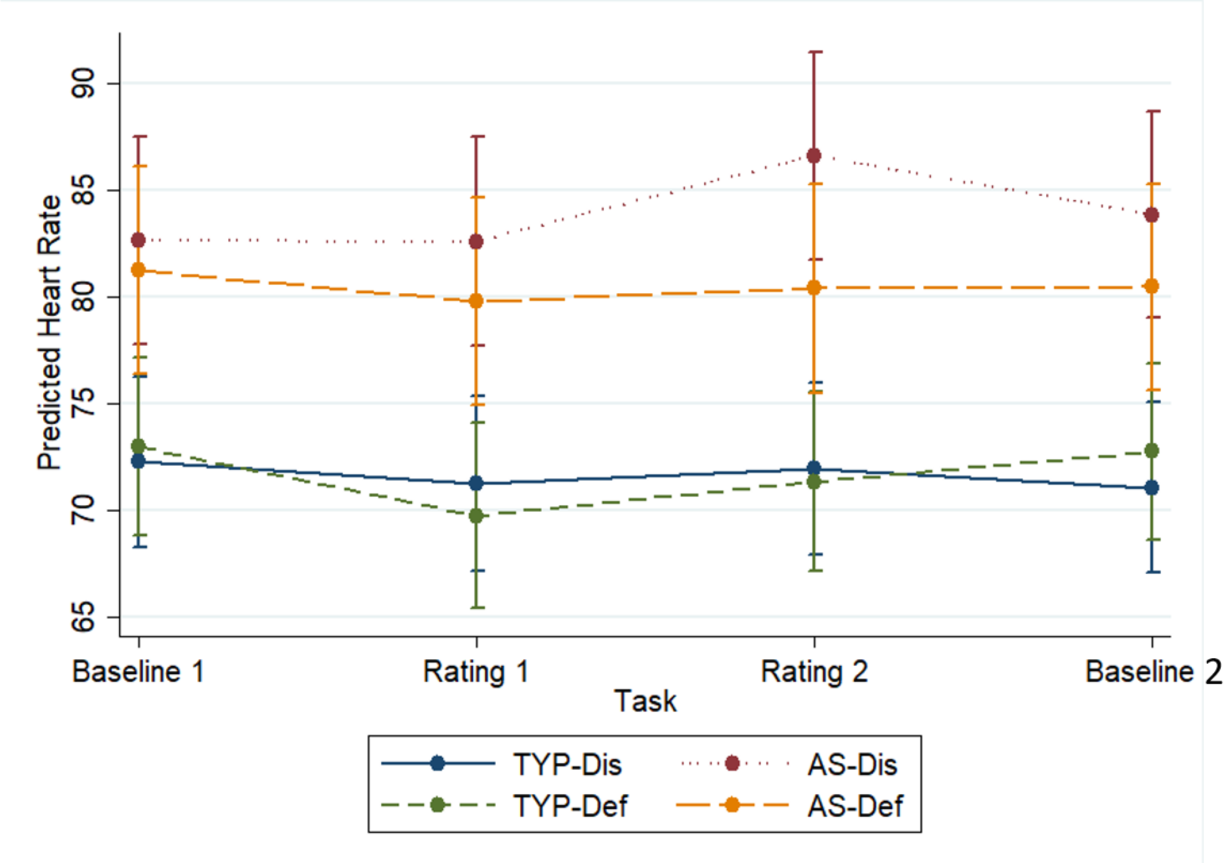

Figure 9. Depiction of a mixed effects model showing predicted change in heart rate for each time point. Error bars represent 95% confidence intervals.

Table 19. *Post-Hoc Results Over Time for Heart Rate with Bonferroni Corrections*

	Contrast	Z	P	95% CI
ASD				
Defusion				
Baseline 1 to Rating 1	-1.44	-.41	1.00	-10.70, 7.83
Baseline 1 to Rating 2	-.84	-.24	1.00	-10.10, 8.42
Baseline 1 to Baseline 2	-.77	-.22	1.00	-9.99. 8.45
Rating 1 to Rating 2	.59	.17	1.00	-8.71, 9.89
Rating 1 to Baseline 2	.67	.19	1.00	-8.59, 9.92
Rating 2 to Baseline 2	.07	.02	1.00	-9.18, 9.33
Distraction				
Baseline 1 to Rating 1	-.03	-.01	1.00	-9.29, 9.23
Baseline 1 to Rating 2	3.98	1.13	1.00	-5.28, 13.24
Baseline 1 to Baseline 2	1.23	.35	1.00	-7.99, 10.45
Rating 1 to Rating 2	4.01	1.14	1.00	-5.28, 13.30
Rating 1 to Baseline 2	1.26	.36	1.00	-8.00, 10.52
Rating 2 to Baseline 2	-2.75	-.78	1.00	-12.01, 6.50
NT				
Defusion				
Baseline 1 to Rating 1	-3.23	-1.06	1.00	-11.32, 4.85
Baseline 1 to Rating 2	-1.63	-.54	1.00	-9.55, 6.29
Baseline 1 to Baseline 2	-.23	-.08	1.00	-8.11, 7.65
Rating 1 to Rating 2	1.60	.52	1.00	-6.52, 9.72
Rating 1 to Baseline 2	3.00	.98	1.00	-5.08, 11.09
Rating 2 to Baseline 2	1.40	.47	1.00	-6.52, 9.32
Distraction				
Baseline 1 to Rating 1	-1.04	-.36	1.00	-8.74, 6.66
Baseline 1 to Rating 2	-.35	-.12	1.00	-7.98, 7.28
Baseline 1 to Baseline 2	-1.23	-.43	1.00	-8.83, 6.36
Rating 1 to Rating 2	.69	.23	1.00	-7.05, 8.42
Rating 1 to Baseline 2	-.19	-.07	1.00	-7.89, 7.51
Rating 2 to Baseline 2	-.88	-.30	1.00	-8.51, 6.75

Note: Significance denotes a significant change from pre-test to post-test.

