Daily Fluctuations in Self-Control Demands and Alcohol Intake

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Predictions made by the self-control strength model were tested in a sample of underage social drinkers using ecological momentary assessment methodology. On days that participants experienced more self-control demands than average, they were more likely to violate their self-imposed drinking limit after controlling for mood and urge to drink. There was no relationship between self-control demands and urge or intention to drink, nor were self-control demands related to plans to limit drinking. When individuals planned to limit their alcohol intake, they were more affected by self-control demands than when they did not plan to limit their alcohol intake. Trait self-control moderated these relationships. Consistent with the self-control strength model, it appears that exerting self-control in nondrinking areas undermines individuals' capacity to exert self-control of drinking in daily life.

All too often, people break their promises to themselves to not overindulge. A vow to not eat dessert or a decision not to drink alcohol that night is broken despite the fervent desire to lose weight or cut back on drinking. Indeed, research on New Year's resolutions indicates that up to 25% of such promises are broken in the 1st week alone (Norcross, Ratzin, & Payne, 1989; see also Marlatt & Gordon, 1985). Self-change clearly is not easy, and individuals frequently fail in their attempts to alter their habits (Polivy & Herman, 2002). Recent research on self-regulation has started to shed light on why individuals have so much trouble keeping promises to themselves. In particular, a newly developed model of self-control suggests that individuals are especially likely to fail at self-change when they lack a resource needed for self-control. The purpose of the present study was to investigate the role of this resource in underage social drinkers' attempts to cut back on alcohol consumption in their daily life.

Researchers have proposed that this limited inner resource, known as *self-control strength*, is required for the exertion of self-control (Muraven & Baumeister, 2000). Self-control strength is required any time an individual inhibits, overrides, or changes a behavior, urge, emotion, or thought to reach a goal or follow a rule. For example, when an individual overrides the desire to drink or limits how much he or she consumes, he or she will use self-control strength. Self-control strength is a resource needed for any and all attempts at self-control.

Self-control strength is important because it has been theorized that individuals' level of strength is related to their ability to exert self-control. Individuals who have more self-control strength should be more likely to succeed at self-control than individuals lower in self-control strength. For the regulation of alcohol intake, this means that having less strength may reduce individuals' ability to resist the temptation to drink. Thus, when individuals are lower in self-control strength, they should be more likely to violate a self-imposed limit on alcohol intake than when more self-control strength is available to them. Individuals' level of self-control strength has no effect on tasks that do not require self-control (Muraven & Slessareva, 2003). Hence, behaviors that do not require self-control (e.g., unrestrained drinking) should not be affected by the individual's level of self-control strength.

It is important to note that self-control strength is replenished slowly, and the pool of strength is small. After the exertion of self-control, individuals are lower in strength and remain so for some time. Sleep is probably the primary way of regaining lost strength. Quite simply, self-control strength is depleted in the process of self-control. Because of the limited amount of self-control strength and its slow recovery, the effects of exerting self-control extend beyond the initial act of self-control and influence later self-control attempts. This means that individuals who have exerted self-control are lower in strength than individuals who have not exerted self-control and remain so for some time. Recent research has suggested that the desire to conserve limited resources plays a critical role in this process (Muraven, Shmueli, Slessareva, & Burkley, 2005). Thus, individuals with a small pool of resources (e.g., lower in trait self-control) may be more affected

by self-control demands than individuals with a large pool of resources.

As noted above, individuals' level of self-control strength is related to their self-control performance. Hence, depleted individuals should be more likely to fail at self-control attempts. Indeed, recent research supports that conclusion. For example, male social drinkers were placed in a situation that required restraint over alcohol (they thought they were going to take a driving simulator test after drinking). Participants who depleted their self-control strength by regulating their thoughts consumed more alcohol and were more intoxicated in a subsequent ad lib drinking task than participants who worked on arithmetic problems before drinking (Muraven, Collins, & Nienhaus, 2002). Regulating one's thoughts was no more frustrating, effortful, unpleasant, or arousing than solving math problems; the only difference between the two tasks was how much self-control was required. In short, limiting alcohol intake required self-control, and individuals lower in self-control strength because of previous demands on that resource were less able to control their intake.

