

# Creating a Safe Haven for Children: The Effect of Parent-Child Attachment and Parenting Strategy on Children's Risk Perceptions to Climate Change

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## Research Article

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# Abstract

Children's climate change risk perceptions including their attitudes and mitigation behaviors, which are crucial to protect themselves from the consequence of climate extremes. However, recent studies have not identified the complex interplay effects between children's climate change risk perceptions and their family relationships. This study explored the effects of parent-child attachment, parenting strategies as well as their co-influence on children's risk perceptions to cope with climate changes through investigating a pilot disaster education program in China. Data was collected from 1,710 children aged 8–12 in 45 primary schools in Sichuan Province in 2018. We used Ordinary Least Square Regression and Principal Component Analysis to evaluate the effects of parent-child attachment, different parenting styles and their co-influencing mechanism on children's risk perceptions. The results found that frequent parent-children interactions had significantly positive effects on children's risk perceptions, and these effects were more significant in the single-raised children than the children raised by two parents. We further established a conceptual framework for understanding the different parent-child attachment patterns for children's climate change risk perception based on a mathematical quadrant between frequent parent-child interactions and available attached figures, and found children's risk perceptions are varied attributed to different patterns of parent-child attachment. Theoretical implications related to climate change and practical implications for family and community mitigation were discussed.

## 1. Introduction

Climate change risk perceptions are regarded as individual's cognition or beliefs across multi-domains, including natural hazards, risk exposures, and health behaviors, as well as the internal and subjective sense of risks regarding their consequence, probability, severity, and vulnerability (Slovic 1987; Burns and Slovic 2012; Kellens et al. 2013; Wang and Lin 2018; Shukla et al. 2019). Risk perceptions especially in the light of climate change are essential for people to avoid risk exposure, to promote risk communication, and to enhance mitigation behaviors to actual risks (Siegrist and Árvai 2020; Wilson et al., 2019). Millions of children throughout the world are the most vulnerable populations during climate change in the long run, as their immature characteristics, lower risk perceptions and relative inability to care for themselves compared to adults (United Nations Children's Fund, 2015; IPCC, 2014; Powell and Holleran-Steiker 2017; Bosschaart et al. 2013; Kellens et al. 2013). Children's risk perceptions including their cognition and preparedness behaviors could be cultivated through disaster education, which are also crucial to protect themselves from climate change such as sea level rise, extreme weather patterns (e.g., heat waves or storms), changes of ecosystems, and public health problems (IPCC, 2014). Additionally, rather than passive victims, children could also learn fast and transfer their knowledge and perceptions in support to increasing resilience of their families and communities where they live in (Lawson et al. 2019; Pfefferbaum et al. 2018; Bosschaart et al., 2013; Williams et al., 2017; Mudavanhu et al., 2015).

Despite the importance of children's risk perceptions (Birkholz et al. 2014; Bodoque et al. 2019), the existing studies only evaluated the social determinants of children's risk perceptions including children's agencies, public disaster risk reduction programs (DRR), school interventions and community-based activities (Tewari et al. 2015; Lawson et al. 2019; Olowokere and Okanlawon 2014; Powell and Holleran-Steiker 2017), while regardless of the influence through their family relationships and the co-influencing mechanisms with other social factors (Powell and Holleran-Steiker 2017; Green 2015; Mudavanhu et al. 2015). Most importantly, few studies considered a broader parenting strategies including child-rearing style and children's left-behind status that may influence children's risk perceptions (Lindhout et al. 2009; Zulkefly and Wilkinson 2015). This broad parenting environment should not only considered mother-child attachment, but also considering the effect of attachment relationships with different parenting strategies and multiple caregivers, including fathers, grandparents, foster parents, and other extended relatives.

Attachment theory provides a developed theoretical framework for understanding parent-child relationships and children's social emotional development (Anisworth et al. 1989; Bowlby 1976), it assumes that children who experience responsive care and acquire hazards-related knowledge from their caregivers are more resilient when coping with problems. Additionally, existing literature found the co-influential mechanisms of parent-child attachment and parenting strategies may exist, as parenting strategies can influence the quality of attachment, the quality of attachment may also influence some parenting strategies (Karavasilis 2003; Brumariu and Kerns 2010). It has been noted that shifts between secure and insecure patterns often coincide with changes in parent-child relationships and parenting contexts (i.e. child-rearing style and children's left-behind status) (Karavasilis 2003; Brumariu and Kerns 2010). For instance, separation from a caregiver through the initial removal from their home could create emotional distress for left-behind children (Coleman 2003; Beijersbergen et al. 2012).

However, there has been little consideration of how attachment patterns might moderate and differentiate children's ability to adapt to specific occurrences (e.g. climate extremes, natural disaster, school performance)(Coleman 2003; Kerns et al. 2011), neither has considered the role of parent-child attachment in different parenting strategies in response to natural disaster and climate extremes. Moreover, though existing research has classified parent-child attachment into different patterns based on the frequency of interaction between parents and children, there has been no conceptual framework for understanding the different parent-child attachment patterns for children's climate change risk perception, neither has considered the availability of responsive attachment caregivers, especially in many developing countries where thousands of children are left-behind and severely lack parental companionship.

Due to the large population and frequent disasters, China generally suffered high disaster mortality especially in some disaster-prone areas such as Sichuan province where occurred earthquakes and mudslides frequently (Centre for Research on the Epidemiology of Disasters 2017). But in Sichuan province and many rural areas of China, there were a large outflow of working parents to cities, which leading to millions of children were left behind by their parents at hometown who may extremely lacking in secure parents-attachment and enough cares from their parents (Zhou et al. 2015; Jiang et al. 2019; Jia et al. 2010), which is a good case to study the relationship between parent-child attachment and children's climate change risk perceptions. Thus, we investigated this pilot disaster reduction program conducted in Sichuan Province in 2018 to analyze the effect of parent-child attachment on children's climate change risk perceptions.

Thus this study has four objectives: (1) to describe the impact factors of children's climate change risk perceptions, including social-demographic characteristics, parent-child attachment, and different parenting strategies; (2) to identify how the effects of parent-child attachment on children's climate change risk perceptions vary in different parenting strategies; (3) to reveal the co-influencing mechanisms of parent-child attachment and parenting strategies on children's climate change risk perceptions; and, (4) to establish a conceptual framework of parent-child attachment patterns for children's climate change risk perceptions.

