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Parenting Styles Moderate How Parent and Adolescent Beliefs Shape Each Other's Eating and
Physical Activity: Dyadic Evidence from a Cross-Sectional, U.S. National Survey

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Key Words: Parenting Styles; Theory of Planned Behavior; Parent-Adolescent Relationships; Health Behavior; Dyadic Models of Health Behavior

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Abstract

Psychological theories of health behavior focus on intrapersonal influences on behavior. Greater attention to interpersonal effects and the relational contexts that regulate them has the potential to improve theory, and offer innovative strategies for intervention. This research takes a dyadic approach to understanding how parent and adolescent beliefs influence each other's health behaviors, and how the relationship context of parent-adolescent dyads moderates these effects. Using the Family Life, Activity, Sun, Health, and Eating study (FLASHE), we analyze responses from 1,717 parent-adolescent dyads from across the U.S., and explore a dyadic extension to the Theory of Planned Behavior (TPB). We evaluate how parenting styles that characterize each parent-adolescent dyad moderate the degree to which parents' and adolescents' own attitudes, subjective norms, and perceived behavioral control are associated with the other person's behaviors across four domains: fruit and vegetable consumption, junk food and sugary drinks consumption, engagement in physical activity, and engagement in screen time sedentary behaviors. We find that the association between parents' attitudes, social norms, and perceived behavioral control and their adolescent's eating behavior tends to be stronger when parents have an authoritative parenting style. However, we also find that the association between adolescents' attitudes, social norms, and perceived behavioral control and their parent's eating behavior tends to be stronger when parents have an authoritative parenting style. These findings show the importance of context in evaluating interpersonal influence, and hold implications for health-relevant interventions.

Parenting Styles Moderate How Parent and Adolescent Beliefs Shape Each Other's Eating and Physical Activity: Dyadic Evidence from a Cross-Sectional, U.S. National Survey

Despite the fact that relationships are part and parcel of social psychology, researchers have traditionally focused on specifying the *intrapersonal* processes that govern the behavior of individuals (Berscheid, 1999). However, people are inherently situated in a network of relationships that influence their thoughts, feelings, and behavior. One important context for *interpersonal* influence is physical health, in which there is an emerging consensus that *interpersonal* dynamics are important determinants of health outcomes (e.g., Holt-Lunstad et al., 2017) and health behaviors (Guidetti et al., 2014; Pietromonaco & Collins, 2017). Yet, the prevailing psychological theories of health behavior remain grounded in the intrapersonal perspective that dominated when they were first developed, and provide limited insights regarding how *another person's* beliefs influence an individual's behavior, or how an individual's beliefs influence *another person's* behavior. The goal of the current research is to demonstrate the value of adopting an *interpersonal*, dyadic approach to understanding health behaviors in a specific dyadic context – parent-child relationships – using one of the most oft-tested theories of health behavior - the Theory of Planned Behavior (Ajzen, 1985, 1991).

Consistent with this view, most public health priorities (e.g., poor nutrition, physical inactivity, teen pregnancy, and HIV) involve behaviors that occur predominantly in the context of personal relationships (CDC, 2016). More often than not, we eat, play, and have sex in ways that help us be with, relate to, and/or engage with other people (Leary et al., 1994). Although there is a long-standing literature on the provision and receipt of social support and its effect on behavioral and health outcomes (Cohen & Wills, 1985; House, Landis, & Umberson, 1988; Uchino, 2009), the models underlying this work offer limited guidance regarding how and when

the thoughts and feelings of close others (e.g., parents, spouses, best friends) shape a person's behavior (Huelsenitz et al., 2018; Karney et al., 2010). In the absence of theoretical guidance, investigators are limited in their ability to leverage one of the most powerful contexts in which people strive to be healthy—their close relationships.

Addressing the goals of this special issue, we propose that psychological theories of health behavior would benefit from attending to and systematically examining the influence of close others and, in particular, the relational contexts that regulate their effect on people's health behaviors. Researchers clearly acknowledge Gordon Allport's (1968) emphasis on the "imagined or implied presence of others" in influencing behavior and health through, for example, the assessment of perceived social norms (Ajzen, 1991). With the emergence of dyadic modeling techniques (e.g., Kenny, Kashy & Cook, 2006), it is now possible to account for the real presence of others, by assessing how key characteristics of close others influence people's behavior and delineating the conditions under which these factors predict health-relevant intentions and behaviors most powerfully. In the current research, we adopt a dyadic approach to the measurement and modeling of health behaviors (see also Howland et al., 2016; Huelsenitz et al., 2018; Joyal-Desmarais et al., 2018) to examine the conditions under which parents and their adolescent children tend to affect one another's eating and physical activity behaviors.

A Dyadic Approach to Health Behavior Modeling

Traditional psychological theories of health behavior focus almost exclusively on *intrapersonal* explanations of behavior, such as how a person's *own* characteristics (e.g., their beliefs, attitudes, perceptions, motivations, identity) predict their *own* behaviors. For example, the Theory of Planned Behavior (TPB; Ajzen, 1985, 1991) proposes that a person's *attitudes* (e.g., "I think eating fruit is healthy"), *subjective norms* (e.g., "I think others believe eating fruit

is healthy”), and *perceived behavioral control* (PBC; e.g., “I’m confident in my ability to eat more fruit”) predict their *intentions* (e.g., “I plan to eat more fruit”), which in turn predicts their *behavior* (e.g., eating fruit). The TPB acknowledges that a person’s perception of others can influence their intentions and behavior through subjective norms, but it provides little guidance as to how, when, or in which contexts close others should affect a person’s behavior, either through or independent of subjective norms. Although the subjective norms of close relational partners may overlap somewhat due to shared social networks, this similarity is controlled for in a dyadic extension of the TPB.

