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THE RECIPROCAL PREDICTIVE RELATIONSHIP BETWEEN PERSONALITY AND RISKY BEHAVIORS: AN 8-WAVE LONGITUDINAL STUDY IN EARLY ADOLESCENTS

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THE RECIPROCAL PREDICTIVE RELATIONSHIP
BETWEEN PERSONALITY AND RISKY BEHAVIORS:
AN 8-WAVE LONGITUDINAL STUDY IN EARLY ADOLESCENTS

THESIS

A thesis submitted in partial fulfillment of
the requirements for the degree of Master of
Science in the College of Arts and Sciences
at the University of Kentucky

By

Elizabeth N. Riley

Advisor: Dr. Gregory T. Smith, Professor of Psychology

Lexington, KY

2015

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ABSTRACT OF THESIS

THE RECIPROCAL PREDICTIVE RELATIONSHIP BETWEEN PERSONALITY AND RISKY BEHAVIORS: AN 8-WAVE LONGITUDINAL STUDY IN EARLY ADOLESCENTS

While the overall stability of personality across the lifespan has been well-documented, there is also evidence of meaningful personality change. This is particularly true when individuals are going through periods of developmental transition. Over time, one sees incremental changes not just in behavior but in basic personality as well. 1,906 early adolescents were assessed for urgency scores, levels of maladaptive behavior engagement (drinking, smoking, and binge eating), and pubertal status every six months for four years. Zero-Inflated Poisson structural equation modeling (SEM) was used to test the model of reciprocal influence between behavior and personality. Across most six-month intervals over the course of the four-year study, urgency predicted increased engagement in the maladaptive behaviors. Strikingly, the reverse was true as well: engagement in behaviors predicted subsequent increases in urgency, which is otherwise a stable personality trait. This study is the first to find reciprocal prediction between engagement in maladaptive, risky behaviors and endorsement of the maladaptive personality trait of urgency during the early adolescent years. One implication of these findings is the apparent presence of a positive feedback loop of risk, in which maladaptive behaviors increase high-risk personality traits, which in turn further increase the likelihood of maladaptive behaviors.

KEYWORDS: *personality change; longitudinal; maladaptive behaviors; urgency; early adolescents*

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April 29, 2015

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CHAPTER ONE: INTRODUCTION

Background on Personality Change

Over the past several decades, the conceptualization of personality as dynamic and changing rather than immutably fixed has received more attention in the research literature. The impressive stability of personality across the lifespan has been well documented (e.g., Costa, Herbst, & McCrae, 2000; Terracciano, Costa, & McCrae, 2006); however, within that overall stability, there is also evidence of meaningful change. A particularly important factor for personality change seems to be going through a period of transition, such as the transition from adolescence to early adulthood. Indeed, early adulthood is thought to be a quite significant period of personality change (Roberts, Walton, & Viechtbauer, 2006). Individuals appear to become less neurotic, more agreeable, and more conscientious as they go through this transition (e.g., Bleidorn, 2012; Roberts et al., 2006; Roberts, Wood, & Caspi, 2008).

One explanatory model for why changes occur during these times is social investment theory (Roberts, Wood, & Smith, 2005), which posits that periods of transition require individuals to invest in new social roles (such as settling into a relationship, obtaining a job, etc.), which prompts necessary changes in personality traits in order to meet the demands of these new social roles. This process is understood to operate in what is sometimes called a bottom-up fashion, because engagement in new social roles requires engagement in new behaviors. Engagement in new behaviors, in turn, leads to personality change. For example, engagement in the new or different behavior of paying bills on time may be rewarded by the environment (perhaps in the form of a higher credit score). Thus, a new social role, and repeated engagement in

behaviors that reflect investment in that role, may result in a new reward structure in which, for example, more conscientious behaviors are consistently reinforced, leading to an incremental increase in the personality trait of conscientiousness.

There have been several longitudinal studies that demonstrate personality change over long time frames, the results of which seem to be consistent with the social investment theory framework. Roberts, Caspi, and Moffitt (2001) report findings of both continuity and maturity in a longitudinal study of a young adult cohort followed from the age of 18 to the age of 26. Their results do indicate a degree of personality continuity, but they also found evidence of significant personality change during this transitional period. Over the 8-year time span, individuals became more mature: they demonstrated more control and social confidence, less anger and alienation (Roberts et al., 2001). Results from this same study population also suggest that work-related behaviors such as job attainment, work satisfaction/involvement, and financial security were related to personality changes during this transitional time (Roberts, Caspi & Moffitt, 2003). From the ages of 18-26, individuals are taking on new social roles, inherent to which are behavioral demands that necessitate a high degree of maturity to meet. Thus, changes in personality that reflect general growth towards maturity fit well with social investment theory.

There is also evidence for personality change over shorter time spans in which significant role change occurs. Jackson, Thoemmes, Jonkmann, Ludtke, and Trautwein (2012) explored changes in personality following military training in a population of German young adults. Individuals who had undergone military training had lower levels of agreeableness following training compared to a control group; strikingly, these

personality changes persisted five years after training, even after military-trained participants had gone to college or entered the work force (Jackson et al., 2012). The results of this study indicate that transitional periods marked by highly specific and particular experiences such as military training can produce significant and long-lasting personality change for the individual.

Bleidorn (2012) followed a sample of German high school students over the course of one year as they were undergoing the transitional period from adolescence to adulthood. Even during this short observational period, adolescents demonstrated significant personality change that was consistent with maturation, and was the most pronounced for the trait of conscientiousness (Bleidorn, 2012). In addition, the author states that the personality changes were greatest for older individuals, those who were “directly confronted with this transitional experience” from adolescence to adulthood (Bleidorn, 2012, p. 1594). This research is also consistent with the social investment theory observation that when faced with social role transitions, individuals respond by engaging in role-appropriate behaviors. It seems that, even over short intervals of time, role transitions can lead to significant changes in personality through bottom-up processes.

There is also some evidence for personality change in the opposite direction across role transitions when individuals respond to those transitions in dysfunctional ways. Persons studied from age 18 to 26 who engaged in counterproductive role behaviors, such as stealing from the workplace, fighting with co-workers, and using substances on the job, developed increased levels of negative emotionality and decreased constraint across that transitional period (Roberts, Walton, Bogg, & Caspi, 2006). This

finding suggests that, just as engagement in positive, prosocial behaviors can lead to personality change in an adaptive direction, engagement in negative behaviors can lead to personality change in a maladaptive direction.

Personality Change in Adolescence

In addition to personality change as a function of social role change, there is also evidence for personality change as a function of normal development in adolescents. The dual systems model of adolescent development is one in which the different developmental trajectories of cognitive control and impulsivity in adolescents reflect the differential development of two neurobiological systems. These systems are: the prefrontal cortex, which is important for impulse control, and the amygdala and ventral striatum, which is responsive to emotion and reward (Harden & Tucker-Drob, 2011). These two neurobiological systems are thought to develop along different timelines such that the socioemotional system (the amygdala and ventral striatum) develops early in adolescence, whereas the prefrontal cortex (cognitive control system) is not fully mature until early adulthood (Somerville, Jones, & Casey, 2010). The period of adolescence is thus characterized by a well-developed responsiveness to emotion and reward, but a nascent capacity for cognitive control (Harden & Tucker-Drob, 2011), the combination of which may lead to high levels of impulsivity in adolescents.

There has been a large body of research examining trait changes in impulsivity and impulsivity-related traits over the developmental course of adolescence and young adulthood. Impulsivity has been shown to decline linearly across adolescence and early adulthood and level off once individuals reach their mid-twenties (Harden & Tucker-Drob, 2011; Steinberg, Albert, Cauffman, Banich, Graham, & Woolard, 2008). Theory

and empirical evidence support the view that these changes result, at least in part, from neurocognitive development across the adolescent years. However, the possibility that there are also “bottom-up” processes of behavioral reward structures leading to personality change has not been studied as extensively. One possibility is that a normative progressive engagement in autonomous, prosocial behaviors during adolescence leads to increased conscientiousness and decreased impulsiveness, and a less normative dysfunctional engagement in deviant behaviors produces increases in maladaptive personality traits.

The Current Study

The current study focuses on maladaptive personality change during early adolescence. It has been well established that individual differences in certain high-risk personality traits predict engagement in a host of maladaptive behaviors during these years (MacPherson, Magidson, Reynolds, Kahler, & Lejuez, 2010; Pearson, Combs, Zapolski, & Smith, 2012; Quinn & Harden, 2013; Settles, Zapolski, & Smith, 2014). The intent of the proposed research is to test the hypothesis that it is also true that engagement in maladaptive behaviors predict changes in high-risk personality traits as well. Support for this hypothesis would indicate the value of a more comprehensive model describing a reciprocal process in which maladaptive personality traits and maladaptive behavior each predict increases in the other over time.

Urgency predicts early adolescent engagement in addictive behaviors. Urgency refers to the disposition to engage in rash, impulsive behaviors when highly emotional (Cyders & Smith, 2008). The trait has two facets: negative urgency and positive urgency. They refer to the tendency to act rashly when distressed or when in an unusually positive

mood, respectively. Urgency predicts engagement in, and early onset of, drinking, binge eating, and smoking among early adolescents (Guller, Zapolski, & Smith, 2014; Pearson et al., 2012; Settles et al., 2014), and it does so above and beyond prediction from other impulsivity-related traits. It is thought that the behaviors can provide negative reinforcement in the form of distraction from distress and positive reinforcement in the form of social facilitation for drinking and smoking and pleasurable food consumption in the form of binge eating (Guller, Zapolski, & Smith, in press; Heatherton & Baumeister, 1991; Hersh & Hussong, 2009; Small, Jones-Gotman, & Dagher, 2003).

Investigation of personality change in early adolescence. The aim of the present research is to apply the theory of “bottom-up” behavior-based personality change to the early adolescent period in which youth experience the transition to middle school and pubertal transition. As noted above, there is evidence that impulsivity-related traits, such as the urgency traits, predict engagement in risky behavior among early adolescents. The current study seeks to test whether prediction goes in the opposite direction as well; that is, whether early engagement in risky behaviors leads to subsequent increases in urgency.

