VALIDITY OF THE HANGOVER SYMPTOMS SCALE:

EVIDENCE FROM TWO DIARY STUDIES

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The undersigned, appointed by the dean of the Graduate School, have examined the thesis entitled

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EVIDENCE FROM TWO DIARY STUDIES

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INTRODUCTION

Hangover is the collection of unpleasant or aversive physical and mental symptoms that can occur after an episode of heavy drinking (Swift & Davidson, 1998). Some of the most prominent, frequently studied symptoms of hangover include headache, nausea, thirst, vomiting, and fatigue (e.g., Swift & Davidson, 1998). Hangover is quite common (Slutske, Piasecki, & Hunt-Carter, 2003; Swift & Davidson, 1998). A recent survey indicated that over 60% of college students have experienced a hangover in the last year (Presley, Cheng & Pimentel, 2004). One recent electronic diary investigation, using a liberal threshold for acute hangover endorsement ("did you experience a hangover [even just a little] as a result of last night's drinking"), found that approximately 40% of a college student sample reported at least one hangover during an arbitrary 14-day period (Piasecki, Slutske, Wood, & Hunt-Carter, 2010). In addition, hangover was endorsed after nearly half (46.3%) of drinking episodes reported (Piasecki et al., 2010). Because of the liberal threshold used in these investigations, these can be seen as upper bound estimates of hangover prevalence. To distinguish results obtained using this liberal measure from findings that might be obtained using other assessments, Piasecki et al. referred to the phenomenon they measured as "hangoverlike" experiences (HLE).

Frequent hangover has been found to be associated with premature morbidity and mortality (Kauhanen, Kaplan, Goldberg, Cohen, Lakka, & Salonen, 1997). This suggests that the hangover may play a role in the medical consequences of long-term alcohol abuse (e.g. it may mark acute alcohol-related inflammatory responses). Some cross-

sectional survey research suggests children of alcoholics may be at an increased risk for

hangover (Newlin & Pretorious, 1990; Slutske et al., 2003). A recent electronic diary

investigation found that individuals with a family history of alcoholism were more

susceptible to HLEs (i.e., endorsed HLE at systematically lower drinking levels)

compared to those without a family history of alcoholism (Piasecki et al., 2010).

Connecting these findings with research that suggests children of alcoholics are at an

increased risk for the development of alcoholism (e.g.,, Hussong, Bauer, & Chassin,

2008; Sher, Walitzer, Wood & Brent, 1991), one might infer that hangover susceptibility

is an endophenotype marking risk for alcohol dependence. In addition, *Diagnostic and

Statistical Manual of Mental Disorders* (4th ed.; DSM-IV; American Psychiatric

Association, 1994) criteria for alcohol dependence include spending a great deal of time

recovering from the effects of alcohol. Therefore, hangover can be seen as playing a role

in obtaining a dependence diagnosis. DSM criteria for alcohol dependence also include

tolerance and withdrawal symptoms. Since hangover has been thought to be closely

related to tolerance and withdrawal (e.g., Gauvin, Cheng, & Holloway, 1993; Piasecki,

Sher, Slutske, & Jackson, 2005; Schulteis & Liu, 2006), frequent hangover could be

intimately related to core manifestations of dependence. Additionally, hangover

potentially has consequences for role functioning. The phenomenon has been found to be

related to workplace absence (Ames, Grube, & Moore, 1997) and it has been suggested

that hangover could possibly be related to overall impairment in workplace performance

(Frone, 2006). Finally, looking at the phenomenon from a motivational standpoint,

hangover could either punish drinking behavior or contribute to increased drinking

behaviors. Individuals who experience hangover symptoms might refrain from drinking

in order to avoid the punishing effects of alcohol. Alternatively, those experiencing hangover could be driven to drink alcohol in order to alleviate negative symptoms (i.e., "hair of the dog").

Thus, much evidence and theory suggests that it would be of great value to learn more about hangover and hangoverlike experiences. Perhaps one reason progress in hangover research has been slow is that there is currently no agreement on the best way to measure hangover. Several measures have been developed to evaluate the acute symptomatology of hangover (See Appendix A for a summary of hangover measures). Ylikarhri, Huttunen, Eriksson, and Nikkila (1974) conducted laboratory investigations looking at intensity of alcohol intoxication and the subsequent intensity or degree of hangover experienced. In these investigations, subjects self-reported both their feeling of intoxication and their subsequent feeling of hangover. Subjects reported their level of fatigue, headache, dizziness, nausea, thirst, and tension on a five point scale (0 = absent to 4 = incapacitating) and also rated their feeling of "hangover" on a 100 mm scale. Clinician observers graded immediate physical signs of intoxication and hangover in the subjects as well. Recently, the Acute Hangover Scale (AHS) was developed which measures immediate symptoms (Rohsenow, Howland, Minsky, & Arendt, 2007) in experimental research (See Appendix A for a list of symptoms measured).

Researchers have also constructed measures of hangover symptoms for use in retrospective survey investigations (See Appendix A). For example, Newlin and Pretorious (1990) developed the Hangover Questionnaire (HQ), a survey measure, in order to evaluate differences between sons of alcoholics (FHP) and sons of non-alcoholics (FHN) in hangover symptoms. This measure consisted of 13 self-report items

which assessed symptoms (nausea, vomiting, etc.) and included an item which simply asked the subjects whether or not they experienced a hangover. These items aimed to assess the frequency of symptoms experienced in the past year as well as symptoms experienced early in the drinking lifetimes of the subjects. There have also been a variety of simple face valid hangover question items used in survey research (See Appendix A). For example, Kauhanen et al. (1997) asked participants to report how often they experienced a hangover in the past 12 months. In sum, there have been a variety of measures adapted to slightly different uses but as of yet there is no consensus on the best way to measure hangover or its symptoms.

Measurement instruments that assess hangover *symptoms* or hangover *occurrence* are somewhat common but what has not been examined as thoroughly is individual *susceptibility* to hangover. Wall, Horn, Johnson, Smith, and Carr (2000) used a face-valid item asking, on a Likert-type scale (0 = no hangover to 10 = worst hangover ever), how extreme of a hangover participants would expect if they were to consume six drinks (men) or four drinks (women). This measure aims to assess the likelihood of experiencing a hangover given "binge" drinking. It evaluates susceptibility to hangover at a specific dose but does not address individual susceptibility across a variety of dose intervals. A second limitation to this measure is that it is not directly assessing the actual experiences of an individual. Rather, this is a hypothetical question about expected effects of alcohol. It may be reasonable to infer that the item used by Wall et al. (2000) provides some information about individual differences in hangover susceptibility, but responses could be influenced by a number of factors other than susceptibility. Because beliefs about effects of alcohol are influenced by many factors other than direct

experience (e.g., Jones, Corbin, & Fromme, 2001), how well this item taps individual susceptibility remains unclear.

The Hangover Symptoms Scale (HSS) (see Appendix B) was developed to assess hangover symptoms in the past year (Slutske et al., 2003). The HSS aims to assess symptoms experienced the day after drinking has occurred and was originally developed for survey use. The symptoms measured in the HSS are fatigue/tiredness, headache, nausea, feeling weak, difficulty concentrating, thirst, vomiting, sensitivity to light/sound, sweating more than usual, trouble sleeping, feeling anxious, depressed mood, and trembling/shaking. Symptom items in the HSS were adapted from multiple domains listed in an influential review of hangover data (Swift & Davidson, 1998). Each symptom is assessed in two ways. First, respondents are asked to indicate the *percentage* of drinking occasions after which he or she experienced each symptom in the past year. Next, if the symptom was ever experienced after drinking in the past year, a follow up question asks *how many times* this symptom was experienced. The measure does not include an item requiring the respondent to retrospectively report hangover per se (i.e., in the past year, how many times did you have a hangover after drinking?). The rationale for this was to keep idiosyncratic definitions of "hangover" from complicating interpretations of the level of symptoms experienced. For example, some individuals may label a headache the morning after drinking as a hangover while others may have to suffer fatigue, headache, and vomiting to deem the experience a hangover. For this reason, the HSS uses common hangover symptom items much like diagnostic criteria in order to measure past year hangover incidence.

To develop the HSS and provide preliminary data on reliability and validity, Slutske et al. (2003) conducted a study involving 1474 undergraduates in Introductory to Psychology courses at the University of Missouri-Columbia. Slutske et al. (2003) found that a dichotomized item scoring (i.e. scoring each percent of times symptom item as present or absent and summing across items) method had high internal consistency (coefficient alpha = 0.86) and provided the closest to a normal distribution of scores. This scoring was therefore the chosen method for scoring the HSS. According to Slutske et al. (2003),

> "A one-factor model was judged to be preferable to a two-factor model of hangover symptoms [in part] because: a) the items were all significantly intercorrelated (rs = 0.18–0.56, all ps < 0.001); b) the factor loadings were uniformly high in the one-factor model (i.e., the mean factor loading was 0.62 and all of the loadings were greater than 0.42)" (p. 1446).

Consistent with prior research, individuals with at least one alcoholic parent had significantly higher scores on the HSS than did those with no family history of alcoholism (no parental alcohol problems: mean = 4.9, SD = 3.4; parental alcohol related problems: mean = 5.9, SD = 3.6; t = 4.03, df = 1225, $p < 0.001$). Also, the HSS was related to past-year drinking frequency ($r = 0.44$, $p < 0.001$), frequency of getting drunk ($r = 0.52$, $p < 0.001$), and typical quantity of alcohol consumed when drinking ($r = 0.40$, $p < 0.001$).

These findings provided evidence for the construct validity of the HSS. However, the optimal interpretation of the HSS remains unclear. Though the scale is related to drinking frequency, getting drunk, and quantity of alcohol consumed when drinking, it remains unclear whether the HSS is providing information about hangover *susceptibility*. Instead, the HSS may indirectly index how heavily an individual drinks. Further research

evaluating scoring methods, reliability, and overall construct validity of the HSS could inform future applications and interpretations of the measure.

As stated above, the HSS is a retrospective past year measure that focuses on symptoms rather than self-endorsement of hangover. One set of items asks about the percentage of times symptoms were experienced given drinking in the past year. This strategy corrects for frequency of drinking but does not control for drinking heaviness. A second set of items asks about the number of times symptoms were experienced in the past year. These items assess the frequency with which symptoms were experienced. Neither set of items directly reflect information about *susceptibility* to hangover. Initial results of the Slutske et al. (2003) study found that there were no hangover symptoms that women experienced more often than men. However, after attempting to isolate susceptibility effects by covarying drinking heaviness and drinking frequency, women appeared to be more susceptible to hangover (i.e. had significantly higher marginal means for 9 of 13 symptoms). This finding makes sense considering what is known about sex differences in the pharmacokinetics of alcohol. Therefore, covarying drinking heaviness and frequency is one possible way to reveal individual differences in susceptibility.

The HSS evaluates 13 symptoms selected to represent domains listed by Swift and Davidson (1998). Although all of the 13 items loaded on one common factor, suggesting they tap a unitary dimension, symptoms were endorsed at remarkably different rates. For example, dehydration (72%), fatigue (68%), and headache (62%) were among the most commonly reported symptoms while items such as depressed mood (13%) were far less common (Slutske et al., 2003). The value of these less commonly endorsed items deserves special investigation. On the one hand, perhaps these seemingly

rare symptoms are poor hangover indicators and detract from the construct validity of the measure. On the other hand, it is possible that these items are of great importance (difficult to endorse, indicating more extreme problems) and are very informative.

The current project used data from two electronic diary studies to examine the construct validity and reliability of the HSS. The main goals of the project were to examine differences in scoring methods, evaluate construct validity, and determine whether the HSS predicted hangover occurrence and susceptibility. One additional goal was to evaluate which specific symptom items reported on the HSS at baseline predicted hangover endorsement in diary records. It was also important to determine how well symptoms reported on the HSS predicted endorsement of the corresponding items reported in diary records.

There are a variety of ways to score the HSS and choosing the best method is important for assuring that the scale is performing to its maximum potential. There are two item sets within the measure and there are three main methods of scoring the HSS. First, the items which evaluate what percentage of times individuals experienced symptoms after drinking can be summed to yield a 0 to 52 scale. Second, based on whether the symptom was present or not (0 = not present, 1 and above = present), a sum of dichotomized item scores can be created yielding a 0 to 13 scale. Third, the number of times symptoms were experienced can be summed. A shortened (5 item) version of the scale, based on factor analysis, was also proposed by Slutske et al. (2003) which included items for tired, headache, nauseous, feeling weak, and difficulty concentrating. The same three scoring methods that can be used with the full scale can also be used to score this 5

item short form. Comparing and contrasting these methods is an important preliminary step for HSS research.

Beyond examining differences in scoring methods, it is beneficial to further examine the construct validity of the HSS. Further, it is important to know whether the scale has predictive validity (i.e. do high scores on the HSS predict more frequent hangover experiences?). The current project examines these issues in two samples. Each completed the HSS and also monitored daily experiences, including drinking and hangover, using electronic diaries. Determining whether the HSS predicts hangover frequency in electronic diary studies is critical in evaluating the validity of the measure. If the HSS does not forecast who will experience hangover in the natural environment, this could indicate that the scale is seriously flawed.

Further, whether the HSS predicts hangover *susceptibility* was evaluated. This was assessed by examining the relationship between the number of drinks consumed by individuals and their endorsement of hangover. An interaction of HSS score and number of drinks consumed should predict hangover endorsement if the scale is providing information about individual differences in susceptibility. The relationship between number of drinks consumed and hangovers experienced should be stronger in those with high scores on the HSS if it is tapping individual differences in susceptibility. As noted earlier, Slutske et al. (2003) demonstrated that covarying drinking heaviness may isolate marginal susceptibility information. Therefore, we also conducted analyses that assessed HSS X Number of Drinks interactions after accounting for individual differences in typical drinking heaviness.

A goal of the project was to evaluate which specific symptoms predicted

hangover endorsement. This provides valuable information as to which items are valid

and are good predictors of hangover. Evaluating whether individual items in the HSS

(i.e., headache, nausea, thirst, weakness, tired) predict *corresponding symptoms* in diary

records provides further information regarding the validity of each item. One analysis

evaluated whether individual baseline symptoms were good predictors of hangover in

diary records. Another set of analyses assessed whether individual symptom items

(headache, nausea, thirst, weakness, and tired scores in Sample 1; headache and nausea

scores in Sample 2) on the HSS predicted the endorsement of these individual symptoms

in diary records.

Each sample used electronic diaries to assess hangover symptoms the morning

after drinking but differed in the assessment of these effects. Sample 1 used a liberal

threshold for hangover endorsement item (did you feel hungover this morning (even just

a little) as a result of last night's drinking). Following Piasecki et al. (2010), we will refer

to this liberal criterion as hangoverlike experiences (HLE). In the second sample,

participants were asked whether or not they experienced a hangover per se.

