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# Self-disclosure and perceived responsiveness among youth with asthma

Self-Disclosure and Perceived Responsiveness among Youth with Asthma: Links to Affect and

Anti-Inflammatory Gene Expression

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## Abstract

Self-disclosure and perceived responsiveness are important building blocks of social relationships that have long-lasting consequences for health and well-being. However, the conditions under which self-disclosure and responsiveness are likely to benefit health, and how early in life these benefits arise, remain unclear. Among 141 youth (aged 10-17) with asthma, we investigated how average daily levels of self-disclosure and responsiveness are linked to positive and negative affect and the expression of the glucocorticoid receptor gene *NR3C1*, a marker of improved regulation of stress physiology and immune functioning. Higher levels of self-disclosure were associated with higher *NR3C1* expression and positive affect *only* when perceptions of responsiveness were high. Further, perceived responsiveness was linked to *NR3C1* expression for females but not males. These results suggest that the potential benefits of self-disclosure depend on the extent to which interaction partners are perceived as responsive and that these benefits emerge prior to adulthood.

*Keywords*: Self-disclosure, responsiveness, gene expression, *NR3C1*, positive affect, negative affect

**Self-Disclosure and Perceived Responsiveness among Youth with Asthma: Links to Affect and Anti-Inflammatory Gene Expression**

Self-disclosure and perceived responsiveness are two key intimacy-building processes that promote affiliation with others in ways that make us feel valued, understood, and secure (Reis & Shaver, 1988). A considerable body of work within the romantic relationships literature has shown that these processes play an important role in promoting relationship satisfaction and stability (Gable, Gonzaga, & Strachman, 2006; Laurenceau, Barrett, & Pietromonaco, 1998). An emerging wave of evidence, however, suggests that self-disclosure and responsiveness may benefit not only romantic relationships, but may also have consequences for health and well-being beyond the romantic dyad. This work shows that self-disclosure and responsiveness are associated with the same health benefits that characterize those who enjoy satisfying social relationships (Holt-Lunstad, Smith, & Layton, 2010; Robles, Slatcher, Trombello, & McGinn, 2014), including better physical health (Frattaroli, 2006) and increased longevity (Selcuk & Ong, 2013).

Despite these implications, researchers do not have a clear understanding of the conditions under which self-disclosure and responsiveness are more likely to lead to positive health outcomes. First and foremost, it is not clear how the interplay between self-disclosure and perceived responsiveness may influence health. Although self-disclosure is typically assumed to benefit individuals by subsequently increasing perceptions of responsiveness (Reis & Shaver, 1988), research also suggests that this may not always be the case. Instead, studies show that the positive effects of intimacy-building processes such as disclosure may actually depend on the *degree* to which partners are perceived as responsive (e.g., Gable et al., 2006), so that perceived responsiveness may moderate rather than mediate the beneficial effects of self-disclosure. Second, it is not clear how early in development these benefits may emerge. Because self-disclosure and perceived responsiveness help

to increase a sense of belonging, their consequences should be observed in many types of social bonds that serve intimacy-enhancing functions. Therefore, although self-disclosure and perceived responsiveness have been studied primarily among adults in a romantic relationship context, their effects may also extend to children and adolescents as well as to other types of social relationships, such as those with parents or friends. Finally, it is not clear to what extent individual differences that are typically associated with affiliation processes, such as gender, may also influence the health-related effects of self-disclosure and perceived responsiveness.

The goal of the current study was to investigate these questions in a sample of youth with asthma. Because asthma is an inflammatory disease, we were interested in examining how the interplay between self-disclosure and perceived responsiveness relates to aspects of psychological well-being and biological processes that influence inflammation. Among these aspects, we focused on experiences of positive and negative affect and on the expression of the anti-inflammatory glucocorticoid receptor gene *NR3C1*, which plays an important role in regulating inflammatory responses linked to asthma outcomes (Rosenberg, Miller, Brehm, & Celedon, 2014). Specifically, we investigated whether the effects of self-disclosure and perceived responsiveness are interactive, whether they can be observed among older children and adolescents, and whether they benefit males and females differently.

## When are Self-Disclosure and Perceived Responsiveness Most Beneficial?

Self-disclosure refers to the act of sharing one's thoughts and feelings with others, whereas perceived responsiveness indicates the extent to which individuals believe that others understand, validate, and care for them (Reis & Shaver, 1988). Although distinct, both processes are inherently interpersonal, emerging from interactions between partners and often linked by the common intimacy goals they serve with regards to relationship well-being. For example, interactions in which individuals reveal their thoughts and emotions provide opportunities for partners to respond in ways

that convey understanding and care, which may further strengthen the relationship. As a result, self-disclosure and perceived responsiveness contribute toward building stable and satisfying relationships, with implications for many aspects of well-being (Gable, Reis, Impett, & Asher, 2004; Gordon & Chen, 2016; Laurenceau, Barret, & Rovine, 2005).

Within the close relationships literature, self-disclosure has been traditionally conceptualized as a necessary step towards building intimacy, with responsiveness serving as a mediator of its effects on relationship outcomes (Laurenceau, Barrett, & Pietromonaco, 1998; Reis & Shaver, 1988). According to the interpersonal process model of intimacy (Reis & Shaver, 1988), intimacy is more likely to develop and increase through repeated acts of self-disclosure that allow individuals to gauge how well their partner understands and validates their thoughts and feelings. This premise has been supported by empirical investigations that show that perceived responsiveness partially mediates the effects of self-disclosure on feelings of daily intimacy and marital satisfaction (Laurenceau et al., 1998; Laurenceau et al., 2005). However, one can easily imagine that when partners are unresponsive to one's disclosures, this can diminish feelings of trust and belonging and threaten relationship satisfaction and security.

Self-disclosing behaviors also occur in other types of social contexts that do not involve intimate interaction partners. In these situations, the primary goal of self-disclosure may not be necessarily to increase intimacy, but to establish common ground and increase mutual understanding. Even in these cases, individuals engage in self-disclosure in order to establish satisfying relationships with others, and this goal can only be achieved if others are perceived as caring and validating. Therefore, based on this logic, we reason that self-disclosure may contribute to beneficial outcomes *only* to the extent that interaction partners are perceived as responsive.

Indeed, previous research has already hinted at this alternative. First, past research in expressive writing has indicated that disclosing one's innermost thoughts and feelings may not

always benefit health (Frattaroli, 2006), particularly in those cases when this behavior does not satisfy a search for meaning, comfort, and security (Sbarra, Boals, Mason, Larson, & Mehl, 2013; Zakowski, Herzer, Barrett, Milligan, & Beckman, 2011). Given that perceived responsiveness helps to fullfill these functions when self-disclosure occurs in the context of dyadic interactions, it stands to reason that higher levels of self-disclosure should be more likely to benefit well-being when partners are percieved as highly responsive.

