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Consequences of ‘tiger’ parenting: a cross-cultural study of maternal psychological control and children’s cortisol stress response

Culture, psychological control, cortisol

Stacey N. Doan *et al*.

Stacey N. Doan

1

Twila Tardif

2

Alison Miller

3

Sheryl Olson

2

Daniel Kessler

4

Barbara Felt

5

Li Wang
6

AUTHOR: Please confirm that given names (red) and surnames/family names (green) have been identified correctly.

[1]Department of Psychology Claremont McKenna College USA

[2]School of Public Health University of Michigan USA

[3]Department of Psychology University of Michigan USA

[4]Departments of Psychiatry and Philosophy University of Michigan USA

[5]Department of Pediatrics and Communicable Diseases University of Michigan USA

[6]Department of Psychology and Beijing Key Laboratory of Behavior and Mental Health Peking University China

Address for correspondence: Stacey N. Doan, 850 Columbia Ave., Claremont, California 91711, USA; e-mail: sdoan@cmc.edu

Abstract

Parenting strategies involving psychological control are associated with increased adjustment problems in children. However, no research has examined the extent to which culture and psychological control predict children's stress physiology. We examine cultural differences in maternal psychological control and its associations with children's cortisol. Chinese (N = 59) and American (N = 45) mother-child dyads participated in the study. Mothers reported on psychological control. Children's cortisol was collected during a stressor and two indices of Area Under the Curve (AUC) were computed: AUCg which accounts for total output, and AUCi, which captures reactivity. Results indicate that Chinese mothers reported higher levels of psychological control and Chinese children had higher levels of AUCg than their American counterparts. Across both cultures, psychological control was significantly associated with increased cortisol levels as indexed by AUCg. There were no associations for AUCi. Finally, mediation analyses demonstrated that psychological control fully explained cultural differences in children's cortisol stress response as indexed by AUCg.

Research highlights

- The current study finds higher levels of psychological control in Chinese mothers compared to American mothers.
- Chinese children have higher levels of cortisol, a stress hormone, compared to their American peers.
- Across both American and Chinese children, during a stressor, higher maternal psychological control is associated with higher levels of cortisol output (AUCg), but not reactivity (AUCi).

Introduction

Research on parental control has focused on psychological and behavioral aspects (for a review see Barber, Stolz & Olsen, 2005). Psychological control (PC) is when parents constrain children's autonomy through psychologically manipulative tactics such as the withdrawal of love or induction of guilt (Barber, 2002). Behavioral control focuses on parents' tendency to be aware of and set limits on children's activities and behaviors. Behavioral control contributes to academic competence and decreased behavioral problems (Fletcher, Steinberg & Williams-

Wheeler, 2004), whereas PC increases emotional distress and lowers self-esteem (Barber, 1996; Silk, Morris, Kanaya & Steinberg, 2003). Despite these links, the extent to which PC affects children's stress response has not been studied, despite a host of research from both animal (Meaney & Szyf, 2005) and human studies (Adam, Klines-Dougan & Gunnar, 2006) demonstrating the importance of maternal behavior in programming children's stress response. Moreover, no research has examined possible cultural differences in this relationship.

Psychological control, culture, and children's adjustment

In conceptualizing the consequences of psychological vs. behavioral control, researchers using self-determination theory (Deci & Ryan, 2010) emphasize that the need for psychological autonomy is universal and essential for optimal functioning. When parents exert PC, they undermine the child's self-concept, reducing perceptions of competence and intrinsic motivation (Pomerantz & Thompson, 2008). Whereas behavioral control is related to higher social and academic achievement as well as lower levels of behavioral problems (d'Ailly, 2003; Bean, Barber & Crane, 2006; Vansteenkiste, Zhou, Lens & Soenens, 2005), PC has been found to be correlated with more behavioral problems, emotional distress, and lower achievement (Barber, 1996; Olsen, Yang, Hart, Robinson, Wu *et al*., 2002; Silk *et al*., 2003).

There has been some debate regarding whether the consequences of PC are universal across cultures, however. Culture may affect parenting behaviors in multiple ways. First, the cultural differences in individualistic and collectivistic orientations (Markus & Kitayma, 1991) may influence the extent to which children are expected to demonstrate maturity and control. In addition, culture imbues behaviors with meaning, such that the same behavior may have very different consequences across cultures (Lansford, Deater-Deckard, Dodge, Bates & Petti, 1998). Several studies have examined dimensions of PC in a cross-cultural context. Chao (1994) has argued that the Chinese concept of *guan* – which emphasizes governance, training, and nurturance of children – may result in Chinese parents scoring higher on PC. However, since the ultimate aim is to support children, this approach may not be experienced as rejection. PC is much more common in East Asia (Wang, Pomeranz & Chen 2007), and since some evidence suggests that the extent to which a behavior is associated with negative outcomes depends on its perceived normalcy (Deater-Deckard & Dodge, 1997), the negative effects may be absent. Empirical research by Pomerantz and colleagues (Pomerantz & Wang, 2009; Wang *et al*., 2007), however, demonstrated that PC appears to be associated with negative outcomes in both

American and Chinese children. For example, Wang *et al*. (2007) found that PC had detrimental effects on children's emotional adjustment equally across both cultures.

Relations between maternal behavior and children's stress response

To the best of our knowledge, there is no work that examines maternal PC and children's stress physiology in a cultural context. This is a major gap in the literature as a host of evidence suggests that the stress-response system (SRS) exhibits striking variation across individuals and that these differences are consistently related to psychological and physical functioning (for a review see Miller, Chen & Cole, 2009). Moreover, the SRS is highly malleable and is influenced by early experiences, particularly mother–child interactions (for a review Hostinar, Sullivan & Gunnary, 2014). Animal models have definitively demonstrated that early maternal behavior affects the hypothalamic-pituitary axis (Meaney, 2001). Meaney and colleagues demonstrated that mother rats who engage in higher levels of licking and grooming are more likely to have pups who have lower cortisol levels and respond less fearfully to novelty. In humans, interactions between mother and child extend beyond physical behavior and include a realm of psychological and emotional interactions. For example, it has been theorized that parents who are responsive to the needs of their children and use emotion-coaching have children who are less aroused in distressing situations (Gottman, Katz & Hooven, 1997). On the other hand, negative expressivity and hostility in parents may influence arousal in children and lead to problems with planning and self-control (Hoffman, 2000), which may in turn lead to physiological dysregulation (Doan, Fuller-Rowell & Evans, 2012). However, most studies have looked at maternal sensitivity and no studies have looked specifically at PC as a predictor of children's HPA functioning across different cultural contexts.

