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Distinctions in Alcohol-Induced Memory Impairment: A Mixed Methods Study of En Bloc versus Fragmentary Blackouts

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Abstract

Background: Blackouts – or memory loss for all or part of a drinking event – are reliable predictors of alcohol-related consequences. Studies suggest a distinction between en bloc (complete memory loss) and fragmentary (off-and-on memory loss) blackouts; however, research has not consistently differentiated between these two forms of blackout. This study aimed to validate the distinction between en bloc and fragmentary blackouts among young adults.

Methods: Data were collected using qualitative (Study 1) and quantitative (Study 2) research methods. Participants in both studies were college students with a history of alcohol-induced memory impairment. They were recruited using community advertisement (Study 1, $N=50$, 56% female) and Qualtrics survey panels (Study 2, $N=350$, 56% female). Study 1 participants engaged in eight focus groups. Discussions were audio-recorded, transcribed verbatim, and coded using applied thematic analysis. Findings guided assessment of en bloc and fragmentary blackout in Study 2. In Study 2, a separate sample of participants completed an online survey assessing drinking behavior, alcohol-induced memory impairment, and theoretical correlates of en bloc and fragmentary blackouts.

Results: Study 1 participants differentiated between en bloc and fragmentary blackouts (which they referred to as “blackouts” and “brownouts,” respectively) based on duration and extent of memory loss. They indicated that blackouts occur along a continuum, with en bloc “blackouts” at the extreme. They also stated that the term “blackout drinking” does not always imply memory loss. Study 2 participants reported higher rates of “brownouts” (81%) than “blackouts” (54%). They reported less negative outcome expectancies and attitudes, greater personal approval, higher prevalence estimates, lower self-efficacy, and stronger intentions for “brownouts” than “blackouts” ($p<.001$). Women perceived “blackouts/brownouts” as more prevalent than men and reported lower intentions to experience “blackouts” ($p<.005$).

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Conclusions: Young adults are more permissive of fragmentary than en bloc blackout. En bloc blackouts may be a target for future interventions.

Keywords

alcohol; memory; blackout; predictors; gender

INTRODUCTION

Alcohol-induced blackouts are periods of anterograde amnesia, in which individuals experience complete or partial memory loss for events that occurred while they were drinking (Goodwin et al., 1969). They differ from “passing” out, in that individuals maintain consciousness during the event, so they are able to engage in complex behaviors such as conversing or driving (Wetherill and Fromme, 2016). Blackouts place individuals at increased risk for a number of alcohol-related consequences, including physical injury and overdose (Hingson et al., 2016). Given these consequences, it is concerning that 20% of young adults report a blackout in the past six months, with past-year rates as high as 54% among college students (Barnett et al., 2014; Hingson et al., 2016).

In their seminal study of individuals with alcohol use disorder, Goodwin and colleagues (1969) described two forms of blackout: “en bloc” blackouts, characterized by definite onset and complete memory loss for events that occur, and “fragmentary” blackouts, characterized as “off-and-on” memory loss in which the person only realizes they forgot something when reminded of it later by other people or environmental cues. Neuroscience seems to support a distinction between these forms of memory impairment. Specifically, en bloc blackout involves a disruption in the hippocampus that prevents consolidation of short-term memories into long-term storage; because they are not consolidated, these memories are lost and cannot be retrieved, regardless of attempts to cue those memories (Rose and Grant, 2010; White, 2003). In contrast, in the case of fragmentary blackout, researchers have suggested that memory traces are formed but require cues in order to be retrieved (Hartzler and Fromme, 2003b; Wetherill and Fromme, 2011). In this case, fragmentary blackouts may operate as a function of retrieval-based difficulties in the frontal lobes, rather than acute damage to the limbic system (Hartzler and Fromme, 2003a; Hartzler and Fromme, 2003b). This would support the idea that these are distinct forms of alcohol-induced memory impairment.

Research has not consistently distinguished between en bloc and fragmentary blackouts, due in part to lack of a standardized blackouts assessment in the literature (Wetherill and Fromme, 2016). In the two small studies ($n < 60$) that have differentiated between these forms of blackout, en bloc blackouts were less common than fragmentary blackouts, and individuals who experienced en bloc blackouts evaluated blackouts more negatively than those who experienced fragmentary blackouts (Hartzler and Fromme, 2003a; White et al., 2004). The idea that young adults may evaluate these forms of blackout differently is important because consequences that are evaluated negatively are more likely to lead to behavior change (Merrill et al., 2013). However, studies to date have not contrasted young adults’ perceptions of these forms of blackout directly. Moreover, research has not examined

the extent to which young adults (rather than investigators) differentiate between en bloc and fragmentary blackouts. Better understanding of the extent to which young adults differentiate between these experiences is expected to improve our ability not only to assess these behaviors but also to target these experiences in prevention and intervention efforts.

Psychological theory is useful in determining the prevention and intervention strategies that may enhance behavior change (Michie et al., 2008). The Theory of Reasoned Action and Theory of Planned Behavior suggest that attitudes (driven in part by outcome evaluations), perceived norms, and self-efficacy determine behavioral intentions, which drive behavior (Ajzen, 1985; Fishbein and Ajzen, 1975). The most recent formulation of this theory, the Integrative Model of Behavioral Prediction, maintains intentions as the most immediate antecedent of behavior, acknowledging that the environment and individual differences in skills/abilities may impact the association between intentions and behavior (Fishbein, 2008). This model may be helpful in identifying constructs that differentiate between en bloc and fragmentary blackouts, in that the correlates of en bloc and fragmentary blackouts would be expected to differ if these are indeed two qualitatively different experiences.

