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What Do You Mean "Drunk"? Convergent Validation of Multiple Methods of Mapping Alcohol Expectancy Memory Networks

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The configuration and activation of memory networks have been theorized as mechanisms that underlie the often observed link between alcohol expectancies and drinking. A key component of this network is the expectancy "drunk." The memory network configuration of "drunk" was mapped by using cluster analysis of data gathered from the paired-similarities task (PST) and the Alcohol Expectancy Multi-Axial Assessment (AEMAX). A third task, the free associates task (FA), assessed participants' strongest alcohol expectancy associates and was used as a validity check for the cluster analyses. Six hundred forty-seven 18–19-year-olds completed these measures and a measure of alcohol consumption at baseline assessment for a 5-year longitudinal study. For both the PST and AEMAX, "drunk" clustered with mainly negative and sedating effects (e.g., "sick," "dizzy," "sleepy") in lighter drinkers and with more positive and arousing effects (e.g., "happy," "horny," "outgoing") in heavier drinkers, showing that the cognitive organization of expectancies reflected drinker type (and might influence the choice to drink). Consistent with the cluster analyses, in participants who gave "drunk" as an FA response, heavier drinkers rated the word as more positive and arousing than lighter drinkers. Additionally, gender did not account for the observed drinker-type differences. These results support the notion that for some emerging adults, drinking may be linked to what they mean by the word "drunk."

Keywords: alcohol expectancies, memory networks, binge drinking, information processing, affective valence

In the 1970s and 1980s, traditional psychometric and factor analytic techniques were used to establish a clear link between alcohol expectancies and drinking. These techniques were instrumental in identifying alcohol expectancies as important predictors of drinking and helped generate theories positing information processes within the matrix of influences on alcohol consumption. Two predictions arose from these theories: (a) Individuals would differ on their associative memory networks containing information about the effects of alcohol; and (b) these differences would relate to and perhaps influence the actual behavior of drinking (Goldman, 1989). To advance the testing of expectancies as information processes, Rather and Goldman (1994; Rather, Goldman, Roehrich, & Brannick, 1992) examined the role of alcohol expectancy memory network configuration in the decision to drink.

The network approach was developed by cognitive psychologists to model basic memory processes. Many specific models have been developed (e.g., spreading activation; Collins & Loftus, 1975), but the general network approach to memory is built on the common notion that concepts associated with one another are connected in memory in a netlike manner. The meaning of such concepts (e.g., hammer) then depends on the concepts (e.g., nail, pound) to which they are connected within the network. From the perspective of expectancy theory, activation of associative memory networks is not merely descriptive of phenomena that "go together," but the activation provides an internal context (mindset) that guides prospective decision making (Bar, 2011b). This theoretical framework is now shared across many domains of cognitive–affective science (see Bar, 2011a).

The work of Rather et al. initiated a series of studies based on memory network models, which have demonstrated that regardless of how much people drink, they share some common expectancies in their alcohol-related memory networks.[1] This commonality was illustrated by Reich and Goldman (2005), who identified a broad spectrum of alcohol expectancies by asking over 5,000 college students to complete the phrase, "Alcohol makes me _____." Responses by both light and heavy drinkers spanned the full range of possibilities arrayed along two affective dimensions; valence (positive–negative) and arousal; that is, drinkers of all types freely generated positive effects such as sociability, negative effects such as nausea, arousing effects such as talkativeness, and sedating effects such as drowsiness.

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[1] In describing the results of previous memory network studies, it must be noted that no task directly measures the contents of a memory network. Maps of memory networks are hypothetical constructs derived from conventional self-report tasks whose data can be entered into algorithms like multidimensional scaling (MDS), cluster analysis, and free associate probabilities that subsequently generate meaningful proxies for associative spaces.

Although establishing a common pool of possible expectancies was useful in its own right, the greatest value of alcohol expectancy network models has emerged from efforts to map individual differences (i.e., drinker type) onto the expectancy networks. Both of the Rather studies (using MDS Prefmap and cluster analysis; Rather et al., 1992; Rather & Goldman, 1994), and Reich and Goldman (2005; using free associate probabilities), demonstrated differential weighting of specific components of the network by drinker type. Weighting here refers to the increased probability that specific types of expectancies, expectancies that are clearly biased toward the upper ends of valence, arousal dimensions, or both, and that might provide the mind-set for increased drinking, would be activated when drinkers are placed in an alcohol-consistent context. To this end, numerous studies have demonstrated that memory network activation is contingent on two factors: context and individual drinking history or patterns (Goldman, Darkes, Reich, & Brandon, 2010).

Differential alcohol expectancy memory network weighting has provided insight into the cognitions that play a causal role in the decision to drink (Darkes & Goldman, 1993, 1998; Roehrich & Goldman, 1995; Stein, Goldman, & Del Boca, 2000). To describe the process whereby memory networks differentiate between drinker types, Goldman et al. (2010) drew on a description by Widdows (2004) of how homographs like "bass" gain clear meaning with respect to individual experience. For most people, "bass" can take on different equipotential meanings (music related or a species of fish), and the meaning at any given moment is driven by context (e.g., a guitar or angling gear, respectively). Activation, however, also depends on the interaction of context with individual experience. Because of accumulated experience with contiguity between a stimulus (e.g., "bass") and a context ("music"), a professional musician may require little or no contextual priming to activate the instrument association.