Second, research reveals that behaviors that are supposed to be caring, supportive, and intimacy-enhacing (e.g., social support) may fail to accomplish these goals if they are not percieved as responsive (Bolger & Amarel, 2007; Selcuk & Ong, 2013). This can occur not only when individuals seek to find comfort and validation with regards to a stressful event, but also when they would like to savor the happiness of a positive event by sharing it with others (Gable et al., 2006). Altogether, these studies suggest that when individuals self-disclose, this behavior is most likely to benefit them when interaction partners are perceived as responsive. Therefore, perceived responsiveness may not always serve as a mediator for self-disclosure, but may also serve as a moderator, such that the effects of self-disclosure may be stronger in the context of high levels of perceived responsiveness.

Another goal of our study was to further examine the role of individual differences that typically influence intimacy-related processes. Theoretical models have often discussed the role of gender in moderating the effects of relationship processes on health and well-being, however the empirical evidence remains inconsistent (Robles et al., 2014). We reasoned that gender could play a role in moderating the effects of responsiveness given that the process of building affiliation through intimacy is a very salient aspect of gender identity for women (Cross, Bacon, & Morris, 2000). In contrast to men, women are more communal and tend to define their self-concept in terms of their relationships with others (Guimond, Chatard, Martinot, Crisp, & Redersdorff, 2006). This aspect of

gender identity is also believed to influence the way in which women cope with stressful events, making them more likely than men to seek affiliation and restore feelings of control through the support of others (Taylor, 2006). As a result, one would expect that the benefits associated with high levels of perceived responsiveness might be greater in females compared to males. This difference may be particularly pronounced in adolescence, a time when youth's social behaviors and expectations are more likely to adhere to and be evaluated on the basis of normative gender scripts (Rose & Rudolph, 2006).

### Self-Disclosure, Perceived Responsiveness, and Health

Decades of research have shown that being socially connected to others is strongly associated with lower mortality risk (House, Landis, & Umberson, 1988), increasing the chances of survival for up to 50% for those who are highly socially integrated (Holt-Lunstad, Smith, & Layton, 2010). What emerges from these findings is an overarching theme that the quality of one's social ties may be more important for one's health than just the number of one's connections (Robles et al., 2014). Therefore, given that self-disclosure and perceptions of responsiveness are among the factors that promote greater intimacy and relationship satisfaction, it stands to reason that these processes may also positively influence physical and psychological health.

Existing research supports this claim for a variety of health-related outcomes. Many studies demonstrate that disclosing one's thoughts and feelings about important personal events can lead to improvements in anxiety and depressive symptoms, as well as several indicators of physiological functioning (Frattaroli, 2006), such as better cellular immune functioning (Pennebaker, Kiecolt-Glaser, & Glaser, 1988) and reduced asthma symptoms in adolescents (Warner et al., 2006). Perceived responsiveness is also associated with various health benefits, from better sleep quality (Selcuk, Stanton, Slatcher & Ong, 2017; Troxel, 2010), to reduced experiences of pain (Wilson, Martire, & Sliwinski, 2017), and lower risk of mortality (Selcuk & Ong, 2013).

In line with several theoretical accounts (i.e., attachment theory; Bowlby, 1988; interdependence theory, Kelley & Thibaut, 1978), research suggests that the health-promoting effects of disclosure and responsiveness emerge from their impact on individuals' ability to regulate psychological and physiological responses to stress. First, research has shown that self-disclosure and perceived responsiveness may influence biological systems that control physiological reactions to stress, such as the hypothalamic-pituitary-adrenal (HPA) axis and its main product, the glucocorticoid hormone cortisol (e.g., Slatcher, Selcuk, & Ong, 2015). Second, self-disclosure and responsiveness can also influence affective experiences which can have consequences for health, given that negative emotions are typically associated with dysregulated cortisol production (Polk, Cohen, Doyle, Skoner, & Kirschbaum, 2005) and immune responses (Sin, Graham-Engeland, Ong, & Almeida, 2015), whereas positive emotions are linked to "healthier" cortisol profiles (Ong, Fuller-Rowell, Bonanno, & Almeida, 2011) and lower levels of inflammatory markers (Sin et al., 2015).

For example, higher self-disclosure and perceived responsiveness have been consistently associated with lower daily levels of cortisol. In one study, higher levels of marital disclosure buffered the negative effects of daily work worries on cortisol among married women but not among men (Slatcher, Robles, Repetti, & Fellows, 2010). Further, a recent study showed that higher levels of perceived responsiveness in romantic partners were prospectively associated with steeper daily declines in cortisol profiles via decreases in negative affect over a 10-year period (Slatcher, Selcuk, & Ong, 2015). Additional empirical support for this affective mechanism comes from work showing that responsiveness was associated with better sleep quality through lower levels of anxiety and depression symptoms (Selcuk, Stanton, Slatcher, & Ong, 2017).

This body of work clearly demonstrates that self-disclosure and perceived responsiveness are important for health and suggests that their influence should be observed in at least two important health-related mechanisms: affective experiences and physiological responses controlled by stress-

regulation systems. Building on this research, we tested our ideas in a sample of youth with asthma by targeting youth's emotional experiences and anti-inflammatory gene expression as two important outcomes of interest.

**Beyond the Romantic Dyad**

Although the health-related benefits of self-disclosure and responsiveness have been investigated almost exclusively among romantic partners, research suggests that these effects can also be found in other relationship contexts. Because these processes help to forge emotional bonds, they should also be relevant for individuals from other developmental stages and among various types of close relationships. Most of the evidence for this hypothesis comes from work on the effects of responsive parenting and youth disclosure to parents on children's and adolescents' well-being.

A long line of work in the developmental literature has shown that adolescents' voluntary disclosures to their parents are longitudinally associated with lower levels of negative emotionality (Hamza & Willoughby, 2011; Laird, Bridges, & Marsee, 2013). Although these studies rarely assess parental responsiveness to youth disclosures (Keijsers, Frijns, Branje, & Meeus, 2009), extensive research in other areas suggests that responsive relationships with parents and peers can help to buffer youth from the deleterious health effects of psychosocial stressors (Lansford et al., 2003; Sentse, Lindenberg, Omvlee, Ormel, & Veenstra, 2010). On the other hand, a lack of intimate, caring, and validating relationships has been prospectively associated with lower levels of overall well-being and psychological health (Adam et al., 2011). More specifically, research on parent-child relationships suggests that responsive parental care is linked to adaptive regulation of stress-response systems as indicated by cortisol and immune responses (Hostinar & Gunnar, 2013; Miller et al., 2011). For example, secure attachment to mothers has been associated with healthier cortisol responses in infants (Gunnar, Brodersen, Krueger, & Rigatuso, 1996), and maternal support has

been found to buffer cortisol reactivity to laboratory-staged social stressors in young children (Hostinar, Johnson, & Gunnar, 2015).