The aims of this study followed an exploratory sequential mixed method design, in which a qualitative study helped guide data collection in a subsequent quantitative study (Guest et al., 2012). Consistent with recommendations for measure development (Neale and Strang, 2015), we used qualitative methods to examine young adults' definitions of and distinctions between blackout drinking experiences and to elicit their feedback on empirically-derived definitions of en bloc and fragmentary blackouts. We then sought to confirm the distinction between "blackouts" and "brownouts" that was uncovered in qualitative work using quantitative methods. We used the Integrative Model of Behavioral Prediction (Fishbein, 2008) to identify measurable constructs that might differentiate between en bloc and fragmentary blackouts. These included outcome evaluations, attitudes, perceived norms, self-efficacy, intentions to experience blackouts and brownouts, and the drinking behaviors that lead to both forms of blackout (e.g., drinking quantity and duration, use of other drugs). We hypothesized that participants' outcome evaluations, attitudes, perceived norms, self-efficacy, intentions, and drinking patterns on nights of en bloc and fragmentary blackouts would differ. We also examined gender differences in en bloc and fragmentary blackouts, given unclear gender differences in rates of blackout and attitudes/expectancies for alcohol use (Kirmani and Suman, 2010, Wetherill and Fromme, 2016, Hingson et al., 2016).

STUDY 1: QUALITATIVE METHODS/RESULTS

Participants and Procedure

College students reporting any form of blackout (inability to remember what happened the night before because they had been drinking) in the past six months were recruited from a Northeastern city in the United States to participate in a series of focus groups on alcohol and memory ($k=8$; $N=50$, 5–8/group; see Table 1). College students were chosen as the target population, given high rates of alcohol-induced blackouts on college campuses (Wetherill and Fromme, 2016). Consistent with recommendations for qualitative research (Krueger and Casey, 2014; Ulin, 2005), focus groups were stratified by gender to facilitate discussion; and a trained facilitator, co-facilitator, and note-taker were present for each

group. All participants provided written informed consent. Participants were reminded of privacy/confidentiality considerations at the beginning of the focus group and encouraged to use aliases and/or third-person references to protect their privacy. Discussions followed a semi-structured agenda and lasted 48–70 minutes. Prompts relevant to the current manuscript included, “*What do people mean by ‘blackout drinking’?*” and, “*In what ways do blackouts vary in severity?*”

Immediately following the focus group discussion, participants reviewed definitions of en bloc and fragmentary blackouts that were derived from previous research (Hartzler and Fromme, 2003a; White et al., 2004) and offered written feedback on the wording of the definitions. Upon completion, participants received \$40 cash. Debriefs, which research staff completed immediately following each group, reviewed the major themes of the group and levels of saturation (i.e., the extent to which new data was being generated). Procedures were approved by the Institutional Review Board.

Data Analysis

Through all stages of the study, we took steps to enhance reliability and validity of our findings, attending to Yardley’s (2000) criteria for quality control in qualitative research, including rigor, transparency, and coherence. Focus group discussions were audio recorded, professionally transcribed, and analyzed using applied thematic methods. Applied thematic analysis is a systematic, inductive approach to qualitative data analysis. It involves identifying and describing both implicit and explicit ideas expressed by participants (i.e., themes) and applying codes that represent those themes to raw data as summary markers. Review of the coded data then allows for more in-depth interpretation and presentation of each theme (Guest et al., 2012). A preliminary coding structure was derived deductively from the focus group transcript, and use of open coding and marginal remarks were used to identify important topics not already included in the codebook. Each transcript was then coded independently by at least two members of the research team, and discrepancies were resolved via discussion to bring codes into 100% agreement. Master codes were entered into NVivo10 (QSRInternational, 2010) and double checked for accuracy. Coded data were then reviewed to identify themes. Quotes below are identified by focus group (FG), participant number (P), gender, and age.

Results

Theme 1: “Blackouts” are complete memory loss for substantial periods of time.”Brownouts” are fuzzy or incomplete memories.—Participants identified both the duration and extent of memory loss as factors that differentiate “blackouts” from what they called “brownouts” (or, less commonly, “grayouts”). In terms of timeframe: “*A lot of people will be like, ‘Oh, I got browned out.’ They won’t remember anything about like a 15-minute period. But then they’ll call it a blackout if it’s like over an hour*” (FG4/P1, male, 18y). However, other participants stated that “*an hour’s kind of a weird amount of time. Like you said, it’s never just an hour. It’s usually like, I can’t really—can’t put a number on it, but I feel like it’s pretty substantial*” (FG5/P2, female, 20y). Alternatively, there was some indication that the proportion, rather than total duration, of memory loss is important: “*If you forget the majority of your night—it doesn’t have to be 50%, but just in terms of a*

significant enough portion where you actually have a gap in your memory, a significant gap in your memory—then that will definitely be what we call blacking out” (FG3/P4, male, 19y). In contrast, brownouts were described as *“shorter periods of time—where it’s like in-and-out”* (FG2/P3, male, 19y).

Extent of memory impairment was identified as a distinguishing factor in all eight focus groups, such that brownouts and blackouts refer to *“spotty memory versus no memories,”* respectively (FG2/P5, male, 20y). *“I usually differentiate it to myself in my mind as- A solid block of time, usually, I would consider a blackout because- A brownout is hazy and you remember parts and bits. You remember certain moments in the night. You might forget 20 or 30 minutes that you can’t really remember what happened, but I feel like a blackout is a really solid chunk where there’s just absolutely no memory”* (FG8/P6, male, 18y). *“If you just brownout, then you have kind of a sense of the trajectory of your night the next day. But if you blackout, then you’re actually—there’s no puzzle that you’re putting together. You’re just like, ‘I really have no idea what anything—where I was at any point”* (FG7/P7, female, 20y).

