Published in final edited form as:

Stress. 2018 July ; 21(4): 312–322. doi:10.1080/10253890.2018.1453494.

Affective and Physiological Response to a Novel Parent-Adolescent Conflict Stressor

Emily C. Cook,

Rhode Island College

Orianna Duncan,

Rhode Island College

Mary Ellen Fernandez,

Rhode Island College

Bryan Mercier,

Rhode Island College

Jason Windrow, and

Rhode Island College

Laura R. Stroud

Warren Alpert Brown Medical School

Abstract

Few laboratory paradigms exist that expose adolescents to conflict that might commonly be experienced in parent-adolescent relationships. Given the continued importance of parent-adolescent relationships on adolescent development, as well as the changing expectations in these relationships, we examined the effect of a novel parent-adolescent conflict paradigm on physiological and affective response in a sample of 52 adolescents. The parent-adolescent conflict stressor (PACS) involved adolescent participants (50% girls; $M = 14.75$, $SD = .88$) watching a 12-minute scripted video that asked youth to imagine that they were the teenager in the video, which consisted of parent and adolescent actors having discussions about conflict in their relationship and solving this conflict in either a positive, typical, or hostile manner. Cortisol, alpha amylase, and self-report of negative and positive affect were collected at baseline, following the video, and during a recovery period. Heart rate also was taken continuously while adolescents watched the videos. Hierarchical linear modeling (HLM) analyses indicated significant linear change in alpha amylase and linear and quadratic change in negative affect to the PACS. There also was a significant linear and quadratic change in heart rate during the portion of the video where teens and parents discussed issues of personal responsibility. The PACS marks a preliminary but important first step in developing a parent-adolescent conflict paradigm that can be used across

Address correspondence to Emily Cook, Department of Psychology, 600 Mount Pleasant Ave., Rhode Island College, Providence, RI 02908. Phone: 401-456-8672. ecook@ric.edu.

Declaration of Interest

Support for this project was provided by the Institutional Development Award (IDeA) Network for Biomedical Research Excellence from the National Institute of General Medical Sciences of the National Institutes of Health under grant number P20GM103430.

studies to understand the impact of parent-adolescent conflict on affective and physiological markers associated with stress response.

Lay Summary

We examined the effect of a novel parent-adolescent conflict stress paradigm (PACS) on stress response in a sample of 52 adolescents (50% girls; $M = 14.75$, $SD = .88$). Results indicated an increase in physiological and affective markers associated with stress (alpha amylase and negative affect) and an increase in heart rate when participants viewed the typical and the hostile conflict interactions around issues of personal responsibility compared to the positive interaction. The PACS marks an important first step in developing a stress paradigm that can be used across studies to understand the impact of parent-adolescent conflict on affective and physiological markers of stress.

Keywords

adolescence; affective stress response; HLM; laboratory stressor; parent-adolescent conflict; physiological stress response

Stress is generally conceptualized as occurring when mental, emotional, or physical demands exceed the regulatory capacity of individuals. During adolescence, this may occur when youth experience conflict in family relationships that occur due to changes within the family relationship, such as increases in conflict, decreases in warmth, and an overall realignment process that shifts adolescents' decision making from parents to adolescents (Allen, Hauser, Eickholt, Bell, & O'Connor, 1994). Despite the stress that conflict in parent-adolescent relationships may induce, few studies have utilized a controlled laboratory paradigm to examine the impact of conflict in parent-adolescent relationships on physiological and affective measures that have been associated with how adolescents handle stress. This is surprising given the growing evidence that adolescence is a particularly critical time to consider the impact of stressors on underlying neurobiological systems (Gunnar & Quevedo, 2007).

Much of the research that has attempted to induce stress that adolescents may experience in parent-adolescent relationships has utilized a parent-adolescent conflict paradigm, where adolescents and parents discuss issues of conflict in their relationship and changes in physiology and affect are observed in response to that interaction. Although having adolescents interact with parents while discussing issues of conflict has been associated with physiological changes in a handful of studies (Afifi, Granger, Dene, Joseph, & Aldeis, 2011; Chaplin et al., 2012, Connell Hughes-Scalise, Klostermann, & Azem 2011; Gordis et al., 2010), several studies fail to find significant increases in physiological stress response to parent-adolescent conflict interactions (e.g., Gunnar, Talge, Herrera, 2009). These parent-adolescent conflict paradigms are critical in understanding variability in how parents and adolescents handle conflict in relationships and provide important information about the quality of the parent-adolescent interaction but generally lack standardization that may be needed to compare changes to parent-adolescent conflict in affect and physiology across studies. This lack of standardization may be due to differences in types of conflicts

discussed, level of conflict experienced during the interaction, and an overall lack of control that comes from using a parent-adolescent conflict paradigm that relies on the parents and adolescents to generate the stress they experience. Additionally, these paradigms require that both parents and youth participate in data collection, which increases resources allocated to data collection. It is surprising, given that there are numerous paradigms that model interpersonal stress in adolescent peer relationships (e.g., cyber-ball, Williams & Jarvis, 2006; chat-room, Silk et al., 2011) that researchers have not developed a parent-adolescent conflict paradigm that may be used consistently across studies to elicit a stress response in youth. Thus, the purpose of the current study was to introduce a newly developed parent-adolescent conflict stressor (PACS) that utilizes a video-taped scripted interaction with actors portraying a parent and teenager that could potentially be used to capture physiological and affective responses to parent-adolescent conflict in a controlled setting. The PACS has the potential to contribute to research in multiple ways that include providing uniformity in what parent-adolescent conflict means across studies, providing a parent-adolescent conflict stressor that includes a visual component which could be adapted to assess neural response to parent-adolescent conflict, and by requiring fewer resources because only youth would be needed for participation. This paradigm would not be intended to replace parent-adolescent conflict paradigms that involve a discussion between youth and their parents, but would serve as an alternative that could be used in more controlled conditions to potentially better understand the effects of parent-adolescent conflict on physiological and affective changes that might be associated with stress response. Developing an ecologically valid laboratory paradigm to examine the impact of parent-adolescent conflict on youth is critical to advance our understanding of the mechanisms by which potentially stressful experiences within parent-adolescent relationships may result in negative consequences to development that carry through into adulthood (Romeo & Karatsoreos, 2011).