Table 20. *Post-Hoc Results for Heart Rate by Group with Bonferroni Corrections*

	Contrast	Z	P	95% CI
Heart Rate				
Distraction at Baseline1	10.34	3.23	.01	1.58, 19.09
Distraction at Rating 1	11.35	3.49	<.01	2.45, 20.24
Distraction at Rating 2	14.67	4.54	<.001	5.84, 23.50
Distraction at Baseline2	12.79	4.00	.001	4.04, 21.55
Defusion at Baseline 1	8.25	2.54	.09	-.65, 17.14
Defusion at Rating 1	10.04	3.01	.02	.92, 19.17
Defusion at Rating 2	9.03	2.75	.05	.07, 18.00
Defusion at Baseline2	7.71	2.37	.14	-1.18, 16.60

Note: Positive contrast denotes ASD is elevated, negative contrast denotes NT is elevated

Combining groups. A mixed effects model for heart rate was run to explore the AS group as a whole versus the NT group as a whole with conditions combined (see Figure 10). Similar to the above findings, results showed only a main effect for diagnosis (χ^2 (1, *N*=92) =82.60 , *p*<.0001), with no significant interactions (see Table 21 for combined heart rate change over time). Again, the AS group had higher heart rate than NT group (see Table 22).

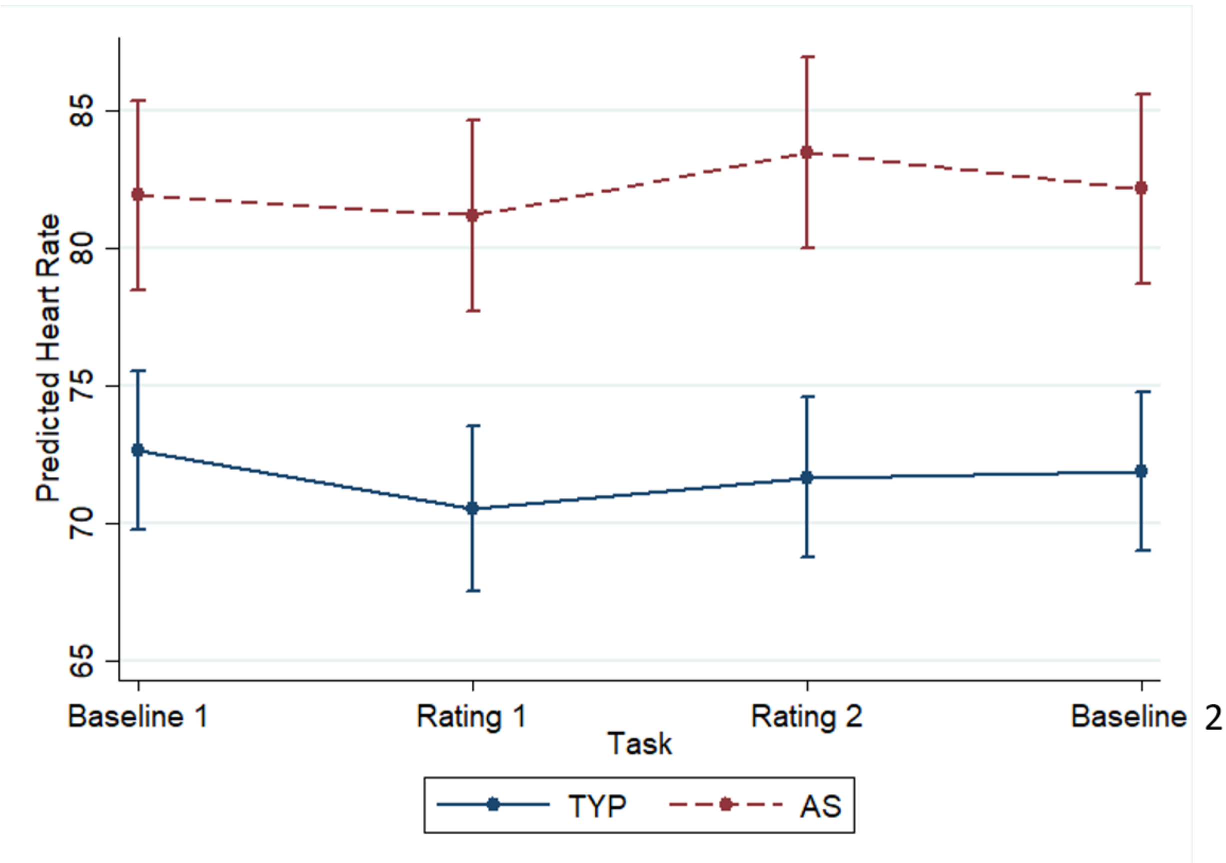

Figure 10. Depiction of a mixed effects model showing predicted change in heart rate for each time point where the Defusion and Distraction groups are combined. Error bars represent 95% confidence intervals.

Table 21. *Post-Hoc Results Over Time for Heart Rate Using Combined Groups with Bonferroni Corrections*

	Contrast	Z	P	95% CI
Group				
AS-Combined				
Baseline 1 to Rating 1	-.73	-.29	1.00	-7.33, 5.86
Baseline 1 to Rating 2	1.57	.63	1.00	-5.03, 8.16
Baseline 1 to Baseline 2	.23	.09	1.00	-6.34, 6.80
Rating 1 to Rating 2	2.30	.92	1.00	-4.32, 8.92
Rating 1 to Baseline 2	.96	.38	1.00	-5.63, 7.56
Rating 2 to Baseline 2	-1.34	-.54	1.00	-7.93, 5.25
NT-Combined				
Baseline 1 to Rating 1	-2.08	-.98	1.00	-7.70, 3.54
Baseline 1 to Rating 2	-.97	-.46	1.00	-6.50, 4.57
Baseline 1 to Baseline 2	-.75	-.36	1.00	-6.26, 4.76
Rating 1 to Rating 2	1.11	.52	1.00	-4.53, 6.75
Rating 1 to Baseline 2	1.33	.62	1.00	-4.29, 6.95
Rating 2 to Baseline 2	.22	.10	1.00	-5.32, 5.75

Note: Significance denotes a significant change from pre-test to post-test

Table 22. *Differences in Heart Rate by Diagnosis Using Combined Groups with Bonferroni Corrections*

	Contrast	Z	P	95% CI
Heart Rate				
Baseline 1	9.30	4.05	<.001	3.56, 15.04
Rating 1	10.65	4.54	<.001	4.79, 16.51
Rating 2	11.84	5.11	<.001	6.05, 17.63
Baseline 2	10.28	4.47	<.001	4.54, 16.02

Note: This table compares heart rate scores for AS vs NT across different time points. Positive scores indicate higher AS heart rate.