Just as likely is the need for very little contextual priming to activate drinking-relevant information in the long-time pub crawler (patrons of a pub may have a third meaning for Bass; a British ale). This type of efficient activation may indeed reflect repeated experience. In an earlier application of this phenomenon to the alcohol field, Stacy (1997) demonstrated this efficiency by having drinkers free associate in response to ambiguous, potentially alcohol-related words such as *pitcher* and *shot*. It is not surprising that the practiced drinkers were more likely to provide alcohol-related responses. Alcohol expectancy theory posits that this same process can be observed in alcohol expectancy activation (Goldman et al., 2010).

This study explores the role of drinking practices in the differential activation of the alcohol expectancy word "drunk." Within the scope of hundreds of previously studied alcohol expectancies, the single expectancy "drunk" is unique, and therefore important for three reasons: First, it is widely held. Reich and Goldman (2005) found that across all drinkers (and even nondrinkers) "drunk" was among the most frequent expectancies generated. "Drunk" (4%) was generated with the fourth highest frequency behind "sick" (7%), "happy" (5%), and "relaxed" (4%), among over 1,000 expectancies. None of the synonyms or slang words for "drunk" (e.g., wasted, intoxicated, inebriated, hammered) fell within the top 50 expectancies. In fact, when compared with 25 other commonly used terms used to describe intoxication, "drunk" was the most familiar (>96%) and the most widely self-used (>78%; Levitt, Sher, & Bartholow, 2009).

Second, unlike other common expectancies, the affective meaning of "drunk" can vary. Other high frequency expectancies are either clearly positive (e.g., happy, relaxed), or clearly negative (e.g., sick, stupid; see Goldman & Darkes, 2004, or Rather & Goldman, 1994, for multidimensional scaling plots depicting where these words fall within the affective dimension of valence). Rather and Goldman (1994) found that "drunk," however, shifted from a negative valence to a positive valence in light and heavy drinkers, respectively. The ambiguous meaning of the word *drunk* (like *bass* discussed above) provides leverage for examining memory network differences by drinker type.

Third, for most people, *drunk* refers to effects associated specifically with ingesting alcohol (notwithstanding figures of speech like "punch drunk"). No other alcohol expectancy, "happy," "sick," "sociable," "sleepy," or even "intoxicated," connotes alcohol, per se. Not only is "drunk" specific to alcohol but it also most often refers to consumption of a relatively large dose. Kerr, Greenfield, and Midanik (2006) showed that although self-reported estimates of the number of drinks to get "drunk" have decreased slightly since the 1970s, they have remained greater than the episodic quantities used to define binge drinking. Periodic consumption of such doses has been associated with an increased risk for adverse consequences (e.g., Knight, Wechsler, Kuo, Sebring, Weitzman, & Schuckit, 2002).

Several methods for network modeling of alcohol expectancy data have been used to study alcohol expectancies, but few studies have used multiple self-report measures to triangulate on specific associations. Hence, an additional purpose of this study was to evaluate the convergence between the memory networks derived from multiple methods for mapping expectancies. Although the search for convergent validity of measures emanates from a psychometric approach to studying behavior, the memory network approach diverges from the purely psychometric tradition. Psychometrists seek measures and items within measures that are purified, have clear meaning, and are standard for each research participant, that is, measurement invariance. In this way, the resultant items as indicators of latent constructs can be assumed to emanate from similar concepts. The approach taken herein accepts that "drunk" is not measurement invariant; "drunk" is blurry with meaning that varies as a function of individual differences. Such items would often be eliminated from consideration that using classical methods, due to potential "cross-loading" or lack of purity or invariance across groups. However, from the perspective of information processing, differences in responses to an item on a questionnaire may not simply reflect participants' variation on some latent trait but may arise because a question worded exactly the same way can mean different things (i.e., be a different question) based on individual differences. Such potentially systematic variation might be treated as error in traditional psychometric models but was considered meaningful and important here.

Specifically, words may not serve merely as predictors of behavior, but as probes of causal processes. The specific word *drunk* was chosen for special examination because of its unique characteristics that may make it a signal item for drinking behavior. On the basis of alcohol expectancy theory and previous memory network research, *drunk* was hypothesized to have associative memory network links with more positive and arousing expectan-

cies in heavier drinkers than lighter drinkers. This pattern was expected to be consistent in both male and female individuals and across multiple measures of alcohol expectancy memory networks. To test this hypothesis, previously used memory network mapping methods (clusters) derived from two measures of expected effects from alcohol—the paired similarities task (PST) and the Alcohol Expectancy Multiaxial Assessment (AEMAX)—and direct assessment of memory network associations to alcohol [free associates (FA)] were administered to emerging adults with varying levels of typical alcohol consumption.

