# Young Adults' Change Talk Within Brief Motivational Intervention in the Emergency Department and Booster Sessions Is Associated With a Decrease in Heavy Drinking Over 1-Year

Stéphanie Blanc[1], Joseph Studer[1,2], Molly Magill[3], Jim McCambridge[4], Nicolas Bertholet[1], Olivier Hugli[5], Jean-Bernard Daeppen[1], and Jacques Gaume[1]

[1] Department of Psychiatry – Addiction Medicine, Lausanne University Hospital and University of Lausanne

[2] Service of Adult Psychiatry North-West, Department of Psychiatry, Lausanne University Hospital and University of Lausanne

[3] Center for Alcohol and Addiction Studies, Brown University School of Public Health

[4] Department of Health Sciences, University of York

[5] Emergency Department, Lausanne University Hospital and University of Lausanne

## Author Note

The data reported in this manuscript were collected as part of a larger data collection, registered in the ISRCTN registry (http://www.isrctn.com/ISRCTN13832949). The aim of the present study was pre-specified in the study protocol (see Supplement 1 in Gaume et al., 2022) and predictor variables measures were collected for this purpose. Findings from the

data collection have been reported in separate manuscripts (Gaume et al., 2022 [published], and Gaume et al., 2023 [published]). This research was presented as a poster at the Research Society on Alcohol-2023 Scientific Meeting in Bellevue, WA, USA. All data will be available at [https://doi.org/10.5281/zenodo.8208652] upon manuscript publication. Analysis code is available by emailing the corresponding author.

This work was supported by the Swiss National Science Foundation (grant number 105319_163123) and the Swiss Foundation for Alcohol Research (grant number 318). The funders had no role in the study design; in the collection, analysis and interpretation of data; in the writing of the report; and in the decision to submit the article for publication. We have no conflict of interest to disclose.

We gratefully thank Velia Decoro, Sophie Decker, Marie Krenger, Julia Maeder Boulanger, and Céline Sunier for the psycholinguistic coding of brief motivational intervention sessions, and Dr. Kathryn S. Gex for sharing latent growth curve model Mplus commands.

Correspondence concerning this article should be addressed to Stéphanie Blanc, Department of Psychiatry-Addiction Medicine, Lausanne University Hospital, Rue du Bugnon 23A, 1011 Lausanne, Switzerland. Email: stephanie.blanc@chuv.ch

## Abstract

***Objective:*** Investigate the effect of Change Talk (CT) within successive brief Motivational Interventions (bMIs) as a mechanism of change for alcohol use. ***Method:*** We conducted a secondary analysis of data from a randomized controlled trial in which 344 young adults (18-35 years old) admitted to a Swiss Emergency Department with alcohol intoxication received either bMI (*N*=171) or brief advice (*N*=173). Participants with a baseline audio-recorded bMI were included (*N*=140; median age 23 [*Q1*-*Q3*: 20-27], 72.9% men). Up to three booster sessions by phone were offered at 1-week, 1-month, and 3-month. Percent CT and CT Average Strength were used as predictor variables. The outcome was the number of Heavy Drinking Days (HDD) over the 30 days prior to research assessments at 1-, 3-, 6-, and 12-month follow-up. A latent growth curve modeling framework was first used to estimate predictor and outcome variable growth parameters (i.e., intercept and slope) over time, and then to regress HDD growth parameters on CT growth parameters. ***Results:*** CT increased specifically from baseline to the 1-week booster session and thereafter remained stable. Higher baseline CT was associated with lower HDD at 1-month (Percent CT: *b*=-0.04 [95% confidence interval -0.06 to -0.01]; Average Strength: *b*=-0.99 [-1.67 to -0.31]). An increase in CT from baseline to the 1-week booster session was related to a decrease in HDD from 1-month to 12-month (Percent CT: *b*=-0.08 [-0.14 to -0.03]; Average Strength: *b*=-2.29 [-3.52 to -1.07]). ***Conclusions:*** Both baseline CT and CT trajectory over the first week are meaningful predictors of HDD.


*Keywords:* Brief Motivational Intervention; Change Talk; Heavy Drinking; Young Adults Admitted to The Emergency Department; Latent Growth Curve Modeling

### *Public Health Significance Statement*

This study indicates that young adults admitted to the emergency department with alcohol intoxication who spoke more in favor of changing their alcohol consumption within an initial brief motivational intervention, as well as those who increased their language toward change across successive early booster sessions, reduced heavy drinking over 1-year.