Skin Conductance as the Primary Outcome Variable

Primary findings. A mixed effects model for skin conductance (see Figure 11) showed a main effect for time (χ^2 (3, N=86) =19.89 , p<.001), diagnosis (χ^2 (1, N=86) =8.40 , p<.01) and a significant interaction for condition by diagnosis (χ^2 (1, N=86) =10.16 , p<.01).

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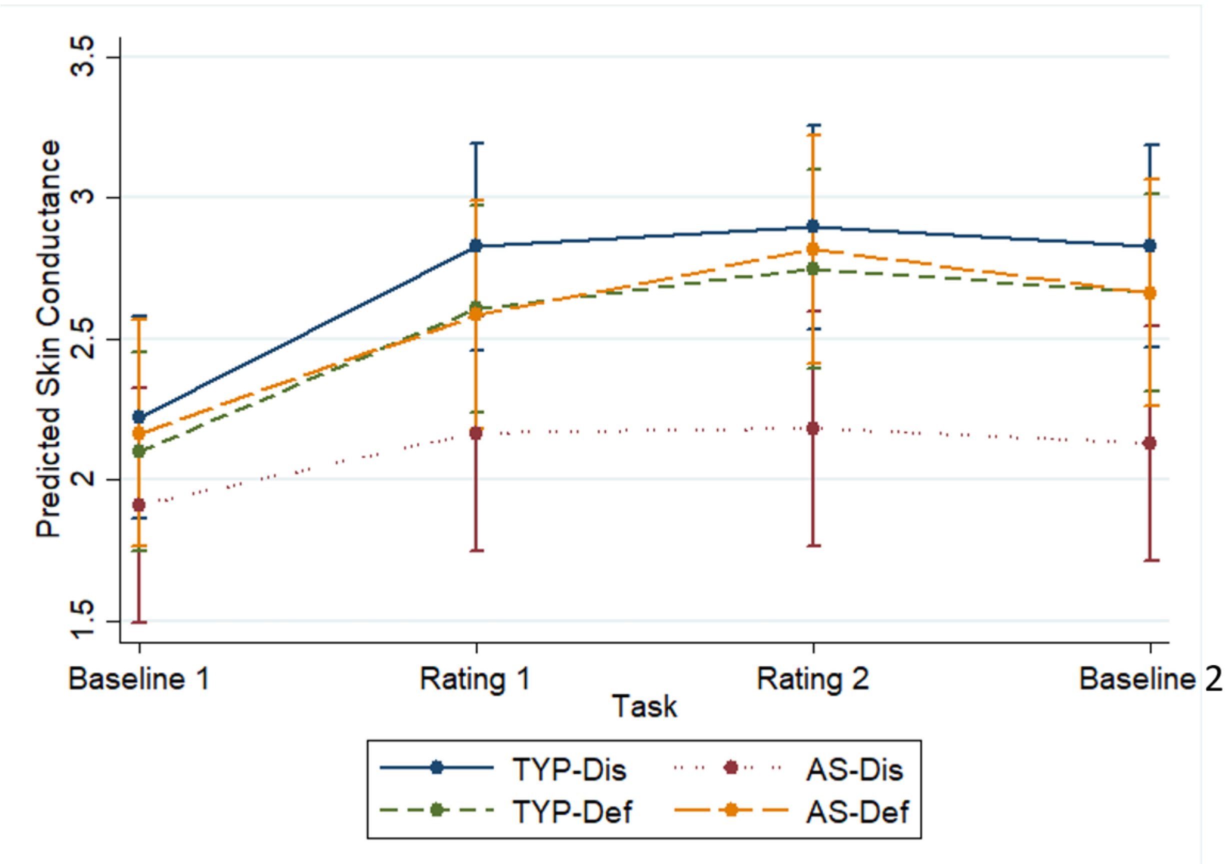

Figure 11. Depiction of a mixed effects model showing predicted change skin conductance for each time point. Error bars represent 95% confidence intervals

The main effect for time suggested that as a whole, participants showed an increase in skin conductance throughout the study. However, post-hoc testing using conservative Bonferroni corrections showed only two near-significant changes, where NT participants in both conditions had a non-significant increase (p =.06) in EDA from the baseline task to the second thought rating task (see Table 23). Concerning the condition by diagnosis interaction, participants in the AS-Dis group appeared to have less skin conductance overall compared to other groups. However, significance was not reached when utilizing conservative post-hoc testing looking at pairwise comparisons (refer to Figure 11 and Table 24).

Table 23. *Post-Hoc Results Over Time for Skin Conductance with Bonferroni Corrections*

