ABSTRACT

Cognitive and Affective Empathy in Children with Autism Spectrum Disorders

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Two of the principal components of empathy are cognitive empathy and affective empathy. Cognitive empathy is the ability to take another person's perspective and understand what they are feeling. Affective empathy is sharing another person's experience and responding emotionally to that person's experience. Several studies have demonstrated cognitive empathy deficits in autism spectrum disorders (ASD). What is less clear is whether affective empathy is also impaired in ASD. To investigate this question, ten children with ASD and thirteen typically developing children between the ages of 7 years, 9 months and 13 years, 1 month, were shown video clips of people experiencing either mild pain or psychosocial distress. Following each video clip, children answered six questions taken from Minio-Paluello, Baron-Cohen, Avenanti, Walsh, and Aglioti (2009) that probed how they thought the person in the video felt and how the video made them feel. No significant difference in either affective or cognitive empathy was found between the typically developing group and the ASD group; however, both groups exhibited more cognitive empathy for videos depicting people in pain than for videos depicting people in psychosocial distress. These results suggest that affective empathy is intact in ASD and that brain areas involved in taking the perspective of a person experiencing embarrassment or loss are not fully developed in middle childhood.

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COGNITIVE AND AFFECTIVE EMPATHY IN CHILDREN WITH AUTISM SPECTRUM DISORDERS

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CHAPTER ONE

Introduction

Autism spectrum disorders (ASD) are a group of neurodevelopmental disorders characterized by deficits in communication and reciprocal social interactions, as well as repetitive or stereotyped behaviors. It was once thought that ASD were characterized by a lack of empathy as well; however, the development of the idea that empathy is a multidimensional construct has birthed studies that demonstrate that this assumption about ASD is an oversimplification (Senland & Higgins-D'Alessandro, 2013). The two broadest subdivisions of empathy are cognitive empathy and affective empathy. Cognitive empathy may be defined as the ability to take another person's perspective or understand another person's mental state (Rueda, Fernández-Berrocal, & Baron-Cohen, 2015). Theory of mind, the ability to infer another's mental state and use such inferences to predict the person's behavior, is often equated with cognitive empathy (Rueda et al., 2015). Affective empathy can be conceived of as an observer's emotional response to another person's situation (Dziobek et al., 2008) or sharing another person's emotional state while recognizing that those emotions are not in response to one's own circumstances (Mazza et al., 2014). Cognitive and affective empathy are served by overlapping but distinct brain networks (Dvash & Shamay-Tsoory, 2014). Cognitive and affective empathy are impacted differently by different disorders; for example, individuals with psychopathy or conduct disorder have intact cognitive empathy but deficient affective empathy (Schwenck et al., 2012).

Cognitive empathy deficits in ASD are well-established (Demurie, de Corel, & Roeyers, 2011; Rueda et al., 2015; Golan, Baron-Cohen, & Golan, 2008). However, the nature of affective empathy in ASD is less clear. Some studies have found that while cognitive empathy is impaired in ASD, affective empathy is intact. Dziobek et al. (2008) administered the Multifaceted Empathy Task (MET) to high-functioning adults with ASD and controls. The MET consists of 23 pairs of photos; one photo in each pair depicts a person experiencing an emotion within a specific context and the other depicts the context alone. Participants were asked to identify the emotion of the person in the photo and, after they responded, they were given feedback about the correct answer. Participants were then asked to rate how aroused the photo made them feel as well as their empathic concern for the person in the photo. While individuals with ASD scored lower than controls on the question asking participants to identify the emotion of the person in the photo, there was no difference between controls and individuals with ASD in empathic concern for the person in the photo or arousal to the scene. These results indicate impairment in cognitive empathy but intact emotional empathy in ASD. Likewise, when Schwenck et al. (2012) presented children with ASD, children with conduct disorder, and non-clinical controls with short video clips depicting emotionally charged situations, children with ASD were less able to identify the emotion of the protagonist and explain why the protagonist felt the way he or she did than the other groups. However, there was no difference between children with ASD and controls in the degree to which they were emotionally affected by the videos, and children with ASD were more emotionally affected by the videos than children with conduct disorder and callous-unemotional traits.