Measurement across multiple biological systems has been recognized as an important standard to understand how multiple systems respond to acute or chronic stressors (Allwood, Handwerker, Kivlighan, Granger, & Stroud, 2011). To assess the effectiveness of the PACS we examined the effect of the stimulus on potential indicators of how adolescents handle stress that included cortisol, salivary alpha amylase (sAA), heart rate, and self-report of negative and positive affect in a sample of middle adolescents. The hypothalamic-pituitary-adrenal axis (HPA-axis) is an important system that responds to stress and plays a critical role in mobilizing resources needed to act in response to stress and is commonly assessed through salivary cortisol. Another important system involved in how our body responds to stress is the autonomic nervous system (ANS), which includes the sympathetic and parasympathetic systems and is important for supporting the flight/fight response and can be assessed with sAA and changes in heart rate. Past research has suggested that it is important to measure individuals' stress response using indicators associated with different systems, as markers such as cortisol and sAA may show different response patterns depending on the type of stress exposure (Rudolph, Troop-Gordon, Granger, 2010; van Stegeren, Wolf, & Kindt, 2008). In fact, research has suggested that during adolescence when compared to childhood, sAA and cardiovascular response may show a more pronounced change to interpersonal stressors, like the one used in this study, as opposed to performance based

stressors (e.g., giving a speech, doing an arithmetic test; Stroud et al., 2009), making it a particularly important marker of stress response to include in the current study. In contrast cortisol has less consistently responded to interpersonal stressors suggesting it may be less sensitive to this type of acute stress experienced in a laboratory setting (Gunnar et al., 2009; Rudolph et al., 2010; Stroud, Tanofsky-Kraff, Wilfley, & Salovey, 2000). Furthermore, sAA may be more likely to change in a larger number of cases than cortisol, with cortisol being more affected by individual difference variables (Granger, Kivlighan, El-Sheikh, Gordis, & Stroud, 2007). Given this past research, we tested the hypothesis that exposure to a parent-adolescent conflict stressor (PACS) would induce increased heart rate, sAA, and cortisol, with the expectation that we would see a more pronounced response to the PACS as measured by sAA and heart rate when compared to cortisol. Additionally, given past research suggesting that changes in affect are a component of how adolescents cope with stress (Cohen, Kessler, & Gordon, 1995), we hypothesized that the PACS would be associated with increased negative affect and decreased positive affect. By testing these hypotheses, we believe that this study marks the first step toward developing a parent-adolescent conflict paradigm that can be used to induce physiological and affective changes associated with stress in adolescents, but acknowledge that this work is preliminary and that only through replication and refinement can we reach our goal of a more standardized visual paradigm that models parent-adolescent conflict.

Methods

Participants

Participants were 52 adolescents who were in grades 9th- 11th with 45% in grade 9, 37% in grade 10, and 18% in grade 11 ($M = 14.75$, $SD = .88$). Youth reported on race/ethnicity and reported being predominately white (62.7% White) with fewer youth identifying as other race/ethnicities (13.7% black/African American and 13.7% multiracial) There was an equal amount of male and female participants (50% female) who participated in the study. Participants were recruited by flyers at community centers, postcards using a commercial mailing list (American Student List), community outreach, and school partnerships. To participate, adolescents met the criteria of English as a first language and being between the ages of 13-16. Participants were excluded from the study if they identified a history of eye problems or difficulties in vision not corrected by contact lenses or glasses and reported a profound intellectual disability (IQ below 80) or developmental disability such as Autism.

Procedures

The study consisted of a two-hour lab visit where adolescents came to a private laboratory space at the college. The purpose of this laboratory visit was to assess adolescents' stress response to a novel parent-adolescent conflict stimulus. Prior to coming to the laboratory, parents and adolescents gave consent and assent for all procedures as required by the Institutional Review Board. Data were collected between 3:00-4:30pm ($M = 3:40$, $SD = .40$) to control for cortisol fluctuations that occur naturally throughout the day (Klimes-Dougan, Hastings, Granger, Usher, & Zahn-Waxler, 2001). Time of data collection was not correlated with any indicators of stress response. Participants completed an intake questionnaire at the beginning of the visit, immediately followed by twenty-five minutes of relaxation to acquire

baseline data on the stress response variables, specifically heart rate, cortisol and sAA. During this relaxation period, participants watched either nature documentaries (Planet Earth) or nature videos set to music. To assess baseline measures of stress response, negative affect, cortisol and sAA were taken once before presentation of the video stimulus (See Fig. 1). Following the video, three more measurements of stress reactivity were assessed to measure adolescents' peak responses and return to baseline following the stressor. Adolescents received \$40 dollars in compensation for data collection.

Parent-Adolescent Conflict Stressor

The independent variable, a video that served as a stressor, was shown to all of the participants following the relaxation period. The video was developed for the purposes of this study and was designed to induce stress that one might experience as a result of parent-adolescent conflict. The video stimulus consisted of 6 interactions that involved a mother and adolescent who were trained actors discussing topics of conflict. The videos were classified into 2 topics: discussing the teen being caught in a lie or the responsibility of the teen cleaning his or her room (personal responsibility, PR). These topics were chosen for the videos because past research has consistently indicated that "cleaning up" is one of the conflicts that parents and adolescents rate as occurring most frequently (e.g., Cook, Chaplin, & Stroud, 2015) and getting caught in a lie was mentioned by parents and adolescents in focus group research, conducted by the current researchers, as a particularly stressful fight. Each topic contained three video conditions (2 minutes each), in which the mother's behavior differed, behaving either in a positive manner, a typical manner that involved some conflict between the teen and mother, and a hostile manner that involved the mother yelling at the teen and making derogatory statements toward the teen (e.g., you are so lazy). Before each segment began, the teen was prompted visually and auditorily with the following statement: *"Please remember to try to put yourself in this teen's shoes and imagine that you are the teen in this interaction. It is very important that while watching this you try as best you can to imagine how you would feel if you were involved in an interaction like this with your mother."* The conditions were designed such that we expected that the typical and the hostile conditions would be more stressful for the youth to watch than the positive condition where the topics were discussed in a positive and supportive manner between the teen and the mother. Because we were interested in assessing cortisol and sAA following the video interactions adolescents always watched the hostile segment of the video last. Gender of the teen in the video matched the gender of the participant and topics (lie and PR) were counterbalanced to minimize order presentation effects (Fig. 2). The video lasted 12 minutes, with heart rate recorded continuously throughout the video.

At the end of the laboratory visit, teens were asked to self-report on follow-up questions regarding their perceptions of the task. These questions were designed to assess the ecological validity of the task. These questions included the following: (a) on a scale from 1 (*not at all realistic*) - 10 (*extremely realistic*), how realistic did you find our mother/teen interaction videos? ; (b) were the fights that the mother and teen had similar to fights you have with your mother? (yes/no); and (c) on a scale from 1 (*not at all*) to 10 (*completely*), how much were you able to put yourself in the teen's shoes while watching the videos? Seventy percent of youth indicated that these fights were similar to fights that they had with

their parents and on average the participants found that the fights were realistic ($M = 6.91$; $SD = 1.69$) and were able to put themselves in the shoes of the adolescents ($M = 6.41$; $SD = 2.11$). These findings suggest some support for the ecological validity of the task in that youth generally believed that this task was realistic and similar to fights experienced in their everyday lives with parents.

Measures

Heart rate.—During the video stimulus a wrist pulse oximeter (Contec CMS50F Pulse Oximeter) was used to measure participants' heart rate continuously. Heart rate was assessed every second during the 12 minutes of the interaction. Preliminary analyses of the data indicated that heart rate did not show pronounced changes when examined every second. Furthermore, we were interested in getting a sense of if heart rate on average differed between the three different conditions: positive, typical, and hostile. Thus, we minimized the data by averaging heart rate measurements into 1 minute assessments resulting in 6 time points across the three lie conditions and 6 time points across the three personal responsibility conditions. The positive condition acted as the baseline condition to compare changes in heart rate that occurred during the typical and hostile conditions.