It may be that personality change occurs even over the relatively short window of time reflecting the transition through the early adolescent years. If it is indeed possible to detect significant personality change during this brief period of time, and if personality change is predictable from early engagement in risky and non-normative behaviors, this will lend substantial support to the “bottom-up” theory of personality change prompted by behavioral engagement.

Does early engagement in drinking, smoking, or binge eating predict increases in urgency? Engagement in these behaviors during early adolescence is rare (Combs,

Pearson, & Smith, 2011; Combs, Spillane, Caudill, Stark, & Smith, 2012; Donovan, 2007) and associated with both current and future harm (Chassin, Presson, Pitts, & Sherman, 2000; Chung, Smith, Donovan, Windle, Faden, & Martin, 2012; Guttmanova et al., 2012; Kotler, Cohen Davies, Pine, & Walsh, 2001; Stice & Martinez, 2005). Nevertheless, each of the behaviors is thought also to provide immediate reinforcement (Doran et al., 2013; Pearson et al., 2012; Smyth et al., 2007; Swendson et al., 2000). Because engagement in these maladaptive behaviors when emotional appears to be reinforced, it is possible that the trait of urgency, reflecting the disposition that led to the behaviors, may be reinforced as well.

Each of these behaviors is often precipitated by subjective distress and functions to provide relief from that distress (Baker et al., 2004; Doran et al., 2013; Haedt-Matt & Keel, 2011; Smyth et al., 2007; Swendson et al., 2000). Each is also described as rash or impulsive, because engagement in them often undermines an individual's health, interests, or long-term goals, despite providing immediate reinforcement (Birkley & Smith, 2011; Cyders & Smith, 2008). For these reasons, drinking, smoking, and binge eating can be considered members of a common behavioral response class of rash, immediate acts that function to alleviate or avoid intense negative affect through similar processes of negative reinforcement. Thus, in addition to exploring the relationships between urgency and each of the maladaptive behaviors (drinking, smoking, and binge eating) individually, we also investigated the relationship between urgency and engagement in any one of this set of behaviors, measured as a response class.

We seek to extend the theories of bottom-up personality change by testing whether engagement in any of these behaviors predicts subsequent increases in urgency

using a longitudinal design. Early adolescents were assessed regularly across a four-year time frame, from the spring of 5th grade (the last year of elementary school) through the spring of 9th grade (the first year of high school); behaviors and urgency were measured at each of 8 time intervals (semi-annual assessments, except that wave 8 was 12 months after wave 7). We intend to test two predictive pathways: the typical direction of prediction, i.e., that urgency predicts subsequent increases in these behaviors; and the reverse pathway from behavioral engagement to urgency. We expect to find a reciprocal relationship between urgency and engagement in these risky behaviors such that urgency predicts increases in behavior engagement and behavior engagement predicts increases in urgency.

Support for this hypothesis will be important for basic psychological theory, clinical theory, and application. With respect to basic theory, evidence that engagement in unusual behaviors can predict personality change during this early stage of development may contribute to further development of theories of personality – behavior relationships. With respect to clinical theory, reciprocal prediction would suggest the presence of a positive feedback loop between urgency and risky behaviors in children and young adolescents and thus lead to more comprehensive models of the risk process. With respect to application, the possibility of such a feedback loop will highlight further the need to intervene very early to prevent an escalation of high-risk personality and high-risk behavior during the adolescent years.

CHAPTER TWO: METHODS

Participants

Participants were 1906 youth in 5th grade at the start of the study; they were drawn from urban, rural, and suburban backgrounds and represented 23 public schools in two school systems. The sample was equally divided between girls (49.9%) and boys. At wave 1, most participants were 11 years old (66.8%), 22.8 % were 10 years old; 10 % were 12 years old; and .2 % were either 9 or 13 years old. The ethnic breakdown of the sample was as follows: 60.9%, European American, 18.7% African American, 8.2 % Hispanic, 3% Asian American, and 8.8% other racial/ethnic groups.

Measures

Demographic and background questionnaire. This measure provided the assessment of the demographic information reported above. Participants were asked to circle their sex, write in their current age (in years), and indicate which label(s) best described their ethnic background.

UPPS-R-Child Version, Positive Urgency and Negative Urgency Scales (Whiteside & Lynam, 2001; Zapolski, Stairs, Settles, Combs, & Smith, 2010). Both scales consist of 8 items and responses are on a four-point Likert scale from 1 (not at all like me) to 4 (very much like me). For positive urgency, a sample item is: “When I am very happy, I tend to do things that may cause problems in my life.” In the current sample, the internal consistency reliability estimate for the positive urgency subscale was .89 at wave 1. For negative urgency, a sample item is: “When I am upset I often act without thinking.” Internal consistency reliability estimate at wave 1 was .85. For both scales internal consistency estimates were slightly higher in later waves.

Drinking Styles Questionnaire (DSQ; Smith, McCarthy, & Goldman, 1995) was used to measure self-reported drinking frequency. The DSQ measures drinking frequency with a single item asking how often one drinks alcohol. Youth were considered to be positive for drinking if they reported ever having consumed at least one drink, where a drink was defined as follows: “. . . a ‘drink’ is more than just a sip or a taste. (A sip or a taste is just a small amount or part of someone else’s drink or only a swallow or two. A drink would be more than that.)” Frequency of drinking was measured at levels ranging from 1-4 times in one’s life to almost daily. This assessment method has proven stable over time and there is good evidence for its validity (Settles, Cyders, & Smith, 2010; Smith, McCarthy, & Goldman, 1995).

Eating Disorder Examination - Questionnaire (EDE-Q; Fairburn & Beglin, 1994). We used the EDE-Q, which is a self-report version of the Eating Disorders Examination semi-structured interview (Cooper & Fairburn, 1993) to assess binge eating behavior. The EDE-Q has been shown to have good reliability and validity, particularly in clinical samples (Cooper & Fairburn, 1993; Luce & Crowther, 1999; Mond, Hay, Rodgers, Owen, & Beumont, 2004). As is typical in studies of youth, we adapted the EDE-Q by using age-appropriate wording, defining concepts that could possibly be difficult to understand, and shortening the length of time referred to in the questions to the past two weeks, per past recommendations (Carter, Stewart, & Fairburn, 2001). To measure binge eating behavior, we used a sequence of two items. The first asked, “In the past two weeks, have there been times when you have eaten what most people would regard as an unusually large amount of food?” The item was dichotomous. Participants who responded “yes” then completed a second item: “If yes, how many times has this

happened in the past two weeks?” There were six response options, ranging from “1-2 days” through “14 days or every day.” We combined the two items, such that 0 reflected no binge eating, 1 reflected having done so 1-2 days of the last 14, and so on.

Smoking Behavior was measured using a single item. Participants were classified as smoking if they had consumed 1 or more cigarettes in their lives. Frequency of smoking ranged from 1-4 times in their lives to almost daily. Numerous single item measures of self-reported cigarette smoking have been used successfully in studies of adolescents (Chassin et al., 2000; Colder et al., 2001; Wills et al., 2002).

The Pubertal Development Scale (PDS; Petersen, Crockett, Richards, & Boxer, 1988). This scale consists of five questions for boys (“do you have facial hair yet?”) and five questions for girls (“have you begun to have your period?”) Evidence for reliability and validity are strong (Brooks-Gunn, Warren, Rosso, & Gargiulo, 1987; Coleman & Coleman, 2002). We used the common dichotomous classification of the PDS (Culbert, Burt, McGue, Iacono, & Klump, 2009) as pre- pubertal or pubertal, with mean scores above 2.5 indicative of pubertal onset.

Procedure

Participants were administered questionnaires at eight time points: Spring of the 5th grade (wave 1), fall and spring of the 6th grade (waves 2, 3), fall and spring of the 7th grade (waves 4, 5) fall and spring of the 8th grade (waves 6, 7), and spring of the 9th grade (wave 8). The questionnaires were administered in 23 public elementary schools at wave 1, in 15 middle schools at waves 2-7, and at 7 high schools in wave 8. A passive-consent procedure was used. Each family was sent a letter, through the U.S. Mail, introducing the study. Families were asked to return an enclosed, stamped letter or call a phone number if

they did not want their child to participate. Out of 1,988 5th graders in the participating schools, 1,906 participated in the study (95.9%). Reasons for non-participation included declination of consent from parents, declination of assent from children, and language or cognitive difficulties.

Questionnaires were administered by study staff in the children's classrooms or in a central location, such as the school cafeteria, during school hours. The questionnaires took 60 minutes or less to complete. Children who left the school system were asked to continue to participate. Those who consented did so either by completing hard copies of questionnaires delivered through the mail or by completing the measures on a secure web site. Retention rate was 75% across all eight waves; retained and not retained participants did not vary on any study variables. This procedure was approved by the University's IRB and by the participating school systems.

Data Analysis

Measurement of addictive behaviors. For each of the three behaviors, individuals endorsed a level of engagement that ranged from 0 = "Never engaged in the behavior" to 5 = engaging in the behavior "daily or almost daily." Using these data, we were able to transform these variables into count variables that represented the relative frequency of engagement in each of the three behaviors of drinking, smoking, and binge eating; this count variable was used to represent behavioral engagement in the following model tests.

Addictive behavior composite: Functional response class. To investigate the relationship between urgency and a variable that represents the functional response class of the set of behaviors, we created an addictive behavior composite variable. This was a

sum of the three count variables of drinking, smoking, and binge eating. This variable was also a count variable reflecting addictive behavioral engagement.

Model test. Structural equation modeling (SEM) was used to test the model of reciprocal influence between behavior and personality, a process that involved proceeding through a series of model tests. Each model allowed for cross-sectional correlations between all variables or disturbance terms. In total, four models examining the reciprocal influence between behavior and urgency were tested: one model for each of the addictive behaviors (drinking, smoking, and binge eating) and one model for the addictive behavior composite (functional response class). The same procedure, described below, was used to test each model.

