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Self-Control Demands and Alcohol-related Problems: Within- and Between-Person Associations

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Abstract

This study tested a multilevel structural model of associations between two aspects of self-control (effortful control and reactivity), self-control demands, alcohol consumption, and alcohol problems and related risk behaviors using daily diary data from 196 young adults (4,177 person-days). Self-control demands were hypothesized to be positively associated with alcohol consumption and alcohol problems and related risk behaviors both within- and between- persons. At the between-person level, self-control demands were hypothesized to mediate the association between trait self-control and alcohol problems and related risk behaviors. At the within-person level, self-control demands had a direct positive effect on alcohol problems and related risk behaviors, over and above alcohol consumption. However, contrary to expectation, self-control demands were inversely associated with alcohol consumption. In contrast, self-control demands were positively associated with alcohol consumption at the between-person level and partially mediated the positive effects of reactivity on consumption and alcohol problems and related risk behaviors. That is, reactivity was associated with higher perceived self-control demands, which in turn predicted higher rates of consumption and alcohol problems and related risk behaviors. Effortful control was not significantly associated with alcohol consumption or self-control demands. The pattern of self-control demand effects at the within-person level suggest that young adults are less likely to drink when struggling to manage their day-to-day behavior, yet if they do drink are more susceptible to negative consequences. Trait effects suggest that individual differences in self-control may be associated with alcohol use patterns in part due to development of, and response to, structured daily routines.

Keywords

alcohol; daily diary; multilevel structural equation model (MSEM); self-control; self-control demands

Self-control, often defined as the ability to override impulses (Baumeister, Vohs, & Tice, 2007), is among the most studied aspects of cognition. State models of self-control emphasize a dynamic process where self-control is a limited, consumable resource that

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varies across time and situations (Muraven & Baumeister, 2000). Factors that deplete this limited resource can lead to self-control failure. Alternatively, trait models of self-control posit that self-control results from transactions between temperament and socio-environmental contexts (Caspi & Roberts, 2001; Wills & Dishion, 2004). Deficits in self-control are central to many forms of psychopathology, including alcohol use disorder (Sher & Trull, 1994). Late adolescence and young adulthood is a developmental period during which regulatory capacity is still developing (Rubia et al., 2000; Steinberg, 2008) and risk for alcohol-related problems peaks (Substance Abuse and Mental Health Service Administration, 2016). Understanding self-regulatory processes that underlie drinking and alcohol-related problems during this developmental period is crucial.

In the current paper, we propose a model that integrates trait and state models of self-control. At the state level, we test within-person effects of daily self-control demands on alcohol consumption and alcohol problems and related risk behaviors. At the trait level, we propose that individual differences in self-control predict the extent to which individuals face daily regulatory challenges and that the ongoing taxing of self-control resources mediates effects on alcohol consumption and associated problems and risk behaviors.

State determinants of self-control outcomes

The strength model of self-control largely addresses “in the moment” exertion of self-control and is thus state-based (Baumeister, Bratslavsky, Muraven, & Tice, 1998; Baumeister et al., 2007). This model conceptualizes self-control as a finite resource that, upon being used, becomes depleted, resulting in short-term deficits in self-control. Importantly, depletion effects occur only after tasks requiring the use of self-control resources (e.g., executive processes), not on simpler, resource independent tasks (Schmeichel & Zell, 2007). Moreover, the effects of depletion are domain independent (Baumeister et al., 1998). Individuals depleted in one domain of self-control (e.g., diet restriction) are affected in unrelated self-control domains (e.g., persistence in cognitive tasks). To illustrate, participants instructed to resist temptation to eat unhealthy foods exhibited lower persistence on a subsequent difficult puzzle task (Baumeister et al., 1998). Such cross-domain effects are consistent with the conceptualization of self-control as an overarching capacity that can be strained in diverse ways. Support for the model is not without limitations. For example, some studies have shown that effects can be nullified by manipulating expectancies about depletion (Job, Dweck, & Walton, 2010; Job, Walton, Bernecker, & Dweck, 2013) or adding incentives (Muraven & Slessareva, 2003), which has led some to question whether effects are truly due to diminished capacity per se (Inzlicht & Schmeichel, 2012; Job et al., 2010). Nonetheless depletion effects consistent with the model have been observed across a wide range of contexts including emotions (Gailliot, Schmeichel, & Baumeister, 2006), decision making (Vohs et al., 2008), engaging in cognitive processing (Schmeichel, Vohs, & Baumeister, 2003) and alcohol consumption (Muraven, Collins, & Neinhaus, 2002; Muraven & Shmueli, 2006). With regard to the latter, after being depleted by a thought-suppression task, individuals high in trait temptation to drink consumed more alcohol than individuals low in trait temptation to drink (Muraven et al., 2002).

