Empathic distress and concern predict aggression in toddlerhood: The moderating role of sex

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Abstract

Impaired empathy is an important risk factor of aggression, but results are contradictory in toddlerhood. The association between empathy and aggression may differ for empathic distress and empathic concern in response to empathy-evoking situations, and for boys and girls. Therefore, the current study investigated whether empathic distress and empathic concern at age 20 months (N = 133, 69 boys) predicted aggression at ages 20 and 30 months (N = 119, 62 boys), while taking a potential moderating effect of sex into account. Empathic behavior was observed during a distress simulation task 20 months post-partum. Physical aggression was assessed through maternal report, using the Physical Aggression Scale for Early Childhood. Linear regression analyses revealed sex differences in the associations between empathic distress and concern on the one hand and physical aggression at age 20 months on the other. Furthermore, physical aggression at age 30 months was predicted by the interaction of sex with empathic distress at age 20 months, while controlling for aggression at age 20 months. More empathic distress and concern were associated with less physical aggression in girls, but not in boys. The findings indicate that the prediction of physical aggression by empathic distress was more robust over time than for empathic concern. This study sheds new light on the intricate relationship between empathy, aggression, and sex from a developmental perspective.

Keywords: Empathy, aggression, toddlerhood, sex.

1. Introduction

Empathy refers to the sharing and understanding of feelings of others, and empathy deficits in adults have been associated with aggressive behavior (Blair, 1995, 2006; Decety, Norman, Berntson, & Cacioppo, 2012; Miller & Eisenberg, 1988). The observation of distress in others has been suggested to prompt the withdrawal of aggression by increasing autonomic arousal, which is experienced as aversive (Blair, 1995, 2006). Thus, understanding the causal link between aggressive behavior and the subsequent experience of aversive arousal due to the distress of the other, motivates people to refrain from actions that harm others. In line with this model, empathy, as measured by affective arousal in response to another individual's distress, has been shown to be impaired in children with conduct disorder (Bons, et al., 2013). In addition, elementary and middle school children involved in interventions targeting improvement of empathy through practice of the recognition of emotions in themselves and others, perspective taking, and responding emotionally to others, have been found to become less aggressive, more prosocial, more assertive, and more empathic (Feshbach & Feshbach, 2011; Jagers, et al., 2007; McMahon & Washburn, 2003; Schonert-Reichl, Smith, Zaidman-Zait, & Hertzman, 2011).

Approximately one out of six children show high and stable levels of aggression from toddlerhood to pre-adolescence (Cote, Vaillancourt, LeBlanc, Nagin, & Tremblay, 2006; Tremblay, 2010; Tremblay, et al., 2004). Considering the association between empathy and aggression, interventions targeting empathy at very young ages may help reducing the chances of developing high and consistent levels of aggression. Therefore, toddlerhood is a particularly important developmental stage to study the association of empathy with aggression. Although both aggressive and empathic behavior can be observed in toddlers, research on the association between empathy and aggression has mainly focused on childhood, adolescence, and adulthood (Hay, Perra, et al., 2010; Lovett & Sheffield, 2007;

McDonald & Messinger, 2011). From school age to adulthood, low to moderate negative associations of empathy with aggression have consistently been shown in both community samples and forensic populations (Jolliffe & Farrington, 2004; Miller & Eisenberg, 1988; Vachon, Lynam, & Johnson, 2013; van Langen, Wissink, van Vugt, Van der Stouwe, & Stams, 2014). However, there is a lack of research on the association between empathy and aggression in the preschool period and the results are mixed.

In children under the age of 6, negative associations between empathy and aggression have been found in studies using observational measures of aggression in peer-play groups and measurements of empathy using videotaped vignettes, parent reports and teacher reports (Strayer & Roberts, 2004), parental reports of aggression and observations of empathy during dyadic play (Hughes, White, Sharpen, & Dunn, 2000), or teacher reports of both empathic and hostile behavior (Belacchi & Farina, 2012). In contrast, positive associations between empathy and aggression were found in boys aged 4-5 years (Feshbach & Feshbach, 1969), with aggression measured by teacher reports and empathy by verbal affective responses to slides showing affective situations, and in 2-year-olds, in a study using maternal reports to measure aggressive behavior and behavioral responses to a recording of a crying infant and an experimenter pretending to hurt herself to measure empathy (Gill & Calkins, 2003). There are also quite a few studies, using similar measurements or paradigms as the studies described above, and examining empathy-aggression associations in children under the age of 6, that did not find significant results in either direction (MacQuiddy, Maise, & Hamilton, 1987; Zahn-Waxler, Cole, Welsh, & Fox, 1995). One study, using both behavioral and physiological markers of empathy did not find concurrent associations between empathy and aggression, but only longitudinal associations (Hastings, et al., 2000), although these results were not replicated in another longitudinal study (Rhee, et al., 2013).

Clearly, more research is necessary on the association between empathy and aggression in young children. Although positive associations between empathy and aggression are counterintuitive, contrasting results may be explained by other factors, such as type of empathic behavior and sex differences.

With respect to type of empathic behavior, a negative association between empathy and aggressive behavior has been shown in particular for affective empathy, which refers to the sharing of the other's emotions and is related to increased autonomic arousal, and to a lesser extent for cognitive empathy, which is based on the understanding of the other person's emotions (Theory of Mind) and starts to develop around the age of 4 (Blair, 2005; Bons, et al., 2013; Smith, 2006), although some precursors for cognitive empathy can already be observed during toddlerhood (Vaish, Carpenter, & Tomasello, 2009). Regarding the development of affective empathy, it should be noted that empathy-eliciting situations during infancy are often emotionally challenging and result in over-arousal (Eisenberg, 2010; Hoffman, 2000). Over-arousal can manifest itself as personal distress and seeking comfort (Geangu, Benga, Stahl, & Striano, 2010; Liew, et al., 2011; McDonald & Messinger, 2011). Empathic distress is considered a rudimentary expression of affective empathy, because it is strongly related to automatic and rudimentary processes such as emotional contagion and emotional resonance (de Waal, 2008).