METHOD

Sample 1

Participants. Data were collected as part of a large electronic diary study focused

on daily experiences in smoking and nonsmoking college students (Piasecki, Richardson,

& Smith, 2007). One hundred twenty-nine student volunteers from Introduction to

Psychology courses at the University of Missouri-Columbia participated in a 14-day

electronic diary study. The sample was made up of 43% smokers ($n = 54$), was 61%

female ($n = 78$), and the average age was 18.74 ($SD = .87$) with a range of 18-23. The

sample was 85% White. For completion of the study, participants were paid $75 and

were given course credit.

 Materials.   Participants in this study kept electronic diaries using personal digital

assistants (PDA; Palm Zire, Palm Inc., Sunnyvale, CA; Pendragon Forms v. 3.1). These

diaries were programmed to beep on a quasi-random basis four times per day, signaling

the participant to complete a report. Subjects were not able to change any of their entries

in the diary once completed. Participants who smoked completed additional assessments

that are not described here because they will not be used in the current analyses.

 Procedure. Students volunteered through a web-based recruitment system and

attended orientation sessions in small groups where they were issued an electronic diary,

received training on how to use the PDA, and had the diary protocol explained to them.

At baseline, subjects completed the HSS (Slutske et al., 2003) as well as a battery of

other questionnaires. Beginning the day after the orientation session, subjects began

recording data and did so for 14 days, coming into the laboratory every three or four days

for data download sessions in which research assistants would back up the data which

had been recorded and field any protocol questions or troubleshoot any technical

problems. While in the field, electronic diaries prompted subjects to respond four times

per day. Hours of the day were divided into four sections (8:00 a.m.-11:00 a.m., 11:00

a.m.-2:00 p.m., 2:00 p.m.-6:00 p.m., 6:00 p.m.-10 p.m.) and one prompt randomly

occurred within each window of time so that the prompts were spaced throughout the

day. Each of these prompts included questions which asked subjects to report their

current level of each of five hangover symptoms. By design (see below) participants only provided information on drinking and hangover in the first completed record of the day.

     Drinking and HLE Assessment. Prompted assessments included items which asked about drinking behaviors from the prior night and hangover that day. The first question was "Did you drink alcohol yesterday?" The sequence of questions would stop if the subject did not report alcohol use. If the subject answered "yes" to the first question, "Have you already reported the total number and type of drinks you reported yesterday?" was asked. The sequence of questions would stop if the subject answered "yes" to the second question in order to avoid assessing the same drinking episode more than once. If the subject answered "yes" to question 1 and "no" to question 2, after a screen reminding them of the definition of a standard drink was presented (a can or bottle of beer, a glass of wine, or a shot of liquor), they were prompted to report the number of standard drinks they consumed yesterday. Participants were free to report any number of drinks using a numeric keypad displayed on the diary screen. Next, participants responded to individual symptom items and then answered the question (yes/no) "Did you feel hungover this morning (even just a little) as a result of last night's drinking?" Asking about hangover in this manner was done in order to have a sensitive measure of morning after drinking effects and to avoid any potential biases associated with common language use of the term hangover. Piasecki et al. (2010) dubbed this assessment a measure of "hangoverlike" experiences (HLE) to distinguish these experiences from a more conservative measure of hangover per se.

Hangover Symptom Assessment in Electronic Diaries. Five hangover symptoms were measured in electronic diaries: headache, nausea, thirst, weakness, tired. Participants were asked to rate their level of each symptom according to how they had felt in the past 15 minutes. Symptom levels were reported on 1 (not at all) to 5 (extremely) Likert-type scales. Within each assessment sequence, the HLE item was presented after symptom items in diary assessments.

Data Selection. A total of 5,773 prompted assessments were completed by participants in the field. It was important to isolate the first records of each day (where, by design of the skip rules, HLE assessments were administered). In order to locate the first report of each day, date/time stamps were used to cluster records into individual days. There were 1,687 first records and 92 (5.5%) were dropped from the final data set due to missing data or apparent mistakes by participants. For example, in some instances, participants reported having drank the previous night but then reported zero drinks. Other times participants said they had already reported last night's drinking when in fact they had not. This left a total of 1,595 records, 270 of which included a report of the prior night's drinking.

Sample 2

Participants. Four hundred and four volunteers participated in a three week electronic diary study focused on alcohol use among smokers and nonsmokers. Participants were recruited from the Columbia, MO community using posted fliers, advertisements in a widely distributed commercial circular, and through mass emails to the faculty, staff, and students of the University of Missouri. By design, the majority of the sample were smokers (64.1%, n = 259) and a smaller nonequivalent comparison

group of nonsmokers was also recruited. The sample was 50.2% female (n = 203) and the average age was 23.52 (SD = 7.55) with a range of 18-70. The sample was 85.6% White. For completion of the study, participants were paid $150.

Materials. Participants in this study kept electronic diaries using personal digital assistants (PDA; Palm m500, Palm Inc., Sunnyvale, CA; programmed by invivodata inc., Pittsburgh, PA). Several types of user-initiated and prompted reports were completed with the electronic diaries. These diaries were programmed to beep on a random basis four times per day, signaling the participant to complete a report. In the bedtime reports, participants were able to set an alarm which would wake them the next day and prompt them to complete a morning report. Each morning, subjects completed an assessment in which they answered questions about the prior night's drinking and acute hangover symptoms. Subjects were not able to change any of their entries in the diary once completed. The focus of the analyses in this project was on the morning reports which included all hangover assessment items. Participants completed additional assessments that are not described here because they are not used in analyses for the current project.

Procedure. Potential participants called the study site in order to learn more about the nature of the study. Study personnel provided interested volunteers with an overview of the study requirements over the telephone. Next, those individuals who were interested completed a screening questionnaire over the phone. In order to be eligible to participate, volunteers had to meet the following criteria: able to speak English, 18 years of age or older, report drinking alcohol at least one time per week on average in the past month, smoking at least one cigarette per week on average with no interest in quitting (drinker-smokers) or smoking less than 20 cigarettes in their lifetime and none in the last

year (drinker-nonsmokers). Those who reported interest in seeking treatment for an alcohol use disorder, had ever unsuccessfully attempted to cut down or quit drinking, or had prior alcohol related offenses (excluding status offenses) were excluded from participation.

Individuals who were eligible to participate were scheduled in small groups for an orientation session in which participants completed a battery of computerized assessments and completed the informed consent process. The questionnaire battery included the HSS, the Alcohol Use Disorder Identification test (AUDIT; Babor, Biddle-Higgins, Saunders & Monteiro, 2001) as well as the F-SMAST (Crews & Sher, 1992) and M-SMAST (Sher & Descutner, 1986), which are adapted versions of the Short Michigan Alcoholism Screening Test (SMAST; Selzer, Vinokur, & van Rooijen, 1975) used to screen for parental alcoholism.

At the end of each orientation session, participants were scheduled to attend a 45-minute training session 1 to 2 days later. At the training session, small groups of participants were trained on how to use the electronic diaries and were each issued one for use in the field. The day of the training session then became Day 1 (of 21 days) of recording. Over the course of the 21 days of recording, participants came to the study office to complete "drop-ins" on four occasions. At these sessions, the staff downloaded data from the electronic diaries and attempted to resolve any problems participants were having with the study or the diaries.

Drinking and Hangover Assessment. Morning reports included items which asked about drinking behaviors from the prior night and hangover that day. The first question was (yes/no) "Did you DRINK ALCOHOL last night?" Drinking related

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questions would stop if the subject answered "no" to the first question. If the subject

answered "yes" to the first question, the next question in the sequence asked (yes/no)

"How many ALCOHOLIC DRINKS did you have?" Subjects were able to report 1-30

drinks. Following the number of drinks question, "Do you have a HANGOVER from

last night's drinking?" (yes/no) was asked. Nausea and headache were assessed as

hangover symptoms in morning reports by asking subjects to report on a 1 to 5 scale, "In

the PAST 15 MINUTES, did you feel NAUSEOUS?" and "In the PAST 15 MINUTES,

did you feel HEADACHE?" These two items were embedded in a series of adjectives

describing various mood states and physical symptoms.

DATA ANALYSIS

Evaluation of Alternate Scoring Techniques. As noted earlier, six scoring

methods (see above) can be used with the HSS. Reliability analyses were conducted for

each of the six scoring methods. Cronbach's alpha and mean inter-item correlations were

evaluated in order to assess the internal consistency of each scoring method. Also, inter-

correlations among the various scoring methods were examined.

Finally, distributions of scores within each of the six scoring methods were

evaluated. Together, this set of analyses was important in determining whether any one

scoring method was picking up unique information or had other desirable properties (e.g.

lack of skewness). We predicted that all of the methods of scoring the HSS would be

strongly intercorrelated. Prior evidence suggested that all of the symptoms loaded on one

common factor. Also, the *number of times* and *percentage of times* the symptoms were experienced after drinking in the past year were expected to be correlated.

   If the scoring methods were strongly intercorrelated as expected, then other features (e.g. distributional properties) would become important for selecting among the possible scoring approaches. It was decided that if all of the scoring methods appeared redundant, then we would conduct the remaining analyses using a dichotomized scoring of the *percentage* of times items based on the suggestion of Slutske et al. (2003). If an alternative scoring method appeared to be favorable, all the remaining analyses could be repeated using this alternative scoring method as well as the method chosen by Slutske et al. (2003).

   Analysis of Diary Data. Generalized estimating equations (GEE) were used for further analyses because of the clustered nature of the data set (participants recorded data for several consecutive days with several records per day) (Liang & Zeger, 1986). This is the chosen method of analysis in many ecological momentary assessment (EMA) studies and can be used for dichotomous or continuous dependent measures. A major benefit of the GEE approach is that it accounts for complex nature of the data. It is assumed that reports within an individual subject are more correlated with one another than reports between subjects and the current models used an AR(1) correlation structure which further assumes that two reports within a subject are more closely related to one another the closer together they occur temporally.

   Forecasting Diary HLE/Hangover from HSS Total Score at Baseline. The first and most basic analyses were to predict HLE/hangover in diary records from an HSS total score. Because of the Slutske et al. (2003) finding that a dichotomized scoring

scheme yielded the closest to a normal distribution of scores, it was presumed that a sum of dichotomized symptom items would be the chosen method for calculating an HSS total score. However, it could have been necessary to also conduct these analyses using an HSS total score calculated by different means (i.e. a sum of the *number of times* each symptom was experienced in the past year) as referenced above. These analyses were important in determining the construct validity of the HSS overall. If the measure was performing well, the total score should predict HLE/hangover occurrence in diary records.

Ability of Individual HSS Symptom Items to Predict HLE/Hangover. Analyses predicting HLE/hangover occurrence from each of the 13 hangover symptom items reported in the HSS at baseline were performed in order to evaluate the relationship between individual symptoms reported in the HSS and HLE/hangover endorsement in diary records. These analyses were informative in identifying which items on the HSS were valuable in the prediction of HLE/hangover. Such information may be useful in future scale development. For example, these analyses might reveal whether uncommon symptoms such as depression were valid or seemed to contribute error to the measure.

Congruence of Hangover Symptoms at Baseline and in Diary Records. In order to assess the relationship between individual item scores on the HSS and individual symptoms reported in diary records, an analysis individually predicting each of the symptoms assessed in diary records (headache, nausea, thirst, weakness, tired in Sample 1; headache and nausea in Sample 2) from the corresponding dichotomized individual item scores on the HSS was completed. Each model used the diary-reported symptom as the criterion and included the HSS symptom score, drink day type (drinking day or non-

drinking day), and an HSS Symptom Score X Drink Day Type interaction variable as predictors. Symptoms reported at baseline on the HSS and symptoms reported in diary records should have been highly correlated if these were quality items. In other words, people who said they had frequent headaches after drinking should not only have endorsed HLE/hangover more often after drinking, but should have specifically complained of headache on post-drinking days. These analyses were informative about the interpretability and validity of the individual HSS items.

Exploring HLE/Hangover Susceptibility Effects. Gauging susceptibility to HLE/hangover involved scrutinizing the association between the amount of alcohol consumed and subsequent HLE/hangover. As a first step, an analysis predicting hangover endorsement from the number of drinks reported in individual drinking episodes was conducted. This analysis was limited to a data set consisting of first reports of each day for days in which drinking was reported. It was important to look at how many drinks individuals consumed when reporting a hangover. In other words, the number of drinks reported in a drinking episode was predictive of HLE/hangover and this provided evidence for the validity of diary-measured HLE/hangover. In addition, determining the average number of drinks consumed when HLE/hangover was endorsed as compared to days after drinking without HLE/hangover provided further validity information. Clearly, the number of drinks consumed should have been significantly related to HLE/hangover endorsement and the average number of drinks consumed should have been higher on HLE/hangover days. Clarifying these relationships helped lay the groundwork for more sophisticated models examining HLE/hangover *susceptibility*.

In order to assess whether the HSS predicted HLE/hangover *susceptibility*, we conducted analyses testing for an HSS X Number of Drinks interaction, using HLE/hangover endorsement in diary records as the dependent measure. If the HSS tapped individual differences in susceptibility, we should have found a stronger relationship between number of drinks consumed and HLE/hangover endorsement among individuals who scored high on the HSS. After completing the initial analyses, it was important to run a second set of analyses which took into account typical drinking heaviness and drinking frequency, using relevant items from the Alcohol Use Disorder Identification Test (AUDIT; Babor, Biddle-Higgins, Saunders, & Monteiro, 2001) as covariates. Recall that Slutske et al. (2003) found that *susceptibility* information was only captured by the HSS after typical drinking heaviness and frequency were covaried (i.e. women did not appear more susceptible to hangover until typical heaviness and frequency were entered into the model). Therefore, this second set of analyses predicted HLE/hangover endorsement from an HSS X Number of Drinks interaction, including typical drinking heaviness and frequency as a covariates.

Incremental Validity of the HSS. In order to evaluate the incremental validity of the HSS, it was important to know whether the scale predicted diary measured HLE/hangover better than simply knowing an individual's typical drinking heaviness and/or frequency. In other words, it was determined whether assessing past year post-drinking symptoms (HSS) helped to forecast HLE/hangover experiences better than merely knowing whether someone was a heavy or binge drinker. Cleary, if the HSS did no better in predicting HLE/hangover than knowing drinking heaviness/frequency, then the scale would not have incremental validity and using a measure such as the AUDIT (a

reliable 10-item questionnaire which examines individual differences in problem drinking

practices) (Babor, et al., 2001) would likely be just as good at forecasting HLE/hangover.

