Two Brief Measures of Alcohol Use Produce Different Results: AUDIT-C and Quick Drinking Screen

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Background: Several psychometrically sound measures of alcohol use have been developed to assess drinking. The Alcohol Use Disorders Identification Test (AUDIT) and its shorter counterpart the AUDIT-C, which contains the first 3 AUDIT questions, were developed by the World Health Organization and have become the preferred brief measures for screening and evaluating problem severity. This study compared the first 3 questions on the AUDIT with another psychometrically sound brief measure of alcohol use, the Quick Drinking Screen (QDS).

Methods: Data were obtained from a randomized controlled trial of a mail-based intervention promoting self-change with 472 alcohol abusers ($n = 280$, no prior alcohol treatment; $n = 192$, prior alcohol treatment). Participants' retrospective self-reports of alcohol consumption were collected using the QDS and the 3 AUDIT-C questions and compared. Although both measures contain similar questions (2 quantity-frequency and 1 binge drinking), they differ in 2 important ways: (i) temporal interval over which data are collected, and (ii) formatting of response options (i.e., a continuous number vs. categorical).

Results: Intraclass correlations for drinking variables were moderate to moderately high. A repeated-measures MANOVA using treatment condition and gender as variables revealed significant differences in absolute values between the 2 drinking measures with the QDS showing greater consumption on almost all variables. Participants' numerical answers on the QDS were compared to their categorical answers to the similar alcohol use questions on the AUDIT-C. The comparison revealed that participants' answers on the AUDIT-C were associated with extreme variability compared to their QDS answers. This variability suggests the AUDIT-C would be unreliable as a quantitative measure of alcohol consumption.

Conclusions: The differences between the 3 alcohol use questions on the AUDIT-C and the same questions on the QDS may reflect the imprecision of the AUDIT-C's drinking response categories. Results suggest that the QDS can be used to identify risky drinking and to provide a more informative characterization of a drinker's alcohol consumption than that provided by the AUDIT-C.

Key Words: Brief Alcohol Screening Measures, Quick Drinking Screen, Alcohol Use Disorders Identification Test, AUDIT-C.

OVER THE PAST 30 years, several retrospective self-report measures of alcohol consumption have been developed. These measures have been reviewed and compared in several articles (Agrawal et al., 2008; Dawson and Room, 2000; Sobell and Sobell, 2003). Because the study in this paper focuses on only 2 brief measures of alcohol use (i.e., Alcohol Use Disorders Identification Test [AUDIT]; Quick Drinking Screen [QDS]), other measures will not be reviewed.

Most brief alcohol use measures like the AUDIT-C and QDS differ in 4 significant ways: (i) assessment of average/typical quantity and frequency (QF) of consumption versus daily drinking; (ii) length of time required to answer the questions; (iii) time frame over which data are collected (e.g., past year, past 90 days); and (iv) wording of the questions.

Because of the need for brevity in many alcohol studies and clinical settings, most QF measures consist of a few questions that ask respondents to summarize their drinking (e.g., *On average how many days per week do you drink?*). The alternative to QF measures is a daily drinking estimation (DDE) measure. One of the earliest and best known DDE measures is the Timeline Followback (TLFB; Sobell and Sobell, 2003). The TLFB and other DDE measures ask drinkers to recall their daily alcohol drinking using a calendar format for intervals ranging from 1 to 12 months.

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The second way alcohol use measures can differ is the length of time it takes to answer questions. Not surprisingly, administration time always relates to the number of questions and the data collection time interval (i.e., 30 vs. 360 days). Because QF measures usually involve a small number of summary questions about drinking, they can be completed quickly. On the other hand, DDE measures take longer as they ask for daily amounts of drinking for intervals spanning several months. While 2 studies with problem drinkers have found that data from shorter and proximal TLFB windows (i.e., 1 to 3 months) are representative of longer pre- and posttreatment functioning (e.g., 12 months; Gioia et al., 2012; Vakili et al., 2008), even short TLFB windows can be time-consuming (i.e., 10 to 15 minutes).

The third way drinking measures can differ is the time frame over which data are collected data. Some brief measures, such as the QDS, offer flexibility when selecting a time frame (e.g., 1 to 12 months), while others use a fixed interval or no time frame. For example, the AUDIT-10, one of the oldest brief screening/assessment measures (Reinert and Allen, 2007; Saunders et al., 1993), contains 10 questions, which use 3 different time frames: (i) first 3 questions have no time frame (e.g., *How often do you have 5 or more drinks on 1 occasion*?); (ii) next 5 use the *last year* (e.g., *How often during the last year have you had a feeling of guilt or remorse after drinking*?); and (iii) last 2 questions use categorical descriptions asking about the *last year* or *lifetime use*.

The fourth way drinking measures can differ is in their wording. Typically, they either inquire about alcohol use by asking for specific information (e.g., number of drinks consumed each day), or a summary answer (e.g., on average, how many days per week do you have a drink containing alcohol). Some QF measures, such as the AUDIT-C, ask people to answer using a limited set of response categories (e.g., AUDIT-C Question 1: *How often do you have a drink containing alcohol? Response categories: never, monthly or less, 2 to 4 times/month, 2 to 3 times/wk, 4 or more times/wk*).

