American Psychological Association
Society for HEALTH PSYCHOLOGY
Health Psychology

0278-6133/18/$12.00

2018, Vol. 37, No. 7, 691–699
http://dx.doi.org/10.1037/hea0000634

Unpredictability, Body Awareness, and Eating in the Absence of Hunger: A Cognitive Schemas Approach

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Objective: The current research examined whether cognitive schemas that emerge in the context of early life stress predict psychological and behavioral outcomes that increase obesity risk. Three studies tested this hypothesis, predicting that having an unpredictability schema—which is a mindset characterized by the belief that the world and the people in it are unpredictable and unreliable—would predict low body awareness and eating in the absence of hunger. ***Method:*** Self-report measures of early life environment, unpredictability schema, body awareness, and eating habits were used in Studies 1–3. Blood glucose and an eating task were used as objective measures of energy need and energy intake in Study 3. ***Results:*** In Study 1, low childhood socioeconomic status (SES), parenting inconsistency, and poor childhood neighborhood quality predicted having an unpredictability schema, which predicted lower body awareness. In Study 2, participants with an unpredictability schema were found to have lower body awareness, less mindful eating, and more self-reported eating in the absence of hunger. In Study 3, the pattern of results from Studies 1 and 2 were conceptually replicated using a laboratory eating task. Participants with an unpredictability schema had lower body awareness, which predicted eating in the absence of hunger. ***Conclusions:*** These results suggest that having an unpredictability schema may be an important predictor of low body awareness and eating in the absence of hunger. Although eating in the absence of hunger may have historically promoted survival in circumstances marked by unpredictability, they may contribute to obesity risk in contemporary food-rich environments.

Keywords: unpredictability schema, body awareness, eating in the absence of hunger, eating behavior, childhood socioeconomic status (SES)

Supplemental materials: http://dx.doi.org/10.1037/hea0000634.supp

Obesity is a growing public health concern in the United States and throughout the rest of the developing world (World Health Organization, 2017). Research suggests that early life socioeconomic disadvantage plays an important role in contributing to obesity risk (e.g., Gonzalez et al., 2012; Kestilä, Rahkonen, Martelin, Lahti-Koski, & Koskinen, 2009), particularly in Westernized societies (Nettle, Andrews, & Bateson, 2017). For example, low SES in early childhood (ages 0–7) predicts an individuals' risk for obesity at age 33, even after controlling for educational attainment and parental body mass index (BMI; Power, Manor, & Matthews, 2003). Other research demonstrates that low early life SES (ages 0 – 12) predicts eating in the absence of energy need (Hill, Prokosch, DelPriore, Griskevicius, & Kramer, 2016), which is a pattern that itself promotes unhealthy weight gain and obesity (Fisher & Birch, 2002). Together, this body of work suggests that early life environments may play an important role in the development of psychological and behavioral patterns that have a lasting impact on energy balance in adulthood (Wells, Evans, Beavis, & Ong, 2010).

Explanations for the association between childhood environments and obesity risk have typically focused on the impact of external economic and sociological factors such as lack of financial resources for purchasing healthful foods, lack of education regarding the energy density of foods, and lack of safe spaces for play and recreation (e.g., Baltrus, Everson-Rose, Lynch, Raghunathan, & Kaplan, 2007; Drewnowski & Specter, 2004; Kant & Graubard, 2013; Laitinen, Power, & Järvelin, 2001). The current research moves the focus inward, examining whether having an unpredictability schema—a mindset characterized by the belief the world and the people in it are unpredictable/unreliable—predicts lower body awareness and eating in the absence of hunger (Cabeza de Baca, Barnett, & Ellis, 2016; Ross & Hill, 2002). Having an unpredictability schema may play a key role in linking early life experiences with psychological and behavioral factors that contribute to overweight and obesity in adulthood.

Early life environments have a lasting impact on behavioral patterns observed in adulthood (see also Mittal & Griskevicius, 2014; Mittal, Griskevicius, Simpson, Sung, & Young, 2015). For example, early life environments have been found to impact how

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This research was funded by the Texas Christian University College of Science and Engineering Research Center. We thank research assistants Lauren Nolan, Sarah Schad, Ashleigh Wells, Maggie Streelman, Kendra Sanguinetti, Katherine Hahn, and Ally Faust for their assistance with collecting the data associated with this research.

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individuals respond to ecological stressors such as violence (Griskevicius, Delton, Robertson, & Tybur, 2011) and resource scarcity (Hill, DelPriore, Rodeheffer, & Butterfield, 2014; Hill, Rodeheffer, DelPriore, & Butterfield, 2013), as well as internal stressors such as hunger (Hill et al., 2016). Evolutionary and health psychologists have therefore become increasingly interested in understanding the impact of early childhood environments on the development of behaviors that impact health and well-being across the lifetime (Griskevicius et al., 2011; Hill et al., 2014, 2016).