A dyadic extension of the TPB takes into account the attitudes, subjective norms, PBC, intentions, and behavior of *both* relationship partners to determine whether these theoretical constructs operate through *interpersonal* channels in addition to *intrapersonal* ones (see Figure 1). For example, we have found evidence that a parent’s intention to exercise and eat fruits/vegetables were associated with their adolescent’s exercise and consumption behaviors, statistically controlling for the effect of the adolescent’s intention on their own behaviors as well as the correlation between the parent’s and the adolescent’s intentions (Joyal-Desmarais et al., 2018; see also Howland et al, 2016).

A key feature of dyadic models is that they afford the opportunity to test how unique characteristics of the relationship itself – such as relationship quality in romantic dyads or parenting style in parent-child dyads – directly affect a health outcome or alter the manner in which relationship partners affect each other, which, in turn, has health implications. For example, the quality of family relationships has been shown to affect the ability of adolescents with Type I Diabetes to control their glycemic levels (Anderson, Holmbeck, Iannotti, McKay, Lochrie, Volkening, & Laffel, 2009) and marital relationships that are characterized by greater

responsiveness or satisfaction afford better long-term health outcomes (Holt-Lunstad, Birmingham, & Jones, 2008; Robles, Slatcher, Trombello, & McGinn, 2014). Additionally, in earlier work with romantic couples, we found that relationship quality moderates the interpersonal effects of certain TPB constructs (Howland et al., 2016). Specifically, the subjective norms held by one's romantic partner were more likely to predict one's own intentions to exercise when the relationship was higher in quality. The present study builds upon these findings by exploring how characteristics of the parent-child relationship regulate when the beliefs held by parents and their adolescent children are most likely to be associated with one another's eating and physical activity behaviors.

Parent-Adolescent Relationships and Health Behaviors

Parent-adolescent relationships are a particularly important and rich context in which to examine interpersonal determinants of health behaviors. Parents often act as role models for health-promoting behaviors (Morrongiello, Corbett, & Bellissimo, 2008) and frequently try to control their children's health-relevant behaviors (Birch & Fisher, 1998; Casey & Rozin, 1989). Health is often discussed in families (Bylund & Duck, 2004), and parents and children typically have many opportunities to influence each other's health behaviors by virtue of living in the same household (Patrick & Nicklas, 2005). Adolescence also marks a developmental stage in which children begin to seek more independence from parental influence, make their own choices, and attempt to have greater influence on decisions in the family (Palan & Wilkes, 1997). Thus, both parents and children may be motivated to influence each other during this stage of life.

Developmental scholars have long recognized that parenting characteristics—such as the degree to which parents are responsive, demanding, and autonomy-granting toward their

children—play an important role in the development and socialization of children (Baumrind, 1966; Darling & Steinberg, 1993). Certain parenting characteristics are known to help children and adolescents develop important competencies, such as learning how to balance their own needs and responsibilities in relation to those of other people and society. Parents who are responsive and constructively demanding, for example, have children who tend to be more cooperative, more psychosocially mature for their age, and more successful academically (Baumrind, 1989, 1991). Thus, the kind of parenting that children receive may influence important downstream outcomes.

Observing these different patterns of parenting characteristics, Baumrind (1966) and others (Maccoby & Martin, 1983; Maccoby, 1992) developed a parenting typology based on combinations of two traits: *demandingness* and *responsiveness*. Authoritative parents (those who are highly demanding and highly responsive) tend to have high but reasonable expectations for their children, respect their opinions, want to know about their troubles, and express warmth toward their children. Permissive parents (those who are less demanding and highly responsive) put fewer expectations on their children, but still show respect for, care about, and behave warmly toward them. Authoritarian parents (those who are high in demandingness and low in responsiveness) set strict rules for their children and expect them to be followed without question, refusing to consider their children's perspectives and desires. Uninvolved parents (those who are low in demandingness and responsiveness) are often unaware of or do not care about their children's needs or opinions, and hold minimal expectations for their children. Out of these four parenting styles, authoritative parenting represents the ideal amount of responsiveness and demandingness that may lead to a closer parent-child relationship and engender a context in which parents and children are able to influence one another (Baumrind, 1989, 1991).

In addition to the parenting style dimensions of responsiveness and demandingness, *autonomy-granting* has been considered as a third dimension of particular relevance to adolescence. It consists of parents respecting their children's independence and encouraging them to make their own decisions (Darling & Toyokawa, 1997). Though children with autonomy-granting parents may have more control over their own behaviors, because their parents have listened to and trusted them, they may also be more likely to be receptive to their parents' influence.

Health researchers have just begun to investigate how parenting styles are associated with the health behaviors enacted by children and adolescents. For example, Guidetti and colleagues (2016) found that authoritative parenting predicted similarity in parent-adolescent food liking, which in turn predicted similarity in consumption. This finding is consistent with the thesis that an authoritative parenting style creates a social context in which there is greater potential for mutual influence. Recent reviews (Davison & Birch, 2001; Sleddens et al., 2011; Vollmer & Mobley, 2013; Ventura & Birch, 2008) indicate that parents who enact an authoritative parenting style (high on both responsiveness and demandingness) have teenagers that report consuming *more* fruits and/or vegetables and *fewer* high fat foods and/or *less* sugar. A handful of studies that address the link between authoritative parenting and adolescents' physical activity and sedentary behaviors were also identified, but the results are mixed. Nevertheless, the conclusions of these reviews are consistent with the thesis that certain parenting styles should, in fact, be systematically related to the strength of parental influence on teenagers' health-relevant behaviors. For example, the association between parents' TPB attitudes, social norms, and perceived behavioral control and teenager's eating behavior ought to be stronger when parents have an authoritative parenting style, and weaker if they do not. To date, health behavior

research has focused on the effects of an authoritative parenting style. However, the broader literature on parenting styles suggests that responsive and age-appropriate autonomy-granting parenting also motivates children to be more open to parental socialization (Darling & Steinberg, 1993), which should allow parents who enact these parenting qualities to have greater impact on how their children think, feel, and behave with regard to health-relevant behaviors. To identify which of these parenting characteristics moderate associations between parents' and adolescents' beliefs and each other's behaviors, we examined authoritative parenting style, responsiveness, and autonomy-granting separately.