To date, the predictions of the self-control strength model have been examined only in laboratory settings. In the present study, we examined self-control in participants' daily lives, as they went about their routines and experienced self-control demands. In particular, self-control strength likely fluctuates across days, on the basis of the amount of the self-control demands the individual experiences. Some days will require more self-control than others, and this will contribute to changes in self-control strength. For example, frustrating or anger-provoking events may warrant mood regulation, which could deplete individuals' self-control strength (Muraven, Tice, & Baumeister, 1998). Coping with stress also may deplete self-control strength (Muraven, 2003). Self-control strength likely varies across days within individuals, on the basis of the number of self-control demands they face. By relating these fluctuations in self-control demands to social drinkers' ability to regulate their alcohol intake, we hoped to test the predictions of the self-control strength model in an ecologically valid way.

The Present Study

The purpose of the present study was to focus on the relationship between self-control demands and alcohol limit violations. Other research on the electronic diary (ED) has focused on drinking episodes, with a particular interest in how the amount of alcohol consumed is related to mood and attributions for drinking immediately before and after the episode (Muraven, Collins, Morsheimer, Shiffman, & Paty, in press-b) and how guilt and self-blame about limit violations are related to drinking behavior (Muraven, Collins, Morsheimer, Shiffman, & Paty, in press-a). The present study complements that research but examined very different variables related to alcohol consumption and limit violations.

Individuals often try to restrain their alcohol intake (Bensley, 1991; Collins, 1993; Greenfield, Guydish, & Temple, 1989). Such efforts at restraint require self-control (Brown, 1998; Hodgson, 1989; Marlatt & Parks, 1982). Thus, one would expect that individuals who are less able to exert self-control should be more likely to fail at restraint and violate their personal drinking limits than individuals who have greater self-control capacity. More precisely, on days when individuals experience more self-control demand than normal, they should be more likely to drink to excess than on days when they experience fewer self-control demands.

The relationship between self-control demand and alcohol intake should hold even after controlling for mood and urge. Although events that deplete self-control strength may evoke negative moods or increase the urge to drink (e.g., the self-medication model; Swendsen et al., 2000), the effects of depletion on drinking to excess should be evident above and beyond the effects of negative mood or urge to drink. Similarly, the effects of depletion should matter more when individuals are trying to limit their alcohol intake than when they are not limiting their drinking. Individuals who are not regulating their alcohol intake, and hence not exerting self-control, should not be affected by the depletion of self-control strength (Muraven & Slessareva, 2003).

We also examined the role of individual differences in trait self-control on the relationship between self-control demands and the regulation of alcohol intake. Individuals lower in trait self-control may have a smaller pool of self-control strength, and therefore self-control demands may lead to poorer regulation of alcohol intake among these individuals as compared to individuals higher in trait self-control (Muraven, Shmueli, et al., 2005). Also, because self-control strength is presumed to be recovered during rest, we predicted that there would not be a relationship between self-control demands one day and regulation of alcohol intake the next.

We tested these hypotheses in a sample of underage social drinkers using ecological momentary assessment (EMA) methods, which allow researchers to collect self-reports of mood, thoughts, and behaviors related to relatively rare events that are difficult to capture in a laboratory setting (e.g., drinking to excess), while minimizing memory and other biases (Shiffman & Stone, 1998). In addition, we used EMA diary methods to collect self-reports of mood and self-control demands on a daily basis for 3 weeks. We collected these data using palm-top computers running custom software, which allowed us to capture events as they occurred, ensuring highly accurate data entry and minimal missing data and reduced memory and other self-report biases. Thus, we used an ecologically valid and highly reliable technique to assess the relationship between self-control demands and violation of drinking limits.

Method

Participants

The present sample consisted of 106 (49 male and 57 female) underage social drinkers in the greater Buffalo, New York, area who responded to advertisements for a study on daily drinking in young adults. To be eligible for the initial study, participants had to be between the ages of 18 and 20 years ($M = 19.3$, $SD = 0.79$), drink a minimum of three drinks a week ($M = 18.57$, $SD = 10.56$, range = 3–51), and have no current or previous medical diagnosis or treatment for alcohol abuse (self-reported and assessed through clinical interviews and the Short Michigan Alcoholism Screening Test; Selzer, Vinokur, & Rooijen, 1975). The majority of participants (86%) indicated a European American background and the remainder were mainly Asian American and African American. Over half the participants (54.2%) had Roman Catholic beliefs. Almost all (95%) were in school at least part time, and two thirds were employed at least part time. Participants began drinking regularly at 16.6 years ($SD = 1.63$, range = 10–20). Approximately half (55 participants) had a family history of alcohol problems.