Despite the growing interest in the lasting effects of childhood environments on health, until recently, little was known about the proximate psychological mechanisms that develop in response to early life environments that guide health-relevant behaviors in adulthood. Drawing from insights on life history theory (Kaplan & Gangestad, 2005; Stearns, 1992), Cabeza de Baca and colleagues (2016) recently redressed this empirical gap by demonstrating that one's early life environments promote the development of cognitive schemas that direct perception and behavior in ways that would help the individual survive and reproduce in their expected adult environment.

According to this perspective, when developmental experiences are consistent and predictable, children will develop a working model of the world in which caretakers are perceived as being reliable and the environment is perceived as controllable—a predictability schema (Cabeza de Baca et al., 2016). However, when the environment is inconsistent and stressful, children will develop a working model of the world in which caretakers are perceived as being unreliable and the environment is perceived as uncontrollable—an unpredictability schema. These developmentally informed cognitive schemas are then reasoned to direct self-regulatory behaviors by influencing the perceived benefits associated with long-term planning, self-control, and the delay of gratification (Cabeza de Baca et al., 2016; Hill, Ross, & Low, 1997; Ross & Hill, 2002). Consistent with this hypothesis, research finds that having an unpredictability schema predicts increased impulsivity, sensation seeking, and risk taking (Cabeza de Baca et al., 2016; Ross & Hill, 2002). Each of these outcomes—although they are perceived as being undesirable or maladaptive in environments that reward long-term planning and the ability to delay gratification—would yield larger payoffs than those available from long-term planning in environments marked by uncertainty and unreliable social partners (Ellis, Bianchi, Griskevicius, & Frankenhuis, 2017; Ellis, Figueredo, Brumbach, & Schlomer, 2009).

The current research examined the relationship between having an unpredictability schema and factors that are known to contribute to obesity risk. Specifically, the current work sought to establish whether having an unpredictability schema predicts low body awareness and eating in the absence of hunger. Body awareness refers to one's attunement to cues bearing on the internal conditions of the body. In addition to playing an important role in the regulation of stress, mood, and arousal, body awareness plays an important role in regulating eating behavior and energy balance (Bekker, Croon, van Balkom, & Vermee, 2008; Craig, 2002, 2010; Mehling et al., 2009). Accordingly, body awareness is a potentially important mediator of energy dysregulation in response to stressful and unpredictable early life environments.

Research in neuroscience suggests that early life stress may fundamentally alter the development of interoceptive pathways in the brain that facilitate body awareness (e.g., Schulz & Vögele, 2015). In particular, research suggests that developmental exposure to chronic stress may favor increased investment in the neural substrates that allow for rapid processing of the external environment, decreasing investment in those used to process internal cues (Mirams, Poliakoff, Brown, & Lloyd, 2012). Such a developmental tradeoff is favored in the context of chronic stress because the presence of stressors requires heightened vigilance to cues present in one's external environment, even if it comes at the expense of diminished awareness of one's internal states. Consistent with this idea, research shows that early life developmental stress increases the risk of developing mental and physical health problems linked to altered perception of bodily sensations (e.g., depression, dissociative disorders, and energy dysregulation; Frodl, Reinhold, Koutsouleris, Reiser, & Meisenzahl, 2010; Hill et al., 2016; Sanders, McRoberts, & Tollefson, 1989).

Three studies were conducted to examine the relationship between having an unpredictability schema, body awareness, and eating in the absence of hunger. The first study tested the hypothesis that exposure to stressors that are characteristic of low childhood SES would predict having an unpredictability schema, which would predict low body awareness. The second study was designed to build off of Study 1 by testing the hypothesis that having an unpredictability schema would predict eating in the absence of hunger through its negative impact on body awareness. The last study was designed to test for a conceptual replication of this effect using blood glucose and a laboratory eating task as objective measures of energy need and energy intake.

Study 1

Study 1 was designed to test the prediction that having low childhood SES (a known risk factor for eating in the absence of hunger) would predict greater exposure to environmental and interpersonal unpredictability (parental inconsistency, household unpredictability, and poor neighborhood quality), leading to a more pronounced unpredictability schema and lowered body awareness.

Method

Participants. Participants included 353 men ($n = 154$) and women ($n = 199$) recruited from a midsize city in the southern United States. Participants were recruited using online advertisements and from a university departmental participant pool. To qualify, participants were between the ages of 18 to 30 ($M_{age} = 19.75$, $SD = 2.39$). Participants were not excluded on the basis of race, sexual orientation, or SES. A large sample of participants were recruited to ensure (a) the sample would be large enough to supply sufficient power to detect any relationship that might exist between the predictor and the outcome variables, and (b) the sample would have a range of childhood experiences that could be used to examine the relationship between key developmental factors and having an unpredictability schema. All research was approved by the Texas Christian University Institutional Review Board.