Cortisol and alpha amylase.—Cortisol and sAA were obtained through salivary samples. Adolescents were asked to stick a cotton strip between their back molars and the inside of their cheek. Assay kits were purchased from Salimetrics Laboratories (State College, PA). Samples were stored at -40°C . Saliva was collected 4 times during the visit: once after the relaxation period (35 min into the session), once after the parent-adolescent conflict video task to assess peak sAA (65 min into the session), once 80 minutes into the session (peak cortisol), and finally at the conclusion of the data collection (100 min into the visit; see Fig 1). Saliva was evaluated in duplicate for cortisol and sAA at the Laboratory for Biological Health Psychology (Brandeis University, Waltham, MA) using a competitive chemiluminescence immunoassay (CLA; IBL-International Toronto, ON, Canada). The intra-assay coefficients of variation for the assay kits for cortisol ranged from 3.4% to 4.7% and for sAA from 1.95%-2.80%. The inter-assay coefficients of variation for cortisol ranged from 1.8%-6.3% and for sAA from 2.2%-3.6%. sAA is reported in units per milliliter within the text and cortisol is reported as nanomoles per liter. Winsoring was used on the raw data scores for the stress reactivity measures that were three standard deviations from the mean (Kertes & Gunna, 2004).

Negative and positive affect.—Self-reported negative and positive affect were collected at 4 points during the visit using the Positive and Negative Affect Schedule (PANAS; Watson, Clark & Tellegan, 1988). The PANAS survey consists of 10 items that assess negative affect (e.g., distressed, upset, or guilty) and 10 items that assess positive affect (e.g., excited, enthusiastic, strong). Each item was rated on a scale of 1 (*slightly or not at all*) to 5 (*extremely*) and an average of the 10 items was taken for negative affect with higher scores indicating more negative affect and an average of the 10 items was taken for positive affect with higher scores indicating more positive affect. The PANAS was administered after the relaxation period to assess baseline affect, directly following the video task, again 15 minutes later, and finally during the recovery period (NA: $\alpha = .70$ -.74; PA: $\alpha = .88$ -.90).

Plan of Analyses

Multilevel modeling using HLM 7.0 (Raudenbush, Bryk, & Congdon, 2010) was used to examine affective and physiological changes to the PACS. HLM has several advantages that include increased statistical power to detect differences in relatively small samples, modeling of missing data through FIML, and modeling correlated observations within each individual (Bryk & Raudenbush, 1992). Additionally, HLM has advantages over repeated measures ANOVA which is commonly used to assess changes in response to a stressor such that data does not have to be completely balanced (different number of observations per individual) and observations do not need to be regularly spaced (Hruschka, Kohrt, Worthman, 2005). In the present study, we were interested in examining level 1 models of change in stress response outcomes (within-person variability) and if there was any variability at level 2 in stress response across participants at baseline, following the stressor, and recovery.

Quadratic models were estimated given past research suggesting that physiological response to a stressor is best modeled using a quadratic function (e.g., Klimes-Dougan et al., 2001; Morris & Rao, 2014). For example, past research generally suggests that when participants are exposed to a laboratory stressor they initially show an increase in physiological response that would be captured by linear change parameters and then a decline in stress response (a recovery period), which would better be captured by quadratic change parameters. Below we have presented a quadratic change model for sAA as an example of how individual stress response was modeled. It is important to note that preliminary models indicated that all of the indicators of stress response (sAA, cortisol, affect, and heart rate) were best modeled including linear and quadratic slopes. In the quadratic change model presented below, π_0 represents the sAA trajectory's intercept at the start of the PACS, π_1 represents the instantaneous rate of change in sAA levels (i.e., slope), most likely representing the change to the parent-adolescent conflict stressor and π_2 represents how this rate of change changes over the course of the visit, which includes recovery following the stressor. This level one model also takes into account error that is attributed to time of measurement at level 1.

The level two model displayed below is an unconditional model that includes random intercepts and slopes. By including random intercepts and random slopes we can examine the extent to which individuals vary from the average intercept and slope for a given measure of stress response. For example, do adolescents differ in their linear rate of sAA response. Estimating random effects will provide information on whether there is variability in how adolescents responded to the stressor, which future studies may want to examine.

Level-1 Model:

$$sAA = \pi_0 + \pi_1 \text{Time} + \pi_2 \text{Time}^2 + e_{ti}$$

Level-2 Model:

$$\Pi_{0i} = \beta_{00} + r_{0i}$$

$$\Pi_1 = \beta_{10} + r_{20i}$$

$$\Pi_2 = \beta_{20} + r_{30i}$$

Results

Preliminary Analyses

Mean changes in affective and physiological stress responses are represented in figure 3. Adolescents evidenced an increase in sAA and negative affect from baseline measurements taken at time point 35 to measurements taken following the PACS at time point 65. Independent samples t-tests indicated that these increases to the stressor were significant for sAA, $t(51) = 4.140$, $p = .000$ and for negative affect, $t(51) = 3.54$, $p = .001$, with both means increasing post-PACS when compared to baseline assessments. Adolescents evidenced a decrease in positive affect to the PACS but this decrease was not statistically significant, $t(51) = -1.94$, $p = .06$. Means for cortisol suggested a linear decrease in cortisol across all time points, which is consistent with afternoon decreases that occur naturally in cortisol (Horrocks et al., 1990). Mean heart rate changes were examined to see if there were increases in heart rate when comparing the positive conditions to the typical and hostile conditions. When comparing average heart rate in the positive lie condition to the typical lie condition and the hostile lie condition no significant increases in heart rate were found. For the PR condition we did see significant increases in heart rate when comparing the positive PR to the typical PR condition, $t(45) = 3.15$, $p = .003$, and when comparing the positive PR condition to the hostile PR condition, $t(45) = 2.14$, $p = .04$, such that heart rate increased during the viewing of the typical condition and the hostile PR condition when compared to the positive PR condition. To further evaluate changes across all time points HLM models were estimated.

In basic correlation analyses, we examined the relationship between several covariates (grade, age, gender, race/ethnicity, economic hardship, puberty, day in menstrual cycle, medication, caffeine use, time of data collection, and order of PACS presentation) and indicators of stress response. These analyses indicated few significant associations with the exception that heart rate taken during the different conditions of the PACS was associated with race/ethnicity such that youth who self-identified as white (dummy coded 0), as compared to youth who identified as other races/ethnicities (dummy coded 1), were less likely to evidence increased heart rate to the positive lie condition ($r = .31$, $p = .04$), the hostile lie condition ($r = .30$, $p = .04$), the typical PR condition ($r = .32$, $p = .04$), and the hostile PR condition ($r = .30$, $p = .04$). Other significant correlations included the association between gender (dummy coded with male = 0) and negative affect such that negative affect

at time points 15, 45, 60, and 75 were more strongly evidenced for females than males (r s ranged = .29-.36, $p < .05$). As such these covariates were included in HLM models for heart rate and negative affect after unconditional models with no covariates were examined.