In addition, the effect of self-control demands has been explored using experience sampling methods. For example, increased daily self-control demands during the day have been associated not only with alcohol consumption and intoxication (Muraven, Collins, Shiffman, &Paty, 2005), but also with interpersonal conflict and neglecting one's responsibilities (Simons, Wills, Emery, & Spelman, 2015) and violating one's drinking limits (Muraven et al., 2005). Notably, Simons et al. (2015) found within-person effects of self-control demands on consequences over and above the effects of intoxication. These results suggest that daily variation in self-control demands are associated within-person with subsequent decreases in regulation of alcohol consumption (Muraven et al., 2005) and ability to navigate social interactions and sustain goal-directed behavior (Simons et al., 2015).

Trait Self-Control

Dual process models of self-control posit two systems; one comprising controlled processes (effortful control) and one comprising reactive processes (reactivity, disinhibition; Lieberman, 2007; Stacy & Wiers, 2010; Wills, Simons, & Gibbons, 2015). Attainment of goals depends on the interplay between these systems (i.e., strength of impulses and strength of controlled, effortful processes; Hofmann, Friese, & Strack, 2009). When disinhibition and temptations to act counter to one's goals become strong, effortful control must take over to achieve successful self-regulation and goal attainment. This controlled process is deliberate, requiring the use of limited cognitive resources (Hofmann, Friese, & Wiers, 2008).

These different aspects of self-control exhibit unique associations with substance use and related problems. For instance, constructs related to the controlled process of self-control such as conscientiousness (Bogg & Roberts, 2004) and future time perspective (Keough, Zimbardo, & Boyd, 1999) have been inversely related to alcohol use. Impulsiveness, a construct related to the reactive component of self-control, has been positively associated with alcohol use and related problems (Patock- Peckham, Cheong, Balhorn, & Nagoshi, 2001; Simons, Carey, & Gaher, 2004; Simons, Gaher, Oliver, Bush, & Palmer, 2005; Simons, Hahn, Simons, & Murase, 2017). Moreover, disinhibition and impulsivity have long been established as robust predictors of alcohol use disorder (Sher & Trull, 1994). Importantly, constructs related to impulsivity have been significantly associated with alcohol-related problems while controlling for alcohol use (Coskunpinar, Dir, & Cyders, 2013; Simons, Carey, & Wills, 2009; Simons et al., 2005), suggesting that these individuals experience problems with regulation of behavior while intoxicated that is independent of alcohol consumption.

The effects of self-control traits on behavior are often indirect. These effects can stem from effects on learning (e.g., acquired preparedness; Smith & Anderson, 2004), proactive strategies for avoiding self-control failure (e.g., implementation intentions; Gollwitzer & Sheeran, 2006), socio-environmental context (e.g., peer group; Wills et al., 2013), and occurrence of temptation or self-control efforts (Hofmann, Baumeister, Förster, & Vohs, 2012; Imhoff, Schmidt, & Gerstenberg, 2014; Milyavskaya & Inzlicht, 2017). For example, there is evidence that the effect of self-control on substance use is indirect via socio-environmental contexts that serve to either promote (e.g., substance using peers, life stress) or inhibit (e.g., academic competence) substance use (Wills, Pokhrel, Morehouse, & Fenster,

2011; Wills et al., 2013). Indirect effects of self-control traits on substance use are complex and warrant further investigation.

Given the effortful nature of the controlled process, fewer encounters with self-control impulses and temptations may be a fruitful path to successful self-regulation (Hofmann & Kotabe, 2012). Indeed, evidence suggests that goal attainment depends on strength of everyday temptations and not on individuals controlling themselves, per se (Milyavskaya & Inzlicht, 2017). Self-control has also been inversely associated with the experience of temptations (Hofmann et al., 2012) and frequency of needing to inhibit urges (Imhoff et al., 2014). Furthermore, recent research has emphasized the concept of 'effortless self-control' (Fujita, 2011) and automatic, routinized control processes (e.g., habits; Galla & Duckworth, 2015) that foster adaptive self-regulatory outcomes. In addition, trait self-control is associated with decreased effortful inhibition in the enactment of important health behaviors (e.g., exercise, healthy snacking, sleeping; Galla & Duckworth, 2015).

Collectively, the somewhat ironic conclusion of the above research is that a hallmark of good self-control may be its infrequent utilization. Thus, we propose that effortful control, characterized by planfulness, problem solving, and goal-setting will be inversely associated with the typical daily level of self-control demands (e.g., perceived effort to control behavior and emotion). In contrast, reactivity characterized by impulsive choice, behavioral reactivity, and distractibility is posited to predict higher levels of day-to-day strain related to controlling behavior. Consistent with the strength model of self-control (Baumeister et al., 2007), high self- control demands may imply increased taxing of one's resources, greater barriers to succeed in self-regulation, and consequently increased likelihood of self-control failure resulting in higher alcohol consumption and problems. Hence, individuals' characteristic level self-control demands are hypothesized, in part, to mediate effects of effortful control and reactivity on alcohol consumption and associated problems.

