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Research paper

Associations between cognitive and affective empathy and internalizing symptoms in late childhood

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ABSTRACT

Background: Empathy is a multidimensional construct, which includes cognitive and affective components. Studies in adults have demonstrated that both cognitive and affective empathy are associated with anxious and depressive symptoms. The aim of this study was to examine these associations in childhood.
Methods: Participants were 127 9- and 10-year-old children, recruited from the community. Self-report measures of cognitive and affective empathy, and internalizing symptoms were administered, as well as a task-based measure of cognitive empathy.
Results: Canonical correlation analysis demonstrated that components of affective empathy, specifically affective sharing and empathic distress, were associated with internalizing (particularly social anxiety) symptoms (R_c = 0.63, non-parametric $p < .001$). Cognitive empathy was not associated with internalizing symptoms.
Limitations: Most of our findings were based around self-report measures of empathy, which may not accurately reflect empathy ability.
Conclusions: Findings suggests that children who share each other's emotions strongly are more likely to experience anxiety, particularly of a social nature.

1. Introduction

Depressive and anxiety disorders are amongst the greatest contributors to the burden of disease globally (World Health Organisation, 2017). Major depressive disorder is also the most prevalent lifetime mental health disorder, and over a quarter of the population experience an anxiety disorder during their life (United States; Kessler et al., 2005). Anxiety disorders have an early onset in life, with 50% diagnosed during childhood, and 75% diagnosed by the end of adolescence (Kessler et al., 2005). The median age of onset of depressive disorders tends to be later, in early adulthood (Kessler et al., 2005). However, elevated levels of both depressive and anxiety symptoms are prevalent in young people. For example, O'Connor et al. (2020) found that approximately 30% of children in a community sample experienced at least one episode of internalizing difficulties.

Importantly, the presence of early life symptoms or disorders increases the risk for ongoing and more severe disorders throughout the lifespan (Costello et al., 2002). There is significant burden of these disorders on individuals and society, and an increased risk of prolonged problems throughout life associated with childhood symptoms. There are also limitations in current approaches to identification and treatment of these early symptoms. Based on these aforementioned factors, there is need for continued examination of the mechanisms underlying anxiety and depression in childhood.

Children's level of empathy, that is, their ability to understand and share the emotions of other people with whom they interact (Shamay-Tsoory, 2011), may play an important role in the emergence of anxious and depressive symptoms. Empathy is a multidimensional

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construct, which includes cognitive (understanding another's emotional state) and affective (experiencing and reacting to another's emotional state) components (Davis, 1983; Shamay-Tsoory, 2011). Beyond this general division, there is no clear consensus in the literature on a single model of empathy. In the current study, we focused on four empathy components that have been examined relatively commonly in prior empirical research: cognitive empathy, and three specific affective empathy components: affective sharing, empathic concern, and empathic distress. Cognitive empathy and affective sharing are considered empathy processes, while empathic concern and empathic distress are considered emotional reactions to the experiences of others (Davis, 1983), that may result from underlying empathy processes. The specific components investigated in this study are defined in Table 1. Given that multiple overlapping terms are used in the literature, these are also outlined in the table. Basic affective empathy components emerge in children from a very young age (Zahn-Waxler and Van Hulle, 2012). Development of the cognitive component lags behind the affective. By the age of five or six, most children can pass basic cognitive empathy/theory of mind tests (first order-false belief, O'Reilly and Peterson, 2015). Importantly for our study, there is substantial evidence for continued cognitive empathy development through middle childhood and into adolescence (e.g. Devine et al., 2016; Devine and Hughes, 2016; Dumontheil et al., 2010; Vetter et al., 2013).

Studies with adult samples have identified associations between the different components of affective empathy and depressive symptoms. A systematic review by Schreiter (2013) concluded that increased empathic distress was associated with increased depressive symptoms, which may arise from alterations in emotion regulation or self-other-distinction (Lamm et al., 2007), or behavioral feedback loops (O'Connor et al., 2007). In contrast, Schreiter (2013) found very few associations between empathic concern and depressive symptoms. A subsequent study provided preliminary evidence that affective sharing may put people at risk for experiencing low mood, while empathic concern might be protective (Klimecki et al., 2014).

There is evidence that both self-report and task-based measures of cognitive empathy are decreased in people with depression or elevated depressive symptoms (see Bennik et al., 2019 for large self-report study; see Schreiter et al., 2013 for review). Depressive symptoms may reduce cognitive empathy due to general dampening of cognitive functioning (Schreiter et al., 2013). However, there are also some studies that found no associations (e.g. Derntl et al., 2012; Lee, 2009; Schneider et al., 2012; Thoma et al., 2011).

The literature regarding the associations between empathy and anxiety in adults is relatively smaller, and mostly focuses on social anxiety disorders or traits. Two studies have found a positive association between self-reported affective empathy and anxiety (empathic distress in Shu et al., 2017; both empathic distress and affective sharing in Tibi-Elhanany & Shamay-Tsoory, 2011). Several studies have also found that people with high levels of social or other forms of anxiety perform less accurately on tasks of cognitive empathy (e.g. Alvi et al., 2020). In particular, for people with social anxiety, errors have been characterized by excessive theory of mind or 'over-mentalizing' (e.g. Washburn et al., 2016). However, others found no deficits in task-based cognitive empathy in socially anxious individuals (Morrison et al., 2019, 2016). To our knowledge, no studies have reported associations between anxiety and self-reported cognitive empathy.