In addition, a major limitation of past research on PC is the use of questionnaire measures to measure behavioral and emotional adjustment. While useful, questionnaire data may be influenced by reporting and memory biases. Moreover, this type of data does not shed light on physical, more objective measures of health and physiological functioning. Finally, past research has focused almost exclusively on middle childhood and adolescence. This is particularly problematic as early childhood is a period of immense developmental significance for the emergence of self-control and emotion regulation (Posner & Rothbart, 2000; Olson, Sameroff, Lunkenheimer & Kerr, 2009).

In the current study, we investigated three research questions. First, we examined cultural differences in maternal PC and children's physiological response to a common stressor. Second, we explored associations between PC and children's cortisol. Finally, we examined the extent to which culture moderated relationships between maternal PC and children's cortisol, and whether maternal PC mediated possible cultural differences in children's physiological stress. We hypothesized that Chinese mothers would have higher levels of PC, and that Chinese children would have higher levels of cortisol in response to a lab stressor as compared to their American peers. More importantly, we hypothesized that maternal PC would mediate cultural differences in children's stress response and that the association between maternal PC and children's stress response would not vary across the two cultures.

We chose to examine relatively urban, higher SES children from American and mainland Chinese backgrounds to avoid additional confounds of massively different environments. Furthermore, the majority of past research on PC has focused on comparisons of American and Chinese youth. Our study was designed to build upon previous research and expand the current focus from psychological and behavioral measures to physiological measures, with a view towards examining the integrated effects of PC and the identification of potential mechanisms for when and how such effects might occur.

Method

Participants

Participants were recruited from suburban areas of Beijing, China and a suburban university town in the midwestern United States. Sixty children from China (30 boys, *M* age = 52.43) and 58 children from the United States (26 boys, *M* age = 54.15), for a total of 118 mother-child dyads, participated. We excluded 14 children who had conditions that would influence cortisol levels (e.g. asthma, medications) and children of Asian backgrounds in the American sample. Of the remaining American mothers ($N = 45$), five were African American, and two did not report race or ethnicity. Children were recruited through local preschools. All children were from middle-class backgrounds, with the majority of mothers (Chinese 50%, and American 90%) having obtained a college education or beyond.

Procedures

Parents completed a packet of questionnaires on family background characteristics, both children's and parents' emotional and behavioral functioning, and parenting styles (discussed below). The questionnaires were translated and back-translated by two English-Chinese bilingual speakers and checked by both native English and Mandarin speakers to ensure an equivalence of literal and sense meaning, as well as natural sounding expressions.

Children were tested in a room at their preschools or in a child-friendly laboratory. For induction of stress, a mild stressor was induced by a computer game that became progressively more difficult as the participant made progress, until it became impossible to win. At the end of the game, the child had lost, a loud buzzer beeped, and a 'frowny' face symbol appeared on the screen. The experimenter first played the game with the child (during this practice session, the game was in a 'no-lose' mode such that it was impossible to fail). The game was restarted after the child won. The child was then left alone to play the game and was told that if they won, they would receive a prize. At that point, the game was covertly activated into 'no-win' mode. In the 'no-win' mode, if the child gets close to achieving the victory condition, the game 'breaks' by having a random response to the child's key presses and it becomes impossible to win. Sixty seconds after hearing the 'game over' buzzer, the experimenter returned to the room and asked the child if the game was won and expressed concern when the child said no. A second experimenter then entered the room and explained that the game was broken and needed to be fixed. The first experimenter then apologized to the child, and said that he/she did a great job and would have won the game if it hadn't been broken. The child was then given a chance to pick a prize.

Measures

Psychological control

PC was assessed using items from the Socialization of Moral Affect Questionnaire (Rosenberg, Tagney, Denham, Leonard & Widmaier, 1994) which tapped into guilt induction and maternal love withdrawal. Parents rated the extent to which they would endorse specific strategies when dealing with their children in varying circumstances (e.g. catching their child cheating, having a messy room, fighting in school), on a scale of 1 to 6. Strategies for guilt induction include such sample items as 'say to my child, "it really ruins my day to hear that you behave that way"'. A sample response item for love withdrawal includes, 'no one likes people who fight in school, including me'. The scales were translated and back-translated by bilingual Chinese and English speakers. Reliability for both the American (Cronbach's $\alpha = .85$) and Chinese sample (Cronbach's $\alpha = .78$) was acceptable.

Cortisol

Trained research assistants collected salivary cortisol using Salivettes (Salimetrics, LLC State College, PA). The first sample was obtained after arrival at the study space. The second sample was obtained at time 0, after a 30 minute, quiet, play session, immediately before the challenge task. This second sample served as the baseline value for computation of AUCg. Saliva samples were then collected every 10 minutes for the first hour and at 75 and 90 minutes after the challenge task. Saliva was absorbed in cotton dental rolls without flavoring or stimulant by gentle chewing for one minute. Samples were then refrigerated and centrifuged within 24 hours of collection at 3000 rpm for 5 minutes. All saliva samples were stored at −20°C until assayed in duplicate for cortisol concentration using commercial kits (High Sensitivity Salivary Cortisol Enzyme Immunoassay Kit, Salimetrics, LLC State College, PA) at both project sites. Inter-assay variability was less than 5% at both sites. Ten samples were assayed in both locations to determine inter-site reliability, and the Pearson correlation for sample values across sites was 0.95, with no systematic variation in cortisol levels between the two sites.

The fraction of missing data for the cortisol responses was small (1.5%) with a few subjects having incomplete data in different tasks. We imputed missing values and used the complete data set for all the analyses. Missing cortisol data were imputed using the IVEWARE24 SAS macro following a multivariate regression model with missing values imputed sequentially based on the observed values within and across tasks. Data were log transformed for the imputation process to improve normality and transformed back to the original scale after imputation. Because of overall differences in the mean cortisol values for China and the United States, the imputation was performed separately by country.

Area under the curve

We computed two variables for our cortisol assessments, using previously established formulas and guidelines (Pruessner, Kirschbaum, Meinlschmid & Hellhammer, 2003). Area under the curve with respect to ground (AUCg) is the total area under the curve of all measurements. It takes into account both sensitivity (the difference between the single measurements from each other) and intensity (the distance of these measures from ground). Area under the curve with respect to increase (AUCi) is calculated with reference to the baseline measurement and it ignores the distance from zero for all measurements and emphasizes the changes over time. With endocrinological data, AUCg is assumed to be a measure more related to total hormonal output, whereas AUCi is a parameter that emphasizes the changes over time and is more related to sensitivity of the system (Fekedulegn, Andrew, Burchfiel, Violanti, Hartley *et al.*, 2007). Of the two, AUCg is generally considered more reliable (Hellhammer, Fries, Schweisthal, Schlotz, Stone *at al.*, 2007).

IQ

Evidence suggests that IQ can serve as a protective factor against stress (Saltzman, Weems & Carrion, 2006), thus the Block Design subscale of the Wechsler Preschool and Primary Scale of Intelligence-Revised (WPPSI-R; Weschler, 1989) was administered to all children and served as a covariate for all analyses. The Block Design subtest has been found to correlate highly with full scale IQ (Ward, 1990) and does not require a verbal response from the child. Thus, it was a useful index of cognitive maturity in this multi-national study and was less likely to be contaminated by cultural or linguistic factors than verbal measures of IQ.