The Current Research

Through the integration of perspectives from health psychology and interpersonal relationships, the present study delineates the conditions under which beliefs held by close others may be most strongly associated with health-relevant behaviors. Using data from a large, national sample of U.S. parents and their adolescents (1,717 parent-adolescent dyads), we build on a dyadic extension of the TPB delineated in our prior work (see Figure 1; Joyal-Desmarais et al., 2018, open access preprint at osf.io/ksj57). In that research, we found that parents' health beliefs (i.e., their attitudes, subjective norms, and PBC) and parents' intentions typically are associated with their adolescent's health behaviors (paths F and K of Figure 1) across four health domains: fruit and vegetable consumption (FV), junk food and sugary beverage intake (JF), physical activity (PA), and screen time sedentary behavior (SB). Notably, we also found that adolescents' health beliefs and intentions are frequently associated with their parent's health behaviors (paths C and J of Figure 1). These interpersonal associations hold above and beyond both intrapersonal effects and correlations between parent-adolescent dyads for each construct in the model (see Figure 1). The present research substantially builds upon this work by exploring

the specific relationship context in which parents' TPB health beliefs are most and least strongly associated with their adolescent's health behaviors in these four domains. Specifically, we examine the following question: When parents have a more *authoritative* parenting style or when they are more *responsive* or *autonomy-granting*, are their TPB health beliefs and intentions more strongly associated with their adolescent's health behaviors? Although developmental research and theory has focused on how parenting styles regulate the degree of influence parents have on their adolescents, our dyadic model affords the opportunity to also examine in parallel the degree to which different parenting styles regulate the strength of the association between adolescents' beliefs and their parent's behaviors.

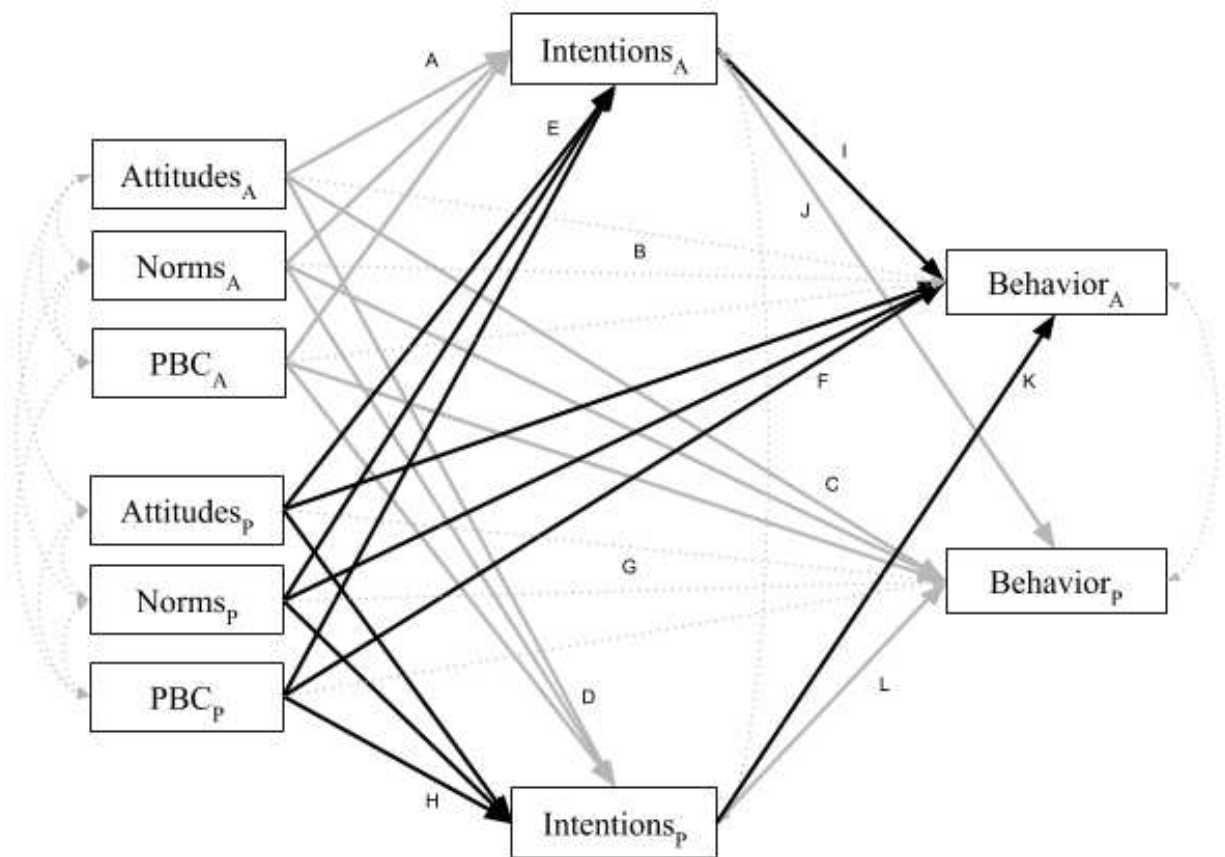


Figure 1. A dyadic extension of the Theory of Planned Behavior. Solid paths represent *interpersonal* effects (unidirectional arrows), and dashed paths represent *intrapersonal* effects (unidirectional arrows) or correlations (bidirectional arrows). Letters A through L represent the

path estimates. A, B, C, D, E, and F are the sum the three corresponding paths for beliefs (i.e., Attitudes, Norms, Perceived Behavioral Control [PBC]). Subscripts denote Adolescents (A) and Parents (P). Dark solid paths represent the total interpersonal effect of parent beliefs on adolescent behavior, which equals $E*I + F + H*K$. Gray solid paths represent the total interpersonal effect of adolescent beliefs on parent behavior, which equals $A*J + C + D*L$.