Theme 2: Blackouts occur along a continuum, with en bloc “blackouts” at the extreme.—Participants indicated that brownouts are particularly difficult to define because memories are fallible to begin with: *“If you’re really drunk one night, then the whole night becomes a little bit hazy anyway, and you haven’t necessarily browned out or blacked out, but the line between that drunken haze and brownout is much more blurred”* (FG7/P2, female, 20y). Similarly, *“There’s different levels of being ‘turnt’...you can be lightly buzzed, or you can be drinking a lot...but being blackout is another level”* (FG5/P4, female, 18y). To this point, one participant stated, *“Brownout just sort of covers any other memory loss that’s not complete”* (FG2/P4, male, 21y).

Theme 3: The term “blackout drinking” does not always imply memory loss.—In all groups, participants reported that “blackout drinking” is sometimes used as a hyperbole or colloquial term that implies heavy drinking or loss of control, but not necessarily memory loss: *“I might say something like, ‘Oh, gonna get blackout tonight.’ But what I mean is, ‘I’m going to get very comfortably drunk, and if I don’t remember it, then so be it”* (FG5/P4, female, 18y). Participants seemed to indicate that this non-specific use of the term “blackout drinking” is used primarily in anticipation of a heavy drinking episode: *“I’ve definitely had that experience, where it’s like—I say that I’m gonna get blackout, but I really just mean I wanna go out and drink a lot and have fun, but I don’t necessarily wanna lose my memory”* (FG7/P4, female, 19y). *“[When people say, ‘I’m getting blackout drunk tonight’], they just mean very drunk. It’s just an exaggeration”* (FG2/P4, male, 21y). Participants also reported using this non-specific term in reference to someone else who seemed out of control: *“When I see somebody at a party that- I’m being told that they’re blackout drunk, that doesn’t mean we’re saying, with absolute certainty, that they won’t remember this tomorrow. It just means they’re at a state past what they can handle”* (FG1/P6, female, 21y). The term “blackout” seemed to take on a more precise definition – implying memory loss – when used in reference to a specific drinking episode that occurred

in the past: “*Only if someone tells me they were blackout drunk will I associate it with, ‘Oh, you didn’t remember anything’*” (FG1/P8, female, 22y).

Operational definitions.—“Blackouts” are defined inconsistently in the literature. For example, one item on the Rutgers Alcohol Problem Index (White and Labouvie, 2000) assesses how often in the past year an individual has “*suddenly found yourself in a place that you could not remember getting to;*” the Alcohol Use Disorders Identification Test (AUDIT; Saunders et al., 1993) assesses how often during the last year one has “*been unable to remember what happened the night before because you had been drinking;*” and the Brief Young Adult Alcohol Consequences Questionnaire (Kahler et al., 2008) assesses how often in the past month one has “*not been able to remember large stretches of time while drinking heavily.*” In addition, some researchers use their own definition or description of blackouts to assess alcohol-induced memory impairment (Wetherill and Fromme, 2016). This study aimed to contribute to this literature by gathering participant feedback on definitions of en bloc and fragmentary blackouts that were derived from previous research (Hartzler and Fromme, 2003a; White et al., 2004).

The definition of en bloc blackout proposed to participants was “*being unable to remember what happened while you were drinking, even if someone gives you clues or tries to remind you later.*” Participants in one focus group suggested adding the hour timeframe (e.g., “*being unable to remember an hour or more*”) to this definition. However, because the amount of time required was controversial and duration is not a requisite for the characterization of en bloc blackout in the empirical literature (Goodwin et al., 1969; Hartzler and Fromme, 2003a; White et al., 2004), we did not revise the definition to include a specified amount of time.

The proposed definition of fragmentary blackout was “*having fuzzy or incomplete memories of drinking events that become clear only when people give you cues or remind you later.*” Participants identified two issues with this definition. First, they described fuzzy or incomplete memories as “brownouts,” regardless of cued recall. Second, they indicated that other people are not necessary to trigger memory recall; this could occur spontaneously or with environmental cues. Thus, fragmentary blackout was operationalized as: “*having fuzzy or incomplete memories of drinking events OR remembering drinking events only after someone or something jogs your memory.*” These were the definitions used in Study 2 to elicit data on frequency and theoretical correlates of en bloc and fragmentary blackout. To be consistent with participants’ language, the terms “blackout” and “brownout” were used to refer to en bloc and fragmentary blackout, respectively. Reminders of the operational definitions for these terms were embedded within items and/or provided on each page of the Study 2 survey.

STUDY 2: QUANTITATIVE METHODS/RESULTS

Participants and Procedure

A separate sample of college students was recruited to participate in an anonymous online survey using Qualtrics survey panels. Interested panelists completed four screening items online from remote locations. Those who met screening criteria were then redirected to the informed consent page, and those who provided informed consent completed the online

survey. Participants were eligible to participate if they were (a) 18–29 years, (b) an undergraduate student, (c) enrolled full-time, and (d) unable to remember events that happened while drinking in the past 12 months. Past-year blackout was included as a screening criterion to ensure adequate representation of participants who had experienced en bloc blackout. Participants received incentives that ranged in value from \$2.25 to \$5.25. All procedures were approved by the Institutional Review Board.

Participant demographics are depicted in Table 1. Of the 521 individuals who responded to the survey invitation, 402 met initial screening criteria and consented to participate. Of those who consented, 18 were missing >70% of data, 3 indicated random responding, 13 were graduate students, and 18 denied past-year blackout on the AUDIT during completion of the survey. Thus, 350 participants were included in Study 2. Participants attended college/universities in 46 separate states in the continental United States.

Measures

Alcohol-induced memory impairment.—The blackout item read, “*How many times in the past 30 days have you had a blackout (i.e., been unable to remember events that happened while you were drinking, even if someone tried to remind you later)?*” Response options ranged from 0 (*never*) to 4 (*twice a week or more*; see Table 2). If participants reported a blackout in the past 30 days, they responded to three follow-up questions regarding the night of their most recent blackout: the number of standard drinks consumed, how many hours they drank, and if they used drugs in combination with alcohol (see Table 2). Drinking quantity and duration, along with biological sex and weight, were used to estimate BAC, which was calculated using the Widmark (1932) formula. Participants then indicated if they had ever experienced a blackout on a night during which they consumed only alcohol (no other drugs).