Results

Preliminary analyses

Examination of both AUC cortisol values revealed substantial skewness in the data. As recommended by Tabachnick and Fidell (2001), we subjected the scores to a natural log transformation. Natural log scores are therefore used in all analyses, but for ease of interpretation untransformed means are presented in the tables of descriptive statistics. Some of the children did not complete all the tasks, thus the degrees of freedom varied slightly across analyses.

Maternal psychological control and children's stress response

Table 1 lists the means and standard deviations of mother and child variables by culture for study participants. To test our first hypothesis, that Chinese mothers would have higher levels of PC, we conducted a 2 (culture) × 2 (sex) analysis of covariance (ANCOVA) on PC with child age, IQ, and maternal education as covariates. Consistent with our prediction, the effect of culture was highly significant, $F(5, 86) = 57.34$, $p < .001$, $\eta_p^2 = .40$. No other effects reached significance. Analysis of PC showed that even after controlling for mothers' education level, child IQ, age, and sex, Chinese mothers ($M = 2.80$, $SE = .08$) had higher levels of PC as compared to their European American ($M = 1.7$, $SE = .10$) counterparts.

With regard to children's cortisol response, in addition to the previous control variables, we added 'time since waking' to the model, as cortisol has a diurnal rhythm and is influenced by time of day. Results showed that Chinese children ($M = 2.17$, $SE = .07$) had significantly higher levels of cortisol as indexed by AUCg as compared to their American peers (*M* = 1.88, *SE* = .07), *F*(1, 77) = 6.02, *p* = .02, η_p^2 = .07. With regard to AUCi, culture was not a significant predictor *F*(1, 76) = .21, *p* = .67, η_p^2 = .003). Because there was no differences in mean levels of AUCi across the two cultures, follow-up mediation and moderation analyses focused on AUCg.

Further examination of our data suggests that not all children's cortisol levels increased as a function of the stressor – indeed, some pre-transformed values of AUCi were negative. Thus, we followed up our analyses of AUCi, by only looking at the subset of children with non-negative values (those individuals for whom the stressor elicited an increase in cortisol from baseline). Results based on this subsample (*N* = 41) suggest that culture was a marginally significant predictor *F*(1, 30) = 2.65 *p* = .11, η_p^2 = .08, with Chinese children (*M* = .89, *SE* = .28) having higher levels of reactivity compared to their American peers (*M* = .01, *SE* = .40).

Finally, we examined the extent to which there may be cultural differences in children's cortisol levels, independent of their experience in the lab. However, no cultural differences were found in children's initial cortisol sample, which indexes their experiences approximately 30 minutes before entering the lab.

Relation of psychological control to children's stress response

Hierarchical regression analyses were conducted to examine the effects of PC on children's cortisol levels, independent of culture, sex, age, IQ, time since waking, and maternal education. Table 2 reports the summary of results from the regression analyses predicting AUCg. We were interested in whether maternal PC could account for variance in children's stress response independent of group and individual differences. Therefore in the first step of the equation, background variables including culture, sex, age, IQ, and maternal education, along with time since waking, were entered. These variables, combined, predicted 17% of the variance in children's cortisol, *F*(6, 76) = 2.53, *p* = .03. Next, in order to see if PC would increase the variance explained above these control variables, we added maternal PC to Step 2 of the model. Maternal PC increased the variance explained to 22%, *F*(1, 75) = 3.04, *p* = .007. The *F* change was significant, *p* = .03. Finally, to test whether culture moderated the effects of PC on children's stress response, we added the interaction terms of culture × PC to the model. Neither interaction term nor the *F* change reached significance, suggesting that the effects of PC are similar across cultures. In sum, the results indicated that regardless of culture, maternal use of PC positively predicted children's cortisol levels. We conducted the same analyses for AUCi, and none of the relationships were significant. PC also did not predict the initial cortisol level at the first time point.

Did maternal psychological control mediate cultural effects on children's cortisol?

Finally, to test whether maternal PC mediated cultural differences in cortisol levels, bootstrapping analyses were conducted using methods described by Preacher and Hayes (2008) for estimating direct and indirect effects with multiple mediators. This statistical method has several advantages: it does not rely on the assumption of a normal sampling distribution (MacKinnon, Lockwood & Williams, 2004; Preacher & Hayes, 2004; Shrout & Bolger, 2002), and the number of inferential tests is minimized, thus reducing the likelihood of Type I error. Cortisol AUCg was entered as the dependent variable, culture was entered as the predictor variable, and maternal PC was entered as the proposed mediator. All models controlled for child sex, child age, maternal education, child IQ, and time since waking. Culture (the independent variable) was a significant predictor of PC. Culture was also a significant predictor of child cortisol levels (AUCg). The direct effect of culture became non-significant when maternal PC was included in the model as the mediator (direct effect of culture = .09, p = .53). The specific indirect effect of maternal PC as a mediator between culture and child cortisol levels showed a point estimate of .21 (SE = .08), and a 95% CI .05 to .37. In sum, maternal PC fully mediated the effect of culture on children's cortisol stress response. The mediation results are summarized in Figure 1.

Discussion

We investigated cultural differences in levels of maternal PC and two indicators of children's stress response, total output of cortisol (AUCg) and reactivity (AUCi). Results of our study indicated that Chinese mothers scored higher on PC compared to their American counterparts. Chinese children had higher levels of total cortisol output during the stressor task. Across both cultures, maternal PC was positively associated with higher levels of cortisol. Moreover, maternal PC fully mediated cultural differences in children's cortisol. However, there were no cultural differences in cortisol reactivity (AUCi).

Our findings are consistent with animal models that have demonstrated that maternal behavior affects HPA functioning (Sapolsky, Meaney & McEwen, 1985). Furthermore, work by Gunnar and colleagues substantiates the idea that early social experiences, particularly parent–child interactions, play a pivotal role in shaping the response and regulation of the stress response system (for a review see Hostinar *et al*., 2014). Understanding factors that influence children's stress response is paramount, as the functioning of the HPA axis and its end product cortisol has been associated with a variety of outcomes including cognitive processes like memory (Het, Ramlow & Wolf, 2005; Lupien, de Leon, De Santi, Convit, Tarshish *et al*., 1998) and executive function (McCormick, Lewis, Somley & Kahan, 2007). In addition, cortisol has also been associated with physical (Fraser, Ingam, Anderson, Morrison, Davies *et al*., 1999; Wei, McDonald & Walker, 2004; Miller *et al*., 2009) and mental health (Bhagwagar, Hafizi & Cowen, 2005).