Research examining the association between empathy and internalizing symptoms in young people is scarce and results are mixed. Regarding affective empathy, one study of 9- to 15-year-olds found no differences in empathic distress between depressed and healthy participants (Hughes et al., 2011). On the other hand, Olweus and Endresen (1998) reported that increased empathic distress in 13- to 16-year-olds was related to increased depressive symptoms. They also found that boys with increased empathic concern had increased anxiety symptoms, though this finding has not been replicated in the literature. A link between empathic distress and depressive symptoms in children may arise for similar reasons to adults, with increased empathic distress resulting in children becoming more highly aroused and emotionally dysregulated. These children may more often focus on their own distress and turn away from the distress of others, withdrawing socially and adopting avoidant strategies. In the long-term these processes may promote depressive symptoms (Zahn-Waxler et al., 1992).

Direct evidence for an association between cognitive empathy and depressive symptoms is lacking in children, however indirectly it has been shown that cognitive empathy is important for social competence (Liddle & Nettle, 2006), and better social competence is associated with less depressive symptoms (e.g. Rudolph et al., 1994).

Several studies describe reduced cognitive empathy associated with (social) anxiety in children (Banerjee and Henderson, 2001; Colonnesi et al., 2017; Nikolić, 2017). For example, Banerjee and Henderson (2001) found that, in 6- to 11-year-old children, higher social anxiety was related to reduced performance on two complex theory of mind tasks, but not to performance on a simple second order false belief task.

Although somewhat mixed, the available adult literature is suggestive of differential associations between components of empathy and both anxiety and depressive symptoms. However, literature in children is lacking. The current study sought to fill this gap by exploring associations between empathy and internalizing symptoms in a sample of children from the community. We examined the period of middle/late childhood (ages 9 and 10), a period of considerable social change (transition from full dependency on a family unit to more emotional connections to peers) (Franco and Levitt, 1998). This period is also thought to be crucial for developing key social-emotional skills important for predicting positive outcomes (Duong and Bradshaw, 2017). We employed measures that tap into different components of empathy using a combination of self-report and task-based measures. Previous

Table 1
Empathy component definitions.

Empathy component	Definition	Reference	Similar/overlapping terms
Cognitive empathy	The ability to infer and understand another's mental state (emotions, thoughts).	Shamay-Tsoory (2011)	Perspective taking Mentalizing Mind-reading Theory of mind
Affective sharing	The capacity to share the same emotion as another.	Decety ad Moriguchi (2007)	Affective empathy Affective/ Empathic resonance Affective matching Emotion(al) contagion
Empathic concern	Experiencing feelings of sympathy, compassion or concern for another person in distress.	Davis (1983) and Decety (2010)	Compassion Sympathy
Empathic distress	Experiencing discomfort, uneasiness or distress when exposed to the distress of others.	Davis (1983) and Decety (2010)	Personal distress Empathic stress

literature has tended to examine either depression or anxiety in isolation. However, given the comorbidity of these disorders/symptoms in children (Wadsworth et al., 2001), we examined associations with both depressive and anxiety symptoms.

Based on previous research in adults and preliminary work in children, we hypothesized that higher levels of empathic distress and lower levels of cognitive empathy would be associated with higher depressive and anxiety symptoms (particularly social anxiety symptoms). Given inconsistencies in the limited literature regarding links between internalizing symptoms and affective sharing or empathic concern, we made no specific hypotheses about these associations.

2. Methods

2.1. Design

The current study used a subset of data from the Families and Childhood Transitions Study (FACTS), a longitudinal, community-based cohort study. The study consisted of two waves of data, approximately 18 months apart, collected from children and their families. The study included a range of assessments, capturing environmental and biological factors that may be important predictors of mental health (see Simmons et al., 2017 for protocol paper). Ethical approval was granted by the University of Melbourne Human Research Ethics Office (#1339904). The current study utilised child self-report measures of empathy, internalizing symptoms and a cognitive empathy task collected from wave two of the project (empathy measures were only assessed at wave two).

2.2. Participants

127 children (*M* age [*SD*] = 10 years [5 months], *n* females [%] = 68 [54]) participated in the wave two assessment and completed all relevant measures for this analysis. These children were initially recruited 18 months earlier for wave one of the study. As the larger study aimed to maximize variation in socioeconomic status, recruitment (occurring mostly through schools) targeted metropolitan areas classified as falling within the lower tertile of socioeconomic disadvantage (Pink, 2011). This targeting ensured that even at wave two of the study, families from lower socio-economic areas were well represented. Children at wave one were screened (and excluded) for significant motor or sensory impairment, developmental or intellectual disorder, and due to the larger study containing a Magnetic Resonance Imaging brain scan, neurological conditions, history of head trauma/loss of consciousness, regular psychoactive or steroid medications, claustrophobia, and presence/likelihood of non-removable ferrous metals in their body. T-tests (using the Welch approximation to account for unequal variance) showed that children who were included in the current analysis ($n = 127$) and the children who participated in wave 1 but were not included in this analysis ($n = 36$; either withdrew after wave one or did not complete the specific measures required for CCA analysis) did not differ on depression or anxiety symptoms (p values > 0.1). See Table 2 for participants' race and ethnicity, missing data: 5%.