## **2. Research Design And Method**

### **2.1 Data and study design**

To further access the health vulnerability of residents under climate change risk in western China, a disaster reduction education program targeted to residents and children was funded jointly by the Public Health Emergency Center of the Chinese Center for Disease Control and Prevention and the United Nations Children's Fund. This program was conducted in three pilot areas; Shifang City, Yuexi County, and Lu County. These mountainous areas are exposed frequent floods, mudslides, and landslides caused by heavy rain storms and the region's dense network of rivers.

The data collection was a part of the project on disaster risk reduction in western China, and the pre-designed questionnaire in this study was developed from the reports published by UNICEF (United Nations Children's Fund 2015), with a special focus on children's risk awareness and preparedness to specific climate change events. Only aggregated data was used and participants will remain anonymous. Sun Yat-Sen University has provided guidelines for this study procedures. Additionally, the datasets collected and analyzed during the current study are available from the corresponding author on request.

During the survey, the primary school teachers were trained by the disaster education program to monitor the students to fill the pre-designed questionnaire to assess their climate change risk perception. Due to children's limited cognitive ability, pictures and short videos were used to simulate specific disaster scenes and guide children to complete the questionnaire. Besides, external validation including unified training for investigators and quality control after investigation were conducted to guarantee the quality of data collection. Specifically, after the questionnaire is filled out by the investigator, it shall be checked by the quality control personnel with missing items, wrong items and logic errors, and placed on file after signed by the investigators and inspectors together. Besides, the Propensity Score Matching Method was applied in the statistical analysis to further control the sample selection bias and avoid the self-reported problematic associations.

### **2.2 Sampling and questionnaire design**

A multistage stratified random sampling method was adopted to recruit respondents. First, the project team randomly selected 45 primary schools from each township in these three counties, including Shifang City 16 schools, Lu County 20 schools and Yuexi

County 9 schools. Then, for each school, a random class of grade 4 to grade 5 was selected and at least 50 students with age 8-12 were surveyed. Specifically, if the class size is more than 50 students, 50 students are randomly selected to participate in the survey. If the class size is less than 50 students, the whole class will participate in the survey, and another class will be selected and some students will be randomly selected to conduct the survey.

In October of 2016, 2250 questionnaires were distributed in each of the three counties (i.e., Shifang City 800, Lu County 1000 and Yuexi County 450), after excluding 58 questionnaires due to data-quality issues, we finally collected the individual data of a number of 2192 (97.42%) students (baseline group). In October of 2018, another 1800 students (i.e., Shifang City 640, Lu County 800 and Yuexi County 360) conducted the survey, and we finally collected 1710 (95%) samples in these primary schools in 2018 post-intervention. Additionally, we did not follow up the same students group because children's perception increased significantly with their age growing (Christiansen et al. 2018; Mudavanhu et al. 2015).

The questionnaire had several parts, including individual and family information (e.g., age, grade, gender, ethnic, disaster experience and household income), climate change risk perception (the knowledge of climate change and its secondary disasters, including flood evacuation, gastrointestinal disease, respiratory disease, safety telephone identification, earthquake evacuation and emergency preparedness), and parent-child interactions and parenting strategy (children's left-behind status and child-rearing style).

## 2.4 Measurement

In line with Inventory of Parent and Peer Attachment (IPPA) (Armsden and Greenberg, 1987, Xie et al. 2019), the measurement of parent-child attachment in this study included four dichotomous questions about children's attachment relationship with their parents: did they ask their parents for help in time; did they tell their parents about their crisis; did they attend disaster drills with their parents; and, did their parents pay attention to their demands. Responses were reconstructed as a continuous variable, ranging from 0 (almost no interaction) to 4 (very good interaction) in order to indicate the quality of the parent-child attachment. Parenting strategies included the child's left-behind status (left-behind or not left-behind) and child-rearing style (raised by parents together or single-raised, and non-parental caregivers), and both variables were constructed as two dummy variables. We further classified them into nine dummy variables to identify the parenting strategies (i.e. completely left-behind, non-left-behind, father works outside, mother works outside, raised by parents together, raised by father alone, raised by mother alone, raised by grandparents, raised by other relatives). Several control variables such as children's gender, grade, household income, and survey regions were included, and we also considered the confounding effects of disaster risk reduction programs, namely whether the child participated in any intervention programs at school (i.e. drinking water safety, food safety, personal hygiene, prevention of infectious diseases, emergency call for help, escape and rescue from climate extremes). The detailed descriptive statistics of all the study's variables are presented in the Table 1.

Table 1. Descriptive statistics of variables in this study

Variables	Definition	Mean	Min	Max
Dependent variables				
Climate change risk perception	Principal Component Analysis scores for 23 questions of individual cognition of knowledge of climate extremes and the secondary disasters <sup>1</sup> .	-8.43E-10	-1.468	0.219
Explanatory variables				
Parenting strategies				
Children's left-behind status	Partly left-behind =1 Completely left-behind =0	0.706	0	1
Father Work Outside	Yes =1 No =0	0.313	0	1
Mother Work Outside	Yes =1 No =0	0.065	0	1
Non-Left-behind	Yes =1 No =0	0.328	0	1
Child-rearing style	Raised by parents together =1 Single raised, and non-parental caregivers =0	0.534	0	1
Raised by Father alone	Yes =1 No =0	0.062	0	1
Raised by Mother alone	Yes =1 No =0	0.154	0	1
Raised by Grandparents	Yes =1 No =0	0.229	0	1
Raised by other Relatives	Yes =1 No =0	0.021	0	1
Parent-child attachment	Frequency of interaction between parents and children.	3.206	0	4
Control variables				
Gender	Boy =1 Girl =0	0.470	0	1
Minority	Minority =1 Hanzu =0	0.736	0	1
Disaster experience	Yes =1 No =0	0.397	0	1
Less than 10,000	Yes =1 No =0	0.214	0	1
Between 10,000 and 30,000	Yes =1 No =0	0.295	0	1
Between 30,000 and 50,000	Yes =1 No =0	0.180	0	1
Between 50,000 and 70,000	Yes =1 No =0	0.104	0	1
More than 70,000	Yes =1 No =0	0.208	0	1
Grade3	Yes =1 No =0	0.012	0	1
Grade4	Yes =1 No =0	0.100	0	1
Grade5	Yes =1 No =0	0.677	0	1

Grade6	Yes =1 No =0	0.211	0	1
Shifang City	Yes =1 No =0	0.351	0	1
Yuxi County	Yes =1 No =0	0.387	0	1
Lu County	Yes =1 No =0	0.263	0	1
Received DRR education	Received =1 Not received =0	0.884	0	1
Note: Household income: More than 70,000=ref, Grade: Grade 6=ref, Survey regions: Lu County=ref.				