	Contrast	Z	P	95% CI
ASD				
Defusion				
Baseline 1 to Rating 1	.42	1.44	.90	-.35, 1.19
Baseline 1 to Rating 2	.65	2.24	.15	-.12, 1.42
Baseline 1 to Baseline 2	.50	1.71	.52	-.27, 1.27
Rating 1 to Rating 2	.23	.80	1.00	-.53, 1.00
Rating 1 to Baseline 2	.08	.27	1.00	-.69, .85
Rating 2 to Baseline 2	-.15	-.53	1.00	-.92, .61
Distraction				
Baseline 1 to Rating 1	.26	.86	1.00	-.53, 1.05
Baseline 1 to Rating 2	.27	.91	1.00	-.52, 1.06
Baseline 1 to Baseline 2	.22	.74	1.00	-.57, 1.01
Rating 1 to Rating 2	.02	.06	1.00	-.77, .81
Rating 1 to Baseline 2	-.04	-.12	1.00	-.83, .75
Rating 2 to Baseline 2	-.05	-.18	1.00	-.84, .74
NT				
Defusion				
Baseline 1 to Rating 1	.51	1.95	.304	-.18, 1.19
Baseline 1 to Rating 2	.65	2.56	.06	-.02, 1.32
Baseline 1 to Baseline 2	.56	2.22	.16	-.11, 1.23
Rating 1 to Rating 2	.14	.55	1.00	-.54, .83
Rating 1 to Baseline 2	.06	.22	1.00	-.63, .74
Rating 2 to Baseline 2	-.08	-.33	1.00	-.75, .58
Distraction				
Baseline 1 to Rating 1	.60	2.31	.13	-.09, 1.29
Baseline 1 to Rating 2	.67	2.60	.06	-.01, 1.36
Baseline 1 to Baseline 2	.61	2.35	.11	-.08, 1.29
Rating 1 to Rating 2	.07	.27	1.00	-.62, .76
Rating 1 to Baseline 2	.00	.01	1.00	-.69, .69
Rating 2 to Baseline 2	-.07	-.26	1.00	-.75, .62

Note: Significance denotes a significant change from pre-test to post-test.

Table 24. *Post -Hoc Results for Skin Conductance by Group with Bonferroni Corrections*

	Contrast	Z	P	95% CI
Skin Conductance				
Distraction at Baseline1	-.31	-1.12	1.00	-1.08, .45
Distraction at Rating 1	-.66	-2.34	.15	-1.43, .11
Distraction at Rating 2	-.71	-2.55	.09	-1.48, .05
Distraction at Baseline2	-.70	-2.50	.10	-1.46, .06
Defusion at Baseline 1	.07	.24	1.00	-.68, .81
Defusion at Rating 1	-.02	-.08	1.00	-.78, .74
Defusion at Rating 2	.07	.25	1.00	-.68, .82
Defusion at Baseline2	.00	.00	1.00	-.75, .75

Note: Positive contrast denotes ASD is elevated, negative contrast denotes NT is elevated

Combining groups. A final mixed effects model was run looking at all AS participants compared to all NT participants regardless of condition (see Figure 12).

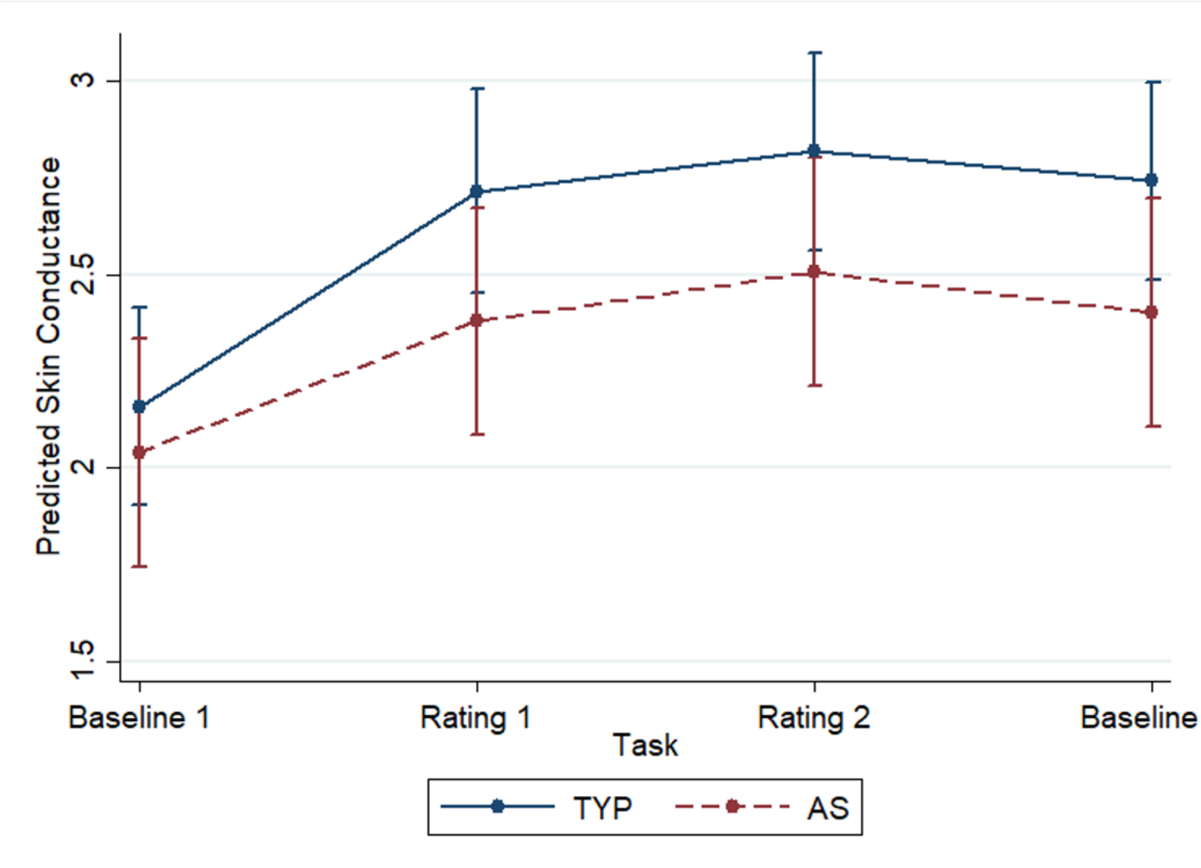

Figure 12. Depiction of a mixed effects model showing predicted change skin conductance for each time point where the Defusion and Distraction groups are combined. Error bars represent 95% confidence intervals.

Results showed a main effect for time (χ^2 (3, N=86) =19.36 , p<.001 and diagnosis (χ^2 (1, N=86) =7.70 , p<.01, with no significant interactions. Post-hoc testing showed a significant increase in skin conductance for NT-Com from Baseline task to Rating 1, Rating 2, and Recovery task (see Table 25). While the main effect of diagnosis suggested that as a whole, the NT-Com group presented with higher skin conductance compared to AS-Com, post-hoc testing using conservative Bonferroni corrections showed no significant pairwise comparisons (see Table 26 and Figure 12).