Table 2
Descriptive statistics characterizing the sample used for the CCA analysis

Demographic measure	
Sex *N* (%) - Female	68 (53.54)
Age (years) *M* (*SD*)	10.00 (4.55)
Est. FSIQ *M* (*SD*)	106.40 (10.91)
Parent Education *n* (%)	
Partial/Complete High School	23 (18.11)
Partial/Complete University	59 (46.46)
Partial/Complete Post-Graduate Degree	45 (35.43)
Neighborhood advantage *n* (%)	
Quintile 1	28 (22.05)
Quintile 2	33 (25.98)
Quintile 3	30 (23.62)
Quintile 4	24 (18.90)
Quintile 5	12 (9.45)
Race *n* (%)	
White	92 (72.44)
Asian	14 (11.02)
Mixed or other	14 (11.02)
Ethnicity *n* (%)	
Australian (or New Zealander)	75 (59.06)
Australian/European	17 (13.39)
Australian/Asian	11 (8.66)
Asian	6 (4.72)
European	3 (2.36)
Other	8 (6.30)

Note. Abbreviations: CCA = Canonical Correlation Analysis, Est. FSIQ = Estimated full scale IQ, Neighborhood advantage is listed from least advantage to most.

2.3. Measures

2.3.1. Empathy measures

See Supplementary Measures for the format of the empathy questionnaire. For all empathy measures described, higher scores indicate higher self-report of empathy (or higher performance in the case of the empathy task).

2.3.1.1. Adolescent measure of empathy and sympathy (AMES). Cognitive empathy, affective empathy (i.e., affective sharing), and sympathy (i.e., empathic concern) were measured by a self-report questionnaire measure, the Adolescent Measure of Empathy and Sympathy (AMES; Vossen et al., 2015). Each subscale contains 4 items, for a total of 12 items, rated on a 5-point Likert scale. An example of an item measuring affective sharing is "When a friend is angry, I feel angry too". The other feelings addressed by the affective sharing subscale are sadness, fear, and nervousness. An example of an item measuring cognitive empathy is "I can easily tell how others are feeling". An example of an item measuring empathic concern is "I feel sorry for someone who is treated unfairly". This measure has been validated in 10- to 15-year-olds, and has robust psychometrics, including satisfactory internal consistency, and test-retest reliability over two weeks (Vossen et al., 2015). The cognitive empathy and sympathy subscales were validated against the perspective taking and empathic concern subscales of a well-used adult empathy self-report measure (the Interpersonal Reactivity Index).

2.3.1.2. Empathic responsiveness questionnaire, empathic distress subscale. This Empathic Responsiveness Questionnaire (ERQ: Olweus and Endresen, 1998) has two subscales; empathic concern (not used in this study) and empathic distress. The empathic distress scale has three items, ranked on a Likert scale of 1 to 6, and is appropriate for 9- and 10-year-olds. While the original measure had four items, we combined two items with very minor differences ("When I see a girl who is distressed I sometimes feel like crying" and "When I see a boy who is distressed I sometimes feel like crying") into one item ("When I see a girl/boy who is distressed I sometimes feel like crying").

2.3.1.3. Silent films. This video based task was designed to be an analogue of Happe's Strange Stories task (Happé, 1994; White et al., 2009), and was used to assess cognitive empathy. It comprises five short film clips (mean length of 25s) from a classic silent film: Harold Lloyd's comedy Safety Last (Roach et al., 1923). The clips depict instances of deception, false belief, and misunderstanding. The task requires participants to use their understanding of beliefs and desires to explain the behavior of characters in scenarios. Children are asked six questions after watching the clips and are awarded two points for correct answers, one point for partially correct answers, and zero points for incorrect answers. The use of silent film clips broadens the task's applicability for use with different language groups and with children of low verbal

ability. It has been validated in 7- to 13-year-olds and has good psychometric properties. These include: good internal consistency (established using a confirmatory factor analysis framework), lack of ceiling effects, 1 month test-retest reliability, strong correlation to the established theory of mind measure Strange Stories, demonstration of individual differences over and above verbal ability and narrative comprehension, and dissociation from executive function (Devine and Hughes, 2016, 2013; Wang et al., 2016). Although task-based measurement of affective empathy components was desirable, none of the available tasks (Dziobek et al., 2008; Kanske et al., 2015) were validated in children at the time of study design.

2.3.2. Internalizing measures

2.3.2.4. CDI-2. The Children's Depression Inventory (CDI) is a widely used and validated self-report measure of depressive symptoms in children. The revised version (CDI-2: Kovacs, 2010) was used in the current study and has 27 items and four subscales; negative mood and physical symptoms, negative self-esteem, ineffectiveness and interpersonal problems. The child is asked to chose the answer which was most applicable for the past two weeks. For example, "I am sad once in a while", "I am sad many times" or "I am sad all the time". Higher scores indicate higher endorsement of symptoms (this is the same for the SCAS described below).