Procedure and materials. Participants were instructed to complete the online study on a personal computer in a quiet space. After providing informed consent, participants completed a battery of measures using Qualtrics Research Suite (2015) including a

measure of childhood SES (Cronbach's alpha = .80; Griskevicius et al., 2011), a 3-item childhood household unpredictability scale (Cronbach's alpha = .74; Mittal et al., 2015), as well as measures of parenting inconsistency (Cronbach's alpha = .68) and neighborhood quality (Cronbach's alpha = .72) developed for the purposes of this study. Participants then completed the Unpredictability Schema Questionnaire (Cronbach's alpha = .79; Cabeza de Baca et al., 2016) and the Body Awareness Questionnaire (BAQ; Cronbach's alpha = .85; Shields, Mallory, & Simon, 1989). Detailed descriptions of scales with sample items are available in the online supplemental materials.

Results

Bivariate correlation analyses were first performed to examine the relationship between childhood SES, household unpredictability, parenting inconsistency, poor neighborhood quality, the unpredictability schema, and body awareness (Table 1). Next, a path analysis was conducted (Loehlin, 1998) using MPlus (Muthén, 2007) to assess the relationship between childhood SES, environmental factors such as general household unpredictability, parenting inconsistency, and poor neighborhood quality on having an unpredictability schema and body awareness. Specifically, the following path was analyzed: Childhood SES → Intervening Environmental Factors (household unpredictability, parenting inconsistency, poor neighborhood quality) → Unpredictability Schema → Body Awareness. No participants were excluded from the analysis.

Results revealed that childhood SES significantly predicted household unpredictability, $b = -.20$, $SE = .05$, $\beta = -.23$, $p \leq .001$, 95% CI [−.31, −.10], parenting inconsistency, $b = -.12$, $SE = .04$, $\beta = -.17$, $p \leq .001$, 95% CI [−.04, −.21], and living in a poor-quality neighborhood, $b = -.42$, $SE = .04$, $\beta = -.55$, $p \leq .001$, 95% CI [−.50, −.34]. As childhood SES increased, each of these markers of environmental unpredictability decreased. Additionally, results revealed that parenting inconsistency, $b = .23$, $SE = .04$, $\beta = .39$, $p \leq .001$, 95% CI [.31, .15] and living in a poor-quality neighborhood, $b = .10$, $SE = .03$, $\beta = .17$, $p \leq .01$, 95% CI [.03, .16] each predicted having an unpredictability schema. Household unpredictability did not predict having an unpredictability schema once parenting and neighborhood quality were considered, $b = -.05$, $SE = .04$, $\beta = -.10$, $p = .11$, 95% CI [−.12, .02]. Lastly, as an unpredictability schema increased, body awareness decreased, $b = -.50$, $SE = .10$, $\beta = -.30$, $p \leq .001$, 95% CI [−.70, −.31], as displayed in Figure 1. Next, three indirect effects in the model were tested. There was a significant indirect effect of childhood SES on body awareness, via parenting inconsistency and unpredictability schema, $b = .01$, $SE = .006$, 95% CI [.01, .03]. In addition, there was a significant indirect effect of childhood SES on body awareness, via poor neighborhood quality and unpredictability schema, $b = .02$, $SE = .008$, 95% CI [.01, .04]. However, the indirect effect of childhood SES on body awareness was not significant, via household unpredictability, and the unpredictability schema, 95% CI [−.016, .001]. Results did not differ between male and female participants (all interactions with sex, $ps > .09$).

Discussion

Study 1 demonstrated that (a) an individual's early life environment plays an important role in the development of an unpredictability schema (those with more unpredictable environments had a more robust unpredictability schema), and that (b) having an unpredictability schema was predictive of lower body awareness. As evidenced by the results, parenting inconsistency and poor neighborhood quality are likely more important antecedents to having an unpredictability schema than household unpredictability, per se (i.e., once controlling for the effects of inconsistent parenting). This is consistent with past research (Cabeza de Baca et al., 2016) and lends continued support for the hypothesis that having an unpredictability schema may play a key role in mediating the relationship between one's early life experiences and adult outcomes (Cabeza de Baca et al., 2016; Ross & Hill, 2002). Additionally, these results found initial support for the hypothesized link between having an unpredictability schema and lower body awareness—a hypothesis explored more deeply in Study 2.

Study 2

Study 2 was designed to build upon the results of Study 1 by first attempting to replicate the relationship between having an unpredictability schema and lowered body awareness, and then examine whether low body awareness predicts differences in self-reported eating behaviors that are known to predict unhealthy weight gain. Specifically, it was hypothesized that having an unpredictability schema would predict lowered body awareness, less mindful eating, and more eating in the absence of hunger.