Table 25. *Post-Hoc Results Over Time for EDA Using Combined Groups with Bonferroni Corrections*

	Contrast	Z	P	95% CI
Group				
AS-Combined				
Baseline 1 to Rating 1	.34	1.60	.66	-.22, .90
Baseline 1 to Rating 2	.47	2.20	.17	-.09, 1.03
Baseline 1 to Baseline 2	.36	1.71	.53	-.20, .92
Rating 1 to Rating 2	.13	.60	1.00	-.43, .69
Rating 1 to Baseline 2	.02	.11	1.00	-.54, .58
Rating 2 to Baseline 2	-.10	-.49	1.00	-.66, .46
NT-Combined				
Baseline 1 to Rating 1	.56	2.97	.02	.06, 1.05
Baseline 1 to Rating 2	.66	3.58	<.01	.17, 1.15
Baseline 1 to Baseline 2	.58	3.17	<.01	.10, 1.07
Rating 1 to Rating 2	.10	.56	1.00	-.39, .60
Rating 1 to Baseline 2	.03	.15	1.00	-.47, .52
Rating 2 to Baseline 2	-.08	-.41	1.00	-.56, .41

Note: Significance denotes a significant change from pre-test to post-test.

Table 26. *Differences in Skin Conductance by Diagnosis Using Combined Groups with Bonferroni Corrections*

	Contrast	Z	P	95% CI
Heart Rate				
Baseline 1	-.12	-.60	1.00	-.62, .38
Rating 1	-.34	-1.66	.38	-.84, .17
Rating 2	-.31	-1.57	.47	-.81, .18
Baseline 2	-.34	-1.71	.35	-.84, .16

Note: This table compares skin conductance scores for AS vs NT across different time points. Positive scores indicate higher AS skin conductance.

Discussion

There is a need for more research on effective treatments for anxiety and depression in adults with AS (Spain et al., 2015; Weston et al., 2016). There is a growing body of research which suggests that third-wave behavioral principles such as non-reactivity to inner experience and mindfulness may play an especially important role in the treatment if psychological distress for people with AS (Maisel et al., 2016; Mazefsky & White, 2014). While various comprehensive Mindfulness and Acceptance Based Intervention (MABI) protocols have been shown to reduce depression and anxiety in adults with AS (de Bruin et al., 2015; Kiep et al., 2014; Pahnke et al., 2014), this study is the first to explore the interplay between one specific MABI component (i.e., cognitive defusion) and psychological distress in this population.

Dispositional Cognitive Fusion

The current study's hypothesis that the AS group would show higher trait levels of cognitive fusion than the NT group was supported. One important diagnostic feature of AS is behavioral inflexibility (American Psychiatric Association, 2013), which can include insistence on sameness, RRBs, 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 behave in rigid and restricted ways based on the content of their cognitions rather than effective action (Blackledge, 2015). While inflexible behavior in AS has been 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 important factor could be elevated levels of cognitive fusion, though further research is needed to clarify this relationship.

Cognitive Fusion Associations with Psychological Distress

The study's second hypothesis that higher levels of cognitive fusion would be related to elevated psychological distress for both groups was supported. 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, Eifert, 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.

Defusion versus Distraction

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 showing the utility of semantic satiation in neurotypical people (Deacon et al., 2011; Mandavia et al., 2015; Masuda, Feinstein, et al., 2010; Masuda et al., 2004; Masuda, Twohig, et al., 2010; Ritzert et al., 2015) to a sample of participants with AS. This finding is particularly salient given that distraction tasks requiring participants to purposefully re-focus their attention on neutral stimuli, such as the comparison condition used in the current study, have been found to be active and useful interventions (Dörfel et al., 2014; Wade et al., 2009; Webb et al., 2012).

Additionally, AS and NT participants in both defusion and distraction conditions reported reduced thought discomfort at the follow-up points, suggesting that both interventions had longer-term benefits, even when the participants were not explicitly told to practice. Similarly for thought believability, AS-Dis, NT-Dis, and NT-Def all maintained reductions during the follow-up periods. However, defusion was not as beneficial for the AS group, who showed an increase in thought believability at the one- and two-week follow-ups. Apart from AS-Def, these follow-up results corroborate findings by Deacon et al., (2011), who showed that semantic satiation and cognitive restructuring were similarly effective for a NT sample of young adults at a one-week follow-up. The current study is the only known study to extend these findings to a two-week period, and additionally to show that a brief defusion exercise has long term benefits in reducing thought discomfort for AS participants.

The finding that after post-test, the AS-Def group was the only one shown to deteriorate in terms of thought believability was unexpected. One interpretation of this finding is that the AS group in the defusion condition had a more difficult time integrating the knowledge and use of the intervention in their day to day lives than the other groups. This corroborates recent findings that adults with AS do improve from counseling, yet take longer than people without autism (Anderberg et al., 2017). In this case, it may be that the idea of defusion is a more novel concept than distraction, and AS participants had a harder time holding onto this new type of information during the follow-up periods without explicit instructions to practice or more systematic support. In fact, adults with AS often struggle with the integration of new concepts (Solomon, Frank, et al., 2015; Solomon, Ragland, et al., 2015). However it is important to note that this explanation is made with much caution, as the participants randomized into AS-Dis were more distressed and had higher believability at baseline than AS-Def. This makes direct comparisons between the two groups difficult.

The study's hypothesis that defusion would reduce thought believability more than distraction was not supported. 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 (Masuda, Twohig, et al., 2010) and others finding 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 with distraction, people are able to step back and more objectively view their thoughts as less realistic. This is an another example of how two distinct interventions (semantic satiation and distraction) can affect the same important transdiagnostic principle of cognitive fusion (Arch, Eifert, et al., 2012).