2.3.2.5. SCAS. The Spence Childrens Anxiety Scale (SCAS: Spence, 1998) is a self-report measure of anxiety symptoms. There are 44 items in total, 38 of which are used to create six subscales: social phobia, separation anxiety, physical injury worries, obsessive compulsive symptoms, generalized anxiety symptoms and panic/agoraphobia (tapping symptoms relevant to DSM-IV disorders). Each item is rated on a 4-point scale: "never" "sometimes", "often" or "always". The SCAS is a widely used and validated measure (Ahlen et al., 2018).

2.3.3. Demographics

Neighborhood advantage. The Index of Relative Socio-Economic Advantage and Disadvantage (IRSAD) from the Socio-Economic Indexes for Areas (SEIFA) is a measure of neighborhood advantage created by the Australian Bureau of Statistics (ABS), and based on 2011 Australian census data (Pink, 2011). See Supplementary Materials for details.

IQ. Three subtests, matrix reasoning, vocabularly and symbol search from the Wechsler Intelligence Scale for Children – Version IV (WISC-IV: Wechsler, 2003 Australian Language Adaptation edition), were used to create a prorated IQ (Sattler & Dumont, 2004).

Parent education. Mothers reported their highest level of education (only mothers were involved in the wider study (Simmons et al. 2017)).

2.4. Procedure

2.4.1. Data collection

Children attended an assessment session at the local children's hospital (or for some participants who were unable to attend, during a home visit) where they completed pen and paper self-report measures and were administered the Silent Films task on a tablet.

2.4.2. Analysis

The code to reproduce these analyses can be found at: https://github.com/kbkatebray/cca_emp_int (DOI: 10.5281/zenodo.3993828). Missing data at the item level (<1% overall) were imputed using the mean item substitution approach in cases where more than 70% of items were completed (4 participants had more than 30% missing from any one subscale and were excluded) (Downey and King, 1998). Only participants with all subscales were included in the canonical correlation analysis (CCA), n =127. Raw scores were used for both the CDI-2 and SCAS (T-scores were calculated for descriptive purposes). CDI-2 subscales were dichotomized as approximately half of participants reported no symptoms (subscale score greater than zero, or not); remaining subscales remained untransformed. SCAS scores were also skewed, but were deemed to have adequate spread to allow examination of continuous data.

To investigate associations between empathy and internalizing symptoms, canonical correlation analysis (CCA), a multivariate technique, was employed. CCA examines all the components within one model, limiting the probability of Type I error (Sherry and Henson, 2005). The literature has demonstrated the importance of examining multiple components of empathy. Conversely, previous research has tended to examine either depression or anxiety in isolation. However, we know that these disorders/symptoms are comorbid (Cummings et al., 2014). This is especially the case in children where anxiety and depressive symptoms are less distinct entities (Wadsworth et al., 2001). The CCA framework is thus a concise and appropriate model through which to examine the relationships between these two sets of variables.

CCA was performed in R (version 3.5.2) using the package 'cca' (version 1.2; https://CRAN.R-project.org/package=CCA). CCA was used to investigate the multivariate association between two sets of observed variables (X [four self-reported components of empathy, the total score on the 'Silent Films' task and covariates] and Y [four subscales of the CDI-2 and the six subscales of the SCAS]). Several covariates were included in the current analysis: sex, neighborhood advantage, parent education, and IQ (which included a measure of verbal ability). We chose not to control for age given the small age range in our sample. Please refer to Supplementary Materials for a brief primer and further explanation of how each stage of the model was assessed in the current analysis.

Permutation testing was conducted for the evaluation of Wilk's statistic, the canonical correlation, and the structure coefficients. We calculated the CCA 10,000 times on permuted versions of the dataset. We focused on the results that were consistently significant across parametric and non-parametric significance tests. Due to complexities in controling for covariates in CCA analysis, three approaches were taken (covariates included in the X variable set, covariates included in the Y variable set, and covariates regressed out of both X and Y sets. For simplicity, the model with covariates included in the X set of variables is displayed in the main text, but for thoroughness results that were consistent across the three approaches are also described. Please see the Supplementary Materials for further discussion on covariates and for results from the two additional analyses (Figs. S2 and S3, and Tables S3-6).

3. Results

3.1. Descriptive statistics

The sample of children had relatively equal distribution across sexes. The majority were white Australians, with most parents having tertiary education. There was an equal spread across different levels of neighborhood advantage. Demographics are presented in Table 2 and descriptive statistics for the key measures used in the CCA analysis are presented in Table 3. See Supplementary Table S1 for T-scores for descriptive purposes. Bivariate correlations were computed for all the measures used in the CCA including covariates and are displayed in Supplementary Table S2.

3.2. Canonical correlation analysis

The analysis yielded nine functions. The full model was statistically significant (Wilk's $\lambda = 0.30$, F [90, 742.75] = 1.59, $p < .001$, non-parametric p-value) and explained about 70% of the variance shared between the variable sets across all functions ($1 - \lambda = 0.70$).