Similar results have also been observed with regards to immune activity. A series of studies on the links between family climate and parent-child relationships have shown that individuals who recall warm relationships with their parents are more likely to show lower pro-inflammatory activity in adulthood (Chen, Miller, Kobor, & Cole, 2011; Miller et al., 2011). More recently, investigations in youth with asthma have shown that maternal responsiveness is associated with lower pro-inflammatory activity and that this effect is mediated through higher levels of youth positive affect (Tobin et al., 2015). Based on these findings, one would expect that self-disclosure and responsiveness should be linked to health-related outcomes even among adolescents, particularly since the need to enhance intimacy in interpersonal relationships becomes an important developmental goal during this period (Smetana, Campione-Barr, & Metzger, 2006). To date, however, this hypothesis has never been directly tested.

**Present Research**

To summarize, the purpose of our investigation was to examine if the health-promoting effects of self-disclosure would depend on the degree to which interaction partners are perceived as responsive, as well as such effects would be observed outside the context of romantic relationships. Our study tested these hypotheses in a sample of youth with asthma, a chronic disease caused by inflammation of the airways that affects more than 10 million youth in the United States (Blackman & Gurka, 2007). Asthma provides a highly relevant context for testing our hypotheses given that interpersonal stressors that involve challenges in affiliating with others can contribute to the exacerbation of asthma in several ways, from increased expression of daily symptoms (Tobin et al., 2015) to increased production of pro-inflammatory markers (Chen et al., 2006).

Here we expand on prior work in two important ways. First, we investigated one of the

molecular pathways believed to underlie the rise of chronic inflammation, the expression of the anti-inflammatory glucocorticoid receptor gene *NR3C1*. The glucocorticoid receptor, encoded by the gene *NR3C1*, is a key regulator of the inflammatory response. Cortisol binds to and activates the glucocorticoid receptor, which then regulates transcriptional processes with consequent decrease in inflammation (Hayashi et al., 2004). When *NR3C1* is under-expressed, several deleterious consequences may ensue: 1) inflammation may become chronically active and 2) cells may not be able to receive cortisol's signals to down-regulate the inflammatory immune response due to the lower number of available receptors (also known as glucocorticoid resistance; Carpe et al., 2010). In the case of asthma, this may result in higher levels of pro-inflammatory markers responsible for asthma attacks (Chen and Miller, 2007), increasing, thus, the risk of disease exacerbation (Rosenberg et al., 2014). Studies in youth with asthma already show that experiences of interpersonal stressors such as peer rejection (Murphy, Slavich, Chen, & Miller, 2015), family conflict (Ehrlich, Miller, & Chen, 2015), negative family emotional climate (Farrell et al., 2018), and lower maternal warmth (Stanton et al., 2017) are negatively associated with glucocorticoid receptor gene expression. Therefore, there is good reason to expect that self-disclosure and responsiveness may also play a role in *NR3C1* expression.

Second, because youth with asthma are more likely to suffer from psychological conditions that involve difficulties with emotion regulation (e.g., depression, Blackman & Gurka, 2007), and because affective experiences have been previously linked to inflammatory outcomes among this population (Tobin et al., 2015), we also investigated the ways in which self-disclosure and responsiveness are related to experiences of positive and negative affect assessed from youths' daily reports of mood.

Based on a strong body of work suggesting that intimacy processes are important for health, and on the idea that disclosing to an un-responsive interaction partner would not enhance feelings

of intimacy and security, we hypothesized that higher levels of self-disclosure would be associated with higher *NR3C1* expression, higher positive affect, and lower negative affect only when followed by higher perceptions of responsiveness. In terms of gender differences, we hypothesized that higher levels of responsiveness would be more strongly associated with higher levels of *NR3C1* expression, greater positive affect, and lower negative affect in female relative to male youth.

## Method

### Participants

Participants were enrolled in a larger project examining the effects of family environments on childhood asthma. Youths and their primary caregivers were recruited from (MASKED FOR REVIEW) area hospitals and schools. Families were eligible to participate if youth were between the ages of 10-17 with a diagnosis of mild to severe asthma confirmed by medical report. Families were excluded if youth were using oral steroid medication(s), diagnosed with a chronic condition other than asthma (e.g., endocrine disorders), or diagnosed with a medical condition that may interfere with immune system function (e.g., pregnancy, chemotherapy, or radiotherapy in the past year). Participation in the study included two components: a laboratory visit and a four-day diary assessment followed by a blood draw session. The current analyses focused on data collected from the baseline laboratory session and youth daily diary reports.

A sample of 194 families was recruited; a-priori power analyses indicated that this sample would have sufficient power to test social/health processes with effect sizes ranging from small to medium. Youth without gene expression data (because of failed blood draw or assay related problems) were not included in the current analyses, leaving a sample of 142 youth. One additional participant was excluded for not providing valid responses to the self-disclosure measure, resulting in a final sample of 141 youth (see "Statistical Analysis Strategy"). This final sample included 82 male (*Mean age* = 12.54, *SD* = 1.79) and 59 female (*Mean age* = 13.23, *SD* = 1.95) youth. With regards to

ethnicity, 75.2% of youth identified as African American, with the rest indicating European and

Hispanic ethnicity. Annual parental income ranged from $0-$7,825 tax bracket to the $97,926-

$174,850 tax bracket with a median range of $7,826-$31,850, and 58.3% of the parents had

completed at least 12 years of education. Asthma severity diagnosis ranged from mild intermittent to

severe, with 28.8% of participants having mild to moderate asthma, 39.9% having moderate to

severe asthma and 31.3% of participants having severe asthma. No differences in any of the

demographic or independent variables emerged between the full and the reduced sample (all $p$s >

.10).

**Procedure**

Parents and their children completed a series of questionnaires and a chronic stress interview

during an initial session taking place in the laboratory. Following this visit, youth completed paper

daily diaries for two weekdays and two weekend days, where they reported on one important topic

they had discussed with someone during the day. At the end of this period we conducted a

peripheral blood draw on each youth for gene expression analyses. Written assent and consent were

obtained from the participating youth and their parent respectively. Families were paid up to $540

for their participation across all study waves. All study procedures were approved by the

Institutional Review Board at (MASKED FOR REVIEW).

**Primary Measures**

**Self-disclosure and perceived responsiveness.** The daily measures for self-disclosure and

perceived responsiveness were adapted from measures of these constructs utilized in past research

(Laurenceau, Barrett, & Pietromonaco, 1998). Self-disclosure was assessed each day for four days by

prompting youth to reflect on the most meaningful and important conversation of their day in

which they shared their thoughts and feelings with someone else. Interaction partners included a

variety of relationship figures, such as parents, friends, relatives, and teachers. Youth were then

asked to rate on a scale of 1 (*not at all*) to 5 (*extremely*) the extent to which they talked about facts and information, their thoughts, and their feelings. The ratings from these statements were averaged into one aggregate self-disclosure score, with higher scores representing higher levels of self-disclosure over four days ($M = 2.77$, $SD = 1.11$, $\alpha = 0.87$[1]).