Although the alcohol field's focus has long been on dependence and tertiary treatment, in recent years the focus has become broader, consistent with public health and brief interventions. With this shift has been a need for shorter alcohol assessment measures. For several reasons (i.e., convenient, practical, consumer friendly, less resource taxing, faster, fewer refusals), brief alcohol screening measures have considerable appeal for clinical and research purposes (Meneses-Gaya et al., 2009). If time is of a premium (e.g., primary healthcare or medical settings) or when doing a brief alcohol screen for clinical or research purposes (Agrawal et al., 2008), brief measures are recommended. To this end, shortened versions of the AUDIT (Meneses-Gaya et al., 2009) have emerged. One of these, the AUDIT-C, uses the first 3 questions on the AUDIT, which focus on harmful alcohol consumption but with no time frame (e.g., *How often do you have a drink containing alcohol?*). Over the years, the AUDIT-C has evolved into an independent psychometrically sound brief alcohol screening/assessment measure that has

been able to identify risky drinking in general populations (Bradley et al., 2007; Dawson and Room, 2000; Dawson et al., 2005; Gomez et al., 2005). The QDS has similarly been used to screen for risky drinking in general populations (Dum et al., 2009; Sobell et al., 2003).

As reported in other studies, the binge drinking criteria for Question 3 on the AUDIT (binge/risky drinking) was reduced from ≥6 to ≥5 drinks (Babor et al., 2006). The AUDIT's 3 alcohol use questions provide estimates of (i) frequency of drinking, (ii) quantity of typical drinking, and (iii) frequency of risky/binge drinking. Although the AUDIT-C and QDS inquire about the same 3 alcohol use questions, the QDS includes a variable time frame (i.e., current study is 3 months), while the AUDIT-C does not use a time frame.

Because few, if any, studies need to use more than 1 brief alcohol screening measure, the opportunity to compare different measures is rare. The parent study (Gioia et al., 2016) for the present analysis was a randomized controlled trial (RCT) of a mail-based intervention to promote self-change with 2 different groups of individuals with alcohol problems (no prior alcohol treatment; received prior alcohol treatment, but currently drinking) who completed both the QDS and the AUDIT.

The QDS, a psychometrically sound QF measure (Dum et al., 2009; Roy et al., 2008; Sobell et al., 2003), assesses average alcohol consumption over a designated time frame (e.g., past 30 days, 6 months) using summary estimates of days or amounts of drinking. In the present study, it was used to evaluate the initial eligibility of those who called in response to study ads. Once participants signed a consent, they were sent assessment materials, which included a 90-days TLFB and the AUDIT. In the parent study, the AUDIT was used as a measure of drinking severity, not a screening measure.

A few years ago, Rubinsky and colleagues (2013) pointed out that the AUDIT-C, in addition to being a screening measure, "may also serve as an excellent marker of alcohol misuse severity" (p. 1385). Using data from the 2001 to 2002 National Epidemiologic Survey on Alcohol and Related Conditions (Grant and Dawson, 2006), they examined the relationship between AUDIT-C scores (range 0 to 12, with higher scores indicating more hazardous and harmful drinking) and mean daily drinking and alcohol use diagnoses. They found a relatively strong relationship between the measures, suggesting that in addition to aiding screening decisions AUDIT-C scores can provide healthcare providers with important clinical information about patient-specific risks and problem severity.

Unlike the QDS, the 3 alcohol consumption questions on the AUDIT and AUDIT-C use categorical responses, forcing respondents to select from a limited set of possible answers. For example, for Question 2 ("*How many drinks do you have on a typical day when you are drinking?*") there are 6 possible answers ("*none,*" "*1 or 2,*" "*3 or 4,*" "*5 or 6,*" "*7 to 9,*" or "*10 or more*"). For Question 3 on binge drinking ("*How often do you have 5 or more drinks on 1 occasion?*"),

there are 5 possible answers ("*never,*" "*less than monthly,*" "*monthly,*" "*weekly,*" or "*daily or almost daily*"). Thus, on Question 3, a drinker who actually had 3 binge drinking days per week (e.g., Friday through Sunday) is forced on the AUDIT-C to describe their drinking as either "*weekly*" or "*daily or almost daily,*" even though such drinking occurred only 3 times a week. Similar problems occur with the other 2 AUDIT-C alcohol use questions. For Question 2, any respondent who reports consuming 10 or more drinks on a typical day, whether it is 12, 15, or 30 drinks, the numerical amount will be coded as 10. In contrast, the 3 QDS questions are worded to elicit continuous quantitative answers (e. g, drinking "*X*" number of days from 0 to 90 days).

This report presents a post hoc data analysis that compared alcohol abusers' answers to the 3 alcohol use questions on the QDS with their answers to the 3 corresponding alcohol use questions on the AUDIT-C.

MATERIALS AND METHODS

Participants

The parent study, an RCT of a mail-based alcohol intervention, was approved by Nova Southeastern University's Institutional Review Board. Because details about the RCT from which the data in this study were derived have been reported elsewhere (Gioia et al., 2016), only details relevant to the present study are presented. The parent study never involved face-to-face contact with participants.