Alcohol use is a major public health problem among young adults (Adam et al., 2020; Tanner-Smith & Lipsey, 2014; World Health Organization, 2021). Alcohol intoxication and heavy episodic drinking in early adulthood are related to poorer subsequent outcomes (e.g., injuries, trauma, violence, health issues, etc.; McCambridge et al., 2011; Rehm, 2011). Moreover, intoxicated young adults' admissions to Emergency Departments (EDs) have increased overtime (Bertholet et al., 2014; Mullins et al., 2017; Piccioni et al., 2020; Wicki & Stucki, 2014), with increased risks of ED readmissions and poorer psychiatric, substance use, and social outcomes (Adam et al., 2020; Adam et al., 2016; Herbert et al., 2015; Hoy, 2017). Developing and implementing effective prevention measures is thus needed.

*Brief Motivational Intervention* (bMI), derived from Motivational Interviewing (MI) (Miller & Rollnick, 2013), has shown promising results regarding alcohol consumption among ED-admitted young adults (Newton et al., 2013; Taggart et al., 2013; Tanner-Smith & Lipsey, 2014; Wicki et al., 2014). We developed a bMI model (including a baseline session and up to three booster sessions) for young adults (18-35 years old) presenting to the ED with alcohol intoxication (Gaume et al., 2021), and conducted a Randomized Controlled Trial (RCT) that demonstrated a statistically significant lower number of *Heavy Drinking Days* (HDD, i.e., days with six standard drinks or more, ≥60 grams of ethanol; World Health Organization, 2018) over 1-year, compared to a Brief Advice (BA) control group (Gaume et al., 2022). The next step in this project was to analyze the mechanisms of change related to the significant bMI effects on HDD.

In recent years, numerous studies have investigated bMI mechanisms related to addiction outcomes. Among these, therapists' and participants' within-session behaviors such as therapists' MI skills and *participants' Change Talk* (CT, i.e., participants' language toward the targeted behavioral change) are understood to be important in securing treatment effects

(Longabaugh et al., 2005; Miller & Moyers, 2015; Moos, 2007). This study focused on participants' CT, which has been proposed as a mechanism of change in MI (Miller & Rose, 2009) and has been empirically tested in a number of clinical trials. Meta-analyses on mechanisms of change within MI and bMI studies indicated that (a) contrary to MI theory, CT frequency within MI session did not predict participants outcomes; but (b) a greater frequency of *Sustain Talk* (ST, i.e., participant's language away from behavior change) predicted poorer outcomes; and (c) a greater proportion of CT relative to ST predicted better outcomes (Magill et al., 2018; Magill et al., 2014; Pace et al., 2017). In addition, higher *participants' CT strength* (i.e., intensity/conviction in the statement) has been shown to be related to greater behavior change in individual and meta-analyses studies (Amrhein et al., 2003; Gaume et al., 2016; Magill et al., 2019a; Magill et al., 2014).

Most studies have evaluated CT at the session level while research on CT trajectory within the session or over the course of successive MI sessions has been less common. However, the MI theoretical model does propose that client language should change over time, in response to MI (Miller & Rose, 2009) and increases in participant's CT within the session has been related to better outcomes (Amrhein et al., 2003; Bertholet et al., 2010; Borsari et al., 2018; Campbell et al., 2010) or has mediated bMI effects on alcohol-related consequences (Magill et al., 2019b). To the best of our knowledge, no study has investigated CT trajectory over successive bMI sessions. The nearest such study is a treatment study examining CT progression over the course of four Motivational Enhancement Therapy sessions among outpatients with mild to moderate alcohol dependence with some promising findings (Campbell et al., 2010).

The purpose of the present study was to assess whether CT within successive bMI sessions is a mechanism of change for alcohol use among young adults admitted to the ED with alcohol intoxication. Our hypotheses were as follows:

1. Higher baseline Percent CT and CT Average Strength would be related to lower HDD at 1-month follow-up.
2. An increase in Percent CT and CT Average strength across sessions would be related to a decrease in HDD over the entire follow-up.