Perceived responsiveness was assessed by asking youth to think about how they felt after talking with their interaction partner. Youth rated on a scale of 1 (*not at all*) to 5 (*extremely*) the extent to which the person really listened to what they were saying, was responsive to what they were saying, and the degree to which youth felt accepted by that person. These three components tap into the core aspects of understanding, caring, and validation that define the construct of responsiveness. Mean scores for the three statements were averaged into one aggregate perceived responsiveness score with higher ratings reflecting higher levels of perceived responsiveness ($M = 3.75$, $SD = 0.98$, $\alpha = 0.94$).

**Positive affect.** Daily experiences of positive affect (PA) were measured by asking youth participants to rate how accurately a series of eight adjectives described their mood over the day. Ratings were provided on a scale of 1 (*not at all*) to 4 (*all of the day*). Adjectives included lively, happy, at ease, full of energy, cheerful, calm (obtained from Cohen, Alper, Doyle, Treanor, & Turner, 2006) as well as proud and loved (obtained from Repetti & Polina, 1994). The mean values for positive affect were aggregated across the four-day period ($M = 2.98$, $SD = 0.59$, $\alpha = 0.86$) with higher scores indicating higher levels of positive affect.

**Negative affect**. Daily negative affect (NA) was measured by asking youths to rate on a scale of 1 (*not at all*) to 4 (*all of the day*) the extent to which a series of six adjectives described their overall mood throughout the day. Items included sad, mean, unhappy, tense, angry, and worried

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[1] All alphas for daily diary scales are calculated from mean levels per item over the four days (e.g., reliability between average disclosure of facts and information, average disclosure of thoughts, and average disclosure of feelings over the 4 days), commensurate with our analyses of these constructs at the person level.

(Cohen, Alper, Doyle, Treanor, & Turner, 2006). In order to aid in youth comprehension, two items were modified from the original scale: *hostile* was reworded to *mean* and *on edge* was reworded to *worried* (Repetti & Polina, 1994). The mean values for negative affect were aggregated across the four-day period ($M = 1.25$, $SD = 0.31$, $\alpha = 0.84$) with higher scores indicating higher levels of negative affect.

*NR3C1* **gene expression**. Following the daily diary period, each youth provided up to 6 mL of peripheral blood for gene expression assays. Blood was drawn between 7:00 AM and 10:00 AM (most commonly at 7:00 AM before youth went to school). Samples were collected into Vacutainer Cell Preparation Tubes containing $K_2EDTA$ (Becton Dickinson and Co., East Rutherford, NJ, USA). In order to assess messenger RNA (mRNA) levels of the glucocorticoid receptor gene *NR3C1,* total RNA was extracted from peripheral blood using the LeukoLOCK Total RNA Isolation System, following manufacturer's protocol (Life Technologies, Grand Island, NY, USA). RNA integrity was assessed on Agilent Bioanalyzer and only samples with RIN $\geq$ 6.0 were included in the study. Total RNA was reverse transcribed to cDNA using SuperScritp III kit (Life Tech), following the manufacturer's protocol. Gene expression was quantified using TaqMan gene expression assays (Applied Biosystems) on an Applied Biosystem 7500-FAST or StepOnePlus real-time PCR thermocycler, following manufacturer's protocol. Average $C_T$ values were calculated for *NR3C1* and the endogenous control *(18S rRNA)* across three technical replicates of each sample. For each sample, the coefficient of variation across replicates was less than 20%. Relative values (in $C_T$ unites) for *NR3C1* in each sample were normalized to the endogenous control and expressed as delta $C_T$ values. These values were reversed in our analyses so that higher scores would indicate higher *NR3C1* expression.

**Covariate Measures**

**Anxiety symptoms**. Youth trait anxiety was included as a covariate in order to rule out any effects of perceived responsiveness on *NR3C1* expression because of personality differences (for example, youth higher in anxiety may report lower levels of perceived responsiveness). Anxiety symptoms were measured through parental report on the Anxiety subscale of the Child Behavioral Checklist (CBCL 4 -18; Achenbach, 1991). The CBCL captures youth's behavioral and emotional problems over the past six months. Parents rated each behavior on a scale from 0 (*not true*) to 2 (*very true or often true*), with higher scores indicating more frequent behavior (*M* = 1.42, *SD* = 1.76, *α* = 0.69).

**Depressive symptoms**. In order to assess depressive symptoms youth completed the Children's Depression Inventory Short Form (CDI:S; Kovacs, 1992), a 10-item measure widely used in children and adolescents. This measure was used to rule out the effect of general negative affectivity on daily positive and negative affect and *NR3C1* expression. Items reflect key symptoms of depression including negative mood, experiences of anhedonia, personal problems, ineffectiveness and negative self-esteem. Participants were asked to select one of three increasingly intense descriptions that best applied over the course of the last two weeks, rated 0-2 (e.g., "I feel like crying once in a while," "I often feel like crying," "I feel like crying every day"). Items were aggregated into a mean score with higher levels reflecting greater depression symptoms (*M* = 0.27, *SD* = 0.32, *α* = 0.80).

**Family conflict**. Family conflict was included as a covariate in order to account for the possibility that higher levels of family conflict could confound the effects of perceived responsiveness on positive and negative affect as well as on *NR3C1* expression. Family conflict was measured through youth report obtained from the Life Stress Interview (LSI; Hammen, 1991). The LSI captures chronic stress in particular domains of participants' lives over the past 6 months before the study visit. Youth were interviewed by a research assistant without the presence of their parent.

The LSI follows a semi-structured format designed to assess functioning across various role domains, such as parent-child relationships and family health among others. Interviewers were trained to elicit information on on-going stressors surrounding youth's relationships with their parents and siblings, while focusing on the objective, contextual aspects of the stressors and not on participants' emotional reactions. Interviews were scored on a 5-point scale anchored by behavioral examples, with 1 indicating superior functioning and 5 indicating exceptionally poor functioning. Reliabilities for chronic stress ratings were based on independent judges' ratings of audiotaped interviews ($n = 34$). Intraclass correlations across all role domains for the youth interviews ranged from $0.71 - 1.00$ ($M = 0.84$). In order to create a measure of family conflict we averaged interview scores from the parent-child conflict and sibling-child conflict domains, with higher scores indicating higher levels of conflict ($M = 2.62$, $SD = 0.77$).

**Asthma-related medication**. Asthma medication use was obtained from daily logs completed across the daily diary period. Youth reported on (1) inhaled beta-agonist use (yes/no), (2) inhaled corticosteroid use (yes/no), (3) inhaled combination of corticosteroid and beta-agonist use (yes/no), (4) oral corticosteroid use (yes/no), and (5) leukotriene-modifying agent use (yes/no). For analyses purposes we created a dichotomous variable (yes/no) by averaging use across four days. If youth had a value above zero for any of the five types of asthma medication, they were given a "yes" score on the dichotomous variable; otherwise, they received a "no" score. Approximately 45.4% of the sample took medication for their asthma.