Rueda et al. (2015) also found impaired cognitive empathy but intact affective empathy in ASD. Rueda et al. administered the Interpersonal Reactivity Index (IRI), a self-assessment designed to measure empathy, and the Eyes test, which requires participants to identify the emotion of people whose eyes are depicted in a series of photographs, to adolescents with ASD and typically developing controls. While participants with ASD scored lower than controls on the perspective taking subscale of the IRI and the Eyes test, which may be considered measures of cognitive empathy, there was no difference between groups in scores on the empathic concern subscale of the IRI, which is often used as a measure of affective empathy. These results are consistent with those obtained by Senland and Higgins-D'Alessandro (2013), who found that high-functioning adolescents with ASD scored lower than controls on the perspective taking subscale of the IRI but higher than controls on the personal distress subscale, while there was no difference between groups in scores on the empathic concern subscale.

Pouw, Rieffe, Oosterveld, Huskens, and Stockmann (2013) also obtained results indicating that cognitive empathy is impaired in ASD while affective empathy is intact. Children with ASD and typically developing children filled out the Self Report Instrument for Reactive and Proactive Aggression, the Empathy Questionnaire (EQ) – which has three scales: contagion, personal distress, and understanding – and the anger scale of the Mood Questionnaire. Participants also completed a Theory of Mind task: participants were presented with two video clips in which the character Mr. Bean created false beliefs in another character and, following each clip, asked one question about that character's false beliefs and a control question. Children with ASD scored lower than controls on the understanding scale of the EQ and on the Theory of Mind task, indicating impairment in cognitive empathy. However, there was no difference in scores on the emotional contagion or personal distress scales between controls and children with ASD, suggesting intact affective empathy in ASD.

Fan, Chen, Chen, Decety, and Cheng (2014) took fMRIs and EEG measurements of individuals with ASD as they viewed images either of one person being hurt accidentally or of one person being hurt intentionally by another person. The theory of mind (ToM) network, which is linked to cognitive empathy, includes the medial prefrontal cortex (mPFC) and the posterior superior temporal sulcus/temporoparietal junction (pSTS/TPJ). These brain areas display increased activity while observing another's pain. The anterior mid-cingulate cortex (aMCC), the anterior insula, supplementary motor area, periaqueductal gray, and somatosensory cortex (SI/SII) also display increased activity during observation of another's pain as well as during the experience of one's own pain. Event-related potential (ERP) components including N2 and late phase potentials (LPP) have been linked to affective arousal in response to others' pain and cognitive appraisal, respectively. Suppression of the mu rhythm is thought to originate in the sensorimotor cortex and to reflect sensorimotor resonance, a component of experience sharing. Therefore, the authors predicted that individuals with ASD would display reduced activity in the mPFC and the pSTS/TPJ if cognitive empathy for pain were impaired. Finding reduced activation in the aMCC and anterior insula as well as a reduced N2 as measured by EEG would indicate affective empathy is impaired in ASD. Finally, failure to suppress the mu rhythm would indicate impaired sensorimotor resonance in ASD.

Typically developing controls displayed increased activation in the right mPFC and bilateral pSTS/TPJ relative to participants with ASD, suggesting impaired cognitive empathy in ASD. While anterior insula activation was reduced in ASD relative to controls, the N2 response was greater in ASD than in typically developing controls. Furthermore, sensorimotor resonance was found to be intact in subjects with ASD, as demonstrated by the presence of mu suppression in response to viewing others' pain. Thus, these results suggest affective empathy is intact in ASD. These results are consistent with those of Hadjikhani et al. (2014), who found that activation was observed in areas involved in face and body processing (including the inferior occipital gyrus, the fusiform face area, extrastriate body areas); emotional processing (orbito-frontal cortex and amygdala); pain processing (fronto-insular cortex, SII, periaqueductal gray); and emotional attribution (inferior frontal gyrus, TPJ, superior temporal sulcus) in both controls and individuals with ASD who watched videos of patients at a shoulder clinic moving their painful shoulder. Similar to Fan et al. (2014), Hadjikhani et al. found activation in bilateral mPFC in individuals with typical development but not in individuals with ASD during observation of others' pain, indicating impaired cognitive empathy in ASD.