Method

Participants

Six hundred and forty-seven 18–19-year-old drinkers split evenly between college students and nonstudents were enrolled in a 5-year longitudinal study designed to examine drinking decision processes. Participants annually attended a university campus to complete a comprehensive assessment battery (for which they were paid $100). Participants subsequently completed a truncated assessment (for which they were paid $25) during telephone interviews at 3-month intervals between annual assessments. Data analyzed in this study were extracted from the initial baseline assessment, and the first quarterly interview was conducted 3 months later. Inclusion in the larger study required a sixth grade reading level and consumption of at least one alcohol-containing drink per month over the previous 6 months. Those with obvious psychosis were excluded. Participants included both college students (≈50%) and their same aged noncollege peers.

Measures

Three measures were used to ascertain participants' memory organization of alcohol expectancies: the PST, the AEMAX, and an alcohol-related FA task. These three tasks have been used previously to investigate alcohol expectancy memory networks.

Paired Similarities Task (PST). The PST assessed perceived co-occurrence of common effects of drinking alcohol. Respondents were presented with all possible paired combinations of 16 validated alcohol expectancy words (e.g., happy, angry, sociable) and were instructed to rate on a scale that ranged from 0 (*extremely unlikely*) to 5 (*extremely likely*), the frequency with which those two effects are likely to occur together when "under the influence of alcohol" (e.g., "woozy" & "sleepy"). Similarity data from the PST can be analyzed by using cluster analysis, producing a graphic depiction of the organization of the alcohol expectancy information in participants' memory. Using this method and PST data, Rather and Goldman (1994) found that individual alcohol expectancies fall into semantically related clusters, with cluster membership and "tightness" (i.e., how close together items are grouped within the clusters), reflecting individual drinking histories.

Alcohol Multi-Axial Assessment (AEMAX). Multidimensional scaling-derived memory network depictions (e.g., Rather et al., 1992) led to development of AEMAX (Goldman & Darkes, 2004), a measure of perceived likelihood of occurrence of drinking outcomes. As with the PST, AEMAX responses can be used to create similarity data that can be clustered to effectively map memory networks based on self-reported frequency of specific effects of alcohol. Participants rate the predicted frequency of occurrence on a scale ranging from 0 (*never*) to 6 (*always*) of 132 alcohol expectancy outcomes (words) after "having several drinks of alcohol." Because these 132 words could be collapsed into 32 isomeaning word groups, participants actually provided a rating for four variations of each of the 32 alcohol expectancy words–concepts. The 16 words from the PST were represented within these 32 isomeaning groups. Because the content of the PST is completely embedded within the AEMAX, scores for the 16 words common to the two measures could be used to create network depictions that were comparable between the measures. The AEMAX's utility in providing data for memory network modeling and validity in the prediction of drinking has been demonstrated previously (Goldman & Darkes, 2004).

Free associates task. Participants were instructed to generate up to five responses to the prompt, "Alcohol makes me_____". The participants then were asked to rate each of their five free associates on two 1–7 Likert-type scales: Valence (pleasantness) and arousal. Discrete anchors were not provided; instead, participants were informed that high ratings such as 6 or 7 represented extreme pleasantness or arousal while low ratings such as 2 or 1 represented extreme unpleasantness or sedation. For arousal ratings, participants were given specific word examples, such as *alert*, *active*, and *wide awake* for high arousal and *sleep* and *bored* for low arousal.

Free associate responses are believed to be the purest indicator of automatically accessed memory contents (resulting from implicit processes; Nelson & McEvoy, 2000). The free associate method has been used to evaluate memory networks in adults (Reich & Goldman, 2005) and children (Dunn & Goldman, 2000) and to demonstrate that individuals generate specific expectancy words at different frequencies as a function of their individual drinking histories (Reich & Goldman, 2005). These different associates are thought to represent the most salient (hence, readily activated) expectancies held by individuals in their memory network (Nelson & McEvoy, 2000).

As noted above, the FA task also asked participants to subjectively rate their associates on valence and arousal. These ratings provided a continuous quantitative measure of participants' affective meaning of the word *drunk* (in contrast to the indirect measures of memory network location derived from cluster analysis). In other words, participants reported on whether they thought drunk was a positive (desirable) or negative (undesirable) outcome.

Alcohol Use

The overall longitudinal study assessed drinking behavior by using several methods (individual questions, timeline followback, and structured interviewing). Two individual items in both the baseline battery and the quarterly interviews were specifically related to a drinking style consistent with the word *drunk*: (a) an estimate of quantity of alcohol use per occasion, and (b) an estimate of frequency of drinking to intoxication. These two items were collected during the baseline assessment.