In order to investigate this question, analyses predicting HLE/hangover in diary records,

using the HSS and AUDIT items which tap typical drinking heaviness/frequency as

predictors was conducted. Since the AUDIT is a reliable proxy for drinking heaviness,

including AUDIT items in the model helped to determine whether the HSS had

incremental validity.

In Sample 1, it has been shown that several individual difference factors (i.e. sex,

family history of alcoholism, and smoking status) predict HLE (Piasecki et al., 2010). It

was important to investigate whether these findings generalized to Sample 2 (in

predicting hangover per se). Further, it was critical to determine whether the ability of

the HSS to forecast HLE/hangover would be compromised after these factors were taken

into account. In other words, if the HSS was a valuable instrument, it should have

predicted HLE/hangover in diary records over and above simply knowing these common

individual difference factors. As a conservative model, these individual difference

factors were used as predictors of diary experienced HLE/hangover. Next, the HSS was

added into the model as an additional predictor. This was done in both samples to

determine whether the HSS had incremental validity over simply knowing common

predictive factors of HLE/hangover.

Summary. Completing this set of analyses was vital in determining the reliability

and construct validity of the HSS. Considering past and emerging findings about the

long-term and health related consequences of hangover, it is important to have a

standardized valid measure of the phenomenon. The set of analyses described above

helped to determine whether the HSS might be such a measure. This study evaluated the validity of the HSS in order to determine whether it was an appropriate instrument or whether a revised scale might be needed.

RESULTS

Preliminary Analysis of Scoring Techniques

Internal consistency reliability was relatively high for all six scoring methods (see Table 1). As might be expected, the short forms of each scoring method yielded lower coefficient alphas than their long form counterparts. Although the short forms had lower coefficient alpha values, they each had higher mean inter-item correlations than their corresponding long forms, a finding likely due to the short form items being selected based upon the best factor loadings (Slutske et al., 2003). Inter-correlations of all six scoring methods were moderately to very high (see Table 2). The lowest of the inter-correlations was 0.72, between the *number of times* long form and the *percentage of times* short form in Sample 2, which is not surprising given that these two scoring methods are based upon a different number of items and are based on different questions, the *number of times* items relating to overall frequency of symptoms and the *percentage of times* items tapping the likelihood of symptom endorsement given drinking. In addition to evaluating inter-correlations of the scoring methods and conducting reliability analyses, distributions of scores for each of the scoring methods were reviewed. Because the long form sum of dichotomized item scores yielded close to a normal distribution of scores, had good internal consistency (Sample 1 alpha = .86, Sample 2 alpha = .78), was strongly related to all other possible scoring methods (Sample 1 rs $\geq$ .82, Sample 2 rs $\geq$

.73), and because no other scoring method appeared to perform better, this scoring

method chosen by Slutske et al. (2003) was used in both samples for analyses requiring

an HSS total score.

Sample 1

Diary-Reported Drinking and HLE. Several descriptive findings regarding

Sample 1 (detailed below) have been previously reported by Piasecki et al. (2010).

Ninety-five participants (73.1%) reported at least one drinking episode while taking part

in the study (range = 1-12, *Mdn* = 2, mode = 1). There were a total of 270 reports of

drinking by participants and HLE was endorsed in 125 (46.3%) of these post-drinking

reports. Participants averaged 10.28 drinks on HLE days (*SD* = 5.88; range = 2-30).

Fifty-three participants (40.8%) reported HLE at least once during the 14 day period. Of

participants who reported having experienced at least one HLE, the number of HLE

reports ranged from 1 to 7 (*Mdn* = 2, mode = 1). Drinking and HLE occurrence were

strongly related to day of the week (see Figure 1). Compared to other days of the week,

participants were significantly more likely to drink on Thursdays, Fridays, and Saturdays

(binary variable where Thursday, Friday, and Saturday coded as 1 and all other days of

the week coded as 0) (OR = 5.58, 95% CI = 4.10 – 7.58; $p < .001$). As might be

expected, participants were significantly more likely to experience HLE on Fridays,

Saturdays, and Sundays compared to other days of the week (OR = 5.25, 95% CI = 3.38 –

8.15; $p < .001$). This temporal distribution is congruent with other data concerning

drinking patterns among MU undergraduate (e.g., Wood, et al., 2008), bolstering the

construct validity of the HLE assessment.

Number of Drinks and HLE. Across drinking reports, the number of drinks reported ranged from 1 to 30 ($M = 7.7$; $SD = 5.6$; $Mdn = 7$). As might be expected assuming a dose-dependent relationship between alcohol and hangover, the number of drinks consumed in the drinking episode significantly predicted HLE (OR = 1.20, 95% CI = 1.13-1.29; $p < .001$).

Symptom Ratings. Separate analyses were conducted predicting HLE, drinking without HLE, and drinking with HLE from each individual symptom item assessed in diary records (i.e., more tired than usual, headache, nauseous, very weak, and extremely thirsty or dehydrated; see Table 3). All five hangover symptom items were significantly elevated on days in which HLE was endorsed. There were no symptoms rated higher on days after drinking in which HLE was denied.

HSS Total Score and Diary HLE. Using the dichotomized scoring long form, the HSS total score was significantly related to an aggregate total of HLEs in Sample 1 ($r = 0.38$, $p < .01$). Further, the HSS total score was related to an increased likelihood of endorsing HLE (OR = 1.18, 95% CI = 1.11 – 1.26; $p < .001$) in diary records. However, taking sex and the number of drinks in the episode into account resulted in a non-significant odds ratio predicting HLE from HSS total score in this sample (OR = 1.01, 95% CI = 0.91 – 1.13; $p = 0.82$).

HSS Symptom Items and Diary HLE. Most of the dichotomized symptom scores (i.e. whether or not the participant reported experiencing each symptom after drinking in the past year) were related to an increase in the likelihood of experiencing HLE during the diary monitoring period (see Table 4). The frequency at which participants endorsed each item in the past year is included in Table 4 in order to understand when the

predictive validity of an item was related to how commonly the symptom was experienced. Symptom items vomiting, sweating, anxiety, and trouble sleeping were non-significant. Interestingly, although depression was infrequently reported in the study by Slutske et al. (2003), in Sample 1, depression was endorsed by 23.6% of the sample and was significantly related to the endorsement of HLE (OR = 1.82. 95% CI = 1.14 – 2.89, $p < .05$).

HSS Symptom Reports and Diary-Reported Symptom Levels. Individual GEE models predicting symptom scores (1 to 5 scale) in diary records from corrresponding symptom scores on the HSS, whether it was a drinking day or not, and the interaction of drinking day by HSS symptom score were conducted to evaluate the congruence of HSS symptom scores and the corresponding diary reported symptom levels on days after abstention and days after drinking. Individuals who scored higher on the HSS tired item endorsed being more tired regardless of drinking day type (i.e. day after abstention or day post-drinking day) (GEE coefficient = 0.14; $p < .01$) in diary records (see Figure 3), with a non-significant increase in tiredness for all HSS scores on post-drinking days as compared to days after abstention and a non-significant interaction of drinking day type and HSS symptom score. Those who scored higher on the HSS headache item endorsed having more severe headaches overall (GEE coefficient = 0.06; $p < .05$) (see Figure 4) with a significant increase in headache on post-drinking days as compared to days after abstention (GEE coefficient = 0.20; $p = .01$) and a significant drinking day type by HSS symptom score interaction (GEE coefficient = 0.19; $p < .01$) indicating a greater increase headache after drinking for higher scorers on the HSS headache item. Although nausea scores on the HSS did not significantly predict overall nausea levels in diary records,

there was a significant increase in nausea levels on days after drinking as compared to days after abstention (GEE coefficient = 0.12; $p < .01$) (see Figure 5) and a significant interaction of drinking day type by HSS nausea score interaction was observed (GEE coefficient = 0.21; $p < .01$) indicating a greater increase in nausea after drinking for higher scorers on the HSS nausea item. Participants showed increased weakness on days after drinking (GEE coefficient = 0.29; $p < .001$) (see Figure 6) but no significant HSS weakness score or interaction effects were observed. Individuals who scored higher on the HSS difficulty concentrating item tended to have more difficulty concentrating overall (see Figure 7), with a significant increase in difficulty concentrating on post-drinking days as compared to days after abstention (GEE coefficient = 0.31; $p = .001$) and a significant drinking day type by HSS symptom score interaction (GEE coefficient = 0.21; $p < .05$) indicating a greater increase difficulty concentrating after drinking for higher scorers on the HSS difficulty concentrating item. In summary, there was evidence that 3 HSS items (headache, nausea, difficulty concentrating) identified persons who were especially likely to complain of corresponding symptoms in real-time reports the day after a drinking bout. Higher scorers on these HSS items experienced significantly elevated corresponding symptom levels on days after drinking. Higher scorers on the HSS tired item reported being more tired overall, regardless of whether or not they had consumed alcohol the previous night. Although these individuals endorsed being more tired on days after drinking, the interaction was non-significant.

   HLE Susceptibility. GEE analyses were conducted predicting HLE from HSS total score, the number of drinks in the episode, the number of drinks by HSS total score interaction, and sex (see Table 5). As expected, the number of drinks consumed in the

episode was significantly related to the endorsement of HLE. Also, men were significantly less likely to endorse HLE controlling for HSS total score, number of drinks, and HSS X Number of Drinks. Neither the main effect for the HSS nor the HSS X Number of Drinks interaction were significant. Thus, it did not appear that the HSS was providing more information about susceptibility than we would have from simply knowing the number of drinks consumed in the episode in this sample.

Incremental Validity. Individual GEE models were conducted predicting HLE from an HSS total score and either an AUDIT item tapping typical drinking quantity (Item 2) or an AUDIT item tapping typical heavy drinking frequency (Item 3). In Sample 1, the HSS showed incremental validity over the drinking quantity item (OR = 1.08, 95% CI = 1.01 − 1.16; $p < .01$) and showed marginally significant validity over the heavy drinking item (OR = 1.07, 95% CI = 0.99 − 1.15, $p = .09$).

Piasecki et al. (2010) found that individual difference factors (i.e. sex, family history of alcohol problems, and smoking status) predict HLE endorsement in Sample 1. When all records were included in the analysis, the HSS was shown to have incremental validity over sex (OR = 1.18, 95% CI = 1.11 − 1.26; $p < .001$), family history of alcohol problems (OR = 1.18, 95% CI = 1.10 − 1.25; $p < .001$), and smoking status (OR = 1.17, 95% CI = 1.09 − 1.25; $p < .001$). However, when only days after drinking were analyzed, the HSS score did not appear to have incremental validity over any of the three. Non-significant results were found for the HSS after covarying sex (OR = 1.08, 95% CI = 0.97 − 1.20; $p = .18$), family history of alcohol problems (OR = 1.07, 95% CI = 0.97 − 1.19; $p = .19$), and smoking status (OR = 1.09, 95% CI = 0.98 − 1.21; $p = .12$). These results indicate that although the HSS shows some incremental validity over these three

hangover-related individual difference variables, when assessing HLE experience in diary records overall, a more conservative set of analyses reveals that the HSS may not have predictive power over any of the three. Clearly, the occurrence of drinking is a key factor in these analyses given that HLE cannot occur without drinking.

<center>Sample 2</center>

Diary Reported Drinking and Hangover. Participants were selected based on self-reports of frequent drinking to increase the likelihood of capturing alcohol use episodes via the diary. As expected, nearly all of the participants ($N = 397$, 98.3%) reported at least one drinking episode while taking part in the study (range = 1-22, $Mdn = 6$, mode = 5). There were a total of 2,271 reports of drinking by participants. Hangover was endorsed in 562 (20.7%) post-drinking reports and two hundred thirty-seven participants (62.6%) reported hangover at least once. Participants averaged 9.76 drinks on hangover days ($SD = 4.70$, range = 2-30). Of participants who reported having experienced at least one hangover, the number of hangovers ranged from 1 to 8 (mean = 2.37, mode = 1). Similar to Sample 1, drinking and hangover occurrence were strongly related to day of the week (see Figure 2). Compared to other days of the week, participants were significantly more likely to drink on Thursdays, Fridays, and Saturdays (binary variable where Thursday, Friday, and Saturday coded as 1 and all other days of the week coded as 0) (OR = 3.10, 95% CI = 2.80 – 3.43; $p < .001$). As in Sample 1, participants were significantly more likely to experience hangover on Fridays, Saturdays, and Sundays compared to other days of the week (OR = 3.56, 95% CI = 2.96 – 4.29; $p < .001$).

Number of Drinks and Hangover. Across drinking reports, the number of drinks ranged from 1 to 30 ($M = 5.9$; $SD = 4.6$; $Mdn = 5$). As in Sample 1, the number of drinks

consumed in the drinking episode significantly predicted diary endorsement of hangover (OR = 1.39, 95% CI = 1.36-1.42; $p < .001$).

Symptom Ratings. Relative to days after abstention, headache and nausea levels measured in diary records were modestly elevated in morning reports on days after drinking when hangover was absent (Table 3). As expected, symptom levels were significantly higher on hangover days as compared to days after abstention.

HSS Total Score and Diary Hangover. Similar to Sample 1, using the dichotomized scoring long form, the HSS total score was significantly related to an aggregate total of hangovers ($r = 0.29$, $p < .01$). Also comparable to Sample 1, the HSS total score was related to an increased likelihood of endorsing hangover in Sample 2 (OR = 1.15, 95% CI = 1.12 − 1.19; $p < .001$). In fact, even after taking into account sex and the number of drinks in the episode, this relationship remained significant (OR = 1.13, 95% CI = 1.09 − 1.18; $p < .001$) in this sample. Taken together, results suggest the HSS provides a modest amount of unique information regarding the likelihood of HLE/hangover occurrence.

HSS Symptom Items and Diary Hangover. Comparable to Sample 1, many of the dichotomized symptom scores were related to an increase in the likelihood of experiencing hangover the morning after drinking (see Table 4). In fact, only the vomit item was non-significant in Sample 2. Similar to Sample 1, depression was endorsed by 30.7% of the sample and was significantly related to the endorsement of HLE (OR = 1.27, 95% CI = 1.04 − 1.53, $p < .05$).