During the second and third year of life, empathy-eliciting situations also increasingly result in empathic concern, which includes concern for the wellbeing of others and trying to understand the cause of the feelings of the other, and motivates attempts to reduce the other person's distress (Eisenberg, Eggum, & Di Giunta, 2010; McDonald & Messinger, 2011; Roth-Hanania, Davidov, & Zahn-Waxler, 2011). As a result of development in emotion regulation, self-other differentiation, and perspective taking, toddlers increasingly focus on the other's distress instead of attending exclusively their own distress (Tousignant, Eugene, &

Jackson, 2017). At the age of three, over 50% of the children are able to perform some act of prosocial behavior in response to their mother's distress (Knafo, Zahn-Waxler, Van Hulle, Robinson, & Rhee, 2008; McDonald & Messinger, 2011).

Although empathic distress may not lead to comforting and helping as empathic concern does, it is considered an important aspect of empathy since it reflects the extent to which an individual is affected by the suffering of another person (Batson, Fultz, & Schoenrade, 1987; Eisenberg, et al., 2010; Singer & Klimecki, 2014). Empathic distress has been suggested to inhibit aggression and to be a precursor of empathic concern, for example, by Blair's Violence Inhibition Mechanism model (Blair, 2006; de Waal, 2008; Hoffman, 2000; McDonald & Messinger, 2011; Zahn-Waxler & Radke-Yarrow, 1990). Furthermore, empathic distress and empathic concern can occur simultaneously and have been shown to be positively associated throughout development (Gill & Calkins, 2003; Israelashvili & Karniol, 2018; Liew, et al., 2011; Lin & Grisham, 2017; Young, Fox, & Zahn-Waxler, 1999). Nonetheless, recent research has shown evidence in support of distinct neural systems underlying empathic distress and empathic concern (Decety & Michalska, 2010; Han, et al., 2017; Singer & Klimecki, 2014). In line with Hoffman's stages of empathy, which indicate that empathic concern starts to co-occur with empathic distress as soon as the self-other distinction is present, neuroimaging research in children indicates that brain regions associated with empathic distress develop earlier than brain regions associated with empathic concern, and behavioral research indicates that empathic distress is stable over time, whereas empathic concern increases during the first years of life (Decety, 2010; Decety & Michalska, 2010; Geangu, et al., 2010; Hoffman, 2000; Roth-Hanania, et al., 2011).

Since empathic distress and empathic concern represent different, but related empathic responses, their associations with aggression may differ (Israelashvili & Karniol, 2018; Lin & Grisham, 2017). Empathic distress results solely from affective arousal, which has been

suggested to prompt the inhibition of aggression, and can be hypothesized to be negatively associated with aggression in toddlerhood. Empathic concern is under the influence of arousal as well as other factors, such as socialization and perspective taking (Farrant, Devine, Maybery, & Fletcher, 2012; Vaish, et al., 2009). Because arousal has less influence on empathic concern than on empathic distress, the association between empathic concern and aggression can be hypothesized to be weak or absent. In toddlerhood, however, studies that have included measures of both empathic distress and empathic concern did not indicate clear distinctions between empathic distress and empathic concern in relation to aggression (Gill & Calkins, 2003; Hastings, et al., 2000; Zahn-Waxler, et al., 1995).Thus, other factors might also play a role in explaining the contradictory results regarding empathy-aggression associations in toddlerhood. For example, sex differences could play an important role.

Studies with toddlers have shown that girls generally express more empathic behavior than boys (Hastings, et al., 2000; Knafo, et al., 2008; Spinrad & Stifter, 2006; Zahn-Waxler, Radke-Yarrow, Wagner, & Chapman, 1992; Zahn-Waxler, Robinson, & Emde, 1992). Moreover, females have been shown to be more empathic from birth until adulthood and sex differences in empathy have been suggested to have a neurobiological origin (Christov-Moore, et al., 2014; Schulte-Ruther, Markowitsch, Shah, Fink, & Piefke, 2008). Still, several studies on toddlers did not find sex differences regarding empathy (Gill & Calkins, 2003; Rhee, et al., 2013; Roth-Hanania, et al., 2011; Vaish, et al., 2009). Regarding aggression, boys have been shown to be more aggressive than girls in toddlerhood (Alink, et al., 2006; Baillargeon, et al., 2007) and boys are more likely to follow high and stable trajectories of aggression from toddlerhood to adolescence (Cote, et al., 2006; Tremblay, Hartup, & Archer, 2005; Tremblay, et al., 2004). Consequently, the association between empathy and aggression might be different for boys and girls (Feshbach & Feshbach, 1969). Although empirical findings on sex differences in aggression and empathy are well documented, the potential

moderation effects of the association between empathy and aggression by sex is still not explored enough. Some indications for a moderating effect of sex have been found. A study in 4-7 year-old children demonstrated a positive association between self-reported empathy in response to vignettes and aggression in boys, but not in girls (Feshbach & Feshbach, 1969). On the other hand, another study demonstrated a negative association between parent-reported empathy and psychopathic traits (which include aggression) in 3-13 year-old boys, but not in girls (Dadds, et al., 2009). Research in adults indicate stronger negative associations between self-reported empathy and aggression in women (Stanger, Kavussanu, & Ring, 2016). Based on these studies, it remains unclear if a moderating effect would be present for both empathic concern and empathic distress.

The association between empathy and aggression might be stronger for physical aggression than for other types of aggression in toddlerhood, because physical aggression has been shown to emerge during the first year of life, to peak during the second and third year of life and to decline during the fourth year of life, while other forms of aggression (e.g. verbal aggression) start to increase during the fourth year of life (Alink, et al., 2006; Hay, Perra, et al., 2010; Tremblay, et al., 1999). Moreover, physical aggression has been shown to be a better predictor of continued problem behavior than other types of problem behavior (Broidy, et al., 2003). Therefore, the current study will focus on maternal reports of physical aggression.