Participants were recruited over a 20-month period using the following criteria: (i) saw the study ad and provided the date when they saw the ad; (ii) provided the source of the ad (e.g., name of newspaper or Craigslist); (iii) within 30 days of seeing the ad called and were screened for eligibility; (iv) ≥21 years of age (legal drinking age in the United States); (v) English speaker; (vi) provided a permanent mailing address (e.g., P.O. boxes were excluded); (vii) 1 participant per household; and (viii) in the 90 days prior to seeing the ad reported either binge drinking (i.e., ≥5 standard drinks [SDs] for men or ≥4 SDs for women; 1 U.S. SD = 0.6 oz. of absolute ethanol or 14 g of absolute ethanol) on at least 5 days, or on average, drinking ≥15 SDs per week for men or ≥8 SDs per week for women. These criteria are consistent with risky drinking criteria established by the National Institute on Alcohol Abuse and Alcoholism (NIAAA, 2007).

The 472 participants were assigned to 1 of 2 study arms (1 participant in the parent study was excluded as the AUDIT was not completed properly): (i) no prior treatment (NPT) or self-help for an alcohol problem (*n* = 280), or (ii) prior treatment (PT) or self-help for an alcohol problem, but currently reported still engaging in risky drinking (*n* = 192). Prior alcohol treatment was defined using definitions from past studies (Sobell et al., 1993, 2002). Of the participants found for their 3-month follow-up, 10% were randomly selected to have a collateral interviewed about their postintervention alcohol use.

Study Procedures

Callers responding to the study ads were prescreened by phone for initial eligibility. At the prescreening, the QDS was used to assess callers' self-reported drinking for the 90 days prior to seeing the study ad. Callers who were initially eligible were mailed a consent form and asked to read, sign, and return it in a prepaid self-addressed envelope. When the consent was returned, potential participants were mailed assessment materials, including a 90-day TLFB and the AUDIT, and again asked to return all materials in a prepaid self-addressed envelope. The returned assessment forms were reviewed and eligible participants were entered into the study. In addition, participants were sent a $20.00 check for their participation and the study intervention materials, which were designed to help participants change their alcohol use on their own. Participants in both groups received the same intervention materials. Data from the 90-day follow-up forms are not reported as they are not relevant to the analyses in this paper. All materials and forms were sent to participants using the United States Postal Service.

Alcohol Use Measures

Quick Drinking Screen. The QDS (Dum et al., 2009; Roy et al., 2008; Sobell et al., 2003), a brief retrospective psychometrically sound measure of drinking, was administered at the prescreening interview. The QDS collects reliable aggregate drinking data over a specified interval (in the present study it was 90 days before seeing the study ad) for 3 drinking variables (i.e., number of days drinking, number of standard drinks per drinking day [DDD], and number of binge/risky drinking days). As in other studies and to be consistent with the Centers for Disease Control and Prevention's current binge/risky drinking criteria, for this study the QDS's binge drinking question was changed to ≥4 or drinks on 1 occasion for women and remained as ≥5 drinks on 1 occasion for men (Bertrand et al., 2005; Sayal et al., 2009).

Alcohol Use Disorders Identification Test. The AUDIT (Babor et al., 2001; Reinert and Allen, 2007; Saunders et al., 1993), a psychometrically sound measure of alcohol use and related problems, contains 10 questions that ask about 3 aspects of a person's drinking (i.e., harmful alcohol use [questions 1 to 3], alcohol abuse [questions 4 to 8], and dependence [questions 9 to 10]).

Statistical Analysis

Differences for demographic and drinking variables for participants in the PT and NPT groups were evaluated using 2-tailed independent sample *t*-tests for parametric variables, and chi-square exact tests for nonparametric variables. Bonferroni adjustments (Holland and Copenhaver, 1988) were made for the 8 alcohol-related history variables (see Table 1) thought to be a priori related, thereby setting the Type I error rate at $\alpha = 0.006$ (0.05/8).

A repeated-measures multivariate analysis of variance (MANOVA) was used to examine differences between the QDS and the 3 AUDIT-C questions by treatment group using gender stratified analyses. Gender stratification was used because women generally have lower levels of alcohol consumption than men. Because the 3 AUDIT-C questions are worded to capture categorical drinking data, participants' answers were recoded as continuous data for comparison with the QDS. For the 3 AUDIT-C questions, categorical drinking data were transformed into continuous data by taking the value or the mean of the value of the response categories. Because none of the AUDIT-C questions had a time frame, they were converted to account for 90 days, the QDS interval. For example, for Question 3 on the AUDIT-C (*How often do you have 5 or more drinks on 1 occasion?*), respondents were forced to use 1 of 5 possible answers. Their answers were converted as follows: [*never* (0 days), *less than monthly* (2 days), *monthly* (1 × 3 months = 3 days), *weekly* (12.9 weeks × 1 = 13 days), *daily or almost daily* (mean of 6 and 7 = 6.5 × 12.9 weeks = 84 days)]. For Question 2 on the AUDIT-C (*How many drinks containing alcohol do you have on a typical day when you are drinking?*), the highest response category, which was *10 or more* drinks per day, was coded as 10 for all participants who selected that option. This variable was further evaluated to allow for participants who were heavy drinkers