## Method

### Study Procedure and Sample

The present study is a secondary analysis of data collected during a RCT conducted among young adults presenting to the ED of Lausanne University Hospital (Switzerland) with alcohol intoxication (Gaume et al., 2022). This trial was registered in the ISRCTN registry (http://www.isrctn.com/ISRCTN13832949) and approved by the Ethics Committee of Canton Vaud (protocol n°2016-01476). All participants provided informed consent. Study procedures including sample size determination are detailed elsewhere (Gaume et al., 2022). Briefly, all young adults (18-35 years) who presented to the ED for any cause between December 2016 and August 2019 with blood alcohol concentration >0.5 gram/liter or clinical indication of intoxication as assessed by an ED physician were eligible (*N*=2108). Exclusion criteria were life-threatening conditions, psychiatric or medical contraindications, a detainee status or admission for medico-legal reasons (i.e., accompanied by the police), not speaking French, currently treated for alcohol or substance use disorder, and being too unwell to complete baseline assessment. Remaining participants completed the baseline questionnaire and were then randomized to either the bMI group (*N*=171) or the BA control group (*N*=173). BA consisted of information about alcohol risks and advice to reduce alcohol consumption and

lasted 3 minutes on average. For the present analysis, only participants randomized to the bMI group were included, since CT was largely absent in the BA group. We also included only participants who provided informed consent to audio-record the baseline bMI session, which would allow analysis of participants' CT. Research assistants blinded to group allocation assessed alcohol outcomes at 1-, 3-, 6-, and 12-month follow-ups by phone.

**Intervention**

The intervention consisted of a bMI session taking place within the ED. Participants were then offered up to three booster sessions by phone after 1 week, 1 month and 3 months. Participants not reachable at 1 month were not offered the 3-month booster session.

The intervention model is described in detail elsewhere (Gaume et al., 2021). Briefly, bMI (i.e., baseline and booster sessions) was derived from MI (Miller & Rollnick, 2013) and consisted of three strategies:

1. To create a significant relationship by using relational factors (e.g., acceptance, empathy, collaboration).
2. To enhance participants' CT and reduce ST using MI technical skills (e.g., open-ended questions, affirmations, reflections, summaries).
3. To promote participants' autonomy while giving information and advice about alcohol use, related consequences, and ED admission.

Three main steps structuring the baseline bMI session were:

1. To explore the current situation and increase participants' discrepancy between actual and ideal alcohol use.
2. To evoke change thinking about a hypothetical future.
3. To plan next steps and make them concrete.

The structure of the phone booster sessions was as follows:

1. To remind the participant of phone call's context and summarize previous discussion.
2. To explore the current situation and the concrete steps that occurred since the last session (if any).
3. To reinforce strengths and abilities for change.
4. To plan next steps and make them concrete.

For both baseline and booster sessions, the duration and content of each step varied, depending on the participant's reactions, willingness to discuss and readiness to change.

Seven trained master-level psychologists provided the intervention. The same psychologist provided all baseline and booster sessions to a given participant.

## Measures

### *Participants' CT*

The bMI sessions (i.e., baseline and booster sessions) were audio-recorded and then coded using the Client Language Assessment-Proximal/Distal 3rd version (CLA-PD V3; Magill et al., 2016). This empirically supported instrument is a direct adaptation of the Motivational Interviewing Skill Code 2.5 (MISC 2.5; Houck et al., 2014) and aims at assessing participants' CT within a targeted behavioral treatment session[1]. It demonstrated concurrent validity with the MISC 2.5, with excellent inter-rater reliability, and fair to good internal consistency reliability (Magill et al., 2016).

During a first pass through the recorded session, one coder parsed the flow of participants' language into utterances (i.e., complete thoughts units). Then, during a second pass through the recording, another coder categorized each participant's utterance according

[1] In addition, the CLA-PD V3 presents the advantage to distinguish participants' CT pertaining to *proximal* change outcomes (i.e., related to personal or treatment recommended goals that will facilitate the reduction or cessation of substance use) and *distal* change outcomes (i.e., related to the reduction or cessation of substance use, or related to the reduction of harms associated with substance use). Nevertheless, we did not examine the proximal vs. distal distinction in the present study.

to the proposed codes. Participants' change language included four coded dimensions (reasons, ability, commitment, and taking steps toward or away from behavior change, respectively). CT strength was coded on a scale between -3 and +3, depending on whether it reflects inclination *away from* (-) or *toward* (+) the targeted behavior change, with intensity rated as *high* (3), *medium* (2), or *low* (1). For example, "I won't drink this week" would be coded as "commitment +2", while "I can't just take all the booze out of my house!" would be coded as "ability -3".