Procedure

Participants were recruited by using a variety of methods (e.g., advertisements, call lists, and network sampling) for screening and

enrollment into a 5-year longitudinal study that covered the period from 18–19 to 23–24 years of age. The demographic data, alcohol use data, AEMAX, and PST data were all collected at the baseline assessment session. Free associates data, as well as up-to-date drinking data, were collected 3 months following the baseline assessment.[2]

Statistical Analysis

Cluster analysis. To depict the hypothetical memory network space around the word *drunk*, hierarchical cluster analyses were derived from similarity matrices based on the PST and AEMAX data. These analyses used an average linkage approach between groups and squared euclidean distances. The results are displayed as dendrograms. Visual inspection of group-related differences is used to characterize variations in meaning that can be inferred from structural differences in cluster solutions.

Cluster analysis involves the fitting of each data point into a model that takes into account all other included data points. For example, cluster analysis of AEMAX data will weigh all responses to any one item, such as "alcohol makes one sociable," in relation to the responses to all other AEMAX items entered into the cluster analysis. The final product is a cluster diagram which depicts the relationship (as experienced by the participants in the sample) between all included alcohol expectancy words. The cluster diagram shows which alcohol expectancies are "close together" (e.g., happy and social) and which are farther apart (e.g., social and sick). In this manner, the cluster diagrams derived from expectancy measures can serve as hypothetical maps of participants' expectancy networks.

Quantitative comparisons. Other data included both categorical and continuous variables. Categorical data [e.g., generation of the FA "drunk" (yes/no)] were described by using percentages and proportions and were compared between heavier versus lighter drinkers by using chi-square tests. Because drinking data are typically skewed, Spearman (nonparametric) correlations were chosen to analyze the relationships between drinking variables and FA valence–arousal ratings. The nominal alpha for meeting statistical significance was set at .05.

Results

Sample Characteristics

Six hundred, fifty-seven participants aged 18–19 (59.5% of the participants were 18 years of age) were assessed at baseline. A slight majority (50.4%; 326) were female; 48.9% (321) were male; and 1.5% (10) did not specify their gender. Ethnicity varied, with 59.5% Caucasian (391), 11.4% Hispanic/Latino (75), 11.1% African American (73), 10.2% mixed (67), 6.1% other (40), and 1.7% unspecified (11). At baseline, the mean number of drinks per occasion in the overall sample was 4.59 (1.65). Median frequency of drinking to intoxication was once per month, and the mode was 2–3 times a month. Drinking data were compared across the baseline and quarterly assessments. No significant differences were found for frequency of drinking to intoxication. A significant but relatively small (Cohen's $d = .27$) decrease in drinking quantity was noted, from a mean of 4.59 drinks at baseline to 4.20 drinks at the quarterly assessment, $t(570) = -5.501$; $p < .001$.

Cluster Analyses

Typical quantity. Drinkers were classified based on the number of standard drinks reported per typical drinking occasion. The classifications represented all of the possible responses to the quantity question, with the exception of the lowest (<3 drinks) and highest (>8 drinks) classifications, which were combined with their closest categories to facilitate equal size grouping for cluster analysis. Three notable results emerged: First, clusters were remarkably similar across the two methods; both the PST and AEMAX, although varying in their method of assessing expectancies, provided similar depictions of the associations within an alcohol expectancy memory network. (In this context, "similar" refers to the same words being clustered together across methods.) Second, for each method a clear differentiation emerged as typical drinking increased; as hypothesized, *drunk* was associated with negative and sedating effects among those customarily drinking lower amounts per occasion, whereas heavier drinker's networks linked *drunk* with positive and arousing effects. Hence, the term *drunk* did not have one stable meaning; its meaning, as inferred from its closest associates in the network, varied as a function of customary quantity of alcohol consumed. A third more subtle observation was that differentiation varied slightly by measure. Although the observed structures derived from the different measures were quite similar, the point at which the inferred meaning of *drunk* shifted from negative–sedating to positive–arousing occurred at four drinks per occasion on the PST and five drinks on the AEMAX. It is interesting to note that both levels at which differentiation began were on the cusp of the customary quantity categorized as a heavy drinking (binge) episode. Figure 1 depicts the memory network clusters derived from the PST and the AEMAX across the four middle drinker classifications (the lightest and heaviest classifications were virtually identical to their next closest classification, therefore their dendrograms were omitted for space considerations and readability).

Gender and drinking level. For any study that examines the effects of drinker type on an outcome, gender may confound the results (because of differences in typical drinking levels between genders). To assess the role of gender in memory network differentiation and ensure that the observed drinking level differences were not influenced by differential representation of gender across drinking groups, six cluster solutions were examined in a 2 (gender) × 3 (drinking level) cluster analysis; because the sample was split by gender, drinking quantity was further collapsed to provide within group *n*s that were comparable to the initial drinker-type analysis. The three drinker levels were constructed with cognizance of the conventional binge-drinking criteria of 4–5 drinks per occasion: low or nonbinge drinkers (1–3 drinks per typical occasion; $N = 185$: 65.4% women, 34.6% men), medium or criterion cutoff binge drinkers (4–5 drinks per occasion; $N = 230$: 53% females, 47% males) and heavy or excessive binge drinkers (6 or more drinks per occasion; $N = 222$: 35.6% females, 64.4% males).