HSS Symptom Reports and Diary-Reported Symptom Levels. Similar to Sample 1, those who scored higher on the HSS headache item endorsed having more severe

headaches overall (GEE coefficient = 0.05; $p < .05$) (see Figure 8) with a significant

increase in headache on post-drinking days as compared to days after abstention (GEE

coefficient = 0.10; $p < .01$) and a significant drinking day type by HSS symptom score

interaction (GEE coefficient = 0.23; $p < .001$) indicating a greater increase headache after

drinking for higher scorers on the HSS headache item. In addition, those who scored

higher on the HSS nausea item endorsed having increased nausea overall (GEE

coefficient = 0.07; $p < .001$) (see Figure 9) with a significant increase in nausea on post-

drinking days as compared to days after abstention (GEE coefficient = 0.09; $p < .001$)

and a significant drinking day type by HSS symptom score interaction (GEE coefficient =

0.18; $p < .001$) indicating a greater increase nausea after drinking for higher scorers on

the HSS nausea item. These results corroborate the findings from Sample 1 that

individuals who score highly on specific HSS symptoms tend to complain of the

corresponding symptoms more strongly the morning after drinking. However, note that

these findings do not take the quantity of alcohol consumed into account (because the

predictor indexing *occurrence* of drinking is collinear with the *number* of drinks). Thus,

these results could be explained by a tendency for higher HSS scorers to consume more

drinks per episode and would then not provide clear evidence of a susceptibility effect[1].

 Hangover Susceptibility. As in Sample 1, GEE analyses were conducted

predicting hangover from HSS total score, the number of drinks in the episode, the

number of drinks by HSS total score interaction, and sex (see Table 5). In Sample 2,

HSS scores were predictive of hangover over and above knowing how many drinks were

consumed. These results offer some evidence for the HSS being able to identify

differences in susceptibility, but if it were especially good at doing so, we might expect to

see larger effect sizes and to obtain consistent results across samples. Additionally, we might expect to observe significant effects for the HSS X Number of Drinks interaction term, suggesting a qualitatively different dose-response relation among higher scorers. However, this interaction effect was not significant.

Incremental Validity. Similar results to Sample 1 were found in Sample 2; the HSS had incremental validity over both the drinking quantity AUDIT item (OR = 1.13, 95% CI = 1.09 – 1.17; $p < .01$) and the heavy drinking frequency item (OR = 1.08, 95% CI = 1.08 – 1.15; $p < .01$). Results of Piasecki et al. (2010) regarding individual difference factors (i.e. sex, family history of alcoholism, and smoking status) predicting HLE endorsement were largely replicated in Sample 2 (here predicting hangover rather than HLE; Table 6). Overall, men were more likely to report hangover (Model 1). This effect was not significant when only post-drinking reports were considered (Model 2). When the number of drinks in the episode was added as a covariate (Model 3), men were less likely than women to report a hangover. A weaker relation between number of drinks and hangover was observed among men as compared to women (Model 4). Smokers were no more likely to report hangover overall (Model 1). However, contrary to Sample 1, when only post-drinking reports were considered (Model 2), smokers were less likely to report hangover. When the number of drinks in the episode was added as a covariate (Model 3), no difference between smokers and non-smokers in hangover liability was observed. However, a weaker relation between number of drinks and hangover was observed among smokers as compared to non-smokers (Model 4). Family history of alcohol problems was a marginally significant predictor of hangover (Model 1). This effect remained when only post-drinking reports were considered (Model 2) and

when number of drinks was included as a covariate (Model 3). In addition, individuals

with a family history of alcohol problems showed a stronger relation between the number

of drinks consumed and hangover (Model 4). As opposed to Sample 1, additional

analyses showed the HSS to have incremental validity in predicting hangover over all

three of these individual difference factors in Sample 2; relative to sex (OR = 1.15, 95%

CI = 1.11 – 1.20; $p < .001$), family history of alcohol problems (OR = 1.14, 95% CI =

1.10 – 1.19; $p < .001$), and smoking status (OR = 1.15, 95% CI = 1.11 – 1.20; p < .001).

These models were limited to days after drinking and used hangover endorsement as the

criterion with HSS total score and the individual difference variable (sex, family history

of alcohol problems, smoking status) as predictors.

DISCUSSION

The analyses presented provide evidence for the construct validity of diary-based

measures of drinking and HLE/hangover endorsement. One might expect that if assessed

accurately, drinking and HLE/hangover would be highly related to day of the week.

Indeed, the diary measures of drinking and HLE/hangover were related to day of the

week, with the most drinking taking place on weekends. Additionally, the number of

drinks consumed per episode was highly predictive of diary-reported HLE/hangover the

next day, indicating that diary records reveal the commonly understood dose-dependent

nature of hangover. Further, the average number of drinks consumed on HLE/hangover

days exceeds what is commonly considered a "binge" (Wechsler & Nelson, 2001). Every

hangover symptom measured in diary records was significantly elevated on days in which

HLE/hangover was endorsed, providing evidence for the construct validity of the symptom item measures. Since the AUDIT is a widely accepted standardized measure, one might expect that individuals classified as heavy drinkers according to the scale should be at an increased likelihood of experiencing HLE/hangover. Items from the AUDIT concerning typical drinking quantity and heavy drinking frequency were highly related to the likelihood of experiencing HLE/hangover in diary records. In Sample 1, higher scorers on the typical drinking quantity item were at an increased likelihood of experiencing HLE (OR = 1.67, 95% CI = 1.46 – 1.91, $p < .001$). The same was true for higher scorers on the typical heavy drinking frequency item (OR = 1.98, 95% CI = 1.71 – 2.30, $p < .001$). These results generalized to Sample 2, higher scorers on the typical drinking quantity item (OR = 1.36, 95% CI = 1.26 – 1.47, $p < .001$) and the typical heavy drinking frequency item (OR = 1.76, 95% CI = 1.56 – 1.99, $p < .001$) had increased odds of experiencing hangover in diary records. These results provide further support for EMA as a valid and useful method of assessment in the current project and for hangover research more generally.

The sum of dichotomized symptom items significantly predicted HLE/hangover, indicating that the HSS may be a valuable instrument in identifying individuals who are likely to have hangover experiences. Most of the individual items on the HSS predicted hangover experiences with the exception of some rarely endorsed items such as sweating (Sample 1), trouble sleeping (Sample 1), anxiety (Sample 1), and vomiting (both samples). Vomiting is also unique in that it is a discrete yes/no event whereas the other items are graded experiences. This might explain why the vomit item was endorsed so infrequently and did not significantly predict hangover experiences in either sample.

These results indicate that a majority of items on the HSS are part of the hangover domain and contribute to the validity of the measure while other items are reported infrequently and may be contributing some error. It appears that the depression item, though infrequently endorsed in the Slutske et al. (2003) study, may be a relatively important part of the hangover domain. The rarely endorsed items may not be necessary to include in the scale if a researcher is merely attempting to identify individuals likely to have hangovers. However, these low frequency items could be indicators of severe hangover experiences and may be worth retaining in order to identify individuals who have had or who are likely to have extreme or idiosyncratic hangovers.

High scores on symptom items on the HSS predicted higher levels of corresponding symptoms in diary records with the exception of weakness in Sample 1. Headache, nausea, and difficulty concentrating HSS symptom scores in Sample 1 and headache and nausea HSS scores in Sample 2 predicted an increased vulnerability to these symptoms after drinking. In Sample 1, the HSS tired score simply seemed to predict overall tiredness in diary records. These results reveal the limitations of retrospective self-report. In other words, individuals may not be very good at reporting what percentage of drinking occasions or how often they felt more tired or weak than usual after drinking in the past year. However, results for the difficulty concentrating item (Sample 1) and the headache and nausea items (both samples) indicate that for some symptoms, self-reports of past-year symptom occurrence after drinking can be useful in predicting drinking-induced symptom vulnerability.

Evidence for the HSS picking up susceptibility information was inconsistent. However, results from the large Sample 2 suggested that the HSS may tap some

susceptibility effects. The HSS showed incremental validity over measures of drinking heaviness/frequency and individual difference factors known to be related to hangover (i.e. sex, smoking status, and family history of alcohol problems). These results indicate that once we take typical quantity consumed or heavy drinking frequency into account, we are still getting some extra prediction with the HSS score of which people are likely to be having hangover experiences after drinking. In addition, once taking sex, smoking status, and family history of alcohol problems into account, we still seem to get further prediction of hangover experiences after drinking with the HSS.

Although not the main focus of this investigation, the findings replicate and extend Piasecki et al. (2010) findings concerning the relations between individual difference factors and diary-measured HLE. Women have been shown to have an increased liability to HLE as compared to men when controlling for the number of drinks in the episode (Piasecki et al., 2010). Smokers experience a greater risk for experiencing hangover as compared to non-smokers, controlling for number of drinks. Finally, individuals with a parental history of alcohol problems have an increase in the odds of experiencing hangover at the same number of drinks as those without such a parental history. These findings lay the groundwork for future investigations concerning the potential mechanisms involved in these associations.

Several limitations of the current study should be considered. One limitation is that body mass (important in the pharmacokinetics of alcohol) was not included in the analyses reported above[2]. Body mass is not available in the Sample 1 data but is available for Sample 2. Another limitation is that, although participants were instructed to report alcohol consumption based on "standard drinks", the precise ethanol content of

the drinks reported was unknown, meaning that we could not calculate doses as is often done in laboratory research. Past research has shown that the ethanol content of what individuals consider to be a "standard drink" can vary greatly (e.g., Lemmens, 1994; White, Kraus, McCracken, & Swartzwelder, 2003). Retrospective reports the morning after drinking could be in error, especially for high totals where fragmentary or en bloc blackout could affect recall. Because of the assessment scheme in Sample 2, ratings of headache and nausea could have been influenced by a prior question about the presence/absence of hangover. In other words, if individuals endorsed the hangover item, they might have been more likely to also endorse the headache and/or nausea item. Conversely, denying hangover might have led participants to also deny the presence of headache and/or nausea. Both studies were oversampled for smokers and not all of the analyses presented took smoking status into account. Therefore, results could differ in samples not selected for smoking. Similarly, Sample 2 was sampled for frequent drinkers and the analyses presented could consequently differ if infrequent drinkers or abstainers were included in the sample. The two samples used differing definitions of hangover which could result in a different pattern of correlates. However, this could be seen as a strength of the study because we were able to test the construct validity of the HSS using liberal threshold and conservative hangover endorsement items. Finally, Sample 1 was a smaller and lower-powered sample as compared to Sample 2.

The current research examined the validity of the HSS by assessing whether it forecast the occurrence of hangover during an arbitrary self-monitoring period. This approach assumes that hangover experiences are stable or trait-like. If hangover discourages heavy drinking, at least in some individuals, then this test may not be

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appropriate. That is, the HSS could accurately reflect past-year hangover experiences without strongly predicting future experiences. It may be informative in future research to gauge the accuracy of hangover retrospection per se. In such studies, participants might use electronic diaries to report drinking and hangover symptoms for a given period of time (e.g. one month or even a web-based year-long study) and then complete the HSS at the end of the study period. It is noteworthy that the HSS tended to be positively associated with HLE and hangover experiences in this research, suggesting hangover is at least modestly trait-like. This evidence, then, was inconsistent with the intuitive hypothesis that frequent hangover would strongly inhibit drinking. Future research using a mix of strategies will be necessary to comprehensively assess the validity of the HSS. At a practical level, though, the current findings suggest the HSS may be used to select individuals at elevated risk of near-term hangover or selected hangover symptoms after drinking.

Taken together, these results suggest that at a minimum, the HSS identifies heavy drinkers and for subject recruitment, the HSS could potentially be one valuable tool for finding individuals who are likely to have frequent hangover experiences. Additionally, the HSS could be valuable in identifying individuals likely to experience specific hangover symptoms after drinking. Considering the limited evidence for the HSS picking up susceptibility information, it is hard to determine what further utility the HSS has. It may be necessary to devise a revised scale which better taps individual differences in susceptibility to hangover, perhaps by asking individuals what dose would be required to induce specific symptoms. In other words, a revised scale might again use these 13 symptom items but may assess them differently. One way to better capture susceptibility

information could be to ask individuals how many drinks they would have to consume in order to experience a given symptom (e.g. headache, nausea, thirst) the morning after drinking.

REFERENCES

Ames, G.M., Grube, J.W. & Moore, R.S. (1997). The relationship of drinking and hangovers to workplace problems: An empirical study. *Journal of Studies on Alcohol, 58*, 37-47.

Babor, T.F., Biddle-Higgins, J.C., Saunders, J.B. & Monteiro, M.G. (2001). *AUDIT: The Alcohol Use Disorders Identification Test: Guidelines for Use in Primary Health Care.* Geneva, Switzerland: World Health Organization.

Crews, T. M., & Sher, K. J. (1992). Using adapted short MASTs for assessing parental alcoholism: Reliability and validity. *Alcoholism:Clinical and Experimental Research, 16,* 576–584.

Finnigan, F., Hammersley, R. & Cooper, T. (1998). An examination of next-day hangover effects after a 100 mg/100 ml dose of alcohol in heavy social drinkers. *Addiction, 93,* 1829-1838.

Frone, M.R. (2006). Prevalence and distribution of alcohol use and impairment in the workplace: A U.S. national survey. *Journal of Studies on Alcohol, 67,* 147-156.

Gauvin, D.V., Youngblood, B.D. & Holloway, F.A. (1992). The discriminative stimulus properties of acute ethanol withdrawal (hangover) in rats. *Alcoholism: Clinical and Experimental Research, 16,* 336-341.

Hussong, A., Bauer, D. & Chassin, L. (2008). Telescoped trajectories from alcohol initiation to disorder in children of alcoholic parents. *Journal of Abnormal Psychology, 117,* 63-78.

Jones, B., Corbin, W., & Fromme, K. (2001). A review of expectancy theory and alcohol consumption. *Addiction, 96*(1), 57-72.

Kauhanen, J., Kaplan, G.A., Goldberg, D.D., Cohen, R.D., Lakka, T. & Salonen, J.T. (1997). Frequent hangovers and cardiovascular mortality in middle-aged men. *Epidemiology, 8,* 310-314.

Lemmens, P.H. (1994). The alcohol content of self-report and "standard" drinks. *Addiction, 89,* 593-601.

Liang, K.Y., & Zeger, S.L. (1986). Longitudinal data analysis using general linear models. *Biometrika, 73*, 13-22.

Newlin, D.B. & Pretorious, M.B. (1990). Sons of alcoholics report greater hangover symptoms than sons of nonalcoholics: A pilot study. *Alcoholism: Clinical and*

Experimental Research, 14, 713-716.

Perkins, H.W. (2002). Surveying the damage: A review of research on the consequences of alcohol misuse in college populations. *Journal of Studies on Alcohol, Suppl 14,* 91-100.

Piasecki, T.M., Richardson, A.E., & Smith, S.M. (2007). Self-monitored motives for smoking among college students. *Psychology of Addictive Behaviors, 21*(3), 328-337.