Table 1
Study 1 Correlations Between Measures of Subjective Childhood SES, Household Unpredictability, Parenting Inconsistency, Poor Neighborhood Quality, Unpredictability Schema, and Body Awareness

	Body awareness	Unpredictability schema	Poor neighborhood quality	Parenting inconsistency	Household unpredictability
Childhood SES	−.02	−.10†	−.55***	.17**	−.23***
Household unpredictability	−.03	.20***	.36***	−.63***	
Parenting inconsistency	.16**	−.37***	−.25***		
Poor neighborhood quality	.06	.22***			
Unpredictability schema	−.33***				

Note. SES = socioeconomic status.
† Indicates marginal significance at $p \leq .07$. ** $p \leq .01$. *** $p \leq .001$.

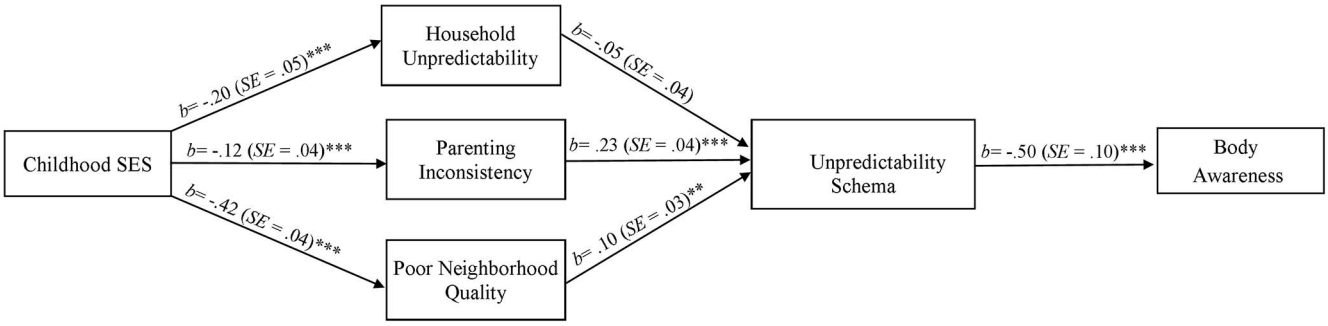

Figure 1. Path model explaining relationship between childhood socioeconomic status (SES) and body awareness via factors of environmental quality (household unpredictability, parenting inconsistency, and poor neighborhood quality) and the unpredictability schema. ** $p \leq .01$. *** $p \leq .001$.

Method

Power analysis. We conducted an a priori power analysis utilizing G*Power software (Version 3.1; Faul, Erdfelder, Buchner, & Lang, 2009; Faul, Erdfelder, Lang, & Buchner, 2007), basing estimates on the correlation coefficient between the unpredictability schema and the BAQ of $r = .33$ in Study 1. Per recommendations outlined by Cohen (1992) and basing calculations on an alpha level of .05 with power at .80, we determined a minimum of 69 participants would be needed for adequate power.

Participants. Participants included 69 men ($n = 16$) and women ($n = 53$) recruited from a medium sized private university in the southern United States. Participants were between the ages of 18 to 30.

Procedure and materials. Participants were recruited via a departmental participant pool and received partial course credit for participation. Eligible participants completed a computerized informed consent document and all participation took place using a computerized survey powered by Qualtrics Research Suite (2015). Participants responded to a battery of questionnaires assessing the unpredictability schema (Cronbach's alpha = .78; Cabeza de Baca et al., 2016), BAQ (Cronbach's alpha = .69; Shields et al., 1989), and self-reports of mindful eating (Cronbach's alpha = .78; Framson et al., 2009) and eating in the absence of hunger (Cronbach's alpha = .91; Tanofsky-Kraff et al., 2008). See the online supplemental materials for full descriptions of the scales and sample items.

Results

One participant was excluded listwise in the final analysis due to missing data. Bivariate correlation analyses were first performed to examine the relationship between the unpredictability schema, body awareness, mindful eating, and eating in the absence of hunger (Table 2). Next, to test the hypothesized path through which scores on the unpredictability schema impact body awareness and eating in the absence of hunger, the PROCESS macro in the Statistical Package for Social Sciences (SPSS) was used to test for serial mediation (Hayes, 2013). The model was set to provide a 95% bias-corrected CI using 10,000 bootstrap resamples (Preacher & Hayes, 2008). In serial mediation, an independent variable (X) is hypothesized to predict a series of mediators (M1, M2) and the dependent variable (DV). For this analysis, the unpredictability schema was entered as the independent variable, body awareness (M1), and mindful eating (M2) as the serial mediators, and eating in the absence of hunger was the DV.