Cultural influences on the relationship between parenting, PC, and children's adjustment have been debated in the literature, but few investigators have examined the extent to which culture might moderate the relations between parenting and children's stress physiology. As PC is more common in East Asian cultures, some have argued that it may be part of a cultural style of parenting and thus may not lead to negative consequences (Chao & Tseng, 2002; Iyengar & Lepper, 1999). In contrast, other scholars have argued that autonomy is a universal psychological need, and thus parental exertion of control in the realm of children's thoughts and feelings should be associated with increased psychological dysfunction, irrespective of culture (Pomerantz & Wang, 2009). Consistent with this perspective, researchers have found that for both American and Japanese students, parents who are more likely to make decisions about children's personal issues have children with dampened emotional responses (Hasebe, Nucci & Nucci, 2004). Barber and colleagues (2005) have also found positive associations between maternal PC and depression in children from the United States and China. Moreover, longitudinal research has shown that parent's PC is associated with decreased emotional well-being across both American and Chinese children (Wang *et al*., 2007).

One pathway by which maternal PC leads to individual differences in adjustment may be through children's stress responses. Our findings demonstrate that maternal PC is associated with higher levels of cortisol during a stressor across both American and Chinese children. While cortisol is necessary for optimal functioning, children with cortisol profiles characterized by hyper and hypo levels of cortisol are at risk for increased adjustment problems (Essex, Klein, Cho & Kalin, 2002; Ruttle, Shirtcliff, Serbin, Fisher, Stack *et al*., 2011).

In our data, maternal PC was not associated with cortisol reactivity (AUCi). Inspection of specific cortisol levels showed that for Chinese but not American children, levels increased after the stressor. It may be that maternal PC is not associated with AUCi because there is not enough variability in the reactivity measure. When we look at only children who had an increase in cortisol due to the stressor, a similar pattern of results appeared, providing some preliminary evidence for the idea that these patterns of associations may hold for AUCi.

The current study was limited to the use of self-reports of maternal PC. Because PC is more commonly accepted as a parenting practice in East Asian cultures, it may be possible that Chinese mothers are more likely to *endorse* utilization of these techniques. In addition, our study was observational and cross-sectional in nature, and thus we must be cautious with respect to any causal interpretations. It is possible that children's cortisol levels could lead to increases in maternal PC. Future work should utilize experimental, intervention and longitudinal designs, which would provide insight into both the direction of causality and the temporal sequencing of these associations. Finally, we measured cortisol during a laboratory task. Although a previous study using the same sample, but a different stressor, revealed a similar pattern of results (Grabell, Olson, Miller, Kessler, Felt *et al*., 2015), it is still possible that children may respond differently to specific types of stressors. Daily diary methods, which measure naturally occurring life stressors, would be beneficial in generalizing the results of our study. Despite these limitations, the cross-cultural nature of our work and the biological measure of adjustment furthers our understanding of the universality of specific parenting styles and how they relate to children's outcomes.

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Figure 1Maternal psychological control mediated the effect of culture on children's cortisol levels.

Note: Values represent betas, numbers in parentheses are the standard errors. $R^2 = .25$, $F(7, 75) = 3.59$, $p = .002$.* = $p < .05$; ** $p < .01$; *** $p < .001$. c = total effect, c′ = direct effect. [a]Americans serve as the reference group, [b]as indexed by Area Under the Curve with respect to ground. Models controlled for child sex, age, IQ, mothers' education and time since waking.

Table 1Means and standard deviations of mother and child variables by culture

	Chinese	American

	M	*SD*	*M*	*SD*
Child age (months)	52.42*	3.32	54.22	4.76
Maternal education	5.43***	1.12	6.26	.81
Block design (IQ)	19.09*	5.42	16.13	6.77
Psychological control (PC)	2.80***	.49	1.78	.55
Cortisol AUCg	8.98***	5.70	5.53	2.38
Cortisol AUCi	.30	5.01	−.81	2.57
Cortisol$_{t=-30}$[a]	.13	.08	.11	.08
Cortisol$_{t=0}$[b]	.09**	.04	.07	.04
Cortisol$_{t=10}$[c]	.08*	.05	.07	.04
Cortisol$_{t=20}$	.11**	.07	.07	.04
Cortisol$_{t=30}$	.12***	.09	.06	.04
Cortisol$_{t=40}$	.12**	.10	.06	.03
Cortisol$_{t=50}$	.11**	.09	.06	.03
Cortisol$_{t=60}$	.11**	.08	.07	.04
Cortisol$_{t=75}$	.09**	.06	.06	.03
Cortisol$_{t=90}$	.08*	.05	.06	.04

Note: [a]cortisol measurements are micrograms per deciliter. A sample was taken 30 minutes before the beginning of the stress task to observe initial cortisol levels, and provide the opportunity for child cortisol levels to return to baseline after any potentially arousing events which may have occurred prior to the start of the study. [b]t = 0 indicates the beginning of the stress task, the number following each subsequent t indicates minutes post the beginning of the stressor. Significant differences between cultures are indicated by $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$ (all significance tests are two-tailed).

Table 2Hierarchical regression analyses for variables predicting children's cortisol

	B	Std. Error	Beta	R^2 and ΔR^2
Model 1				
Culture**	.47	.14	.41	.20**
Sex	−.07	.12	−.06	
Age	−.02	.02	−.13	
IQ	.07	.05	.16	
Maternal education	−.02	.06	−.04	
Time[a]	.02	.02	.08	
Model 2				
Culture	.24	.17	.21	.05*
Sex	−.08	.12	−.07	
Age	−.03	.02	−.18	
IQ	.08	.05	.18	
ME	−.07	.06	−.03	
Time	.00	.02	.012	
Psychological control*	.26	.11	.32	

Note: American children and males were set as the reference group. [a]indicates amount of time since waking, $^{*}p < .05$; $^{**}p < .01$.

<catch-line>Developmental Science
<left-hand running head>Stacey N. Doan et al.
<right-hand running head>Culture, psychological control, cortisol
<section head>SHORT REPORT

<title>Consequences of 'tiger' parenting: a cross-cultural study of maternal psychological control and children's cortisol stress response

<authors>Stacey N. Doan,[1] Twila Tardif,[2] Alison Miller,[3] Sheryl Olson,[2] Daniel Kessler,[4] Barbara Felt[5] and Li Wang[6]

<affils>1. Department of Psychology, Claremont McKenna College, USA
2. School of Public Health, University of Michigan, USA
3. Department of Psychology, University of Michigan, USA
4. Departments of Psychiatry and Philosophy, University of Michigan, USA
5. Department of Pediatrics and Communicable Diseases, University of Michigan, USA
6. Department of Psychology and Beijing Key Laboratory of Behavior and Mental Health, Peking University, China

Address for correspondence: Stacey N. Doan, 850 Columbia Ave., Claremont, California 91711, USA; e-mail: sdoan@cmc.edu

<a-head>Abstract</a-head>

<abstract>Parenting strategies involving psychological control are associated with increased adjustment problems in children. However, no research has examined the extent to which culture and psychological control predict children's stress physiology. We examine cultural differences in maternal psychological control and its associations with children's cortisol. Chinese (N = 59) and American (N = 45) mother-child dyads participated in the study. Mothers reported on psychological control. Children's cortisol was collected during a stressor and two indices of Area Under the Curve (AUC) were computed: AUCg which accounts for total output, and AUCi, which captures reactivity. Results indicate that Chinese mothers reported higher levels of psychological control and Chinese children had higher levels of AUCg than their American counterparts. Across both cultures, psychological control was significantly associated with increased cortisol levels as indexed by AUCg. There were no associations for AUCi. Finally, mediation analyses demonstrated that psychological control fully explained cultural differences in children's cortisol stress response as indexed by AUCg.