Piasecki, T.M., Sher, K.J., Slutske, W.S., & Jackson, K.J. (2005). Hangover frequency and risk for alcohol use disorders: Evidence from a longitudinal high-risk study. *Journal of Abnormal Psychology, 114*(2), 223-234.

Piasecki, T.M., Slutske, W.S., Wood, P.K., & Hunt-Carter, E.E. (2010). Frequency and correlates of diary-measured hangoverlike experiences in a college sample. Psychology of Addictive Behaviors.

Presley, C., Cheng, Y. & Pimentel, E. (2004). Alcohol and drugs on American college campuses: A report to college presidents. Core Institute, Southern Illinois University: Carbondale, IL.

Rohsenow, D.J., Howland, J., Minsky, S.J., Greece, J., Almeida, A. & Roehrs, T.A. (2007). The Acute Hangover Scale: A new measure of immediate hangover symptoms. *Addictive Behaviors, 32*, 1314-1320.

Schulteis, G. & Liu, J. (2006). Brain reward deficits accompany withdrawal (hangover) from acute ethanol in rats. *Alcohol, 39,* 21-28.

Selzer, M., Vinokur, A., & Van Rooijen, L. (1975). A self-administered Short Michigan Alcoholism Screening Test (SMAST). *Journal of Studies on Alcohol, 36,* 117–126.

Sher, K. J., & Descutner, C. (1986). Reports of paternal alcoholism: Reliability across siblings. *Addictive Behaviors, 11,* 25–30.

Sher, K.J., Walitzer, K.S., Wood, P.K. & Brent, E.E. (1991). Characteristics of children of alcoholics: Putative risk factors, substance use and abuse, and psychopathology. *Journal of Abnormal Psychology, 100,* 427-448.

Slutske, W.S., Piasecki, T.M. & Hunt-Carter, E.E. (2003). Development and initial validation of the Hangover Symptoms Scale: Prevalence and correlates of hangover in college students. *Alcoholism: Clinical and Experimental Research, 27*, 1442-1450.

Streufert, S., Pogash, R., Braig, D., Gingrich, D., Kantner, A., Landis, R., Lonardi, L., Roache, J. & Severs, W. (1995). Alcohol hangover and managerial effectiveness. *Alcoholism: Clinical and Experimental Research, 19,* 1141-1146.

Swift, R. & Davidson, D. (1998). Alcohol hangover: Mechanisms and mediators. *Alcohol Health & Research World, 22,* 54-60.

Takala, M., Siro, E., & Toivainen, Y. (1958). Intellectual functions and dexterity during hangover: Experiments after intoxication with brandy and with beer. *Quarterly Journal of Studies on Alcohol, 19*, 1-29.

Wall, T.L., Horn, S.M., Johnson, M.L., Smith, T.L. & Carr, L.G. (2000). Hangover symptoms in Asian Americans with variants in the aldehyde dehydrogenase (ALDH2) gene. *Journal of Studies on Alcohol, 61*, 13-17.

Wechsler, H., & Nelson, T. F. (2001). Binge drinking and the American college student: What's five drinks? *Psychology of Addictive Behaviors, 15,* 287–291.

White, A.M., Kraus, C.L., McCracken, L.A. & Swartzwelder, H.S (2003). Do college students drink more than they think? Use of a free-pour paradigm to determine how college students define standard drinks. *Alcoholism: Clinical and Experimental Research, 27,* 1750-1756.

Ylikarhri, R.H., Huttunen, M.O., Eriksson, C.J.P. & Nikkila, E.A. (1974). Metabolic studies on the pathogenesis of hangover. *European Journal of Clinical Investigation, 4*, 93-100.

[1] The number of drinks consumed in the episode significantly predicted headache (GEE coefficient = .07; $p < .001$) and nausea (GEE coefficient = .05; $p < .001$) in diary records on the morning after drinking. Further, the HSS headache item score predicted the number of drinks per episode (GEE coefficient = .43; $p < .011$). The HSS nausea item score significantly predicted the number of drinks per episode (GEE coefficient = .66; $p = .001$) adding support to the notion that higher scorers on the HSS consume more drinks per episode. In addition, HSS total score was also related to the number of drinks per episode (GEE coefficient = .11; $p < .001$).

[2] Body mass is not available in the Sample 1 data but is available for Sample 2. Upon investigation, it did not appear that including body mass index (BMI) in the analyses reported altered Sample 2 findings. For example, the number of drinks per episode remained a significant predictor of hangover in Sample 2 after controlling for BMI (OR = 1.39, 95% CI = 1.36 – 1.42, $p < .001$). The HSS total score remained significant in predicting hangover after accounting for BMI (OR = 1.16, 95% CI = 1.12 – 1.20, $p < .001$). This association remained significant when adding sex and the number of drinks per episode into the model (OR = 1.40, 95% CI = 1.09 – 1.19, $p < .001$). In addition, analyses reported in Table 5 did not change as a function of adding BMI into the model, indicating that BMI does not affect the relationships reported between hangover and HSS score, number of drinks, sex, or HSS X Number of Drinks.

Table 1. *Results of internal consistency reliability analyses.*

Scoring Form	Sample 1		Sample 2	
	Coefficient Alpha	Mean Inter-Item Correlation	Coefficient Alpha	Mean Inter-Item Correlation
Percentage of Times	0.85	0.30	0.85	0.31
Number of Times	0.88	0.36	0.86	0.32
Dichotomized	0.86	0.31	0.78	0.21
Percentage of Times Short	0.79	0.46	0.81	0.45
Number of Times Short	0.86	0.56	0.83	0.49
Dichotomized Short	0.81	0.47	0.68	0.31

Table 2. *Correlation matrix of HSS scoring forms (Sample 1[coefficients tabled below the diagonal] and Sample 2 [in italics and tabled above the diagonal]).*

Scoring Method	1	2	3	4	5	6
1. Percentage of Times	1	*.84**	*.87**	*.92**	*.68**	*.78**
2. Number of Times	.91**	1	*.88**	*.72**	*.83**	*.76**
3. Dichotomized	.89**	.87**	1	*.78**	*.73**	*.92**
4. Percentage of Times Short	.95**	.87**	.85**	1	*.74**	*.83**
5. Number of Times Short	.87**	.83**	.95**	.90**	1	*.81**
6. Dichotomized Short	.84**	.93**	.82**	.90**	.87**	1

** $p < .01$

Table 3. *Results of Models Testing Differences in Individual Symptoms (within first records of the day on post-drinking days with and without hangover relative to days after abstention).*

Symptom	Abstention (intercept)		Drinking without HLE/hangover		Drinking with HLE/hangover	
	Coefficient	95% CI	Coefficient	95% CI	Coefficient	95% CI
Sample 1						
More tired than usual	1.89	1.80, 1.99	-0.002	-0.19, 0.19	0.35**	0.11, 0.59
Headache	1.22	1.17, 1.26	0.05	-0.07, 0.16	0.80***	0.60, 0.99
Nauseous	1.11	1.08, 1.14	-0.001	-0.08, 0.08	0.52***	0.39, 0.65
Very weak	1.22	1.18, 1.26	-0.01	-0.11, 0.09	0.53***	0.37, 0.68
Extremely thirsty or dehydrated	1.79	1.71, 1.87	0.15	-0.02, 0.31	0.78***	0.55, 1.01
Sample 2						
Headache	1.33	1.30, 1.36	0.06**	0.02, 0.09	1.35***	1.23, 1.46
Nausea	1.16	1.14, 1.18	0.03*	0.01, 0.06	0.83***	0.76, 0.90

Note. CI = confidence interval.
Intercept values are provided for descriptive purposes; statistical tests are not reported because they evaluate the difference from zero. Symptoms were rated on a scale ranging from 1 (not at all) to 5 (extremely [i.e., did not contain a zero value]). Sample 1 items are predicting HLE in these models with Sample 2 items predicting hangover per se.
* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 4. *Results of Dichotomized Symptom Scores Predicting HLE/Hangover on post-drinking days.*

Symptom	Sample 1			Sample 2		
	OR	95% CI	Percentage of sample that endorsed symptom	OR	95% CI	Percentage of sample that endorsed symptom
More tired than usual	12.15***	3.93-37.60	74.0	4.27***	2.02-9.06	94.3
Thirsty	4.58***	2.16-9.74	72.4	7.41***	2.60-21.13	95.3
Difficulty Concentrating	4.22***	2.63-6.78	43.3	1.92***	1.49-2.48	76.2
Very Weak	3.61***	2.26-5.77	41.7	2.10***	1.69-2.61	65.3
Headache	3.26***	2.00-5.32	53.5	3.14***	2.10-4.69	85.9
Sensitive to light/sound	2.58***	1.66-4.02	37.8	1.75***	1.43-2.13	60.6
Nauseous	2.09**	1.32-3.30	48.0	1.88***	1.50-2.36	70.0
Depressed	1.82*	1.14-2.89	23.6	1.27*	1.04-1.53	30.7
Trembling/Shaking	1.73*	1.01-2.95	15.7	1.95***	1.62-2.34	31.7
Sweat	1.54	0.92-2.56	21.3	1.69***	1.41-2.03	36.9
Anxious	1.21	0.68-2.13	16.5	1.53***	1.27-1.84	34.7
Vomit	1.18	0.71-1.96	23.6	1.14	0.94-1.38	35.9
Trouble Sleeping	0.83	0.46-1.50	17.3	1.33**	1.11-1.61	36.4

Note. CI = confidence interval.
* p < .05. ** p < .01. *** p < .001.

Table 5. *Results Predicting HLE/Hangover from HSS Total Score, Number of Drinks in the Episode, HSS X Number of Drinks, and Sex.*

| Variable	Sample 1 (HLE)		Sample 2 (Hangover)	
	OR	95% CI	OR	95% CI
HSS Total Score	0.96	0.79 – 1.18	1.12**	1.03 – 1.21
Number of Drinks	1.22*	10.3 – 1.45	1.24***	1.15 – 1.34
HSS X Number of Drinks	1.01	0.98 – 1.03	1.00	0.99 – 1.01
Sex	0.17***	0.07 – 0.38	0.64***	0.50 – 0.82

Note. CI = confidence interval.
* p < .05. ** p < .01. *** p < .001.

Table 6. *Odds Ratios and Confidence Intervals for Models Predicting Hangover from Individual Difference Variables in Sample 2.*

| Variable	Model 1 OR (95% CI)	Model 2 OR (95% CI)	Model 3 OR (95% CI)	Model 4 OR (95% CI)
Gender				
Male	1.29** (1.07, 1.55)	1.09 (0.88, 1.36)	0.57*** (0.45, 0.73)	1.13 (0.72, 1.78)
No. of drinks	—	—	1.27*** (1.23, 1.30)	1.35*** (1.29, 1.41)
Male X No. of drinks	—	—	—	0.91*** (0.86, 0.96)
Smoking Status				
Smoker	1.06 (0.87, 1.28)	0.74* (0.59, 0.94)	1.02 (0.79, 1.30)	0.46** (0.30, 0.73)
No. of drinks	—	—	1.25*** (1.22, 1.28)	1.18*** (1.14, 1.22)
Smoker X No. of drinks	—	—	—	1.11*** (1.05, 1.16)
Parental alcohol problems				
Parent problems	1.22† (0.98, 1.52)	1.29‡ (0.99, 1.67)	1.77*** (1.34, 2.34)	1.10 (0.64, 1.89)
No. of drinks	—	—	1.25*** (1.22, 1.28)	1.24*** (1.20, 1.27)
Problems X No. of drinks	—	—	—	1.08* (1.00, 1.15)

* p < .05. ** p < .01. *** p < .001. † p = .07. ‡ p = .06 Note. Parent alcohol problems determined using 13 item Fsmast and Msmast scales with cut score of 5 and 4 respectively. In Model 1, the individual difference factor is the sole predictor. In Model 2, analyses were limited to post-drinking records. In Model 3, number of drinks was added as a covariate and in Model 4 an interaction term was added.

Figure 1. *Drinking Episodes and HLE Reported Across Days of the Week in Sample 1.*
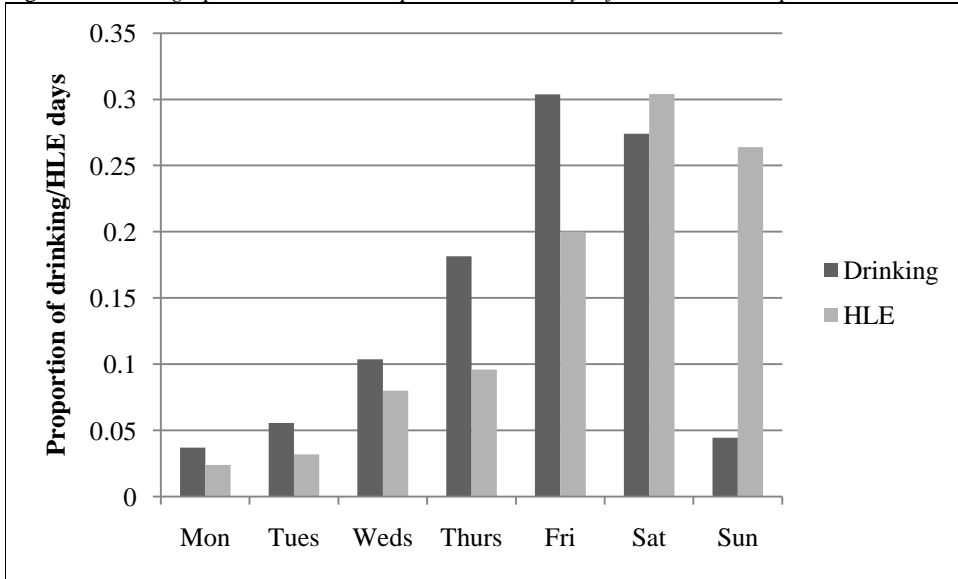
Note. HLE reports are experiences occurring that day and are therefore associated with the drinking episode from the prior day.