Procedure

Participants were recruited through newspaper advertisements and fliers. They called a telephone hotline to be screened for eligibility. Those who met the study's requirements were invited to come to the Research Institute on Addictions in Buffalo. At that time, participants completed a number of questionnaires about their history of drinking, demographics, and attitudes toward alcohol. They also indicated their interest and availability to participate in a more intensive study of drinking behaviors using hand-held computers.

Participants who were willing to participate in the second phase of the study returned to the Research Institute on Addictions, where they were given 1½ to 2 hr of individualized training in the use of the ED. Once an individual had mastered the procedures of using the ED, he or she was provided with an ED for self-monitoring of ongoing behavior. Participants returned to the research site on a weekly basis for individualized, hour-long sessions that focused on data uploading, changing ED batteries, and feedback on use of the ED. During the 3 weeks of involvement in the study, each participant took part in approximately four of these ED-related sessions.

The Electronic Diary

The ED was a small, hand-held computer (Palm Pilot Professional; 4.7 in. × 3.2 in. × 0.7 in. [11.9 cm × 8.1 cm × 1.7 cm], 9.6 oz [272.2 g]; Palm, Inc., Milpitas, CA) used for self-monitoring behavior. It ran custom-designed software to assess participants' mood, drinking behavior, and self-control demands (invivodata, Inc., Pittsburgh, PA). The questions were presented on the computer's 160 × 160 4-gray level passive matrix LCD. Participants responded to the questions by touching an answer on the screen using a stylus. The software prevented participants from skipping questions or providing out-of-range responses. An audible signal alerted participants when it was time to complete scheduled interviews.

Participants were told that we were interested in the day-to-day behavior of social drinkers. They were instructed to use the ED on an ongoing basis and to continue to drink in their typical fashion. They were trained to initiate assessments at the start (*begin drinking*) and end (*end drinking*) of each episode of drinking. A drinking "episode" was individually defined, based on criteria such as a change in location or time. Participants also initiated an assessment on waking every morning. In addition to these self-initiated assessments, the ED prompted participants at random times during the day (with the constraint that no prompts were issued within an hour of a drinking episode) to complete a *random assessment* (approximately four per day) to help establish base rates of behavior. The ED also initiated an evening assessment every night around 6:30 p.m.

The content of the different ED assessments varied somewhat but typically included questions about: mood (11-point Likert rating of overall mood, with anchors of *very bad*, *neutral*, and *very good*), current activities (yes/no rating for working, leisure, driving, etc.), current social context (yes/no rating for the presence of others in the situation, including spouse, friend, family), and location (yes/no ratings of where the respondent was located, including home, bar, or vehicle). Before starting a drinking episode (or as soon they could after beginning drinking), participants reported their mood, urge to drink, and whether they planned to limit their drinking, using 11-point scales. The assessment for the end of the drinking episode also measured the number of drinks consumed, whether they had violated their personal limit for alcohol consumption (on an 11-point scale with anchors of *NO!!* and *YES!!*) as well as how much they went over that limit (number of drinks).

The evening assessment asked participants whether they planned to drink in the future and whether they planned to limit their drinking. Self-control demands were measured in the evening assessment by asking participants to rate on an 11-point scale whether they had to regulate their moods, control their thoughts, deal with stress, or felt overwhelmed that day. Those four items were combined ($\alpha = .75$) to create a measure of self-control demands. From the self-control strength model, we presumed that individuals who experienced more self-control demands should be lower in self-control strength than individuals who experienced fewer self-control demands.

Questionnaires

At the initial session, participants completed several measures that were designed to assess trait individual differences related to alcohol consumption. Two of these measures are relevant to the current study.

General information questionnaire. The general information questionnaire, which has been used in our previous research (e.g., Collins et al., 1998), assesses demographic characteristics (e.g., gender, age, marital status) and drinking-related information (e.g., typical weekly consumption, family history of alcohol and drug abuse). The scale also measures typical experience of negative alcohol-related consequences (e.g., nausea, accidents while intoxicated) and typical use of drugs other than alcohol.