Current study

Understanding psychological processes within-person across time as well as between-persons can provide valuable insights into behavior. While many psychological theories are interested in within-person processes, empirical support for these theories is often derived from between-person data (Curran & Bauer, 2011). Findings from between- and within-person analyses are often at odds (e.g., Colder, Chassin, Lee, & Villalta, 2010; Simons, Wills, & Neal, 2014). For example, Simons et al. (2014) found that trait positive affect (between-person) was inversely related to drinking likelihood. However, state positive affect (within-person) was positively related to drinking likelihood. As such, the present study seeks to examine the effects of both within- and between-person self-control demands on alcohol consumption and problems. Our within-person analysis examines whether self-control demands, alcohol consumption, and problems covary within each person across time. For example, do individuals experience more alcohol problems and related risk behaviors on days when demands on self-control are higher than usual for that individual? Symptoms of alcohol use disorder reflect impaired control (American Psychiatric Association, 2013). However, drinking itself may be considered a goal directed activity and hence effects of self-control demands on drinking may be most apparent when drinking conflicts with current

goals. Hence, we include a daily measure of planned abstention from drinking in order to control for those individuals who planned to drink versus those who did not. We expected self-control demands to predict more alcohol consumption (Muraven et al., 2005) and more alcohol problems and related risk behaviors (Muraven et al., 2005; Simons et al., 2015).

In addition, this study investigated between-person associations of two processes of selfcontrol (i.e., effortful control and reactivity) and alcohol problems and related risk behaviors through the mediating mechanisms of self-control demands and alcohol consumption. We were interested in the ways in which individual differences in effortful control and reactivity predict trait levels of self-control demands, and whether trait levels of self-control demands in-turn predict alcohol consumption and related problems and risk behaviors. We hypothesized that effortful control would be indirectly linked to fewer alcohol problems and related risk behaviors through decreased self-control demands and alcohol consumption (Hofmann et al., 2012; Milyavskaya & Inzlicht, 2017). We expected reactivity to be indirectly linked to more alcohol problems and related risk behaviors via increased self-control demands and alcohol consumption (Muraven et al., 2005; Simons et al., 2015Muraven et al, 2005; Simons et al., 2015). We also expected effortful control to be directly associated with decreased alcohol consumption (Bogg & Roberts, 2004; Keough et al., 1999) and reactivity to be directly associated with increased alcohol problems and related risk behaviors (Simons et al., 2009; Simons et al., 2005).

Method

Participants

Participants were 247 undergraduates ages 18–24 (M = 18.85, SD = 1.14). The sample was 74% female and 86% non-Hispanic white. Of these, 218 reported drinking in their lifetime and were eligible for the analysis. The final analysis sample (n = 196), excluded 21 people due to missing data and 1 person based on model diagnostics. The analysis sample was 77% female and 92% white, 3% Native American, 3% African American, 1.5 % Asian, 1% multiracial, and 1% other race. Three percent of the analysis sample was Hispanic. The sample is consistent with previous similar daily process research of drinking, which have N's ranging from 106 to 284, and between 1,348 and 9,562 days of monitoring (Braitman, Linden-Carmichael, & Henson, 2017; Kaysen et al., 2014; Mohr et al., 2005; Muraven et al., 2005; Park, Armeli, & Tennen, 2004; Patrick & Maggs, 2009; Simons et al., 2015; Simons et al., 2014). Hence this is a moderately sized daily process study.

Baseline measures

Reactivity.—Reactivity was assessed using four indicators: a 5-item measure derived from the Eysenck impulsivity scale (α = .82; Eysenck, Pearson, Easting, & Allsopp, 1985), a 7-item motor impulsivity subscale (α = .68; Patton & Stanford, 1995), an 8-item attention impulsivity scale (α = .75; Patton & Stanford, 1995), and a 6-item distractibility measure (α = .85; Kendall & Williams, 1982). The Eysenck impulsivity and distractibility items were rated on 5-point scales ranging from 1 (*not at all true*) to 5 (*Very True*). The attention impulsivity and motor impulsivity subscales were rated on 4-point scales ranging from 1 (*Rarely/Never*) to 4(*Almost Always/Always*).

Effortful control.—Effortful control was assessed using three indicators: a 7-item measure of planfulness (α = .75; Kendall & Williams, 1982), a 6-item measure of problem solving (α = .83; Wills et al., 2001), and a 10-item measure of goal setting (α = .81; Neal & Carey, 2005). Each item was rated on a 5-point scale ranging from 1 (*not at all true*) to 5 (*very true*).

Daily diary measures

Plan to abstain.—Each morning participants indicated whether they planned to abstain from alcohol the coming night. Response options included "plan NOT to drink", "plan to drink", and "unsure see what happens." Plan NOT to drink (i.e., abstain) was coded with "1" whereas any other response was coded as "0".