<a-head>**Research highlights**</a-head>

- The current study finds higher levels of psychological control in Chinese mothers compared to American mothers.
- Chinese children have higher levels of cortisol, a stress hormone, compared to their American peers.
- Across both American and Chinese children, during a stressor, higher maternal psychological control is associated with higher levels of cortisol output (AUCg), but not reactivity (AUCi).

<a-head>**Introduction**</a-head>

<text>Research on parental control has focused on psychological and behavioral aspects (for a review see Barber, Stolz & Olsen, 2005). Psychological control (PC) is when parents constrain children's autonomy through psychologically manipulative tactics such as the withdrawal of love or induction of guilt (Barber, 2002). Behavioral control focuses on parents' tendency to be aware of and set limits on children's activities and behaviors. Behavioral control contributes to academic competence and decreased behavioral problems (Fletcher, Steinberg & Williams-Wheeler, 2004), whereas PC increases emotional distress and lowers self-esteem (Barber, 1996; Silk, Morris, Kanaya & Steinberg, 2003). Despite these links, the extent to which PC affects children's stress response has not been studied, despite a host of research from both animal (Meaney & Szyf, 2005) and human studies (Adam, Klines-Dougan & Gunnar, 2006) demonstrating the importance of maternal behavior in programming children's stress response. Moreover, no research has examined possible cultural differences in this relationship.

<b-head>Psychological control, culture, and children's adjustment</b-head>

<text>In conceptualizing the consequences of psychological vs. behavioral control, researchers using self-determination theory (Deci & Ryan, 2010) emphasize that the need for psychological autonomy is universal and essential for optimal functioning. When parents exert PC, they undermine the child's self-concept, reducing perceptions of competence and intrinsic motivation (Pomerantz & Thompson, 2008). Whereas behavioral control is related to higher social and academic achievement as well as lower levels of behavioral problems (d'Ailly, 2003; Bean, Barber & Crane, 2006; Vansteenkiste, Zhou, Lens & Soenens, 2005), PC has been found to be correlated with more behavioral problems, emotional distress, and lower achievement (Barber, 1996; Olsen, Yang, Hart, Robinson, Wu et al., 2002; Silk et al., 2003).

<textindent>There has been some debate regarding whether the consequences of PC are universal across cultures, however. Culture may affect parenting behaviors in multiple ways. First, the cultural differences in individualistic and collectivistic orientations (Markus & Kitayma, 1991) may influence the extent to which children are expected to demonstrate maturity and control. In addition, culture imbues behaviors with meaning, such that the same behavior may have very different consequences across cultures (Lansford, Deater-Deckard, Dodge, Bates & Petti, 1998). Several studies have examined dimensions of PC in a cross-cultural context. Chao (1994) has argued that the Chinese concept of guan – which emphasizes governance, training, and nurturance of children – may result in Chinese parents scoring higher on PC.

However, since the ultimate aim is to support children, this approach may not be experienced as rejection. PC is much more common in East Asia (Wang, Pomeranz & Chen 2007), and since some evidence suggests that the extent to which a behavior is associated with negative outcomes depends on its perceived normalcy (Deater-Deckard & Dodge, 1997), the negative effects may be absent. Empirical research by Pomerantz and colleagues (Pomerantz & Wang, 2009; Wang et al., 2007), however, demonstrated that PC appears to be associated with negative outcomes in both American and Chinese children. For example, Wang et al. (2007) found that PC had detrimental effects on children's emotional adjustment equally across both cultures.

<b-head>Relations between maternal behavior and children's stress response</b-head>

<text>To the best of our knowledge, there is no work that examines maternal PC and children's stress physiology in a cultural context. This is a major gap in the literature as a host of evidence suggests that the stress-response system (SRS) exhibits striking variation across individuals and that these differences are consistently related to psychological and physical functioning (for a review see Miller, Chen & Cole, 2009). Moreover, the SRS is highly malleable and is influenced by early experiences, particularly mother–child interactions (for a review Hostinar, Sullivan & Gunnary, 2014). Animal models have definitively demonstrated that early maternal behavior affects the hypothalamic-pituitary axis (Meaney, 2001). Meaney and colleagues demonstrated that mother rats who engage in higher levels of licking and grooming are more likely to have pups who have lower cortisol levels and respond less fearfully to novelty. In humans, interactions between mother and child extend beyond physical behavior and include a realm of psychological and emotional interactions. For example, it has been theorized that parents who are responsive to the needs of their children and use emotion-coaching have children who are less aroused in distressing situations (Gottman, Katz & Hooven, 1997). On the other hand, negative expressivity and hostility in parents may influence arousal in children and lead to problems with planning and self-control (Hoffman, 2000), which may in turn lead to physiological dysregulation (Doan, Fuller-Rowell & Evans, 2012). However, most studies have looked at maternal sensitivity and no studies have looked specifically at PC as a predictor of children's HPA functioning across different cultural contexts.

<textindent>In addition, a major limitation of past research on PC is the use of questionnaire measures to measure behavioral and emotional adjustment. While useful, questionnaire data may be influenced by reporting and memory biases. Moreover, this type of data does not shed light on

physical, more objective measures of health and physiological functioning. Finally, past research has focused almost exclusively on middle childhood and adolescence. This is particularly problematic as early childhood is a period of immense developmental significance for the emergence of self-control and emotion regulation (Posner & Rothbart, 2000; Olson, Sameroff, Lunkenheimer & Kerr, 2009).

<textindent>In the current study, we investigated three research questions. First, we examined cultural differences in maternal PC and children's physiological response to a common stressor. Second, we explored associations between PC and children's cortisol. Finally, we examined the extent to which culture moderated relationships between maternal PC and children's cortisol, and whether maternal PC mediated possible cultural differences in children's physiological stress. We hypothesized that Chinese mothers would have higher levels of PC, and that Chinese children would have higher levels of cortisol in response to a lab stressor as compared to their American peers. More importantly, we hypothesized that maternal PC would mediate cultural differences in children's stress response and that the association between maternal PC and children's stress response would not vary across the two cultures.