The present study aimed to investigate the association between empathy and physical aggression in toddlerhood, while taking into account its different expressions, empathic distress and empathic concern, and sex differences in empathy and physical aggression. A negative association between empathic distress and physical aggression was expected, whereas a weak negative or no association between empathic concern and physical aggression was expected. In addition, girls were expected to show more empathic distress and concern,

and boys were expected to show more physical aggression. Furthermore, a possible moderating effect of sex on the association between empathy and physical aggression was explored.

2. Methods

2.1 Participants

The present study is part of the Mother- Infant Neurodevelopment Study in Leiden, The Netherlands (MINDS - Leiden). MINDS – Leiden is a longitudinal study into neurobiological and neurocognitive predictors of early behavior problems. The study was approved by the ethics committee of the Institute of Education and Child Studies at the Faculty of Social and Behavioural Sciences, Leiden University (ECPW-2011/025), and by the Medical Research Ethics Committee at Leiden University Medical Centre (NL39303.058.12). All participating women provided written informed consent. 162 women were recruited during pregnancy via midwifery clinics, hospitals, prenatal classes and pregnancy fairs. Dutch speaking primiparous women between 17 and 25 years old (M = 23.35, SD = 2.13) with uncomplicated pregnancies were eligible to participate. Women from high-risk backgrounds were oversampled in this study, which increases variance in infant's behavior (see Smaling et al., 2015 for detailed procedures). Data collection for the present study was part of a home visit 20 months post-partum and a lab visit 30 months post-partum. Dropout (N = 29 at 20 months and N = 43 at 30 months) was mainly due to unreachability and unwillingness to participate without explaining the reason. Dropout was not related to ethnicity, level of education and marital status. At the end of the appointments, the child was rewarded with a gift and the mother received a reimbursement for her time.

2.2 Empathy

Behavioral responses to an empathy-evoking situation were observed during a distress simulation task adapted from Zahn-Waxler, Radke-Yarrow, et al. (1992) at age 20 months (N

= 133, 69 boys). The experimenter asked the mother to refrain from interacting with her child or to respond in a neutral way when the child would seek contact with her. Subsequently, the experimenter pretended to bump her toe into a piece of furniture. She pretended to be in pain for 30 seconds and to slowly recover from the pain during another 30 seconds. During this simulation, the experimenter sat down on the floor to rub her foot, she expressed pain vocally (e.g. saying: "ouch, that hurts!") and did not make eye contact with the child. Behavioral responses of the child were videotaped by a second experimenter and coded for two dimensions of empathic distress (higher score indicates more observed behavior): comfort seeking (0-4; does not seek comfort with self or mother; mild self-comforting behavior or seeking proximity to mother; moderate comfort seeking with self or mother, or combining mild comfort seeking with self and mother; moderate comfort seeking by climbing onto mothers lab combined with self-comforting behavior or high levels of comfort seeking with the self or mother; self-comforting behavior for nearly the whole task and high levels of proximity to mother by 'flying' onto the mother's neck) and personal distress (0-3; no distress; mild distress; fear present; whimpers, whines, or cries) (Liew, et al., 2011; Lin & Grisham, 2017; Zahn-Waxler, Radke-Yarrow, et al., 1992). In addition, three dimensions of empathic concern were coded: concerned expressions (0-3; no concern; slight or some concern such as brow furrowing for less than 3 seconds; moderate concern expressed in face or voice; strong facial concern for at least 8 seconds), testing hypotheses (0-4; no hypothesis testing; simple nonverbal gestures such as looking back and forward to the victim's face and foot or simple verbal inquires such as 'hurt?'; a combination of gestures and verbal inquires; at least two distinct combined attempts to understand; four or more combined attempts to understand) and prosocial behavior (0-3; no prosocial behavior; assisting for less than 3 seconds by comforting the experimenter or sharing toys; assisting for 3 to 5 seconds; assisting more than 5 seconds) (Liew, et al., 2011; Lin & Grisham, 2017; Zahn-Waxler, Radke-

Yarrow, et al., 1992). All measures were videotaped and coded afterwards by two reliable coders that created one consensus score in case of differences between them. The ICC's were .850 for testing hypothesis, .807 for prosocial behavior, .692 for concerned expressions, .868 for self-distress and .776 for comfort seeking. The scores on these scales were transformed into standardized scores. In accordance to previous studies, comfort seeking and personal distress were summed to a composite score for empathic distress, and prosocial behavior, hypothesis testing, and concerned expressions were summed to a composite score for empathic concern (Liew, et al., 2011; Lin & Grisham, 2017).

2.3 Physical aggression

In order to measure physical aggression, all mothers completed the physical aggression scale for early childhood (PASEC) at 20 (N = 133, 69 boys) and 30 (N = 119, 62 boys) months of age (Alink, et al., 2006). The PASEC has been shown to be a valid measure to examine physical aggression in infancy and consists of 11 items to be scored on a 3-point Likert scale (0 = not true, 1 = somewhat or sometimes true, 2 = very true or often true) (Alink, et al., 2006). The PASEC combines six items from the Child Behavior Checklist (Achenbach & Rescorla, 2000) and five items constructed by Tremblay, et al. (1999) to measure physical aggression (e.g. hits others, bites others and destroys his/her own things). Scores were added to create one physical aggression score at age 20 months and one physical aggression score at age 30 months (Cronbach's $\alpha = .75$ in infancy and $\alpha = .71$ in toddlerhood).

2.4 Data analysis

All variables were checked for outliers and normality. For physical aggression, the natural log of the PASEC was used because this variable was positively skewed before transformation. No data was missing on the PASEC and empathy observations.