## 2.4 Analytical Strategy

To identify the effect of parent-child attachment and parenting strategy on children's climate change risk perception, the collected data was analyzed using Stata14.0 software. First, in line with previous research, Principal Component Analysis was used to calculate the children's climate change risk perception scores in this study (Slovic 1987; Burns and Slovic 2012). The dependent variable was a continuous variable, so the Ordinary Least Square Regression was applied as a basic assumption in Model 1 to identify the effects of parent-child attachment and parenting strategy on children's climate change risk perception.

Second, to capture the indirect effects of parent-child attachment and parenting strategy on children's climate change risk perception, the baseline model was extended with two interaction items between parent-child attachment and parenting strategies in Model 2. We included two separate interaction terms between parent-child attachment and parenting strategies: parent-child attachment × children's left-behind status and parent-child attachment × child-rearing style. Additionally, to identify how the effects of parent-child attachment on children's climate change risk perception varies in different parenting strategies, the children's left-behind status and child-rearing style were first divided into nine different caregiver subgroups and then regression analyses were conducted accordingly.

Third, to reveal the co-influencing mechanisms of parent-child attachment and parenting strategies on the children's climate change risk perceptions, we illustrated how children left-behind status and child-rearing style modified the effect of parent-child interaction frequency on the children's climate change risk perceptions, respectively.

Finally, based on the previous attachment literature, we established a conceptual framework of parent-child attachment patterns for children's climate change risk perception based on a mathematical quadrant between frequent parent-child interactions and available attached figures. The parent-child attachment patterns were then classified into four types: securely attached, avoidant attached, ambivalent attachments, and disorganized attachments, and children's climate change risk perception were further accessed by categorizing different patterns.

## 3. Results

### 3.1 Description of the impact factors of children's climate change risk perception

Children's climate change risk perception was synthesized from 23 questions touching on 6 aspects of the individual respondent's knowledge of climate extremes and their secondary effects: flood evacuation; gastrointestinal disease; respiratory disease; safety telephone identification; earthquake evacuation; and, emergency preparedness. The Cronbach's alpha of the principal components was 0.853, which confirms the reliability and good quality of the principal components.

Table 2 shows the effects of parent-child attachment on children's climate change risk perception. Specifically, the parent-child attachment had a significantly positive effect on children's climate change risk perception. In Model 1 (Coeff = 0.057; P<0.001) and Model 2 (Coeff = 0.065; P<0.001), the more frequent their interactions with their parents, the higher the children's climate change risk perception score.

Additionally, in Model 2, the child-rearing style had a significantly positive effect on children's climate change risk perception. Children raised by their parents together scored higher than children raised by a single parent or other relatives (Coeff = 0.122; P<0.05).

However, the interaction items between parent-child attachment and child-rearing style had a significantly negative effect. For children raised by parents together, they did not receive the same positive effects of parent-child attachment as their counterparts did (Coeff = -0.036;  $P < 0.05$ ).

Table 2. Description of the impact factors of children's climate change risk perception using OLS regression

Variable	Model (1)		Model (2)	
	Coeff.	(Robust SE)	Coeff.	(Robust SE)
Gender	0.001	(0.009)	0.002	(0.009)
Minority	-0.011	(0.027)	-0.009	(0.027)
Disaster experience	-0.053***	(0.012)	-0.051***	(0.012)
Household income				
Less than 10,000	0.056***	(0.017)	0.060***	(0.017)
Between 10,000 and 30,000	0.067***	(0.015)	0.069***	(0.015)
Between 30,000 and 50,000	0.077***	(0.016)	0.081***	(0.016)
Between 50,000 and 70,000	0.080***	(0.019)	0.082***	(0.019)
Grade				
Grade 3	0.015	(0.037)	0.015	(0.038)
Grade 4	0.048	(0.036)	0.049	(0.037)
Grade 5	0.114***	(0.037)	0.115***	(0.038)
Regional difference				
Shifang City	0.075***	(0.012)	0.075***	(0.012)
Yuxi County	-0.213***	(0.030)	-0.211***	(0.029)
Received DRR education	0.056***	(0.017)	0.056***	(0.017)
Parenting strategies				
Children's left-behind status	0.008	(0.011)	-0.035	(0.058)
Child-rearing style	0.008	(0.010)	0.122**	(0.050)
Parent-child attachment	0.057***	(0.007)	0.065***	(0.133)
Children's left-behind status × parent-child attachment			0.013	(0.016)
Child-rearing style × parent-child attachment			-0.036**	(0.014)
Constant	-0.298***	(0.050)	-0.330***	(0.065)
R <sup>2</sup>	0.414		0.419	
N	1710		1710	
Note: *** $P < 0.001$ ; ** $P < 0.01$ ; * $P < 0.05$ ; More than 70,000=ref, Grade 6=ref, Lu County=ref.				

### 3.2 Different parenting strategies in effect of parent-child attachment on children's climate change risk perception

Table 3 shows how the effect of parent-child attachment on children's climate change risk perception varied in different parenting strategies. Parent-child attachment had a significantly positive effect on children's climate change risk perception in all nine subgroups. However, for children raised by their parents together (Coeff = 0.053;  $P < 0.001$ ) and the non-left-behind children (Coeff =

0.042;  $P < 0.001$ ), they did not receive the same magnitude of positive effects as their counterparts, whose coefficients were relatively lower than the other groups.