Growth Models

This study was interested in the effect of the PACS on adolescents' affective and physiological response. Results are discussed below in regards to both the linear change at the beginning of the study (i.e., the initial rate of change) and the acceleration rate (i.e., the quadratic rate). The acceleration rate describes how the growth rate changes for a given stress response in respect to time for all time points in the study and thus can take into account recovery from the PACS when relevant (i.e., the nonlinear rate).

sAA.—The results indicated that average sAA levels at baseline following the relaxation period were 119 units. sAA evidenced a significant linear change to the PACS (coefficient = 26.39, $p = .04$) with participants on average increasing 26.39 units of sAA from baseline to post-stressor. The quadratic term was non-significant (coefficient = -4.32 , $p = .10$) but did suggest that the effect of time on sAA decreased over the course of the laboratory visit suggesting that on average most adolescents did not continue to show increasing sAA output, perhaps as part of the normative recovery response following a stressor (Table 3). Results further indicated that there was significant variability in sAA at baseline following the relaxation period ($\chi^2(50) = 69.10$, $p = .01$; Table 2) suggesting that adolescents differed significantly in their mean levels of sAA before the PACS. There was not significant variability in how participants responded to the stressor as captured by the linear and quadratic random effect terms.

Cortisol.—Cortisol was 18.43 units for the average participant at baseline and evidenced a significant linear decrease (coefficient = -5.60 , $p < .001$) suggesting that cortisol levels fell 5.6 units during the initial time measurements (Table 1). It is important to note, that because cortisol shows a delayed response, about 20 minutes after a stressor, this drastic decrease in cortisol levels was likely not caused by exposure to the PACS but to the general decrease in cortisol in the afternoon and perhaps further acclimation to the laboratory setting. The quadratic effect also was significant for cortisol response (coefficient = $.75$, $p < .001$) suggesting that the rate of deceleration slowed over the course of the study. There was significant variability in the intercept ($\chi^2(49) = 511.34$, $p < .001$), linear slope ($\chi^2(49) = 144.34$, $p < .001$), and quadratic slope ($\chi^2(49) = 85.38$, $p < .001$; Table 3). This significant variability in baseline levels and cortisol response to the PACS highlight the importance of examining level 2 predictors of this variability in future studies to identify if a subset of youth shows an increased cortisol trajectory to the PACS.

Negative and positive affect.—Results indicated a significant linear and quadratic change in negative affect (Table 1). At baseline, participants self-reported negative affect at 1.11 units. There was a significant increase in negative affect to the PACS (coefficient = $.17$, $p < .001$) and a significant decreased quadratic effect in negative affect across all time points (coefficient = $-.02$, $p = .003$) suggesting a normative recovery response following the stressor. There was not significant variability in the intercept, linear or quadratic response

across participants (Table 3). Because basic correlations indicated that gender was associated with negative affect at various time points, gender was included as a covariate at level 2 of the model. When gender was included as a level 2 covariate, no significant effects of gender were found for the intercept, linear or quadratic slopes, suggesting that girls and boys evidenced similar negative affect response to the laboratory paradigm.

For positive affect, unconditional models indicated no significant linear or quadratic effects (Table 1) suggesting that positive affect did not change in response to the PACS. There was significant variability in the intercept ($\chi^2(50) = 102.98, p < .001$), linear slope ($\chi^2(50) = 76.39, p = .01$), and quadratic slope ($\chi^2(50) = 75.23, p = .01$; Table 3), suggesting that it may be important to examine variability in how positive affect changes in response to the PACS.

Heart rate.—Heart rate response models were examined separately for the two different topics of conflicts that adolescents watched. Because we were interested in assessing linear as well as quadratic change, which requires more than three time points, and we wanted the intercept to represent average heart rate during the positive condition, we averaged the two heart rate measurements taken during the positive condition resulting in models being estimated with five time points.

For the PR condition, heart rate during the positive condition, which served as baseline, was on average 75.53 units. Models indicated a significant linear increase in heart rate (coefficient = 2.79, $p < .01$) as participants watched parents and adolescents solve conflict in a more conflictual way. Interestingly, the quadratic term was negative (coefficient = -0.45, $p = .04$), indicating that the change in heart rate slowed down, or flattened, across the time points, suggesting perhaps a habituation to the stressful conditions. There was significant variability in the intercept ($\chi^2(44) = 128.76, p < .001$), linear slope ($\chi^2(44) = 71.41, p < .003$), and quadratic slope ($\chi^2(44) = 94.37, p < .001$; Table 3). Because basic correlations indicated that race/ethnicity was associated with heart rate during various conditions, race/ethnicity was included as a covariate at level 2 of the model. When race/ethnicity was included as a level 2 covariate, no significant effects of race/ethnicity were found for the intercept, linear or quadratic slopes suggesting that white youth do not differ from youth of other races/ethnicities in heart rate response to the laboratory paradigm.

For the lie condition, unconditional models indicated no significant linear or quadratic effects (Table 2). There was significant variability in the intercept ($\chi^2(44) = 302.34, p < .001$), linear slope ($\chi^2(44) = 86.85, p < .001$), and quadratic slope ($\chi^2(44) = 66.46, p = .01$; Table 3) suggesting that it may be important to examine if certain adolescents respond more to the lie condition than other adolescents. Because basic correlations indicated that race/ethnicity was associated with heart rate during various conditions, race/ethnicity was included as a covariate at level 2 of the model. When race/ethnicity was included as a level 2 covariate there was no significant effect of race/ethnicity on the intercept or slopes.

Discussion

This study introduces a novel parent-adolescent conflict stressor (PACS) to assess affective and physiological response to conflict that might occur in relationships between youth and

parents. Findings indicated that the PACS generally induced increases in physiological and affective response, particularly sAA and negative affect. Heart rate also increased in response to the PR condition, where actors were discussing conflicts that revolve around parents trying to control adolescents' decision making regarding matters of personal responsibility. Thus, results indicate that the PACS was associated with statistically significant change in 3 of the 5 indicators we examined, suggesting preliminary evidence that this task is associated with changes in both physiological and affective indicators that have been associated with stress response. To our knowledge this is the first parent-adolescent video paradigm that provides a visual stimulus and does not require both parents and adolescents to participate in the study. We believe that the PACS offers advantages over previously used parent-adolescent conflict tasks such that there will be more control in how parent-adolescent conflict is defined across studies, which may increase construct validity and aid in interpretation in findings across studies. Furthermore, by including a visual component, this task can be adapted to use in fMRI studies to assess neural responses to parent-adolescent conflict. This contribution is critical so that researchers can better understand the underlying neurobiological response that adolescents experience when confronted with different levels of conflict within relationships with parents.