Finally, exploratory analysis examining pre-post change suggested that for NT participants who scored higher on measures of psychological distress, distraction tended to be more effective than defusion in reducing thought believability from pre-test to post test. In contrast, defusion tended to be more helpful for NT participants who scored lower on measures of distress. For AS participants a similar pattern was found when looking at thought discomfort instead of believability. These results are highly exploratory and thus should be interpreted cautiously. It will be important for future research to test this in an a-priori manner. However, it is worth noting that distraction has been shown to be especially useful for short-term relief during emotionally high intensity, but be a poor long-term coping skill (Sheppes et al., 2015). It may be that people are able to learn how to step back and "defuse" from their thoughts more effectively when they are in a more emotionally calm state, which could lead to longer term improve in their ability to cope with thoughts. In contrast, distraction may be helpful for people who are more acutely distressed, reducing the emotional impact of thoughts temporarily allowing the person to see things more objectively and feel better.

In sum, this study shows that the cognitive defusion technique of semantic satiation is similarly effective as an established active distraction technique for reducing thought believability and thought discomfort for AS and NT participants. While defusion was not helpful in reducing thought believability over a two-week period for the AS group, it did have these benefits in reducing thought discomfort. Semantic satiation has been purported to be best used in clinical work as way to experientially introduce the idea and benefits of defusion to clients (Masuda, Feinstein, et al., 2010; Masuda, Twohig, et al., 2010). The current study provides strong evidence that semantic satiation can indeed be used in this way for clients with high functioning AS. While distraction was also helpful in reducing discomfort and believability, one benefit of utilizing defusion would be to maintain theoretical consistency of therapists utilizing a MABI approach with clients. Finally, in further support of semantic satiation as an acceptable intervention for adults with AS, subjective feasibility and effectiveness ratings showed that overall, the AS group responded more positively towards the defusion condition. This corroborates other findings that MABIs tend to be well-tolerated by people with AS (Kiep et al., 2014; Pahnke et al., 2014; Sizoo & Kuiper, 2017).

Physiology

The current study found no treatment effects with regards to either heart rate or skin conductance. The AS group did have significantly higher heart rate than the NT group regardless of condition or time, suggesting stronger overall sympathetic activation during the study. This was expected, as the AS group in the current study had more psychological distress than the NT group. Interestingly, while the AS-Dis group had higher thought believability and psychological distress than the AS-Def group at baseline, there were no differences between their heart rates at any time point. Further, all participants showed minor but significant increased skin conductance over time, even though participants reported reduced thought believability and thought discomfort. One explanation for this is that the constructs of thought discomfort and thought believability different than the physiological experience of anxiety. For instance, a thought may be highly believable, but fail to elicit a physiological response. Additionally, increasing skin conductance over the course of the study may have simply reflected elevated stress from being a research participant and engaging in unordinary tasks, even while they were learning effective ways to manage specific thoughts. However, it is important to note that these increases were so minor that they are not likely to reflect highly meaningful clinical changes.

Cognitive Fusion as an Emotion Regulation Deficit

We propose that findings from the current study fit into the growing body of literature showing that the high rates comorbid psychopathology AS 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). Considering that cognitive fusion is a transdiagnostic risk factor for inflexibility and distress (Blackledge, 2015; Hayes et al., 2012), it may serve as an especially potent emotion regulation deficit in AS. Not only would elevated cognitive fusion contribute to comorbid psychopathology and inflexibility independently, but it may interact and amplify with other known theorized deficits. For example, if people with AS tend to believe their thoughts to a greater extent, worry about an uncertain future may be especially painful and difficult to deal with, leading to rigid behaviors as a coping mechanism (Boulter et al., 2014; South & Rodgers, 2017). Additionally, research into alexithymia, or the inability to describe inner experience, shows that it plays a major role in leading to anxiety symptoms in AS (Bird & Cook, 2013; Maisel et al., 2016). Interestingly, a recent study suggested that one mechanism through which cognitive fusion leads to psychological distress is by interrupting one's ability to differentiate between emotions (Plonsker, Gavish Biran, Zvielli, & Bernstein, 2017). While more research needs to be done in this area, there is reason to believe that cognitive fusion may be related to alexithymia in AS as well. A major benefit of considering cognitive fusion as an emotion regulation deficit in AS is that it functionally implies a treatment, which the current study provides support for in the form of semantic satiation. Taken together, our study supports Mazefsky & White's (2014) assertion that MABIs may be an especially helpful emotion regulation treatment for people with AS.

Limitations and Future Directions

There are several important limitations to this study. The largest limitation is the lack of a no-treatment control group. Given the difficulty in recruiting a large enough sample with AS for a comparison of two treatment conditions, the decision was made to use two interventions which have consistent support for their short term effectiveness over no-treatment controls (Deacon et al., 2011; Mandavia et al., 2015; Masuda, Feinstein, et al., 2010; Masuda et al., 2004; Masuda, Twohig, et al., 2010; Ritzert et al., 2015; Wade et al., 2009; Webb et al., 2012). However, despite the extant research showing the active nature of both interventions, the results in the current study must be interpreted with caution, as there was no condition to control for placebo or demand characteristics. Another major limitation of the current study was that the AS group showed elevated levels of psychological distress compared to the NT group. This is an important confound, as any 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, AS-Dis appeared to have higher pre-intervention distress than AS-Def. 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.

One unexpected result in the current study was that for the AS group, there was no significant relationship between measures of cognitive fusion and the AQ, a broad measure of dimensional autism symptoms. However, when the AS and NT groups were combined, measures of fusion and the AQ were significantly related. One possible explanation for this is that for people with AS, cognitive fusion might be related to specific aspects of autism such as inflexibility, RRB's, sensory processing issues, or social communication difficulties. If this were the case, perhaps the AQ is too broad of a measure to account for this variance in the AS only group. It would be helpful for future studies to examine how more specific measures of autism are related to levels of cognitive fusion.

An important limitation regarding generalizability of the findings is that experimenters in the current study applied one defusion intervention (e.g. semantic satiation) to all 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.