Trait self-control. We assessed trait self-control using a 47-item scale originally created by Gibbs, Giever, and Martin (1998) to test the relationship between criminal behavior and trait self-control. Their research found a significant association between trait self-control and criminal behavior, such that individuals who scored lower on the scale were much more likely to be engaged in activities consistent with lower self-control (e.g., cutting class, cheating). Thus, the scale appears to be a valid measure of trait self-control. Consistent with the psychometric data reported by Gibbs et al., we found the scale to have excellent internal reliability ($\alpha = .90$), a normal distribution, and a unidimensional factor structure.

Overview of Data Analysis

We focused on the within-person relationship of self-control demands (as measured in the evening assessment) to drinking behavior (as measured in the end-drinking assessment); that is, we were interested in whether individuals were more likely to drink to excess on days when they experienced more self-control demands. Such within-person data are best analyzed using multilevel (or hierarchical) regressions that nest daily observations within people (Kenny, Kashy, & Bolger, 1998; Schwartz & Stone, 1998) rather than repeated measures analysis of variance or ordinary regression analysis, whose assumptions are inconsistent with such data. Also, failing to statistically control for differences in participants' average level of self-control demands may lead to biased statistical tests. Multilevel regression avoids these problems by estimating the within-person (i.e., observations) and between-person (i.e., individual differences) data simultaneously. Moreover, multilevel regression enables researchers to assess whether individual differences (e.g., trait self-control) moderate the within-person relationship.

The hierarchical regression equations were specified in HLM 5.05 (Bryk, Raudenbush, & Congdon, 2000), using restricted maximum likelihood computations. The between-person variation was treated as a random effect, and we person-centered all within-person variables and grand-mean-centered all between-person variables (e.g., Kreft, de Leeuw, & Aiken, 1995; Schwartz & Stone, 1998). For all analyses, a visual examination of residuals indicated that there were no significant outliers or influential cases at the individual level, and the residuals did not deviate significantly from normal. Likewise, plots of the residuals versus predictors indicated that variability did not differ across predictor levels, suggesting that the effects were homoscedastic (Singer & Willett, 2003).

Results

End-Drinking and Evening Assessments

Participants carried the ED for an average of 21 days. They completed 947 drinking assessments and on average consumed

alcohol on 7.37 days ($SD = 3.55$, range: 1–20). They consumed 5.67 ($SD = 4.23$) drinks on days when they had alcohol. On an 11-point scale, they reported being moderately intoxicated when they drank ($M = 5.45$, $SD = 3.10$). They somewhat felt that they had violated a personal consumption limit after drinking ($M = 4.59$, $SD = 3.72$), although the extent of this limit violation was typically small ($M = 1.09$ drinks, $SD = 2.03$). They completed 2,079 evening assessments in the 3-week period. The entire sample reported moderate levels of self-control demands ($M = 21.4$, $SD = 9.13$, range: 4–44), although there was considerable individual and daily variation in self-control demands. Participants' ratings of their self-control demands were normally distributed.

The evening report preceded the first drinking episode on 808 (85.3%) of the total drinking episodes. The average time between the evening report and the start of a drinking episode was 241 min ($SD = 114$). The analyses are limited to cases when the evening report preceded the first drinking episode so that alcohol consumption did not color individuals' reports of self-control demands. This is a prospective analysis of how self-control demands are related to the regulation of alcohol intake. Analyzing all drinking episodes (including those that started before the evening report) had little impact on the results.

The statistical power of hierarchical regression depends on both the number of observations (e.g., evening reports) and the number of groups (e.g., people). The stability and power of the within-person regression estimates are strongly influenced by the number of observations (Bryk & Raudenbush, 2002; Kenny et al., 1998); thus, with more than 2,000 observations, there should be sufficient power to detect relationships between variables, should any exist.