First, Spearman correlations between the ordinal variables of the behavioral responses to the distress simulation task and the PASEC scores were performed for boys and girls

separately. The main and interaction effects of empathic distress, empathic concern, and sex on physical aggression were examined by separate multivariate linear regression analyses for physical aggression at age 20 months and 30 months. Regarding physical aggression at age 20 months, the following variables were entered in the regression: empathic distress, empathic concern, sex, sex × empathic distress, and sex × empathic concern. For the regression analyses regarding physical aggression at age 30 months, physical aggression at 20 months was entered first and the variables described above were entered in the second step of the regression. The empathy variables were centered at the mean in advance and interaction effects were further examined by repeating the regression analyses at different levels (0 for boys and 1 for girls) of the moderator (Aiken, West, & Reno, 1991; Holmbeck, 2002). All analyses were done using the Statistical Package for Social Sciences (SPSS for windows, version 23, SPSS Inc., Chicago) and statistical significance was set at $p < .05$ a priori.

3. Results

Characteristics of the sample are shown in Table 1. Descriptive statistics of the scales of the distress simulation task and physical aggression scores, and Spearman correlations between the scales are shown in Table 2. No sex differences were present on any of the composite measures or individual items of the empathy and aggression instruments. Paired samples T-Tests indicated no difference in physical aggression between age 20 and 30 months (Boys: $t(62) = .858$, $p = .394$, $d = 0.10$; Girls: $t(57) = 1.407$, $p = .165$, $d = 0.22$).

Table 1. *Sample characteristics*

Variable	%	M(SD)
Caucasian ethnicity	86.3%	
Highest education completed		
Primary education	2.3%	
Secondary education	19.1%	
Tertiary education	48.1%	
Bachelor degree or higher	30.5%	
Infant age at 20 months measurement		20.46 (0.71)
Infant age at 30 months measurement		30.65 (1.11)

Note: Maternal background variables were obtained during pregnancy.

Table 2. *Spearman correlations and descriptive statistics of behavioral responses to the distress simulation task at age 20 months and maternal reports of physical aggression at age 20 and 30 months.*

Girls / Boys	1.	1a.	1b.	1c.	2.	2a.	2b.	3.	4.	M girls	SD girls
1. Empathic concern		.556**	.556**	.633**	-.151	.220	-.428**	-.252*	.092	0.04	1.66
1a. Prosocial behavior	.440**		.313**	-.047	-.287*	-.189	-.228	-.100	.270*	0.25	0.64
1b. Hypothesis testing	.595**	.018		-.025	-.186	-.022	-.299*	-.186	.079	1.25	0.61
1c. Concerned expressions	.632**	-.186	.181		.098	.401**	-.234	-.203	-.077	1.34	0.91
2. Empathic distress	.267*	-.097	-.031	.535**		.703**	.738**	-.215	-.325**	0.15	1.39
2a. Personal distress	.333**	-.090	-.016	.637**	.832**		.096	-.241	-.396**	1.02	0.70
2b. Comfort seeking	.099	-.052	-.050	.207	.765**	.312**		-.076	-.141	1.75	1.01
3. Aggression 20 months	.196	.183	.148	.058	.203	.208	.122		.414**	2.50	2.15
4. Aggression 30 months	.129	.117	.231	-.038	.245	.215	.232	.447**		2.07	1.97
M boys	-0.13	0.32	1.16	1.23	-.19	0.86	1.62	3.10	2.71		
SD boys	-1.78	0.83	0.63	0.94	1.60	0.84	0.93	2.62	2.26		

Note: *p≤.05, **p≤.01; No sex differences were found for these variables.

3.1 Main analyses

The results of the regression analyses that were performed to examine main and interaction effects of empathic distress and concern, and sex on physical aggression are shown in Table 3. At age 20 months, no main effects of empathic distress, empathic concern, or sex on physical aggression were found, but interactions of both empathic distress and empathic concern with sex were present. Regarding physical aggression at age 30 months, physical aggression at age 20 months was a significant predictor, but no main effects of empathic distress, empathic concern, and sex were found. Furthermore, an interaction of sex with empathic distress, but not empathic concern, was found.

Table 3. *Regression analyses of the effects of empathic distress, empathic concern and sex on physical aggression.*

	β	t	R^2 change	Sig.	β	t	R^2 change	Sig.
	20 months				**30 months**			
Model 0							.199	<.001
Aggression T1					.446	5.393		<.001
Model 1			.106	.013			.082	.031
Aggression T1					.402	4.776		<.001
Empathic distress	.148	1.329		.186	.172	1.591		.114
Empathic concern	.205	1.788		.076	.048	.423		.673
Sex	-.114	-1.352		.179	-.119	-1.455		.148
Empathic distress × sex	-.239	-2.159		.033	-.308	-2.858		.005
Empathic concern × sex	-.328	-2.885		.005	.060	.528		.598

Note: Aggression T1: physical aggression at age 20 months.

3.2 Post hoc analyses

To be able to interpret the regression lines of empathic distress and empathic concern on physical aggression for boys and girls, post hoc hierarchical regression analyses were performed with sex at level 1, which represents girls (the default is 0, which represents boys and is displayed in table 3), according to the method of Aiken, West, and Reno (Aiken, et al., 1991; Holmbeck, 2002). The results indicated empathic distress did not predict physical aggression in boys (β =.148, t = 1.329, p = .186), but a negative trend was found for girls (β = -.239, t = -1.795, p = .075) at age 20 months. In addition, empathic distress at age 20 months did not predict boys' physical aggression at age 30 months (β = .172, t = 1.591, p = .114), but was a negative predictor of girls' physical aggression at age 30 months (β = -.315, t = -2.436, p = .016), while controlling for physical aggression at age 20 months. Empathic concern was marginally positively associated with physical aggression in boys (β =.205, t = 1.788, p = .076) and negatively associated with physical aggression in girls (β = -.317, t = -2.411, p = .017) at age 20 months.

4. Discussion

The aim of the current study was to investigate whether empathic distress and empathic concern at age 20 months predict physical aggression at age 20 and 30 months, while taking into account possible sex differences. In contrast to our hypotheses, there were no main effects of empathic distress, empathic concern, or sex on physical aggression. The results showed that the effects of empathic distress and empathic concern on physical aggression were moderated by sex. Negative associations between empathic concern and physical aggression at age 20 months, as well as between empathic distress and physical aggression at age 30 months, were present for girls only. No associations between empathy and aggression were found for boys. Regarding prosocial behavior specifically, a positive association was found with physical aggression at age 30 months in girls.