Regarding the physiology findings, there were two major limitations. First, as discussed earlier, physiological effects of the two intervention tasks are difficult to compare, as the defusion condition requires more physical movement than the distraction condition. Future studies should be aware of this when choosing which defusion techniques to explore. Second, the no treatment effects of physiology may not be due to any shortfall of the interventions per say, but rather because participants did not become sufficiently stressed when choosing negative thoughts. Future studies that include measures of physiology should ensure that experimenters can effectively manipulate the physiological stress participant's experience before they receive the targeted interventions.

Conclusion

This study provides support for the important role that cognitive fusion plays in adults with high functioning AS, and that a commonly used brief defusion exercise has practical implications for treatment. The most robust clinical implication from this study is that semantic satiation can be used as a way to experientially introduce the idea of cognitive defusion for adults with AS by immediately reducing thought believability and discomfort of distressing cognitions. While semantic satiation may be more effective in the short-term, clinicians could proceed by engaging in more extensive interventions aimed at reducing the impact of negative thoughts and increasing behavioral flexibility.

Importantly, the current study showed that active neutral distraction worked as well as semantic satiation in helping participants manage their distressing thoughts. Thus, in clinical practice, a decision to use semantic satiation or active distraction should depend on the functional task of the clinician. For instance, clinicians using a MABI approach may find the semantic satiation technique particularly helpful, as it fits with the broader message of acceptance and mindfulness and can serve to assist clients in understanding and applying these evidence based principles. Clinicians may find active neutral distraction useful by using it to teach clients a simple and intuitive way to manage acutely distressing thoughts (Sheppes et al., 2015). Furthermore, depending on clinician judgement it may be clinically indicated to utilize both interventions with the same client.

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Appendix A

Script for Thought Identification

Note: Bold words are what the experimenter says

Before we proceed to the next task in the study, I'd like to you to fill out two more measures. Many people have thoughts that make them feel anxious, nervous, uncomfortable, or distressed. I'd like for you to come up with a negative thought you frequently have which makes you feel bad in some way. Here is a list of common negative thoughts people have. The thought you come up with may or may not be on this list.

(*experimenter hands out the "Common Negative Thoughts" form; See Appendix B)*

Let me know when you have come up with a negative thought.

Experimenter waits for participant

Great, I would like you to write that thought down in this box.

Experimenter waits for participant

What I want you to do next is reduce the thought to a one-word thought that best describes it. For example, the thought "I am a failure" could be reduced to the one-word thought "failure." So, you listed "*XXX*" for your thought, what one-word do you think best captures that thought for you?

Have participant write the one word thought into Qualtrics.

Using these two scales *(experimenter points to Qualtrics survey)* **I'd like you to rate two things: 1) how uncomfortable that thought is to you right now and 2) to what extent do you believe that thought is true or likely to be real. Any questions?**

Appendix B

Handout of Common Negative Thoughts

Examples of distressing thoughts. Choose one thought which you have frequently and causes you discomfort.

1. I will fail
2. I am ugly
3. I am an idiot
4. I am a terrible person
5. I hate myself
6. People will judge me
7. People hate me
8. I have no friends
9. They won't like me
10. People will evaluate me
11. I will go crazy
12. I will die
13. I will be involved in a terrible accident
14. I will get sick
15. I will have a panic attack

Appendix C

Example of the Visual Analogue Scale

Write the full thought you came up with.

Write the thought as a single word.

Rate how much discomfort the thought causes you.

	No discomfort				Moderate discomfort				Extreme discomfort		
	0	10	20	30	40	50	60	70	80	90	100
How much discomfort does the thought cause you?											

Rate how believable the thought is to you.

	Not at all believable				Moderately believable				Extremely believable		
	0	10	20	30	40	50	60	70	80	90	100
How believable is the thought to you?											

Appendix D

Defusion Script

Note: Bold words are what the experimenter says

In this phase of the study, you are asked to do a series of exercises. These exercises do not cause any physical or psychological harm. Rather, they may sound silly, or they may be eye-opening. When you do these exercises, please follow the instructions carefully. If you have any questions, please ask me anytime.

Okay, before we move on, I have a short story to tell you.

What I want to talk to you about now is how language, including thoughts and words, gives us the benefits and problems of knowledge. The power of language has pros and cons: there is a "positive side" and a "negative side". On the positive side, with language and logical thinking we're able to influence the world around us; we can communicate with other people, build comfortable homes, write books, and so on. Without language and logical thinking none of these things would be possible. All of these advantages, however, come at a cost. On the negative side, we are the only species that can imagine a bleak future, contemplate own our death, and worry about our loved ones.

We suffer from the negative aspects of language when we believe our thoughts are literally what they say they are, especially thoughts about ourselves that are evaluative and judgmental. For example, if I have the thought, "I am a failure," if I believe that this thought is the literal truth, I will feel unhappy about myself. We set ourselves up for unhappiness when we treat negative thoughts about ourselves or the future as the unquestioned, literal truth. However, if we instead treated our thoughts as "just thoughts" – something temporarily floating around in our minds that we do not have to accept or believe – we would be less vulnerable to their negative effects.

What I'm trying to describe to you is that when we mistakenly believe that negative or scary thoughts are literally true, we give them the power to make us feel bad. We can take this power back by understanding that our thoughts are simply collections of words, sounds, and images that may or may not have any basis in reality. I realize that what I'm describing may seem a bit abstract and difficult to understand, so let's try a little exercise that should make things more clear.

I'm going to ask you to say a word. Then tell me what comes to mind. I want you to say the word "milk."

Wait for participant response

Good. Now what came to mind when you said that?

Wait for participant response

Okay. What else? What else shows up when we say "milk?"

Wait for participant response

Good what else?