Figure 2. *Drinking Episodes and Hangovers Reported Across Days of the Week in Sample 2.*
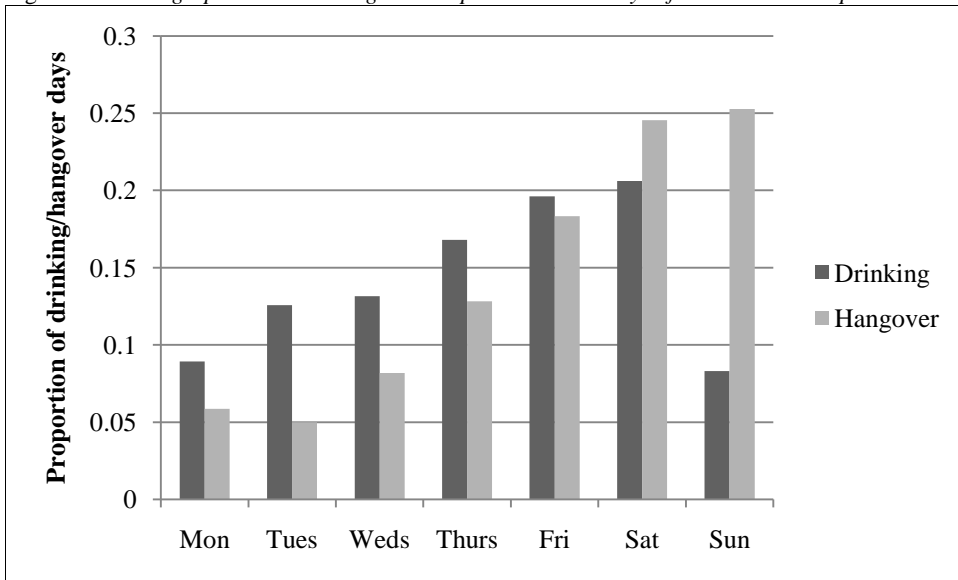
Note. Hangover reports are experiences occurring that day and are therefore associated with the drinking episode from the prior day.

Figure 3. *Diary Reported Levels of Tiredness on Days after Drinking and Days after Abstention in Individuals with Different Scores on the HSS Tired Item (Sample 1).*
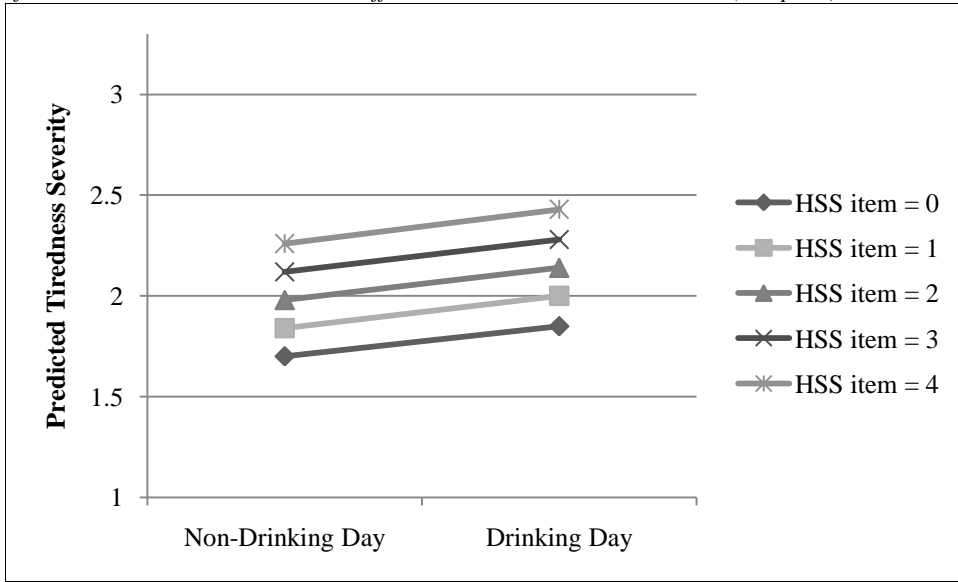

Figure 4. *Diary Reported Headache Levels on Days after Drinking and Days after Abstention in Individuals with Different Scores on the HSS Headache Item (Sample 1).*
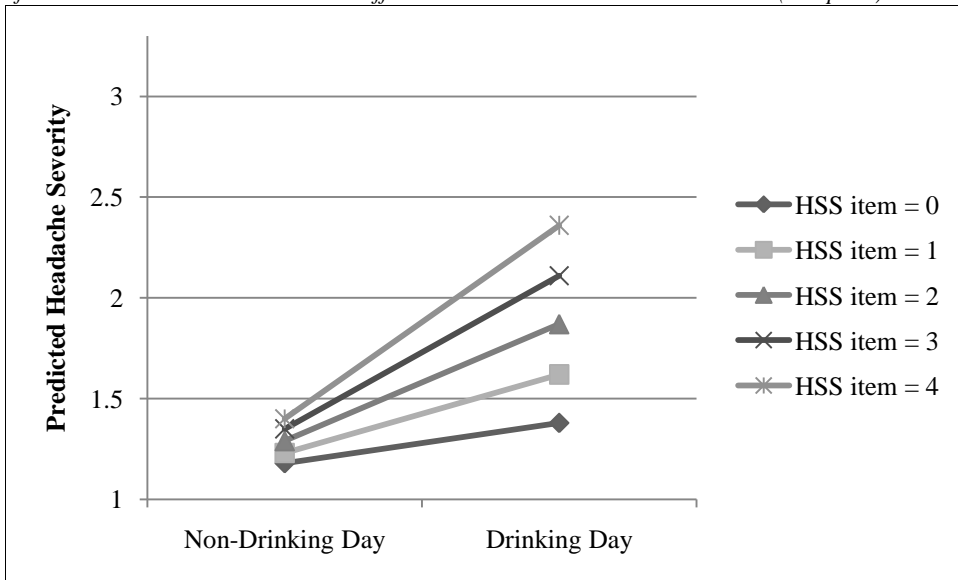
Figure 5. *Diary Reported Nausea Levels on Days after Drinking and Days after Abstention in Individuals with Different Scores on the HSS Nausea Item (Sample 1).*
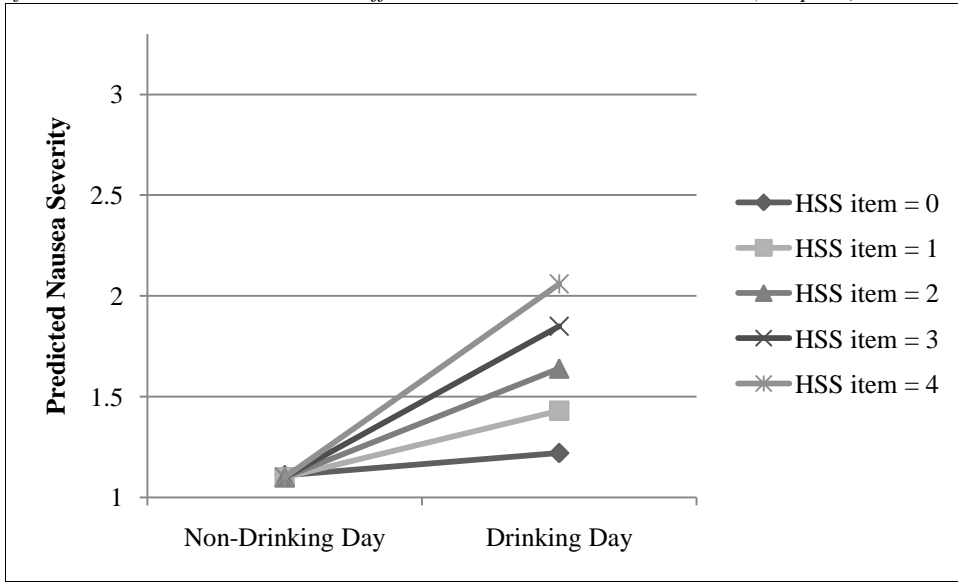

Figure 6. *Diary Reported Feelings of Weakness Levels on Days after Drinking and Days after Abstention in Individuals with Different Scores on the HSS Weakness Item (Sample 1).*
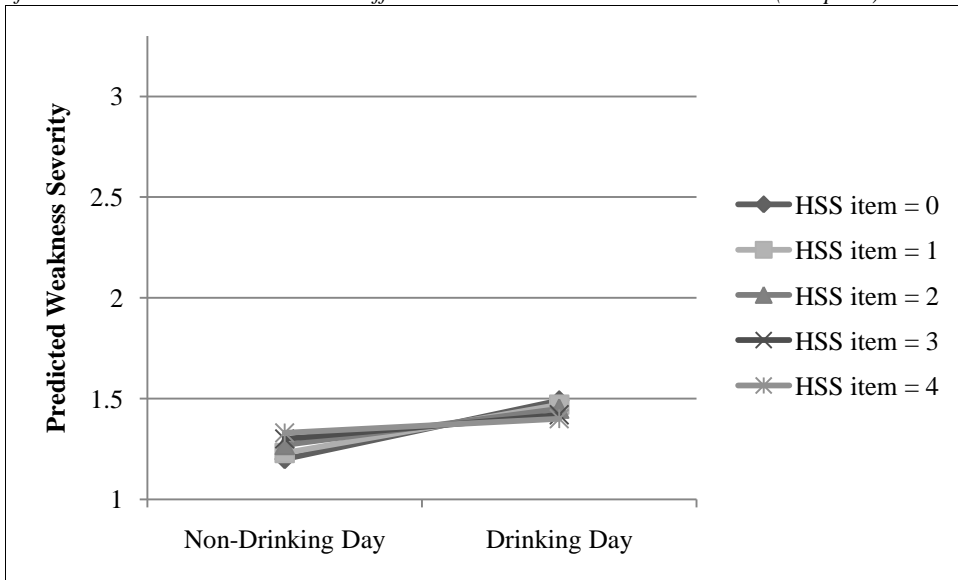
Figure 7. *Diary Reported Difficulty Concentrating on Days after Drinking and Days*
after Abstention in Individuals with Different Scores on the HSS Difficulty Concentrating Item (Sample 1).
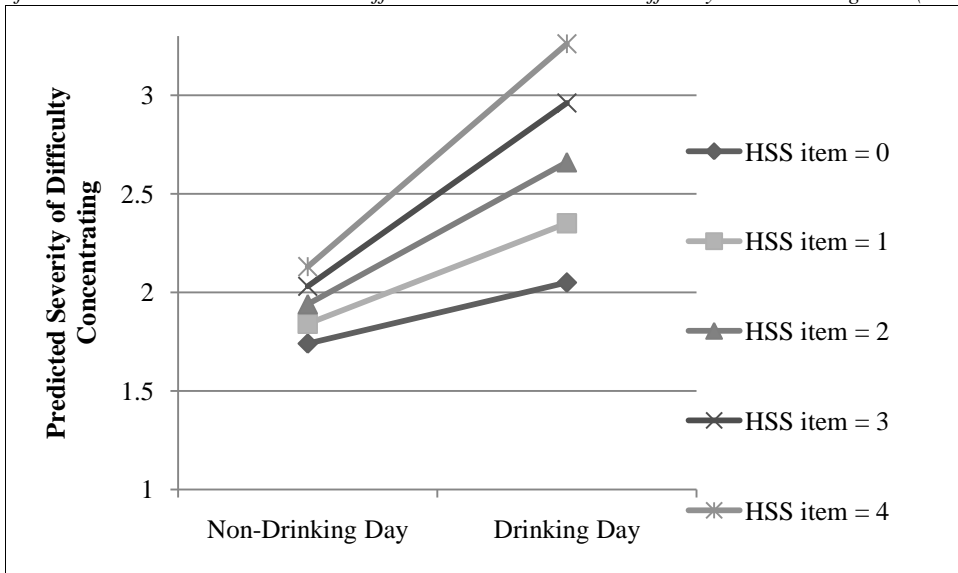

Figure 8. *Diary Reported Headache Levels on Days after Drinking and Days*
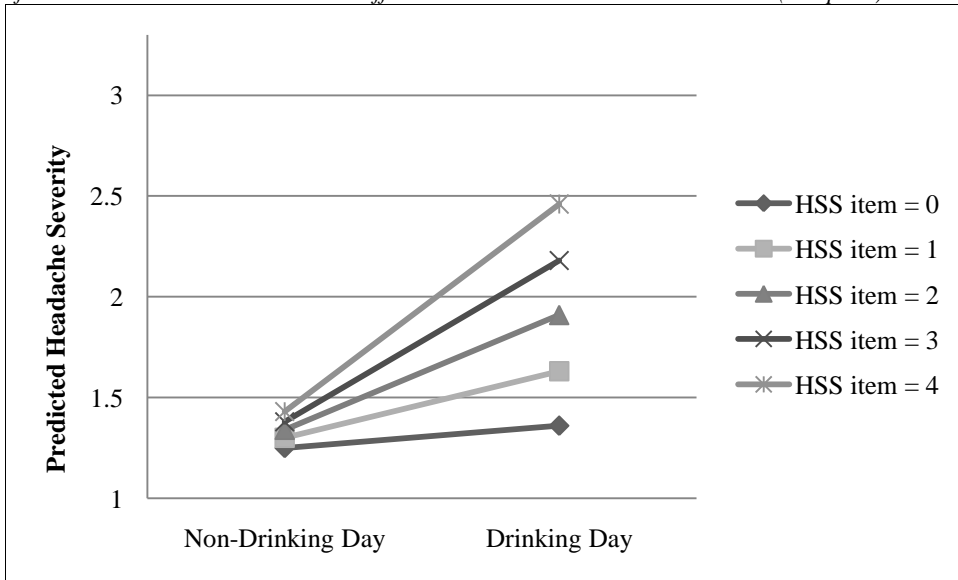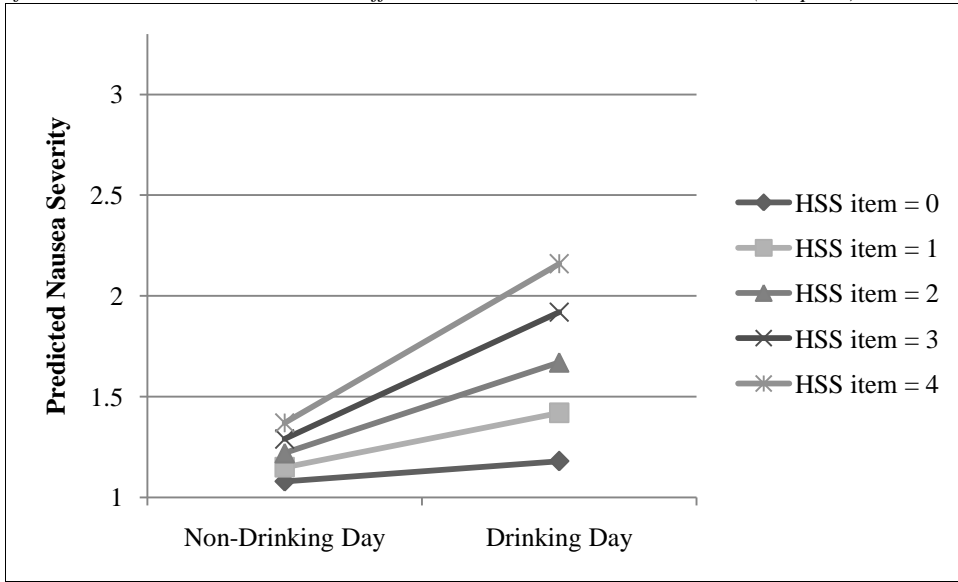*after Abstention in Individuals with Different Scores on the HSS Headache Item (Sample 2).*