[2] The free associates (FA) task data was collected at both the baseline and quarterly assessment. At baseline, the FA was administered after other measures of alcohol expectancy. The FA was administered first at the quarterly assessment. Because we wanted to reduce the possibility of contamination by other measures, we chose to use the quarterly assessment data (3 months later).

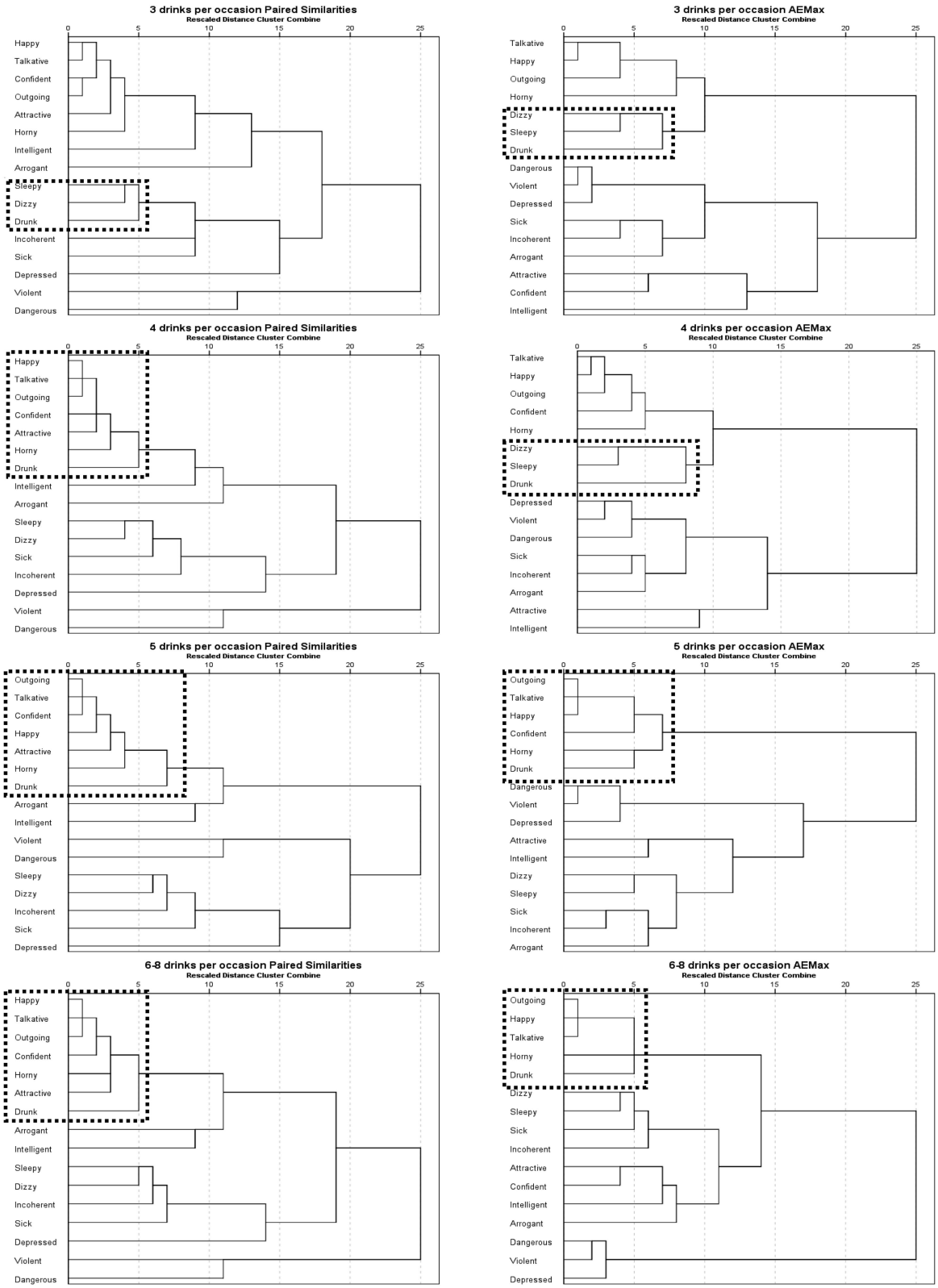

Figure 1. Dendrograms containing clusters of the alcohol expectancy "drunk" derived from the PST (left panel) and the AEMAX (right panel) by drinker level. Expectancies thought to share meaning are more proximal in the memory network space, appearing closer to each other. The bars linking them reflect shorter relative distances between expectancies. The clusters containing "drunk" are indicated by dashed lines.

Similar to the aforementioned cluster analyses, the inferred meaning of *drunk* varied as a function of drinking level; for both measures, *drunk* clustered with mainly negative and sedating effects in lighter drinkers and with more positive and arousing effects in heavier drinkers, regardless of gender. For the light drinkers, *drunk* clustered with *dizzy* and *sleepy*, whereas for medium and heavy drinkers, *drunk* clustered with several positive, arousing, and social effects including *happy*. Men and women shared a common meaning for *drunk* and, more interesting to note, shared a common change in that meaning by drinker type.