The first model specified autoregressive predictions within urgency, puberty and within the behavior of interest; this will represent the baseline model. Urgency at each wave was predicted from urgency scores at the prior wave, behavioral engagement at each wave was also predicted from behavioral engagement at the previous wave, and pubertal status at each wave was predicted from pubertal status at the prior wave.

For the second model, the predictive pathway from urgency at each wave to the behavior the following wave was added. This model tested the degree to which urgency predicted subsequent increases in the composite over each six-month interval during the four-year period. This model represented a test of the more common pathway of prediction, that urgency predicts subsequent increases in these behaviors. In addition, because of the importance of pubertal onset for engagement in addictive behaviors (Dick, Rose, Viken, & Kaprio, 2000), pubertal status at each wave was included as a predictor of the addictive behavior the following wave. Fit indices were conducted to test whether

this model, in which the predictive pathway of urgency to behavior was added, fit the data significantly better than did the first model of autoregressive predictions (Muthén &, Muthén, 2010).

The third model added in prediction from the behavior at each wave to urgency scores the next wave and represented the key hypothesis test of the present study. Again, this third step represented a test of whether the inclusion of these predictions (from behavior to personality) improved model fit. We hypothesize that it would, thus providing support for reciprocal prediction between urgency and addictive behavior involvement across the early adolescent years.

This sequence of models was tested with *Mplus* (Muthén &, Muthén, 2004), using zero-inflated Poisson (ZIP) models. Because each of the three behaviors (drinking, smoking and binge eating) occur at such low base rates in this age group, most youth are not engaging in any of the addictive behaviors. From a statistical estimation point of view, this means that there were an excessive number of 0 values in the data set. ZIP modeling corrects for the excessive number of 0 values in the data set by providing for two simultaneous tests of the predictive pathways. The first is a binomial logistic regression prediction, testing whether urgency and pubertal status predict the presence of non-zero values for the addictive behavior composite. The second predicts variation in the frequency of addictive behavior scores measured as count variables.

There are no chi-square indices of fit in ZIP modeling. Improved model fit is instead assessed by the values of the Akaike information criterion (AIC) and Bayesian information criterion (BIC), both of which measure of the relative quality of each statistical model for a given set of data relative to each of the other models. The AIC is a

relative estimate of the information lost when a given model is used to represent relationships among data; a lower AIC value represents less information lost in the model. The BIC is closely related to the AIC, and is partially based on the likelihood function, which is used to describe the correctness of a parameter given an outcome (set of data). The AIC and BIC introduce penalties for the number of parameters included in the model in order to reduce the possibility of overfitting the data (statistically accounting for random variance in the data set). Both the AIC and the BIC represent criterion for model selection among a finite set of models, and the model with the lowest AIC and BIC values is preferred.

CHAPTER THREE: RESULTS

Descriptive statistics

To assess the reliability of urgency, we measured the internal consistency of urgency at each wave using coefficient alpha. The internal consistency of urgency at Wave 1 (fall of 5th grade) was $\alpha = .91$, and became increasingly higher at subsequent waves. As is true of other personality traits, urgency was quite stable over time. Table 1 presents correlations among urgency, measured at each of the eight waves. As expected, correlations between urgency scores measured at adjacent waves were high, indicating considerable construct stability over the eight waves and 4-year time period.

Table 2 presents the percentages of boys and girls who had achieved pubertal status at each Wave. At Wave 1, 23.7% of girls and 22.9% of boys were considered to have completed puberty; by Wave 8, 80.4% of girls and 78.8% of boys were considered to be pubertal. Table 3 provides descriptive statistics of key variables, measured at each wave for all participants. Tables 4 and 5 provide a breakdown of these data separately by sex.

Consistent with previous data and with our hypotheses, rates of engagement in each of the risky, maladaptive behaviors (drinking, smoking, and binge eating) were low in the early waves of the study. There were slightly different trends in the data regarding the change in engagement in each of these behaviors over time: we have reported the percentage of participants who reported engaging in the behavior of interest at each wave in Tables 3, 4, and 5. These tables do not report differences in amount or frequency of behavioral engagement but rather just having engaged in the behavior *at all* at the time of the assessment (measured by a non-zero score on the behavior variable).

Engagement in drinking behavior and smoking behavior increased steadily over time for both girls and boys. For example, the percentage of all participants who engaged in drinking behavior increased from 12% at Wave 1, to 17.1% at Wave 4, and finally to 47.6% at Wave 8. Fewer participants reported smoking, but this behavior also increased steadily over time for both girls and boys. Total reported smoking rates were 5.4% at Wave 1, 11.3% at Wave 4, and 29.0% at Wave 8.

There was a different trend in reported binge eating behavior: both male and female participants reported high levels of binge eating behavior at Wave 1 (29.3% overall), decreasing engagement in the behavior until it reached a low point at Wave 4 (17.3% overall), then high levels of engagement in binge eating behavior by Wave 8 (28.5% overall engagement). Both boys and girls showed similar patterns, and both reached the low point in binge eating prevalence at Wave 4.

Response class prevalence rates (engaging in at least one of the three behaviors assessed) were measured by a non-zero score on the addictive behavior composite variable and are also presented in Tables 3, 4, and 5. In general, levels of response class engagement were relatively stable until Wave 4, and then increased dramatically in the later waves. At Wave 1, 36.9% of individuals reported engaging in one or more of the rash, impulsive behaviors. By Wave 4, 32.5% of individuals were engaging on one of the response class behaviors, and by wave 8 59.8% of individuals reported engaging in at least one of the three behaviors (drinking, smoking, or binge eating). Figure 1 presents a visual depiction of the trends in prevalence rates of these four variables (drinking, smoking, binge eating, and the addictive behavior composite).

Testing the reciprocal influence of behavior and personality: Response class

As described previously, we used a three-step procedure to test the value of adding prediction from personality to response class behavior engagement and then adding prediction from behavior engagement to personality. Figure 2 presents the final, comprehensive model of the relationship between urgency and the addictive behavior composite. As noted above, ZIP modeling provides two simultaneous tests: a binomial regression and prediction of variation in the count scores. Figure 2 presents the coefficients for the binomial regression and Table 1 of Appendix A provides all path coefficients. Table 6 presents the AIC and BIC scores for each of the three steps in the model selection procedure.

At Step 1 of the ZIP modeling procedure, we tested the significance of the autoregressive pathways from urgency at each wave to urgency at each subsequent wave, the autoregressive pathways from the addictive behavior composite (response class) at each wave to the addictive behavior composite at each subsequent wave, and the autoregressive pathways from pubertal status at each wave to pubertal status at the following wave. Each pathway was significant, which indicates that urgency, engagement in response class behaviors, and puberty are predicted from previous levels of the trait, behavioral engagement, or pubertal status respectively.

At Step 2, we added predictive pathways from urgency scores at each wave to the addictive behavior composite at the following wave. As expected, all of the binomial predictive pathways, except for the path from urgency at Wave 1 to response class at Wave 2, were significant. These data indicate that urgency is a significant predictor of

increases in engagement in behaviors that are part of the response class, i.e., drinking, smoking, and binge eating.

Also included in this step were the predictive pathways from pubertal status to the response class of addictive behaviors at each wave; only the last pathway, from pubertal status at Wave 7 to the response class at Wave 8, was significant, indicating that puberty was not an important predictor of engagement in the response class behaviors above and beyond prediction from urgency for the majority of the time frame studied. The AIC and BIC scores were lower in Step 2 than they were in Step 1. This outcome, together with the significance of the predictive paths, indicates that the inclusion of the Step 2 predictive pathways was justified.

Finally, at Step 3, we added predictive pathways from response class scores (measured as a count variable, representing variance in frequency of engagement) at each wave to urgency scores at the following wave. A majority of the possible pathways from addictive behavior composite scores to urgency were significant, indicating that, at these waves, variance in the frequency of engagement in response class behaviors predicted significant increases in the high-risk personality trait of urgency. These findings are particularly striking given the high degree of stability in the trait of urgency. The pathways that were not significant were at the early waves (Waves 2-4): it is possible that, due to the lower frequency of engagement in the response class behaviors, significant relationships were not able to be detected. Again, the AIC and BIC scores were lower in Step 3 than they were in Step 2 or Step 1.

Because the response class (addictive behavior composite) represents a sum of the three count variables (drinking, smoking, and binge eating), we also decided to conduct

similar model tests on each of the behaviors individually. Due to the nature of the measurement of the response class, the strong reciprocal predictive relationships found between urgency and the addictive behavior composite could have been entirely accounted for by one variable, such that there were extremely strong predictive, reciprocal relationships between drinking and urgency, and no relationships between urgency and smoking or urgency and binge eating. We therefore conducted separate model tests for each of the three behaviors (drinking, smoking and binge eating) in order to determine whether the relationship between urgency and the addictive behavior composite was theoretically sound or whether the apparent response class effect was instead driven by the data from one of the variable relationships.

Testing the reciprocal influence of behavior and personality: Drinking

We again used a three-step procedure to test a sequence of models in order to determine which model best fit the relationships between urgency and drinking behavior. Figure 3 presents the full model of these relationships and coefficients for the binomial regression, Table 2 of Appendix A provides all path coefficients, and Table 7 presents the AIC and BIC scores for each of the three steps in the model selection procedure.

At Step 1, we tested the significance of the autoregressive pathways from urgency at each wave to urgency at each subsequent wave, drinking at each wave to the drinking at each subsequent wave, and pubertal status at each wave to pubertal status at each subsequent wave. Each pathway was significant.

At Step 2, we added predictive pathways from urgency and puberty scores at each wave to drinking at the following wave. As expected, all of the pathways from urgency to drinking were significant, indicating that urgency predicts increases in

drinking behavior. Pubertal status was a significant predictor of drinking at wave 5 and drinking at wave 6 which indicates that puberty is a significant predictor of drinking status only in the middle of this time span. The AIC and BIC scores were lower in Step 2 than they were in Step 1.