Self-Control Demands and Intentions to Drink

Participants' level of self-control demands should not be related to their intentions or plans to drink that night; that is, participants who experience greater self-control demands should not set out to drink more than participants who experience fewer self-control demands. We controlled for day of week in this analysis (and all other analyses) using dummy codes because previous research has suggested that alcohol consumption and other behaviors vary regularly over the week (Argeriou, 1975; West & Hepworth, 1991). To increase readability, these fixed-effect dummy codes for day of week are not shown in the equations. The relationship between intent to drink and self-control demands was tested by specifying the following equation in HLM:

$$\text{Intent}_{ij} = b_{0i} + b_{1i}(\text{Self-control demands}_{ij}) + e_{ij}$$

$$b_i = \gamma_0 + u_i.$$

As shown in Table 1, there was no relationship between self-control demands and intention to drink that night, the amount participants planned to drink, or plans to become intoxicated. Greater self-control demands were not related to plans to drink more that night. Relatedly, participants' urge to drink and plans to limit their intake, as reported in the begin-drinking assessment, were not associated with their self-control demands as measured earlier in the evening assessment. In short, experiencing more self-control demands apparently does not affect participants' decision to drink or their plans to limit drinking.

Table 1
Within-Person Self-Control Demands and Intentions to Drink Alcohol, Controlling for Day of Week

Within-person variable	B	SE	$t(104)$
Intent	−0.0126	0.0148	−0.853[#]
Amount plan to drink	−0.00828	0.0122	−0.676[#]
Plan to become intoxicated	−0.00812	0.0145	−0.562[#]
Urge to drink (before drinking)	−0.01608	0.0149	−1.079[#]
Plans to limit (before drinking)	−0.01629	0.0123	−1.321[#]

[#] $p > .10$.

Self-Control Demands and Limit Violations

The self-control strength model predicts that on days when individuals experience greater self-control demands than average, they should be more likely to drink to excess and violate their self-imposed limits than on days when they experience fewer self-control demands. Moreover, the effect of self-control demands on drinking should be above and beyond the effects of mood and urge to drink. Drinking variables were measured in the after-drinking assessment, and self-control demands were calculated from the evening report. Urge and mood came from the before-drinking assessment and thus gave a very clear picture of desire to drink immediately before participants started to drink. This was tested using the following equations:

$$\text{Drinking}_{ij} = b_{0i} + b_{1i}(\text{Self-control demands}_{ij})$$
$$+ b_{2i}(\text{Urge}_{ij}) + b_{3i}(\text{Mood}_{ij}) + e_{ij},$$
$$b_{0i} = \gamma_{00} + \gamma_{01}(\text{Trait self-control})$$
$$+ \gamma_{02}(\text{Gender}) + u_{0i},$$
$$b_{1i} = \gamma_{10} + \gamma_{11}(\text{Trait self-control})$$
$$+ \gamma_{12}(\text{Gender}) + u_{1i},$$
$$b_{2i} = \gamma_{20} + u_{2i},$$

and

$$b_{3i} = \gamma_{30} + u_{3i}.$$

On days that participants experienced greater than average self-control demands, they were more likely to report violating their self-imposed limits then on days when they experienced fewer self-control demands, above and beyond the effects of day of week, urge and mood before drinking, $B = 0.0170$, $SE = 0.00688$, $t(102) = 2.467$, $p < .025$. Calculation of the pseudo-R^2 statistic (Singer & Willett, 2003) indicated that the addition of the self-control demands term explained approximately 2.5% of the variance in limit violation, above and beyond the amount explained by day of week, urge, and mood before drinking. Calculation of deviance statistics indicated that the model including the self-control demands term fit the data better than urge, mood, and day of week alone, $\chi^2(5, N = 106) = 19.09$, $p < .005$. On days that participants experienced greater than normal self-control demands they also reported drinking more, $B = 0.0131$, $SE = 0.00724$, $t(102) = 1.810$, $p < .06$, pseudo $R^2 = .015$, $\chi^2(5, N = 106) =$

9.444, $p < .10$, and being more intoxicated after drinking, $B = 0.0130$, $SE = 0.00557$, $t(102) = 2.326$, $p < .025$, pseudo $R^2 = .018$, $\chi^2(5, N = 106) = 9.946$, $p < .07$.[1] Quite simply, on days when participants experienced more self-control demands, they became more intoxicated, and they were more likely to violate their self-imposed drinking limits, even after controlling for mood or urge. Experiencing greater self-control demands than average led to greater drinking and less subsequent control over that drinking. This is consistent with previous research on self-control strength that has found that depleted individuals are less able to regulate their alcohol intake (Muraven et al., 2002).