Free Associates

The first associate in a free associate task is thought to be the most salient alcohol expectancy that individuals hold. Variation in associational linkages that were similar to those noted for the PST and the AEMAX were also observed in the first responses generated to the FA task. Among those drinking three or fewer drinks per occasion, *tired* and *happy* were the most frequent first associates. In contrast, as drinking level increased to the moderate to heavy levels (four or more drinks per occasion) *happy* and *drunk* emerged as the most frequent first associates (see Table 1).

Clear differences emerged between those who generated *drunk* as any free associate ($N = 109$; 19%) and those who did not ($N = 465$; 81%). Individuals who reported *drunk* consumed to the point of becoming intoxicated with a higher frequency than individuals who did not report *drunk* (Mann–Whitney U test, $p < .01$). The average number of drinks consumed per occasion for individuals who reported *drunk* was 4.89 (1.80) drinks while those not generating *drunk* drank on average 4.04 (1.79) drinks per occasion, $t(572) = -4.44$; $p < .001$. To rule out gender as a potential confound in this comparison, an analysis of covariance (ANCOVA) was run, using gender as a covariate. The difference remained significant ($p < .01$). Hence, generating *drunk* as a free associate was associated with increased quantity of alcohol use and frequency of drinking to intoxication, verifying the association between the expected effect of drunkenness and risk for heavy episodic drinking.

As a convergent test of the shifts in meaning of *drunk* as a function of drinker type (as seen in the cluster analyses), the ratings of the FA *drunk* and drinking behavior were examined. Consistent with the cluster results, pleasantness and arousal ratings of *drunk* increased with frequency of getting drunk (pleasantness: Spearman's $\rho = .47$, $p < .001$; arousal: Spearman's $\rho = .39$, $p < .001$) and quantity per occasion (pleasantness: Spearman's $\rho = .28$, $p = .003$; arousal: Spearman's $\rho = .55$, $p < .001$).

Because the FA data were collected at the quarterly assessment (3 months after the other expectancy data), drinking data from the quarterly assessment was used for these analyses. As noted previously, however, drinking quantity dropped slightly between assessments. Therefore, these analyses also were run with the baseline drinking data. The same pattern of significant differences in drinking behavior was observed in both sets of drinking data.

Although 49% of the sample were males, significantly more male participants (67%) were among those who reported drunk as a free associate, $\chi^2(1) = 17.66$, $p < .001$. Also, among those who reported drunk, male participants rated *drunk* as more arousing than females ($M = 3.74$, 3.00, respectively), $t(106) = 2.20$, $p = .03$, whereas no differences were observed in valence ratings ($M = 4.28$, 4.46, respectively).

Discussion

Consistent with a memory network model of expectancies, drinking levels varied as a function of the affective properties of *drunk* as inferred from both its nearest memory network links and ratings of its valence and arousing properties. Thus, the meaning of drunk as an expected effect of alcohol was found to be complex and seemed to vary in concert with individual patterns of alcohol use. This variation of *drunk* from a negative to positive expectancy generally occurred at the level of consumption conceptualized as "binge" drinking (e.g., four drinks or more per occasion for women and five or more for men; e.g., Wechsler, Davenport, Dowdall, & Moeykens, 1994), a pattern of heavy episodic consumption associated with increases in negative alcohol-related consequences. Ironically, as getting *drunk* takes on more positive affective tone, the level of drinking it is associated with becomes more problematic–harmful. Hence, becoming *drunk* suggests a certain quality, style, or goal of drinking. That is to say, getting *drunk* may be conceptualized as part of a sequential *causal chain* where drinking occurs with the goal of becoming drunk, a state that is itself (associated with) a means to achieving certain ends (alcohol makes one drunk; drunkenness makes one. . .?; Goldman et al., 2010). The difference in the association of *drunk* may reflect that point where the effect of being *drunk* changes from a pathway to undesirable negative or sedating outcomes following consumption of large doses to one toward desirable positive or arousing effects, hence becoming a valued goal.

Because this study was not a true experiment, these results, of course, introduce a "chicken and egg" problem. Whether *drunk* becomes desirable once it is associated with positive–arousing effects (e.g., intoxication experienced contiguously with positive–arousing outcomes), or whether experienced positive–arousing effects become more powerfully inscribed in the memory of those for whom *drunk* is a desired effect is unclear. Clearly, innate differential affective responses to the effects of alcohol might contribute to these effects as well (Schuckit, Tipp, Smith, Wiesbeck, & Kalmijn, 1997). Given a cross-sectional design, it cannot be clearly determined whether this shift is causal in nature or whether shifts in either direction (e.g., toward positive or negative