Method

Data Source and Sample

The FLASHE sample was recruited by the Ipsos Consumer Opinion Panel over all U.S. regions (Nebeling et al., 2017; Oh et al., 2017). Eligible parents (aged 18 years or older) lived with at least one adolescent (aged 12-17 years) for at least 50% of the time. Within each household, one adolescent was selected randomly to participate in the survey with their parent (either mother or father). 5,027 dyads were invited to participate, and 1,945 dyads enrolled. Participants responded to two surveys—one related to diet (i.e., FV and JF beliefs and behaviors), and another related to physical activity (i.e., PA and SB beliefs and behaviors). Questions related to demographics and parenting styles were included at the end of either the diet or physical activity survey (whichever was randomly assigned to be completed first). The current study uses responses from all dyads that provided responses to the diet ($N = 1646$) and/or the physical activity ($N = 1644$) surveys for a total of 1,717 dyads (see Table 1 for demographics of our sample). Further detail on FLASHE’s development, methodology, and recruitment process are available elsewhere (Mâsse & Lytle, 2017; Nebeling et al., 2017; Oh et al., 2017). Datasets and codebooks can be obtained at: <https://cancercontrol.cancer.gov/brp/hbrb/flashe.html>

Table 1. Descriptive Statistics for Parents and Adolescents in FLASHE Dyads (N dyads = 1,717)

Characteristic	n (%)	Characteristic	n (%)
Parent Sex		Dyad Type	
Male	443 (26%)	Mother - Daughter	599 (36%)
Female	1259 (74%)	Mother - Son	632 (38%)
Adolescent Sex		Father - Daughter	199 (12%)

Male	827 (50%)	Father - Son	226 (14%)
Female	836 (50%)	Parent Education	
Parent Age		Less than a 4-year college degree	905 (53%)
18–34	191 (11%)	4-year college degree or higher	792 (47%)
35–44	743 (44%)	Parent Race/Ethnicity	
45–59	718 (42%)	Non-Hispanic White Only	1176 (70%)
>= 60	50 (3%)	Non-Hispanic Black Only	290 (17%)
Adolescent Age		Hispanic	122 (7%)
12	222 (13%)	Other	99 (6%)
13	333 (20%)	Adolescent Race/Ethnicity	
14	279 (17%)	Non-Hispanic White Only	1053 (64%)
15	301 (18%)	Non-Hispanic Black Only	279 (17%)
16	328 (20%)	Hispanic	166 (10%)
17	204 (12%)	Other	153 (9%)

Preregistration

Our study protocol was preregistered prior to accessing the FLASHE dataset (osf.io/zvzke). The current study follows our preregistered protocol with three exceptions. First, we did not preregister an intentions measure, but added it later to better represent the TPB. The model we present (Figure 1) captures the preregistered paths in addition to those related to intentions, and results are similar when intentions are excluded. Second, we did not preregister analyses for sedentary behavior, but extended our analyses by applying the same protocol we used for the other three health domains. Third, although we did not preregister analyses for authoritative parenting style, this style is derived from our preregistered measures of responsiveness and demandingness.

Our preregistration also describes a moderation analysis involving *adolescent acceptance of parental control*, which was measured with reference to each behavioral domain. We did not include this analysis in the interest of brevity.

Measures

Theory of Planned Behavior Constructs

Beliefs and Intentions. Attitudes, subjective norms, perceived behavioral control, and intentions were assessed with respect to each health behavior domain (FV, JF, PA, SB) using mean scores across items with Likert-type response formats (1 = “strongly disagree”; 5 = “strongly agree”). The FV and PA items focused on engaging in these behaviors, whereas the JF and SB items focused on limiting these behaviors (see Table 2 for details regarding the specific measures). Adolescents and parents each responded to all items, with the exception of one subjective norms item that was asked only of adolescents. Because the present research builds upon findings from Joyal-Desmarais and colleagues (2018), we use the same set of preregistered items to measure TPB constructs. The FLASHE survey was not formally designed to assess the TPB, but the items we use closely correspond to traditional measures of TPB constructs.

Table 2. Items Used to Assess Belief and Intention Variables for Each Health Behavior Domain

TBP Variable	Domain	Item
Attitudes	FV, JF, PA, SB	I would [<i>engage in behavior</i>] because it’s an important thing for me to do
	PA	I don’t like to [<i>engage in behavior</i>] ¹
	PA	If I were to [<i>engage in behavior</i>] it would be fun
Subjective Norms	FV, JF, PA, SB	I would [<i>engage in behavior</i>] because others would be upset with me if I didn’t (i.e., injunctive norm).
	FV, JF, PA, SB	My friends [<i>engage in behavior</i>] (i.e., descriptive norm). ²
PBC	FV, JF, PA, SB	I feel confident in my ability to [<i>engage in behavior</i>].
Intentions	FV, SB, JF, PA	I would [<i>engage in behavior</i>] have thought about it and decided that I want to [<i>engage in behavior</i>]
Example wordings for engagement in each behavior domain:		
FV	eat fruits and vegetables every day	
JF	try to limit how much junk food and sugary drinks I have ¹	
PA	exercise most days of the week	
SB	try to limit the amount of time I spend using electronic devices ¹	

¹Item was reverse-keyed

²Only adolescents responded to this item.