We used two summary scores: Percent CT and CT Average Strength. Percent CT is a commonly used measure of CT (Magill et al., 2018; Miller et al., 2008), computed as the frequency of all utterances expressed toward change (i.e., CT) divided by the sum of the frequency of CT and the frequency of all utterances expressed against change (i.e., CT + ST), then multiplied by 100. CT Average Strength is another summary measure related to actual change in drinking, particularly among young adults (Gaume et al., 2016). It was computed as the mean strength of all change language utterances (i.e., the mean of strength ratings attributed to each CT and ST utterance on the -3 to +3 scale).

Five research assistants not involved in any other study procedure and blinded to all data collected elsewhere coded the sessions. They were trained in using the instrument by coding sessions from other studies (60 hours of training overall). Then, they independently coded all available sessions from the present study. The same coder coded all sessions from each participant. Weekly group supervision enhanced inter-rater reliability. A random sample of 74 sessions (20% of baseline sessions and 18% of booster sessions) was double coded. Coders were blinded as to whether they were coding a single or double coded session. Intra-class correlation (ICC) was computed using two-way mixed-effect models specifying consistency of agreement and individual measurements for each retained code. According to

interpretation benchmarks proposed by Cicchetti (1994), agreement between coders was excellent for retained measures (ICC = 0.79 for Percent CT and 0.84 for CT Average Strength).

### *Alcohol Outcome*

Two primary outcomes were assessed in the RCT: HDD and alcohol-related problems, and a group by time effect observed only on the former (Gaume et al., 2022). HDD was thus selected as the outcome for the present study. Since the parent trial showed no time or group by time differences on alcohol-related problems, we did not include this outcome in our secondary analysis. HDD was defined as days with six standard drinks or more (≥60 grams of ethanol; World Health Organization, 2018) and measured using a 30-day Timeline Follow Back procedure (TLFB procedure; Sobell & Sobell, 1995).

### *Participants' Baseline Characteristics*

Age, sex, citizenship, highest education level, and Alcohol Use Disorder Identification Test score (AUDIT score; Babor et al., 2001) were measured to describe participants characteristics as in the parent RCT (Gaume et al., 2022). Baseline HDD was measured with a single item asking the participant the number of HDD over the previous month, to minimize the impact of assessment reactivity (Gallen, 1974; McCambridge & Kypri, 2011).

## Statistical Analysis

Participants' baseline characteristics were computed using standard descriptive statistics with Stata BE 17.0 (StataCorp., 2021). Analyses of data distribution included descriptive statistics (e.g., mean, median, skewness, kurtosis, etc.) and graphs (i.e., boxplot and histogram). Participants included within this secondary analysis were compared with those having received bMI in the RCT (Gaume et al., 2022), but not included in this analysis

(i.e., those without an audio-recorded and coded session at baseline), using Pearson $X^2$ tests or Wilcoxon Mann-Whitney rank sum tests, as appropriate. Participants with one, two, three or no booster sessions were also compared with each other using Kruskal-Wallis tests or Pearson $X^2$ tests.

The *Latent Growth Curve Model* (LGCM) is a recommended approach for longitudinal data, enabling the growth trajectory of individual parameters (characterized by latent intercepts and slopes) to be computed over several points in time, longitudinal associations between these parameters and one or more static or longitudinal covariates to be tested, and missing data to be handled when specific assumptions are met (e.g., Burant, 2016; Byrne & Crombie, 2003). We used Mplus version 8.3 (Muthén & Muthén, 1998-2017) to perform LGCMs. A similar analysis strategy to that of Gex et al. (2022) was conducted. In a first step, we tested LGCMs (i.e., separately for Percent CT, CT Average Strength, and HDD) with linear, quadratic and then piecewise functions to determine the growth trajectory of each variable. Linear growth estimates a constant change over time, quadratic growth estimates either a u-shape or an inverse u-shape or an accelerating or a slowing rate of linear change, and piecewise growth estimates two different phases of change. We considered three fit indices to assess how well the models fit the data: the Root Mean Square Error of Approximation (RMSEA; Steiger, 1990; Steiger & Lind, 1980), the Comparative Fit Index (CFI; Bentler, 1990) and the Standardized Root Mean Squared Residual (SRMR; Byrne, 1998; Diamantopoulos & Siguaw, 2000). Fit indices are considered to indicate good model of fit if RMSEA <0.06, CFI >0.96, and SRMR<0.05, and acceptable model of fit if RMSEA <0.07, CFI >0.9, and SRMR<0.08 (Hooper et al., 2008). Graphs (see Participants' CT Across BMI Sessions section) and fit indices demonstrated that a linear-linear piecewise LGCM provided the best fit to our data for the predictor variables (i.e., Percent CT and CT Average