<textindent>We chose to examine relatively urban, higher SES children from American and mainland Chinese backgrounds to avoid additional confounds of massively different environments. Furthermore, the majority of past research on PC has focused on comparisons of American and Chinese youth. Our study was designed to build upon previous research and expand the current focus from psychological and behavioral measures to physiological measures, with a view towards examining the integrated effects of PC and the identification of potential mechanisms for when and how such effects might occur.

<a-head>Method</a-head>

<b-head>Participants</b-head>

<text> Participants were recruited from suburban areas of Beijing, China and a suburban university town in the midwestern United States. Sixty children from China (30 boys, M age = 52.43) and 58 children from the United States (26 boys, M age = 54.15), for a total of 118 mother-child dyads, participated. We excluded 14 children who had conditions that would influence cortisol levels (e.g. asthma, medications) and children of Asian backgrounds in the American sample. Of the remaining American mothers (N = 45), five were African American, and two did not report race or ethnicity. Children were recruited through local preschools. All children were from middle-class backgrounds, with the majority of mothers (Chinese 50%, and American 90%) having obtained a college education or beyond.

<b-head>Procedures</b-head>

<text>Parents completed a packet of questionnaires on family background characteristics, both children's and parents' emotional and behavioral functioning, and parenting styles (discussed below). The questionnaires were translated and back-translated by two English-Chinese bilingual speakers and checked by both native English and Mandarin speakers to ensure an equivalence of literal and sense meaning, as well as natural sounding expressions.

<textindent>Children were tested in a room at their preschools or in a child-friendly laboratory. For induction of stress, a mild stressor was induced by a computer game that became progressively more difficult as the participant made progress, until it became impossible to win. At the end of the game, the child had lost, a loud buzzer beeped, and a 'frowny' face symbol appeared on the screen. The experimenter first played the game with the child (during this practice session, the game was in a 'no-lose' mode such that it was impossible to fail). The game was restarted after the child won. The child was then left alone to play the game and was told that if they won, they would receive a prize. At that point, the game was covertly activated into 'no-win' mode. In the 'no-win' mode, if the child gets close to achieving the victory condition, the game 'breaks' by having a random response to the child's key presses and it becomes impossible to win. Sixty seconds after hearing the 'game over' buzzer, the experimenter returned to the room and asked the child if the game was won and expressed concern when the child said no. A second experimenter then entered the room and explained that the game was broken and needed to be fixed. The first experimenter then apologized to the child, and said that he/she did a great job and would have won the game if it hadn't been broken. The child was then given a chance to pick a prize.

<b-head>Measures</b-head>

<c-head>Psychological control</c-head>

<text>PC was assessed using items from the Socialization of Moral Affect Questionnaire (Rosenberg, Tagney, Denham, Leonard & Widmaier, 1994) which tapped into guilt induction and maternal love withdrawal. Parents rated the extent to which they would endorse specific strategies when dealing with their children in varying circumstances (e.g. catching their child cheating, having a messy room, fighting in school), on a scale of 1 to 6. Strategies for guilt

induction include such sample items as ‘say to my child, “it really ruins my day to hear that you behave that way”’. A sample response item for love withdrawal includes, ‘no one likes people who fight in school, including me’. The scales were translated and back-translated by bilingual Chinese and English speakers. Reliability for both the American (Cronbach’s α = .85) and Chinese sample (Cronbach’s α = .78) was acceptable.

<c-head>Cortisol</c-head>

<text>Trained research assistants collected salivary cortisol using Salivettes (Salimetrics, LLC State College, PA). The first sample was obtained after arrival at the study space. The second sample was obtained at time 0, after a 30 minute, quiet, play session, immediately before the challenge task. This second sample served as the baseline value for computation of AUCg. Saliva samples were then collected every 10 minutes for the first hour and at 75 and 90 minutes after the challenge task. Saliva was absorbed in cotton dental rolls without flavoring or stimulant by gentle chewing for one minute. Samples were then refrigerated and centrifuged within 24 hours of collection at 3000 rpm for 5 minutes. All saliva samples were stored at −20°C until assayed in duplicate for cortisol concentration using commercial kits (High Sensitivity Salivary Cortisol Enzyme Immunoassay Kit, Salimetrics, LLC State College, PA) at both project sites. Inter-assay variability was less than 5% at both sites. Ten samples were assayed in both locations to determine inter-site reliability, and the Pearson correlation for sample values across sites was 0.95, with no systematic variation in cortisol levels between the two sites.

<textindent>The fraction of missing data for the cortisol responses was small (1.5%) with a few subjects having incomplete data in different tasks. We imputed missing values and used the complete data set for all the analyses. Missing cortisol data were imputed using the IVEWARE24 SAS macro following a multivariate regression model with missing values imputed sequentially based on the observed values within and across tasks. Data were log transformed for the imputation process to improve normality and transformed back to the original scale after imputation. Because of overall differences in the mean cortisol values for China and the United States, the imputation was performed separately by country.

<d-head>Area under the curve.</d-head>

<text>We computed two variables for our cortisol assessments, using previously established formulas and guidelines (Pruessner, Kirschbaum, Meinlschmid & Hellhammer, 2003). Area under the

curve with respect to ground (AUCg) is the total area under the curve of all measurements. It takes into account both sensitivity (the difference between the single measurements from each other) and intensity (the distance of these measures from ground). Area under the curve with respect to increase (AUCi) is calculated with reference to the baseline measurement and it ignores the distance from zero for all measurements and emphasizes the changes over time. With endocrinological data, AUCg is assumed to be a measure more related to total hormonal output, whereas AUCi is a parameter that emphasizes the changes over time and is more related to sensitivity of the system (Fekedulegn, Andrew, Burchfiel, Violanti, Hartley et al., 2007). Of the two, AUCg is generally considered more reliable (Hellhammer, Fries, Schweisthal, Schlotz, Stone at al., 2007).

<c-head>IQ</c-head>

<text>Evidence suggests that IQ can serve as a protective factor against stress (Saltzman, Weems & Carrion, 2006), thus the Block Design subscale of the Wechsler Preschool and Primary Scale of Intelligence-Revised (WPPSI-R; Weschler, 1989) was administered to all children and served as a covariate for all analyses. The Block Design subtest has been found to correlate highly with full scale IQ (Ward, 1990) and does not require a verbal response from the child. Thus, it was a useful index of cognitive maturity in this multi-national study and was less likely to be contaminated by cultural or linguistic factors than verbal measures of IQ.

<a-head>Results</a-head>

<b-head>Preliminary analyses</b-head>

<text>Examination of both AUC cortisol values revealed substantial skewness in the data. As recommended by Tabachnick and Fidell (2001), we subjected the scores to a natural log transformation. Natural log scores are therefore used in all analyses, but for ease of interpretation untransformed means are presented in the tables of descriptive statistics. Some of the children did not complete all the tasks, thus the degrees of freedom varied slightly across analyses.