In girls, higher levels of empathic distress at age 20 months predicted lower levels physical aggression at age 20 months (marginal effect) and age 30 months, while controlling for physical aggression at age 20 months. These results are in line with our hypotheses, and support both theory and empirical results indicating negative associations between empathy and aggression (Belacchi & Farina, 2012; Blair, 2005; Hughes, et al., 2000; Lovett & Sheffield, 2007; Strayer & Roberts, 2004). However, a positive association between prosocial behavior at age 20 months and physical aggression at age 30 months was present in girls. Possibly, this was due to the fact that empathic distress at age 20 months was negatively associated with both prosocial behavior and physical aggression at age 30 months. These associations may have resulted in the positive association between prosocial behavior and physical aggression at age 30 months in girls. In line with this suggestion, the positive association disappeared when empathic distress was controlled for.

We expected weak negative or no associations between empathic concern and physical aggression, because affective arousal plays less of a role in empathic concern than in empathic distress, and because empathic concern depends on other factors such as socialization and perspective taking (Farrant, et al., 2012; Vaish, et al., 2009). However, higher levels of empathic concern in girls were associated with lower levels of physical aggression at age 20 months. A possible explanation for this association is that empathic concern may still be influenced by affective arousal, despite the additional influence of other factors. Therefore, the same mechanism may cause an association between empathic distress and aggression, and between empathic concern and aggression. Furthermore, perspective taking has also been shown to motivate the withdrawal of aggression and empathic concern might be a mediator of this association (Richardson, Hammock, Smith, Gardner, & Signo, 1994). Therefore, further research is necessary on the affective and cognitive aspects of empathic concern in relation to aggression. However, where empathic distress was predictive of physical aggression both concurrently and longitudinally, empathic concern showed only concurrent effects at age 20 months. This indicates that the prediction of physical aggression by empathic distress is more robust over this early developmental course than for empathic concern.

Although higher levels of empathic distress and empathic concern, and lower levels of physical aggression were expected for girls, no main effects of sex on empathic behavior or aggression were found. Our results were in line with findings in previous studies (Gill & Calkins, 2003; Rhee, et al., 2013; Roth-Hanania, et al., 2011; Vaish, et al., 2009). However, the majority of studies have shown higher levels of empathy in girls than in boys from birth onwards (Christov-Moore, et al., 2014; Hastings, et al., 2000; Knafo, et al., 2008; Spinrad & Stifter, 2006; Zahn-Waxler, Radke-Yarrow, et al., 1992; Zahn-Waxler, Robinson, et al., 1992). Possibly, sex differences in empathy have been masked by differences in social inhibition between boys and girls in response to the distress simulation task. Specific

impairments in inhibition have been shown in aggressive preschool children, in particular in boys (Raaijmakers, et al., 2008). Therefore, boys might have responded more impulsively (e.g. approaching the victim) to the distress simulation task, which could have resulted in more behavioral responses, such as prosocial behavior, hypothesis testing and comfort seeking (Gill & Calkins, 2003). Inhibition impairments could also explain why no association between empathy and physical aggression was found for boys. Thus, boys with impaired inhibition will not only show more empathic behavior, but also more aggression. Inhibition impairments may therefore underlie the positive association between empathy and aggression, and this positive association may counteract the negative association between empathic distress and physical aggression that was initially hypothesized (Eisenberg, et al., 2010; Gill & Calkins, 2003; Lovett & Sheffield, 2007).

Alternatively, the association between empathy and aggression may have been different for boys and girls because of differences between boys and girls in the associations between indicators of empathic behavior. For example, prosocial behavior and hypothesis testing are positively associated in girls only, whereas personal distress and comfort seeking are only positively associated in boys. In addition, the composite scores of empathic concern and empathic distress were positively associated in boys, but not in girls. Therefore, the correlation analyses only supported the empathic concern composite for girls and the empathic distress composite for boys, which is a limitation of the study. However, it should be noted that both composites were supported by their constituents, as empathic concern was positively associated with concerned expressions, hypothesis testing, and prosocial behavior, and empathic distress was positively associated with personal distress and comfort seeking in both boys and girls.

In addition to the lack of sex differences on empathy, no differences between boys and girls on physical aggression were found. The interaction effects between empathic distress

and empathic concern, and physical aggression indicated that lower levels of physical aggression were reported for girls than for boys, but only if their empathic behavior was high. Although higher levels of aggression have previously been found in boys at age 17 months (Baillargeon, et al., 2007) and boys are more likely to follow high and stable trajectories of aggression from toddlerhood to adolescence (Cote, et al., 2006; Tremblay, et al., 2005; Tremblay, et al., 2004), sex differences in aggression might not be clearly present yet in toddlerhood. No sex differences were found until the age of 24 months in a study using the PASEC (Alink, et al., 2006). In addition, a longitudinal study showed more aggression for girls than boys before the age of 24 months, while the opposite was found after 24 months of age (Hay, et al., 2011). Future research on the development of sex differences in aggression is needed.

The current study adds to the literature by focusing on both empathic distress and empathic concern in response to an empathy-eliciting event. As the results showed, at an early developmental stage, empathic distress is an import aspect of empathy and shows more robust associations with physical aggression compared to empathic concern. Furthermore, the use of a longitudinal design is a strength of this study, as it provides insight on how empathic behavior is associated with change in physical aggression over time. Although negative associations between empathy and physical aggression have been found before in toddlerhood, this is the first study to find both cross-sectional and longitudinal effects of empathy-related behavior on physical aggression at this age (Belacchi & Farina, 2012; Hastings, et al., 2000; Hay, Hudson, & Liang, 2010; Hughes, et al., 2000; Strayer & Roberts, 2004).