In addition, intention to limit drinking moderated the relationship between self-control demands and drinking outcomes. As shown in Figure 1, the amount participants consumed depended on both their self-control demands and intentions to limit drinking. When individuals reported that they had firm plans to limit their drinking, they actually drank more if they experienced greater self-control demands; this relationship was less marked when individuals had weakly held plans to limit drinking, $B = 0.00718$, $SE = 0.00106$, $t(102) = 6.768$, $p < .0001$, pseudo $R^2 = .077$, $\chi^2(7, N = 106) = 92.96$, $p < .001$. In other words, when participants were not motivated to limit their alcohol intake (as demonstrated by a weakly held intention to limit drinking), the amount of self-control demands they experienced mattered less than when they were highly motivated to limit their alcohol intake.

Individual Differences

We tested whether there was a cross-level interaction between self-control demands and individual differences in self-control demands and gender. There was no significant main effect or interaction for gender on the relationship between self-control
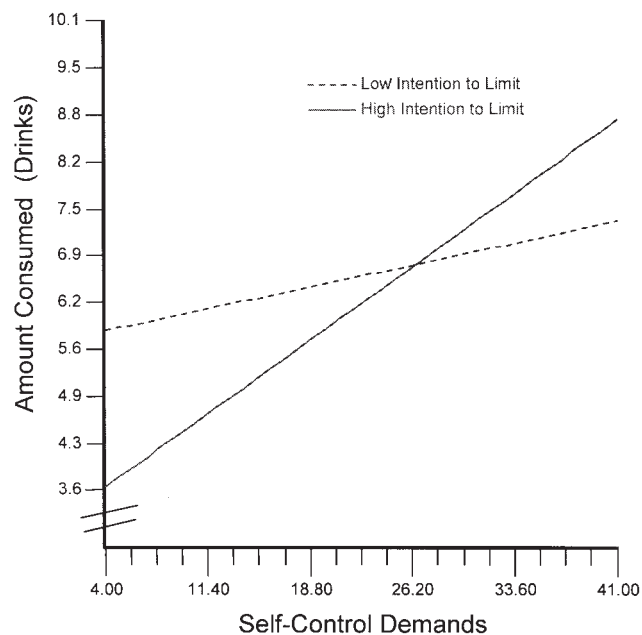

Figure 1. Amount of alcohol consumed (standard drinks) as a function of self-control demands (mean centered) and intention to limit drinking plotted at ± 1 *SD*.

demands and amount consumed. However, trait self-control did moderate the link between self-control demands and alcohol intake, $B = 4.06 \times 10^{-4}$, $SE = 2.06 \times 10^{-4}$, $t(102) = 1.939$, $p < .05$, pseudo $R^2 = .01$, $\chi^2(1, N = 106) = 2.95$, $p < .07$. As shown in Figure 2, the relationship between self-control demands and amount consumed is stronger for individuals low in trait self-control than for individuals high in trait self-control. Although previous research has not looked at the moderating role of trait self-control, this is consistent with recent theorizing (e.g., Muraven, Shmueli, et al., 2005) that suggests that the smaller the pool of self-control resources, the greater the effect of self-control demands on performance.

Subsequent Days

Finally, the self-control strength model predicts that depleted strength is recovered slowly. Although the processes underlying the replenishment of strength are unclear (see Tice, Baumeister, Shmueli, Dale, & Muraven, 2004), the model predicts that rest should lead to the recovery of lost self-control strength. Thus, strength is likely recovered during sleep, and therefore self-control demands one day should not predict self-control failure the next. Consistent with this, there was no relationship between self-control demands and amount of alcohol consumed the next day, $B = 0.00823$, $SE = 0.0157$, $t(102) = 0.522$, *ns,* and self-control demands and self-reports of limit violations the next day, $B = 0.0105$, $SE = 0.0145$, $t(102) = 0.725$, *ns*.