Table 3. Different parenting strategies in effect of parent-child attachment on children's climate change risk perception using OLS regression

Variable	Completely Left -behind	Father Work Outside	Mother Work Outside	Non-Left -behind	Raised by Parents together	Raised by Father alone	Raised by Mother alone	Raised by Grandparents	Raised by other Relatives
Parent-child attachment	0.053*** (0.009)	0.062*** (0.008)	0.093*** (0.023)	0.043*** (0.008)	0.042*** (0.007)	0.139*** (0.022)	0.056*** (0.012)	0.053*** (0.009)	0.091** (0.039)
Children's left-behind status	-	-	-	-	0.030* (0.017)	-0.022 (0.087)	0.012 (0.047)	0.014 (0.020)	-0.047 (0.095)
Child-rearing style	-0.008 (0.018)	0.015 (0.016)	0.092 (0.061)	-0.006 (0.032)	-	-	-	-	-
Confounds	Control	Control	Control	Control	Control	Control	Control	Control	Control
Constant	-0.264** (0.103)	-0.371*** (0.088)	-0.609** (0.305)	-0.169 (0.115)	-0.299*** (0.073)	-0.834*** (0.273)	-0.314* (0.181)	-0.179* (0.105)	-0.301 (0.318)
R <sup>2</sup>	0.493	0.384	0.434	0.409	0.401	0.565	0.469	0.474	0.624
N	502	535	112	561	913	106	263	392	36
Note: *** $P < 0.001$ ; ** $P < 0.01$ ; * $P < 0.05$ . Standard errors are in parentheses.									

Additionally, caregiver's gender differences influenced the effect of parent-child attachment on the children's climate change risk perceptions. For children whose fathers worked away from home (Coeff = 0.062;  $P < 0.001$ ) or those who were raised by their mothers alone (Coeff = 0.056;  $P < 0.001$ ), the better the parent-child attachment, the higher children's climate change risk perception scores. However, those scores were not as high as children whose mothers worked away from home (Coeff = 0.093;  $P < 0.001$ ) or were raised by their fathers alone (Coeff = 0.139;  $P < 0.001$ ).

### 3.3 Conditional effects of parenting strategies on parent-child attachment for children's climate change risk perception

The graphs in Figures 1a and 1b illustrate how children's left-behind status and child-rearing style modified the effect of parent-child attachment on children's climate change risk perception, respectively. Figure 1a shows the marginal effects of children's left-behind status across the full range of parent-child attachment. When parent-child interaction was less frequent, left-behind children had higher climate change risk perception scores. However, when parent-child interactions were more frequent, both left-behind and non-left-behind children had much higher scores, and the gap between them narrowed significantly and was not as pronounced as when there were less frequent parent-child interactions.

Figure 1b also shows the marginal effects of child-rearing style across the full range of the parent-child attachment. When parent-child interactions were less frequent, children raised by parents together had higher climate change risk perception scores. When parent-child interactions were more frequent, however, children raised by both parents together had scores lower than children raised by a single parent or other relatives. Overall, using these figures, we can see that children's left-behind status and child-rearing style had different effects depending on the frequency of parent-child interactions.

## 4. Conceptual Framework Of Parent-child Attachment Patterns For Children’s Climate Change Risk Perception

### 4.1 Classifications of parent-child attachment patterns

To further investigate the indirect effect of parent-child attachment, we conceptualized a framework of parent-child attachment patterns for children’s climate change risk perception based on the previous literature about the classification of parent-child attachments. As shown in Table 4, all four types of attached children share distinct differences in frequency of interactions with their caregivers and availability of responsive attachment caregivers, through which we conceptualized a framework of parent-child attachment patterns for children’s climate change risk perception.

Table 4. Classifications of parent-child attachment patterns

Subgroups	Items	Reference
Securely Attached Children (A)	Use their attachment figures as a secure base and as a safe haven to return to in terms of risk; perceive their caregivers as responsive, sensitive to their need.	(Bowlby 1976, 1983; Kerns et al., 2011; Anisworth et al., 1978)
Avoidant Attached Children (B)	Little display of affect or secure-base behavior; do not seek out the caregiver when distressed, though have high levels of parental involvement and support.	(Brumariu and Kerns 2013)
Ambivalent Attached Children (C)	Manifest high levels of attachment behavior to caregivers, though have deficient contact with attachment figures whom they view as inconsistently responsive.	(Anisworth 1969, 1989; Scott et al., 2011; Dubois-Comtois et al., 2011)
Disorganized Attached Children (D)	Behavior appears to lack observable goal and intention; low coordination and disruptive affective communication, which poses negative affect on their emotion and behavior.	(Main and Solomon;1990; Green et al., 2007; Miljkovitch et al., 2013)
Note. Descriptions in Groups A, B, and C are based on Ainsworth et al. (1989). Descriptions in Group D are based on Main and Solomon (1990)		

### 4.2 Conceptual framework of parent-child attachment patterns for children’s climate change risk perception

As shown in Figure 2, four patterns were included based on the level of parent-child interaction and magnitude of available attachment figures. Securely attached children had a high frequency of parent-child interactions and sufficient attached figures (i.e. positive parenting strategies: not left-behind and raised by both parents together), ambivalent attached children had frequent parent-child interactions but deficient attached figures (i.e. negative parenting strategies: left-behind and not raised by both parents together). Children who formed avoidant attachments had available caregivers but a low frequency of parent-child interactions, and children with disorganized attachments had neither available caregivers nor frequent parent-child interactions.

### 4.3 Children’s climate change risk perception in different parent-child attachment patterns

Figures 3a and 3b show the distribution of children’s climate change risk perceptions in different parent-child attachment patterns. As shown in both figures, the mean scores of the securely and ambivalently attached children were higher than those of the disorganized and avoidant attached children, and there were more outside values in the former, while the gap between the latter two was much wider. We further categorized the mean scores of the children’s climate change risk perception in different parent-child attachment patterns.

To be specific, in Figure 3a, securely attached children scored the best (Mean scores = 0.0625), and avoidant attached children had the lowest scores (Mean scores = -0.1807). In Figure 3b, ambivalent attached children had the highest scores (Mean scores = 0.0609), and disorganized attached children scored the lowest (Mean scores = -0.1855). Overall, using these figures, we reconfirm that children’s left-behind status and child-rearing style had different effects depending on parent-child attachment.

## 5. Discussion

Children need not be passive victims, but instead may contribute to disaster risk reduction activities. Involving children into disaster risk reduction and through fast learning, they can transfer their hazards-related awareness and knowledge to their families and neighbors, and therefore have the potential capability to change the disaster attitudes, awareness, and preparedness of their families and communities (Williams et al. 2017; Bosschaart et al. 2013; Mudavanhu et al. 2015).