Some studies have found not only that affective empathy is intact in ASD, but that high-functioning individuals with ASD are also able to identify basic emotions, such as happy, sad, angry, fear, disgust, and surprise. However, they are impaired in their ability to recognize complex emotions, such as embarrassment and guilt (Golan et al., 2008). For example, Deschamps, Been, and Matthys (2014) read vignettes in which the protagonist displayed either angry, happy, sad, or fearful emotion to 6- and 7-year-olds with and without ASD. Children were asked to identify the emotion of the protagonist as well as the emotion they felt in response to the story. There was no difference between children with ASD and controls in their ability to identify the emotion of the protagonist or in the emotions they experienced in response to the story. However, the most impaired individuals with ASD, as indicated by their scores on the Social Responsiveness Scale (SRS), differed from controls in their ability to identify fear. Fear is often difficult to recognize for individuals with ASD.

This may be because most of the facial cues that indicate fear are located around the eyes, and individuals with ASD attend less to the eyes and the area around the eyes than typically developing individuals (Deschamps et al.). Nevertheless, these results suggest intact affective empathy in ASD as well as an intact ability to recognize basic emotion, with the exception of fear among individuals lower on the spectrum. These results are paralleled by the findings of Ponnet, Roeyers, Buysse, de Clercq, and van der Heyden (2004), who created the Empathic Accuracy Task to assess higher-order cognitive empathy in individuals with ASD. The Empathic Accuracy Task consists of two videos, each of which depicts a different male-female dyad, strangers to one another before recording began. In one video, the man and woman get-to-know-one-another conversation. In the other video, the man and woman play a board game. Ponnet and colleagues presented both of these videos to adults with Asperger syndrome and typically developed controls. The video was paused at certain predesignated points, and participants were asked to infer either the thoughts or feelings of the person in the video at the point where the video was stopped. The people in the video had previously watched the video of themselves and stopped it at these points to write down what they were thinking and feeling at those points. The authors also administered the Eyes test and the Strange Stories task to participants. In the Strange Stories task, participants are read 6 short stories. Following each story, participants were asked, "Was it true, what X said?" and "Why did X say that?" The Strange Stories task is a measure of cognitive empathy. Both the empathic accuracy task and the Eyes test are measures of empathic accuracy, which requires cognitive empathy.

High-functioning adults with ASD performed as well as controls on the Eyes test, the Strange Stories task, and in inferring the thoughts and feelings of the people who played a game in one of the videos in the Empathic Accuracy task. However, individuals with Asperger syndrome scored lower on inferring thoughts and feelings in the video of the getting-to-know-one-another conversation than controls. Independent ratings of the videos demonstrated that thoughts and feelings fell into one of six categories: thoughts/feelings about the self, about the interaction partner, about other person(s), about the research context, about an environmental object/event, about a past memory. Furthermore, in the video in which the man and woman played a game, targets had more thoughts/feelings about the research context, about an environmental object/event, and about a past memory than in the video in which the man and woman had a conversation to get to know one another. These results highlight the difficulties that even high-functioning individuals with ASD have with understanding complex social interactions and inferring what one person is thinking about what another person is thinking.