At Step 3, we added predictive pathways from drinking behavior (the count variable) at each wave to urgency scores at the following wave. All seven of the possible pathways from drinking to urgency were significant, indicating that engagement in drinking behavior consistently predicted significant increases in urgency. As can be seen in Table 7, the AIC and BIC scores were lower in Step 3 (the third model) than they were in Step 2 or Step 1.

Testing the reciprocal influence of behavior and personality: Smoking

Figure 4 presents the data from tests of the binomial logistic regression of the ZIP model in which urgency and puberty predicting the presence of non-zero values for smoking. Table 3 of Appendix A presents a comparison of the data from the binomial logistic regression and the variation in the frequency of smoking behavior scores and Table 8 presents the AIC and BIC scores for each of the three steps in the model selection procedure.

Step 1 again tested the significance of the autoregressive pathways for urgency, smoking behavior, and puberty. Each pathway was significant.

In Step 2, we added predictive pathways from urgency scores at each wave to smoking at the following wave. As expected, all of these pathways, except for the very first pathway from urgency at wave 1 to smoking at wave 2, were significant, indicating that urgency predicted increases in smoking behavior. We also added pathways from

pubertal status at each wave to smoking at the following wave and found that pubertal status was a significant predictor of smoking behavior Waves, 5, 6, and 8. The AIC and BIC scores were lower in Step 2 than the previous step.

At Step 3, we included pathways from smoking scores at each wave to urgency scores at the following wave. Again, smoking behavior was measured as a count variable in this step, which represents variance in frequency of engagement in smoking. Four of the seven possible pathways in this model were significant. The three non-significant pathways from smoking to urgency were the first three pathways, those pathways at the earliest waves at which prevalence rates for smoking were under 10%. These data indicate that, at the later waves of this study, engagement in smoking behavior predicted significant increases in urgency. The AIC and BIC scores were lowest in Step 3.

Testing the reciprocal influence of behavior and personality: Binge eating

Figure 5 presents the full model of the relationship between urgency and binge eating behavior; Table 9 presents the AIC and BIC scores for each of the three steps in the model selection procedure.

Step 1 included only autoregressive pathways from urgency, binge eating, and puberty at each wave to urgency, binge eating, and puberty at the subsequent wave. Each autoregressive pathway was significant.

Step 2 included predictive pathways from urgency scores at each wave to binge eating at the following wave. Figure 5 presents the data from tests of the binomial logistic regression of the ZIP model in which urgency and puberty predicting the presence of non-zero values for binge eating, and Table 4 of Appendix A presents a comparison of the data from the binomial logistic regression and the variation in the frequency of

drinking behavior. Urgency significantly predicted engagement in binge eating in the later waves (Waves 4-8), but failed to do so in the first three waves, when engagement in binge eating is at high, but decreasing, levels. After Wave 4, once prevalence rates of binge eating behavior increased, urgency emerged as a significant predictor of the behavior. Pubertal status was not a significant predictor of dichotomous binge eating behavior in any waves. The AIC and BIC scores were lower in Step 2 than in Step 1.

Finally, in Step 3, we added predictive pathways from binge eating scores (measured as a count variable) at each wave to urgency scores at the following wave. The results are somewhat mixed. The frequency of binge eating behavior at Wave 1 appears as a significant predictor of urgency scores at Wave 2. The pathways from binge eating at Waves 2 and 3 to urgency scores at Waves 3 and 4 are not significant, but binge eating scores at Waves 4 and 5 reemerge as a significant predictor of increases in urgency at Waves 5 and 6. Variance in binge eating behavior was not a significant predictor of urgency scores at the later waves (Waves 7 and 8). Still, the AIC and BIC scores were lower in Step 3 than they were in Step 2 or Step 1, indicating that this final model, which includes predictive pathways from the binge eating to urgency, represents a better fit of the data compared to the first two models that did not include these pathways.

CHAPTER FOUR: DISCUSSION

This study is the first to find reciprocal prediction between engagement in a response class of maladaptive, risky behaviors and endorsement of the maladaptive personality trait of urgency during the early adolescent years. Across most six month intervals of prediction over the course of the four year study, urgency predicted increased engagement in response class behaviors. Strikingly, the reverse was true as well: engagement in response class behaviors predicted subsequent increases in urgency, which is otherwise a stable personality trait. It appears that these effects are quite strong for two of the response class behaviors, drinking and smoking, and less strong for the third, binge eating. We next consider important differences between the first two behaviors and the third that may explain the difference. We then discuss the importance of the findings for each specific behavior.

Why Binge Eating Differs from Drinking and Smoking

Changes in behavior prevalence over time. The prevalence rates of drinking and smoking behavior increased steadily over time in both boys and girls, which is consistent with past research that indicates these behaviors start out with very low prevalence rates in children then increase dramatically over time (Chassin, Presson, Sherman, & Edwards, 1990; Smith, Goldman, Greenbaum, & Christiansen, 1995). However, the rates of engagement in binge eating in our sample demonstrated a different pattern: rates decreased from Wave 1 to Wave 4, then increased from Wave 4 to Wave 8. There is less data available on the trends of binge eating behavior in children and early adolescents, but engagement in this behavior appears to begin at a very young age and prior research has also documented (a) a decline in binge eating during the late preadolescent to early

adolescent years (Tanofsky-Kraff, Shoemaker, Olsen, Rozan, Wolkoff, et al., 2011) and (b) subsequent increases in the behavior over time (Neumark-Sztainer, Wall, Larson, Eisenberg, & Loth, 2011). Unlike drinking and smoking, all youth eat, so it is possible that early in development one sees increasing control over food intake, but later one sees the emergence of loss of control and clinical binge eating. If so, some binge eating behavior may not represent the same kind of departure from cultural norms and social rules as does early adolescent drinking and smoking.

Binge eating and negative reinforcement. Drinking and smoking are likely to bring positive reinforcement, as youth engage in those behaviors with their friends in social settings, but this is unlikely to be the case for binge eating. Binge eating tends to occur in secret, and is associated with high levels of shame and embarrassment. It also appears to operate primarily through negative reinforcement (Pearson, Riley, Davis, & Smith, 2014; Pearson, Wonderlich, & Smith, in press). Indeed, negative urgency predicts the subsequent onset of binge eating and increases in binge eating in adolescents (Pearson et al., 2012; Smith et al., 2007), but positive urgency does not differentiate binge eaters from others (Cyders et al., 2007). In addition, expectancies that eating large amounts of food will serve to alleviate distress significantly predict binge eating longitudinally in child and adolescent samples (Pearson et al., 2012; Smith et al., 2007).

In the current study, we used an urgency composite score that combined both positive and negative urgency. The inclusion of positive urgency might have biased the composite against predicting, and being predicted by, binge eating more strongly than was observed.

Reciprocal Prediction between Drinking and Urgency

As expected, and consistent with past longitudinal research (Settles et al., 2010, 2014), urgency significantly predicted drinking behavior at each of the 6-month intervals over the 4-year timespan of this study. Most importantly for the current study, variation in the frequency of engagement in drinking behavior was a significant predictor of increases in urgency at each of the 6-month intervals across the four-year study period. This finding constitutes the first documentation that engagement in drinking behavior predicts subsequent changes in personality during the early adolescent years.

Reciprocal Prediction between Smoking and Urgency

Again consistent with past data (Guller et al., in press) and with our hypothesis, urgency significantly predicted increased smoking behavior, in this case at six of the seven-possible time-lagged predictions over the 4-year timespan of this study. Engagement in smoking behavior also predicted increases in the high-risk personality trait of urgency across four out of the seven possible time-lagged predictions.

Those waves in which smoking was not a significant predictor of change in urgency were early in the longitudinal period, when the prevalence rates of smoking behavior were extremely low, and thus variation on the predictor was quite limited. It is possible that smoking behavior would have emerged as a significant predictor of increases in urgency even at these young ages with a greater number of participants or greater prevalence of and frequency of engagement in smoking behavior. Alternatively, perhaps this process is present only for older individuals.

Reciprocal Prediction between Binge Eating and Urgency

The pattern of prediction between binge eating and urgency was less consistent. During both the early waves and the later waves, but not during the middle waves, variation in binge eating and urgency significantly predicted increases in the other. We discussed differences between binge eating and other behaviors above. We intend to follow this study by testing a similar model for binge eating, using only the trait of negative urgency. Perhaps the reciprocal predictive process will be more consistently present when we do so. Alternatively, because of the possibility that binge eating does not represent the same departure from social norms as the other behaviors, it may be that the process is fundamentally different for this behavior.

Reciprocal Prediction between the Response Class of Addictive Behaviors and Urgency

Turning back to our modeling of a response class that included all three behaviors, urgency significantly predicted the response class composite at six of the seven-possible time-lagged predictions. Engagement in these risky, maladaptive behaviors also predicted increases in the high-risk personality trait of urgency across a majority of waves, in five out of the seven possible prediction pathways. It is important to consider the response class results as an exceptionally wide-frame view of maladaptive behavior involvement in early adolescents. This wide-frame view may be useful for aggregate purposes, but it may not prove to be most helpful for understanding risky behavior – personality relationships among youth. This issue merits further inquiry.

The Role of Pubertal Status

Although puberty is associated with increased levels of engagement in a number of risky, maladaptive behaviors, even among children at the same age but with different pubertal statuses (Klump, McGue, & Iokono, 2003; Spear, 2000), in the current study pubertal status most often did not predict beyond prediction from the trait of urgency. One possibility is that, consistent with Cyders and Smith (2008), one main mechanism by which puberty exerts its influence is through increases in urgency (see Davis & Smith, 2015 for documentation that pubertal onset is associated with increases in the trait). If increased urgency is the more active and more proximal predictor of risky behavior involvement, the impact of puberty when urgency is included in predictive models might not be apparent. It is also true that pubertal change has different impacts on different youth; its effect may not be accurately modeled with a single, directional predictive pathway.

Towards a Developmentally Integrative Model of Personality Change

We see the results of the present study as providing compelling support for the possibility that “bottom-up” behavior-based personality change may exist in the developmental transition period of early adolescence. However, the exact mechanisms by which behavioral engagement relates to, or possibly elicits, subsequent personality change are not yet clear. It is likely that bottom-up, behavior-based personality change occurs in tandem with other important developmental processes, and it is important to contextualize and integrate these findings within the overall developmental experience of early adolescents.