Recent studies focused mainly on formal school education, nevertheless neglect important factors such as family relationship and parent-child attachment (Christiansen et al. 2018; Mudavanhu et al. 2015; Pfefferbaum et al. 2018; Williams et al. 2017). Previous literature also failed to fully recognize the importance of family relationships in cultivating children's risk perceptions, and thus underestimated the value of parent-child attachment as a proactive factor in achieving disaster preparedness and community resilience (Walker et al. 2012; Williams et al. 2017). Our results imply that frequent parent-child interactions have a positive effect on children's climate change risk perception, which are consistent with public health studies that highlight parent and family factors. For instance, these results correspond more or less with the results of Peek (2008) and Lawson et al. (2019), who found that high-quality parent-child interactions (e.g., spending time with child by naming, counting, or drawing things; playing with the child; telling stories to the child; taking the child outside the home; singing songs with the child; and, reading books or looking at pictures with the child) were associated with secure attachments between children and parents, and children with better intergenerational interaction with their parents are more likely internalize effective ways to manage negative emotions in the threat of climate extremes, which in turn led to psycho-social health and resilience in the community.

However, our study not only proved the positive impact of parent-child attachment, but also provided robust evidence on the parenting strategy among attachment figures, as well as illustrating how the broader family system interfaces with parent-child attachments. Existing attachment literatures and frameworks focused mainly on mother-child attachment, and assumes that that mothers provide relatively more safe-haven support and fathers provide relatively more secure-base support to children in late middle childhood and early adolescence (Karavasilis 2003; Kerns et al. 2011). However, it should be noted that more comprehensive studies exploring multiple dimensions of attachment figures such as fathering and non-parental caregivers as predictors of children's cognitive ability and interpersonal relationships would complement existing literature meaningfully. Our results indicate a variation in the role of caregivers and gender differences in the effect of parent-child attachments, Thus including multiple caregivers as part of a network of attachment figures may expand the organization of internal working models of attachment.

This is the first study that conceptualizes a framework for understanding the different parent-child attachment patterns for children's climate change risk perception. Our study not only provides evidence for the correlation between parent-child attachment classifications and quality of observed parenting difference, but also conceptualizes a co-influential mechanism between parent-child attachment and parenting strategy and through which conceptualized a framework of parent-child attachment patterns for children's climate change risk perception, and found that attachment relationships varied in the quality of the children's climate change risk perceptions (shown in Fig. 3). Previous research underlined the associations between attachment relationship and parenting with dyadic measures (Scott et al. 2011), while the present study further rated quality of parenting as two distinct and separate construct to avoid conflation with dyadic qualities of the relationship. We found that children's left-behind status and child-rearing style had different effects depending on the frequency of parent-child interactions, which were consistent with previous research (Zhao et al. 2020; Zhou et al. 2015). Besides, different measures in the model confirmed a particularly strong test of the distinct role of parent-child attachment representations, these findings from direct observation help to substantiate the construct validity of parent-child attachment classifications by showing they are reliably associated with concurrent real-life interaction patterns, and it can be supposed that a broader parenting context also needs to be considered in future studies.

This study's findings have several policy implications. First, millions of children throughout the world are affected by disasters each year (United Nations Children's Fund 2015). Although multiple interventions through authorities and social-network channels are applied for climate change and extreme events, parents are clearly the primary social figures in their children's lives. They are not only attachment figures but also teachers and playmates. Thus, disaster reduction programs offer an opportunity to involve both caregivers and their children into climate adaptation systems. Second, by considering multiple attachment figures, this study has raised theoretical issues for attachment theory. Central to the theory is a set of propositions about how attachments are formed and the influence of attachment relationships on subsequent development.

Hence, parental obligation is not limited to parents.

Other attachment figures such as grandparents, foster parents, and extended relatives also need to be considered.

Future efforts might focus on helping children establish community networks that could provide influence, commitment, and resources to facilitate their acceptance, application, and implementation (Peek 2008). Finally, for left-behind children who lack parental companionship, especially those living in poverty or in marginal and underdeveloped areas, they assume a disproportionate share of the burden created by disasters because their parents work in cities year-round (Green 2015; Powell and Holleran-Steiker 2017; Ronoh et al. 2015). Therefore, the government should pay more attention to this vulnerable group and address the loss of parent-child interactions and use school interventions and community services to help them to understand the risks of disasters and make sure they are sufficiently prepared (Zhou et al. 2015; Gao et al. 2010).

This study also has several limitations. First, it relies on self-reporting by children. Due to their cognitive immaturity and possible social desirability bias, they may have overstated their responses. Nevertheless, this is an acceptable approach to assessing children's attachment representations, their answers were scored based on the content of what they said and their cognition to hazard risks in a coherent and organized way. Second, though our study recognized the importance of the broader parenting context, only children's left-behind status and rearing style were included.

We could not consider all the possible attachment figures (i.e., foster parents, extended relatives), which await further validation. Finally, we know less about the role of alternative caregivers in terms of children's long-term development. When studying the intergenerational effects of parent-child attachment and parenting strategy, it would be ideal if we could observe parents interacting with their offspring, then return two or three decades later and observe the toddlers of the first wave now interacting with their own offspring.

## 6. Conclusion

As major participants in disaster mitigation activities, children should be engaged into disaster reduction programs. Our findings suggest that a broader context of parent-child attachment and parenting strategies can help families and communities build up concerns for natural hazards, and frequent interactions between parents and children are essential for children's social, emotional, and cognitive development. To cultivate the climate change risk perceptions of children and the broader community's preparedness challenges, more attention should be paid to vulnerable children, especially those left-behind or with few interactions with their parents.

### Note

1. Children's climate change risk perception was synthesized from children's response to 23 specific questions: Flood evacuation (During flooding disaster: Run to higher ground for shelter; Grab fixed objects; Grab floating objects; Climb up the telegraph pole; Swim away when trapped by floods) ; Gastrointestinal disease (To prevent gastrointestinal disease, is it right cover mouth when coughing; Drink raw water; Regular ventilation indoors; Vaccinate during epidemic season); Respiratory disease (To prevent respiratory disease, is it right to wear mask; Wash hands with soap; Eat cooked food; Use sanitary toilets); Safety telephone identification (Whether or not know about safety telephone: 110, 120, 122, 119, 12320); Earthquake evacuation (During an earthquake, is it right to squat in the open during the earthquake; if there is no time to escape from the house, is it right that the indoor unsafe location includes small spaces such as bathroom, kitchen, storage room); and Emergency preparedness (Whether or not know about nearby shelter; evacuation route; hospital).