The Effect of the PACS on sAA and HR

We found that the PACS was effective at inducing a physiological response in adolescents as measured by alpha amylase. Despite research consistently suggesting that problems in family relationships are one of the chief sources of stress for adolescents (Compas, 1987; Lohman & Jarvis, 2000), few studies have examined if parent-adolescent conflict has an effect on stress response as measured by sAA. In fact, we only identified a handful of studies that include sAA as an outcome when examining stress response to parent-adolescent conflict (Afiffi et al., 2011; Gordis, Margolin, Spies, Susman, & Granger, 2010; Weichold, Butting, & Silberseisen, 2008), with most studies focusing on cortisol response or heart rate variability. This is surprising given past research that sAA is an important marker of how the ANS responds to stress, particularly for interpersonal stress (Granger et al., 2007; Stroud et al., 2009). Thus, the current study contributes significantly to the research by suggesting that sAA is an important marker to assess when considering parent-adolescent conflict. This is particularly salient given that research has begun to suggest that sAA, when compared to other markers of stress, specifically cortisol, may have differential associations with psychopathology with studies suggesting more pronounced relationship between sAA and social anxiety (Van Veen et al., 2008) and sAA and externalizing behaviors in toddlers (Hill-Soderlund et al., 2015). Future research needs to examine if parent-adolescent conflict is associated with sAA both in laboratory studies and studies in adolescents' daily lives and consider the distinct influence on adjustment.

Findings also indicated changes in heart rate to the PACS; these changes only indicated a significant increase in heart rate to the personal responsibility condition. Past research has consistently shown that parents and adolescents fight most about issues that youth believe are matters of personal responsibility that parents should not have jurisdiction over (Eisenberg et al., 2008; Smetana, 1989). Our findings confirm that those arguments when handled in a conflictual way may induce an increase in heart rate to that conflict. It is

surprising that topics of conflict that involve “getting caught in a lie” did not induce heart rate changes. It is possible that although this is a conflict that teens and parents experience, it is not experienced by most youth on a regular basis and perhaps has less personal salience. Future studies should explore adolescents’ perception of the stressfulness of both types of conflicts, as well as if different types of conflicts are associated differentially with adolescent outcomes.

HLM models suggested that although we saw changes in heart rate to the PR condition that change was both linear and quadratic indicating that across the time points changes in heart rate slowed down. This can best be understood by comparing basic mean levels of heart rate, which suggested that means in heart rate basically did not statistically change from the typical condition (average of two time points $M=79.92$) to the hostile condition (average of two time points $M=80.40$). This finding may suggest that adolescents view conflict that is handled in a more typical way where parents restrict autonomy of youth as comparable to conflict experienced within the family that is more hostile in tone. Past research in adolescents’ daily lives, however, has suggested that conflict that is hostile and intense is associated with more negative adjustment among youth than conflict that occurs within a supportive context (Steinberg & Silk, 2002) suggesting that in the current study youth should find the hostile condition more stressful. It is possible that adolescents did not continue to significantly increase their heart rate response to the hostile condition (as indicated by the significant quadratic effect) because it was perhaps not an ecologically valid representation of the level of parent-adolescent conflict experienced in daily life, an explanation that fits with research indicating that most youth and parents report conflicts that involve mildly aversive interactions and rarely involve high levels of hostility (Allison & Schultz, 2004). Lastly, it is possible that the flattening of heart rate across the two conflictual conditions may simply be an artifact representing habituation. Future research should consider showing shorter segments of the PACS to reduce participant burden and further explore if differences in the conditions are an artifact of length of time or a true finding.

It is important to note, that the two physiological changes that responded to the PACS were changes in sAA and heart rate. Some research has suggested that changes in heart rate and sAA may simply reflect emotional (positive and negative) and physical arousal more generally (Adam, Hoyt, & Granger, 2011; Chatterton et al., 1996) and thus should cautiously be interpreted as biomarkers of stress. In contrast, countless studies have suggested that heart rate and sAA show marked increase to psychological stress that is not physical in nature (Benschop et al., 1998; Granger et al., 2007; Nater & Rohleder, 2009 for reviews). Furthermore, recent research provides evidence that sAA changes are present while controlling for arousal (Sanchez-Navarro, Maldonado, Martinez, Enguix, & Ortiz, 2012) and that sAA is associated with other well-established indicators of SNS activation (Nater & Rohleder, 2009; Thoma, Kirschbaum, Wolf, & Rohleder, 2012). Nevertheless, given this concern it is possible that changes in heart rate and sAA are simply due to adolescents being physically aroused during the task and not stressed. Although plausible this contention is not likely in the current study as basic correlational analyses suggested either non-significant negative associations or significant negative associations between the positive affect scale, and specifically the item of excitement on that scale, and sAA and heart rate. Furthermore, positive associations, although not always statistically significant were found between sAA,

heart rate and negative affect suggesting that changes in sAA and heart rate were likely to be associated with decreased positive affect, decreased excitement, and increased negative affect providing support that changes in these physiological responses were not simply a function of excitement and arousal.

The Effect of the PACS on Cortisol

Similar to previous studies, we did not find an increase in cortisol response to parent-adolescent conflict (Gunnar et al., 2009). Studies examining responses from different physiological stress response systems have not consistently found that response in one system is associated with response to stress in the other system (Granger et al., 2006; Laurent, Powers, & Granger, 2013). Thus, in the current study it is not surprising that we saw a sAA response but no response for cortisol. This is consistent with evidence from previous research that a change in cortisol may be more difficult to induce in laboratory settings and may be more difficult to induce across all participants (Granger et al., 2007; Gunnar et al., 2009). In fact, response measures that assess ANS activation, of which sAA is one, have generally been associated with the effort or challenge components of stress, whereas response measures of HPA activation (e.g., cortisol) have been associated with distress and withdraw from the stressor (Laurent et al., 2013). Adolescents in the current study were exposed to a parent-adolescent conflict stressor where they were asked to imagine they were the adolescent in the interaction; this prompt discourages adolescents from simply withdrawing from the stressor and asks that they imagine themselves as an active participant. Furthermore, parent-adolescent conflict that occurs in daily life involves effort, as well as both approach and withdraw, suggesting that stressors which try to capture this in the laboratory setting would be more sensitive to measures of ANS activation than HPA activation. This finding is certainly borne out by past research that generally does not find a cortisol response to parent-adolescent conflict interactions in laboratory settings (Gunnar et al., 2009) and reinforces the importance of measuring adolescents' response to parent-adolescent conflict with multiple indicators of stress.