The brownout item read, “*How many times in the past 30 days have you had a brownout (i.e., had fuzzy or incomplete memories of drinking events OR remembered drinking events only after someone or something jogged your memory)?*” Follow-up items paralleled those used for blackouts.

Theoretical correlates.—Outcome evaluations, attitudes, norms, self-efficacy, and intentions were assessed separately for blackouts and brownouts using adapted versions of previously-developed measures (Carey et al., 1999; Hu et al., 2007; Katz et al., 2000; Hagger et al., 2012). All items and response options are depicted in Table 3. For the attitudes items, response options were averaged to create one attitudes score for blackouts ($\alpha=.93$) and brownouts ($\alpha=.94$). Reminders of the study definition of ‘blackout’ and ‘brownout’ were displayed on each new page of the survey.

Typical drinking behavior.—Past-month alcohol use and consequences were assessed for descriptive purposes. Drinking quantity and frequency were assessed using the Daily Drinking Questionnaire (α for daily quantity reports = .88; Collins et al., 1985). Alcohol-related consequences were assessed using the Brief Young Adult Alcohol Consequences Questionnaire (Kahler et al., 2008), which demonstrated high internal consistency in this sample ($\alpha=.90$). These scales are considered reliable and valid measures of drinking quantity

and consequences, respectively, within this population (Kahler et al., 2008; Sobell and Sobell, 2003).

Data Screening and Analysis Plan

Data were screened for outliers and violations of assumptions of analysis of variance prior to analysis. Outliers for drinks per week ($n = 4$) and drinks per drinking day ($n = 3$) variables were replaced with the value that was three standard deviations and one integer above the mean (Tabachnick & Fidell, 2006). Based on findings that college students overestimate BACs (Kraus et al., 2005), BAC estimates associated with coma or death ($> .40\%$; $n = 1$) were recoded as .40. Negative BAC estimates were recoded as 0. After recoding these variables, skewness and kurtosis estimates were within the normal range (Kline, 2011).

Descriptive statistics were used to determine the past 30-day incidence of blackouts and brownouts. Independent samples t -tests were used to determine differences in event-level drinking between individuals who experienced blackouts versus brownouts. Paired samples t -tests were used to determine within-person differences in theoretical correlates of blackouts versus brownouts. In comparison to women, men were older [$t(276)=7.54$, $p<.001$; men $M=23.0$, $SD=3.0$; women $M=20.8$, $SD=2.3$], reported consuming more drinks per week [$t(217^1)=4.03$, $p<.001$; men $M=14.4$, $SD=13.4$; women $M=9.6$, $SD=7.1$], and experienced more alcohol-related consequences [$t(265^1)=3.40$, $p=.001$; men $M=10.8$, $SD=6.8$; women $M=8.6$, $SD=4.9$]. Therefore, univariate analyses of covariance to determine differences in theoretical correlates of blackouts/brownouts between men and women controlled for age, drinks per week, and consequences. Bonferroni adjustment ($\alpha=.05/11=.005$) was used to control for inflation in Type I error in these tests.

Results

Incidence.—Brownouts occurred more frequently than blackouts (see Tables 1 and 2). Of 350 participants, 48 (14%) denied experiencing a blackout or brownout in the past month, 130 (37%) reported only one form of memory impairment (see Table 1), and 172 (49%) experienced both blackout and brownout in the past month. Data regarding the frequency of blackouts/brownouts and details regarding the most recent blackout/brownout drinking episode are depicted in Table 2. Compared to individuals who experienced only a brownout ($n=113$), individuals who experienced a blackout ($n=189$) consumed a greater number of drinks during their last blackout/brownout drinking episode [$t(292)=3.67$, $p < .001$]. Groups did not differ significantly in drinking duration [$t(296)=1.97$, $p=.05$], estimated blackout/brownout BAC [$t(290)=1.54$, $p=.13$], or use of drugs [$\chi^2(1)=0.46$, $p=.50$; see Table 2] when collapsed across sex. The majority of participants (~80%) reported a lifetime history of blackouts/brownouts in the absence of drug use.

Theoretical correlates.—Consistent with hypotheses, participants reported less negative outcome beliefs and attitudes, were more approving, perceived greater peer approval, and estimated higher actual rates of brownouts than blackouts (see Table 4). They reported greater confidence in their abilities to avoid blackouts than brownouts and expressed stronger intentions to experience a brownout versus blackout in the next 30 days (see Table 4). That is, across all theoretical correlates, blackouts and brownouts were distinct.

Gender differences.—Gender differences in incidence and theoretical correlates of blackouts are presented in Tables 2 and 5, respectively. In the past 30 days, men (67%) were more likely than women (44%) to report a blackout. The past-30-day incidence of brownout was not significantly different for men (77%) and women (85%). During their most recent blackout experience, men consumed a similar amount of alcohol as women for a longer duration of time, resulting in significantly lower estimated BACs (see Table 2). In the case of the most recent brownout, men consumed a greater amount of alcohol than women in a similar amount of time, but still achieved lower estimated BACs when accounting for sex and weight (see Table 2). In comparison to men, women perceived higher prevalence of blackouts and brownouts among other men and women during college. They also reported weaker intentions to experience a blackout in the next 30 days (see Table 5).