Self-control demands.—Self-control demands were assessed during the evening using 8 items that were rated on 7-point scales ranging from 1 = *not at all* to 7 = *extremely*. Six items assessed the extent to which individuals had to regulate mood, deal with overwhelming feelings, control thoughts, and deal with stress (Muraven et al., 2005). Participants also answered two additional items regarding the extent to which they had to force themselves to do something they did not want to do and the extent to which they forced themselves to not do something they wanted to do (Simons et al., 2015). We calculated reliability (McDonald's Omega; McDonald, 2013) at the within- and between-persons level following the procedure of Geldhof, Preacher, and Zyphur (2014). The scale exhibited good reliability at both the within- (ω = .86) and between- (ω = .91) levels.

Alcohol consumption, problems, and related risk behaviors.—Alcohol consumption and related problems were measured during the morning assessment (¡10 am) and reflected behavior the previous night. Each was scored as a count variable. Alcohol consumption was assessed as total number of standard drinks consumed the previous night. The definition of a standard drink was provided to participants as equal to 12 ounces of beer, 5 ounces of wine, or 1.5oz of hard liquor. Alcohol problems and related risk behaviors were assessed using 14 problems including alcohol use disorder symptoms such as drinking more than intended, being unable to stop or limit alcohol use, having to drink more than usual to get the desired effect, feeling alcohol effects less for the amount used, drinking when promised self not to, and experiencing withdrawal symptoms. Passing out, blacking out, vomiting, and being hungover as a result of drinking were also included. Interpersonal and conduct problems composed the remaining alcohol problems and related risk behaviors. These included getting into a verbal argument or fight, coercing someone into sexual activity, physically assaulting someone, and vandalizing property. Hence, the construct includes both problems that are the direct result of intoxication (e.g., passing out) as well as problems that are associated with, but not exclusive to, intoxication (e.g., verbal argument or fights). Consistent with previous research, the latter associated risk behaviors were assessed independent of drinking and did not require the participant to make an attribution regarding whether the behavior was "due to drinking"(Gmel, Labhart, Fallu, & Kuntsche, 2012; Neal & Fromme, 2007).[1] Validity of these and related items is supported by expected associations with criterion variables in previous research (Simons et al., 2005; Simons et al., 2015; Simons et al., 2014).

Procedure

The study was approved by the university's Institutional Review Board. Undergraduates ages 18 to 25 were invited to participate in the study. Participants were recruited through an online research participation website at a state university. After providing informed consent for the study, participants completed a baseline survey. Participants then received a link to take an online survey twice a day for 30 days. The morning surveys (¡10am) assessed plans to abstain from using alcohol the coming night, alcohol consumption, and problems the previous night. The evening surveys (¡5pm) assessed self-control demands. Participants earned course credit for taking part in the study. In addition, participants who completed the study were entered into a random drawing for a chance to win one of two $50 prizes.

Analysis plan

We tested a multilevel structural equation model (MSEM) in Mplus 8 (Muthén & Muthén, 2017) in wich day(Level 1) were nested within persons (Level 2). Problems, drinking, and self-control demands were decomposed into latent within- and between-person parts, thus distinguishing effects at each level (Lüdtke et al., 2008; Preacher, Zyphur, & Zhang, 2010; Simons et al., 2014). For predictors with a fixed slope, the resulting Level 1 variable is person- centered, for those with a random slope the observed Level 1 score is used (Muthén & Muthén, 2017; Preacher et al., 2010). The abstaining plan variable was centered at the person-mean and day-of-the week indicators were observed scores. The model contained 3 time-varying (within- person) outcome variables: self-control demands, alcohol problems and related risk behaviors, and alcohol consumption (i.e., nighttime number of drinks) plus day of the week indicators. Alcohol problems and related risk behaviors and alcohol consumption were specified as count variables with a negative binomial reference distribution. Self-control demands were treated as a continuous variable. At Level 1, abstaining plan was included as a predictor of self-control demands and drinking.[2] In addition, 6 day-of-week indicator variables were used to control for variation in alcohol problems and related risk behaviors, alcohol consumption, and self-control demands across days. Self-control demands had both direct and indirect (via alcohol consumption) effects on alcohol problems and related risk behaviors. Thus, we examined the within-person associations (Level 1) between self-control demands and alcohol consumption and alcohol problems and related risk behaviors. Alcohol consumption had a random slope variance component. Thus, the observed score is used at Level 1. In contrast, the self-control demands variable does not have a random slope and is thus person-centered. This is a random intercept model and thus, within-person self-control demands are predicting deviations from the individual's expected drinking level and alcohol problems and related risk behaviors for a given day of the week.

[1]We estimated a model that included only problems explicitly associated with alcohol use (e.g., drinking more than intended, blacking out, vomiting). The direction of associations and pattern of statistical significance remained unchanged, so the original outcome measure which included problems explicitly associated with alcohol use as well as other behavioral risks (e.g., physically assaulting someone, vandalizing property) was retained as the final model.

[2]An anonymous reviewer asked for inclusion of a planned abstention and self-control demands interaction at Level 1. We tested this using the methods of Preacher, Zhang, and Zyphur (2016). The interaction was not significant (b = 0.02, p = .876) and was thus dropped for parsimony.