Strength). Piecewise LGCMs were estimated with a latent intercept set at baseline (i.e., baseline value of corresponding variable) and two latent slopes: slope 1 representing change of corresponding variable from baseline to 1-week booster session, and slope 2 from 1-week to 3-month booster sessions. In the piecewise models, the residual variance of each predictor variable at baseline was fixed at zero for identification purposes. Graph and fit indices demonstrated that a linear model provided the best fit to our data for the outcome variable (HDD). This linear model was estimated with a latent intercept set at 1-month follow-up (i.e., first outcome value) and a latent slope representing HDD change from 1- to 12-month follow-up.

In a second step, the effects of the predictor variables (i.e., CT) on the outcome (i.e., HDD) were tested using two separate LGCMs including regressions of the predictor variable on the outcome (Model 1=HDD on Percent CT; Model 2= HDD on CT Average Strength). Figure 1 describes the conceptual model of our statistical analysis. In all models, intercept and slope of HDD were adjusted for the baseline measure of HDD. Models 1 and 2 did not converge when including a regression of HDD on CT slope 2 (nearly flat slope from 1-week to 3-month booster sessions). Therefore, we computed only the effects of intercept and slope 1 on HDD.

Booster sessions and follow-up included missing data. According to Enders (2010), the assumption of Missing Data at Random (MAR) is considered consistent for this type of longitudinal data analysis. Therefore, we handled missing data with Full Information Maximum Likelihood (FIML) estimation, as it directly estimates unbiased model parameters and standard errors using all available participants' data for MAR (Acock, 2005; Enders, 2001; Enders & Bandalos, 2001). FIML was thus computed to handle participants with missing data within booster sessions and/or follow-ups. Furthermore, Maximum Likelihood

estimations with Robust standard errors (MLR) were performed across all models as the outcome variable (HDD) presented a skewed distribution.

Finally, two sensitivity analyses were conducted to assess the robustness of the results of our primary analysis. In the first one, we repeated our primary analysis while also adjusting for sex, age, and highest education level (in addition to baseline measure of HDD) to control for potential confounders. In the second one, we repeated our primary analysis with Maximum Likelihood estimation (ML) analysis and bootstrapping (*N* draws= 10,000) instead of MLR to further test the robustness of our handling of the skewed distribution for our outcome variable (HDD) (Pek et al., 2018). In all analyses, the level of significance was set at 5% ($p<.05$).

### Transparency and Openness

We report how we determined our sample size, all manipulations, and all measures in the study, and we follow JARS (Kazak, 2018). All data will be available at [https://doi.org/10.5281/zenodo.8208652] upon manuscript publication. Analysis code is available by emailing the corresponding author. The aim of the present study (i.e., analysis of bMI mechanisms of change) was pre-specified in the study protocol (see Supplement 1 in Gaume et al., 2022) and predictor variables measures were collected for this purpose. However, the analytical approach was not specified and the present analysis was not registered.

## Results

### Participants' Flow and Baseline Characteristics

A total of 140 participants were included in our secondary analysis (Figure 2). Participants' median age was 23 years old, they were mainly men (72.8%) and of Swiss citizenship (65%), see Table 1. No difference was shown when comparing participants

baseline characteristics included in the present analysis with those receiving bMI who were not included in this analysis, except for sex ($X^2$ (1, $N$=170) = 5.76, $p$=.02) (Table 1). The mean number *(SD)* of HDD was 3.0 (4.9) at 1-month, 3.1 (4.8) at 3-month, 3.6 (5.1) at 6-month, and 3.2 (4.8) at 12-month. Follow-up rates (Figure 2) were also similar to those of the RCT (Gaume et al., 2022), and were 82.1% at 1-month, 80.7% at 3-month, 77.1% at 6-month, and 79.3% at 12-month.