Figure 9. *Diary Reported Nausea Levels on Days after Drinking and Days after Abstention in Individuals with Different Scores on the HSS Nausea Item (Sample 2).*

APPENDIX A

Review of Hangover Measures

Experimental and Laboratory Measures of Acute Hangover Symptoms

Author(s)	Citation	Details	Symptoms Measured
Damrau, F. & Liddy, E. (1960).	Hangovers and whisky congeners: Comparison of whisky with vodka. *Journal of the National Medical Association, 52,* 262-265.	Participants were asked to self-report whether specific symptoms (headache, halitosis, gastric irritation, fatigue, dizziness, loss of taste) were absent/present.	• Headache • Halitosis • Gastric Irritation • Fatigue • Dizziness • Loss of Taste
Chapman, L. (1970).	Experimental induction of hangover. *Quarterly Journal of Studies on Alcohol*, *(Suppl 5),* 67-86.	The morning after consuming alcohol, participants were asked to rate their level of hangover on a 0 to 7 scale (0 = no hangover at all to 7 = the most severe hangover possible). Subjects self-reported whether specific symptoms (thirst, fatigue, drowsiness, trouble sleeping, general malaise, nausea, loss of appetite, dizziness or feelings of faintness, headache, depression, anxiety) were absent/present.	• Thirst • Fatigue • Drowsiness • Trouble Sleeping • General Malaise • Nausea • Loss of Appetite • Dizziness/Faintness • Headache • Depression • Anxiety • Level of Hangover
Ylikarhri, R.H., Huttunen, M.O., Eriksson, C.J.P., & Nikkila, E.A. (1974).	Metabolic studies on the pathogenesis of hangover. *European Journal of Clinical Investigation, 4*, 93-100.	Subjects self-reported their feeling of intoxication and subsequent feeling of hangover. Subjects reported level of fatigue, headache, dizziness, nausea, thirst, and tension on a five point scale (0 = absent to 4 = incapacitating) and rated hangover intensity using a 100 mm scale. Experimenters graded physical signs of intoxication and hangover in the subjects.	• Fatigue • Headache • Dizziness • Nausea • Thirst • Tension • Hangover Intensity

Collins, W.E. & Chiles, W.D. (1980).	Laboratory performance during acute alcohol intoxication and hangover. *Human Factors, 22,* 445-462.	The morning after drinking, subjects rated their level of hangover based on 20 items from Gunn (1973) plus four additional items added by the authors (feel like throwing up, stomach ache, hungry, headache, loose bowels, tight bowels, muscle aches, shaking, dizzy, feel hot, feel confused, eyes burn, backache, nose runs, nervous, tired, dry mouth, feel sad or depressed, ringing in ears, hurts to move, thirsty, nauseated, heartburn). A final item measured was "rate your hangover" which received a separate score and was also scored as part of the overall hangover score. All items were rated on a 0-3 scale.	• Feel like throwing up • Stomach Ache • Hungry • Headache • Loose Bowels • Tight Bowels • Muscle Aches • Shaking • Dizziness • Feeling Hot • Feeling Confused • Eyes Burning • Backache • Nose Runs • Nervousness • Tired • Dry Mouth • Feeling Sad/Depressed • Ringing in Ears • Hurts to Move • Thirst • Nausea • Heartburn • Hangover Intensity
McCaul, M., Turkkan, D., Svikis, D., & Bigelow, G. (1991).	Alcohol and secobarbital effects as a function of familial alcoholism: Extended intoxication and increased withdrawal effects. *Alcoholism: Clinical and Experimental Research, 15*(1), 94-101.	Hangover was measured based on 10 withdrawal symptoms (sweaty, loss of appetite, shaky, trouble concentrating, racing heart, anxious, alcohol craving, tired, restless, and irritable). Items were scored on a 0-9 scale where zero indicated "not at all" and nine indicated "most ever."	• Sweaty • Loss of Appetite • Shaky • Trouble Concentrating • Racing Heart • Anxious • Alcohol Craving • Tired • Restless • Irritable

Roehrs, T., Yoon, J., & Roth, T. (1991).	Nocturnal and next-day effects of ethanol and basal level of sleepiness. *Human Psychopharmacology, 6,* 307-311.	Hangover symptoms were measured using a 0-4 scale in which zero indicated "none" and four indicated incapacitating." Hangover symptoms measured were headache, dizziness, nausea, stomach ache, thirsty, heart racing, and tired. Subjects also reported their overall level of hangover on a 10 cm line, similar to methods used in previous experimental research (e.g., Ylikarhri et al., 1974).	• Headache • Dizziness • Nausea • Stomach Ache • Thirsty • Heart Racing • Tired • Level of Hangover
Streufert, S., Pogash, R., Braig, D., Gingrich, D., Kantner, A., Landis, R., Lonardi, L., Roache, J., & Severs, W. (1995).	Alcohol hangover and managerial effectiveness. *Alcoholism: Clinical and Experimental Research, 19,* 1141-1146.	Profile of Mood States (POMS) questionnaire items were used to measure hangover symptoms across time the day after drinking had occurred. Items measured from the POMS included confusion-bewilderment, tension-anxiety, fatigue, vigor, total mood disturbance, and arousal. In addition to measuring these symptoms, this study used items from a symptom questionnaire (Griffiths, Bigelow, & Liebson, 1979) as well. These additional symptom items included items such as sleepiness, nausea, tired and worn out, and confusion.	• Confusion • Bewilderment • Tension-anxiety • Fatigue • Vigor • Total Mood Disturbance • Arousal • Sleepiness • Nausea • Tired and worn out • Confusion • Awake/Perked Up • Difficulty Concentrating • Drowsy/Mentally Slowed • Muscles very relaxed • Nervousness/Tension • Alert/Clear Minded • Apathetic • Dry Mouth • Tremor/Shaky • Clumsy/Uncoordinated • Tired/Lazy • Lightheaded/Dizzy • Shaky/Trembly Hands • Stomach Pains • Dazed • Body Heavy • Irritable/Grumpy • Less than usually active mind

Pittler, M.H., White, A.R., Stevinson, C., & Ernst, E. (2003).	Effectiveness of artichoke extract in preventing alcohol induced hangovers: A randomized controlled trial. *Canadian Medical Association Journal, 169,* 1269-1273.	Researchers identified 29 common hangover symptoms and had participants indicate how severe each symptom would be during a typical hangover. Based on their responses, the 20 items rated as most severe were used on their final scale. Similar to past research (Ylikarhri et al., 1974), investigators used a 10 cm visual scale to measure symptom severity as well as overall hangover severity. This visual scale measure ranged from "not at all" to "as bad as can be imagined."	• Alertness • Clumsiness/Uncoordination • Dazed State • Difficulty Concentrating • Drowsiness/Mental Slowness • Dry Mouth • Exhaustion • Headache • Hunger • Irritability • Laziness/Fatigue • Lightheadedness/Dizziness • Loose Bowels • Muscle Aches • Nausea • Sleepiness • Stomach Pains • Thirst • Trembling Hands • Tremor
Verster, J.C., van Duin, D., Volkerts, E.R., Schreuder, A.H., & Verbaten, M.N. (2003).	Alcohol hangover effects on memory functioning and vigilance performance after an evening of binge drinking. *Neuropsychopharmacology, 28,* 740-746.	The measure used in this study asked subjects to report their level of sleepiness, drowsiness, concentration problems, headache, dizziness, lightheadedness, coordination problems, diplopia, palpitations, tinnitus, dry mouth, thirst, agitation, gastrointestinal disturbances, and nausea. A composite "hangover intensity" score was calculated from the number of reported adverse events reported (moderate intensity = 1 point, severe intensity = 2 points).	• Sleepiness • Drowsiness • Concentration Problems • Headache • Dizziness • Lightheadedness • Coordination • Diplopia • Palpitations • Tinnitus • Dry Mouth • Thirst • Agitation • Gastrointestinal Disturbance • Nausea

Wiese, J.G., McPherson, S., Odden, M.C., & Shlipak, M.G. (2004).	Effect of opuntia ficus indica on symptoms of the alcohol hangover. *Archives of Internal Medicine, 164,* 1334-1340.	In measuring hangover symptoms, researchers developed a hangover symptom index which assessed nine symptoms on a seven point scale (0 = no symptoms; 6 = worst possible symptoms). Symptoms measured in this study were nausea, headache, anorexia, dry mouth, soreness, weakness, tremulousness, diarrhea, and dizziness. A severe hangover which interfered with daily responsibilities was defined as having a symptom index of 18 or higher (mean of 2 points per symptom).	• Nausea • Headache • Anorexia • Dry Mouth • Soreness • Weakness • Tremulousness • Diarrhea • Dizziness
McKinney, A. & Coyle, K. (2006).	Alcohol hangover effects on measures of affect the morning after a normal night's drinking. *Alcohol & Alcoholism, 41,* 54-60.	McKinney and Coyle (2006) used the 13 hangover experiences questionnaire (Newlin & Pretorius, 1990) items in conjunction with the hangover symptoms questionnaire (Myrstein, Rydberg, & Idstrom, 1980) items which are adjectives that refer to after-effects of hangover.	• Hangover after drinking • Headache while drinking • Headache morning after drinking • Vomited after drinking • Fell asleep when didn't want to • Took medicine to get over hangover • Regretted behavior while drinking • Forgot things that happened while drinking • Nausea the morning after • Did things wouldn't normally do while drinking • Woke up early morning after • Woke up too late morning after • Regretted having drunk too much

Rohsenow, D.J., Howland, J., Minsky, S.J., & Arendt, J.T. (2006).	Effects of heavy drinking by maritime academy cadets on hangover, perceived sleep, and next-day ship power plant operation. *Journal of Studies on Alcohol, 67,* 406-415.	The Acute Hangover Scale (AHS) aimed to measure immediate symptoms and used eight items from Roehrs et al. (1991) and added an appetite item from Chapman (1970) to make up a nine item scale. This measure used an eight point scale to measure the severity of symptoms experienced (0 = none; 7 = incapacitating). A later study showed this scale to be reliable, having a standardized Cronbach's alpha of 0.84 (Rohsenow, Howland, Minsky, Greece, Almeida, & Roehrs, 2007).	• Headache • Dizziness • Nausea • Stomach Ache • Thirsty • Heart Racing • Tired • Level of Hangover • Loss of Appetite
Kruisselbrink, L.D., Martin, K.L., Megeny, M., Fowles, J.R., & Murphy, R.J.L. (2006).	Physical and psychomotor functioning of females the morning after consuming low to moderate quantities of beer. *Journal of Studies on Alcohol, 67,* 416-420.	Subjects in this study rated the presence of eight common hangover symptoms (headache, dizziness, nausea, upset stomach, tremors, fatigue, dry mouth, and irritability) on a 7-point Likert scale from 0 (not at all) to 6 (very much). The majority of these items are found in the measure used in Ylikahri et al. (1974).	• Headache • Dizziness • Nausea • Upset Stomach • Tremors • Fatigue • Dry Mouth • Irritability

Retrospective Interview and Survey Measures of Hangover and Hangover Symptoms

Author(s)	Citation	Details	Symptoms Measured
Gunn, R. (1973).	Hangovers and attitudes toward drinking. *Quarterly Journal of Studies on Alcohol, 34*, 194-198.	This measure asked subjects how often they would have a hangover after drinking and how severe they would experience each of 20 symptoms (e.g., headache, tiredness, and dry mouth). Subjects were also asked how many drinks they had on nights that resulted in a hangover the next morning.	• 20 symptom items not otherwise specified (headache, tiredness, dry mouth, etc.)
Harburg, E., Davis, D., Cummings, K.M., & Gunn, R. (1981).	Negative affect, alcohol consumption and hangover symptoms among normal drinkers in a small community. *Journal of Studies on Alcohol, 42*(11), 998-1012.	Subjects in this study were asked whether they had or had not experienced any of the following hangover symptoms the last time they had more to drink than they had intended or got drunk: headache or hangover; stomach pains; loss of appetite; tremors, shaking hands; anxiety; thoughts of suicide; diarrhea; or blackout, loss of memory. These symptoms were then split up into mild, moderate, and severe categories.	• Headache/Hangover • Stomach Pains • Loss of Appetite • Tremors • Shaking Hands • Anxiety • Thoughts of Suicide • Diarrhea • Blackout/Loss of Memory
Poikolainen, K. (1983).	Inebriation and mortality. *International Journal of Epidemiology, 12*, 151-155.	Subjects were asked how many times they had a hangover in the past year. Subjects were also asked how they felt when experiencing hangover symptoms. Specifically, participants were asked "How do you feel when you have a hangover (do you have headache, fatigue, tremors, nausea; are you absent from work)?"	• Past year frequency of hangover • Headache • Fatigue • Tremors • Nausea • Work Absence
Smith, C.M. & Barnes, G.M. (1983).	Signs and symptoms of hangover: Prevalence and relationship to alcohol use in a general adult population. *Drug and Alcohol Dependence, 11,* 249-269.	Smith and Barnes (1983) assessed hangover symptoms by asking about the frequency at which individuals experienced hangover in the past year. Also, subjects were asked to think about the last time they experienced a hangover and were asked whether they experienced specific symptoms. Symptoms measured in this sample were headache, nausea, hands shaking, nervousness, depression, hot/cold flashes, and vomiting.	• Past year frequency of hangover • Headache • Nausea • Hands Shaking • Nervousness • Depression • Hot/Cold Flashes • Vomiting