Table 1
Most Frequent First Associate by Drinker Level

Variable	1–3 drinks (225)	4–5 drinks (179)	6 + drinks (170)
Most frequent 1st associate	Tired (14.7%)	Happy (16.8%)	Happy (19.4%)
2nd most frequent 1st associate	Happy (13.3%)	Drunk (12.8%)	Drunk (19.4%)
3rd most frequent 1st associate	Dizzy (9.7%)	Tired (8.4%)	Tired (7.1%)

associations) would occur within individuals over time and predict shifts in drinking. Regardless of whether *drunk* is an antecedent or consequent of general drinking habits, expectancy theory would predict that its situational activation and links to positive expectancy words would create a mind-set that tips the scale toward the decision to drink (Bar, 2011b). This mind-set also may be influenced by whether drinkers' memory networks are weighted more toward initial or later effects of alcohol (i.e., as blood alcohol levels are rising or falling). Prior research has demonstrated that stimulant (positive arousing) effects are linked with initial alcohol effects (when BAC levels are ascending), whereas negative-sedating effects are linked with later effects (when BAC levels are descending; Martin, Earleywine, Musty, Perrine, & Swift, 1993). Perhaps the positive-arousing effects associated with ascending BAC are more salient to heavier drinkers, whereas the negative-sedating effects associated with descending BAC are more salient to lighter drinkers. This difference in salience may have a formative influence on alcohol expectancy memory networks.

Male and female individuals who drank similar quantities produced nearly identical alcohol expectancy clusters across 16 commonly expected effects of alcohol. This similarity suggested the existence of a commonly shared aspect of expectancies that was not (or less) influenced by gender but by differences in customary drinking. On the FA task, male individuals were more likely than female individuals to report *drunk*, and male individuals rated *drunk* as more arousing than female individuals (with no differences in pleasantness ratings). This finding suggests that there may be a gender difference in individuals' tendency to conceptualize the effects of alcohol, or it is simply confounded with drinking (men were heavier drinkers). Future research efforts could involve merging this finding with other findings that have suggested a difference in expectancies between genders (e.g., Des Rosiers, Noll, & Goldman, 2005) in an exploration of the nuances in alcohol expectancies across genders.

A caveat must be taken into consideration when interpreting cluster analysis data. Specifically, there are no effective ways of testing model significance (reliability). The lack of quantitative test underscores the importance of demonstrating consistency across methods. In this study, the shift in associational linkages of *drunk* was observed in separate models using data from two different measures, thereby evidencing convergent validity. Furthermore, the fact that the shift in associational linkage of *drunk* reflected differences in drinking quantities indicated face validity for these models. Therefore, we feel that the risk commonly associated with cluster analysis (that models generated without indices of fit or significance may not be robust) is sufficiently diminished in our results.

Overall, the consistency in alcohol expectancy memory organization demonstrated between the PST and the AEMAX supported their convergent validity. The PST and AEMAX shifts in associational linkages of "drunk" also was reflected in participants' first associate responses, suggesting that although these measures varied as a function of their task requirements, all three reflected a common associative memory network.

Although each of these three measures would be considered explicit because participants were consciously responding to direct questions, their ability to foresee, and influence, an associational map of their memory organization is difficult to imagine. The nature of these approaches, therefore, blurs the distinction between implicit and explicit measures of alcohol expectancy memory networks. In conclusion, the unique nature and variable meaning of the word *drunk* may be important for understanding the nature of alcohol expectancies and how they influence drinking behaviors. Exploring subjective valuation of *drunk* could have the potential of developing into a brief and efficient way for gaining insight into an individual's alcohol expectancy network, and more importantly, into dangerous drinking styles. Words are not "just" words—they have meaning: That meaning is not static but changes as a function of context and individual differences. To understand the motivations for drinking to drunkenness and how they affect decisions to drink, we must understand what it means to become *drunk*.

References

Bar, M. (Ed.). (2011a). *Predictions and the brain.* New York, NY: Oxford University Press.

Bar, M. (2011b). The proactive brain. In M. Bar (Ed.), *Predictions and the brain* (pp. 13–26). New York, NY: Oxford University Press. doi:10.1093/acprof:oso/9780195395518.003.0010

Collins, A. M., & Loftus, E. F. (1975). A spreading activation theory of semantic processing. *Psychological Review, 82,* 407–428. doi:10.1037/0033-295X.82.6.407

Darkes, J., & Goldman, M. S. (1993). Expectancy challenge and drinking reduction: Experimental evidence for a mediational process. *Journal of Consulting and Clinical Psychology, 61,* 344–353. doi:10.1037/0022-006X.61.2.344

Darkes, J., & Goldman, M. S. (1998). Expectancy challenge and drinking reduction: Process and structure in the alcohol expectancy network. *Experimental and Clinical Psychopharmacology, 6,* 64–76. doi:10.1037/1064-1297.6.1.64

Des Rosiers, S. E., Noll, J. A., & Goldman, M. S. (2002). An exploratory study of alcohol expectancies in semantic space as a function of gender. *Alcoholism: Clinical and Experimental Research, 26*(Suppl. 5), 35A.