Participation in booster sessions is presented in Figure 2. Specifically, 53 participants completed all booster sessions, 34 completed two, 25 completed one, and 28 had no booster session. A total of 88.4% of the booster sessions were audio-recorded and coded at 1-week, 88.5% at 1-month, and 89.5% at 3-month. There was no significant difference in baseline characteristics and in HDD at follow-ups between participants with one, two, three or no booster sessions. The mean duration *(SD)* of sessions was 38.8 minutes (13.7) for baseline bMI session, and 13.8 minutes (8.2), 14.5 minutes (10.5), and 15.1 minutes (11.6) for the 1-week, 1-month, and 3-month phone booster sessions, respectively.

**Participants' CT Across BMI Sessions**

Percent CT and CT Average Strength across bMI sessions are depicted in Figures 3 and 4. Both CT measures had similar patterns across sessions. CT during baseline session indicated that participants mainly expressed inclination toward change (mean *[SD]* = 67.3 [19.7] for Percent CT and 0.7 [0.8] for CT Average Strength). CT then steeply increased at 1-week booster session (Percent CT slope 1 mean [*SE*] = 13.834 [2.022], p<.001; CT Average Strength slope 1 mean = 0.516 [0.073], p<.001) and remained at similar high levels throughout booster sessions. Descriptive statistics of CT and ST frequencies, as well as Percent CT and CT Average Strength across bMI sessions are presented in Supplemental Table 1.

**Participants' CT Effects on HDD**

The primary analysis (Models 1 and 2) showed acceptable fit indices (see Supplemental Table 2). The models testing the effects of CT on HDD are presented in Table 2. All effects were significant. In model 1, HDD intercept on Percent CT intercept indicated that a 10% higher Percent CT at baseline session was related to 0.4 lower HDD at 1-month. HDD slope on Percent CT slope 1 indicated that a 10% increase in Percent CT from baseline to 1-week booster session was related to a decrease of 0.8 HDD from 1-month to 12-month. In model 2, one point of CT Average Strength more at baseline session was related to one lower HDD at 1-month. In addition, an increase of one point in CT Average Strength from baseline to 1-week booster session was related to a decrease of 2.3 HDD from 1 month to 12 months.

To further characterize these results, Figures 5 and 6 depict the predicted change in HDD over the entire follow-up according to high vs. low levels of Percent CT and CT Average Strength growth parameters (i.e., intercept and slope 1) respectively. High levels of CT growth parameters were defined by adding 1 *SD* to the growth parameters means, while low levels of CT growth parameters were defined by subtracting 1 *SD* to the growth parameters means. Both graphs showed similar trends. Participants with a high level of CT at baseline and a high increase in CT from baseline to the 1-week booster session had the most favorable HDD trajectory over 12 months, with predicted values of HDD close to zero at 1-month and a negative slope indicating predicted values lower than 0. On the other hand, participants with a high level of CT at baseline followed by a slight decrease in CT from baseline to the 1-week booster increased their drinking over time, with predicted HDD moving from almost 0 to 2 HDD at 12 months. Participants with a low level of CT at baseline and with a high increase in CT from baseline to 1-week booster session demonstrated a

favorable trajectory, from about 1.5 HDD at 1 month to about 1 HDD at 12 months. Finally, participants with a low level of CT at baseline and a slight decrease in CT from baseline to the 1-week booster session were those with the poorest HDD trajectory, moving from a predicted HDD value of about 1.5 at 1 month to more than 3 HDD at 12 months.

Fit indices of both sensitivity analyses were appropriate, excepted for SRMR in sensitivity analysis 1 (SRMR=0.095, upper limit <0.08; Hooper et al., 2008) and Model 2 RMSEA in sensitivity analysis 2 (RMSEA=0.076, upper limit <0.07; Hooper et al., 2008), see Supplemental Table 2. Both sensitivity analyses supported our findings with similar estimates and levels of significance (see Supplemental Table 3).

## Discussion

As hypothesized, baseline CT measures and CT trajectories across sessions were associated with better HDD outcomes among young adults admitted to the ED with alcohol intoxication. Specifically, we found that baseline Percent CT and CT Average Strength were related to HDD during the first month after ED visit, and increasing CT from baseline to 1-week booster session was associated with reducing HDD over 12 months.