**Statistical Analysis Strategy and Potential Covariates**

In addition to the psychological covariates of youth's anxiety symptoms, depressive symptoms, and family conflict we also tested several other covariates based on their *a priori* potential to influence *NR3C1* expression, PA, and NA. In particular, we tested the demographic and asthma-related covariates of youths' age, ethnicity (0 = White, 1 = non-White), medication use (0 = no, 1 =

yes), asthma severity diagnosis, and parents' education (0 = high school or less, 1 = some college or more).

To address analytic problems related to missing data, we tested our hypotheses by using the expectation maximization algorithm (EM) to replace missing values for continuous data. The EM method provides unbiased parameter estimates and improves statistical power of analyses (Enders, 2001). In the analyses reported below, the main sample of 194 youth was reduced to 141 individuals after excluding participants without gene expression data and one additional participant who did not provide valid information to the self-disclosure question (participant reported talking to God). As a result, all study variables except *NR3C1* expression were imputed. In order to ensure the robustness of our results, in a second set of analyses we utilized the full sample of 193 youth and imputed all missing values of the study variables (see supplemental materials). Because the expectation maximization algorithm does not allow value replacement for dichotomous variables, we used mode replacement to replace missing values for dichotomous data. Then, to facilitate interpretation, all continuous predictors and potential covariates were standardized.

We first investigated the relations among primary study variables and covariates using bivariate correlation analyses (see Table 1). Next, to test our specific hypotheses, we conducted three multiple regression analyses: (1) *NR3C1* expression as the outcome variable, (2) PA as the outcome variable, and (3) NA as the outcome variable. We tested the interaction between perceived responsiveness and self-disclosure and the interaction between perceived responsiveness and gender in separate models. We also tested the two interactions in a combined model and results remained the same (see Tables 2-4). We, therefore, discuss the interactions from the separate models in the main text.

In the analyses for self-disclosure, the predictor variables were standardized scores on self-disclosure, standardized scores on perceived responsiveness, and the interaction between self-

disclosure and perceived responsiveness. In the analyses for gender, the predictor variables were

dummy-coded gender (0 = male, 1 = female), standardized scores on perceived responsiveness, and

the interaction between gender and perceived responsiveness. We tested models with covariates that

correlated with the outcome variable at a significance level of $p < .10$. For *NR3C1* expression, the

significant covariates were ethnicity and anxiety symptoms. For PA, the significant covariates were

age, depressive symptoms, and family conflict. For NA, the significant covariates were asthma

severity diagnosis, depressive symptoms, and family conflict.

## Results

### *NR3C1* Expression

**Effects of perceived responsiveness and self-disclosure.** We first assessed the

associations between perceived responsiveness, self-disclosure and *NR3C1* expression in a simple

effects model while controlling for covariates. Regression analyses revealed that neither perceived

responsiveness ($\beta$ = -.07, $t(136)$ = -.27, $p$ = .78, 95% CI [-0.54, 0.41]), nor self-disclosure ($\beta$ = 0.16,

$t(136)$ = 0. 68, $p$ = .50, 95% CI [-0.32, 0.65] were significant predictors of *NR3C1* expression in this

model. We then repeated the analyses by adding the interaction term in the model. In line with

hypotheses, a significant interaction between perceived responsiveness and self-disclosure emerged

for youths' expression of *NR3C1* (see Table 2). As seen in Figure 1A, for youths who perceived

their interaction partners as highly responsive, higher self-disclosure was linked with higher *NR3C1*

expression ($\beta$ = 0.58, $t(135)$ = 2.26, $p$ = .03, 95% CI [0.07, 1.08]). Youths who perceived lower levels

of responsiveness, on the other hand, showed lower *NR3C1* expression as self-disclosure increased

 ($\beta$ = -0.87, $t(135)$ = -2.47, $p$ = .01, 95% CI [-1.57, -0.18]). This interaction remained robust in the

combined model.

**Effects of perceived responsiveness and gender.** Regression analyses with perceived

responsiveness and gender as predictors did not reveal a significant association between gender and

*NR3C1* expression (β =0.59, *t*(136) = 1.55, *p* = .12, 95% CI [-0.16, 1.35]). As expected, a significant interaction between perceived responsiveness and gender emerged for youths' expression of *NR3C1* (see Table 2). As seen in Figure 1B, for youth who perceived their interaction partners as highly responsive, *NR3C1* expression was higher among females than males (β = 1.70, *t*(135) = 3.21, *p* = .002, 95% CI [0.65, 2.74]). For those who perceived their interaction partners as less responsive, *NR3C1* expression did not vary as a function of gender (β = -0.72, *t*(135) = -1.24, *p* = .22, 95% CI [-1.86, 0.43]). This interaction remained robust in the combined model.

**Positive Affect**

      **Effects of perceived responsiveness and self-disclosure.** Analyses in the simple effects model revealed that perceived responsiveness was significantly associated with PA, such that youth who perceived higher levels of responsiveness reported higher levels of PA (β = 0.17, *t*(135) = 2.91, *p* < .01, 95% CI [ 0.05, 0.28]). Self-disclosure was not significantly associated with PA (β = 0.09, *t*(135) = 1.59, *p* = .12, 95% CI [ -0.02, 0.20], after controlling for covariates). Once the interaction term was added in the model, we observed the predicted significant interaction between perceived responsiveness and self-disclosure for youths' PA (see Table 3). As seen in Figure 2, higher levels of self-disclosure were linked with higher PA (β = 0.14, *t*(134) = 2.42, *p* = .02, 95% CI [0.03, 0.26]) only for youth who perceived their interaction partners as highly responsive. For youths who perceived lower levels of responsiveness from others PA experiences did not vary as a function of self-disclosure (β = -0.08, *t*(134) = -.96, *p* = .34, 95% CI [-0.26, 0.309]). This interaction remained robust in the combined model.

      **Effects of perceived responsiveness and gender.** Regression analyses with perceived responsiveness and gender as predictors did not reveal a significant association between gender and PA (β = -0.01, *t*(135) = -0.08, *p* = .94, 95% CI [-0.19, 0.17], after controlling for covariates). We then repeated analyses with the interaction term in the model. As seen in Table 3, the interaction between

perceived responsiveness and gender for youths' PA was not significant in any of the gender models so we did not decompose it further.