DISCUSSION

These studies replicate and extend previous research by documenting distinctions in young adults' definitions of, experiences with, and perceptions of en bloc ("blackouts") and fragmentary blackouts ("brownouts"). Both qualitative and quantitative findings confirm that en bloc and fragmentary blackouts are distinct constructs. Although alcohol-induced memory impairment was perceived as falling along a continuum, participants reliably differentiated between en bloc and fragmentary blackouts based on the duration and extent of memory loss (i.e., blackouts were conceptualized as longer in duration with more complete memory loss). Further, college students endorsed greater incidence and more permissive attitudes toward fragmentary than en bloc blackouts. While rates of past-month fragmentary blackout (81%) were consistent with the 77 to 78% reported in previous samples of individuals with a history of alcohol-induced memory impairment, rates of en bloc blackout (54%) exceeded previous estimates of 22 to 23% (Hartzler and Fromme, 2003a; White et al., 2004). Moreover, 48% of those who experienced en bloc blackout and 51% of those who experienced fragmentary blackout reported multiple instances of alcohol-induced memory impairment in the past 30 days. These data support the conclusion that alcohol-induced memory impairment recurs within individuals over time (Barnett et al., 2014).

Given participant distinction between en bloc and fragmentary blackouts, the self-reported drinking behaviors associated with the two forms of memory impairment were surprisingly similar. On average, participants reported consuming 8.4 standard drinks over 4.2 hours (reaching estimated BACs of .16) for en bloc blackout events and 6.7 drinks over 3.8 hours (estimated BACs of .14) for fragmentary blackout events. Moreover, rates of drug use in en bloc (28%) and fragmentary (24%) blackout events did not differ to the extent found in previous studies (62% vs. 11% in Hartzler & Fromme, 2003a); and the majority of participants stated that, at some point, they had experienced alcohol-induced memory impairment in the absence of drug use. Therefore, while the synergistic effects of alcohol and other drugs may compound memory impairment (White, 2003), a number of individuals seem to experience en bloc and fragmentary blackouts in the absence of any drug use, and at relatively similar BACs. One explanation for this, which has been suggested in previous studies, is that individuals who experience blackouts have a biological vulnerability to alcohol-induced memory impairment (Wetherill and Fromme, 2016). It is also possible that

unmeasured variables (e.g., low food intake) influenced blackout events or that estimations of drinking quantity/duration were imprecise (Kraus et al., 2005).

In spite of the apparent similarities in drinking patterns that lead to en bloc and fragmentary blackouts, the distinctions young adults made between these two forms of blackout were striking. For each theoretically-derived correlate assessed – and among both men and women – young adults who had experienced alcohol-induced memory impairment consistently rated en bloc blackouts more negatively than fragmentary blackouts. This may explain why college students, on average, report being only “a little” bothered by non-specific forms of blackout (Barnett et al., 2015; Merrill et al., 2013; White and Ray, 2014): someone who experiences a fragmentary blackout may evaluate that ‘blackout’ less negatively than someone who experiences an en bloc blackout. Our data suggest that the same individual may also evaluate these two experiences differently.

Despite primarily negative perceptions, some participants expressed intent to experience en bloc or fragmentary blackout in the next 30 days. The extent to which participants truly intend to experience alcohol-induced memory impairment in this context is unclear, as qualitative data indicated that young adults may use the term “blackout drinking” to label a style of heavy alcohol use associated with willingness, but not necessarily intent, to lose memory as a result of drinking. That being said, one of the intentions items used in this study specifically assessed intention to “lose your memory of the night’s events.” Given strong associations between intentions and drinking behavior (Cooke et al., 2016), these data do not bode well for the prevention of blackout levels of drinking. Research examining the longitudinal associations between the theoretical correlates of blackouts (including attitudes, norms, self-efficacy, and intentions; Fishbein, 2008; Yzer, 2012) and actual blackout behavior is encouraged.

Clinical Implications

From an assessment perspective, it is important to note that young adults reported sometimes using the term “blackout drinking” as a colloquial term for heavy drinking. This non-specific version of the phrase seemed to be used primarily in anticipation of heavy drinking and in reference to others’ drinking. However, the non-specific nature of this term, in combination with variability in levels of alcohol-induced memory impairment, indicate a need for researchers/providers to be precise in their terminology (i.e., providing clear definitions of “blackout drinking” and “alcohol-induced blackout” when those terms are used).

Collectively, findings suggest that young adults have different perceptions and attitudes toward en bloc and fragmentary blackouts, although attitudes/perceptions of both are primarily negative. This information may inform prevention and intervention efforts for high-risk drinking among young adults. For example, findings suggest that feedback comparing personal drinking to ‘typical’ peers may elicit meaningful discrepancies between actual and perceived rates of blackout for individuals who have experienced a blackout. Injunctive norms feedback, which compares personal attitudes toward certain alcohol consequences with the typical peer’s attitudes toward those consequences, is also a promising but understudied alcohol intervention (Prince et al., 2015). Given the considerable discrepancy between personal and perceived approval for en bloc blackouts in this study,

injunctive norms feedback may be a particularly promising intervention approach for this behavior.

In contrast to previous studies, which did not find gender differences in experience of en bloc or fragmentary blackouts (Hartzler and Fromme, 2003a), women in this study reported significantly lower rates of en bloc blackout and non-significantly higher rates of fragmentary blackout than men. Women also perceived higher prevalence of en bloc and fragmentary blackouts and lower intentions to experience an en bloc blackout in the next 30 days. While gender is not a consistent moderator of traditional alcohol interventions, there is some evidence that women are more responsive to brief interventions than men (Carey et al., 2007). Moreover, there is evidence that women, but not men, may reduce their drinking as a result of alcohol-induced memory impairment (Read et al., 2013). Both motivational interviewing and social marketing campaigns have been associated with decreases in alcohol-induced memory impairment among college students (Kazemi et al., 2013; Su et al., 2017). Future studies are needed to determine the efficacy of these interventions among both men and women.