Overall, our findings are consistent with results regarding the predictive value of within-session Percent CT (Magill et al., 2018; Magill et al., 2014; Pace et al., 2017), as well as CT strength (Amrhein et al., 2003; Gaume et al., 2016; Magill et al., 2019a; Magill et al., 2014) on alcohol outcomes. Several studies have examined the links between CT and outcomes among non-treatment seeking young adults (Apodaca et al., 2014; Borsari et al., 2015; Gaume et al., 2013; Gaume et al., 2016; Vader et al., 2010). Participants in the present study expressed high inclination toward change within the baseline session, consistent with the concept that an ED admission may represent a “teachable moment”. Indeed, ED admission has an inherent motivating effect (Castro et al., 2021; Longabaugh et al., 1995),

which might lead to increase participant motivation and readiness to change, and thus explain the relatively high levels of CT.

CT also increased steeply from baseline to 1-week booster session and then remained relatively high and stable over time. Booster sessions aimed at providing an opportunity for participants to be supported in their change process by sharing the steps they took toward change as well as their difficulties. The observed steep increase between baseline and booster sessions may indicate that participants used this opportunity and mostly evoked inclination toward further change and/or first steps in direction of change.

The present study is among the first to investigate the effect of participants' CT trajectory across bMI sessions and, as hypothesized, these trajectories were associated with favorable changes in HDD. These findings lend further support to CT as an important mechanism of change in MI. When investigating CT across four successive Motivational Enhancement Therapy sessions, Campbell et al. (2010) found that an increase in commitment strength between the first and the fourth sessions was related to not exceeding national drinking guidelines at 6-month follow-up. In contrast to our results, they found no association between overall CT strength trajectory and outcome. This difference could be explained by the different study population and setting (adult outpatients treated for mild to moderate alcohol dependence), the intervention provided (Motivational Enhancement Therapy), the type of trajectories analysis (mean difference between first and last session), and the small sample size ($N$=28). Of note, the effect of overall CT strength was in the expected direction but non-significant.

Our study has several strengths. To the best of our knowledge, this is the first study assessing CT effects on alcohol outcome across successive bMI sessions. Data came from a RCT that showed significant effects of bMI on HDD (Gaume et al., 2022). Session coding

was performed in a reliable way, as indicated by excellent ICCs for both CT measures. Both CT measures (i.e., Percent CT and CT Average Strength) were consistent in their impact on HDD at short-term and HDD change over time. Finally, LGCM provided acceptable fit indices, and primary results were supported by both sensitivity analyses.

The study also has several limitations. First, there were missing data in booster sessions and follow-up assessments. The intervention design was based on the MI principle of participants' autonomy support, and booster sessions were offered to all participants, who accepted or refused them as they preferred. Therefore, participants who received no or few booster sessions might be individuals who thought they did not need booster intervention, who might be less motivated to change their alcohol use, or who did not appreciate the bMI approach. They might have specific characteristics that were not accounted for in our measures or statistical models. Nevertheless, our analyses suggest that this effect should be small since (a) there were no significant differences in baseline characteristics and in HDD at follow-ups between participants with one, two, three or no booster sessions; (b) all models in primary and sensitivity analyses provided consistent findings; and (c) multiple imputation for follow-up attrition in the parent RCT confirmed intervention effects with similar patterns of significance and effect sizes (Gaume et al., 2022). Second, LGCMs did not converge when including a regression of HDD on CT slope 2 (i.e., trajectory from 1-week to 3-month booster sessions), and this regression had to be removed from the model. This may be explained by the nearly flat slope observed after 1-week booster session. Third, the use of a specific time point and the estimate of trajectory over time (i.e., intercept and slope, respectively) as predictors of change is subject to lower reliability in growth context (Brandmaier et al., 2018; Shryane, 2021) and potentially sensitive to coding. Fourth, our screening criteria (i.e., blood alcohol concentration >0.5 gram/liter or clinical indication of intoxication as assessed by an

ED physician) may have introduced a misclassification bias. Specifically, people whose blood alcohol concentration has dropped below our threshold or people with no blood alcohol concentration test and no clinical evidence of intoxication due to tolerance associated with severe alcohol use disorders may have been missed. Finally, the study population consisted of French-speaking young adults, admitted to a Swiss ED with alcohol intoxication, and we did not collect data on race and ethnicity as it is not common practice in Europe. This may impact external validity of our findings.