Other studies indicate that both cognitive and affective empathy are impaired in ASD. Several studies measured affective empathy using self-report techniques. Mazza et al. (2014) administered several tests to measure cognitive and affective empathy in children with ASD, including the Multifaceted Empathy Test (MET), the same test administered by Dziobek et al. (2008). Assessing a larger sample than Dziobek et al. had tested, Mazza et al. found impaired cognitive empathy as well as a deficit in affective empathy for negative emotions specifically in ASD. The authors hypothesized that a lack of empathy for negative emotions in ASD may be due to difficulties in processing others' distress cues. The observed deficit in empathy for negative emotions could also be a consequence of averting attention away from stimuli that signal negative emotions in order to minimize personal distress (Fan et al., 2014). Several studies have demonstrated that individuals with ASD experience higher personal distress than typically developing individuals (Senland & Higgins-D'Alessandro, 2013; Rogers, Dziobek, Hassenstab, Wolf, & Convit, 2007); cognitive empathy may be necessary to recognize a source of emotions outside oneself and generate an appropriate response (Pouw et al., 2013). Since individuals with ASD tend to have deficits in cognitive empathy, they may experience high levels of personal distress when observing others' distress but are hindered in their ability to produce a helping response. Consequently, they learn to avert their attention from others' distress signals in order to minimize personal distress.

Schneider et al. (2013) showed 32 short video clips depicting lay actors relating short stories with either emotional content or neutral content to 28 adults with high-functioning autism spectrum disorders (HFASD) and 28 typically developed adults. After each video, participants were asked to rate on a -3 to +3 visual analog scale how they thought the protagonist felt, where -3 meant very negative, 0 meant neutral, and +3 meant very positive. Participants were also asked to rate how the video made them feel using the same scale. Adults with HFASD correctly identified the emotion of the people of the video less frequently than controls and reported the target self emotion less frequently than controls. These results suggest that both cognitive and affective empathy are impaired in ASD. On the other hand, Schulte-Rüther et al. (2014) found that individuals with ASD reported fewer congruent emotions with people making either neutral or emotional facial expressions in a series of photographs, even though they were able to identify the emotions of the people in the photos as well as controls. Greimel et al. (2010) presented adolescents with ASD and typically developing controls with pictures of happy, sad, and neutral facial expressions. Facial expressions were either strong or weak. Participants completed three tasks in an fMRI: an other-task, a self-task, and a high-level baseline. During the other-task, participants were asked to empathize with the person whose face appeared in the photo and to infer their mental state; participants could choose between "sad," "neutral," and "happy." During the self-task, participants were asked to empathize with the person in the photo and judge their own emotional response to the person in the photo. In the high-level baseline, participants were asked to judge whether faces were thin, average, or wide; this task was used to control for brain activity that resulted from face processing in general. Adolescents with ASD performed as well as controls when presented with strong facial expressions. However, adolescents with ASD correctly identified weak facial expressions less frequently than typically developing controls and reported fewer congruent responses in themselves than controls did when viewing weak facial expressions, suggesting impaired affective empathy as well as impaired cognitive empathy.