At the between-person level (Level 2), a structural equation model was tested whereby we examined between-person associations between self-control (i.e., effortful-control and reactivity), trait level self-control demands, alcohol consumption, and alcohol problems and related risk behaviors. Effortful control and reactivity were latent variables composed of the indicators described above (in the measures subsection). Latent between-person alcohol consumption and self-control demands variables were also created using the individual-level data as indicators. This procedure accounts for measurement error and reduces bias in the between- person effects (Lüdtke et al., 2008; Preacher et al., 2010; Simons et al., 2014). Alcohol consumption was regressed on effortful control and self-control demands, self-control demands were regressed on effortful control and reactivity, and alcohol problems and related risk behaviors were regressed on reactivity and alcohol consumption.

Results

Descriptive statistics

Our analysis sample consisted of 196 people (4,177 person days). Twenty-one participants were excluded from analyses due to having less than 7 days of monitoring data. One participant was excluded due to diagnostics. Compliance with the protocol in the analysis sample was good with 82% completion of evening assessments and 92% of morning assessments. Due to patterns of missing data across assessments, the analytic model ended up with 76% of potential analysis days. This was a relatively light drinking sample, with 23.4% of participants yielding no variance in alcohol use and 28.1% yielding no variance in problems. Participants reported alcohol consumption on 13.9% of study days and reported at least one alcohol problem and related risk behaviors on 10.3% of study days. Table 1 presents descriptive statistics. Between-person correlations are presented in Table 2.

Measurement model

We tested a confirmatory factor analysis (CFA) of the between-person effortful control and reactivity indicators using Mplus 8 with maximum likelihood estimation (Muthén & Muthén, 2017). The fit of the initial hypothesized two-factor model was not ideal $\chi^2(13, N= 196) = 32.63$, $p = .002$; RMSEA = .09, 90% CI (.05, .13); CFI = .94; SRMR = .05. Modification indices suggested allowing the measurement errors of Eysenck impulsivity and motor impulsivity to covary. This resulted in improved model fit $\chi^2(12, N= 196) = 17.06$, $p = .147$; RMSEA = .05, 90% CI (.00, .09); CFI = .98; SRMR = .03.

MSEM Analysis

We tested the MSEM described in the analysis plan using Mplus 8 (Muthén & Muthén, 2017). This analysis included 4,177 days nested in 196 individuals. To create a more parsimonious model, the nonsignificant direct effect of self-control demands on alcohol problems and related risk behaviors at Level 2 was dropped. The final results of the model are presented in Table 3. The final model is depicted in Figure 1.

Within-person effects.—The plan to abstain covariate was inversely associated with consumption but not significantly associated with self-control demands. Planning to abstain from alcohol was a strong predictor of alcohol consumption. Planning to not drink was

associated with approximately a 49% reduction in the incidence-rate of drinking. Contrary to expectation, self- control demands were inversely rather than positively related to alcohol consumption at the within-person level. An incidence-rate ratio (IRR) of 0.83 indicates that, controlling for the participant's plan to abstain from alcohol that day and the day of the week, the incidence-rate of alcohol use decreases by 17% for every unit increase in self-control demands. As expected, however, the within-person direct effect of self-control demands on alcohol problems and related risk behaviors was positive. Here the incidence-rate of alcohol problems and related risk behaviors increases 13% for every unit increase in self-control demands. These results suggest that individuals tend to drink less alcohol on days when their experience of self-control demands are higher than their typical level. However, controlling for drinking level, individuals are at increased risk for problematic outcomes on days characterized by increased self-control demands. Given the count mediator and outcome, we were unable to calculate indirect and total effects of self-control demands at Level 1.

Between-person effects.—As hypothesized, reactivity was positively related to alcohol problems and related risk behaviors. However, contrary to hypothesis, effortful control was not significantly associated with alcohol use. Also contrary to hypothesis, effortful control was not significantly related to self-control demands. Reactivity was positively associated with selfcontrol demands and self-control demands were positively associated with alcohol consumption. This latter effect indicates that, on average, people who experience more self-control demands tend to drink more alcohol.

Indirect effects.: There was a significant indirect association between self-control demands and alcohol problems and related risk behaviors via alcohol consumption ($ab = 0.25$, $p = .007$). Reactivity was also indirectly associated with alcohol problems and related risk behaviors via self-control demands and alcohol use ($abc = 0.14$, $p = .040$). The hypothesized indirect effects of effortful control on alcohol problems and related risk behaviors via selfcontrol demands and alcohol consumption ($abc = 0.06$, $p = .513$) and via alcohol consumption ($ab = -0.33$, $p = .224$) were not supported.

Discussion

This study tested a multilevel dual-process model of alcohol consumption and related problems and risk behaviors. The model analyzed the unique effects of effortful control and reactivity on alcohol consumption and alcohol problems and related risk behaviors via selfcontrol demands. Moreover, the model disaggregated between- and within-person effects of self-control demands on alcohol consumption and alcohol problems and related risk behaviors. Guided by the theoretical underpinnings of the strength model of self-control (Baumeister et al., 2007), we expected self-control demands to explain differential effects of effortful control and reactivity on alcohol use and related problems and risk behaviors. Moreover, we expected within-person self-control demands to predict alcohol consumption and problems and related risk behaviors. There was mixed support for the hypothesized effects at each level of analysis.