Table 1. Baseline Characteristics by Treatment Group

Variable	No prior treatment (NPT) n = 280	Prior treatment (PT) N = 192	Statistic[a]	p-Value
Female (%)	58.93	40.62	$\chi^2(1)$ = 15.28	<0.001
Married or common law (%)	30.71	25.00	$\chi^2(1)$ = 1.83	0.176
White (%)	62.86	62.50	$\chi^2(1)$ = 0.006	0.937
Full-time or self-employed (%)	47.86	35.94	$\chi^2(1)$ = 6.60	0.010
White-collar occupation (%)	48.21[b]	22.92[c]	$\chi^2(1)$ = 29.59	<0.001
Described alcohol problem major/very major (%)[d]	49.64[e]	73.44	$\chi^2(1)$ = 26.31	<0.001
Reported past alcohol withdrawal symptoms (%)[d]	22.50	47.92	$\chi^2(1)$ = 33.36	<0.001
Mean (st. dev.) age, years	41.97 (13.32)	45.89 (11.42)	$t(470)$ = −3.32	0.001
Mean (st. dev.) education, years	14.33 (2.40)	13.64 (2.16)	$t(470)$ = 3.19	0.002
Mean (st. dev.) yrs alcohol problem[d]	10.74 (10.11)	18.35 (11.43)	$t(470)$ = −7.61	<0.001
Mean (st. dev.) alcohol arrests[d]	0.44 (1.07)	3.08 (7.08)	$t(470)$ = −6.15	<0.001
Mean (st. dev.) alcohol hospitalizations[d]	0.22 (0.93)	2.65 (5.21)	$t(470)$ = −7.64	<0.001
Mean (st. dev.) alcohol quit attempts[d]	5.69 (9.23)[e]	9.65 (12.76)[f]	$t(468)$ = −3.91	<0.001
Mean (st. dev.) AUDIT-10 score[d]	20.41 (7.37)	25.65 (7.14)	$t(470)$ = −7.69	<0.001
Mean (st. dev.) alcohol consequences[d]	3.58 (2.12)	5.03 (1.80)	$t(470)$ = −7.73	<0.001
Mean (st. dev.) readiness to change score	7.84 (1.95)[e]	8.11 (1.80)	$t(469)$ = −1.51	0.131
Mean (st. dev.) confidence to change score	73.99 (21.37)	71.65 (20.33)[f]	$t(469)$ = 1.19	0.235

[a]Pearson's chi-square test, 2-tailed t-test, or 2 × 2 univariate ANOVA. [b]n = 266. [c]n = 177. [d]Bonferroni adjustments were made for the 8 alcohol history variables thought a priori to be related, in order to maintain an α = 0.05 family-wise error rate; thus, the individual test α level was set at α = 0.006 (0.05/8). [e]n = 279. [f]n = 19.

Drinking variables, derived from the TLFB, are for the 90 days prior to the intervention. Unless otherwise indicated, all other variables are lifetime. Readiness to change scores range from 1 = not at all ready to 10 = definitely ready. Confidence to change scores range from 0 = not at all confident to 100 = totally confident. AUDIT-10 = scores range from 0 to 40; a score of ≥8 is suggestive of an alcohol problem (Allen et al., 1997).

(>10 drinks per day) but were forced to use the AUDIT-C's 10 or more category to capture their drinking. To address this issue, additional analyses were performed using a recoded value of 20 for all participants who selected *10 or more*. This further analysis found no significant differences in the results between 10 and the recode of 20. The strength of the relationship between the QDS and AUDIT-C was evaluated using intraclass correlation coefficients (ICCs).

RESULTS

Participant Characteristics

A Grubbs test was performed to identify participants with extreme scores on the 3 QDS and AUDIT-C drinking variables. Although both groups had participants with extreme scores (PT, n = 4; NPT, n = 3), further analyses revealed that the extreme scores did not affect the significance of the ICCs, MANOVA, or t-tests. Thus, they were included in all analyses.

At the 3-month follow-up, 96.2% (454/472) of all participants were interviewed. Of those participants found for follow-up, a random 12.1% (57/472) had a collateral interviewed to confirm their postintervention self-reports. Although those results are not reported here, the collaterals' reports of participants' self-reports of postintervention drinking and alcohol-related consequences were very consistent.