Limitations

This research is the first to systematically differentiate between en bloc and fragmentary blackout in a large, diverse sample of young adults. However, certain aspects of the sample and research design limit the conclusions that can be drawn. First, eligibility criteria included a history of alcohol-induced memory impairment. While this facilitated recruitment of participants who had experienced en bloc blackouts, it also precludes estimation of the prevalence of en bloc/fragmentary blackouts among young adults who drink alcohol, as both forms of alcohol-induced memory impairment are overrepresented in these samples. Similarly, we recruited college students because they are a population at high risk for alcohol-induced memory impairment (Wetherill and Fromme, 2016); however, this limits our ability to generalize to young adults who are not in college. Future studies are needed to determine the differential prevalence and perceptions of en bloc and fragmentary blackouts among young adults, particularly more moderate drinkers and those who are not in college.

We were also limited by lack of consensus in the literature on how to define and measure alcohol-induced memory impairment. Most studies use single ‘blackouts’ items that do not differentiate between en bloc and fragmentary blackout (Wetherill and Fromme, 2016). As such, we used qualitative methods to inform our definitions of en bloc (“blackouts”) and fragmentary blackouts (“brownouts”). Based on these data, we included “fuzzy or incomplete memories of drinking events” as a fragmentary blackout experience. This definition of fragmentary blackout has not been used in previous research and may capture more variability in alcohol-induced memory impairment than definitions that require cueing to facilitate recall (Hartzler and Fromme, 2003a). Moreover, although previous characterizations of en bloc and fragmentary blackouts note the distinct onset of en bloc (relative to fragmentary) blackout (White et al., 2004, Goodwin et al., 1969), this was not identified spontaneously by participants as a distinguishing factor between the two forms of memory impairment. Future studies may include specific prompts about onset in order to determine the relative importance of onset in characterizing blackout experiences. In

contrast to qualitative findings regarding onset of memory impairment, participants consistently identified duration of memory loss as a distinguishing factor between en bloc and fragmentary blackouts, but did not reach consensus on the amount of time that distinguishes between these forms of memory loss. They also indicated that alcohol-induced memory impairment may occur along a continuum, with en bloc “blackouts” at the extreme. Standardized assessment of the variations and distinctions in alcohol-induced memory impairment are needed to accurately and reliably assess these constructs. Notably, assessment of blackouts is likely to be limited by use of self-report data, as “blackouts” are defined as lack of retrospective recall for drinking events (Wetherill and Fromme, 2016).

Conclusion

Young adults distinguish between en bloc and fragmentary blackouts, endorsing more permissive attitudes and perceptions of fragmentary versus en bloc forms of alcohol-induced memory impairment. The rate of past-month alcohol-induced memory impairment, particularly en bloc blackout, among young adults is concerning. Young adults with a past-year history of alcohol-induced memory impairment are also likely to have a recent blackout experience, corroborating previous reports that blackouts recur within individuals over time. While the majority of participants indicated negative perceptions of alcohol-induced memory impairment, some reported positive attitudes. In combination with high incidence rates, these data suggest that blackout-specific prevention and intervention efforts may be warranted.

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Table 1

Demographic characteristics of college students with a history of alcohol-induced memory impairment.

	Qualitative Study 1		Quantitative Study 2			
	Total (N = 50)	Total (N = 350)	Neither (n = 48)	Only FB (n = 113)	Only EB (n = 17)	Both (n = 172)
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Female (vs. male)	28 (56%)	197 (56%)	22 (46%)	88 (78%)	8 (47%)	79 (46%)
Race ¹						
White/Caucasian	28 (56%)	256 (73%)	34 (71%)	94 (83%)	11 (65%)	117 (68%)
Black/African Am.	6 (12%)	42 (12%)	7 (15%)	8 (7%)	3 (18%)	24 (14%)
Asian	12 (24%)	39 (11%)	4 (8%)	10 (9%)	3 (18%)	22 (13%)
Nat. Am. or Nat. Al.	0 (0%)	5 (1%)	0 (0%)	2 (2%)	1 (6%)	2 (1%)
Nat. Haw. or Pac. Isl.	0 (0%)	1 (<1%)	0 (0%)	1 (1%)	0 (0%)	0 (0%)
Other	3 (6%)	22 (6%)	3 (6%)	5 (4%)	0 (0%)	14 (8%)
Hispanic/Latino	8 (16%)	62 (18%)	6 (13%)	16 (14%)	2 (12%)	38 (22%)
Year in school						
First Year	18 (36%)	64 (18%)	13 (27%)	13 (12%)	7 (41%)	31 (18%)
Sophomore	6 (12%)	76 (22%)	11 (23%)	21 (19%)	3 (18%)	41 (24%)
Junior	20 (40%)	98 (28%)	11 (23%)	40 (35%)	3 (18%)	44 (26%)
Senior	6 (12%)	112 (32%)	13 (27%)	39 (35%)	4 (24%)	56 (33%)
Type of institution						
4-year (vs. 2-year)	50 (100%)	326 (93%)	46 (96%)	110 (97%)	15 (88%)	155 (90%)
Public (vs. private)	---	258 (74%)	37 (77%)	73 (65%)	15 (88%)	133 (77%)
Housing						
Dormitory	---	115 (33%)	17 (35%)	36 (32%)	7 (41%)	55 (32%)
Off-campus residence	---	157 (45%)	18 (38%)	48 (43%)	6 (35%)	85 (49%)
With family/spouse	---	68 (19%)	12 (25%)	23 (20%)	4 (24%)	29 (17%)
Frat house	---	10 (3%)	1 (2%)	6 (5%)	0 (0%)	3 (2%)
Frat member	---	106 (30%)	13 (27%)	26 (23%)	6 (35%)	61 (36%)
Varsity athlete	---	65 (19%)	6 (13%)	8 (7%)	3 (18%)	48 (28%)
	<i>M(SD)</i>	<i>M(SD)</i>	<i>M(SD)</i>	<i>M(SD)</i>	<i>M(SD)</i>	<i>M(SD)</i>
Age	19.9 (1.2)	21.8 (2.8)	20.7 (2.7)	21.3 (2.4)	22.2 (2.6)	22.4 (3.0)
Drinks per week	14.3 (10.1)	11.7 (10.6)	7.3 (6.2)	9.7 (6.8)	9.2 (5.6)	14.6 (12.9)
Drinks per drinking day	3.1 (1.2)	3.9 (2.5)	3.4 (2.1)	3.8 (1.9)	3.1 (1.6)	4.1 (2.9)
Typical weekly BAC	---	.06 (.07)	.04 (.06)	.06 (.05)	.06 (.06)	.06 (.08)
Alcohol consequences	9.1 (4.3)	9.6 (5.9)	4.9 (4.1)	7.4 (4.2)	8.1 (4.6)	12.4 (6.0)