Within-person Effects

At Level 1, contrary to our hypothesis, our analysis of the effect of self-control demands on alcohol consumption yielded an inverse effect. This is at odds with findings from Muraven et al. (2005) who found a positive effect. The reason for this discrepancy is unclear but may be a function of sample differences. Muraven et al. included only individuals who drank alcohol regularly (i.e., at least three drinks a week) whereas we included a wider range of drinkers (i.e., young adults who have consumed alcohol at some point in their lives). Moreover, our measure of self-control demands was slightly different in that it used two additional items regarding the extent to which individuals had to force themselves to do something they did not want to do and the extent to which individuals forced themselves to not do something they wanted to do. Among college students, academic requirements (e.g., upcoming tests, studying) may be a prominent source of self-control demands and are incompatible with drinking. Indeed, research indicates that pending exams or early morning classes are associated with decreased alcohol consumption (Wood, Sher, & Rutledge, 2007) and decreased demand for alcohol (Gentile, Librizzi, & Martinetti, 2012; Skidmore & Murphy, 2011). This may account for the unexpected inverse within-person association between demands and alcohol consumption. However, it is interesting that this effect was observed even after accounting for the individual's plan to abstain that night.

In contrast to the effect on alcohol consumption, the association between self-control demands and alcohol problems and related risk behaviors was significant and positive, consistent with our hypothesis. Hence, although perceived elevations in self-control demands were associated with decreases in drinking behavior; controlling for drinking level, self-control demands were associated with elevated rates of problems and related risk behaviors. These findings suggest that the extent to which one's daily life places demands on self-control is associated with a diminished ability to regulate drinking and social interactions later that same day. Viewed through the lens of the strength model of self-control, increased self-control demands leads to depletion of resources resulting in limited capacity to regulate behavior later that evening. The fact that demands predict problems over and above drinking itself suggests that individuals experiencing greater self-control demands than usual have difficulty managing their behavior, including both alcohol intake (e.g., drinking more than intended) as well as social interactions (e.g., getting into arguments).

Between-person Effects

Consistent with hypotheses, reactivity was positively related with alcohol problems and related risk behaviors. This is consistent with a considerable amount of research regarding the propensity to experience substance problems over and above use afforded by reactive processes such as impulsivity (e.g., Coskunpinar et al., 2013; Simons et al., 2009).

Also, as expected, reactivity was positively associated with self-control demands. This suggests that individuals high in trait-level reactivity may be more likely to encounter environments that tax self-control. Consistent with this, poor behavioral control has been directly associated with peers who use substances as well as negative life events (Wills et al., 2013), each of which could contribute to increased demands on self-control (e.g., dealing with stress, forcing oneself to not do something one wants to do). The positive association

between reactivity and self-control demands, coupled with the significant indirect effect of reactivity on alcohol problems and related risk behaviors, suggests that reactive individuals exert more effort in attempts to regulate behavior while ultimately being more prone to self-regulatory failure. Though the construct of reactivity may invoke ideas of being “care-free”, the associated dysrégulation in mood and socioenvironmental context may pose constant challenges (Wills et al., 2013; Wills, Simons, Sussman, & Knight, 2016). The present results indicate that high degrees of self-control demands are associated with greater alcohol consumption.

Contrary to our hypothesis, effortful control was not significantly related to self-control demands or alcohol use in the multivariate model. Previous research suggests that effects of effortful control on health outcomes may be accounted for in part by socio-environmental contexts such as peer groups or academic engagement (Wills et al., 2013) or adaptive routines (Galla & Duckworth, 2015). Though speculative, effortful control may have opposing effects on self-control demands, both decreasing demands via establishing routines and health promoting environments and increasing demands via selection of competitive environments, high goals, and stringent personal standards.

Limitations

Although the daily process design facilitates understanding of the temporal relationships, the non-experimental design of this study precludes causal inference. For example, there may be interesting reciprocal associations, whereby heavy drinking predicts heightened perceived selfcontrol demands the following day. Also, the sample was a relatively homogeneous sample of mostly White female college students. Generalizing to samples with different demographic characteristics or with differing levels of alcohol use remains an empirical question. In respect to the latter, person-level associations between self-control constructs, self-control demands, and intoxication may vary in samples with different rates of high risk drinking (Simons et al., 2015).

The lack of familiar indices of effect size at the between-person level limits interpretations of clinical significance. However, incidence-rate ratios computed from within- person effects facilitate interpretation at Level 1. Here, one can interpret changes in the incidence-rate of alcohol consumption and alcohol problems and related risk beahviors as changes occur in self-control demands.