In addition, infants' empathic behavior was examined using videotaped observations of an empathy-evoking task that were double coded for empathy-related behavior. In order to increase the reliability of the empathy measure, the distress simulation was performed by the

experimenter rather than the child's mother. This is a limitation of the study because it is likely that distress in unfamiliar people evokes less empathic concern and more empathic distress in infants than distress in familiar people (Preston & De Waal, 2002; Young, et al., 1999). The fact that maternal reports have been used to measure physical aggression might be a limitation of the current study. Parent reports provide ecologically valid information about behavior in daily situations, but maternal reports of physical aggression might be biased by maternal factors such as personality, memory capacity, and tendency of social desirability response (Kagan, Snidman, Arcus, & Reznick, 1994). Still, the PASEC has shown to be a reliable and valid measure of physical aggression in toddlerhood (Alink, et al., 2006; Koot, Van Den Oord, Verhulst, & Boomsma, 1997). Furthermore, our results also indicated stability of physical aggression over time ($r(119) = .446$, $p < .001$). It should also be noted that structural equation modeling could have been a more optimal method to deal with latent variables (empathic concern and empathic distress) and the longitudinal nature of the data (De Stavola, et al., 2006).

To conclude, this study revealed that the association between empathy and physical aggression is already present in toddlerhood. In particular, more empathic concern in response to an empathy-evoking situation at age 20 months predicted lower levels of physical aggression in girls, but not boys, at age 20 months. Furthermore, in girls, more empathic distress at age 20 months predicted lower levels of physical aggression at age 30 months, while controlling for physical aggression at age 20 months. The current study suggests that the basis for the association between empathy and physical aggression is established in toddlerhood. Future studies should investigate the effects of interventions aiming to increase empathy and reduce aggression. Furthermore, more research is needed to address the effect of other factors (e.g. inhibition) on empathy and aggression in toddlerhood. Finally, more

research is needed into the development of the association between empathy and aggression in boys.

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References

Achenbach, T. M., & Rescorla, L. A. (2000). *Manual for the ASEBA preschool forms & profiles: An integrated system of multi-informant assessment; Child behavior checklist for ages 1 1/2-5; Language development survey; Caregiver-teacher report form*: University of Vermont.

Aiken, L. S., West, S. G., & Reno, R. R. (1991). *Multiple regression: Testing and interpreting interactions*: Sage.

Alink, L. R., Mesman, J., Van Zeijl, J., Stolk, M. N., Juffer, F., Koot, H. M., Bakermans-Kranenburg, M. J., & Van IJzendoorn, M. H. (2006). The early childhood aggression curve: Development of physical aggression in 10-to 50-month-old children. *Child development, 77*, 954-966.

Baillargeon, R. H., Zoccolillo, M., Keenan, K., Côté, S., Pérusse, D., Wu, H.-X., Boivin, M., & Tremblay, R. E. (2007). Gender differences in physical aggression: A prospective population-based survey of children before and after 2 years of age. *Developmental psychology, 43*, 13.

Batson, C. D., Fultz, J., & Schoenrade, P. A. (1987). Distress and empathy: Two qualitatively distinct vicarious emotions with different motivational consequences. *Journal of personality, 55*, 19-39.

Belacchi, C., & Farina, E. (2012). Feeling and thinking of others: affective and cognitive empathy and emotion comprehension in prosocial/hostile preschoolers. *Aggress Behav, 38*, 150-165.

Blair, R. J. (1995). A cognitive developmental approach to morality: Investigating the psychopath. *Cognition, 57*, 1-29.

Blair, R. J. (2005). Responding to the emotions of others: dissociating forms of empathy through the study of typical and psychiatric populations. *Conscious Cogn, 14*, 698-718.

Blair, R. J. (2006). The emergence of psychopathy: implications for the neuropsychological approach to developmental disorders. *Cognition, 101*, 414-442.

Bons, D., van den Broek, E., Scheepers, F., Herpers, P., Rommelse, N., & Buitelaar, J. K. (2013). Motor, emotional, and cognitive empathy in children and adolescents with autism spectrum disorder and conduct disorder. *J Abnorm Child Psychol, 41*, 425-443.

Broidy, L. M., Nagin, D. S., Tremblay, R. E., Bates, J. E., Brame, B., Dodge, K. A., Fergusson, D., Horwood, J. L., Loeber, R., & Laird, R. (2003). Developmental trajectories of childhood disruptive behaviors and adolescent delinquency: a six-site, cross-national study. *Developmental psychology, 39*, 222.

Christov-Moore, L., Simpson, E. A., Coude, G., Grigaityte, K., Iacoboni, M., & Ferrari, P. F. (2014). Empathy: gender effects in brain and behavior. *Neurosci Biobehav Rev, 46 Pt 4*, 604-627.

Cote, S. M., Vaillancourt, T., LeBlanc, J. C., Nagin, D. S., & Tremblay, R. E. (2006). The development of physical aggression from toddlerhood to pre-adolescence: a nation wide longitudinal study of Canadian children. *J Abnorm Child Psychol, 34*, 71-85.

Dadds, M. R., Hawes, D. J., Frost, A. D. J., Vassallo, S., Bunn, P., Hunter, K., & Merz, S. (2009). Learning to 'talk the talk': the relationship of psychopathic traits to deficits in empathy across childhood. *Journal of Child Psychology and Psychiatry, 50*, 599-606.

De Stavola, B. L., Nitsch, D., dos Santos Silva, I., McCormack, V., Hardy, R., Mann, V., Cole, T. J., Morton, S., & Leon, D. A. (2006). Statistical issues in life course epidemiology. *Am J Epidemiol, 163*, 84-96.

de Waal, F. B. (2008). Putting the altruism back into altruism: the evolution of empathy. *Annu Rev Psychol, 59*, 279-300.