Baseline characteristics by treatment groups (PT, n = 192; NPT, n = 280) are shown in Table 1. As expected, participants in the NPT versus PT group differed significantly on several variables. One noteworthy difference is that there were significantly more females in the NPT (59%) versus PT (41%) group. This was not surprising as the literature shows

Table 2. Means (St. Dev.) and Intraclass Correlation Coefficients (ICCs) Comparing the 3 Alcohol Use AUDIT-C Questions with the Similar Questions on the Quick Drinking Screen (QDS) for 280 (115 Males, 165 Females) Participants Who Received No Prior Alcohol Treatment and 192 (114 Males, 78 Females) Participants Who Had Received Prior Alcohol Treatment

Variable	Mean (St. Dev.)		ICC[a] (p)
	QDS	AUDIT-C	
# of days drinking in past 90 days			
No prior treatment males	61.41 (21.80)	57.99 (19.78)	0.53 (<0.001)
No prior treatment females	60.27 (23.87)	55.76 (21.45)	0.56 (<0.001)
Prior treatment males	68.28 (21.51)	62.18 (17.50)	0.37 (<0.001)
Prior treatment females	60.13 (19.96)	55.23 (21.96)	0.43 (<0.001)
# of binge drinking days in past 90 days[b]			
No prior treatment males	42.57 (29.02)	32.19 (34.66)	0.58 (<0.001)
No prior treatment females	41.16 (29.27)	24.84 (32.25)	0.40 (<0.001)
Prior treatment males	54.28 (29.57)	35.64 (34.48)	0.29 (<0.001)
Prior treatment females	44.76 (29.67)	34.42 (35.51)	0.25 (0.012)
# SDs per drinking day in past 90 days			
No prior treatment males	6.74 (4.09)	5.97 (2.30)	0.30 (<0.001)
No prior treatment females	4.95 (2.57)	4.98 (2.25)	0.58 (<0.001)
Prior treatment males	7.84 (4.54)	6.07 (2.31)	0.38 (<0.001)
Prior treatment females	6.32 (4.01)	6.14 (2.44)	0.45 (<0.001)

[a]ICC = Intraclass correlations (type = absolute agreement and single measure).
[b]AUDIT-C = ≥5 SDs for males and females; QDS = males ≥ 5 SDs; females ≥ 4 SDs.
SD = standard drink (1 SD = 14 g absolute alcohol).

there are more males in treatment studies and more females in studies where participants have not received treatment (Klingemann and Sobell, 2007). For this reason, the data in Tables 2 and 3 were analyzed and stratified by gender.

Of the 17 variables in Table 1, 7 are demographic (e.g., education, age, gender), 2 evaluated motivation to change

Table 3. Results of Multivariate and Univariate Analyses of Variance Comparing the 3 Alcohol Use AUDIT-C Questions with the Similar Questions on the Quick Drinking Screen (QDS) for 280 (115 Males, 165 Females) Participants Who Received No Prior Alcohol Treatment and 192 (114 Males, 78 Females) Participants Who Received Prior Alcohol Treatment

| | Multivariate | | | Univariate | | | | | |
| | | | | QDS | | | AUDIT-C | | |
Variable	F	p	η^2	F(df)	p	η^2	F(df)	p	η^2
# of days drinking in past 90 days									
Treatment condition	1.28[a]	0.281	0.005	2.53[c]	0.113	0.005	0.902[c]	0.343	0.002
Gender	3.48[a]	0.032	0.015	4.82[c]	0.029	0.010	5.67[c]	0.018	0.012
Treatment condition × Gender	1.47[a]	0.231	0.006	2.75[c]	0.098	0.006	1.50[c]	0.222	0.003
# of binge drinking days in past 90 days[e]									
Treatment condition	4.16[a]	0.016	0.018	7.49[c]	0.006	0.016	4.06[c]	0.044	0.009
Gender	2.04[a]	0.131	0.009	3.81[c]	0.052	0.008	1.76[c]	0.186	0.004
Treatment condition × Gender	2.57[a]	0.077	0.011	2.10[c]	0.148	0.004	0.900[c]	0.343	0.002
# SDs per drinking day in past 90 days									
Treatment condition	6.92[b]	0.001	0.029	11.66[c]	0.001	0.024	8.22[d]	0.004	0.017
Gender	10.82[b]	<0.001	0.044	21.26[c]	<0.001	0.043	4.28[d]	0.039	0.009
Treatment condition × Gender	3.28[b]	0.039	0.014	0.183[c]	0.669	0.000	5.80[d]	0.016	0.012

[a]Mutivariate df = 2, 467. [b]Multivariate df = 2, 466. [c]Univariate df = 1, 468. [d]Univariate df = 1, 467. [e]AUDIT-C = ≥ 5 SDs for males and females; QDS = Males ≥ 5 SDs; Females ≥ 4 SDs.
SD = standard drink (1 SD = 14 g absolute alcohol).

(i.e., readiness, confidence), and 8 assessed lifetime alcohol use (e.g., years alcohol problem). As expected, significant differences occurred between the participants in the 2 groups for all 8 alcohol history variables. These differences reflect that PT participants had more severe alcohol problem histories than the NPT participants.

On average, about one-quarter of all participants were married, two-thirds were white, they had a mean age of 44 years, and they averaged about 2 years of college. As mentioned above, there were significantly more females in the NPT (59%) versus the PT group (41%), and about twice as many participants in the NPT (48%) versus the PT (23%) group had white-collar jobs. Both groups of participants had a mean score on the AUDIT-10 well beyond the cut-off suggested for screening for an alcohol problem (score ≥8; Reinert and Allen, 2007). These results are consistent with previous studies comparing participants in past treatment with those who had never received treatment (reviewed in Klingemann and Sobell, 2007). Interestingly, both groups at baseline had high readiness and confidence to change scores and did not differ significantly on either of these 2 motivational variables.