Note.

¹Categories were not mutually exclusive. ---Not assessed. African Am. = African American. Nat Al. = Native Alaskan. Nat Am = Native American. Nat Haw = Native Hawaiian. Pac Isl = Pacific Islander. Frat = fraternity/sorority. Neither = reported neither form of memory impairment (blackout or brownout) in the past month. FB = reported only fragmentary blackout ("brownout") in the past month. EB = reported only en bloc blackout ("blackout") in the past month. Both = reported both forms of memory impairment in the past month.

Table 2

Characteristics of en bloc (“blackouts”) and fragmentary blackouts (“brownouts”) among college students with past-year history of alcohol-induced memory impairment.

Blackout	Total sample (N = 350)	Women (n = 197)	Men (n = 153)	χ^2 (df)	p
	n (%)	n (%)	n (%)		
Past-month blackout	189 (54%)	87 (44%)	102 (67%)	17.56 (1)	< .001
Never	161 (46%)	110 (56%)	51 (33%)	--	--
1 time	98 (28%)	58 (29%)	40 (26%)	--	--
2–3 times	65 (19%)	26 (13%)	39 (26%)	--	--
Weekly	18 (5%)	3 (2%)	15 (10%)	--	--
Twice a week or more	8 (2%)	0 (0%)	8 (5%)	--	--
Most recent blackout	<i>M</i> or <i>n</i> /189	<i>M</i> or <i>n</i> /87	<i>M</i> or <i>n</i> /102	<i>t</i> or χ^2 (df)	<i>p</i>
Drinking quantity (<i>SD</i>)	8.39 (5.14)	7.93 (4.51)	8.77 (5.61)	1.15 (186 ⁺)	.25
Hours of drinking (<i>SD</i>)	4.24 (2.72)	3.83 (1.58)	4.59 (3.37)	2.04 (148 ⁺)	.04
Est. BAC (<i>SD</i>)	.16 (.11)	.19 (.11)	.13 (.11)	-3.83 (185)	< .001
Use of drugs (%)	52 (28%)	19 (22%)	33 (32%)	2.60 (1)	.11
Blackout without drugs	153 (81%)	74 (85%)	79 (77%)	1.76 (1)	.18
Brownout	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)	χ^2 (df)	<i>p</i>
Past-month brownout	285 (81%)	167 (85%)	118 (77%)	3.33 (1)	.07
Never	65 (18%)	30 (15%)	35 (23%)	--	--
1 time	139 (40%)	91 (46%)	48 (31%)	--	--
2–3 times	109 (31%)	64 (33%)	45 (29%)	--	--
Weekly	27 (8%)	11 (6%)	16 (11%)	--	--
Twice a week or more	10 (3%)	1 (<1%)	9 (6%)	--	--
Most recent brownout [‡]	<i>M</i> or <i>n</i> /113 [‡]	<i>M</i> or <i>n</i> /88 [‡]	<i>M</i> or <i>n</i> /25 [‡]	<i>t</i> or χ^2 (df)	<i>p</i>
Drinking quantity (<i>SD</i>)	6.68 (2.68)	6.39 (2.50)	7.72 (3.09)	2.23 (111)	.03
Hours of drinking (<i>SD</i>)	3.77 (1.49)	3.82 (1.47)	3.60 (1.56)	-0.65 (111)	.52
Est. BAC (<i>SD</i>)	.14 (.08)	.15 (.08)	.11 (.07)	-2.01 (111)	.047
Use of drugs (%)	27 (24%)	19 (22%)	8 (32%)	1.16 (1)	.28
Brownout without drugs	97 (86%)	78 (89%)	19 (76%)	2.56 (1)	.11

Note.

⁺Equal variances not assumed.

[‡]For the sake of comparison, data depicted are from participants who only experienced a brownout in the past month (excluding those who had also experienced a blackout). EB = en bloc blackout. FB = fragmentary blackout.

Table 3. Items and response options for theoretical correlates of en bloc (“blackouts”) and fragmentary blackouts (“brownouts”).