Discussion

On days when participants experienced more self-control demands than average, they tended to drink more alcohol, were more intoxicated, and were more likely to report violating a personal limit on alcohol intake compared with days when participants experienced fewer self-control demands. The relationships between self-control demands and alcohol intake held even after mood before drinking and urge to drink were statistically controlled. In other words, self-control demands were associated with poorer regulation of alcohol intake, above and beyond any negative mood or desire to drink that may have been produced by the self-control demands. The strength of this association was small to moderate in magnitude (although pseudo-R^2 values should be interpreted with caution; Singer & Willett, 2003). Consistent with the experimental evidence (Muraven et al., 2002), when participants experienced more self-control demands in their daily lives they were less able to regulate their subsequent alcohol intake and were more likely to drink to excess. It is important to note that the measurement of self-control demands preceded the drinking episode; thus, this study prospectively examined the relationship between self-control demands and drinking behavior as it unfolds over time.

In addition, we found that intention to regulate alcohol intake moderated the relationship between self-control demands and alcohol consumption. The link between self-control demands and amount consumed was weak on days that participants did not plan

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[1] These relationships remained significant (and were strengthened) when the time between the evening report and the episode was statistically controlled.
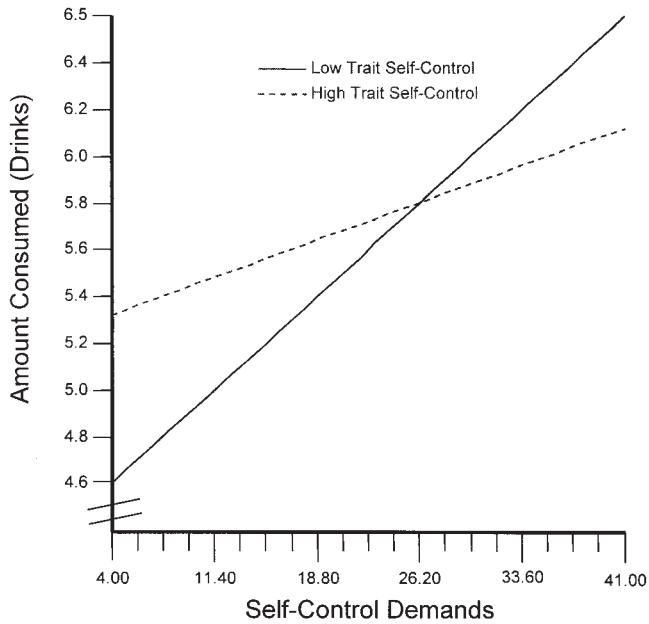
Figure 2. Amount of alcohol consumed (standard drinks) as a function of self-control demands (mean centered) and trait self-control plotted at ±1 *SD*.

to limit their alcohol intake. On the other hand, self-control demands predicted amount consumed much more strongly on days that participants intended to control their alcohol intake. As observed in previous research (e.g., Muraven & Slessareva, 2003), the depletion of self-control strength affected performance only on tasks that required self-control. Exerting self-control had no effect on tasks that did not require self-control. So, if individuals did not plan to limit their drinking, they were not exerting self-control, and therefore the depletion of self-control strength did not affect them. The weak relationship between self-control demands and alcohol intake on days that participants were not strongly motivated to regulate their alcohol intake indicated that experiencing self-control demands did not increase the desire to drink per se; instead, self-control demands appeared to undermine participants' ability to regulate their alcohol intake, which is consistent with the self-control strength model.

The amount of self-control demands participants experienced also was not related to their intent to drink that night, their plans to become intoxicated, their urge to drink at the start of a drinking episode, or their plans to limit drinking as reported at the start of a drinking episode. Quite simply, self-control demands do not seem to increase participants' desire to drink or their intentions to regulate their alcohol intake. Any effect that self-control demands have on alcohol intake appears to be mediated through participants' ability to regulate their alcohol intake. Indeed, as noted above, a significant relationship exists between self-control demands and drinking behavior even after controlling for mood before drinking and urge to drink. Thus, the present study suggests that individuals are likely to fail at regulating their drinking when they experience an increase in self-control demands.

Previous research has found that addictive lapses are especially likely to occur at times of stress and negative emotions (e.g.,

Hodgins, el Guebaly, & Armstrong, 1995; for a review of the role of self-control resources in addictive lapses, see Muraven & Baumeister, 2000; Shiffman et al., 1997). The present research suggests that the process of coping with those demands may lead to a loss of self-control and increased likelihood of lapsing, even after considering any increase in the desire to drink associated with the situation. Self-control demands may reduce individuals' self-control performance, and this decline in self-control performance can lead to a breakdown in the regulation of alcohol intake.