Results revealed a significant indirect effect of unpredictability schema scores on eating in the absence of hunger (indirect effect = .08, $SE = .05$, 95% CI [.01, .24] via body awareness and mindful eating. A higher score on the unpredictability schema scale was associated with lower body awareness (more unpredictability = lower body awareness), $b = -.29$ ($SE = .13$), $p \leq .05$, indicating that having an unpredictability schema predicted less body awareness. Body awareness, in turn, predicted greater self-reported mindful eating $b = .45$ ($SE = .12$), $p \leq .01$. Next, mindful eating was found to predict less eating in the absence of hunger, $b = -.60$ ($SE = .14$), $p \leq .001$. The direct association between an unpredictability schema and eating in the absence of hunger was also significant, $b = .41$ ($SE = .15$), $p \leq .01$, in the expected direction with a more robust unpredictability schema predicting more eating in the absence of hunger (Figure 2). Results did not differ between male and female participants (all interactions with sex, $ps > .09$).

Discussion

The results of Study 2 conceptually replicated the result of Study 1, demonstrating that having an unpredictability schema predicts lowered body awareness. Further, Study 2 extended these results, demonstrating that having an unpredictability schema predicts self-reported eating behaviors. Specifically, having a higher unpredictability schema predicts less mindful eating and more eating in the absence of hunger through its impact on body aware-

Table 2
Study 2 Correlations Between Measures of the Unpredictability Schema, Body Awareness Questionnaire, Mindful Eating Scale, and Eating in the Absence of Hunger Scale

	Eating in the absence of hunger	Mindful eating	Body awareness
Unpredictability schema	.37**	−.28*	−.27*
Body awareness	−.00	.46***	
Mindful eating	−.46***		

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

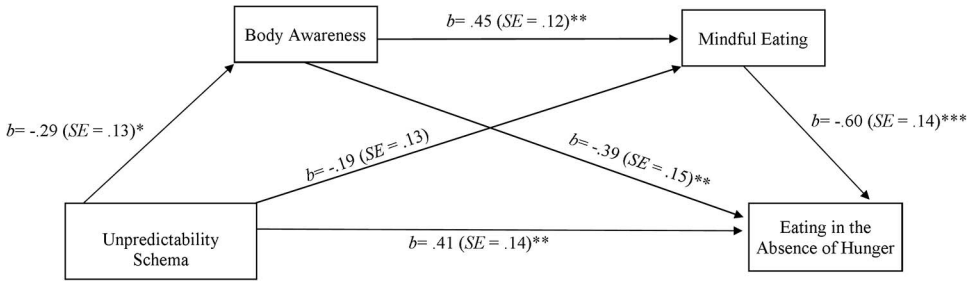

Figure 2. Serial mediation model with the unpredictability schema significantly predicting body awareness, mindful eating, and eating in the absence of hunger. * $p \leq .05$. ** $p \leq .01$. *** $p \leq .001$.

ness. Taken together, the results of this serial mediation model, along with the significant correlations between the aforementioned variables, indicate that having an unpredictability schema may be a significant driver in the development of body awareness, intuitive (or mindful) eating behaviors, and, ultimately, eating in the absence of energy need.

Study 3

Study 3 was designed to test whether the pattern of results observed in Study 2 could be conceptually replicated using a laboratory eating task. Specifically, Study 3 was designed to test the hypothesis that having an unpredictability schema would predict lower body awareness and more eating in the absence of energy need, and current energy need (measured using blood glucose) would moderate the relationship between body awareness and calories consumed. To test this hypothesis, participants came into the lab one at a time to participate in what was ostensibly a consumer taste-test study. Participant blood glucose was measured using a glucometer (which served as a proxy measure of participants' current energy need) and then the consumer taste-test eating opportunity was administered. Participants then completed demographic information, including the unpredictability schema and body awareness scales used in Studies 1 and 2.

Method

Power analysis. We conducted an a priori power analysis utilizing G*Power software (Version 3.1; Faul et al., 2009, 2007) basing estimates on the use of four predictors (unpredictability schema, body awareness, blood glucose, and the interaction between body awareness and blood glucose) to determine that the necessary sample size was 60 participants. We increased the number of participants to $N = 80$, given the numerous internal and external factors that influence eating behaviors (e.g., time of day, Schachter, 1968; mood and dietary quality, Conner, Brookie, Richardson, & Polak, 2015; Lesani, Mohammadpoorasl, Javadi, Esfeh, & Fakhari, 2016) and technical issues that typically arise with conducting this type of research.

Participants. Participants included 80 female ($n = 53$) and male ($n = 27$) undergraduates at a medium sized private university in the southern United States who participated in exchange for partial course credit. Participants were prescreened to only include those who were nonobese with a BMI <30, without diabetes, without food allergies, or any health condition that would impede a blood glucose check (e.g., hemophilia).