Conclusion

This study highlights several potential paradoxes in associations between self-control and alcohol problems and related risk behaviors. Daily increases in self-control demands were associated with less drinking behavior, yet heightened rates of problems associated with drinking. Self-control demands exhibited an inverse association with drinking at the daily level, yet a positive association was exhibited at the between-person level. The effects of reactivity on alcohol consumption were mediated by seemingly *greater* efforts to regulate behavior, whereas effortful control was not associated with self-control demands. Constructs such as stress, temptation, and impulse control ostensibly reflect two factors; a stimulus or event and the individual’s response. Effects of reactivity on alcohol problems and related

risk behaviors may stem from a complex interplay of the cultivation of a socioenvironmental context that places ongoing demands on self-control in conjunction with diminished capacity to regulate behavior in the face of these demands.

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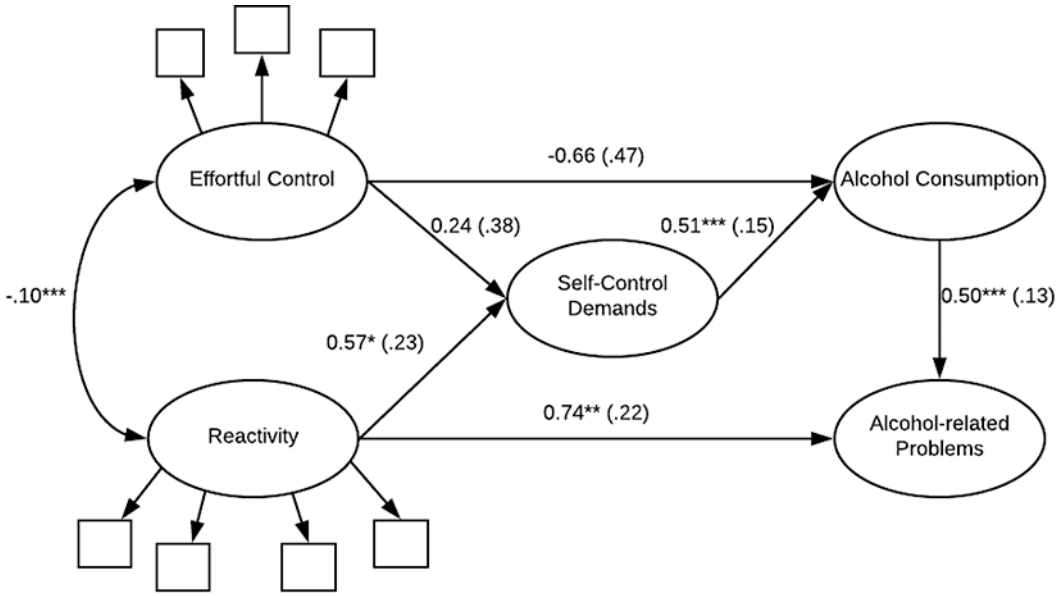

Between-Person (Level 2)

Within-Person (Level 1)

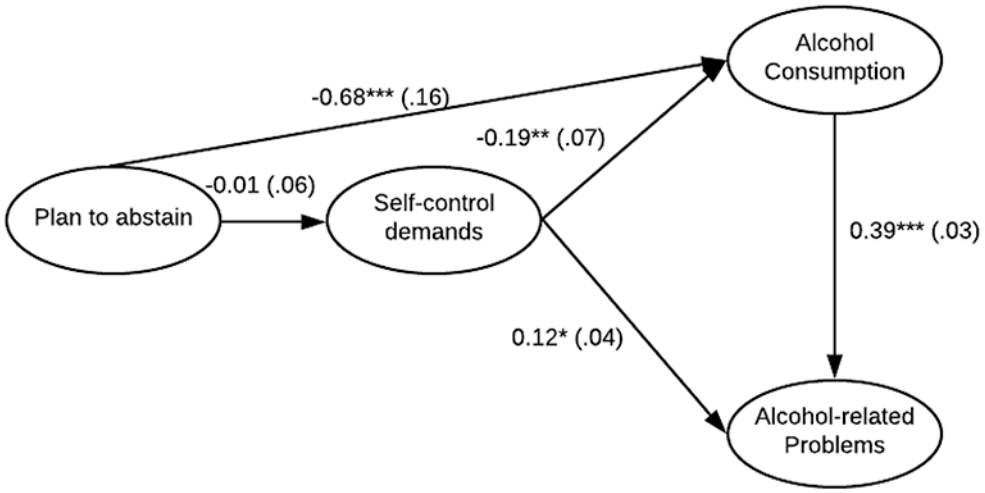

Figure 1.

Multilevel structural model depicting within-and between-person effects. Unstandardized coefficients with standard errors (in parentheses). $N = 196$ persons, 4177 person days. Gender is a covariate but paths are omitted for clarity. $*p < .05$, $**p < .01$, *** $p < .001$.