As shown in Table 4, only the first test of the canonical dimensions

Table 3
Means, standard deviations, range, skew and kurtosis for the key measures used in the CCA.

Measure of interest	*N*	Mean	*SD*	Range	Skew	Kurtosis	Cronbach's *α*
Empathy							
Affective Sharing	127	9.59*	3.69	16.00	0.35	-0.22	.84
Cognitive Empathy	127	13.34	2.79	16.00	-0.15	0.06	.68
Empathic Concern	127	16.53	2.32	11.00	-0.43	-0.17	.58
Empathic Distress	127	8.16*	3.09	15.00	0.31	-0.29	.64
Silent Films	127	7.68	2.21	11.00	-0.54	0.44	.31
CDI-2 (before binarization)							
Neg. mood/phys. symptoms	127	2.61	2.31	9.00	0.68	-0.42	.62
Negative self-esteem	127	0.84	1.20	5.00	1.62	2.07	.61
Ineffectiveness	127	2.63	2.43	10.00	0.95	0.06	.70
Interpersonal problems	127	0.73	1.21	5.00	1.70	1.91	.65
SCAS							
Separation anxiety	127	3.96*	3.03	16.00	0.96	1.23	.71
Social phobia	127	3.51*	2.91	12.00	0.77	-0.14	.75
Physical injury fears	127	3.65*	2.59	12.00	0.72	0.15	.75
Generalized anxiety	127	4.94*	2.94	16.00	0.65	0.52	.74
Obsessive compulsive	127	5.02	3.42	14.00	0.53	-0.21	.52
Panic/agoraphobia	127	2.67	2.83	14.00	1.41	2.16	.76

Note. * Indicates significant difference between males and females in mean scores, in all cases female children had higher mean scores. Abbreviations: CCA = Canonical Correlation Analysis, CDI-2 = Children's Depression Inventory 2, SCAS = Spence Childrens Anxiety Scale.

Table 4
Pertinent values from the CCA analysis for each of the nine canonical functions created.

Dim.	R_c	R_c^2	Wilk's Λ	Multiple *F*	*df* 1	*df* 2	Para. *p* (*F*)	Non-para. *p* (*F*)	Para. *p* (R_c)	Non-para. *p* (R_c)
1	**.63**	**.40**	**.30**	**1.59**	**90**	**742.75**	**.001***	**.001***	**< .001***	**< .001***
2	.51	.26	.50	1.12	72	670.60	.249	.030*	< .001*	.002*
3	.38	.15	.68	0.78	56	597.68	.876	.232	< .001*	.111
4	.31	.09	.80	0.60	42	524.09	.978	.376	< .001*	.279
5	.27	.07	.88	0.47	30	450.00	.993	.463	.003*	.153
6	.16	.03	.95	0.28	20	375.73	.999	.765	.071	.793
7	.13	.02	.98	0.23	12	301.91	.997	.651	.151	.591
8	.08	.01	.99	0.14	6	230.00	.991	.651	.352	.529
9	.01	.00	> .99	-	2	-	-	-	.900	.935

Note. * = <0.05, bold text = both parametric and non-parametric *p*-value significant. Abbreviations: CCA = Canonical Correlation Analysis, Dim. = Dimension, R_c = Canonical Correlation, R_c^2 = Canonical Correlation Squared, para. = parametric.

was significant with both parametric and non-parametric tests, therefore only the first function was interpreted.

There was a moderate positive association between the empathy synthetic variable and the internalizing symptoms synthetic variable (R_c = 0.63, non-parametric $p < .001$). See Supplementary Materials Fig. S1 for a scatterplot demonstrating the correlation.

Examination of the structure coefficients from function 1 revealed that the main empathy contributor to the X (empathy and covariates) set of variables was affective sharing, followed by empathic distress (see Table 5 for values). Sex and neighborhood disadvantage also contributed to the empathy (plus covariates) synthetic variable score. Cognitive empathy, empathic concern and the Silent Films task did not contribute significantly to the construction of the empathy (plus covariates) synthetic variable score. To summarize, a more negative empathy (plus covariates) synthetic variable score indicated higher affective sharing, empathic distress, higher likelihood of being female and living in a less advantaged neighborhood.

For the internalizing or Y set of variables, all the subscales significantly contributed to the 'internalizing synthetic variable score'. The strongest contributor according to the structure coefficient was social phobia. The next three most related contributors were separation anxiety, generalized anxiety and physical injury fears. Depressive symptoms also contributed to the internalizing synthetic variable score, albeit less strongly than most anxiety symptoms. To summarize, a more negative internalizing synthetic variable score indicated higher internalizing symptoms.

Multicollinearity between the X and Y variable sets was checked by examining the variance inflation factor (VIF) of the variables within regression models. None of the VIFs exceeded a conservative cutoff of 2, suggesting that multicollinearity was not an issue (see Craney and Surles, 2002; Thompson et al., 2017 for discussion). However, it should be noted that some of the standardized canonical coefficients and the structure coefficients for the same observed variable differed in what they implied about the relevance of the variable for the model. Fluctuations in the strengths of these two measures can indicate the presence of multicollinearity (Sherry and Henson, 2005). Given that structure coefficients are suggested to be more robust to multicollinearity (Sherry and Henson, 2005), these coefficients were focused on for interpretation.