Behavior. To assess eating behaviors, adolescents and parents each completed diet-related items (6 for FV; 16 for JF) selected from the 2009-2010 *National Health and Nutrition*

Examination Survey (Epidemiology and Genomics Research Program, National Cancer Institute, 2016) and the *National Youth Physical Activity and Nutrition Survey* (Centers for Disease Control and Prevention, 2010). To assess PA and SB, adolescents completed 12 items (8 for PA; 4 for SB) taken from the *Youth Activity Profile* (Saint-Maurice et al., 2017; Saint-Maurice & Welk, 2015); whereas parents completed six items from the *International Physical Activity Questionnaire* (IPAQ) Short Form (Craig et al., 2003) to assess PA, and six items from the *Project Eat Surveys* (Taverno Ross, Larson, Graham, & Neumark-Sztainer, 2014), the *Growing Up Today Study* (Falbe et al., 2013), and the *TREC Idea Study* (Lytle, 2009) to assess SB. Table 3 summarizes assessments across each behavior domain for parents and adolescents and provides example items for each behavior domain.

Table 3. Description of Scales Used to Assess Each Health Behavior

Domain	Assessed for	# of Items	Example Item (Scale/Anchors)	Scored using
FV	A; P	6	"During the past 7 days, how many times did you eat a green salad, with or without other vegetables?" (1 = not having consumed the item; 6 = 3 or more times per day)	Mean of items
JF	A; P	16	"During the past 7 days, how many times did you eat pizza like frozen, fast food or homemade pizza?" (1 = not having consumed the item; 6 = 3 or more times per day)	Mean of items
PA	A	8	"How many days did you walk or bike to school? If you can't remember, try to estimate." (0 = "0 days [never]" to 4 = "4-5 days [most every day])	Mean of items
PA	P	6	"During the last 7 days, on how many days did you walk for at least 10 minutes at a time?" (Indicated number of days)	Protocol from IPAQ Group (2005)
SB	A	4	How much time did you spend watching TV? This includes time spent watching movies or sports but <i>not</i> time spent playing video games. (1= "I didn't really use [device] at all" to 5 = "I used [device] more than 3 hours per day")	Mean of items
SB	P	6	About how many hours <i>per day</i> do you use each electronic device? Television (1= not at all; 6 = 6+ hours)	Mean of items

FV = fruit and vegetable consumption; JF = junk food and sugary beverage intake; PA = physical activity; SB = screen time sedentary behavior; A = Adolescents; P = Parents.

Moderators

Parenting Styles. Parents and adolescents both responded to six items, selected from the original 15-item *Parenting Style Inventory II* (PSI-II; Darling & Toyokawa, 1997) and modified for use in the FLASHE study. The PSI-II assesses three parenting style dimensions: emotional *responsiveness*, psychological *autonomy-granting*, and *demandingness*. All items were answered on a 5-point scale (i.e., 1 = “strongly disagree”; 3 = “neither disagree nor agree”; 5 = “strongly agree”) and were phrased appropriately for parent and adolescent respondents. To assess *responsiveness* participants responded to two items: “My teenager can count on me if he/she has a problem” and “My parent(s) don't like me to tell them my troubles” (reverse-coded). Items used to assess *autonomy-granting* were: “My parent(s) respect my privacy” and “I make most decisions about what my teenager can do” (reverse-coded). We used items assessing *demandingness* to form a measure of authoritative parenting. The items were: “My parent(s) expect me to follow family rules” and “I let my teenager get away with things” (reverse-coded). The mean of parent and adolescent responses was calculated to form a relationship-level assessment of each dimension¹. Each dimension was then dichotomized using median splits (see Table 4). Dyads at the median value on a moderator were placed into the high group. Because the median of autonomy-granting is equal to the scale's neutral mid-point, these dyads were put in the low group, such that the high group represents only dyads who affirmed that the parent is autonomy-granting. Following prior literature (Baumrind, 1991; Darling & Steinberg, 1993), we created a dichotomous variable reflecting *authoritative parenting*, which is the combination of high demandingness and high responsiveness (i.e., highly authoritative) versus the other three

¹ Because the parenting styles scales combine parent and adolescent reports of parenting style (each assessed with only 2 items), the alpha values for the scales were attenuated.

combinations of demandingness and responsiveness (i.e., less authoritative).

Table 4. Descriptive Statistics and Correlation Matrix for the Parenting Style Moderator Variables

	High (N)	Low (N)	M (SD)	Md	α_s	r	
						1	2
1 Demandingness	1010	636	4.06 (.60)	4	0.55		
2 Responsiveness	1000	644	4.56 (.56)	4.75	0.58	0.32	
3 Autonomy-Granting	796	845	3.13 (.64)	3	0.51	-0.09	0.12
4 Authoritative	676	952	-	-	-		

Sample size for high and low values on each moderator is depicted. Authoritative parenting is a combination of high demandingness and high responsiveness. Correlations are all $p < .001$.

Statistical Analyses

We conducted dyadic analyses using the Actor-Partner Interdependence Model (APIM; Kenny, Kashy, & Cook, 2006), which uses nested structures to test the independent contribution of *partner* effects (i.e., interpersonal effects, such as the effect of parents' PBC on their adolescents' behavior) and *actor* effects (i.e., intrapersonal effects, such as the effect of adolescents' PBC on their own behavior). In Joyal-Desmarais and colleagues (2018), we report results of this basic model. The focus of the present analyses is to test whether three relationship-level factors assessing parenting style—responsiveness, autonomy-granting, and authoritative parenting—moderate the pattern of partner effects observed within the parent-adolescent dyads.

Specifically, we used structural equation modeling (SEM) with the lavaan package (Rosseel, 2012) in R (R Core team, 2017) to fit a two-group model for high and low values on each moderator variable (e.g., high vs. low parental responsiveness) following the approach developed by Manne and colleagues (2017). First, we conducted chi-squared omnibus tests that compared a constrained model (in which all paths were forced to be equal across high versus low values of each moderator) to an unconstrained model (in which all paths were allowed to vary across the two groups). Second, we examined interpersonal effects (see the gray and black solid arrows depicted in Figure 1) for high versus low values on each parenting style moderator.