Pristach, A., Smith, C., & Whitney, R. (1983).	Alcohol withdrawal syndromes: Prediction from detailed medical and drinking histories. *Drug and Alcohol Dependence, 11,* 177-199.	Subjects in this study were not given a description of hangover but were asked whether they had ever experienced one and were asked to give their own description of a hangover. "The most common symptom reported was headache, followed by weakness or incapacitation and nausea/vomiting." Participants in this study were also asked about the change in frequency of hangovers they had experienced over their drinking lifetimes.	• Self-reported description • Change in frequency over drinking lifetime
Watson, C.G., Anderson, D.H., & Jacobs, L. (1985).	Factor analysis of the aftereffects of drinking in alcoholics. *Journal of Clinical Psychology, 41*(1), 111-117.	Subjects in this study were asked to report how often they "experienced each of 19 effects after drinking – sleepiness, agitation, depression, nausea, headache, reddening of the skin, anxiety, muscle weakness, dry mouth, tingling, warmth, general feelings of discomfort, seizures, shakes/tremors, relaxation, feeling romantic, alertness, confidence, and happiness – on 5 point scales (4 = 'every time he drinks,' 3 = 'usually after he drinks,' 2 = 'less than half the time after he drinks,' 1 = 'only rarely after drinking,' 0 = 'never after drinking')." An adapted version of this measure was used in a later study which aimed to establish the construct validity of an aftereffect-based subtyping system (Watson, Tilleskjor, & Jacobs, (1990).	• Sleepiness • Agitation • Depression • Nausea • Headache • Reddening of the skin • Anxiety • Muscle Weakness • Dry Mouth • Tingling • Warmth • General Discomfort • Seizures • Shakes/Tremors • Relaxation • Feeling Romantic • Alertness • Confidence • Happiness

| Newlin, D.B. & Pretorius, M.B. (1990). | Sons of alcoholics report greater hangover symptoms than sons of nonalcoholics: A pilot study. *Alcoholism: Clinical and Experimental Research, 14,* 713-716. | The Hangover Questionnaire (HQ) consisted of 13 self-report items which assessed symptoms (nausea, vomiting, etc.) and also included an item which simply asked the subjects whether or not they experienced a hangover. These items aimed to assess the frequency of symptoms experienced in the past year as well as symptoms experienced early in the drinking lifetimes of the subjects. This is an early example of a survey measure which aimed to measure past year symptom experience. | Hangover after drinking Headache while drinking Headache morning after drinking Vomited after drinking Fell asleep when didn't want to Took medicine to get over hangover Regretted behavior while drinking Forgot things that happened while drinking Nausea the morning after Did things wouldn't normally do while drinking Woke up early morning after Woke up too late morning after Regretted having drank too much |
| Harburg, E., Gleiberman, L., DiFranceisco, W., & Peele, S. (1994). | Towards a concept of sensible drinking and an illustration of measure. *Alcohol and Alcoholism, 29*(4), 439-450. | Researchers developed a measure which asked whether symptoms were absent or present. Specifically, the measure asked, "When you had more to drink than you intended or you got drunk, did you have (1) anxiety; (2) diarrhea; (3) blackouts; (4) suicide thoughts; (5) tremors (among the eight items used)." These five symptom items were the only ones specified. | Anxiety Diarrhea Blackouts Suicide Thoughts Tremors |

Kauhanen, J., Kaplan, G.A., Goldberg, D.D., Cohen, R.D., Lakka, T., & Salonen, J.T. (1997).	Frequent hangovers and cardiovascular mortality in middle-aged men. *Epidemiology, 8,* 310-314.	Researchers attempted to assess hangover frequency in the past year in a survey. This measure asked participants, "How often did you experience hangover in the past 12 months?" Response options were once a year, 2-3 times a year, 4-5 times a year, about once every 2 months, about monthly, 2-3 times a month, about once a week, and at least twice a week. Researchers in this study dichotomized the scores based on "monthly vs less than monthly."	• Past year hangover frequency
Yokoyama, M., Yokoyama, A., Yokoyama, T., Funazu, K., Haman, G., Kondo, S., Yamashita, T., & Nakamura, H. (2005).	Hangover susceptibility In relation to aldehyde dehydrogenase-2 genotype, alcohol flushing, and mean corpuscular volume in Japanese workers. *Alcoholism: Clinical and Experimental Research, 29,* 1165-1171.	This scale asked subjects to report how many times they had experienced a hangover in the past year (never, 1-2, 3-4, 5-9, or $\geq$ 10 times) and to specify the usual amount of drinking from which they had hangover (<1, 1-1.9, 2-2.9, 3-3.9, 4-4.9, 5-5.9, or $\geq$6 units). Symptoms measured were headache, dizziness, nausea, diarrhea, anorexia, palpitation, fatigue, depressive feelings, and anxiety. Subjects were also asked how long their average hangover lasted (<2, 2-3.9, 4-5.9, or $\geq$6 hr).	• Past year hangover frequency • Amount consumed prior to hangover days • Headache • Dizziness • Nausea • Diarrhea • Anorexia • Palpitation • Fatigue • Depressive Feelings • Anxiety • Length of Hangover
Span, S.A. & Earleywine, M. (1999).	Familial risk for alcoholism and hangover symptoms. *Addictive Behaviors, 24,* 121-125.	Subjects completed two questionnaires which were based on previous measures. The first scale included items such as sweaty, loss of appetite, and shaky and was based on the measure used by McCaul et al. (1991). The second scale was made up of 12 items such as "I would get a headache the morning after drinking" and "I would regret having drunk too much," based on the measure used by Newlin and Pretorius (1990). The 12 items used in the second questionnaire were not specified.	• Sweaty • Loss of Appetite • Shaky • Trouble Concentrating • Racing Heart • Alcohol Craving • Tired • Restless • Irritable • Headache • Regret

Wall, T.L., Horn, S.M., Johnson, M.L., Smith, T.L., & Carr, L.G. (2000).	Hangover symptoms in Asian Americans with variants in the aldehyde dehydrogenase (ALDH2) gene. *Journal of Studies on Alcohol, 61*, 13-17.	The scale used in this study attempted to measure liability to hangover by asking participants to report on a Likert-type scale (0 = no hangover to 10 = worst hangover ever) how extreme of a hangover they would expect if they were to consume six standard drinks (males) or four standard drinks (females).	• Likelihood of hangover experience after a "binge"
Slutske, W.S., Piasecki, T.M., & Hunt-Carter, E.E. (2003).	Development and initial validation of the Hangover Symptoms Scale: Prevalence and correlates of hangover in college students. *Alcoholism: Clinical and Experimental Research, 27*, 1442-1450.	The Hangover Symptoms Scale (HSS), originally developed for survey use, aimed to assess hangover experiences in the past year by asking about specific symptoms experienced the day after drinking. The symptoms measured in the HSS included items such as dehydration, nausea, vomiting, and headache which were adapted from multiple domains listed in a review of hangover data (Swift & Davidson, 1998). The assessment scheme of the HSS was made up of two parts. First, it is asked what percentage of drinking occasions specific symptoms were experienced. Second, if the symptom was ever experienced after drinking in the past year, a follow up question asked how many times this symptom was experienced in the past year.	• Tired • Headache • Nausea • Weakness • Difficulty Concentrating • Thirst/Dehydration • Vomiting • Sensitive to Light/Sound • Sweating • Trouble Sleeping • Anxiety • Depression • Trembling/Shaking

APPENDIX B

Hangover Symptoms Scale

1. Within the past 12 months when you drank alcohol, how often did you feel more tired than usual the next morning?

> 1 = Never (0% of the time)   **GO TO QUESTION 2**
> 2 = Occasionally (about 25% of the time)
> 3 = About half the time (50% of the time)
> 4 = Most of the time (75% of the time)
> 5 = Every time I drank alcohol (100% of the time)

1a. In the past 12 months, how many times did you feel more tired than usual the next morning after drinking alcohol?

> A = 2 times or less (once or twice per year)
> B = 3-11 times (less than once per month)
> C = 12-51 times (more than once per month, but not every week)
> D = 52 times or more (once per week or more frequently)

2. Within the past 12 months when you drank alcohol, how often did you experience a headache the next morning?

> 1 = Never (0% of the time)   **GO TO QUESTION 3**
> 2 = Occasionally (about 25% of the time)
> 3 = About half the time (50% of the time)
> 4 = Most of the time (75% of the time)
> 5 = Every time I drank alcohol (100% of the time)

2a. In the past 12 months, how many times did you experience a headache the next morning after drinking alcohol?

> A = 2 times or less (once or twice per year)
> B = 3-11 times (less than once per month)
> C = 12-51 times (more than once per month, but not every week)
> D = 52 times or more (once per week or more frequently)

3. Within the past 12 months when you drank alcohol, how often did you feel very nauseous the next morning?

> 1 = Never (0% of the time)   **GO TO QUESTION 4**
> 2 = Occasionally (about 25% of the time)
> 3 = About half the time (50% of the time)
> 4 = Most of the time (75% of the time)
> 5 = Every time I drank alcohol (100% of the time)

3a.	In the past 12 months, how many times did you feel very nauseous the next morning after drinking alcohol?

> A = 2 times or less (once or twice per year)
> B = 3-11 times (less than once per month)
> C = 12-51 times (more than once per month, but not every week)
> D = 52 times or more (once per week or more frequently)

4.	Within the past 12 months when you drank alcohol, how often did you feel very weak the next morning?

> 1 = Never (0% of the time)   **GO TO QUESTION 5**
> 2 = Occasionally (about 25% of the time)
> 3 = About half the time (50% of the time)
> 4 = Most of the time (75% of the time)
> 5 = Every time I drank alcohol (100% of the time)

4a.	In the past 12 months, how many times did you feel very weak the next morning after drinking alcohol?

> A = 2 times or less (once or twice per year)
> B = 3-11 times (less than once per month)
> C = 12-51 times (more than once per month, but not every week)
> D = 52 times or more (once per week or more frequently)

5.	Within the past 12 months when you drank alcohol, how often did you have difficulty concentrating on things the next morning?

> 1 = Never (0% of the time)   **GO TO QUESTION 6**
> 2 = Occasionally (about 25% of the time)
> 3 = About half the time (50% of the time)
> 4 = Most of the time (75% of the time)
> 5 = Every time I drank alcohol (100% of the time)

5a.	In the past 12 months, how many times did you have difficulty concentrating on things the next morning after drinking alcohol?

> A = 2 times or less (once or twice per year)
> B = 3-11 times (less than once per month)
> C = 12-51 times (more than once per month, but not every week)
> D = 52 times or more (once per week or more frequently)

6. Within the past 12 months when you drank alcohol, how often did you feel extremely thirsty or dehydrated the next morning?

> 1 = Never (0% of the time)   **GO TO QUESTION 7**
> 2 = Occasionally (about 25% of the time)
> 3 = About half the time (50% of the time)
> 4 = Most of the time (75% of the time)
> 5 = Every time I drank alcohol (100% of the time)

6a. In the past 12 months, how many times did you feel extremely thirsty or dehydrated the next morning after drinking alcohol?

> A = 2 times or less (once or twice per year)
> B = 3-11 times (less than once per month)
> C = 12-51 times (more than once per month, but not every week)
> D = 52 times or more (once per week or more frequently)

7. Within the past 12 months when you drank alcohol, how often did you vomit the next morning?

> 1 = Never (0% of the time)   **GO TO QUESTION 8**
> 2 = Occasionally (about 25% of the time)
> 3 = About half the time (50% of the time)
> 4 = Most of the time (75% of the time)
> 5 = Every time I drank alcohol (100% of the time)

7a. In the past 12 months, how many times did you vomit the next morning after drinking alcohol?

> A = 2 times or less (once or twice per year)
> B = 3-11 times (less than once per month)
> C = 12-51 times (more than once per month, but not every week)
> D = 52 times or more (once per week or more frequently)

8. Within the past 12 months when you drank alcohol, how often did you feel more sensitive to light and sound than usual the next morning?

> 1 = Never (0% of the time)   **GO TO QUESTION 9**
> 2 = Occasionally (about 25% of the time)
> 3 = About half the time (50% of the time)
> 4 = Most of the time (75% of the time)
> 5 = Every time I drank alcohol (100% of the time)

8a. In the past 12 months, how many times did you feel more sensitive to light and sound than usual the next morning after drinking alcohol?

>   A = 2 times or less (once or twice per year)
>   B = 3-11 times (less than once per month)
>   C = 12-51 times (more than once per month, but not every week)
>   D = 52 times or more (once per week or more frequently)

9.   Within the past 12 months when you drank alcohol, how often did you sweat more than usual the next morning?

>   1 = Never (0% of the time)   **GO TO QUESTION 10**
>   2 = Occasionally (about 25% of the time)
>   3 = About half the time (50% of the time)
>   4 = Most of the time (75% of the time)
>   5 = Every time I drank alcohol (100% of the time)

9a. In the past 12 months, how many times did you sweat more than usual the next morning after drinking alcohol?

>   A = 2 times or less (once or twice per year)
>   B = 3-11 times (less than once per month)
>   C = 12-51 times (more than once per month, but not every week)
>   D = 52 times or more (once per week or more frequently)

10. Within the past 12 months when you drank alcohol, how often did you have a lot of trouble sleeping?

>   1 = Never (0% of the time)   **GO TO QUESTION 11**
>   2 = Occasionally (about 25% of the time)
>   3 = About half the time (50% of the time)
>   4 = Most of the time (75% of the time)
>   5 = Every time I drank alcohol (100% of the time)

10a. In the past 12 months, how many times did you have a lot of trouble sleeping after drinking alcohol?

>   A = 2 times or less (once or twice per year)
>   B = 3-11 times (less than once per month)
>   C = 12-51 times (more than once per month, but not every week)
>   D = 52 times or more (once per week or more frequently)

11. Within the past 12 months when you drank alcohol, how often did you feel anxious the next morning?

> 1 = Never (0% of the time)   **GO TO QUESTION 12**
> 2 = Occasionally (about 25% of the time)
> 3 = About half the time (50% of the time)
> 4 = Most of the time (75% of the time)
> 5 = Every time I drank alcohol (100% of the time)

11a. In the past 12 months, how many times did you feel anxious the next morning after drinking alcohol?

> A = 2 times or less (once or twice per year)
> B = 3-11 times (less than once per month)
> C = 12-51 times (more than once per month, but not every week)
> D = 52 times or more (once per week or more frequently)

12. Within the past 12 months when you drank alcohol, how often did you feel depressed the next morning?

> 1 = Never (0% of the time)   **GO TO QUESTION 13**
> 2 = Occasionally (about 25% of the time)
> 3 = About half the time (50% of the time)
> 4 = Most of the time (75% of the time)
> 5 = Every time I drank alcohol (100% of the time)

12a. In the past 12 months, how many times did you feel depressed the next morning after drinking alcohol?

> A = 2 times or less (once or twice per year)
> B = 3-11 times (less than once per month)
> C = 12-51 times (more than once per month, but not every week)
> D = 52 times or more (once per week or more frequently)

13. Within the past 12 months when you drank alcohol, how often did you experience trembling or shaking the next morning?

> 1 = Never (0% of the time)   **SKIP QUESTION 13a.**
> 2 = Occasionally (about 25% of the time)
> 3 = About half the time (50% of the time)
> 4 = Most of the time (75% of the time)
> 5 = Every time I drank alcohol (100% of the time)

13a. In the past 12 months, how many times did you experience trembling or shaking the next morning after drinking alcohol?

> A = 2 times or less (once or twice per year)
> B = 3-11 times (less than once per month)
> C = 12-51 times (more than once per month, but not every week)
> D = 52 times or more (once per week or more frequently)