Overall, the CCA demonstrated that, in our sample, children that had high affective sharing, and empathic distress, (and were female and from less advantaged neighborhoods) were the most likely to report high anxiety and depressive symptoms. See Fig. 1 for a diagram representing the CCA model.

3.2.1. *Consistency across models with different treatment of covariates*

One significant (both parametric and non-parametric) and relevant (variance accounted for) function was found across all three covariate models. Only one model supported a second function and on further examination the canonical correlation was mostly underpined by the association between the cognitive empathy task and IQ. Across all models, within this first function, affective sharing and empathic distress significantly contributed to the empathy variable, and all of the anxiety subscales, plus the ineffectiveness and negative mood depressive subscales contributed to the internalizing variable. Child sex was the only covariate that consistently contributed across the two models where covariates were explicitly modeled. See Supplementary Figures S2-3 and Tables S3-8 for more details.

Table 5
Coefficients for X and Y variables, first function.

X Variables	Standardized X canonical coefficients	Structure coefficient (r_s)	Squared structure coefficient (r_s^2)	Para. p (r_s)	Non-para. p (r_s)
Affective Sharing	**-0.50**	**-.62**	**.38**	**< .001***	**< .001***
Cognitive Empathy	0.48	.25	.06	.004	.002*
Empathic Concern	0.06	.02	.00	.803	.402
Empathic Distress	**-0.34**	**-.49**	**.24**	**< .001***	**< .001***
Silent Films	-0.01	-.02	.00	.812	.411
Sex	**-0.46**	**-.60**	**.36**	**< .001***	**< .001***
IQ	0.08	.08	.01	.353	.177
Parent Education	-0.09	-.02	.00	.841	.411
Neighborhood Advantage	**0.34**	**.34**	**.12**	**< .001***	**< .001***
Y Variables					
Negative mood/ physical symptoms	**-0.04**	**-.37**	**.14**	**< .001***	**< .001***
Negative self-esteem	**-0.05**	**-.30**	**.09**	**.001***	**< .001***
Ineffectiveness	**-0.23**	**-.46**	**.22**	**< .001***	**< .001***
Interpersonal problems	**0.05**	**-.30**	**.09**	**< .001***	**< .001***
Separation anxiety	**-0.47**	**-.74**	**.54**	**< .001***	**< .001***
Social phobia	**-0.72**	**-.86**	**.74**	**< .001***	**< .001***
Physical injury fears	**-0.06**	**-.50**	**.25**	**< .001***	**< .001***
Generalized anxiety	**-0.19**	**-.55**	**.31**	**< .001***	**< .001***
Obsessive compulsive	**0.28**	**-.36**	**.13**	**< .001***	**< .001***
Panic/ agoraphobia	**0.34**	**-.37**	**.13**	**< .001***	**< .001***

Note. * Survive correction for multiple comparisons (Bonferroni). Bold text = both parametric and non-parametric p-value significant.

4. Discussion

This study examined the association between empathy and symptoms of anxiety and depression in a community sample of 9- and 10-year-old children. Findings demonstrated that affective empathy components (affective sharing and empathic distress) were positively related to internalizing symptoms, particularly social anxiety symptoms. Cognitive empathy (as measured by self-report and task), and empathic concern did not relate to anxiety or depressive symptoms.

The main accumulation of evidence in the literature points to the positive association between empathic distress and depressive symptoms in adults (Schreiter et al., 2013). There are also a few studies finding associations between empathic distress and anxiety (Shu et al., 2017; Tibi-Elhanany and Shamay-Tsoory, 2011), and one finding an association between affective sharing and anxiety (Tibi-Elhanany and Shamay-Tsoory, 2011). In children, 'excessive empathy', and empathic distress have been related to depressive symptoms (Olweus and Endresen, 1998; Robins and Hinkley, 1989). As such, our findings are broadly consistent with previous literature, with both depressive and anxiety symptoms relating to these affective empathy components. However, in our study the contribution of anxiety symptoms to the association was predominant. This may be due to the relative prevalence of anxiety symptoms compared to depressive symptoms in this age group.

Emotion regulation or self-other distinction may be responsible for the association between the affective empathy components and internalizing symptoms. Studies have shown that emotion regulation is implicated in depression and anxiety (Amstadter, 2008; Ehring et al., 2010). Decety (2010) described emotion regulation as one of the core processes involved in empathy. Others have argued that people may respond more with empathic distress rather than empathic concern if their ability for self-other distinction and emotion regulation is not well developed (Lamm et al., 2007). Further, both Powell (2018) and Tully et al. (2016) found that emotion regulation moderated the association between affective empathy and depression and anxiety. A link between emotion regulation and empathy is also suggested by developmental brain imaging work. There is increasing maturation of brain areas involved in emotion regulation from adolescence to adulthood (the brain areas recruited change from more basic emotion processing to those involved in higher order processes; (Pozzi et al., 2021)). These brain changes mirror findings that empathic distress decreases from adolescence through early adulthood (Eisenberg et al., 2005). There is