Support for moderation of interpersonal effects was determined by comparing effect estimates for high versus low values in relation to each other's confidence intervals (CIs). Estimates for both high *and* low levels of the moderator that were outside each other's 95% CIs were interpreted as strong support for moderation. When only one estimate for either high *or* low levels of the moderator was outside the 95% CI of the other, this was interpreted as moderate support for moderation. Finally, estimates for high *and* low levels of the moderator that were both within each other's 95% CIs were interpreted as failure to find support for moderation (see Table 5). This approach allowed us to determine whether the interpersonal effects of one person's beliefs on the other's behavior (depicted in Figure 1) differed for dyads with high versus low levels of the moderator (see Manne et al., 2017; Ledermann, Macho, & Kenny, 2011). Models were fit using full information maximum likelihood, and all beliefs, intentions, and behavior variables were standardized to allow for comparisons across path estimates. Confidence intervals around estimates were formed using the adjusted bootstrap percentile method (Rosseel, 2012). R code used for variable construction and analyses can be obtained at our project page (osf.io/x3jav).

Results

Our analyses provide an examination of whether aspects of the relational context (i.e., parenting style) moderate the degree to which the beliefs held by parents and adolescents are associated with each other's behaviors. First, we consider this question at the omnibus level, examining whether there are any overall differences across relational contexts for each of the four behaviors (i.e., FV, JF, PA, and SB). Second, we consider more specific patterns of moderating effects for the three parenting styles (i.e., adolescents whose parents were high versus low in responsiveness, autonomy-granting, and authoritativeness) on the extent to which

(a) parents' health beliefs are associated with their adolescent's health behaviors, and (b) adolescents' health beliefs are associated with their parent's health behaviors.

Test for Model Differences in High and Low Values of Parenting Style Variables

We conducted a chi-squared omnibus test to determine whether there were differences in model fit constraining all effects to be equal versus unconstrained across dyads with high versus low levels of each moderator. In the domain of fruit/vegetable consumption, there were no significant differences between the constrained and unconstrained models for high versus low levels of responsiveness, autonomy-granting, and authoritative parenting ($p = .083$, $p = .052$, and $p = .200$, respectively). However, all three moderators were significant for junk food intake ($p < .0001$, $p = 0.010$, and $p < 0.001$, respectively), one was significant in the domain for physical activity ($p < .0001$, $p = .094$, and $p = .051$, respectively), and two were significant for sedentary behavior ($p = .003$, $p = .653$, and $p = .020$, respectively). Taken together, we found significant support for six tests of moderation, marginal support for an additional four tests, and failed to find support for only two tests. This indicates that parenting style variables generally moderated our model. These findings were further substantiated by more specific moderation tests of the interpersonal effects in our model.

The Association Between Parent Beliefs and Adolescent Behavior

We evaluated whether parenting styles moderated the association between parent beliefs and adolescent behavior by comparing effect estimates for high versus low values of each moderator to each other's confidence intervals (see Table 5). We found support for four of twelve possible moderating effects. Adolescents who had *highly* responsive parents were *more* likely to act in line with their parent's beliefs about limiting junk food intake (high: $b = .061$ $CI[-.03, .15]$; low: $b = -.10$ $CI[-.28, .08]$). Adolescents with *highly* responsive parents were also more

likely to engage in a level of physical activity that aligns with their parent's beliefs (high: .06 [-.02, .14]; low: -.07 [-.22, .08]). Additionally, adolescents whose parents were *lower* in autonomy-granting were *more* likely to act in line with their parent's beliefs about limiting junk food intake (high: -.10 [-.22, .01]; low: .12 [-.04, .28]). Finally, adolescents whose parents had an authoritative style were *more* likely to act in line with their parent's beliefs about limiting junk food intake than adolescents whose parents who did not have an authoritative parenting style (high: .07 [-.04, .18]; low: -.06 [-.21, .09]).

The Association between Adolescent Beliefs and Parent Behavior

Because a dyadic approach allows us to model mutual influence between relational partners, we also examined the moderating effects of parenting styles on the extent to which adolescents' health beliefs were associated with their parent's behavior (see Table 5). Our analyses provided support for seven of twelve possible moderating effects. Specifically, parents who were *highly* responsive were *more* likely to act in line with their *adolescent's* beliefs about limiting both junk food intake (high: .13 [.04, .22]; low: -.05 [-.18, .09]) and sedentary behavior (high: .02 [-.07, .11]; low: -.22 [-.35, -.09]). Additionally, parents who were *lower* in autonomy-granting were *more* likely to act in line with their adolescent's beliefs about limiting junk food intake (high: -.002 [-.10, .09]; low: .14 [.03, .25]) and engaging in physical activity (high: .03 [-.05, .12]; low: .12 [.02, .22]). Finally, parents who had an authoritative style were *more* likely to act in line with their adolescent's beliefs about eating fruits and vegetables (high: .31 [.21, .42]; low: .20 [.18, .28]), and limiting both junk food intake (high: .13 [.02, .24]; low: .004 [-.10, .12]) and sedentary behavior (high: .03 [-.09, .14]; low: -.15 [-.26, -.05]).