Decety, J. (2010). The neurodevelopment of empathy in humans. *Dev Neurosci, 32*, 257-267.
Decety, J., & Michalska, K. J. (2010). Neurodevelopmental changes in the circuits underlying empathy and sympathy from childhood to adulthood. *Dev Sci, 13*, 886-899.
Decety, J., Norman, G. J., Berntson, G. G., & Cacioppo, J. T. (2012). A neurobehavioral evolutionary perspective on the mechanisms underlying empathy. *Progress in Neurobiology, 98*, 38-48.
Eisenberg, N. (2010). Empathy-related responding: Links with self-regulation, moral judgment, and moral behavior. In M. Mikulincer & P. R. Shaver (Eds.), *Prosocial motives, emotions, and behavior: The better angels of our nature* (pp. 129-148). Washington, DC, US: American Psychological Association.
Eisenberg, N., Eggum, N. D., & Di Giunta, L. (2010). Empathy-related Responding: Associations with Prosocial Behavior, Aggression, and Intergroup Relations. *Soc Issues Policy Rev, 4*, 143-180.
Farrant, B. M., Devine, T. A. J., Maybery, M. T., & Fletcher, J. (2012). Empathy, Perspective Taking and Prosocial Behaviour: The Importance of Parenting Practices. *Infant and Child Development, 21*, 175-188.
Feshbach, N. D., & Feshbach, S. (1969). The relationship between empathy and aggression in two age groups. *Developmental psychology, 1*, 102.
Feshbach, N. D., & Feshbach, S. (2011). 7 Empathy and Education. *The social neuroscience of empathy*, 85.
Geangu, E., Benga, O., Stahl, D., & Striano, T. (2010). Contagious crying beyond the first days of life. *Infant Behavior and Development, 33*, 279-288.
Gill, K. L., & Calkins, S. D. (2003). Do aggressive/destructive toddlers lack concern for others? Behavioral and physiological indicators of empathic responding in 2-year-old children. *Development and Psychopathology, 15*, 55-71.
Han, X., He, K., Wu, B., Shi, Z., Liu, Y., Luo, S., Wei, K., Wu, X., & Han, S. (2017). Empathy for pain motivates actions without altruistic effects: evidence of motor dynamics and brain activity. *Soc Cogn Affect Neurosci, 12*, 893-901.
Hastings, P. D., Zahn-Waxler, C., Robinson, J., Usher, B., & Bridges, D. (2000). The development of concern for others in children with behavior problems. *Developmental psychology, 36*, 531.
Hay, D. F., Hudson, K., & Liang, W. (2010). Links between preschool children's prosocial skills and aggressive conduct problems: The contribution of ADHD symptoms. *Early Childhood Research Quarterly, 25*, 493-501.
Hay, D. F., Nash, A., Caplan, M., Swartzentruber, J., Ishikawa, F., & Vespo, J. E. (2011). The emergence of gender differences in physical aggression in the context of conflict between young peers. *Br J Dev Psychol, 29*, 158-175.
Hay, D. F., Perra, O., Hudson, K., Waters, C. S., Mundy, L., Phillips, R., Goodyer, I., Harold, G., Thapar, A., van Goozen, S., & Team, C. (2010). Identifying early signs of aggression: psychometric properties of the Cardiff infant contentiousness scale. *Aggress Behav, 36*, 351-357.
Hoffman, M. (2000). *Empathy and Moral Development: Implications for Caring and Justice* Cambridge, UK: Cambridge University Press.
Holmbeck, G. N. (2002). Post-hoc probing of significant moderational and mediational effects in studies of pediatric populations. *Journal of pediatric psychology, 27*, 87-96.
Hughes, C., White, A., Sharpen, J., & Dunn, J. (2000). Antisocial, angry, and unsympathetic:"Hard-to-manage" preschoolers' peer problems and possible cognitive influences. *The Journal of Child Psychology and Psychiatry and Allied Disciplines, 41*, 169-179.

Israelashvili, J., & Karniol, R. (2018). Testing alternative models of dispositional empathy: The Affect-to-Cognition (ACM) versus the Cognition-to-Affect (CAM) model. *Personality and individual differences, 121*, 161-169.

Jagers, R. J., Morgan-Lopez, A. A., Howard, T. L., Browne, D. C., Flay, B. R., & Aban Aya, C. (2007). Mediators of the development and prevention of violent behavior. *Prev Sci, 8*, 171-179.

Jolliffe, D., & Farrington, D. P. (2004). Empathy and offending: A systematic review and meta-analysis. *Aggression and Violent Behavior, 9*, 441-476.

Kagan, J., Snidman, N., Arcus, D., & Reznick, J. S. (1994). *Galen's prophecy: Temperament in human nature*: Basic Books.

Knafo, A., Zahn-Waxler, C., Van Hulle, C., Robinson, J. L., & Rhee, S. H. (2008). The developmental origins of a disposition toward empathy: Genetic and environmental contributions. *Emotion, 8*, 737-752.

Koot, H. M., Van Den Oord, E. J., Verhulst, F. C., & Boomsma, D. I. (1997). Behavioral and emotional problems in young preschoolers: Cross-cultural testing of the validity of the Child Behavior Checklist/2-3. *Journal of abnormal child psychology, 25*, 183-196.

Liew, J., Eisenberg, N., Spinrad, T. L., Eggum, N. D., Haugen, R. G., Kupfer, A., Reiser, M. R., Smith, C. L., Lemery-Chalfant, K., & Baham, M. E. (2011). Physiological Regulation and Fearfulness as Predictors of Young Children's Empathy-related Reactions. *Soc Dev, 20*, 111-113.

Lin, H. C., & Grisham, M. (2017). Distressed yet empathically sensitive: Preschoolers' responses to infant crying. *Infant Behav Dev, 49*, 46-49.

Lovett, B. J., & Sheffield, R. A. (2007). Affective empathy deficits in aggressive children and adolescents: a critical review. *Clin Psychol Rev, 27*, 1-13.

MacQuiddy, S. L., Maise, S. J., & Hamilton, S. B. (1987). Empathy and affective perspective-taking skills in parent-identified conduct-disordered boys. *Journal of Clinical Child Psychology, 16*, 260-268.

McDonald, N. M., & Messinger, D. S. (2011). The Development of Empathy: How, When, and Why In A. Acerbi, J. A. Lombo & J. J. Sanguineti (Eds.), *Free will, Emotions, and Moral Actions: Philosophy and Neuroscience in Dialogue.*: IF-Press.