## 7. Declarations

### Ethical Approval and Consent to Participate

Ethical approval was approved by the ethical committee of Sun Yat-Sen University. Written informed consent was obtained from individual or guardian participants.

**Consent to Publish** Not applicable

### Authors Contributions

Shuang Zhong: Funding acquisition, Writing-Reviewing and Editing, Software, Validation, Project administration.

Qiu Cheng: Conceptualization, Methodology, Formal analysis, Data curation, Writing-Original draft preparation;

Guangyuan Jia: Visualization, Investigation Methodology;

Kinglun Ngok: Funding acquisition, Writing-Reviewing, Supervision. Investigation;

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## Competing interests:

We declare no competing interests.

## Availability of data and materials

The data sets supporting the results of this article are included within the article and its additional files.

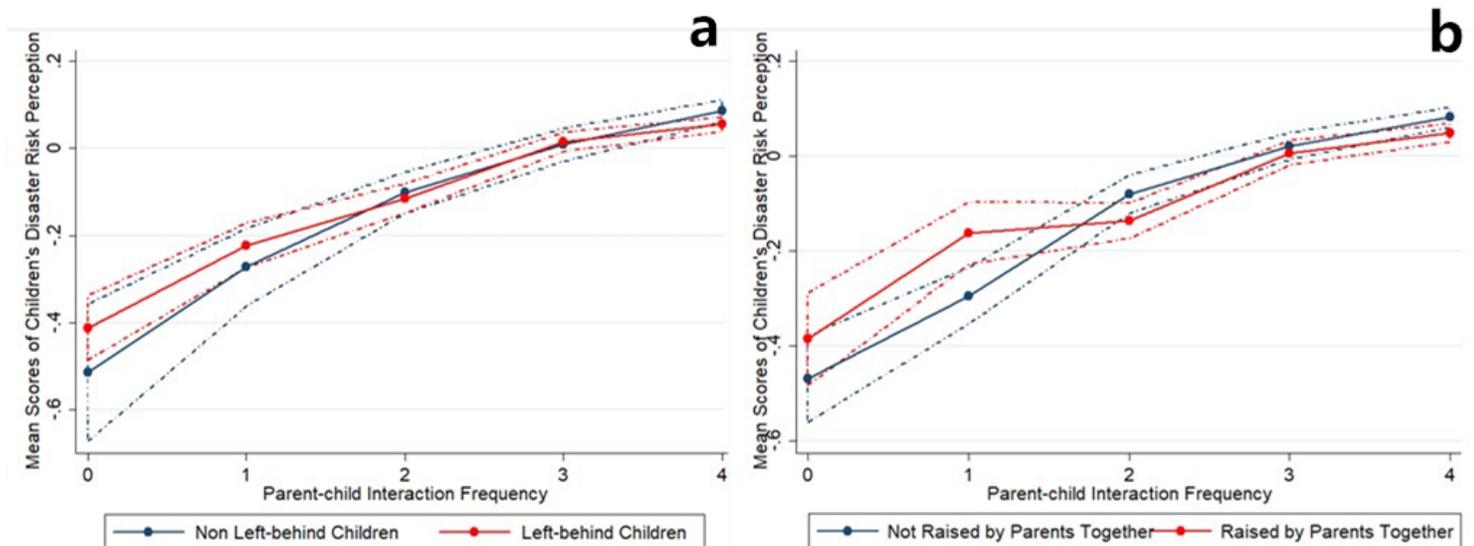
## 8. References

1. Ainsworth MD (1969) Object relations, dependency, and attachment: a theoretical review of the infant-mother relationship. *Child Dev* 40:969–1025
2. Ainsworth MD (1989) Attachments beyond infancy. *American Psychologist*, 44, 709–16
3. Armsden GC, Greenberg MT (1987) The inventory of parent and peer attachment: individual differences and their relationship to psychological well-being in adolescence. *Journal of Youth Adolescence* 16(5):427–454
4. Beijersbergen MD, Juffer F, Bakermans-Kranenburg MJ, van IJzendoorn M (2012) Remaining or becoming secure: Parental sensitive support predicts attachment continuity from infancy to adolescence in a longitudinal adoption study. *Dev Psychol* 48:1277–1282
5. Birkholz S, Muro M, Jeffrey P, Smith HM (2014) Rethinking the relationship between flood risk perception and flood management. *Science of Total Environment* 478:12–20
6. Bodoque JM, Díez-Herrero A, Amerigo M, García JA, Olcina J (2019) Enhancing flash flood risk perception and awareness of mitigation actions through risk communication: A pre-post survey design. *J Hydrol* 568:769–779
7. Bosschaart A, Kuiper W, van der Schee J, Schoonenboom J (2013) The role of knowledge in students' flood-risk perception. *Nat Hazards* 69:1661–1680
8. Bowlby J (1976) *Attachment and Loss Volume II Separation Anxiety and Anger*: Basic Books
9. Bowlby J. Volume III (1983) *Attachment and Loss. Basic Books, Loss Sadness*
10. Brumariu LE, Kerns KA (2010) Parent–child attachment and internalizing symptoms in childhood and adolescence: A review of empirical findings and future directions. *Dev Psychopathol* 22:177–203
11. Burns WJ, Slovic P (2012) Risk perception and behaviors: anticipating and responding to crises. *Risk Anal* 32:579–582
12. Centre for Research on the Epidemiology of Disasters (2017) *Annual Disaster Statistical Review of 2016*. Retrieved from: [http://www.cred.be/sites/default/files/ADSR\\_2016.pdf](http://www.cred.be/sites/default/files/ADSR_2016.pdf)
13. Christiansen LB, Lund-Cramer P, Brondeel R, Smedegaard S, Holt AD, Skovgaard T (2018) Improving children's physical self-perception through a school-based physical activity intervention: The Move for Well-being in School study. *Mental Health Physical Activity* 14:31–38
14. Coleman PK (2003) Perceptions of parent-child attachment, social self-efficacy, and peer relationships in middle childhood. *Infant Child Development* 12:351–368
15. Dubois-Comtois K, Cyr C, Moss E (2011) Attachment behavior and mother-child conversations as predictors of attachment representations in middle childhood: A longitudinal study. *Attachment Human Development* 13:335–357
16. Gao Y, Li LP, Kim JH, Lau J, Griffiths S (2010) The impact of parental migration on health status and health behaviours among left behind adolescent school children in China. *BMC Public Health* 10:56