Table 5. Interpersonal Effect Estimates for High vs. Low Values on Each Parenting Style Moderator

Moderator & Level	Behavior Domain							
	FV		JF		PA		SB	
	<i>b</i>	95% CI	<i>b</i>	95% CI	<i>b</i>	95% CI	<i>b</i>	95% CI
<i>Association between Parent Beliefs and Adolescent Behavior (Figure 1 paths: EI + F + HK)</i>								
Responsiveness								
High	0.195***	[0.107, 0.283]	0.061	[-0.03, 0.152]	0.06	[-0.017, 0.137]	0.016	[-0.077, 0.108]
Low	0.23**	[0.073, 0.386]	-0.1	[-0.282, 0.082]	-0.067	[-0.216, 0.082]	-0.061	[-0.248, 0.125]
Autonomy-Granting								
High	0.191***	[0.091, 0.291]	-0.104	[-0.215, 0.006]	0.031	[-0.058, 0.12]	-0.036	[-0.145, 0.074]
Low	0.231***	[0.099, 0.363]	0.121	[-0.037, 0.279]	0.04	[-0.088, 0.168]	-0.083	[-0.248, 0.081]
Authoritative								
High	0.16**	[0.05, 0.269]	0.068	[-0.041, 0.178]	0.104*	[0.009, 0.199]	0.007	[-0.102, 0.115]
Low	0.222***	[0.092, 0.351]	-0.058	[-0.211, 0.094]	0.017	[-0.104, 0.139]	-0.044	[-0.214, 0.126]
<i>Association between Adolescent Beliefs and Parent Behavior (Figure 1 paths: AJ + C + DL)</i>								
Responsiveness								
High	0.274***	[0.192, 0.356]	0.128**	[0.041, 0.215]	0.051	[-0.029, 0.131]	0.021	[-0.071, 0.112]
Low	0.214***	[0.111, 0.317]	-0.048	[-0.182, 0.087]	0.119*	[0.01, 0.229]	-0.221***	[-0.35, -0.091]
Autonomy-Granting								
High	0.279***	[0.193, 0.365]	-0.002	[-0.102, 0.099]	0.034	[-0.049, 0.116]	-0.068	[-0.173, 0.038]
Low	0.213***	[0.12, 0.307]	0.141*	[0.031, 0.251]	0.122*	[0.022, 0.222]	-0.077	[-0.183, 0.03]
Authoritative								
High	0.314***	[0.206, 0.421]	0.129*	[0.021, 0.237]	0.093	[-0.009, 0.194]	0.027	[-0.086, 0.14]
Low	0.198***	[0.117, 0.279]	0.004	[-0.099, 0.107]	0.071	[-0.013, 0.156]	-0.152**	[-0.255, -0.049]

All estimates are standardized. Text in italics represents *moderate* support for moderation (i.e., one estimate for either high *or* low levels of the moderator is outside the CI of the other). Bold dark text represents *strong* support for moderation (i.e., estimates for both high *and* low levels of the moderator are outside each other's CIs). Gray text represents no support for moderation (i.e., estimates for both high *and* low levels of the moderator are within each other's CIs). FV = Fruit and vegetable consumption; JF = Junk food and sugary drinks intake; PA = Physical activity; SB = Screen time sedentary behavior.

*** $p < .001$; ** $p < .01$; * $p < .05$

Discussion

In this paper, we proposed that psychological theories of health behavior can benefit from assessing and modeling the influence of close others and, in particular, the relational contexts in which partners most strongly affect each other's health behaviors. We then examined a dyadic extension of the Theory of Planned Behavior and found that the relationship context of parent-adolescent dyads *does* moderate the strength of associations between both parents' and adolescents' health beliefs on one another's behaviors in four health domains.

Prior research has highlighted the importance of parenting styles for adolescent psychosocial adjustment and health behavior (Baumrind, 1989, 1991; Vollmer & Mobley, 2013), suggesting that certain parenting styles ought to moderate the link between parents' beliefs/goals/values and their adolescent's health behavior (Darling & Steinberg, 1993; Sleddens et al., 2011). Our results confirm the importance of parenting styles on parent-adolescent dynamics, revealing that these dynamics are regulated by certain parenting styles. Among the three parenting styles we evaluated, authoritative parenting was most likely to regulate interpersonal effects in both directions – from parent-to-adolescent and from adolescent-to-parent – across three of the four health behavior domains.

We also found that parenting styles more frequently and strongly moderate associations between adolescents' beliefs and their parent's behavior than parent-to-adolescent associations. Our research, as well as that of others who have adopted a dyadic approach, indicates that adolescents can influence their parents, just as parents influence their adolescents (Coensens, De Mol, De Bourdeaudhuij & Buysse, 2010; Dwyer et al., 2017; Guidetti et al., 2016 Joyal-Desmarais et al., 2018).

Our earlier research with romantic couples showed that interpersonal effects are moderated by relationship quality (Howland et al., 2016). The current study expands on these findings by demonstrating that when parent-adolescent relationships are higher in quality (as indexed by certain parenting styles), adolescents are more capable of influencing their parents. For example, parents who had an authoritative style were *more* likely to act in line with their adolescent's beliefs about eating fruits and vegetables, limiting junk food intake, and reducing sedentary behavior. Given the constellation of findings, we suspect that the moderating effect of relationship quality (broadly defined) on health-related interpersonal effects may generalize across many different types of close relationships, making it an important variable for future theorizing and possible interventions.

Implications for Health Behavior Interventions

Targeting relationship quality. These results have several implications for health interventions. First, an intervention may not need to directly target an adolescent's health beliefs in order to influence their health behavior. Interventions that target the quality of the relationship between parents and their teenagers have the potential to amplify the influence of parents' beliefs on their adolescent's behavior. If, for example, a parent already believes that limiting junk food intake is important, feasible, and normative, an intervention that increases the parent's use of an authoritative parenting style may reduce their adolescent's junk food consumption. This is important when one considers that it may be challenging to directly change adolescents' beliefs regarding junk food. Furthermore, parents often have more favorable views about limiting junk food than their adolescent children do. Second, targeting relationship quality may also be more efficient, especially if the objective is to improve an adolescent's health behavior across several domains. For example, adopting the traditional, individual-centered approach advocated by the

Theory of Planned Behavior (or, more broadly, the reasoned action approach; Fishbein, 2008) requires targeting adolescents' beliefs in each health behavior domain. In contrast, our dyadic approach suggests that when an adolescent's parent already holds favorable beliefs about certain health behaviors, it may be more efficient to target relationship quality, which then might have radiating consequences for several health behavior outcomes. Research on this topic is limited, but it is a clear direction for future work. Interventions aimed at parenting quality and health behaviors tend to focus on eating outcomes or weight, but they underscore that changing parenting styles is feasible (e.g., Eshel, Daelmans, de Mello, & Martines, 2006), and that this approach has promising behavioral health implications (for reviews, see Ventura & Birch, 2008; Devor & Ginsburg, 2005; Sung-Chan, Sung, Zhau, & Brownson, 2013).