Youth who engage in behaviors such as drinking, smoking, and binge eating as young as 5th or 6th grade are more likely than other youth to also experience problems such as poor school performance and rejection from mainstream peers (Bierman & Wargo, 1995; Crosnoe, 2007; King, Meehan, Trim, & Chassin, 2006; Masten, Faden, Zucker, & Spear, 2008). Because humans have core needs for belongingness and competence (Deci and Ryan, 2000), youth having these kinds of difficulties seek out relationships with peers who are also struggling. These new relationships are thought to offer some form of personal enhancement and acceptance, which the adolescents believe is less attainable elsewhere (Kaplan, Martin, and Robbins, 1984). Related to this is what is called an “extreme peer orientation” which reflects a willingness to engage in risk behaviors and to put asides one’s goals in favor of peer acceptance (Fuligni and Eccles, 1993).

One can see how engagement in risky behaviors and affiliation with a peer group likely to act similarly could well involve the other factors that lead to personality change. A youth might well experience a change in self-perception, likely experienced as self-insight, in the direction of seeing himself or herself as rebellious, deviant, or as free from typical social rules. Because the youth’s peers are also engaging in maladaptive behaviors, such a youth is also likely to experience observational learning that increases the likelihood of engaging in such behaviors. Friends who drink together or smoke together are likely to experience the event positively, and a youth who observes peers engaging in such behaviors and having fun is likely to associate such behaviors with reinforcement.

From this perspective, early adolescent engagement in new behaviors (such as drinking, smoking, or binge eating) is perhaps best understood as an important marker of a set of changes, involving behavior, peer affiliation, self-perception, and the like that, together, result in personality change. Thus, we do not consider our findings to indicate that behavior change operates independently of other factors to produce personality change. Instead, following classic models of developmental psychopathology (Cicchetti & Rogosch, 2002), we believe that a complex, interacting process of engagement in new behaviors, new self-perceptions, new peer affiliations, new observational learning, and internalization of new feedback from others combine to facilitate real, meaningful personality change.

More broadly, early adolescence is a time of rapid physical and social development, characterized by a dense spacing of significant life events to which an individual must adapt. Periods of transition often require repeated engagement in new behaviors in order to respond to an individual's changing environment and his or her new place in it. This rapid succession of novel stimuli and different behavior engagement, combined with an increased emphasis placed on peer relationships often lead early adolescents to adopt new social roles and new self-images. This complex process of engaging in new behaviors and seeing oneself differently can lead to change in what are otherwise stable personality characteristics of youth.

Alternative Explanation for Findings

As compelling as we believe our account of personality change is, there is an alternative explanation for the present findings: perhaps it is a more simple process. There could be a developmental process of maladaptive personality and behavior change

that began far before early adolescence and unfolds in a variety of ways over time: sometimes with behavior change occurring before personality change, other times with personality change occurring before behavior change, other times with change in self-perception occurring first. That is, perhaps the relationships among the variables we have described actually operate in a non-causal way. Instead, perhaps each process we described develops over time due to other factors that precede and cause all of the events we consider. For example, genetic factors and early developmental vulnerabilities could provide a strong diathesis that leads to the emergence of all the factors we have described in some youth. The current data certainly do not rule out this possibility.

Limitations

The results presented here should be considered within the important limitations of this longitudinal research. First, within the broad data trends presented here, there are likely many different categorizations of participants. Within each overall trend of behavior engagement (i.e., overall steady increase in drinking/smoking, decrease then increase in binge eating) there are certainly different trajectories of behavioral engagement for different individuals. The macro-trends for individual behavioral engagement and the even wider scope of the response class data described in the present study collapse across those trajectories and other individual differences, which allows for greater power and stability of findings, though perhaps at the expense of lost information.

Second, though there were relatively low attrition rates in this study (retention was over 75% across 8 waves of data), and there is good evidence for the validity of the expectation maximization method for addressing missing data, we cannot know whether the results would have differed with even higher retention. Third, all data collected on

urgency, pubertal status, and level of engagement in drinking, smoking and binge eating was done by questionnaire and was not clarified by interview data. Although there is substantial evidence for the validity of all measures utilized in this study, interviews could have provided further clarification of questionnaire items and perhaps more specific assessment. Finally, early adolescence is a time of rapid and profound social, physical, and personal development, a process that is influenced by a seemingly infinite number of factors. There is a need to integrate our current findings into larger models that include other factors, such as parental and peer behavior and genetic risk to create a more comprehensive understanding of the risk for engagement in risky, maladaptive behaviors in early adolescents.

Implications for Theory and Application

With respect to theory, increased understanding of factors that lead to personality change enhances understanding of a core contributor to individual differences. The possible presence of behavior-driven personality change in youth, which may occur alongside normal developmental changes in personality, must be considered in models of personality development. An important avenue of future research will be to isolate the specific developmental factors that have the biggest impact on personality change.

The current finding of reciprocal prediction between maladaptive behavior and a maladaptive personality trait is also important clinically. It reflects a positive feedback loop of risk, in which, over time, dysfunctional behaviors occur with greater frequency and the personality disposition to engage in such behaviors increases as well. There may be a need to intervene early and to focus attention on both behavior change and personality change with youth.

Appendix A

Table 1.

A comparison of the data from the two pathways tested in Step 2 of the response class ZIP model, the prediction of response class behaviors from urgency and puberty.

Predictor variable	Outcome variable	Pathway 1. Binomial logistic regression prediction	Pathway 2. Count variable (scale score) prediction
W1 Urgency	W2 Response class	.10	.12**
W1 Puberty	W2 Response class	.08	.22*
W2 Urgency	W3 Response class	.29**	.14**
W2 Puberty	W3 Response class	.06	.01
W3 Urgency	W4 Response class	.40**	.02
W3 Puberty	W4 Response class	.15	.17
W4 Urgency	W5 Response class	.34**	.05
W4 Puberty	W5 Response class	.28	.08
W5 Urgency	W6 Response class	.25**	.09**
W5 Puberty	W6 Response class	.22	.12
W6 Urgency	W7 Response class	.28**	.09**
W6 Puberty	W7 Response class	.05	.37**
W7 Urgency	W8 Response class	.28**	.09**
W7 Puberty	W8 Response class	.56**	.21**

Note. W1 Urgency = urgency at measured Wave 1, W1 Puberty = puberty measured at Wave 1, W1 Response class = addictive behavior composite measured at Wave 1. This table provides comparative data of Step 2 of the ZIP models, which allow for simultaneous tests of two predictive pathways, (1) a binomial logistic regression prediction, testing whether urgency and pubertal status predict the presence of non-zero values for the addictive behavior composite, and (2) a second pathway that predicts variation in the frequency of addictive behavior scores measured as a count variable. Data presented unstandardized beta weights predicting the (1) dichotomous presence of or (2) variance in frequency of the addictive behavior composite. * $p < .05$ ** $p < .01$.

Table 2.

A comparison of the data from the two pathways tested in Step 2 of the drinking ZIP model, the prediction of drinking behavior from urgency and puberty.

Predictor variable	Outcome variable	Pathway 1. Binomial logistic regression prediction	Pathway 2. Count variable (scale score) prediction
W1 Urgency	W2 Drinking	.31**	.06
W1 Puberty	W2 Drinking	.53	.25
W2 Urgency	W3 Drinking	.51**	.06
W2 Puberty	W3 Drinking	.37	.18
W3 Urgency	W4 Drinking	.29**	.02
W3 Puberty	W4 Drinking	.01	.15
W4 Urgency	W5 Drinking	.57**	.03
W4 Puberty	W5 Drinking	.57*	.09
W5 Urgency	W6 Drinking	.38**	.09**
W5 Puberty	W6 Drinking	.51*	.13
W6 Urgency	W7 Drinking	.35**	.08*
W6 Puberty	W7 Drinking	.32	.18*
W7 Urgency	W8 Drinking	.83**	.01
W7 Puberty	W8 Drinking	.54	.27**

Note. W1 Urgency = urgency at measured Wave 1, W1 Puberty = puberty measured at Wave 1, W1 Drinking = drinking behavior composite measured at Wave 1. This table provides comparative data of Step 2 of the ZIP models, which allow for simultaneous tests of two predictive pathways, (1) a binomial logistic regression prediction, testing whether urgency and pubertal status predict the presence of non-zero values for drinking behavior, and (2) a second pathway that predicts variation in the frequency of drinking behavior scores measured as a count variable. Data presented unstandardized beta weights predicting the (1) dichotomous presence of or (2) variance in frequency of drinking behavior. * $p < .05$ ** $p < .01$.

Table 3.

A comparison of the data from the two pathways tested in Step 2 of the smoking ZIP model, the prediction of smoking behavior from urgency and puberty.

Predictor variable	Outcome variable	Pathway 1. Binomial logistic regression prediction	Pathway 2. Count variable (scale score) prediction
W1 Urgency	W2 Smoking	.06	.24**
W1 Puberty	W2 Smoking	.39	.10
W2 Urgency	W3 Smoking	.63**	.04
W2 Puberty	W3 Smoking	.41	.09
W3 Urgency	W4 Smoking	.44**	.05
W3 Puberty	W4 Smoking	.07	.07
W4 Urgency	W5 Smoking	.47**	.01
W4 Puberty	W5 Smoking	.80**	.05
W5 Urgency	W6 Smoking	.46**	.07
W5 Puberty	W6 Smoking	.52*	.10
W6 Urgency	W7 Smoking	.46**	.14**
W6 Puberty	W7 Smoking	.44	.56**
W7 Urgency	W8 Smoking	.52**	.04
W7 Puberty	W8 Smoking	.61*	.12

Note. W1 Urgency = urgency at measured Wave 1, W1 Puberty = puberty measured at Wave 1, W1 Smoking = smoking behavior composite measured at Wave 1. This table provides comparative data of Step 2 of the ZIP models, which allow for simultaneous tests of two predictive pathways, (1) a binomial logistic regression prediction, testing whether urgency and pubertal status predict the presence of non-zero values for smoking behavior, and (2) a second pathway that predicts variation in the frequency of smoking behavior scores measured as a count variable. Data presented unstandardized beta weights predicting the (1) dichotomous presence of or (2) variance in frequency of smoking behavior. * $p < .05$ ** $p < .01$.