<b-head>Maternal psychological control and children's stress response</b-head>

<text>Table 1 lists the means and standard deviations of mother and child variables by culture for study participants. To test our first hypothesis, that Chinese mothers would have higher levels of PC, we conducted a 2 (culture) × 2 (sex) analysis of covariance (ANCOVA) on PC with child age, IQ, and maternal education as covariates. Consistent with our prediction, the effect of

culture was highly significant, $F(5, 86) = 57.34$, $p < .001$, $\eta_p^2 = .40$. No other effects reached significance. Analysis of PC showed that even after controlling for mothers' education level, child IQ, age, and sex, Chinese mothers (M = 2.80, SE = .08) had higher levels of PC as compared to their European American (M = 1.7, SE = .10) counterparts.

<set Table 1>

<textindent>With regard to children's cortisol response, in addition to the previous control variables, we added 'time since waking' to the model, as cortisol has a diurnal rhythm and is influenced by time of day. Results showed that Chinese children (M = 2.17, SE = .07) had significantly higher levels of cortisol as indexed by AUCg as compared to their American peers (M = 1.88, SE = .07), $F(1, 77) = 6.02$, $p = .02$, $\eta_p^2 = .07$. With regard to AUCi, culture was not a significant predictor $F(1, 76) = .21$, $p = .67$, $\eta_p^2 = .003$). Because there was no differences in mean levels of AUCi across the two cultures, follow-up mediation and moderation analyses focused on AUCg.

<textindent>Further examination of our data suggests that not all children's cortisol levels increased as a function of the stressor – indeed, some pre-transformed values of AUCi were negative. Thus, we followed up our analyses of AUCi, by only looking at the subset of children with non-negative values (those individuals for whom the stressor elicited an increase in cortisol from baseline). Results based on this subsample (N = 41) suggest that culture was a marginally significant predictor $F(1, 30) = 2.65$ $p = .11$, $\eta_p^2 = .08$, with Chinese children (M = .89, SE = .28) having higher levels of reactivity compared to their American peers (M = .01, SE = .40).

<textindent>Finally, we examined the extent to which there may be cultural differences in children's cortisol levels, independent of their experience in the lab. However, no cultural differences were found in children's initial cortisol sample, which indexes their experiences approximately 30 minutes before entering the lab.

<b-head>Relation of psychological control to children's stress response</b-head>

<text>Hierarchical regression analyses were conducted to examine the effects of PC on children's cortisol levels, independent of culture, sex, age, IQ, time since waking, and maternal education. Table 2 reports the summary of results from the regression analyses predicting AUCg. We were interested in whether maternal PC could account for variance in children's stress response independent of group and individual differences. Therefore in the first step of the equation, background variables including culture, sex, age, IQ, and maternal education, along

with time since waking, were entered. These variables, combined, predicted 17% of the variance in children's cortisol, $F(6, 76) = 2.53$, $p = .03$. Next, in order to see if PC would increase the variance explained above these control variables, we added maternal PC to Step 2 of the model. Maternal PC increased the variance explained to 22%, $F(1, 75) = 3.04$, $p = .007$. The F change was significant, $p = .03$. Finally, to test whether culture moderated the effects of PC on children's stress response, we added the interaction terms of culture × PC to the model. Neither interaction term nor the F change reached significance, suggesting that the effects of PC are similar across cultures. In sum, the results indicated that regardless of culture, maternal use of PC positively predicted children's cortisol levels. We conducted the same analyses for AUCi, and none of the relationships were significant. PC also did not predict the initial cortisol level at the first time point.

<set Table 2>

<b-head>Did maternal psychological control mediate cultural effects on children's cortisol?</b-head>

<text>Finally, to test whether maternal PC mediated cultural differences in cortisol levels, bootstrapping analyses were conducted using methods described by Preacher and Hayes (2008) for estimating direct and indirect effects with multiple mediators. This statistical method has several advantages: it does not rely on the assumption of a normal sampling distribution (MacKinnon, Lockwood & Williams, 2004; Preacher & Hayes, 2004; Shrout & Bolger, 2002), and the number of inferential tests is minimized, thus reducing the likelihood of Type I error. Cortisol AUCg was entered as the dependent variable, culture was entered as the predictor variable, and maternal PC was entered as the proposed mediator. All models controlled for child sex, child age, maternal education, child IQ, and time since waking. Culture (the independent variable) was a significant predictor of PC. Culture was also a significant predictor of child cortisol levels (AUCg). The direct effect of culture became non-significant when maternal PC was included in the model as the mediator (direct effect of culture = .09, $p = .53$). The specific indirect effect of maternal PC as a mediator between culture and child cortisol levels showed a point estimate of .21 (SE = .08), and a 95% CI .05 to .37. In sum, maternal PC fully mediated the effect of culture on children's cortisol stress response. The mediation results are summarized in Figure 1.

<set Fig 1>

<a-head>**Discussion**</a-head>

<text>We investigated cultural differences in levels of maternal PC and two indicators of children's stress response, total output of cortisol (AUCg) and reactivity (AUCi). Results of our study indicated that Chinese mothers scored higher on PC compared to their American counterparts. Chinese children had higher levels of total cortisol output during the stressor task. Across both cultures, maternal PC was positively associated with higher levels of cortisol. Moreover, maternal PC fully mediated cultural differences in children's cortisol. However, there were no cultural differences in cortisol reactivity (AUCi).

<textindent>Our findings are consistent with animal models that have demonstrated that maternal behavior affects HPA functioning (Sapolsky, Meaney & McEwen, 1985). Furthermore, work by Gunnar and colleagues substantiates the idea that early social experiences, particularly parent–child interactions, play a pivotal role in shaping the response and regulation of the stress response system (for a review see Hostinar et al., 2014). Understanding factors that influence children's stress response is paramount, as the functioning of the HPA axis and its end product cortisol has been associated with a variety of outcomes including cognitive processes like memory (Het, Ramlow & Wolf, 2005; Lupien, de Leon, De Santi, Convit, Tarshish et al., 1998) and executive function (McCormick, Lewis, Somley & Kahan, 2007). In addition, cortisol has also been associated with physical (Fraser, Ingam, Anderson, Morrison, Davies et al., 1999; Wei, McDonald & Walker, 2004; Miller et al., 2009) and mental health (Bhagwagar, Hafizi & Cowen, 2005).