**Negative Affect**

**Effects of perceived responsiveness and self-disclosure.** Although perceived self-disclosure showed a significant bivariate association with NA (see Table 1), this association was no longer significant in the regression model after controlling for family conflict, youth depressive symptoms and asthma severity. The interaction between perceived responsiveness and self-disclosure for youths' NA reached statistical significance in the individual self-disclosure model ($\beta$ = -0.06, $t(137)$ = -2.49, $p$ = .01, 95% CI [-0.11, -0.01]), however, as seen in Table 4, this result was not robust after accounting for covariates. Although the interaction term was significant in the combined model, the simple slopes did not reach significance, $p$s > .10, so we do not interpret this interaction further.

**Effects of perceived responsiveness and gender.** Finally, as seen in Table 4, neither gender, nor the interaction between perceived responsiveness and gender were significant predictors for youths' NA. The interaction was also non-significant in the combined model.[2]

## Discussion

This study tested how self-disclosure and responsiveness in the daily lives of youth with asthma are related to positive and negative affect and *NR3C1* gene expression. First, we found that higher levels of perceived responsiveness over four days were associated with higher levels of positive affect. Second, higher levels of self-disclosure were associated with higher levels of *NR3C1* expression and higher levels of positive affect *only* when accompanied by higher perceptions of partner responsiveness. Finally, we also found that higher levels of perceived responsiveness were

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[2] All findings remained consistent in the full, imputed sample of 193 youth (see supplemental materials).

linked to higher *NR3C1* expression in female but not in male youth.

Our findings offer novel contributions to both the social psychology literature and the health psychology literature. Within the social psychology literature, responsiveness is typically treated as a mediator of the effects of self-disclosure on relationship well-being and partner well-being (Reis, 2012). Our findings are among the first to suggest that engaging in higher levels of self-disclosure may enhance physical and psychological health only when followed by higher levels of responsiveness, which was indicated by the significant interaction between self-disclosure and perceived responsiveness on *NR3C1* expression and positive affect in our sample. Therefore, our findings emphasize a neglected function of responsiveness within the domain of intimacy processes, suggesting that responsiveness may serve as a moderator (rather than exclusively as a mediator) of the effects of self-disclosure on health and well-being.

This additional role of responsiveness as a moderator has a few noteworthy implications. First, current theoretical reasoning (see Reis, Clark & Holmes, 2004) emphasizes that the development of intimacy relies heavily on the communication process between interaction partners and that self-disclosure plays a large role in increasing intimacy by creating opportunities for individuals to behave responsively towards one another. Our findings build on this argument and suggest that the association between self-disclosure and perceived responsiveness may be highly dynamic and that high levels of self-disclosure may not always ensure an increase in responsiveness and intimacy. Rather, this equation may also depend on other relational factors such as the context in which self-disclosure takes place, or the partners' motivations for responding with validation and care. For example, in the context of ambivalent relationships where interaction partners are inconsistent in the way in which they respond to one another, self-disclosure may not always be received responsively and may not necessarily benefit health (Holt-Lunstad, Uchino, Smith & Hicks, 2007).

Second, our findings may have implications about interventions intended to improve well-being by harnessing intimacy-related processes. Several research lines in the literature point to the fact that suppressing one's emotions, or not opening up to one's partner, may lead to reduced intimacy (Peters & Jamieson, 2016), and detrimental physiological outcomes (Haase, Holley, Block, Verstaen, & Levenson, 2016; Peters & Jamieson, 2016; Slatcher et al., 2010). However, our findings show that for those who engage in high levels of disclosure, the anticipated benefits may be strengthened only in the presence of high levels of perceived responsiveness. Therefore, for those who view disclosure as a preferred means of bonding with others, the sought-after outcomes of finding comfort, reassurance, and validation may not ensue if interaction partners are not perceived as responsive. As our gene expression findings imply, high levels of disclosure may instead be associated with detrimental rather than beneficial outcomes in the absence of responsiveness. These findings, therefore, highlight the possibility of not only intervening by helping individuals to respond in more responsive ways, but also by helping them to learn how to identify and seek out others that may serve as reliable sources of support in times of need. In the case of youth, intervention efforts might be directed at the family level by counseling parents and family members on ways in which to convey responsiveness, but also on youth themselves by counseling them on how to identify responsive behaviors in teachers, friends, or new members of their social network.

Our findings also speak to the influence of individual differences in moderating the link between responsiveness and health-related processes by suggesting that females might be more likely to benefit from higher levels of responsiveness than males. These results align with other findings in the literature which show that self-disclosure is more likely to benefit wives than their husbands in terms of daily cortisol activity and certain aspects of sleep quality (Kane, Slatcher, Reynolds, Repetti, & Robles, 2014; Slatcher et al., 2010). Altogether, this collection of findings supports established theoretical accounts that intimacy-enhancing processes should have a stronger impact on the well-

being of women, given that they are a central part of women's social identity and because they may serve as primary means of coping with stress (Cross et al., 2000; Taylor, 2006). Nonetheless, we note that the pattern of our results for *NR3C1* expression in males also suggests that there may be no effect of responsiveness in this group (rather than just a weaker effect compared to females), which was unexpected. Therefore, our results need to be replicated with a different sample to further clarify our findings.

Within the health literature, our results provide further support for the importance of intimacy-building processes for health and well-being. Past research has shown, for example, that perceived responsiveness is associated with both psychological well-being, such as lower levels of depression and anxiety (Selcuk, Stanton, Slatcher, & Ong, 2017) and biological processes that underlie health outcomes such as daily cortisol activity and immune functioning (Jaremka et al., 2013; Slatcher, Selcuk, & Ong, 2015). Our results support these accounts and extend current research in several important directions. First, our findings on perceived responsiveness and positive affect align with findings from several adult populations that demonstrate the role of interpersonal factors on emotional processes (for reviews see Farrell, Imami, Stanton, & Slatcher, *in press*; Slatcher & Selcuk, 2017) and the importance of these associations for health and well-being. Relationship researchers have argued for quite some time that affective processes constitute key proximal mechanisms of the links between relationships and health (Gottman, Coan, Carrere, & Swanson, 1998; Slatcher & Selcuk, 2017). A small but growing number of studies has started to provide strong empirical evidence for these claims by examining the mediating role of affective processes on health (Ditzen, Hoppmann, & Klumb, 2008; Slatcher et al., 2015; Stanton et al., in press). With regard to responsiveness in particular, several studies have shown that its links to psychological well-being, health behaviors, and biological processes are mediated by emotional experiences and lower affective reactivity to daily stressors (Selcuk et al., 2015; Selcuk et al., 2017; Slatcher et al., 2015;

Stanton et al., 2018). Similar effects have also been documented with regards to self-disclosure, negative affect, and sleep among married couples (Kane et al., 2014). Our findings add further evidence to this literature and align with the idea that positive affect may be a potential mechanistic pathway underlying the effects of perceived responsiveness on health-related outcomes. Moreover, our findings are among the first to document the link between perceived responsiveness and affective experiences in youth. As we continue to collect further data on this project, we look forward to testing these mechanistic pathways between perceived responsiveness, emotional processes, and health outcomes in a longitudinal framework.