Comparison of the AUDIT-C and QDS

Table 2 shows the means (st. dev.) for the 3 drinking variables by treatment group and gender and ICCs (ICC type = absolute agreement and single measure). The ICC values are modest and lower than ICCs found when the QDS was compared with the TLFB (Roy et al., 2008; Sobell et al., 2003).

Table 3 presents the results of the repeated-measures MANOVA. For drinking frequency, the only significant effect was for gender, which was significant at both the multivariate and univariate levels. Across all 3 variables and both

measures (AUDIT-C and QDS), males reported drinking significantly more than females. For binge drinking days, the only significant effect was for treatment, which was significant at both the multivariate and univariate levels. Regardless of the measure, participants in the PT group reported significantly more binge drinking days than those in the NPT group. Finally, for drinking intensity (mean standard drinks consumed per drinking day) the multivariate analysis found significant main effects for Treatment Condition and Gender as well as a significant Treatment Condition × Gender effect that qualified the main effects. Specifically, there was a significant interaction for reports of drinking intensity questions on the AUDIT-C but not the QDS. The interaction for the AUDIT-C revealed that males in the NPT group drank more DDD than did women, but there were no gender differences for the PT group.

Two scatterplots, 1 for each group (Fig. 1, prior treatment; Fig. 2, no prior treatment), are displayed using participants' self-reports of mean DDD from the QDS against their same reports of mean DDD from the first 3 questions on the AUDIT-C using the converted values for the AUDIT-C categories discussed earlier.

Both scatterplots show huge inconsistencies between participants' reports of mean DDD on the QDS compared to their categorical answers on the AUDIT-C drinking intensity Question 2. For example, in the 2 scatterplots consider those participants who reported drinking a mean of 8 DDD on the QDS. These same participants' responses on the AUDIT-C ranged from 3.5 to 10 per drinking day, with no obvious clustering at 8 on the AUDIT-C. In other words, for participants who had very similar mean numbers of DDD on the QDS, there was little predictability of their AUDIT-C responses. On the AUDIT-C, some participants might report drinking 3 to 4 DDD while others, who drank about the same amount, might report drinking
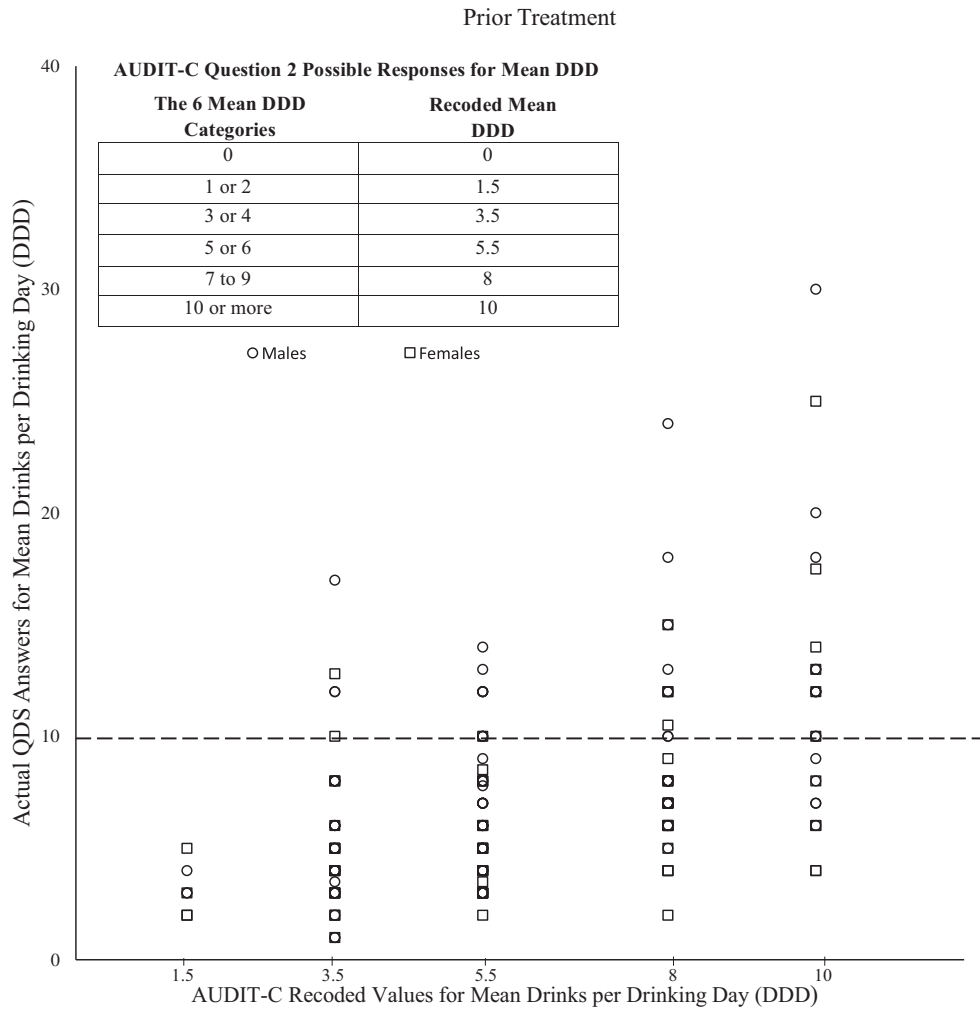
Prior Treatment