Dunn, M. E., & Goldman, M. S. (2000). Validation of multidimensional scaling-based modeling of alcohol expectancies in memory: Age and drinking-related differences in expectancies of children assessed as first associates. *Alcoholism: Clinical and Experimental Research, 24,* 1639–1646. doi:10.1111/j.1530-0277.2000.tb01965.x

Goldman, M. S. (1989). Alcohol expectancies as cognitive-behavioral psychology: Theory and practice. In T. Løberg, W. R. Miller, P. E. Nathan, & G. A. Marlatt (Eds.), *Addictive behaviors: Prevention and early intervention* (pp. 11–30). Lisse, the Netherlands: Swets & Zeitlinger Publishers.

Goldman, M. S., & Darkes, J. (2004). Alcohol expectancy multi-axial assessment (A. E. Max): A memory network-based approach. *Psychological Assessment, 16,* 4–15. doi:10.1037/1040-3590.16.1.4

Goldman, M. S., Darkes, J., Reich, R. R., & Brandon, K. O. (2010). From DNA to conscious thought: Anticipatory processing as a transdisciplinary bridge in addiction. In D. Ross (Ed.), *What is addiction?* (pp. 291–334). Boston, MA: MIT Press.

Kerr, W. C., Greenfield, T. K., & Midanik, L. T. (2006). How many drinks does it take you to feel drunk? Trends and predictors for subjective drunkenness. *Addiction, 101,* 1428–1437. doi:10.1111/j.1360-0443.2006.01533.x

Knight, J., Wechsler, H., Kuo, M., Sebring, M., Weitzman, E., & Schuckit, M. (2002). Alcohol abuse and dependence among U.S. college students. *Journal of Studies on Alcohol, 63,* 263–270.

Levitt, A., Sher, K., & Bartholow, B. (2009). The language of intoxication: Preliminary investigation. *Alcoholism: Clinical and Experimental Research, 33,* 448–454. doi:10.1111/j.1530-0277.2008.00855.x

Martin, C. S., Earleywine, M., Musty, R. E., Perrine, M. W., & Swift,

R. M. (1993). Development and validation of the biphasic alcohol effects scale. *Alcoholism: Clinical and Experimental Research, 17,* 140–146. doi:10.1111/j.1530-0277.1993.tb00739.x

Nelson, D. L., & McEvoy, C. L. (2000). What is free association and what does it measure? *Memory & Cognition, 28,* 887–899. doi:10.3758/BF03209337

Rather, B. C., & Goldman, M. S. (1994). Drinking-related differences in the memory organization of alcohol expectancies. *Experimental and Clinical Psychopharmacology, 2,* 167–183. doi:10.1037/1064-1297.2.2.167

Rather, B. C., Goldman, M. S., Roehrich, L., & Brannick, M. (1992). Empirical Modeling of an alcohol expectancy memory network using multidimensional scaling. *Journal of Abnormal Psychology, 101,* 174–183. doi:10.1037/0021-843X.101.1.174

Reich, R. R., & Goldman, M. S. (2005). Exploring the alcohol expectancy memory network: The utility of free associates. *Psychology of Addictive Behaviors, 19,* 317–325. doi:10.1037/0893-164X.19.3.317

Reich, R. R., Goldman, M. S., & Noll, J. A. (2004). Using the false memory paradigm to test two key elements of alcohol expectancy theory. *Experimental and Clinical Psychopharmacology, 12 (2),* 102–110. doi:10.1037/1064-1297.12.2.102

Roehrich, L., & Goldman, M. S. (1995). Implicit priming of alcohol expectancy memory processes and subsequent drinking behavior. *Experimental and Clinical Psychopharmacology, 3,* 402–410. doi:10.1037/1064-1297.3.4.402

Schuckit, M. A., Tipp, J. E., Smith, T. L., Wiesbeck, G. A., & Kalmijn, J. (1997). The relationship between self-rating of the effects of alcohol and alcohol challenge results in ninety-eight young men. *Journal of Studies on Alcohol, 58,* 397–404.

Stacy, A. W. (1997). Memory activation and expectancy as prospective predictors of alcohol and marijuana use. *Journal of Abnormal Psychology, 106,* 61–73. doi:10.1037/0021-843X.106.1.61

Stein, K. D., Goldman, M. S., & Del Boca, F. K. (2000). The influence of alcohol expectancy priming and mood manipulation on subsequent alcohol consumption. *Journal of Abnormal Psychology, 109,* 106–115. doi:10.1037/0021-843X.109.1.106

Wechsler, H., Davenport, A., Dowdall, G., & Moeykens, B. (1994). Health and behavioral consequences of binge drinking in college: A national survey of students at 140 campuses. *Journal of American Medical Association, 272,* 1672–1677. doi:10.1001/jama.1994.03520210056032

Weinberger, A. H., Darkes, J., Del Boca, F. K., Greenbaum, P. E., & Goldman, M. S. (2006). Items as context: The effect of item order on factor structure and predictive validity. *Basic and Applied Social Psychology, 28,* 17–26. doi:10.1207/s15324834basp2801_2

Widdows, D. (2004). *Geometry and meaning.* Stanford, CA: CSLI Publications.

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