Table 4.

A comparison of the data from the two pathways tested in Step 2 of the binge eating ZIP model, the prediction of binge eating behavior from urgency and puberty.

Predictor variable	Outcome variable	Pathway 1. Binomial logistic regression prediction	Pathway 2. Count variable (scale score) prediction
W1 Urgency	W2 binge eating	.13	.06
W1 Puberty	W2 Binge eating	.11	.29*
W2 Urgency	W3 Binge eating	.11	.19**
W2 Puberty	W3 Binge eating	.14	.30*
W3 Urgency	W4 Binge eating	.39**	.05
W3 Puberty	W4 Binge eating	.33	.11
W4 Urgency	W5 Binge eating	.21*	.00
W4 Puberty	W5 Binge eating	.09	.08
W5 Urgency	W6 Binge eating	.22**	.05
W5 Puberty	W6 Binge eating	.07	.01
W6 Urgency	W7 Binge eating	.24**	.01
W6 Puberty	W7 Binge eating	.37	.26
W7 Urgency	W8 Binge eating	.32**	.06
W7 Puberty	W8 Binge eating	.43	.46**

Note. W1 Urgency = urgency at measured Wave 1, W1 Puberty = puberty measured at Wave 1, W1 Binge eating = binge eating behavior composite measured at Wave 1. This table provides comparative data of Step 2 of the ZIP models, which allow for simultaneous tests of two predictive pathways, (1) a binomial logistic regression prediction, testing whether urgency and pubertal status predict the presence of non-zero values for binge eating behavior, and (2) a second pathway that predicts variation in the frequency of binge eating behavior scores measured as a count variable. Data presented unstandardized beta weights predicting the (1) dichotomous presence of or (2) variance in frequency of binge eating behavior. * $p < .05$ ** $p < .01$.

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Table 1.

Correlations among urgency measured at each wave

	Urgency W1	Urgency W2	Urgency W3	Urgency W4	Urgency W5	Urgency W6	Urgency W7
Urgency W1							
Urgency W2	.57*						
Urgency W3	.53*	.65*					
Urgency W4	.49*	.59*	.66*				
Urgency W5	.45*	.56*	.61*	.65*			
Urgency W6	.45*	.53*	.62*	.66*	.70*		
Urgency W7	.40*	.47*	.52*	.58*	.63*	.66*	
Urgency W8	.33*	.39*	.43*	.47*	.52*	.57*	.67*

Note. * $p < .001$.

Table 2.

Percentages of individuals considered pubertal at each wave

	Girls N = 936	Boys N = 970
Wave 1	23.7%	22.9%
Wave 2	31.1%	33.3%
Wave 3	42.1%	42.1%
Wave 4	48.9%	51.9%
Wave 5	62.8%	62.8%
Wave 6	61.8%	63.5%
Wave 7	72.4%	74.3%
Wave 8	80.4%	78.8%

Note. Scores on the Pubertal Developmental Scale (PDS) range from 0-5. We used the common dichotomous classification of the PDS (Culbert, Burt, McGue, Iacono, & Klump, 2009) as pre-pubertal or pubertal, with mean scores above 2.5 indicative of pubertal onset.

Table 3.

Descriptive statistics of key variables measured at all waves, all participants (N = 1906)

	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7	Wave 8
Urgency Scores Mean (SD)	4.35 (1.30)	4.15 (1.33)	4.21 (1.38)	4.24 (1.36)	4.24 (1.38)	4.25 (1.34)	4.27 (1.34)	4.34 (1.27)
Drinking behavior	12.0%	11.3%	14.3%	17.1%	21.4%	30.9%	31.8%	47.6%
Smoking behavior	5.4%	6.8%	8.0%	11.3%	14.4%	21.3%	21.1%	29.0%
Binge eating behavior	29.3%	21.0%	20.0%	17.3%	19.2%	28.0%	28.0%	28.5%
Addictive behavior composite	36.7%	31.3%	32.0%	32.2%	37.5%	48.6%	49.2%	59.2%

Note. Drinking, smoking, binge eating and addictive behavior composite engagement are represented by the percentage of individuals who endorsed engaging in that behavior at each wave.

Table 4.

*Descriptive statistics of key variables measured at all waves, male participants only
(N = 970)*

	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7	Wave 8
Urgency Scores Mean (SD)	4.34 (1.34)	4.13 (1.32)	4.22 (1.37)	4.27 (1.37)	4.22 (1.38)	4.26 (1.35)	4.27 (1.34)	4.35 (1.27)
Drinking behavior	10.6%	10.5%	12.6%	16.2%	20.2%	30.7%	32.4%	46.8%
Smoking behavior	5.2%	6.5%	7.5%	10.8%	13.7%	21.4%	20.8%	28.2%
Binge eating behavior	30.1%	21.0%	19.7%	17.2%	19.0%	27.9%	26.8%	28.4%
Addictive behavior composite	36.6%	30.0%	30.9%	32.0%	36.9%	47.1%	48.0%	58.6%

Note. Drinking, smoking, binge eating and addictive behavior composite engagement are represented by the percentage of individuals who endorsed engaging in that behavior at each wave.

Table 5.

*Descriptive statistics of key variables measured at all waves, female participants only
(N = 936)*

	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7	Wave 8
Urgency Scores Mean (SD)	4.36 (1.27)	4.18 (1.34)	4.20 (1.38)	4.21 (1.35)	4.27 (1.38)	4.23 (1.32)	4.27 (1.34)	4.33 (1.26)
Drinking behavior	13.5%	12.2%	16.1%	18.1%	22.5%	31.1%	31.3%	46.3%
Smoking behavior	5.6%	7.1%	8.4%	11.9%	15.1%	21.2%	21.4%	29.8%
Binge eating behavior	28.4%	20.9%	20.4%	17.3%	19.3%	28.0%	29.2%	28.6%
Addictive behavior composite	36.9%	32.6%	33.0%	32.5%	38.1%	50.1%	50.3%	59.8%

Note. Drinking, smoking, binge eating and addictive behavior composite engagement are represented by the percentage of individuals who endorsed engaging in that behavior at each wave.

Table 6.

Akaike information criterion (AIC) and Bayesian information criterion (BIC) values for each step of the reciprocal model between response class (addictive behavior composite) and urgency

	Number of Free Parameters	AIC	BIC
Step 1	84	97712.24	98178.68
Step 2	112	97223.37	97845.28
Step 3	119	97107.60	97768.31

Table 7.

Akaike information criterion (AIC) and Bayesian information criterion (BIC) values for each step of the reciprocal model between drinking and urgency

	Number of Free Parameters	AIC	BIC
Step 1	84	79684.91	80151.35
Step 2	112	79402.65	80024.56
Step 3	119	79292.42	79953.20

Table 8.

Akaike information criterion (AIC) and Bayesian information criterion (BIC) values for each step of the reciprocal model between smoking and urgency

	Number of Free Parameters	AIC	BIC
Step 1	84	74970.13	75436.57
Step 2	112	74640.54	75262.45
Step 3	119	74592.64	75253.42

Table 9.

Akaike information criterion (AIC) and Bayesian information criterion (BIC) values for each step of the reciprocal model between binge eating and urgency

	Number of Free Parameters	AIC	BIC
Step 1	84	84904.43	85370.86
Step 2	112	84721.78	85343.69
Step 3	119	84701.52	85362.30

Figure 1.

Prevalence rates of drinking, smoking, binge eating, and the addictive behavior composite over 8 waves