17. Green CJ (2015) Toward young children as active researchers: a critical review of the methodologies and methods in early childhood environmental education. *The Journal of Environmental Education* 46:207–229
18. Habibov NN (2012) Does childcare have an impact on the quality of parent–child interaction? Evidence from post-Soviet Kyrgyzstan, Tajikistan, and Uzbekistan. *Child Youth Service Review* 34:2367–2373
19. Jia Z, Shi L, Cao Y, Delancey J, Tian W (2010) Health-related quality of life of “left-behind children”: a cross-sectional survey in rural China. *Qual Life Res* 19:775–780
20. Jiang H, Hu H, Zhu X, Jiang H (2019) Effects of school-based and community-based protection services on victimization incidence among left-behind children in china. *Child Youth Serv Rev* 101:239–245
21. Karavasilis LL (2003) Associations between parenting style and quality of attachment to mother in middle childhood and adolescence. *Int J Behav Dev* 2:153–164
22. Kellens W, Terpstra T, De Maeyer P (2013) Perception and Communication of Flood Risks: A Systematic Review of Empirical Research. *Risk Anal* 33:24–49
23. Kerns KA, Brumariu LE, Seibert A (2011) Multi-method assessment of mother-child attachment: Links to parenting and child depressive symptoms in middle childhood. *Attachment Human Development* 13:315–333
24. Lawson DF, Stevenson KT, Peterson MN, Carrier SJ, Seekamp E (2019) Children can foster climate change concern among their parents. *Nature Climate Change* 9:458–462
25. Lindhout IE, Markus MT, Hoogendijk TH, Hoogendijk THG, Boer F (2009) Temperament and parental child-rearing style: unique contributions to clinical anxiety disorders in childhood. *European Child Adolescent Psychiatry* 18:439–446
26. Main M, Solomon J (1986) Discovery of a new, insecure disorganized/disoriented attachment pattern. In: Brazelton TB, Yogman M (eds) *Affective development in infancy*. Ablex, Norwood, pp 95–124
27. Miljkovitch R, Moran G, Roy C, Lyne J, Margarita FG, Blaise P, Carole MN, Ayala B (2013) Maternal interactive behaviour as a predictor of preschoolers’ attachment representations among full term and premature samples. *Early Human Dev* 89:349–354
28. Mudavanhu C, Manyena SB, Collins AE, Bongo P, Mavhura E, Manatsa D (2015) Taking children’s voices in disaster risk reduction a step forward. *International Journal of Disaster Risk Science* 6:267–281
29. Olowokere AE, Okanlawon FA (2014) The effects of a school-based psychosocial intervention on resilience and health outcomes among vulnerable children. *The Journal of School Nursing* 30:206–215
30. Peek L (2008) Children and disasters: understanding vulnerability, developing capacities, and promoting resilience – an introduction. *Children Youth Environments* 18:1–29
31. Pfefferbaum B, Pfefferbaum RL, Van Horn RL (2018) Involving children in disaster risk reduction: the importance of participation. *European Journal of Psychotraumatology* 9:sup2, 1425577
32. Powell T, Holleran-Steiker LK (2017) Supporting children after a disaster: a case study of a psychosocial school-based intervention. *Clin Soc Work J* 45:176–188
33. Ronoh S, Gaillard JC, Marlowe J (2015) Children with disabilities and disaster risk reduction: a review. *International Journal of Disaster Risk Science* 6:38–48
34. Scott S, Briskman J, Woolgar M, Humayun S (2011) Attachment in adolescence: overlap with parenting and unique prediction of behavioural adjustment. *J Child Psychol Psychiatry* 52:1052–1062
35. Shukla R, Agarwal A, Sachdeva K, Kurths J, Joshi PK (2019) Climate change perception: an analysis of climate change and risk perceptions among farmer types of Indian Western Himalayas. *Clim Change* 152:103–119
36. Siegrist M, Árvai J (2020) Risk Perception: Reflections on 40 Years of Research. *Risk Anal*. <https://doi.org/10.1111/risa.13599>
37. Slovic P (1987) Perception of risk. *Science* 236(4799):280–285
38. Tewari HR, Bhowmick PK, McCormick M (2015) Roles of government and community support, flood experience, and flood education in livelihood resilience. *Journal of Sociology Social Welfare* 42:101
39. United Nations Children’s Fund (2015) Unless we act now: The impact of climate change on children. Retrieved from: [https://www.unicef.org/media/50391/file/Unless\\_we\\_act\\_now\\_The\\_impact\\_of\\_climate\\_change\\_on\\_children-ENG.pdf](https://www.unicef.org/media/50391/file/Unless_we_act_now_The_impact_of_climate_change_on_children-ENG.pdf)
40. Wang X, Lin L (2018) How Climate Change Risk Perceptions Are Related to Moral Judgment and Guilt in China. *Climate Risk Management*. doi:<https://doi.org/10.1016/j.crm.2018.02.005>

41. Walker M, Whittle R, Medd W, Burningham K, Tapsell S (2012) 'It came up to here': learning from children's flood narratives. *Children's Geographies* 2:135–150
42. Williams S, McEwen LJ, Quinn N (2017) As the climate changes: intergenerational action-based learning in relation to flood education. *The Journal of Environmental Education* 48:154–171
43. Wilson RS, Zwickle A, Walpole H (2018) Developing a broadly applicable measure of risk perception. *Risk Anal* 39:777–791
44. Xie X, Chen W, Zhu X, He D (2019) Parents' phubbing increases adolescents' mobile phone addiction: roles of parent-child attachment, deviant peers, and gender. *Child Youth Serv Rev* 105:104426
45. Zhao X, Fu F, Zhou LQ (2020) The mediating mechanism between psychological resilience and mental health among left-behind children in china. *Child Youth Serv Rev* 110:104686
46. Zhou C, Sylvia S, Zhang L, Luo R, Yi H, Liu C, Shi Y, Loyalka P, Chu J, Medina A, Rozelle S (2015) China's left-behind children: impact of parental migration on health, nutrition, and educational outcomes. *Health Affair* 34:1964–1971
47. Zulkefly NS, Wilkinson RB (2015) Measuring specific attachment relationships of mother, father and peer in Malaysian adolescents. *Child Indic Res* 8:767–788

## Figures



**Figure 1**

The conditional effects of children's left-behind status and child-rearing style on parent-child attachment for increasing children's climate change risk perception: the marginal effects of children's left-behind status and child-rearing style. Note: —Solid line is for average marginal effects, —Dash line is for 95% confidence intervals.