Table 1

Descriptive Statistics

Variable	*N*	*M*	*SD*	Range	Skew	Kurtosis
Impulsivity	196	2.34	0.88	1.00–5.00	0.82	3.32
Motor impulsivity	196	2.28	0.53	1.00–3.86	0.41	0.31
Attention impulsivity	196	2.25	0.55	1.13–3.75	0.24	−0.63
Distractibility	196	2.60	0.87	1.00–4.83	0.28	−0.62
Goal setting	196	3.89	0.50	2.00–5.00	−0.64	1.39
Planfulness	196	3.74	0.65	1.71–5.00	−0.60	0.08
Problem solving	196	4.05	0.65	1.67–5.00	−0.75	0.87
Plan to abstain	4,177	0.81	0.39	0.00–1.00	−1.59	0.54
Self-control demands	4,177	2.54	1.39	1.00–7.00	0.78	0.05
Alcohol-related problems	4,177	0.17	0.69	0.00–10.00	7.36	77.05
Alcohol consumption	4,177	0.73	2.39	0.00–25.00	4.36	25.96

Note. Alcohol-related problems = alcohol problems and related risk behaviors.

Table 2

Correlation Matrix for Observed Variables (N= 196)

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. Sex	1.00											
2. Impulsivity	0.15*	1.00										
3. Motor impulsivity	0.13	0.54***	1.00									
4. Attention impulsivity	0.08	0.43***	0.37***	1.00								
5. Distractibility	0.14*	0.50***	0.39***	0.57***	1.00							
6. Goal setting	−0.05	−0.13	−0.07	−0.22**	−0.34***	1.00						
7. Planfulness	−0.09	−0.26***	−0.26***	−0.24***	−0.38***	0.47***	1.00					
8. Problem solving	−0.08	−0.23**	−0.22**	−0.22**	−0.23**	0.48***	0.49***	1.00				
9. Plan to abstain	−0.23**	−0.17*	−0.15*	−0.10	−0.22**	0.14*	0.10	0.02	1.00			
10. Self-control demands	−0.04	0.27***	0.20**	0.15*	0.16*	−0.13	−0.08	0.04	−0.24***	1.00		
11. Alcohol-related problems	0.04	0.28***	0.25***	0.12	0.26***	−0.09	−0.20**	−0.28***	−0.20**	0.16*	1.00	
12. Alcohol consumption	0.25***	0.18*	0.23**	0.10	0.20**	−0.13	−0.17*	−0.21**	−0.54***	0.14*	0.60***	1.00

Note. $N = 196$,

Gender is coded 0 = *women*, 1 = *men*. Alcohol related problems = alcohol problems and related risk behaviors. Plan to abstain, Self-control demands, Alcohol consumption, and Alcohol-related problems reflect observed subject means

* $p < 0.05$,

** $p < 0.01$,

*** $p < 0.001$.

Table 3

Self-control Demands, Consumption, and Problems: Between- and Within-Person Effects

	Outcomes										
	Self-control demands			Consumption				Problems			
Predictors	***b***	***SE***	***p***	***b***	***SE***	***p***	**IRR**	***b***	***SE***	***p***	**IRR**
Intercept	−0.03	0.09	.749	−2.40	0.30	<001		−2.96	0.21	<001	
Gender	−0.21	0.16	.203	0.79	0.30	.008		0.21	0.25	.402	
Effortful control	0.24	0.38	.519	−0.66	0.47	.161					
Reactivity	0.57	0.23	.015					0.74	0.22	.001	
Self-control demands				0.51	0.15	<001					
Alcohol consumption								0.50	0.13	<001	
Plan to abstain	**0.01**	**0.06**	**.933**	**−0.68**	**0.16**	**<.001**	**0.51**				
Self-control demands				**−0.19**	**0.07**	**.003**	**0.83**	**0.12**	**0.04**	**.008**	**1.13**
Alcohol consumption								**0.39**	**0.03**	**<.001**	**1.48**
Day of week covariates											
Monday	**0.16**	**0.05**	**.002**	**−0.29**	**0.33**	**.383**		**−0.44**	**0.24**	**.067**	
Tuesday	**0.25**	**0.06**	**<.001**	**−0.35**	**0.34**	**.302**		**−0.17**	**0.22**	**.423**	
Wednesday	**0.29**	**0.05**	**<.001**	**0.37**	**0.31**	**.239**		**−0.05**	**0.21**	**.803**	
Thursday	**0.20**	**0.05**	**<.001**	**1.25**	**0.39**	**<.001**		**0.11**	**0.21**	**.603**	
Friday	**0.06**	**0.06**	**.304**	**2.18**	**0.29**	**<.001**		**−0.10**	**0.23**	**.663**	
Saturday	**−0.17**	**0.06**	**.002**	**2.22**	**0.28**	**<.001**		**−0.24**	**0.24**	**.314**	

Note. L1 n = 4,177, L2 n = 196. Log-likelihood = −11806.84. Akaike information Criterion (AIC) = 23763.67. Bayesian information Criterion (BIC) = 24238.98. IRR = Incidence-rate ratio. Gender is coded 0 = *women*, 1 = *men*. Between-person effects are regular font. Within-person effects are bold font. Coefficients are unstandardized.