Facial mimicry studies also suggest impaired affective empathy in ASD. Oberman, Winkielman, and Ramachandran (2009) presented male children with high-functioning ASD and typically developing male children with photos of emotional facial expressions and measured the activity of facial muscles using electromyography to assess spontaneous and voluntary mimicry of facial expressions. The authors found that while children with ASD performed as well as controls when voluntarily mimicking emotional facial expressions, there was a delay in peak facial muscle activity when children with ASD spontaneously mimicked emotional facial expressions. Similarly, Mathersul, McDonald, and Rushby (2013) found that high-functioning adults with ASD did not have stronger zygomaticus responses to pictures of happy faces than pictures of angry faces nor stronger corrugator responses to pictures of angry faces than pictures of happy faces, as measured by EMG. Zygomaticus major pulls up the corners of the mouth when smiling; corrugator supercilii furrows the brow when a person scowls. Adults with typical development did show greater zygomaticus responses to happy faces than angry faces and greater corrugator responses to angry faces. Beall, Moody, McIntosh, Hepburn, and Reed (2008) measured facial EMG responses of typically developing children and children with ASD toward pictures of happy, angry, and fearful facial expressions. They found that typically developing children respond congruently to happy faces by increasing activity of the zygomaticus major and to angry facial expressions by increasing activity of the medial frontalis muscle, thereby producing a fearful facial expression. Moreover, the degree of matching does not correlate with age in typically developing children. Children with ASD, on the other hand, did not show increased activity of zygomaticus, corrugator supercilii, or medial frontalis in response to happy faces or angry faces. Fearful faces elicited increased activity of corrugator supercilii 600 ms post-stimulus onset and a mixed corrugator and medial frontalis response beginning around 800 ms in children with ASD. Furthermore, degree of matching to happy facial expressions was significantly positively correlated with age in children with ASD ($r = .82$). The fact that typically developing children generated a fearful facial expression in response to viewing angry facial expressions suggests that rapid facial responses to emotional facial expressions have an emotional component, as opposed to being a purely motor response. The absence of rapid facial responses of children with ASD in this study suggests a dysfunctional emotional response to others' emotions in ASD. Facial mimicry is a way of sharing others' emotional experience, which is the essence of affective empathy. Consequently, the observation of abnormal facial mimicry in ASD suggests an impairment in affective empathy.

The current study investigates whether affective empathy is indeed impaired in children with ASD. Children with ASD and age-matched typically developing controls were shown videos of a man being hit in the head with a baseball, hitting himself in the hand with a hammer, dropping and breaking a glass, and getting a stain on his shirt when another person runs into him while he is holding a piece of pizza. Following each video, children were asked a series of questions that investigated the thoughts and feelings they attributed to the man in the video and the feelings they experienced in response to the videos. The questions used were adapted from Minio-Paluello, Baron-Cohen, Avenanti, Walsh, and Aglioti (2009).

CHAPTER TWO

Method

Participants

Ten high-functioning children with ASD (9 male, 1 female) were recruited through the Baylor Autism Resource Center (BARC) and from the community. Children recruited through the BARC had their diagnosis confirmed by the BARC. One male in the ASD group was excluded from final analysis because he did not understand the task. Participants' ages ranged from 7 years, 9 months to 13 years, 1 month. A sample of thirteen typically developing children (8 male, 5 female) was recruited from the community in Waco, TX and the Dallas, TX area. Three females in the typically developing group were excluded from the final analysis in order to achieve a gender-matched sample. Participants' ages ranged from 8 years, 1 month to 12 years, 9 months.

Procedure

Children with ASD who were recruited through the BARC were tested at the Baylor Center for Developmental Disabilities (BCDD); children with ASD who were recruited from the community were tested in their homes. Typically developing children were tested in locations convenient for the families. Each child tested at the BCDD was brought into a conference room and tested individually. Each typically developing child was tested individually in a quiet room at the testing site. Participants were shown four video clips lasting approximately 3 to 6 seconds each. The clips were presented in random order on a laptop using VLC, a media player. One clip depicted a man being hit in the eye with a baseball as he reaches up to catch it (Figure 1); the second depicted a man hitting himself in the hand with a hammer (Figure 2); the third depicted a man dropping and breaking a glass (Figure 3); and the fourth depicted a man bumping into another man holding a plate of pizza, causing pizza sauce to stain the shirt of the man holding the plate (Figure 4). Following each video clip, the researcher read six questions to participants; participants indicated their response to each question on a 100 mm visual analog scale below the text of the question. The questions and corresponding scales are as follows: (a) “How much does the video grab your attention?” 0 mm corresponded to “does not grab my attention at all” and 100 mm corresponded to “completely grabs my attention;” (b) “How much does the video upset you?” 0 mm corresponded to “not at all” and 100 mm corresponded to “as much as I could be upset;” (c) “How much during the experiment were you able to identify with the person in the video by thinking how he/she felt?” 0 mm corresponded to “I could not identify with the person in the video at all” and 100 mm corresponded to “I completely identified with the person in the video;” (d) “How much do you feel sorry for the person in the video?” 0 mm corresponded to “not sorry at all” and 100 mm corresponded to “very sorry;” (e) “How strong was the pain felt by the person in the video?” (in the videos of the man breaking the glass and the man bumping into the man holding the plate of pizza, this question was replaced with the question “How strong were the feelings of the person in the video?”) 0 mm corresponded to “not strong at all” and 100 mm corresponded to “as strong as possible;” and (f) “How unpleasant was the pain felt by the person in the video?” (in the videos of the man breaking the glass and the man bumping into the man holding the plate of pizza, this question was replaced with the question, “How unpleasant were the feelings of the person in the video?”) 0 mm corresponded to “not unpleasant at all” and 100 mm corresponded to “as unpleasant as possible.”