Procedure and materials. Participants attended sessions individually in a private laboratory space, where they were informed the purpose of the study was to better understand consumer preferences for snack foods. Participants completed a computerized informed consent using Qualtrics Research Suite (Version 48367; 2015). Participants' blood glucose reading was obtained (see the online supplemental materials for details) and recorded, then participants were informed of the ruse involving a consumer taste test of snack products. The two products included: a 1 oz bag of chocolate chip cookies (Chips Ahoy! brand) and a .9 oz bag of pretzels (Snyder's brand). The snack items were presented to participants in standard white styrofoam bowls along with an 8 oz bottle of water to cleanse the palate between taste tests. Participants were instructed to follow all on-screen prompts for guidance on how/when to consume the snacks. Participants were asked to engage in the following process first with the pretzels, then separately with the cookies. Participants were instructed to visually inspect the pretzels and then asked questions about the appearance of the snack items to help buttress the cover story (e.g., "Do you think that this is a product that you would like to buy?"). Then, participants were instructed to eat one pretzel, by chewing and swallowing normally. After eating one of the pretzels, participants were asked how much they liked it (on a 7-point Likert scale: 1 = *Dislike Extremely* and 7 = *Like Extremely*) followed by additional questions to help reinforce the cover story (e.g., "How much would you expect to pay for a serving size bag of this product?"). This process was repeated exactly as described for the cookie tasting and evaluation.

After the participants tasted and evaluated each of the products, they were made to wait for 2 min, ostensibly to allow for their product ratings to be uploaded to a remote, secure server, which was included to bolster the consumer taste-test ruse. Participants were instructed that they could eat as little or as much of the remaining food as they would like during this waiting period and throughout the remainder of the survey. After the 2-min waiting period had elapsed, participants completed a survey that asked them questions about their age, height, and weight. Participants then completed the unpredictability schema (Cronbach's alpha = .74; Cabeza de Baca et al., 2016) and the BAQ (Cronbach's alpha = .84; Shields et al., 1989). The total number of calories consumed by each participant was calculated by weighing the uneaten snacks using a

Taylor digital nutrition scale, which was then subtracted from the starting weight of each sample. The total weight in grams consumed was then converted to calories consumed based on nutritional guidelines on the product package. Total calories consumed served as our dependent measure in Study 3.

Results

Eight participants were excluded in the final analysis due to providing problematic feedback, $n = 3$ (e.g., correctly guessing the purpose of the study), admitting to not honestly responding to questions, $n = 2$, failing to pass the attention filter, $n = 1$, and listwise exclusions due to missing data, $n = 2$, leaving 72 participants for the final analyses. Before running the primary statistical model, bivariate correlation analyses were performed to examine the relationship between all measured variables (Table 3).

Next, the hypothesis that having an unpredictability schema would predict low body awareness and eating in the absence of hunger was tested using the following moderated mediation model: Unpredictability Schema → Body Awareness → Food Intake, with the path between body awareness and food intake being moderated by participants' measured blood glucose levels. The model was run using the PROCESS macro (Model 14; Hayes, 2013) in SPSS. Ten thousand bootstrap resamples were used to generate a bias-corrected 95% CI for each indirect effect (Preacher & Hayes, 2004). In this model, the unpredictability schema was the independent variable (X), body awareness was the mediator (M_i), and number of overall calories consumed (combining cookies and pretzels) was the dependent measure (Y). Blood glucose was entered as the critical moderator (V) in the path between the mediator and the dependent measure. As in previous research using this testing paradigm (Hill et al., 2016), cookie and pretzel liking, participant sex, and BMI were included in the model as covariates. The relationship with each of these covariates and the dependent measure was cookie liking: $b = 19.94$, $p \leq .001$; pretzel liking: $b = 11.98$, $p = .02$; participant sex: $b = -23.08$, $p = .19$; BMI: $b = .91$, $p = .77$.

Furthermore, results revealed a significant indirect effect, suggesting full conditional moderated mediation with a nonsignificant direct effect, $b = -1.28$ ($SE = 18.78$), 95% CI [−38.80, 36.25], $t(70) = -.07$, $p = .95$. Specifically, results revealed that having a higher unpredictability schema predicted lowered body awareness, $b = -.98$ ($SE = .21$), 95% CI [−1.40, −.57], $t(70) = -4.74$, $p \leq .001$. As unpredictability schema scores increased, body awareness decreased. Furthermore, the model revealed that there was a significant interaction between body awareness and blood glucose on calories consumed, $b = -1.24$ ($SE = .43$), 95% CI [−2.10 −.40], $t(70) = -2.92$, $p = .005$. For participants whose energy need was high (1 *SD* below the mean of blood glucose), there was no relationship between body awareness and food intake, $b = -13.22$, $SE = 12.09$, 95% CI [−39.17, 8.41]. Participants ate comparable amounts of food across levels of body awareness. For participants whose energy need was low (those with blood glucose scores 1 *SD* above the mean), however, body awareness mediated food intake, with those having higher body awareness eating significantly fewer calories, $b = 36.14$, $SE = 15.29$, 95% CI [10.82, 72.71], as displayed in Figure 3.