McMahon, S. D., & Washburn, J. J. (2003). Violence prevention: An evaluation of program effects with urban African American students. *Journal of Primary Prevention, 24*, 43-62.

Miller, P. A., & Eisenberg, N. (1988). The relation of empathy to aggressive and externalizing/antisocial behavior. *Psychological bulletin, 103*, 324.

Preston, S. D., & De Waal, F. B. (2002). Empathy: Its ultimate and proximate bases. *Behavioral and brain sciences, 25*, 1-20.

Raaijmakers, M. A., Smidts, D. P., Sergeant, J. A., Maassen, G. H., Posthumus, J. A., van Engeland, H., & Matthys, W. (2008). Executive functions in preschool children with aggressive behavior: impairments in inhibitory control. *J Abnorm Child Psychol, 36*, 1097-1107.

Rhee, S. H., Friedman, N. P., Boeldt, D. L., Corley, R. P., Hewitt, J. K., Knafo, A., Lahey, B. B., Robinson, J., Van Hulle, C. A., Waldman, I. D., Young, S. E., & Zahn-Waxler, C. (2013). Early concern and disregard for others as predictors of antisocial behavior. *J Child Psychol Psychiatry, 54*, 157-166.

Richardson, D. R., Hammock, G. S., Smith, S. M., Gardner, W., & Signo, M. (1994). Empathy as a cognitive inhibitor of interpersonal aggression. *Aggressive Behavior, 20*, 275-289.

Roth-Hanania, R., Davidov, M., & Zahn-Waxler, C. (2011). Empathy development from 8 to 16 months: early signs of concern for others. *Infant Behav Dev, 34*, 447-458.

Schonert-Reichl, K. A., Smith, V., Zaidman-Zait, A., & Hertzman, C. (2011). Promoting Children's Prosocial Behaviors in School: Impact of the "Roots of Empathy" Program on the Social and Emotional Competence of School-Aged Children. *School Mental Health, 4*, 1-21.

Schulte-Ruther, M., Markowitsch, H. J., Shah, N. J., Fink, G. R., & Piefke, M. (2008). Gender differences in brain networks supporting empathy. *Neuroimage, 42*, 393-403.

Singer, T., & Klimecki, O. M. (2014). Empathy and compassion. *Curr Biol, 24*, R875-R878.

Smaling, H. J., Huijbregts, S. C., Suurland, J., Van Der Heijden, K. B., Van Goozen, S. H., & Swaab, H. (2015). Prenatal reflective functioning in primiparous women with a high-risk profile. *Infant Ment Health J, 36*, 251-261.

Smith, A. (2006). Cognitive empathy and emotional empathy in human behavior and evolution. *The Psychological Record, 56*, 3-21.

Spinrad, T. L., & Stifter, C. A. (2006). Toddlers' empathy-related responding to distress: Predictions from negative emotionality and maternal behavior in infancy. *Infancy, 10*, 97-121.

Stanger, N., Kavussanu, M., & Ring, C. (2016). Gender Moderates the Relationship Between Empathy and Aggressiveness in Sport: The Mediating Role of Anger. *Journal of Applied Sport Psychology*, 1-15.

Strayer, J., & Roberts, W. (2004). Empathy and Observed Anger and Aggression in Five-Year-Olds. *Social Development, 13*, 1-13.

Tousignant, B., Eugene, F., & Jackson, P. L. (2017). A developmental perspective on the neural bases of human empathy. *Infant Behav Dev, 48*, 5-12.

Tremblay, R. E. (2010). Developmental origins of disruptive behaviour problems: the 'original sin' hypothesis, epigenetics and their consequences for prevention. *J Child Psychol Psychiatry, 51*, 341-367.

Tremblay, R. E., Hartup, W. W., & Archer, J. (2005). *Developmental origins of aggression*: Guilford Press.

Tremblay, R. E., Japel, C., Perusse, D., McDuff, P., Boivin, M., Zoccolillo, M., & Montplaisir, J. (1999). The search for the age of 'onset'of physical aggression: Rousseau and Bandura revisited. *Criminal Behaviour and Mental Health, 9*, 8-23.

Tremblay, R. E., Nagin, D. S., Seguin, J. R., Zoccolillo, M., Zelazo, P. D., Boivin, M., Perusse, D., & Japel, C. (2004). Physical aggression during early childhood: Trajectories and predictors. *Pediatrics, 114*, e43-e50.

Vachon, D. D., Lynam, D. R., & Johnson, J. A. (2013). The (non)relation between empathy and aggression: surprising results from a meta-analysis. *Psychol Bull, 140*, 751-773.

Vaish, A., Carpenter, M., & Tomasello, M. (2009). Sympathy through affective perspective taking and its relation to prosocial behavior in toddlers. *Developmental psychology, 45*, 534.

van Langen, M. A. M., Wissink, I. B., van Vugt, E. S., Van der Stouwe, T., & Stams, G. J. J. M. (2014). The relation between empathy and offending: A meta-analysis. *Aggression and Violent Behavior, 19*, 179-189.

Young, S. K., Fox, N. A., & Zahn-Waxler, C. (1999). The relations between temperament and empathy in 2-year-olds. *Developmental psychology, 35*, 1189.

Zahn-Waxler, C., Cole, P. M., Welsh, J. D., & Fox, N. A. (1995). Psychophysiological correlates of empathy and prosocial behaviors in preschool children with behavior problems. *Development and Psychopathology, 7*, 27-48.

Zahn-Waxler, C., & Radke-Yarrow, M. (1990). The origins of empathic concern. *Motivation and Emotion, 14*, 107-130.

Zahn-Waxler, C., Radke-Yarrow, M., Wagner, E., & Chapman, M. (1992). Development of concern for others. *Developmental psychology, 28*, 126.

Zahn-Waxler, C., Robinson, J. L., & Emde, R. N. (1992). The development of empathy in twins. *Developmental psychology, 28*, 1038.