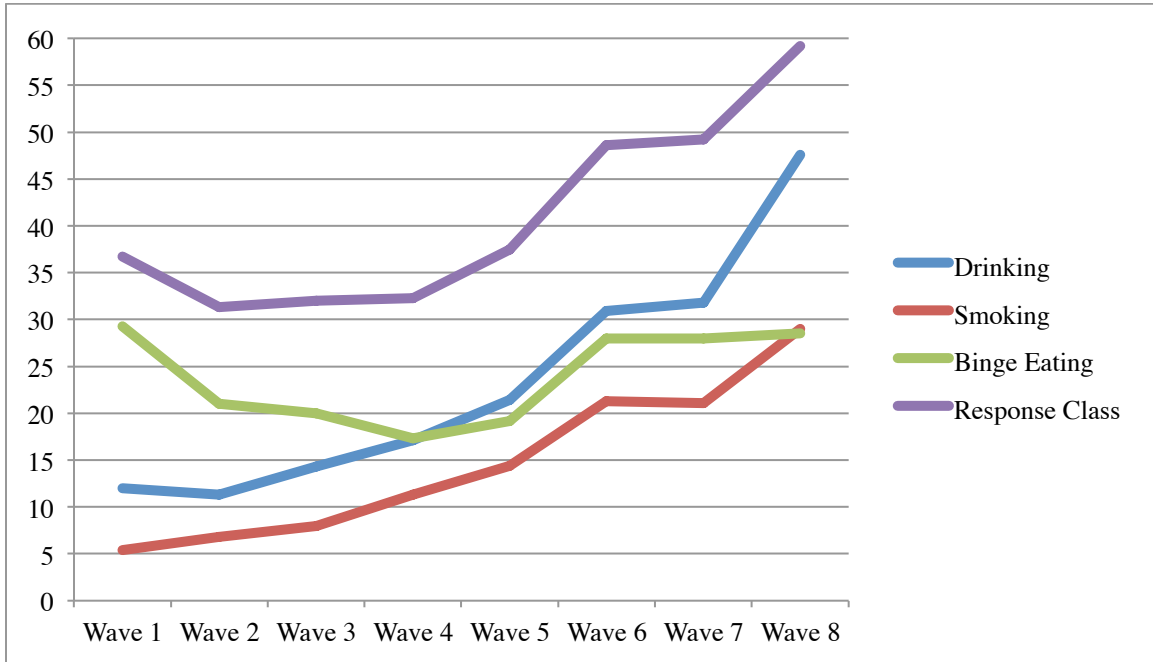
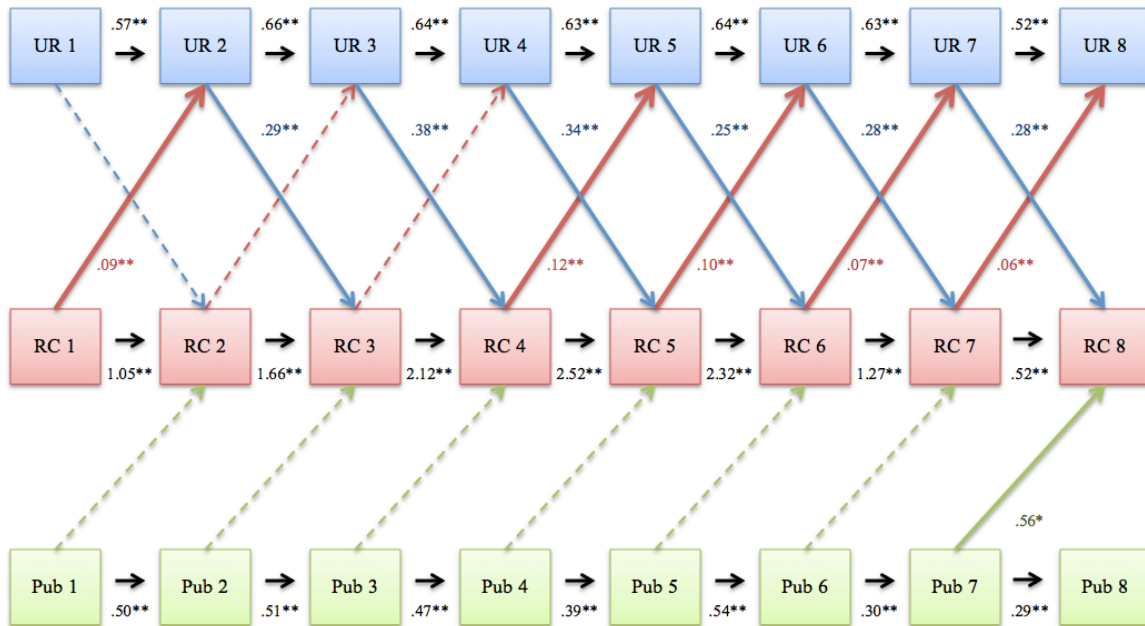


Figure 2.

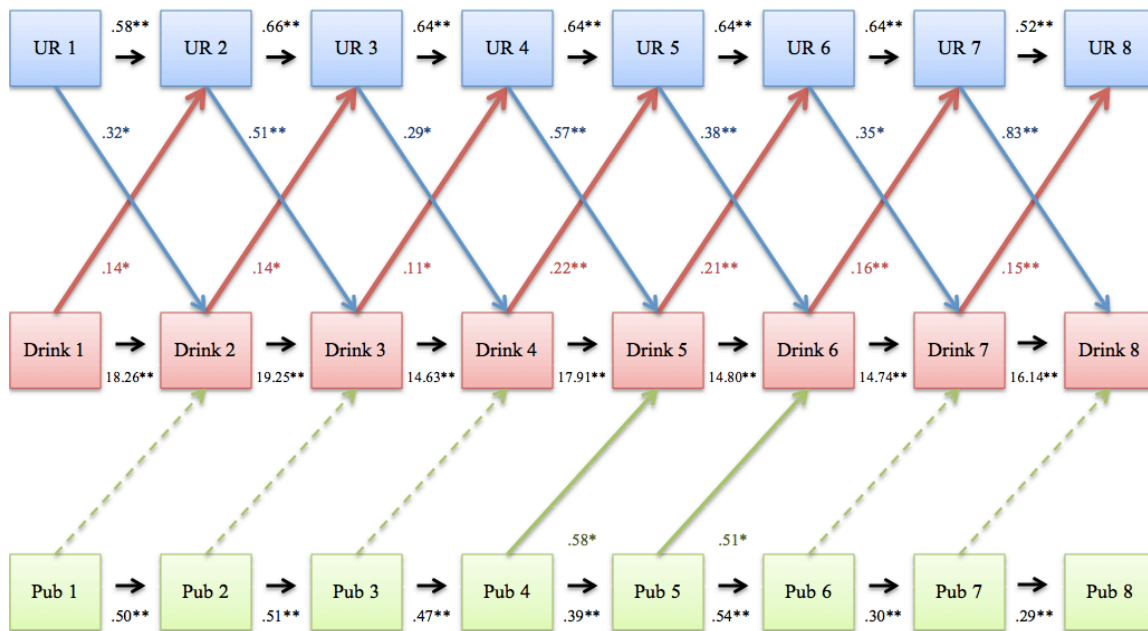
Reciprocal model between response class (addictive behavior composite) and urgency at all waves



Note. UR 1 = Urgency at Wave 1, RC 1 = response class (addictive behavior composite) at Wave 1, measured as a count variable. Horizontal lines connecting urgency at each wave with urgency at the subsequent waves and response class at each wave with response class at the subsequent waves represent Step 1 of the model, the autoregressive pathways. Text in black represents the estimate of the autoregressive effects. Dashed blue lines connecting urgency at each wave with response class at the subsequent waves represent the pathways added at Step 2 of the model, urgency predicting increased engagement in response class behavior. Text in blue represents the estimate of the pathway from urgency to the response class. The red, solid lines connecting response class behavior at each wave with urgency at the subsequent waves represent the pathways added at Step 3 of the model, engagement in response class behavior predicting increases in urgency. Text in red represents the estimate of the pathway from the response class to urgency. Dashed lines represent non-significant pathways. * $p < .05$ ** $p < .001$.

Figure 3.

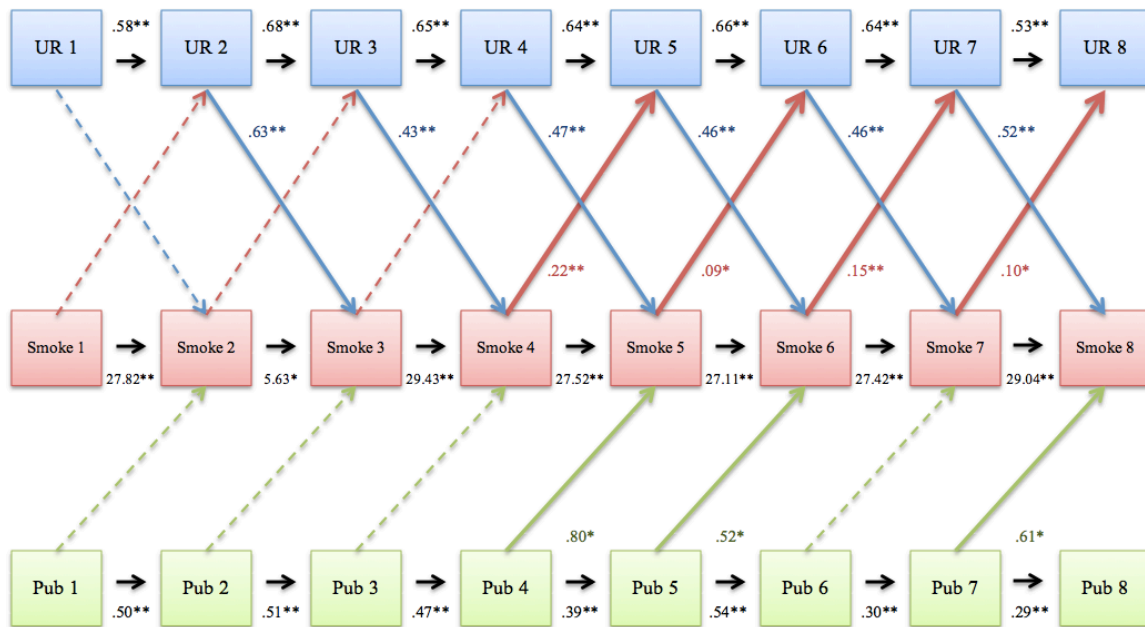
Reciprocal model between drinking and urgency at all waves



Note. UR 1 = Urgency at Wave 1, Drink 1 = drinking behavior at Wave 1, measured as a count variable. Horizontal lines connecting urgency at each wave with urgency at the subsequent waves and drinking at each wave with drinking at the subsequent waves represent Step 1 of the model, the autoregressive pathways. Text in black represents the estimate of the autoregressive effects. Dashed blue lines connecting urgency at each wave with drinking at the subsequent waves represent the pathways added at Step 2 of the model, urgency predicting increased engagement in drinking behavior. Text in blue represents the estimate of the pathway from urgency to drinking. The red, solid lines connecting drinking behavior at each wave with urgency at the subsequent waves represent the pathways added at Step 3 of the model, engagement in drinking behavior predicting increases in urgency. Text in red represents the estimate of the pathway from drinking to urgency. Dashed lines represent non-significant pathways. * $p < .01$ ** $p < .01$.

Figure 4.