The interaction between body awareness and blood glucose was further probed using the PROCESS macro (Model 1; Hayes, 2013). Body awareness was entered as the predictor variable (X), blood glucose as the moderator (M), and calories consumed as the outcome or DV (Y), while controlling for product liking, participant sex, and BMI. Results revealed that, for participants with high body awareness (+1 *SD* above the mean), food intake varied according to bodily need. They consumed a higher number of calories when their blood sugar was low than when it was high, $b = -36.42$, $SE = 12.10$, 95% CI [−60.60, −12.24], $t(70) = -3.01$, $p = .004$ (Figure 4). For participants with low levels of body awareness (−1 *SD* below the mean), however, there was no relationship between bodily energy need and food intake, $b = 13.73$, $SE = 11.56$, 95% CI [−9.37, 36.52], $t(70) = 1.19$, $p = .24$. These results are consistent with the results from Study 2, demonstrating that having an unpredictability schema predicts lowered body awareness, which predicts eating in the absence of bodily energy need. Moreover, all results remained significant without the covariates in the model.

Table 3
Study 3 Correlations Between Measures of the Unpredictability Schema, Body Awareness, Blood Glucose, BMI, and Calories Consumed

	Unpredictability schema	Calories consumed	BMI	Blood glucose
Body awareness	−.49***	−.09	.04	−.31
Blood glucose	.19	−.18	.14	
BMI	−.02	−.06		
Calories consumed	−.09			

Note. BMI = body mass index.
*** $p \leq .001$.

Discussion

In Study 3, the results of Studies 1 and 2 were conceptually replicated and extended to examine eating behavior in a lab-based paradigm. First, consistent with observations in Studies 1 and 2, higher scores on the unpredictability schema predicted lower body awareness. Additionally, the results of Study 3 indicated that individuals low in body awareness were prone to eating in the absence of hunger. Although those with higher body awareness ate as a function of their blood glucose or energy need, those with lower body awareness ate comparable amounts of food regardless of their energy need. These results lend support for the hypothesis that having an unpredictability schema predicts lowered body awareness and eating in the absence of energy need.

General Discussion

The present research tested the hypothesis that participants who have an unpredictability schema—which is characterized by the belief the world and the people in it are unpredictable and unreliable—would have lower body awareness and more eating in the absence of hunger. Support for this hypothesis was found across three studies. Participants who reported having an unpredictability schema had lower body awareness (Studies 1–3) and were more prone to eating in the absence of hunger.

In addition to identifying a novel risk factor for low body awareness and eating in the absence of hunger, these results open

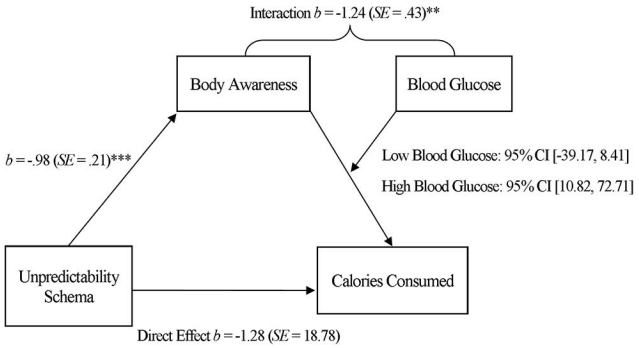

Figure 3. Conditional moderated mediation (Model 14) with the unpredictability schema significantly predicting body awareness with a significant interaction between body awareness and blood glucose on calories consumed, while controlling for product liking and participant body mass index. ** $p \leq .01$. *** $p \leq .001$.

new possibilities for treatment and intervention. For example, interventions aimed at changing an individual's levels of interpersonal trust and locus of control—both important facets of an unpredictability schema—may promote heightened body awareness and less eating in the absence of hunger. Similarly, given that an unpredictability schema is found to impact dysregulated eating behavior through its impact on body awareness, this is another potentially promising target for intervention. Interventions aimed at mindfulness and other means of increasing body awareness may be a fruitful means of increasing awareness of bodily states and decrease eating in the absence of hunger. Lastly, given that having an unpredictability schema has been linked with other socially undesirable outcomes (e.g., increased risk taking, externalizing behaviors), it raises the possibility that these outcomes may similarly be mediated through low body awareness. If this possibility is supported, it suggests that clinical interventions targeted at improving body awareness may have a cascading positive impact on a number of outcomes, including eating behaviors (the target of the current investigation).