Variability in Adolescents' PACS Response

Heart rate models, cortisol models, and positive affect models indicated significant variability in adolescents' response to the PACS. Importantly this variability does not appear to be attributed to study correlates that were examined including gender, race/ethnicity, age, and other aspects associated with the collection of data (e.g., presentation of stimulus). Past research focusing on cortisol response to parent-adolescent stressors has generally suggested that increased cortisol response is only seen in a subset of youth (Gunnar et al., 2009). In our sample we saw a 10% increase in cortisol (generally considered a meaningful increase/decrease; Granger et al., 2007) in 12% of youth and in contrast a 10% decrease in cortisol for 38% of our youth. Research and theoretical models have recognized that individuals show variability in their response to stress, with some youth showing heightened responses to stress and some youth evidencing a blunted response to stress (Del Giudice, Ellis, & Shirtcliff, 2011; Gunnar, Frenn, Wewerka, & Van Ryzin, 2009; McEwen, 2007). Thus, our finding that there was significant variability in cortisol response and that the PACS was not associated with an increase in cortisol for many of the youth is not surprising and parallels past research. Unfortunately, given our smaller sample size and power concerns we did not

test for potential characteristics that might affect responses to the PACS. It will be important in future research to capture this variability and model different profiles of affective and physiological response and if certain characteristics of youth may make them more vulnerable to heightened or blunted responses to parent-adolescent conflict; analyses that will require larger sample sizes. A particularly important area of future research, will be examining if youth who have less supportive and more conflictual relationships with their parents at home are more likely to evidence a certain profile of cortisol response to the PACS. This area of research will provide insight into the ecological validity of the task and provide further evidence of the negative effects that parenting may have on adolescents' physiological response to stress.

Limitations and Future Directions

Although the PACS marks an advance in understanding the effect of parent-adolescent conflict on adolescent affective and physiological response to stress, there are limitations to the paradigm and this study that need to be addressed in future research. In regards to the paradigm, videos only included mothers and teenagers discussing issues of conflict. Past research has indicated that fathers and teenagers have different relationships than mothers and teenagers and that parents may have different effects on adjustment (Lamb & Lewis, 2005; Laible & Carlo, 2004). Thus it will be important in future studies to include videos with fathers. Similarly, the video only included white youth and white mothers. Given that this was a pilot study and funds were limited, we could only develop one set of videos and made the choice to develop videos representing white youth and mothers because we anticipated that our sample would have a higher percentage of white youth participating based on the demographics of past research studies in our lab. This approach is, however, limited given that youth from other ethnic and cultural backgrounds might differ in the interactions they have with parents (Phinney, Kim-Jo, Osorio, & Vihjalmsdottir, 2005). Additionally, it is important to note that the PACS asked adolescents to put themselves in the shoes of the teenager from the video but did not specifically assess response to conflict in that adolescents family-of-origin. Interactions that adolescents have with their parents in everyday life may have different meaning to youth than conflicts that they observe others having in a laboratory setting given that interactions with parents have valence attached to those exchanges that may strengthen or lessen their impact. Nevertheless, we believe that this is a promising laboratory approach that can be used across studies to simulate the types of conflict experienced by youth within their homes. Future refinements of the task should focus on ways to increase the "realness" of this task and objectively evaluate whether the PACS induces a similar affective and physiological response when compared to real-life conflicts with parents.

Our study is also limited in our measurement of stress response in two ways. First, we only assessed changes in cortisol, sAA, and negative affect response to the stressor as a whole and did not examine if the different portions and topics of the video (i.e., typical conflict and hostile conflict for lie and PR) elicited different sAA, cortisol, and negative affect response. Differential responses to topic of conflict and how that conflict is handled may be important to youth's development, with conflict that occurs on a regular basis and is hostile in tone and lacking in support having more of a deleterious impact on youth than conflict interactions

that occur less frequently (Eisenberg, Hofer, & Spinrad, 2008; Steinberg, 2001). Additionally, we only assessed affective and physiological response to the PACS and did not assess neural response. A real strength of this paradigm as compared to previous parent-adolescent conflict paradigms is that this stressor is visual and as such could be used in fMRI research or in eye tracking studies to assess neural changes associated with parent-adolescent conflict. Currently, our lab is examining pupil response to the PACS as a neural indicator of cognitive and emotional load.

Conclusion

Despite limitations, this study marks an important contribution to research by providing preliminary evidence that a visual parent-adolescent conflict paradigm results in increased physiological and affective response that may be associated with how adolescents' process stress. Developing visual paradigms that model conflict experienced in parent-adolescent relationships is an important first step in understanding the neurobiological mechanisms that underlie adolescents' response to stress experienced within the family that may be associated with increased psychopathology during the time of adolescence. Future research is needed to continue development and refinement of such tasks so that parent-adolescent conflict researchers have a task that can be utilized across studies in much the same way that peer rejection researchers have used cyber-ball to understand the effect of peer rejection on physiological and affective indicators associated with stress response. Furthermore, it will be important for future studies to refine the current stressor for use with larger and more diverse samples of adolescents to assess its validity for capturing stress response associated with parent-adolescent conflict.

Acknowledgments

Support for this project was provided by the Institutional Development Award (IDeA) Network for Biomedical Research Excellence from the National Institute of General Medical Sciences of the National Institutes of Health under grant number P20GM103430. Special thanks to research assistants Amber Champagne, Nathan Felkel, Donald Pimental, Kelly Pisapia, Eric Vaught, and Kristen Wilkinson. Thanks also to all the adolescents who participated.

References

- Afifi TD, Granger DA, Denes A, Joseph A, & Aldeis D (2011). Parents' communication skills and adolescents' salivary α -amylase and cortisol response patterns. *Communication Monographs*, 78(3), 273–295. 10.1080/03637751.2011.589460
- Allen JP, Hauser ST, Eickholt C, Bell KL, & O'Connor TG (1994). Autonomy and relatedness in family interactions as predictors of expressions of negative adolescent affect. *Journal of Research on Adolescence*, 4(4), 535–552.
- Allison BN, & Schultz JB (2004). Parent-adolescent conflict in early adolescence. *Adolescence*, 39(153), 101–119. [PubMed: 15230069]
- Allwood MA, Handwerker K, Kivlighan KT, Granger DA, & Stroud LR (2011). Direct and moderating links of salivary alpha-amylase and cortisol stress-reactivity to youth behavioral and emotional adjustment. *Biological Psychology*, 88(1), 57–64. [PubMed: 21771636]
- Benschop RJ, Geenen R, Mills PJ, Naliboff BD, Kiecolt-Glaser JK, Herbert TB, & Gilmore SL (1998). Cardiovascular and immune responses to acute psychological stress in young and old women: a meta-analysis. *Psychosomatic Medicine*, 60(3), 290–296. [PubMed: 9625216]