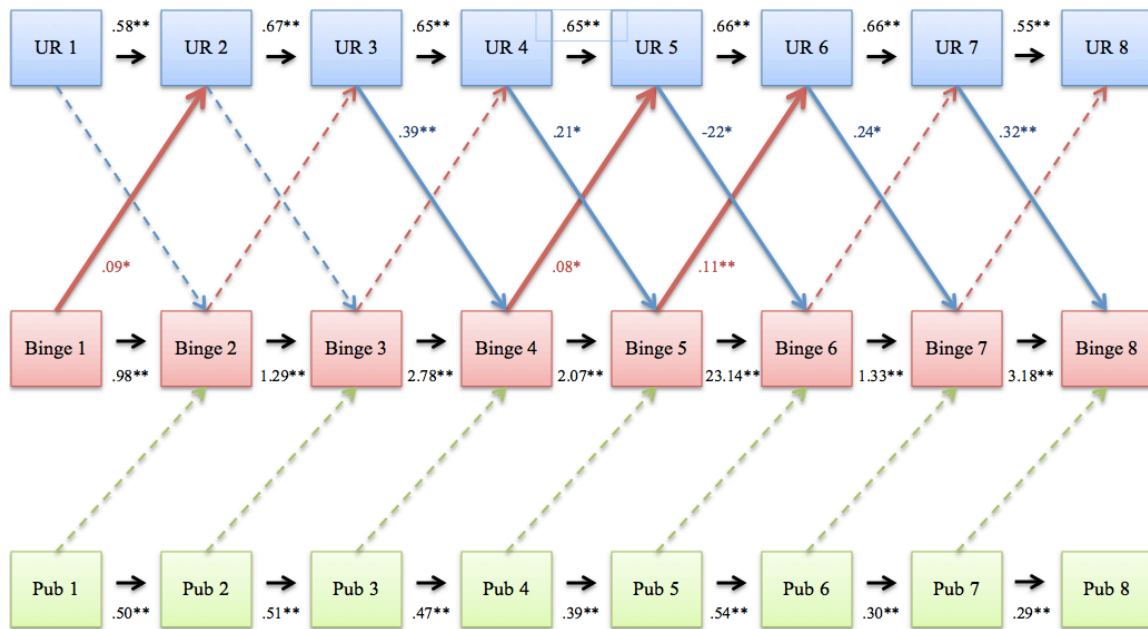
Reciprocal model between smoking and urgency at all waves



Note. UR 1 = Urgency at Wave 1, Smoke 1 = smoking behavior at Wave 1, measured as a count variable. Horizontal lines connecting urgency at each wave with urgency at the subsequent waves and smoking at each wave with smoking at the subsequent waves represent Step 1 of the model, the autoregressive pathways. Text in black represents the estimate of the autoregressive effects. Dashed blue lines connecting urgency at each wave with smoking at the subsequent waves represent the pathways added at Step 2 of the model, urgency predicting increased engagement in smoking behavior. Text in blue represents the estimate of the pathway from urgency to smoking. The red, solid lines connecting smoking behavior at each wave with urgency at the subsequent waves represent the pathways added at Step 3 of the model, engagement in smoking behavior predicting increases in urgency. Text in red represents the estimate of the pathway from smoking to urgency. Dashed lines represent non-significant pathways. * $p < .05$ ** $p < .001$.

Figure 5.

Reciprocal model between binge eating and urgency at all waves



Note. UR 1 = Urgency at Wave 1, Binge 1 = binge eating behavior at Wave 1, measured as a count variable. Horizontal lines connecting urgency at each wave with urgency at the subsequent waves and binge eating at each wave with binge eating at the subsequent waves represent Step 1 of the model, the autoregressive pathways. Text in black represents the estimate of the autoregressive effects. Dashed blue lines connecting urgency at each wave with binge eating at the subsequent waves represent the pathways added at Step 2 of the model, urgency predicting increased engagement in binge eating behavior. Text in blue represents the estimate of the pathway from urgency to binge eating. The red, solid lines connecting binge eating behavior at each wave with urgency at the subsequent waves represent the pathways added at Step 3 of the model, engagement in binge eating behavior predicting increases in urgency. Text in red estimates the pathway from binge eating to urgency. Dashed lines represent specified but non-significant pathways. * $p < .05$ ** $p < .01$.

VITA

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EDUCATION

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RESEARCH GRANTS RECEIVED

T32 NIDA Pre-doctoral Traineeship, DA035200: Research Training in Drug Abuse
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Personality Change and Problem Behavior: A Positive Feedback Loop of
Increasing Risk.

\$26,920 training costs.

Lipman Endowment Fund for Research on Alcohol Abuse, Department of Psychology,
University of Kentucky. Fall 2015 - Spring 2016.

Pilot Test of a New, Integrative Model of Psychopathology.

\$3,000 research costs, Principle Investigator with Heather Davis.

PUBLICATIONS

1. **Riley, E. N.**, Davis, H. A., Combs, J. L., Jordan, C. E., & Smith, G. T. (under review, European Eating Disorders Review). Non-suicidal self-injury as a risk factor for purging onset: Negatively reinforced behaviors that reduce emotional distress.
2. Davis, H. A., **Riley, E. N.**, & Smith, G. T. (in press). Transactions between personality and psychosocial learning: Advances in the acquired preparedness model of risk. In P. M. Monti, S. M. Colby, and T. A. O’Leary (Eds.), *Adolescents, Alcohol, and Substance Abuse: Reaching Teens through Brief Interventions* (2nd Edition). New York: Guilford Press.
3. Davis, H.A., Guller, L., **Riley, E.N.**, & Smith, G.T. (in press). A Positive Feedback Loop of Smoking Risk. In N. Columbus (Ed.) *Nicotine Dependence, Smoking*

- Cessation and Smoke: Exposure, Chemical Components and Health Consequences.
4. **Riley, E. N.**, Davis, H. A. & Smith, G. T. (in press). Personality Change and Problem Behavior: A Positive Feedback Loop of Increasing Risk in Early Adolescence. In N. Columbus (Ed.), *Advances in Psychology Research*.
 5. **Riley, E. N.**, Combs, H., Davis, H., A., & Smith, G. T. (in press) Theory as evidence: Criterion validity in neuropsychological testing. In Bowden, S. C. (Ed.), *Evidence-Based Neuropsychological Practice: National Academy of Neuropsychology*. NY: Oxford University press.
 6. **Riley, E. N.**, Combs, J. L., Jordan, C. E., & Smith, G. T. (2015). Negative Urgency and Lack of Perseverance: Identification of Differential Pathways of Onset and Maintenance Risk in the Longitudinal Prediction of Nonsuicidal Self-Injury. *Behavior Therapy*, available online DOI: 10.1016/j.beth.2015.03.002.
 7. Levinson, C.A., Rodebaugh, T.L., Kass, A., **Riley, E.N.**, Stark, L., McCallum, K., & Lenze, E.J. (2014) A double-blind clinical trial of Exposure Therapy in combination with D-Cycloserine for food anxiety in patients with Anorexia and Bulimia Nervosa. *The Journal of Clinical Psychiatry*.
 8. **Riley, E. N.**, Combs, J. L., Davis, H.A., & Smith, G. T. (2014) Impulsive behaviors that distract from distress: Non-suicidal self-injury. In M. Olmstead (Ed.), *Psychology of Impulsivity: New Research*
 9. Levinson, C. A., Rapp, J., & **Riley, E.N.** (2014). Addressing the fear of fat: Extending imaginal exposure therapy for anxiety disorders to anorexia nervosa. *Eating and Weight Disorders – Studies on Anorexia, Bulimia and Obesity*, 1-4, available online DOI: 10.1007/s40519-014-0115-6.
 10. Pearson, C. M., **Riley, E. N.**, Davis, H. A., & Smith, G. T. (2014). Two pathways toward impulsive action: An integrative risk model for bulimic behavior in youth. *Journal of Child Psychology and Psychiatry*.
 11. Derefinko, K. J., Bailey, U. L., Milich, R., Lorch, E. P., & **Riley, E.N.** (2009). The effects of stimulant medication on the online story narrations of children with ADHD. *School Mental Health*, 1, 171-182.

POSTER PRESENTATIONS

1. **Riley, E.N.**, Rukavina, M. E., & Smith, G.T. (2015, June). The reciprocal predictive relationship between personality and drinking: a positive feedback loop of risk. *Research Society on Alcoholism*, San Antonio, TX.
2. Dir, A. L., Cyders, M. A., **Riley, E.N.**, Smith, G.T. (2015, June). Tinder use and associations with problematic alcohol use and sexual hookups among college females. *Research Society on Alcoholism*, San Antonio, TX.
3. **Riley, E.N.** & Smith, G.T. (2015, April). The reciprocal relationship between urgency and smoking behavior: A positive feedback loop of risk in early adolescents. *Interdisciplinary Graduate Student Conference for Research on Children at Risk*. Lexington, KY.
4. **Riley, E.N.**, Davis, H.A., Combs, J.L., Jordan, C. E, & Smith, G.T. (2014, September). Purging as a Self-Harming Act. *Eating Disorders Research Society*, San Diego, CA.

5. **Riley, E.N.**, Combs, J.L., Jordan, C. E., & Smith, G.T. (2014, June). Negative urgency and depression: Trait-based predictors of self-injury over time. International Society for the Study of Self-Injury. Evanston, IL.
6. Pearson, C. M., **Riley, E. N.**, Davis, H. A., & Smith, G. T. (2013, September). Toward an Integrative Model of Child and Adolescent Risk for Bulimic Behaviors. Eating Disorders Research Society. Bethesda, MD.
7. **Riley, E.N.**, Levinson, C. A., & Rodebaugh, T. (2012, November). Does Social Appearance Anxiety and Maladaptive Perfectionism Predict Restrained Eating Over Time? Association for Behavioral and Cognitive Therapies. National Harbor, MD.
8. **Riley, E.N.**, Derefinko, K., Bailey, U., Lorch, E. P., & Milich, R. (2008, April). The effects of stimulant medication on online story narration in children with ADHD. Conference on Human Development. Indianapolis, IN.
9. Freer, B., **Riley, E.N.**, Lorch, E. P., & Milich, R. (2007, April). Developmental changes in children's goal-based story representation. Society for Research in Child Development. Boston, MA.

ACADEMIC HONORS AND AWARDS

University of Kentucky

2015 Research Society on Alcoholism: Enoch Gordis Research Award Finalist
 Daniel R. Reedy Quality Achievement Award: received in recognition of high confidence in academic potential (2013 – present)

Washington University in St. Louis

Honor Society Memberships

 Psi Chi (Psychology)

 Lambda Alpha (Anthropology)

 Sigma Xi (Scientific Research)

Ethan A.H. Shepley Award: one of twelve undergraduate seniors awarded for excellence in leadership, scholarship and service to the Washington University Community

Danforth Scholars Program: one of 35 students awarded a full-tuition scholarship to Washington University for excellence in community service, leadership and academic pursuit