AUDIT-C Question 2 Possible Responses for Mean DDD

The 6 Mean DDD Categories	Recoded Mean DDD
0	0
1 or 2	1.5
3 or 4	3.5
5 or 6	5.5
7 to 9	8
10 or more	10

Fig. 1. Scatterplot comparing the prior treatment group participants' self-reports of their mean number of drinks per drinking day (DDD) out of 90 days on the Quick Drinking Screen (QDS) with their AUDIT-C reports. For the AUDIT-C, DDD are derived from Question 2 using means from the question's 6 categorical responses (see text for explanation).

7 to 9 drinks. The scatterplots for the other 2 drinking variables are similar, but to save space they are not shown here.

DISCUSSION

The study described in this paper was a post hoc data analysis comparing 2 brief psychometrically sound retrospective alcohol use screening measures (i.e., AUDIT-C and QDS). Data came from an RCT of a mail-based intervention promoting self-change with 472 alcohol abusers (Gioia et al., 2016). Data were from 2 different participant groups, alcohol abusers who had never received prior treatment (NPT) and those who had received prior treatment (PT), but still had a drinking problem when interviewed.

Moderate associations were found between the 2 measures and were typically higher among participants in the NPT group than those in PT group. The ICC values are lower than ones found in previous studies of the QDS and might in

some part reflect the limited options available for converted AUDIT-C scoring categories.

Not surprisingly, participants in the PT group reported drinking more heavily than those who had never been treated. In addition, QDS reports of drinking were typically higher than similar reports obtained using participants' AUDIT-C answers converted to a 90-day interval.

Although both measures asked similar QF questions, the lack of precision in the wording of the AUDIT-C questions might have contributed to the inconsistencies between them: (i) the 3 alcohol use questions on the AUDIT-C do not use a time frame over which drinking data are to be recalled, whereas the QDS uses a specific time frame (this study used 90 days before the seeing the ad); and (ii) Question 3 on the AUDIT-C in this study did not differentiate binge drinking levels (≥ 5 drinks) between males and females, whereas the QDS used a different level for males and females (≥ 5 and ≥ 4 drinks, respectively). The AUDIT-C's use of a lower binge drinking criterion for women could result in more binge days for women.

No Prior Treatment

AUDIT-C Question 2 Possible Responses for Mean DDD

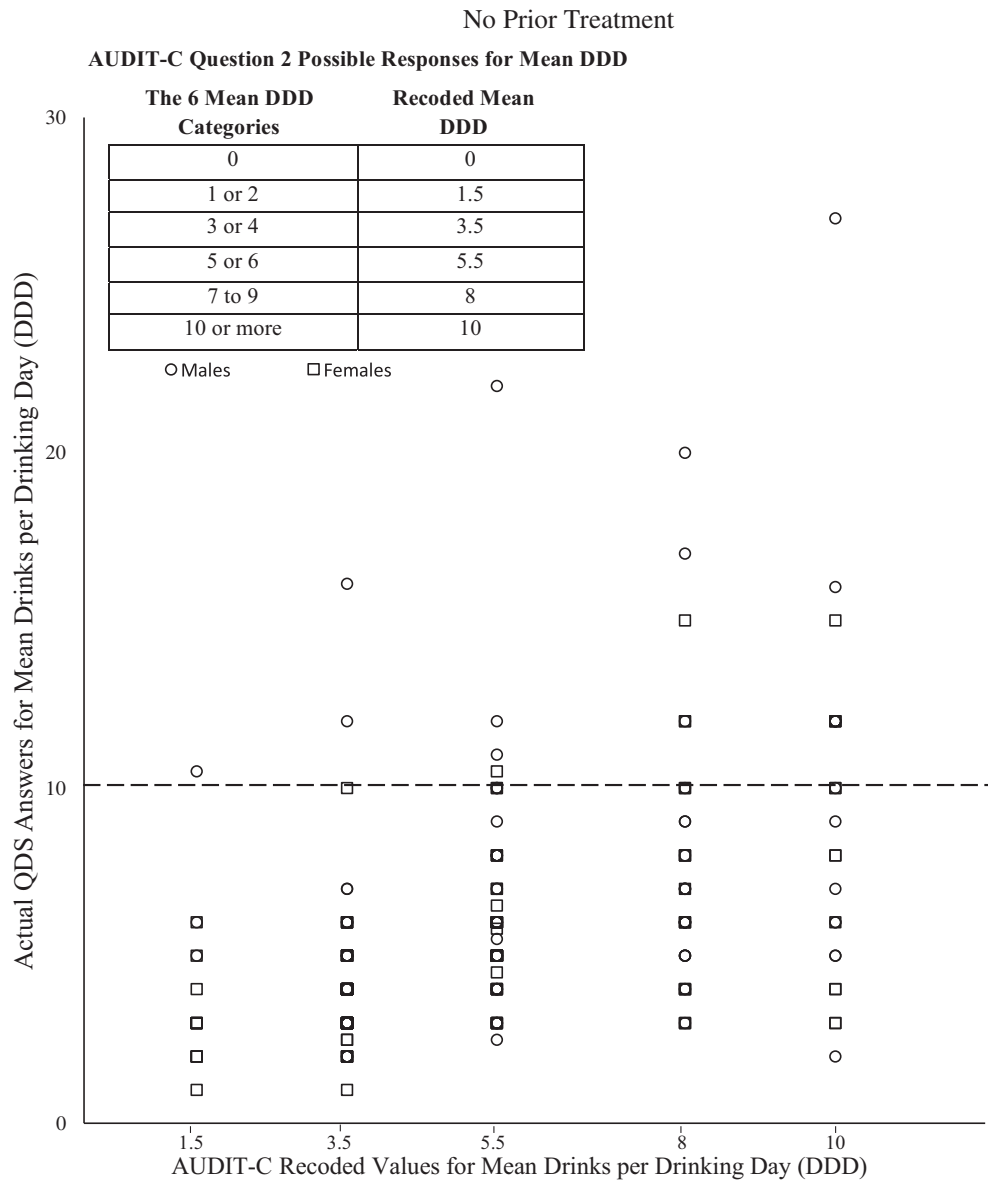| The 6 Mean DDD Categories	Recoded Mean DDD
0	0
1 or 2	1.5
3 or 4	3.5
5 or 6	5.5
7 to 9	8
10 or more	10