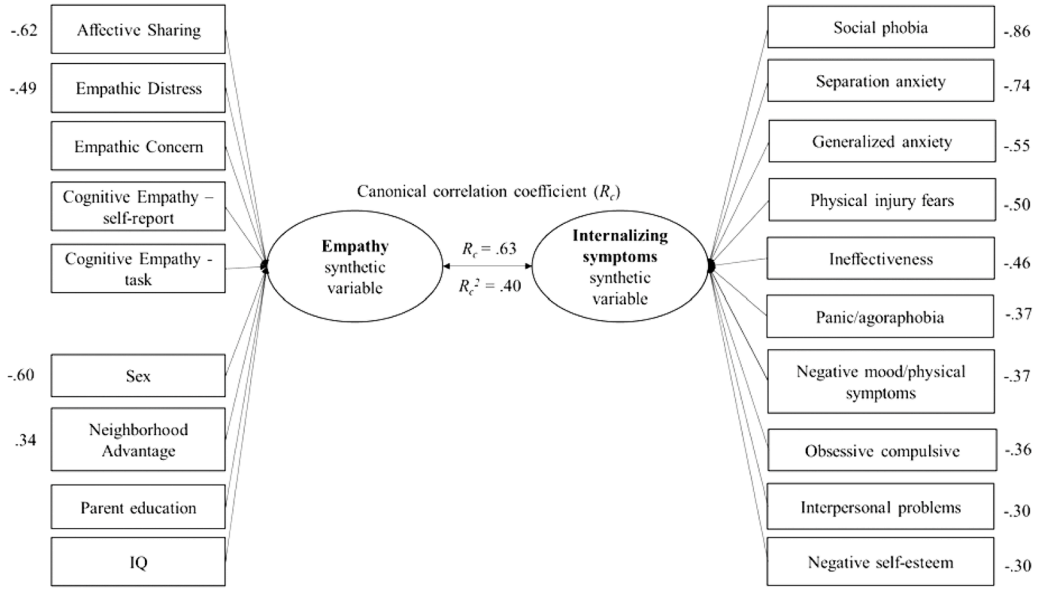

Fig. 1. Diagram depicting results of the Canonical Correlation Analysis. Original X variables represented by rectangles on left, Y variables on right. Created synthetic variables represented by ovals. Structure coefficients are the values on the outside of the rectangles.

also some evidence to suggest a dip in emotion regulation ability around the time of puberty, which may implicate an influence of pubertal hormones (Cracco et al., 2017). Whether or not these potentially pubertally-driven changes in emotion regulation are related more or differently to empathic distress in developing versus adult samples is an interesting question that requires further research. More broadly, establishing whether empathic distress is simply a result of lack of emotion regulation or self-other distinction is important for understanding more about how to intervene with children experiencing internalizing symptoms associated with the experience of empathic distress.

Alternatively, the association between affective empathy components and internalizing symptoms in children could reflect a common underlying tendency such as emotional reactivity. Emotional reactivity (as defined by the degree to which a person responds to environmental stimuli with either emotion "flooding", lability, or hypersensitivity) has been linked to negative mood, attachment anxiety and interpersonal problems (Wei et al., 2005). Children that are more sensitive to emotional states (both their own and others) may be more likely to report both higher levels of affective empathy components and high levels of anxiety and depressive symptoms. Whether it is a perceived sensitivity or an objective sensitivity is yet to be established, however, both of these sensitivities could be useful for diagnostic and treatment purposes. Given the cross-sectional nature of our study, it is unclear whether engaging in affective sharing or feeling empathic distress might put children at risk for subsequent internalizing symptoms, or whether the presence of internalizing symptoms alters empathy mechanisms. Tone and Tully (2014) have described empathy as a "risky strength". They argue that high levels of empathic distress in combination with various intra- or inter-individual moderators throughout development can increase risk for internalizing problems. Similarly, Zahn-Waxler and Van Hulle (2012) propose that a high capacity for empathy on its own is not detrimental, but when coupled with other elements it may become a risk factor for later anxiety and depressive symptoms. Future research is needed to examine how these associations change with age, and to disentangle the direction of association.

Several other factors that were not assessed in this study may play a role in the association between empathy and internalizing symptoms. For example, factors such as worry and rumination have been shown to mediate a link between empathy and anxiety (Knight et al., 2019). Childhood trauma, which has been shown to increase risk for both elevated self-reported empathy (Greenberg et al., 2018) and internalizing symptoms (Watters and Wojciak, 2020), indicates there might be common precipitating factors. Our lack of findings in regards to cognitive empathy and depressive symptoms may be explained by developmental factors. Affective sharing (in the form of emotion contagion), and the resulting feeling of empathic distress, are present in a rudimentary form from birth (Zahn-Waxler & Van Hulle, 2012). Unlike affective empathy, which develops very early, cognitive empathy is still developing throughout middle childhood (Devine and Hughes, 2016). Thus, it may be that more complex cognitive empathy skills drive the association commonly seen with depressive symptoms in adults, and these skills may not be present in children aged 9 to 10. Alternatively, the fact that depressive symptoms were relatively low in our child community sample may mean that associations are difficult to detect at this age. A more surprising result was the lack of association between cognitive empathy and anxiety symptoms, particularly in regards to social anxiety, with several previous studies in both adults and children reporting that reduced cognitive empathy was associated with greater anxiety (Banerjee and Henderson, 2001; Colonnesi et al., 2017; Hezel and McNally, 2014; Hünefeldt et al., 2013; Nikolić et al., 2019; Washburn et al., 2016).