***Figure 1*. Still photo taken from video of person being hit in the head with a ball**

***Figure 2*. Still photo taken from video of person hitting his hand with a hammer**

***Figure 3*. Still photo taken from video of a person dropping a glass**

***Figure 4*. Still photo taken from video of a man bumping into a person carrying pizza**

CHAPTER THREE

Results

Means and standard errors for overall cognitive empathy and overall affective empathy in each group are summarized in Table 1. The mean cognitive empathy score for children with ASD was 69.5 with a standard error of 3.14, and the mean affective empathy score for children with ASD was 55.9 with a standard error of 3.9. The mean cognitive empathy score for typically developing children was 61.7 with a standard error of 3.0 and the mean affective empathy score for typically developing children was 52.6 with a standard error of 3.6. There were no significant differences between children with ASD and typically developing children in affective empathy overall or cognitive empathy overall [$F(1,16)=.301$, $p=.591$, $\eta^2=.018$]. However, cognitive empathy scores overall were higher than affective empathy scores overall [$F(1,16)=7.340$, $p=.015$, $\eta^2=.314$].

Table 1. Means and Standard Errors of Cognitive and Affective Empathy in Children with ASD and Typically Developing Children

	Cognitive		Affective		Total	
	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error
ASD	69.5	3.1	55.9	3.9	62.7	2.6
TD	61.7	3.0	52.6	3.6	57.1	2.4
Combined	65.6	2.3	54.2	2.7	59.9	1.8

Cognitive and affective empathy for physical pain versus psychosocial distress were examined specifically. There was a significant interaction between empathy type (affective vs. cognitive) and story type (physical pain vs. psychosocial distress) [$F(1,16) = 8.3$, $p = .011$, $\eta^2 = .343$] – children in both groups reported higher cognitive empathy for videos depicting people experiencing physical pain (ASD: M = 75.2, SEM = 4.2; TD: M = 66.1, SEM = 4.1) than toward videos depicting psychosocial distress (ASD: M = 63.8, 5.3; TD: M = 57.2, SEM = 4.5). Each group experienced similar levels of affective empathy for both videos depicting physical pain (ASD: M = 56.2, SEM = 5.2; TD: M = 48.6, SEM = 4.9) and videos depicting psychosocial distress (ASD: M = 55.5, SEM = 5.8; TD: M= 56.6, SEM = 5.3). Means and standard errors are summarized in Table 2.

Table 2. Mean Responses and Standard Errors to Questions Assessing Cognitive and Affective Empathy in Children with ASD and Typically Developing Children

	Cognitive		Affective		Total	
Children with ASD						
	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error
Physical	75.2	4.2	56.2	5.2	65.7	3.5
Psychosocial	63.8	5.3	55.5	5.8	59.7	3.9
Total	69.5	3.1	55.9	3.9	62.7	2.6
Typically Developing Children						
	Mean	Standard Error	Mean	Standard Error	Mean	Standard Error
Physical	66.1	4.1	48.6	4.9	57.3	3.3
Psychosocial	57.2	4.5	56.6	5.3	56.9	3.5
Total	61.7	3.0	52.6	3.6	57.1	2.4

Age did not correlate with cognitive empathy ($p = .897$) nor affective empathy ($p = .522$). However, there was a trend toward a moderate positive correlation between cognitive and affective empathy ($r = .408$, $p = .093$).