Second, our findings are among the first to show that the health-promoting effects of perceived responsiveness are not exclusive to adult romantic partners but can also be found earlier in development and amidst other types of relationships (i.e., friends and relatives). Future research should continue to investigate whether self-disclosure and perceived responsiveness in late childhood and adolescence can have a long-term impact in shaping other important relationship processes and individual differences related to health, such as attachment security, or emotional reactivity to life events. Given that the transition from childhood to adolescence is marked by physical and social transformations (Gordon-Larsen, The, & Adir, 2010), future research should continue to investigate whether the impact of self-disclosure and responsiveness processes on health may be altered by developments in puberty and social roles.

Third, our study is among the first to suggest that *NR3C1* expression can serve as a potential pathway through which self-disclosure and perceived responsiveness can impact immune responses and health-related outcomes in youth with asthma. As such, our study contributes to the growing field of social genomics and, in particular, to the literature demonstrating the importance of affiliation processes on inflammation regulatory processes (i.e., Murphy et al., 2013; Miller, Lachman, et al., 2011). Given that lack of responsiveness can be perceived as a form of neglect, or

rejection, by one's interaction partners, our findings dovetail nicely with previous findings showing the impact of interpersonal rejection on anti-inflammatory gene expression (Murphy et al., 2013). In addition, our findings extend existing literature as they are among the first to focus on youth's perceptions of validation and care by their interaction partners in moments when they were opening up about an important event. As a result, our findings provide insights on avenues for future interventions, suggesting a specific social process that can be targeted in order to improve youth health.

Despite its contributions, our study has several limitations worth noting. First, we cannot pinpoint causality in our findings due to the correlational nature of our data. Second, our sample is relatively small for detecting moderation effects, however we note that our results remained consistent in the larger, imputed sample of 193 youth. Third, we do not know the extent to which these daily interactions are embedded within the context of responsive relationships. Past research has shown that perceived responsiveness may also be characterized as a trait-level characteristic (Reis, 2007), which may, in and of itself, influence the weight that participants assign to partners' expression of responsiveness over a specific interval in time (Lemay & Neal, 2014). Finally, our findings on *NR3C1* expression could be confounded by potential gene-environment interactions, as well as by genetic variants that influence responses to glucocorticoids (Kendler, 1996; Maranville, Baxter, Witonsky, Chase, & Di Rienzo, 2013). Future studies should investigate the influence of self-disclosure and responsiveness on genome-wide expression in order to identify whether additional genes influence inflammatory processes as a function of these processes. Additionally, it is not clear if the current links to *NR3C1* expression directly translate to the clinical phenotype. First, existing research has not identified clinically relevant thresholds for glucocorticoid receptor availability, and, second, the timing from reduced *NR3C1* expression to the manifestation of clinical outcomes is not clear. Finally, although medication use did not show significant effects in our analyses, we cannot

rule out the possibility that medication use outside the daily diary period could continue to influence *NR3C1* expression. Future studies with prospective designs are needed to clarify some of these points.

Self-disclosure and perceived responsiveness are considered to be the building blocks through which social interactions evolve to become intimate and secure relationships. The current findings imply that these processes may not only help one build satisfying relationships but also sustain positive health outcomes. We hope that this study will contribute to future research with the goal of understanding the potential clinical implications of intimacy processes and the ways in which they may facilitate providing effective social support to close others.

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Table 1

*Correlations among Study Variables*

| | Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | *NR3C1* Expression | __ | | | | | | | | | | | | | |
| 2 | Positive Affect | .15+ | __ | | | | | | | | | | | | |
| 3 | Negative Affect | -.04 | -.23** | __ | | | | | | | | | | | |
| 4 | Perceived Responsiveness | .04 | .38** | -.02 | __ | | | | | | | | | | |
| 5 | Self-Disclosure | .07 | .22* | .17* | .62** | __ | | | | | | | | | |
| 6 | Gender[a] | .12 | -.06 | .11 | .15+ | .32** | __ | | | | | | | | |
| 7 | Age | -.05 | -.24** | .09 | .12 | .16 | .18* | __ | | | | | | | |
| 8 | Ethnicity[b] | -.14+ | .05 | -.09 | -.15+ | -.21* | -.02 | -.19* | __ | | | | | | |
| 9 | Medication Use[c] | .08 | -.03 | -.05 | .02 | .13 | .03 | .04 | -.26** | __ | | | | | |
| 10 | Asthma Severity Diagnosis | -.05 | -.08 | .16 | .04 | .10 | .25** | .17* | -.10 | .29** | __ | | | | |
| 11 | Parental Education[d] | .02 | -.06 | .07 | .16 | .08 | -.12 | -.06 | -.27** | .06 | -.16 | __ | | | |
| 12 | Anxiety Symptoms | -.18* | -.07 | .11 | -.05 | .06 | .03 | .07 | .03 | -.07 | .21* | .05 | __ | | |
| 13 | Depressive Symptoms | -.09 | -.36** | .49** | -.11 | .19* | .21* | .06 | .004 | -.01 | .07 | -.06 | .18* | __ | |
| 14 | Family Conflict | -.06 | -.18* | .24** | -.19* | -.12 | .12 | .17* | .05 | .09 | -.10 | -.05 | .02 | .16+ | __ |

*Note.* N = 141 youth. Continuous scores were calculated such that higher scores indicate greater standing on the variable (e.g., greater perceived responsiveness).

[a]0 = male, 1 = female; [b]0 = White, 1 = non-White; [c]0 = no, 1 = yes; [d]0 = high school or less, 1 = some college or more.

+*p* < .10, *\*p* < .05, *\*\*p* < .01

Table 2

*Associations of the Interaction of Perceived Responsiveness and Self-Disclosure and the Interaction of Perceived Responsiveness and Gender with Glucocorticoid Receptor Gene* NR3C1 *Expression*

| Variable | *NR3C1* Expression | | |
|---|---|---|---|
| | Coeff | *SE* | 95% CI |
| **Self-Disclosure Model** | | | |
| Perceived Responsiveness | 0.59* | 0.28 | [0.02, 1.15] |
| Self-Disclosure | -0.15 | 0.25 | [-0.64, 0.34] |
| Responsiveness × Disclosure | 0.72*** | 0.19 | [0.36, 1.09] |
| Ethnicity | -0.55 | 0.45 | [-1.44, 0.33] |
| Anxiety Symptoms | -0.43* | 0.18 | [-0.79, -0.07] |
| **Gender Model** | | | |
| Perceived Responsiveness | -0.35 | 0.22 | [-0.78, 0.08] |
| Gender | 0.49 | 0.37 | [-0.25, 1.23] |
| Responsiveness × Gender | 1.21** | 0.41 | [0.40, 2.02] |
| Ethnicity | -0.63 | 0.45 | [-1.51, 0.26] |
| Anxiety Symptoms | -0.46* | 0.18 | [-0.82, -0.09] |
| **Combined Model** | | | |
| Perceived Responsiveness | 0.38 | 0.35 | [-0.30, 1.06] |
| Self-Disclosure | -0.26 | 0.26 | [-0.77, 0.24] |
| Gender | 0.63 | 0.38 | [-0.12, 1.39] |
| Responsiveness × Disclosure | 0.63** | 0.21 | [0.22, 1.04] |
| Responsiveness × Gender | 0.59 | 0.45 | [-0.29, 1.48] |
| Ethnicity | -0.57 | 0.44 | [-1.46, 0.31] |
| Anxiety Symptoms | -0.45* | 0.18 | [-0.81, -0.10] |