It is of note that the Silent Films task had low internal consistency in our sample (see Supplementary Materials, Table S1), relative to other work in children of a similar age (Devine and Hughes, 2013). Previous studies have shown the Silent Films task can detect individual differences in cognitive empathy over and above verbal ability and executive function (Devine and Hughes, 2016, 2013; Wang et al., 2016). It is not clear why this measure had low internal consistency in our sample. Silent Films' association to self-report cognitive empathy measures has not been established.

Several limitations should be taken into account when interpreting our findings. Most of our measures of empathy were self-report, which may limit comparisons with other research employing task-based measures. There has been little investigation into the comparability of different types of empathy measurement. For example, during measure development, self-report measures are commonly validated against other more established self-report measures, and new tasks validated against established tasks (e.g. the Silent Films task was validated against the Strange Stories task; (Devine and Hughes, 2013)). In the current study we found no association between our self-report and task-based measure of cognitive empathy (see Supplementary Table S2). Recently, Murphy and Lilienfeld (2019) found using meta-analytic techniques that self-report measures and task-based measures of cognitive empathy have no relationship to one another, which empathy researchers will need to address. The lack of association between self-report cognitive empathy and performance on the cognitive empathy task in our sample may indicate that the ability to evaluate one's own cognitive empathy skills (meta-cognition) as required for self-report may not yet be developed enough to warrant use of self-report in this age group. There is research to suggest that children may be particularly prone to giving socially desirable responses when assessed by, or in the presence of adults (Crandall et al., 1965). Findings from specific studies indicate that higher socially desirable responding is related to decreased self-reported antisocial behaviour towards peers and decreased depressive and anxiety symptoms (Camerini and Schulz, 2018; Logan et al., 2008). Future research should take a broader approach to the measurement of empathy, including self, parent or teacher-reports, empathic ability measures, and consider calculating latent factors to deal with measurement error.

The causal nature of the association between empathy and internalizing symptoms is unclear due to the cross-sectional nature of the study, and the role of other mediating or moderating factors is unknown. Further, there are other ways that the association between empathy and symptoms could have been examined. We did not investigate non-linear relationships, however Tully et al. (2016) found a quadratic relationship between cognitive empathy and depressive symptoms. In several psychiatric/neurodevelopmental conditions, affective versus cognitive empathy appears to be selectively impaired (e.g., affective empathy dysfunction with psychopathic tendencies and cognitive empathy dysfunction with autism spectrum traits; Jones et al.,(2010). Cox et al. (2012) found that a ratio of affective to cognitive empathy related to trait aggression and impulsivity, and functional connectivity in the brain in ways that were different to looking at the individual components alone. These studies highlight the nuanced and dynamic ways that components of empathy can be explored. Examining the associations between internalizing symptoms and ratios of empathy components, or interactions between components would be interesting avenues to explore in future research.

Tte level of conceptual overlap between aspects of empathy and internalizing symptom scales is unclear. For example, empathic distress and depressive symptoms both tap into feelings of distress. Whether affective empathy causes changes in internalizing symptoms, or might be more appropriately conceived of as an internalizing symptom, as opposed to a related but separate phenonenon, should be considered in future research.

Middle/late childhood is still fairly early for the emergence of depressive symptoms, and therefore future longitudinal studies could clarify if associations with depressive symptoms become more prominent with age. In addition, future research may wish to investigate how sex interacts with the empathy components to have an effect on internalizing symptoms, as sex differences are well established in both self-

report empathy and internalizing symptoms (Altemus et al., 2014; Baez et al., 2017). Finally, lack of significant associations (e.g., between cognitive empathy and depression) may have been due to a relatively small sample size. In conclusion, the results from our study demonstrated that higher levels of affective sharing and empathic distress were associated with increased internalizing (particularly anxiety) symptoms in children. Cognitive empathy was not associated with internalizing symptoms, which may speak to developmental differences between children and adults, or measurement limitations. Although intact empathy is important for success in the social realm, findings suggest that high levels of particular types of empathy may co-exist with high levels of anxiety in mid/late childhood.

Authors' contribution

KB and SW devised the outline of the manuscript.
KB analyzed the data and wrote the first draft of the manuscript.
KB, EP, SR, CD, NV collected the data.
OS provided clinical guidance during the larger study.
NV was project manager on the larger study.
KB, VA, CP, EP, OS, NV, SR, CD, NA and SW edited the manuscript.
SW, OS, NA conceptualised the larger study.
All authors contributed significantly to the study and approved the final version of the manuscript.

Declaration of Competing Interest

All authors report no biomedical financial interests or potential conflicts of interest.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jad.2021.04.034.

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