There were several limitations of the current research. First, this body of research relied partially on retrospective and self-report measures. While retrospective and self-report measures are more prone to error (e.g., misremembering, influence of current relationship status with parents clouding childhood occurrences) than objective, observable measures, the pattern of results was conceptually replicated across three studies using separate populations and a variety of methodologies. This suggests that the effect captures an empirically verifiable phenomenon. Additionally, although beyond the scope of the current research, future research would also benefit from explicitly testing the degree whether the unpredictability schema scale predicts outcomes known to be linked to early life stress—including low body awareness and eating in the absence of hunger—when compared with each of its individual components (e.g., having an external locus of control or low interpersonal trust). Lastly, future research would benefit from explicitly examining whether decreased body awareness in the context of environmental uncertainty serves any useful, adaptive function. For example, because hunger imposes a cognitive burden on those who notice the cues (Van Dillen, Papies, & Hofmann, 2013; Ward & Mann, 2000), it is possible that lower body awareness in the context of food unpredictability may promote better cognitive function under conditions of scarcity. Additionally, it is possible that those with less body awareness experience a concomitant increase in attunement to *external* cues. Future research would benefit from examining these intriguing and clinically relevant possibilities that extend from the current results.

Future research would also benefit from examining the neural underpinnings of the current results. For example, research suggests that the insula plays a key role in body and self-awareness (Craig, 2004, 2010; Critchley & Harrison, 2013; Critchley, Wiens, Rotshtein, Öhman & Dolan, 2004; Pollatos, Gramann, & Schandry, 2007) as well as behavioral outcomes known to be associated with having an unpredictability schema (e.g., risk-taking; Cabeza de Baca et al., 2016; Ellis et al., 2009). The insula is part of the insular cortex which is embedded deep within the most prominent fissure in the brain, the lateral sulcus (Craig, 2009). The insula is a brain region known to receive and integrate sensations of pain, temperature, gastric distention, vasomotor flushing, and taste (Craig, 2011). Having an unpredictability schema may predict less insula activity, which may be the neural mechanism promoting body awareness and eating in the absence of hunger in this context.

Together, the results of the current research indicate the importance of environmental unpredictability (typical in low SES settings) on the development of body awareness and energy regulation mechanisms. Further, the results suggest that the unpredictability schema may be a valuable measure that health researchers can incorporate into their tool box to better understand the impact of the childhood environment on the development of perceptions and behaviors that have implications for health. Lastly, it provides an illustration of how researchers can employ an evolutionary perspective to better understand health behaviors in ways that can help advance knowledge in the field and develop novel interventions aimed at combatting unhealthy behaviors (Ahlstrom, Dinh, Haselton, & Tomiyama, 2017).

Developing a belief system permeated by low confidence in parents and stunted beliefs in the promise of the future has a lasting impact on somatic investment, a focus on the here and now, and opportunistic tendencies regarding calorie consumption. While overconsuming calories is commonly thought of as a maladaptive strategy that encourages excess weight and negates health and

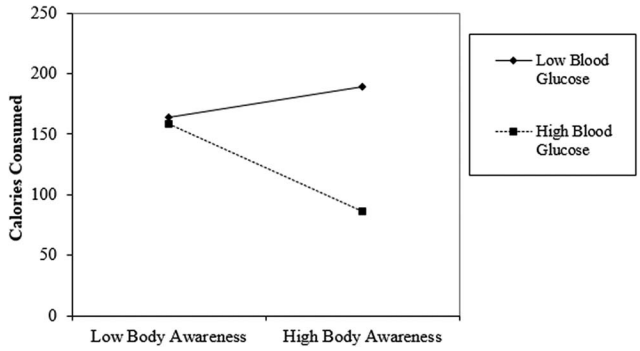

Figure 4. Moderated regression model using the PROCESS macro (Model 1; Hayes, 2013) to probe the effect of blood glucose on interoceptive body awareness and calories consumed.

mobility, it is perhaps a highly adaptive strategy that allows individuals reared in unpredictable circumstances the ability to maximize survival chances by storing calories for a day when they may be in short supply.

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Received July 17, 2017
Revision received March 22, 2018
Accepted March 27, 2018 ■

Correction to Jakubowski et al. (2016)

In the article, "Is Daytime Napping Associated With Inflammation in Adolescents?" by Karen P. Jakubowski, Martica H. Hall, Anna L. Marsland, and Karen A. Matthews (*Health Psychology,* 2016, Vol. 35, No. 12, 1298–1306, http://dx.doi.org/10.1037/hea0000369), Table 1 contains an error. The unit of measurement for IL-6 should be pg/mL instead of mg/L. This error did not impact the results or the interpretation of the findings.

http://dx.doi.org/10.1037/hea0000642