Wait for participant response

See if you can imagine the taste of milk? *(Pause)* **Can you picture what it looks like, white and creamy?**

Wait for participant response

Okay. Let's see if this fits. What came across your mind were things about actual milk and your experience with it. All that happened is that we made a strange sound —*(experimenter says it slowly)* **mmmiiilllkkkk---and lots of those things show up. Notice that there isn't any milk in this room, not at all. But milk was in the room psychologically, in our minds. You and I were seeing it, tasting it, and feeling it –yet, only the word was actually here.**

Now, here is an exercise that I'd like you to try. The exercise is a little silly, but I am going to do it with you so we can all be silly together. What I am going to ask you to do is to say the word, "milk," out loud, over-and-over again, and as rapidly as possible, and then notice what happens. Are you ready?

Wait for participant response

Okay Let's do it. Say "milk" over and over again…go! *(experimenter provides the prompt "Louder" or "Faster" at 10 and 20 seconds. They say "Stop" at 30 seconds).*

Tell me what came to mind while you kept repeating it?

Wait for participant response

Often times, people notice that the psychological aspects of milk that were here a few minutes ago disappear. The creamy, white, liquid stuff goes away. When you said it the first time, it was as if milk was actually here, in the room. But when you said it again and again and again, you began to lose that meaning and the words became just a meaningless sound. What I am suggesting is that what happens in this exercise may be applied to negative and anxiety provoking thoughts that we have. When you say things to yourself, you can see these thoughts as simply thoughts. They don't have to represent the literal truth.

What I want to talk to you about now is how when you literally believe your own thoughts it can affect how you feel. To illustrate, people with a lot of anxiety often experience negative emotions when they believe their distressing thoughts are literally true. Fortunately, the "milk exercise" is an effective tool you can use to take away the literal meaning of thoughts. And when thoughts lose their literal meaning, they will lose their ability to make you feel upset.

Earlier you came up with a 'one-word thought' that causes you anxiety or distress.

Now, I'm going to have you do the milk exercise, one more time, with this one-word thought. So remember, say the word "XXX" out loud, over-and-over again, and as rapidly as possible.

Do you have any questions?

Wait for participant response

Are you ready? *(Pause)* **Go!** *(experimenter then provides the prompt "Louder" or "Faster" at 10 and 20 seconds. After 30 seconds, they say "stop.").*

Appendix E

Distraction Script

Note: Bold words are what the experimenter says

In this phase, you are asked to do a series of exercises. These exercises do not cause any physical or psychological harm. Rather, they may sound silly, or they may be eye-opening. When you do these exercises, please follow the instructions carefully. If you have any questions, please ask me anytime.

Okay, before we move on, I have a short story to tell you.

What I want to talk to you about now is how language, including thoughts and words, gives us the benefits and problems of knowledge. The power of language has pros and cons: there is a "positive side" and a "negative side". On the positive side, with language and logical thinking we're able to influence the world around us; we can communicate with other people, build comfortable homes, write books, and so on. Without language and logical thinking none of these things would be possible. All of these advantages, however, come at a cost. On the negative side, we are the only species that can imagine a bleak future, contemplate own our death, and worry about our loved ones.

We suffer from the negative aspects of language when we become overwhelmed by thoughts and we are not able to get our minds off of them. For example, if I have the thought, "I am a failure," and I continually focus on that thought throughout the day, I will feel unhappy about myself. We set ourselves up for unhappiness when we allow our attention to be focused on negative thoughts. However, if we are able to focus our attention off our negative thoughts and onto something less threatening, we would be less vulnerable to their negative effects.

What I'm trying to describe to you is that when we allow ourselves to focus on negative thinking, those thoughts have the power to make us feel bad. We can take this power back by learning how to shift our attention onto something else. I realize that what I'm describing may seem a bit abstract and difficult to understand, so let's try a little exercise that should make things more clear.

I'm going to ask you to say a word. Then tell me what comes to mind. I want you to say the word "milk."

Wait for participant response

Good. Now what came to mind when you said that?

Wait for participant response

Okay. what else? What else shows up when we say "milk?"

Wait for participant response

Good what else?

Wait for participant response

See if you can imagine the taste of milk? *(Pause)* **Can you picture what it looks like, white and creamy?**

Wait for participant response

Okay. let's see if this fits. What came across your mind were things about actual milk and your experience with it. All that happened is that we made a strange sound —*(say it slowly)* **mmmiiillllkkkk---and lots of those things show up. Notice that there isn't any milk in this room, not at all. But milk was in the room psychologically, in our minds. You and I were seeing it, tasting it, and feeling it –yet, only the word was actually here.**

(experimenter then administers shapes handout; See Appendix F)

Now, here is an exercise that I'd like you to try. I am going to have you say the word "milk" out loud, and then do your best to not think about anything related to "milk" for 30 seconds. Instead, distract yourself from anything milk related by focusing your attention on this picture of shapes.

Okay Let's do it. Say "milk" out loud, one time, and then distract yourself by paying attention to these shapes! *(Experimenter provides the prompt "pay attention to the shapes" at 10 and 20 seconds. After 30 seconds they say "STOP").*

Tell me what that was like

Wait for participant response

When we distract ourselves with something else, we are able to re-focus our attention away from a particular thought. What I am suggesting is that what happens in this exercise may be applied to negative and anxiety provoking thoughts that we have. When you have thoughts that cause you distress, you are able to simply distract yourself by paying attention to something else.

What I want to talk to you about now is how when you stay focused on a negative thought it can affect how you feel. To illustrate, people with a lot of anxiety often experience negative emotions when they focus on thoughts which are distressing or anxiety provoking. Fortunately, the "milk exercise" is an effective tool you can use to shift your attention away from upsetting thoughts and onto something less distressing. And when paying attention to something else, thoughts lose their ability to make you feel upset.

Earlier you listed a 'one-word thought' that most readily come to mind that causes you anxiety or distress.

Now, we're going to do the milk exercise, one more time, with this one-word thought. So remember, say the word "XXX" out loud, one time, and then distract yourself from anything related to "XXX" by paying attention to the picture of shapes.

Do you have any questions?

Wait for participant response

Are you ready? Go *(experimenter provides the prompt "pay attention to the shapes" at 10 and 20 seconds. After 30 seconds they say "stop.").*

Appendix F

Shapes Handout for Distraction Task

Note: The handout was given to participants horizontal-wise with the blue circle above the blue square.