- Bryk AS, & Raudenbush SW (1992). Advanced quantitative techniques in the social sciences, 1. Hierarchical linear models: Applications and data analysis methods. Thousand Oaks, CA: Sage Publications.
- Chaplin TM, Sinha R, Simmons J, Healy S, Mayes LC, Hommer RE, & Crowley MJ (2012). Parent-adolescent conflict interactions and adolescent alcohol use. *Addictive Behaviors*, 37, 605–612. 10.1016/j.addbeh.2012.01.004 [PubMed: 22341765]
- Chatterton RT, Vogelsong KM, Lu YC, Ellman AB, & Hudgens GA (1996). Salivary α -amylase as a measure of endogenous adrenergic activity. *Clinical Physiology and Functional Imaging*, 16(4), 433–448.
- Cohen S, Kessler RC, & Gordon LU (1995). Strategies for measuring stress in studies of psychiatric and physical disorders In Cohen S, Kessler RC, & Gordon LU (Eds.), *Measuring stress: A guide for health and social scientists* (pp. 3–26). New York: Oxford University Press.
- Compas BE (1987). Coping with stress during childhood and adolescence. *Psychological Bulletin*, 101(3), 393–403. [PubMed: 3602247]
- Connell AM, Hughes-Scalise A, Klostermann S, & Azem T (2011). Maternal depression and the heart of parenting: Respiratory sinus arrhythmia and affective dynamics during parent–adolescent interactions. *Journal of Family Psychology*, 25(5), 653–662. 10.1037/a0025225 [PubMed: 21875198]
- Cook EC, Chaplin TM, & Stroud LR (2015). The relationship between autonomy and relatedness and adolescents' adrenocortical and cardiovascular stress response. *Journal of Youth and Adolescence*, 44(11), 1999–2011. DOI 10.1007/s10964-015-0331-z [PubMed: 26199079]
- Del Giudice M, Ellis BJ, & Shirtcliff EA (2011). The adaptive calibration model of stress responsivity. *Neuroscience & Biobehavioral Reviews*, 35(7), 1562–1592. [PubMed: 21145350]
- Eisenberg N, Hofer C & Spinrad TL (2008) Understanding mother-adolescent conflict discussions: Concurrent and across-time prediction from youths' dispositions and parenting. *Monographs of the Society for Research in Child Development*, 73(2), vii–160. 10.1111/j.1540-5834.2008.00470.x
- Gordis EB, Margolin G, Spies LA, Susman EJ, & Granger DA (2010). Interparental aggression and parent–adolescent salivary alpha amylase symmetry. *Physiology & Behavior*, 100(3), 225–233. 10.1016/j.physbeh.2010.01.006 [PubMed: 20096715]
- Granger DA, Kivlighan KT, Blair C, El-Sheikh M, Mize J, Lisonbee JA, Buckhalt JA, Stroud LR, Handwerger K, & Schwartz EB (2006). Integrating the measurement of salivary α -amylase into studies of child health, development, and social relationships. *Journal of Social and Personal Relationships*, 23(2), 267–290.
- Granger DA, Kivlighan KT, El-Sheikh M, Gordis EB, & Stroud LR (2007). Salivary α -amylase in biobehavioral research. *Annals of the New York Academy of Sciences*, 1098(1), 122–144. doi: 10.1196/annals.1384.008 [PubMed: 17332070]
- Gunnar MR, Frenn K, Wewerka SS, & Van Ryzin MJ (2009). Moderate versus severe early life stress: Associations with stress reactivity and regulation in 10–12-year-old children. *Psychoneuroendocrinology*, 34(1), 62–75. [PubMed: 18835102]
- Gunnar MR, Talge NM, & Herrera A (2009). Stressor paradigms in developmental studies: What does and does not work to produce mean increases in salivary cortisol. *Psychoneuroendocrinology*, 34(7), 953–967. doi:10.1016/j.psyneuen.2009.02.010 [PubMed: 19321267]
- Gunnar M, & Quevedo K (2007). The neurobiology of stress and development. *Annual Review Psychology*, 58, 145–173. 10.4103/0975-7406.111818
- Hill-Soderlund AL, Holochwest SJ, Willoughby MT, Granger DA, Gariépy JL, Mills-Koonce WR, & Cox MJ (2015). The developmental course of salivary alpha-amylase and cortisol from 12 to 36 months: Relations with early poverty and later behavior problems. *Psychoneuroendocrinology*, 52, 311–323. [PubMed: 25245323]
- Horrocks PM, Jones AF, Ratcliffe WA, Holder G, White A, Holder R, Ratcliffe JG & London DR (1990). Patterns of ACTH and cortisol pulsatility over twenty-four hours in normal males and females. *Clinical Endocrinology*, 32(1), 127–134. [PubMed: 2158868]
- Hruschka DJ, Kohrt BA, & Worthman CM (2005). Estimating between-and within-individual variation in cortisol levels using multilevel models. *Psychoneuroendocrinology*, 30(7), 698–714. [PubMed: 15854786]

- Kertes DA, & Gunnar MR (2004). Evening activities as a potential confound in research on the adrenocortical system in children. *Child Development*, 75(1), 193–204. [PubMed: 15015684]
- Klimes-Dougan B, Hastings PD, Granger DA, Usher BA, & Zahn-Waxler C (2001). Adrenocortical activity in at-risk and normally developing adolescents: Individual differences in salivary cortisol basal levels, diurnal variation, and responses to social challenges. *Development and Psychopathology*, 13(3), 695–719. [PubMed: 11523855]
- Lohman BJ, & Jarvis PA (2000). Adolescent stressors, coping strategies, and psychological health studied in the family context. *Journal of Youth and Adolescence*, 29(1), 15–43.
- Laible DJ, & Carlo G (2004). The differential relations of maternal and paternal support and control to adolescent social competence, self-worth, and sympathy. *Journal of Adolescent Research*, 19, 759–782. doi:10.1177/0743558403260094.
- Lamb ME, & Lewis C (2005). The role of parent–child relationships in child development In Bornstein MH & Lamb ME (Eds.), *Developmental Science: An advanced textbook* (pp. 429–468). Mahwah: Lawrence Erlbaum Associates.
- Laurent HK, Powers SI, & Granger DA (2013). Refining the multisystem view of the stress response: Coordination among cortisol, alpha-amylase, and subjective stress in response to relationship conflict. *Physiology & Behavior*, 119, 52–60. [PubMed: 23684904]
- McEwen BS (2007). Physiology and Neurobiology of stress and adaptation: Central role of the brain. *Physiological Review*, 87, 873–904.
- Morris MC, & Rao U (2014). Cortisol response to psychosocial stress during a depressive episode and remission. *Stress*, 17(1), 51–58. [PubMed: 24144001]
- Phinney JS, Kim-Jo T, Osorio S, & Vilhjálmsdóttir P (2005). Autonomy and relatedness in adolescent-parent disagreements: Ethnic and developmental factors. *Journal of Adolescent Research*, 20(1), 8–39.
- Raudenbush SW, Bryk AS, & Congdon R (2010). *HLM 7.00 for Windows*, Scientific Software International. Inc, Lincolnwood, IL.
- Romeo RD, & Karatsoreos IN (2011). Adolescence and Stress: From hypothalamic-pituitary-adrenal function to brain development The handbook of stress: Neuropsychological effects on the brain, First edition (269–284). United Kingdom: Wiley-Blackwell.
- Rudolph KD, Troop-Gordon W, & Granger DA (2010). Peer victimization and aggression: Moderation by individual differences in salivary cortisol and alpha-amylase. *Journal of Abnormal Child Psychology*, 38(6), 843–856. [PubMed: 20405198]
- Sánchez-Navarro JP, Maldonado EF, Martínez-Selva JM, Enguix A, & Ortiz C (2012). Salivary alpha-amylase changes promoted by sustained exposure to affective pictures. *Psychophysiology*, 49(12), 1601–1609. [PubMed: 23078627]
- Silk JS, Stroud LR, Siegle GJ, Dahl RE, Lee KH, & Nelson EE (2011). Peer acceptance and rejection through the eyes of youth: pupillary, eyetracking and ecological data from the Chatroom Interact task. *Social Cognitive and Affective Neuroscience*, 7(1), 93–105. [PubMed: 21775386]
- Smetana JG (1989). Adolescents' and parents' reasoning about actual family conflict. *Child Development*, 5, 1052–1067.
- Steinberg L (2001). We know some things: Parent–adolescent relationships in retrospect and prospect. *Journal of Research on Adolescence*, 11(1), 1–19.
- Steinberg L, & Silk JS (2002). Parenting adolescents. *Handbook of parenting*, 1, 103–133.
- Stroud LR, Tanofsky-Kraff M, Wilfley DE, & Salovey P (2000). The Yale Interpersonal Stressor (YIPS): Affective, physiological, and behavioral responses to a novel interpersonal rejection paradigm. *Annals of Behavioral Medicine*, 22(3), 204–213. [PubMed: 11126465]
- Stroud LR, Foster E, Papandonatos GD, Handwerker K, Granger DA, Kivlighan KT, & Niaura R (2009). Stress response and the adolescent transition: Performance versus peer rejection stressors. *Development and Psychopathology*, 21(1), 47–68. [PubMed: 19144222]
- Thoma MV, Kirschbaum C, Wolf JM, & Rohleder N (2012). Acute stress responses in salivary alpha-amylase predict increases of plasma norepinephrine. *Biological Psychology*, 91(3), 342–348. [PubMed: 22954623]