Item	Response Options and Scoring				
Outcome evaluations					
If I were to have a blackout/brownout, good things would happen.	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)
If I were to have a blackout/brownout, bad things would happen.	Strongly disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly agree (5)
Attitudes					
If I had a blackout/brownout, it would be...	Unenjoyable (1)	(2)	(3)	(4)	Enjoyable (5)
If I had a blackout/brownout, it would be...	Bad (1)	(2)	(3)	(4)	Good (5)
If I had a blackout/brownout, it would be...	Harmful (1)	(2)	(3)	(4)	Beneficial (5)
If I had a blackout/brownout, it would be...	Foolish (1)	(2)	(3)	(4)	Wise (5)
If I had a blackout/brownout, it would be...	Unpleasant (1)	(2)	(3)	(4)	Pleasant (5)
If I had a blackout/brownout, it would be...	Dangerous (1)	(2)	(3)	(4)	Safe (5)
Injunctive norms					
To what extent do you approve or disapprove of having a blackout/brownout?	Strongly disapprove (1)	Somewhat disapprove (2)	Neutral (3)	Somewhat approve (4)	Strongly approve (5)
To what extent does the typical college student drinker approve or disapprove of having a blackout/brownout?	Strongly disapproves (1)	Somewhat disapproves (2)	Neutral (3)	Somewhat approves (4)	Strongly approves (5)
Descriptive norms					
What percent of male/female college student drinkers has had a blackout/brownout by the end of senior year?	0–100%				
What percent of male/female college student drinkers has a blackout/brownout in a typical month?	0–100%				
Self-efficacy					
Please indicate how confident you are that you could avoid a blackout/brownout if you wanted to do so.	0–100%				
Intentions					
In the past 30 days, how often have you consumed alcohol with the intention of losing your memory of the night’s events?	Never (0)	1 time (1)	2–3 times (2)	Weekly (3)	Twice a week or more (4)

Item	Response Options and Scoring					
In the next 30 days, I intend to have a blackout/brownout as a result of my drinking.	Strongly disagree (1)	Moderately disagree (2)	Slightly disagree (3)	Slightly agree (4)	Moderately agree (5)	Strongly agree (6)

Note. All 'blackout' and 'brownout' items were presented separately. Any 'male' and 'female' items were also presented separately.

Table 4

Differences in theoretical correlates of en bloc (“blackouts”) and fragmentary blackouts (“brownouts”) among college students with past-year history of alcohol-induced memory impairment (N = 350).

Determinant (scale range)	Blackout	Brownout	Paired samples t-test	
	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	<i>t</i> (349)	95% CI
Outcome beliefs (1–5)				
Good things would happen.	1.80 (1.02)	2.34 (1.04)	–12.41	–0.62, –0.45
Bad things would happen.	3.92 (1.07)	3.50 (1.03)	7.75	0.32, 0.53
Attitudes (1–5)	1.82 (0.94)	2.33 (0.95)	–13.31	–0.59, –0.44
Injunctive norms (1–5)				
Personal approval	2.09 (1.14)	2.60 (1.10)	–9.79	–0.62, –0.41
Perceived approval	2.95 (1.11)	3.35 (1.11)	–9.26	–0.49, –0.32
Female descriptive norms (0–100)				
% by end of senior year	58.75 (22.29)	70.28 (23.18)	–14.73	–13.07, –9.99
% in a typical month	39.76 (22.59)	50.83 (22.73)	–14.91	–12.54, –9.62
Male descriptive norms (0–100)				
% by end of senior year	67.58 (23.24)	73.46 (23.09)	–8.55	–7.23, –4.53
% in a typical month	50.22 (23.90)	58.64 (22.59)	–10.70	–9.96, –6.87
Self-efficacy (0–100)	80.22 (24.87)	74.24 (24.94)	6.96	4.29, 7.67
Intentions (1–6)	2.01 (1.49)	2.46 (1.59)	–7.20	–0.57, –0.32

Note. CI = confidence interval. Higher scores indicate stronger agreement, more positive attitudes, and stronger approval. All paired-sample *p*-values < .001.

Differences in theoretical correlates of en bloc ("blackouts") and fragmentary blackouts ("brownouts") among male (n = 153) versus female (n = 197) college students with past-year history of alcohol-induced memory impairment.

Table 5

Determinant (scale range)	Blackout			Brownout		
	Women M (SE)	Men M (SE)	Difference F(345) p	Women M (SE)	Men M (SE)	Difference F(345) p
Outcome beliefs (1–5)						
Good things would happen.	1.67 (0.07)	1.97 (0.09)	6.63 .01	2.25 (0.08)	2.46 (0.09)	2.80 .10
Bad things would happen.	4.01 (0.08)	3.80 (0.09)	2.69 .10	3.46 (0.08)	3.54 (0.09)	0.48 .49
Attitudes (1–5)	1.70 (0.07)	1.98 (0.08)	7.03 .01	2.34 (0.07)	2.32 (0.08)	0.05 .82
Injunctive norms (1–5)						
Personal approval	1.95 (0.08)	2.27 (0.09)	5.77 .02	2.55 (0.08)	2.68 (0.09)	1.04 .31
Perceived other approval	2.86 (0.08)	3.07 (0.09)	2.55 .11	3.35 (0.08)	3.36 (0.09)	.001 .98
Female descriptive norms (0–100)						
% by end of senior year	62.07 (1.62)	54.46 (1.86)	8.70 .003	75.74 (1.65)	63.25 (1.89)	22.60 <.001
% in a typical month	38.50 (1.60)	41.38 (1.84)	1.28 .26	52.20 (1.63)	49.07 (1.87)	1.46 .23
Male descriptive norms (0–100)						
% by end of senior year	71.24 (1.67)	62.87 (1.92)	9.90 .002	77.01 (1.66)	68.88 (1.91)	9.49 .002
% in a typical month	49.73 (1.70)	50.85 (1.95)	0.17 .68	60.54 (1.61)	56.18 (1.85)	2.89 .01
Self-efficacy (0–100%)	83.04 (1.79)	76.58 (2.06)	5.12 .02	74.78 (1.83)	73.54 (2.10)	0.18 .67
Intentions (1–6)	1.66 (0.10)	2.46 (0.12)	24.02 <.001	2.29 (0.11)	2.67 (0.13)	4.36 .04

Note. Estimated means and between-group effects, controlling for group differences in age, drinks per week, and alcohol-related consequences. Between-group differences that are significant at $p < .005$ are highlighted in gray. Within male and female groups, all paired-sample comparisons of psychosocial correlates of blackouts versus brownouts were significant ($p < .02$).