In addition to the main effect of self-control demands on alcohol intake, we found that trait self-control moderated this relationship. In particular, individuals high in trait self-control were less affected by self-control demands than individuals lower in trait self-control: On days when they experienced more self-control demands, individuals high in trait self-control drank less and were less likely to violate their limits than individuals low in trait self-control. On the basis of recent research suggesting that individuals are motivated to conserve self-control strength (Muraven, Shmueli, et al., 2005), this result suggests that individuals high in trait self-control may have a larger pool of resources at their disposal and therefore are less affected by self-control demands than individuals lower in trait self-control. Evidence also suggests that individuals who exert self-control regularly may become more efficient in their use of these resources and therefore more immune to the effects of self-control demands (Muraven, Baumeister, & Tice, 1999).

We also tested whether self-control strength is replenished through sleep (although other mechanisms are possible as well; see Tice et al., 2004). Consistent with the predictions of the self-control strength model (Muraven & Baumeister, 2000), there was no relationship between self-control demands one day and alcohol consumption the next, which suggests that the intervening sleep may have removed the effect of depletion. It is clear that more work is needed to test these hypotheses.

The results indicate that experiencing greater-than-average self-control demands is associated with increased drinking; however, the correlational nature of the study limits us from stating unequivocally that self-control demands lead to poorer alcohol regulation. On the other hand, the data were collected prospectively, which helps establish a causal pathway. The pattern of results also was consistent with the predictions of the self-control strength model and less consistent with the predictions of other models of alcohol dysregulation. For example, self-control demands were not related to urge to drink; neither did they decrease the intention to limit drinking, and self-control demands also affected only those individuals who planned to limit their drinking. Thus, it seems likely that self-control demands interfere with the ability to exert self-control and, overall, the results suggest that self-control demands may contribute to excessive drinking in daily life.

Although the lack of experimental control is a cost of using such ecologically valid methods, it is balanced by the benefits. In particular, the present study enabled us to test aspects of the self-control strength model in a community sample of underage drinkers as they went about their daily life. This provides a rich stream of data that would be difficult or impossible to collect in a laboratory setting and helps us to establish the practical importance of the self-control strength model. We were also able to test the predictions of the self-control strength model within people, to

show that individual fluctuations in self-control demands are associated with changes in self-control ability.

The data in these analyses are based on self-report. We had no way of determining whether drinking episodes may have been omitted or whether the reported alcohol consumption was accurate. Likewise, participants' reports of self-control demands were not independently verified. However, because the data collection was done prospectively on hand-held computers, this study avoided many of the biases associated with self-report (e.g., memory failures, missing data, and certain demand characteristics). These features are strengths of EMA methods (Shiffman & Stone, 1998). Using hand-held computers for the data collection avoided the retrospective diary completion that plagues paper-and-pencil diaries (Stone, Shiffman, Schwartz, Broderick, & Hufford, 2002). Pilot studies have demonstrated that EMAs have excellent reliability and closely match collaterals' reports of drinking. Our measure of self-control demands is consistent with previous theorizing on self-control strength and empirical evidence (Muraven & Baumeister, 2000; Muraven et al., 1998), yet its broad nature may have captured some variance unrelated to self-control strength. By refining the measures of self-control demands and self-control strength and making multiple measurements of these constructs throughout the day, future investigators can further assess the predictions of the self-control strength model. Finally, although prior studies have not found significant age differences in the operation of self-control strength, it may be worthwhile to replicate the results in different samples, including adult social drinkers and problem drinkers.

The present results are consistent with the predictions of the self-control strength model. Self-control demands may deplete individuals' self-control strength, which could lead to poorer self-control in other domains. On days when they experienced more self-control demands, social drinkers drank more; were more intoxicated; and were more likely to violate a personal, self-imposed limit on their alcohol intake. Self-control demands did not increase the desire to drink but instead seemed to undermine the ability to regulate alcohol intake. By testing the model in an ecologically valid manner, the significance of managing self-control resources in daily life becomes clearer.

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