No three-way or higher-order interactions were found to be significant.

CHAPTER FOUR

Discussion

In this experiment, we sought to determine whether cognitive and affective empathy are impaired in autism spectrum disorders (ASD). Ten children with ASD and thirteen typically developing children watched two videos depicting an actor in physical pain and two videos depicting an actor experiencing psychosocial distress. After each video, children answered six questions about their emotional responses to the video and their inferences about the thoughts and feelings of the actor. There were no significant differences between children with ASD and typically developing children in either cognitive or affective empathy. However, children in both groups reported higher cognitive empathy for actors experiencing physical pain than those experiencing psychosocial distress while both groups reported similar levels of affective empathy while watching the two types of videos.

Perhaps the most surprising finding of this study is the lack of a cognitive empathy deficit among children with ASD. Numerous studies have reported cognitive empathy deficits in children as well as adults with ASD (Dziobek et al., 2008; Rueda et al., 2015; Schwenck et al., 2012). However, some studies (Deschamps et al., 2014; Ponnet et al., 2004) have found little to no deficit in cognitive empathy in individuals with ASD. The autism group in this study may not have exhibited a deficit in cognitive empathy because the questions implied that the actor was in pain or that his feelings were unpleasant, whereas other studies used open-ended questions that asked participants to identify the emotion of the protagonist in the video or story. Individuals with ASD often have difficulties recognizing or identifying emotions (Demurie et al., 2011; Golan et al., 2008). Explicitly observing that the person in the video was feeling pain and then asking participants to rate the intensity and unpleasantness of that pain may have circumvented this particular difficulty and tapped into participants' affective empathy. The results obtained by Dziobek et al. (2008) support this interpretation. Dziobek et al. presented participants with photographs of people and asked them to select one mental state descriptor of four possible choices. After participants chose a descriptor, they were given feedback on the correct answer. Then, they were asked to rate their level of arousal and empathic concern for the person in the photo. This study found that individuals with ASD were impaired in their ability to identify the emotions of the individuals in the photograph, but once they were given feedback about the actual mental state of the individuals depicted, they reported similar levels of emotional empathy to typically developing individuals. Consequently, the results in this study may reflect intact affective empathy in children with ASD rather than typical levels of cognitive empathy. Another possible explanation is that increased autism awareness has encouraged parents to seek testing and treatment for children earlier in life, and this early intervention restores autistic children's cognitive empathy to levels observed in typically developing children.

The results of this study suggest that there is no difference in levels of affective empathy between children with ASD and typically developing children. These results are in line with those of Dziobek et al. (2008), Fan et al. (2014), Hadjikhani et al. (2014), Rueda et al. (2015), and Schwenck et al. (2012), who also found intact affective empathy in individuals with ASD. Affective arousal in response to another's experience is linked to sensorimotor resonance (Decety, 2010). Fan et al. found intact sensorimotor resonance, as measured by mu suppression while viewing pictures of people in pain caused either non-intentionally or intentionally by another person, in individuals with ASD. Likewise, Hadjikhani et al. found that individuals with ASD who viewed video clips of patients at a shoulder clinic rotating their painful shoulder exhibited activation in brain areas involved in face and body processing (including the inferior occipital gyrus, the fusiform face area, and extrastriate body areas) as well as brain areas involved in pain processing (including fronto-insular cortex, S2, and periaqueductal grey) at similar levels as typically developing individuals who viewed the same video clips. Interestingly, activation in the bilateral medial prefrontal cortex, which is recruited during tasks that underpin cognitive empathy, was observed in typically developing individuals while viewing others in pain, but not in individuals with ASD. These results suggest that typical patterns of sensorimotor resonance in individuals with ASD underpin typical levels of affective empathy in individuals with ASD, while atypical functionality in areas of frontal cortex involved in inferring others' thoughts and emotions limit the cognitive empathy capacity of individuals with ASD. On the other hand, Minio-Paluello et al. (2009) found that adults with Asperger's syndrome – now classified as high-functioning ASD in the DSM V (American Psychiatric Association, 2013) – experienced significantly reduced motor evoked potentials in the first dorsal interosseous and abductor digiti minimi muscles relative to typically developing individuals while viewing a video clip of a needle injected into the part of the hand where those muscles are located. The absence of sensorimotor resonance in individuals with ASD in this study could be attributed to the use of electromyography rather than fMRI and EEG to assess sensorimotor resonance. It may also be due to different levels of sensorimotor resonance and affective empathy in different subpopulations of individuals with ASD. Further research with subpopulations defined according to either patterns of symptoms or brain pathology could elucidate whether disparity of results is due to different levels of empathy in different subpopulations of individuals with ASD.