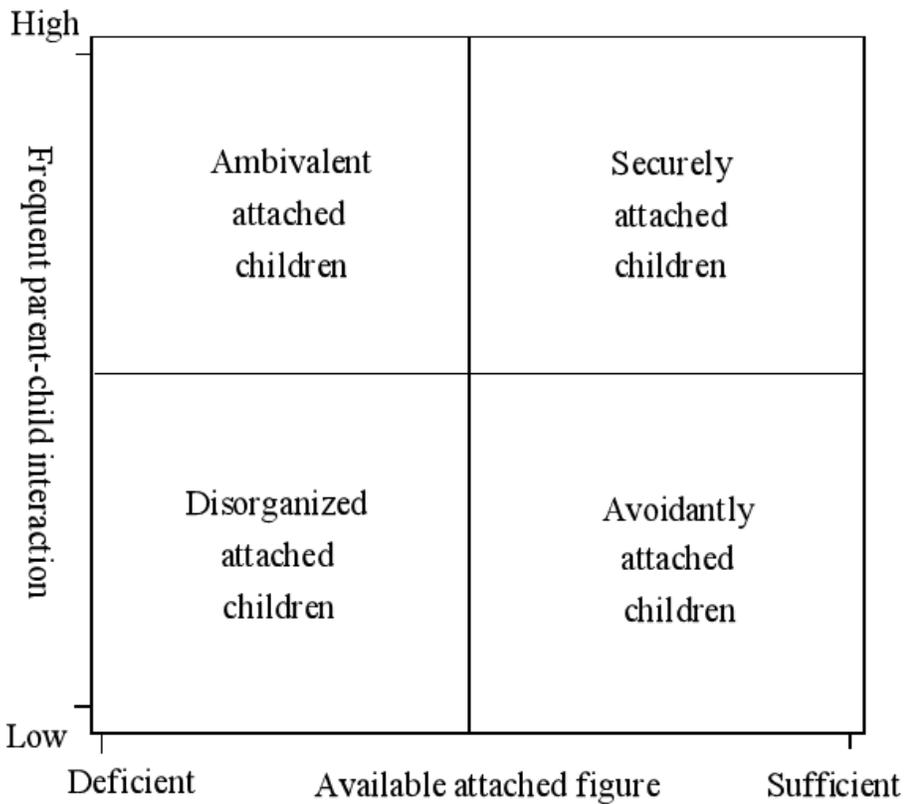


Figure 2

Conceptual framework of parent-child attachment patterns for children's climate change risk perception.

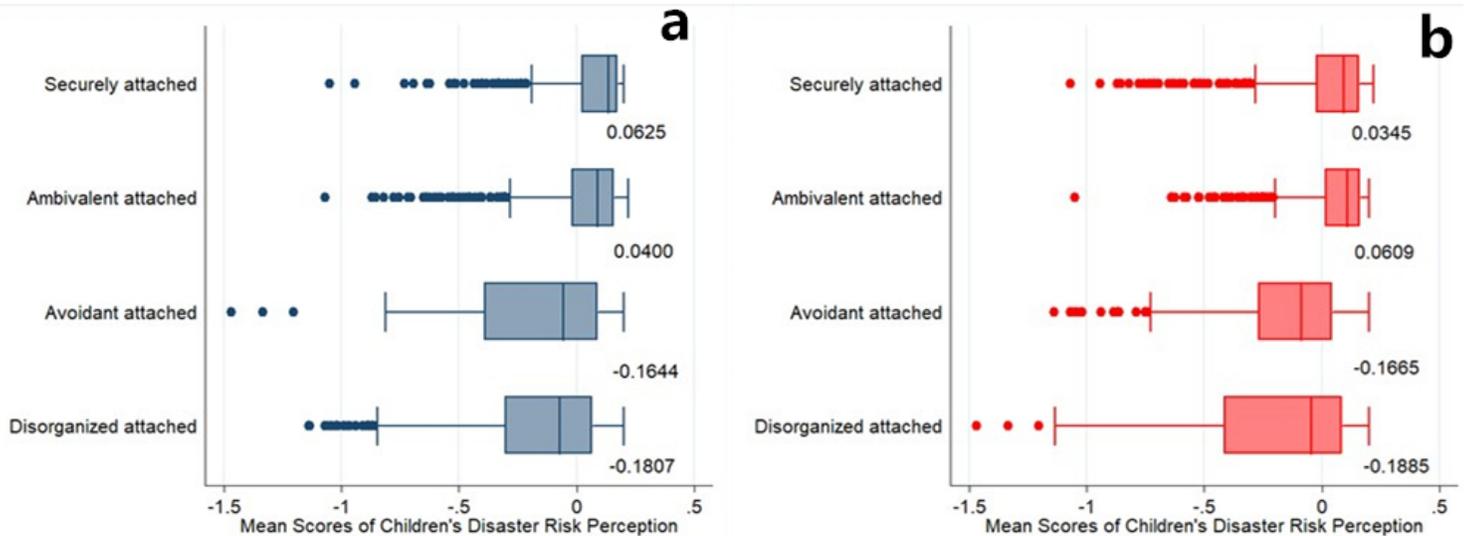


Figure 3

Children's climate change risk perception in different parent-child attachment patterns. Error bars show 95% confidence interval. Note: In Figure 3a, the patterns of child-parent attachment are based on parent-child attachment and children's left-behind status, while in 3b they are based on parent-child attachment and child-rearing style.