- van Stegeren AH, Wolf OT, & Kindt M (2008). Salivary alpha amylase and cortisol responses to different stress tasks: impact of sex. *International Journal of Psychophysiology*, 69(1), 33–40. [PubMed: 18417235]
- Van Veen JF, Van Vliet IM, DeRijk RH, Van Pelt J, Mertens B, & Zitman FG (2008). Elevated alpha-amylase but not cortisol in generalized social anxiety disorder. *Psychoneuroendocrinology*, 33(10), 1313–1321. [PubMed: 18757137]
- Watson D, Clark LA, & Tellegen A (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of Personality and Social Psychology*, 54(6), 1063–1070. [PubMed: 3397865]
- Weichold K, Büttig S, & Silbereisen RK (2008). Effects of pubertal timing on communication behaviors and stress reactivity in young women during conflict discussions with their mothers. *Journal of Youth and Adolescence*, 37(9), 1123–1133.
- Williams KD, & Jarvis B (2006). Cyberball: A program for use in research on ostracism and interpersonal acceptance. *Behavior Research Methods, Instruments, and Computers*, 38, 174–180.

Figure 1. Flow of Visit

Note. The figure represents the time points at which different measures of stress response were assessed throughout the laboratory visit. sAA= alpha amylase, NA = negative affect, HR = heart rate.

Figure 2. The Parent-Adolescent Conflict Stressor (PACS)

Note. The video was shown to participants for 12 minutes and was counterbalanced such that half the participants were randomly assigned to watch Telling a Lie first or Responsibility first and then completed the other video condition afterward. Within the different topics of conflict each participant was exposed to three conditions that were always presented in order of positive, typical, and hostile.

Figure 3. Mean Changes in Physiological and Affective Stress Response to the PACS

Note. In the sAA, cortisol, and affect graphs BL = baseline, P= peak, PT = post-task, and REC= recovery. In the heart rate graph, heart rate was taken during the video across the 12 minutes and averaged every minute such that each condition has two average heart rate measurements. Conditions are represented by P = positive, T = typical, and H = hostile.

Table 1.
Unconditional Growth Models Assessing Change in sAA, Cortisol, and Negative Affect

	sAA				Cortisol				Negative Affect				Positive Affect			
	Estimate (SE)	CI (95%)	t (50)		Estimate (SE)	CI (95%)	t (49)		Estimate (SE)	CI (95%)	t (50)	Estimate (SE)	CI (95%)	t (50)		
Fixed Effects																
Intercept	119.32 (18.37)	83.32, 155	6.49 *		18.43(1.82)	14.87, 21.99	10.11 *		1.11 (.08)	0.96, 1.27	14.03 *	2.08 (0.15)	1.79, 2.37	13.50 *		
Linear	26.39 (11.1)	4.68, 48.1	1.98 *		-5.60 (0.90)	-5.77, -5.43	-6.29 *		0.17(.06)	0.06, 0.32	2.62 *	0.05 (0.12)	-0.21, 0.28	0.38		
Quadratic	-4.32 (2.58)	-9.37, 0.73	-1.69		0.75 (0.13)	0.5, 1.00	5.46 *		-.02 (.00)	-.02, -.02	-3.13 *	-0.02 (0.02)	-0.05, 0.01	-0.64		

Note.

* indicates statistically significant below .05.

Unconditional Growth Models for Heart Rate Taken During the Parent-Adolescent Conflict Stressor

Table 2.

	HR during Lie Condition				HR during PR Condition			
	Estimate (SE)	CI (95%)	t (df)	p	Estimate (SE)	CI (95%)	t (44)	p
Fixed Effects								
Intercept	78.83 (4.1)	70.80, 86.86	19.02 *	<.001	75.53 (2.07)	71.50, 79.58	36.39 *	<.001
Linear	3.03 (2.29)	-1.45, 5.32	1.33	.18	2.79 (1.05)	0.73, 4.85	2.63 *	.01
Quadratic	-0.36 (0.31)	-0.96, 0.24	-1.16	.25	-0.45(.20)	-.084, -0.06	-2.16 *	.04

Note.

* indicates statistically significant below .05.

Table 3.
Variance Components for Unconditional Growth Models Assessing Changes to the Parent-Adolescent Conflict Stressor

	sAA		Cortisol		Negative Affect		Positive Affect		HR Lie		HR PR	
	Estimate (SD)	Chi-Square	Estimate (SD)	Chi-Square	Estimate (SD)	Chi-Square	Estimate (SD)	Chi-Square	Estimate (SD)	Chi-Square	Estimate (SD)	Chi-Square
Fixed Effects												
Intercept	3551.86 (59.59)	69.10 *	145.01 (12.04)	511.34 *	0.07 (0.27)	64.48	0.65 (0.81)	102.98 *	726.87 (26.60)	302.34 *	146.46 (12.10)	128.76 *
Linear	1830.47 (42.78)	60.68	26.73 (5.17)	144.34 *	0.02 (0.17)	54.80	0.27 (0.51)	76.39 *	211.94 (14.55)	86.85 *	22.61 (4.75)	71.41 *
Quadratic	62.67 (7.91)	57.67	0.45 (0.67)	85.38 *	0.01 (0.03)	53.44	0.09 (0.01)	75.23 *	3.84 (1.96)	66.46 *	1.13 (1.00)	94.37 *

Note.
* indicates that significant variability at $p < .05$.