Targeting adolescents and other family members. Marketers have capitalized on the insight that adolescents' can influence their parent's behavior when purchases are being made (Preston & White, 2004). Our findings reinforce the notion that adolescents' beliefs are associated with their parent's health behavior (above and beyond parent beliefs), and that this is particularly true when parent-adolescent relationships are good. This suggests that careful thought should be given to whom a specific intervention should be targeted. Targeting one family member might have rippling effects that change the behavior of several members in a family (e.g., Cornelius, Gettens & Gorin, 2016; Gorin, Wing, Fava, et al., 2008), and one family member in particular may be more able or likely to influence the others.

Implications for Health Behavior Theories

Given that dominant psychological theories of health behavior emerged during the cognitive revolution, it is not surprising that they focus on how an individual's *own* characteristics (e.g., their beliefs) influence their *own* behavior instead of focusing on

interpersonal explanations. There is a growing interest in the effects of interpersonal influence (Berli et al., 2016, 2018; Dwyer et al., 2017; Guidetti et al., 2012), and the emergence of dyadic modeling techniques has enabled researchers to measure and model the influence of key characteristics of significant others, and to delineate the conditions under which these factors expand our ability to predict health-relevant intentions and behaviors (Karney et al., 2010). Our results demonstrate that a dyadic approach to theories of health behavior has the potential to introduce greater clarity and specificity into our theorizing.

Limitations and Strengths

The current research has some limitations. First, although NCI's FLASHE study was designed to maximize sample similarity to U.S. demographics and regions (Nebling et al., 2017; On et al., 2017), participants in the study were fairly well educated and there were more female than male parents. Second, the TPB constructs and parenting style moderators were assessed by a relatively small number of items, making them more susceptible to measurement error. That said, items for FLASHE were selected through expert consensus and cognitive testing, and despite the small number of items, they load well and are similarly reliable in relation to larger scales (Nebling et al., 2017). Furthermore, although FLASHE was designed to examine parenting styles, it was not formally designed to assess TPB constructs. However, given the close resemblance of constructs in health behavior theories (Sheeran et al., 2017), we were able to identify items that adequately captured each TPB construct, and these items replicated prior intrapersonal findings from the TPB (Armitage & Conner, 2001; McEachan et al., 2016) across all four behavioral domains. In contrast, health behaviors were assessed in greater detail with well-validated scales, making them more reliable and perhaps more generalizable. Third, these data are cross-sectional. As a result, our inferences are limited to identifying potential

intrapersonal and interpersonal associations, rather than causal relations. Future studies should make use of longitudinal and/or experimental designs to elucidate causal patterns in dyadic extensions of TPB models. Finally, we did not evaluate the effects of age and gender in the current study, but acknowledge that they may be important variables to model in future work. The moderating effect of autonomy-granting, for example, may dissipate as adolescents age. Moreover, lower levels of autonomy-granting may yield stronger associations between parents' beliefs and their adolescent's behavior when teenagers are younger, but weaker associations when teenagers are older and more likely to desire greater autonomy. Future research should explore these possibilities.

There are also several noteworthy strengths of the current work. First, through NCI's FLASHE dataset, we had access to a large, national sample of 1,717 parent-adolescent dyads. Accordingly, our study had more statistical power to detect the effects of interest than has typically been the case for most dyadic designs, and it should generalize reasonably well to the U.S. population of parents who have adolescent children. Second, the sampling of responses from both members of each dyad (i.e., parents and their adolescents) allowed us to use the APIM, which properly and simultaneously models intrapersonal and interpersonal effects as well as relevant correlations between adolescent and parent constructs (see Figure 1; Kenny et al., 2006). This strong analytic framework enabled us to disentangle effects that are uniquely interpersonal from those that are intrapersonal. For example, we could determine whether adolescents' subjective norms were uniquely associated with their parent's behavior because the APIM accounts for correlations between adolescents' and their parent's subjective norms as well as the association between parents' subjective norms on their own behavior. Finally, to our knowledge, these results represent the only attempt to date to evaluate the conditions under

which a dyadic model of health behavior is mostly likely to yield interpersonal effects. It is also one of the first studies to evaluate a dyadic model across four important health behavior domains, and across three relationship-level contexts (parenting styles).

Conclusion

In conclusion, most psychological theories of health focus on intrapersonal influences on behavior. Greater attention to interpersonal effects and, in particular, the relational contexts that regulate them can both improve theory and better inform interventions. In this research, we found that the association between parents' TPB attitudes, social norms, and perceived behavioral control and their adolescent's eating behavior was stronger when parents had an authoritative parenting style. Importantly, we also found that the association between adolescents' TPB attitudes, subjective norms, and perceived behavioral control and their parent's eating behavior was stronger when the parents had an authoritative parenting style. These results accentuate the importance of taking into account the context of the relationship in dyadic models of health behavior, and they point to novel targets for health-relevant interventions.

Open practices

This article earned Preregistration, Open Materials, and Open Data badges for transparent practices. All relevant information, including R code, can be obtained on our project page: <https://osf.io/x3jav>. The direct link to our preregistration is <https://osf.io/zvzke>. Datasets and codebooks used in this article come from the National Cancer Institute's Family Life, Activity, Sun, Health, and Eating (FLASHE) study, which are publicly accessible at: <https://cancercontrol.cancer.gov/brp/hbrb/flashe.html>.

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