*Note.* $N$ = 141 youth. Coeff = coefficient; *SE* = standard error; CI = confidence interval. Continuous scores were calculated such that higher scores indicate greater standing on the variable (e.g., greater perceived responsiveness). Continuous predictors and covariates were standardized. Ethnicity (0 = White, 1 = non-White) and gender (0 = male, 1 = female) were dummy-coded.
*$p$ < .05, **$p$ < .01, ***$p$ < .001

Table 3

*Associations of the Interaction of Perceived Responsiveness and Self-Disclosure and the Interaction of Perceived Responsiveness and Gender with Positive Affect*

| Variable | Positive Affect | | |
|---|---|---|---|
| | Coeff | *SE* | 95% CI |
| **Self-Disclosure Model** | | | |
| Perceived Responsiveness | 0.28*** | 0.07 | [0.14, 0.41] |
| Self-Disclosure | 0.03 | 0.06 | [-0.09, 0.15] |
| Responsiveness × Disclosure | 0.11* | 0.04 | [0.03, 0.20] |
| Age | -0.16*** | 0.04 | [-0.24, -0.07] |
| Depressive Symptoms | -0.18*** | 0.05 | [-0.27, -0.09] |
| Family Conflict | 0.00 | 0.04 | [-0.09, 0.09] |
| **Gender Model** | | | |
| Perceived Responsiveness | 0.21*** | 0.05 | [0.10, 0.31] |
| Gender | -0.01 | 0.09 | [-0.19, 0.17] |
| Responsiveness × Gender | 0.05 | 0.09 | [-0.14, 0.25] |
| Age | -0.16** | 0.04 | [-0.25, -0.07] |
| Depressive Symptoms | -0.17*** | 0.05 | [-0.26, -0.08] |
| Family Conflict | -0.01 | 0.05 | [-0.10, 0.08] |
| **Combined Model** | | | |
| Perceived Responsiveness | 0.32*** | 0.08 | [0.16, 0.48] |
| Self-Disclosure | 0.04 | 0.06 | [-0.09, 0.16] |
| Gender | -0.02 | 0.09 | [-0.20, 0.16] |
| Responsiveness × Disclosure | 0.14** | 0.05 | [0.04, 0.23] |
| Responsiveness × Gender | -0.11 | 0.10 | [-0.33, 0.10] |
| Age | -0.16*** | 0.04 | [-0.24, -0.07] |
| Depressive Symptoms | -0.19*** | 0.05 | [-0.28, -0.09] |
| Family Conflict | -0.01 | 0.05 | [-0.07, 0.10] |

*Note.* $N = 141$ youth. Coeff = coefficient; *SE* = standard error; CI = confidence interval. Continuous scores were calculated such that higher scores indicate greater standing on the variable (e.g., greater perceived responsiveness). Continuous predictors and covariates were standardized. Gender was dummy-coded (0 = male, 1 = female).
*$p < .05$, **$p < .01$, ***$p < .001$

Table 4

*Associations of the Interaction of Perceived Responsiveness and Self-Disclosure and the Interaction of Perceived Responsiveness and Gender with Negative Affect*

| Variable | Negative Affect | | |
|---|---|---|---|
| | Coeff | *SE* | 95% CI |
| **Self-Disclosure Model** | | | |
| Perceived Responsiveness | -0.03 | 0.04 | [-0.11, 0.04] |
| Self-Disclosure | 0.05 | 0.03 | [-0.02, 0.12] |
| Responsiveness × Disclosure | -0.04 | 0.02 | [-0.08, 0.01] |
| Asthma Severity Diagnosis | 0.04+ | 0.02 | [-0.02, 0.09] |
| Depressive Symptoms | 0.13*** | 0.02 | [0.08, 0.18] |
| Family Conflict | 0.06** | 0.02 | [0.01, 0.10] |
| **Gender Model** | | | |
| Perceived Responsiveness | 0.01 | 0.03 | [-0.05, 0.06] |
| Gender | -0.02 | 0.05 | [-0.14, 0.05] |
| Responsiveness × Gender | 0.05 | 0.05 | [-0.05, 0.16] |
| Asthma Severity Diagnosis | 0.05* | 0.02 | [0.001, 0.09] |
| Depressive Symptoms | 0.15*** | 0.02 | [0.10, 0.19] |
| Family Conflict | 0.06* | 0.02 | [0.01, 0.11] |
| **Combined Model** | | | |
| Perceived Responsiveness | -0.08 | 0.04 | [-0.17, 0.01] |
| Self-Disclosure | 0.06 | 0.03 | [-0.01, 0.12] |
| Gender | -0.06 | 0.05 | [-0.16, -0.04] |
| Responsiveness × Disclosure | -0.06* | 0.03 | [-0.11, -0.01] |
| Responsiveness × Gender | 0.11+ | 0.06 | [-0.01, 0.22] |
| Asthma Severity Diagnosis | 0.05+ | 0.02 | [-0.001, 0.09] |
| Depressive Symptoms | 0.14*** | 0.03 | [0.09, 0.19] |
| Family Conflict | 0.05* | 0.02 | [0.01, 0.10] |

*Note.* N = 141 youth. Coeff = coefficient; *SE* = standard error; CI = confidence interval. Continuous scores were calculated such that higher scores indicate greater standing on the variable (e.g., greater perceived responsiveness). Continuous predictors and covariates were standardized. Gender was dummy-coded (0 = male, 1 = female).
+*p* < .10, **p* < .05, ***p* < .01, ****p* < .001

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Insert Figure 1 Here

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*Figure 1*. N = 141 youth. Interaction between perceived responsiveness and self-disclosure on youths' expression of the glucocorticoid receptor gene *NR3C1* (Panel A). Interaction between perceived responsiveness and gender on youths' expression of the glucocorticoid receptor gene *NR3C1* (Panel B). Lower and higher perceived responsiveness represent ± 1 *SD*. Shaded areas represent 95% confidence intervals for the simple slopes.

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Insert Figure 2 Here

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*Figure 2.* $N$ = 141 youth. Interaction between perceived responsiveness and self-disclosure on

youths' positive affect. Lower and higher perceived responsiveness represent ± 1 *SD*.  Shaded areas

represent 95% confidence intervals for the simple slopes.