Both typically developing children and children with ASD reported higher cognitive empathy for videos depicting physical pain than for videos depicting psychosocial distress, while they reported similar levels of affective empathy for both types of videos. This may be because social situations require more advanced cognitive empathy than individuals in middle childhood possess. While affective arousal in response to others' distress develops within the first year of life, cognitive understanding of others' emotions takes longer to develop (Decety, 2010). Children are able to pass false-belief tests, the most rudimentary test of theory of mind, by age 4 or 5. Throughout middle childhood, children's ability to infer what other people are thinking and to understand how people's thoughts influence their emotions increases. For example, interpretive theory of mind tasks present participants with a picture of a scene or object, then cover the picture so only a small portion of the scene or object can be seen and ask participants to predict how a naïve viewer, without prior exposure to the unobscured picture, would interpret the obscured picture. Children typically do not succeed in this task until age 6 or 7, and scores continue to improve into adulthood. This improvement in scores demonstrates improving ability to infer others' thoughts throughout childhood and adolescence. In a similar study, children between the ages of 5 and 10 were presented with vignettes about two characters who experience negative, positive, or ambiguous events. Participants were informed that both characters feel the same about each event at first, but one begins to think positively about the event while the other begins to think negatively. All age groups predicted that the two characters would feel more similarly in response to negative events and most disparately in response to ambiguous events – but the predicted gap between the two characters' emotions widened with increasing age of participants (Lagattuta et al., 2015). These results suggest growing cognitive empathy throughout middle childhood. While observation of another's pain activates evolutionarily old neural circuits that develop early in life, observing and understanding distress as a result of social situations requires mentalizing abilities that rely heavily on areas of the frontal cortex that do not finish developing until early adulthood. Thus, participants' partially developed mentalizing abilities may have contributed to the greater overall cognitive empathy for individuals experiencing physical pain than for individuals experiencing psychosocial distress.

It is likely that not all the questions in the questionnaire measured cognitive and affective empathy. For example, the question, "How sorry did you feel for the person in the video?" is a measure of sympathy more than a measure of empathy. Conducting a pilot study and item analysis of the questions beforehand could produce questions that more precisely measure the variables of interest. In addition, the intensity of the experiences and the emotions of the actor in the video were relatively weak. Typically developing children and children with ASD might have had similar levels of empathy simply because the reactions the videos elicited were relatively weak. Thus, though there might actually be a difference in empathy between the two groups, no difference would manifest because one group was responding at lower levels than it would toward a more serious event. Presenting situations with higher stakes might elicit stronger reactions in the group with stronger empathy and produce a significant difference between the two groups. Finally, the power level in this study was quite small. Conducting the study with more participants in each group would increase power and improve the generalizability of results.

This study found that affective empathy is intact in high-functioning children with ASD between the ages of 8 and 12 and that children have more cognitive empathy for physical pain than for psychosocial distress. Increasing the severity of the pain and distress experienced by protagonists in the videos used in this study, as well as increasing the sample size, could produce larger effect sizes and provide more ground for analysis.

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