<textindent>Cultural influences on the relationship between parenting, PC, and children's adjustment have been debated in the literature, but few investigators have examined the extent to which culture might moderate the relations between parenting and children's stress physiology. As PC is more common in East Asian cultures, some have argued that it may be part of a cultural style of parenting and thus may not lead to negative consequences (Chao & Tseng, 2002; Iyengar & Lepper, 1999). In contrast, other scholars have argued that autonomy is a universal psychological need, and thus parental exertion of control in the realm of children's thoughts and feelings should be associated with increased psychological dysfunction, irrespective of culture (Pomerantz & Wang, 2009). Consistent with this perspective, researchers have found that for both American and Japanese students, parents who are more likely to make decisions about children's personal issues have children with dampened emotional responses (Hasebe, Nucci &

Nucci, 2004). Barber and colleagues (2005) have also found positive associations between maternal PC and depression in children from the United States and China. Moreover, longitudinal research has shown that parent's PC is associated with decreased emotional well-being across both American and Chinese children (Wang et al., 2007).

<textindent>One pathway by which maternal PC leads to individual differences in adjustment may be through children's stress responses. Our findings demonstrate that maternal PC is associated with higher levels of cortisol during a stressor across both American and Chinese children. While cortisol is necessary for optimal functioning, children with cortisol profiles characterized by hyper and hypo levels of cortisol are at risk for increased adjustment problems (Essex, Klein, Cho & Kalin, 2002; Ruttle, Shirtcliff, Serbin, Fisher, Stack et al., 2011).

<textindent>In our data, maternal PC was not associated with cortisol reactivity (AUCi). Inspection of specific cortisol levels showed that for Chinese but not American children, levels increased after the stressor. It may be that maternal PC is not associated with AUCi because there is not enough variability in the reactivity measure. When we look at only children who had an increase in cortisol due to the stressor, a similar pattern of results appeared, providing some preliminary evidence for the idea that these patterns of associations may hold for AUCi.

<textindent>The current study was limited to the use of self-reports of maternal PC. Because PC is more commonly accepted as a parenting practice in East Asian cultures, it may be possible that Chinese mothers are more likely to endorse utilization of these techniques. In addition, our study was observational and cross-sectional in nature, and thus we must be cautious with respect to any causal interpretations. It is possible that children's cortisol levels could lead to increases in maternal PC. Future work should utilize experimental, intervention and longitudinal designs, which would provide insight into both the direction of causality and the temporal sequencing of these associations. Finally, we measured cortisol during a laboratory task. Although a previous study using the same sample, but a different stressor, revealed a similar pattern of results (Grabell, Olson, Miller, Kessler, Felt et al., 2015), it is still possible that children may respond differently to specific types of stressors. Daily diary methods, which measure naturally occurring life stressors, would be beneficial in generalizing the results of our study. Despite these limitations, the cross-cultural nature of our work and the biological measure of adjustment furthers our understanding of the universality of specific parenting styles and how they relate to children's outcomes. **Table 1**

Means and standard deviations of mother and child variables by culture

	Chinese		American	
	M	SD	M	SD
Child age (months)	52.42*	3.32	54.22	4.76
Maternal education	5.43***	1.12	6.26	.81
Block design (IQ)	19.09*	5.42	16.13	6.77
Psychological control (PC)	2.80***	.49	1.78	.55
Cortisol AUCg	8.98***	5.70	5.53	2.38
Cortisol AUCi	.30	5.01	-.81	2.57
$Cortisol_{t=-30}$[a]	.13	.08	.11	.08
$Cortisol_{t=0}$[b]	.09**	.04	.07	.04
$Cortisol_{t=10}$[c]	.08*	.05	.07	.04
$Cortisol_{t=20}$	.11**	.07	.07	.04
$Cortisol_{t=30}$	.12***	.09	.06	.04
$Cortisol_{t=40}$	.12**	.10	.06	.03
$Cortisol_{t=50}$	.11**	.09	.06	.03
$Cortisol_{t=60}$	.11**	.08	.07	.04
$Cortisol_{t=75}$	.09**	.06	.06	.03
$Cortisol_{t=90}$	.08*	.05	.06	.04

Note: [a]cortisol measurements are micrograms per deciliter. A sample was taken 30 minutes before the beginning of the stress task to observe initial cortisol levels, and provide the opportunity for child cortisol levels to return to baseline after any potentially arousing events which may have occurred prior to the start of the study. [b]t = 0 indicates the beginning of the stress task, the number following each subsequent t indicates minutes post the beginning of the stressor. Significant differences between cultures are indicated by *p < .05; **p < .01; ***p < .001 (all significance tests are two-tailed).

Table 2

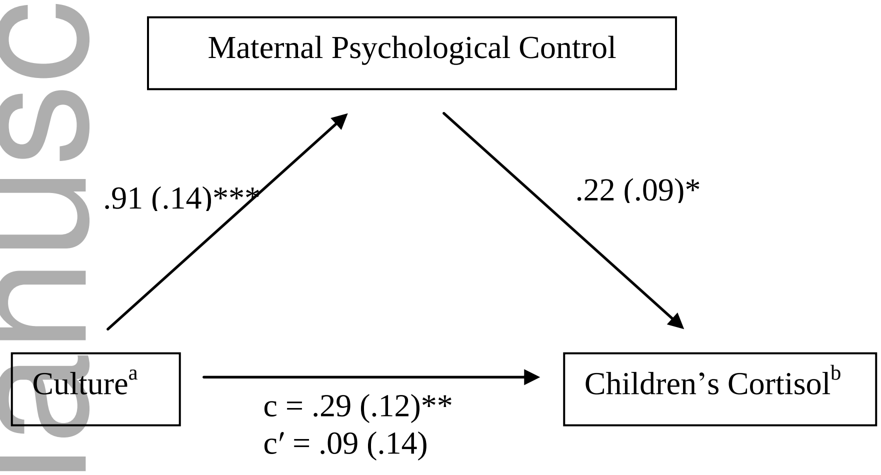
Hierarchical regression analyses for variables predicting children's cortisol

	B	Std. Error	Beta	R^2 and ΔR^2
Model 1				.20**
Culture**	.47	.14	.41	
Sex	−.07	.12	−.06	
Age	−.02	.02	−.13	
IQ	.07	.05	.16	
Maternal education	−.02	.06	−.04	
Time[a]	.02	.02	.08	
Model 2				.05*
Culture	.24	.17	.21	
Sex	−.08	.12	−.07	
Age	−.03	.02	−.18	
IQ	.08	.05	.18	
ME	−.07	.06	−.03	
Time	.00	.02	.012	
Psychological control*	.26	.11	.32	

Note: American children and males were set as the reference group. [a]indicates amount of time since waking, *p < .05; **p < .01.

<Figure Caption>

Figure 1 *Maternal psychological control mediated the effect of culture on children's* cortisol levels.



Note: Values represent betas, numbers in parentheses are the standard errors. $R^2 = .25$, $F(7, 75) = 3.59$, $p = .002$.* = $p < .05$; ** $p < .01$; *** $p < .001$. c = total effect, c′ = direct effect. [a]Americans serve as the reference group, [b]as indexed by Area Under the Curve with respect to ground. Models controlled for child sex, age, IQ, mothers' education and time since waking.

<a-head>**References**</a-head>

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