○ Males   □ Females

Fig. 2. Scatterplot comparing the No Treatment group participants' reports of their mean number of drinks per drinking day (DDD) out of 90 days on the Quick Drinking Screen (QDS) with their AUDIT-C reports. For the AUDIT-C, DDD are derived from Question 2 using means from the question's 6 categorical responses (see text for explanation).

Another thing that might have contributed to differences between the measures is the mode of administration. First, it is important to note that this study was not designed to compare and evaluate the AUDIT-C and the QDS. Rather the need to screen for eligible participants in the parent study provided a post hoc opportunity to compare the 2 measures. In the parent study, the QDS was administered by a research assistant by telephone as a way to screen for potentially eligible participants. Once respondents were deemed eligible for the RCT, several assessment measures including the AUDIT were mailed to them. Previous studies have found that when 2 drinking measures have been used and the administration was not counterbalanced, the second measure often results in slightly higher self-reports of alcohol use. It has been thought

that this occurs because participants may give more thought to their drinking at the second interview, particularly in light of seeking help for their drinking. It also has been argued that individuals with alcohol use disorders will report more on a self-administered drinking measure than to an interviewer. In the present study, the interviewer administered measure yielded slightly higher reports of alcohol consumption compared to the self-administered measure.

In the context of Rubinsky and colleagues (2013) suggestion that AUDIT-C scores can serve as a marker of alcohol misuse severity, the most important finding in this study is the very high degree of variability in participants' responses. As discussed earlier, this variability appears to be a direct result of the categorical options participants were forced to

select from to describe their drinking using the AUDIT-C. Earlier in the paper we discussed the serious problem that the categorical response of *10 or more* drinks poses for Question 2. As shown in Figs 1 and 2, whatever number of drinks a person reports beyond 10 drinks (e.g., 12, 22, or 30 drinks), it can only be counted as 10 drinks. Complicating this matter further, participants who on the QDS reported drinking 10 or more DDD would be expected to pick the response category of *10 or more* on the AUDIT-C; however, as shown in Figs 1 and 2, any participant whose QDS answer was *10 or more* drinks are shown about the dotted lines. As can be seen, many such participants reported their mean daily drinking using the AUDIT-C categories of 7 to 9, 5 or 6, and even 3 or 4 drinks.

This study has strengths and limitations. Strengths include: (i) a large participant sample; (ii) 2 very different participant groups—1 more severe and that had been in prior treatment for an alcohol problem and 1 that had a less severe drinking problem history and had never been in prior treatment; (iii) almost half of participants were female; (iv) 40% were nonwhite; and (v) collaterals were used to validate a randomly selected subsample of participants' self-reports of drinking. The study has 2 limitations. First, the QDS and AUDIT were not administered in a counterbalanced order. However, as discussed earlier, the study results are counterintuitive with respect to administration order. Second, results cannot be generalized at this time to drinkers younger than 21 years of age.

In conclusion, while the QDS and AUDIT-C are both psychometrically sound brief alcohol screening measures, participants reported higher levels of alcohol use on the QDS compared to the 3 questions on the AUDIT-C. In addition, when participants' AUDIT-C categorical answers for the alcohol use questions were converted to continuous data and compared to participants' QDS answers for the same 3 drinking questions, there was substantial variability in AUDIT-C answers by individuals who, according to their QDS answers, drank at similar levels. This greatly limits the value of the first 3 alcohol use questions on the AUDIT-C for reflecting alcohol problem severity. At this time, the QDS is recommended for use in settings where it is desirable for a screening measure to also provide information on alcohol problem severity. Finally, it is recommended that when using the AUDIT-C, researchers and clinicians should include a gender-specific binge drinking criterion.

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CONFLICT OF INTEREST

The authors have no conflicts of interest.

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