From a clinical perspective, our findings suggest that clinicians should not only pay attention to patient CT within a bMI session but also to its progression over time in shorter booster sessions, thus providing evidence in line with the intervention approach. There is no basis for recommendations about the number of booster sessions in our study, as they were not randomly allocated to participants. Our results nonetheless show that the 1-week booster was key; participants increased their level of CT during the first week after ED admission on average, and this increase was related to more favorable HDD trajectory. On the one hand, the additional booster sessions at 1- and 3-month may have helped participants to maintain a relatively high level of CT and change in alcohol consumption, but the models including this flatter slope did not converge, limiting further interpretation. On the other hand, these additional booster sessions may not be clinically relevant and cost-effective since there is a lack of knowledge related to the effects of multiple booster sessions on alcohol use targeting ED patients, and the effects of a single booster session have been scarcely tested in this setting (Field et al., 2014; Longabaugh et al., 2001; Mello et al., 2005). This calls for further studies empirically examining the relative efficacy and the optimal number of bMI booster sessions. Note also that our analysis focused solely on the link between participants' CT and alcohol outcome, without taking into account the links between therapists MI skills and

participants' CT (Magill et al., 2018; Magill et al., 2014; Miller & Rollnick, 2013). It should also be borne in mind that we selected an alcohol consumption measure (HDD) as the outcome variable for this study as there was a specific group by time effect identified in the parent trial. Although some RCTs showed results in favor of bMI effects on alcohol-related problems compared to standard care among young adults admitted to the ED with alcohol intoxication (Monti et al., 1999; Smith et al., 2003), we did not examine participants' CT effects on this outcome, since the parent trial found no difference between bMI and BA groups, and no time differences, indicating no change of this outcome over the course of the follow-up (Gaume et al., 2022). Therefore, the present findings should not be generalized to alcohol problem outcomes. Future research should examine the links across successive bMI sessions of the range of variables discussed here, and assess their impacts on alcohol use outcomes.

## Conclusion

The purpose of this secondary analysis was to assess whether CT (i.e., Percent CT and CT Average Strength) within a baseline bMI and up to three booster sessions was a mechanism of change in HDD among young adults admitted to the ED with alcohol intoxication. LGCMs for both CT measures indicated that CT increased from baseline to 1-week booster session and thereafter remained stable. Higher baseline CT was related to lower HDD at 1-month, and an increase in CT from baseline to 1-week booster session was related to a decrease in HDD from 1 month to 12 months. To our knowledge, this is the first study assessing CT effects on alcohol use across successive bMI sessions. While these results need to be confirmed by additional studies on multiple sessions, the key conclusions to be drawn from this study are that both CT initially, and how it develops across sessions, are meaningful predictors of reduced HDD.

## References

Acock, A. C. (2005). Working with missing values. *Journal of Marriage and Family*, *67*, 1012-1028. https://doi.org/10.1111/j.1741-3737.2005.00191.x

Adam, A., Faouzi, M., McNeely, J., Yersin, B., Daeppen, J. B., & Bertholet, N. (2020). Further utilization of emergency department and inpatient psychiatric services among young adults admitted at the emergency department with clinical alcohol intoxication. *Journal of Addiction Medicine*, *14*(1), 32-38. https://doi.org/10.1097/ADM.0000000000000529

Adam, A., Faouzi, M., Yersin, B., Bodenmann, P., Daeppen, J. B., & Bertholet, N. (2016). Women and men admitted for alcohol intoxication at an emergency department: Alcohol use disorders, substance use and health and social status 7 years later. *Alcohol and Alcoholism*, *51*(5), 567-575. https://doi.org/10.1093/alcalc/agw035

Amrhein, P. C., Miller, W. R., Yahne, C. E., Palmer, M., & Fulcher, L. (2003). Client commitment language during motivational interviewing predicts drug use outcomes. *Journal of Consulting and Clinical Psychology*, *71*(5), 862-878. https://doi.org/10.1037/0022-006X.71.5.862

Apodaca, T. R., Borsari, B., Jackson, K. M., Magill, M., Longabaugh, R., Mastroleo, N. R., & Barnett, N. P. (2014). Sustain talk predicts poorer outcomes among mandated college student drinkers receiving a brief motivational intervention. *Psychology of Addictive Behaviors*, *28*(3), 631-638. https://doi.org/10.1037/a0037296

Babor, T. F., Higgins-Biddle, J. C., Saunders, J. B., & Monteiro, M. G. (2001). *AUDIT: The alcohol use disorders identification test: Guidelines for use in primary health care* (2nd ed.). World Health Organization. https://apps.who.int/iris/handle/10665/67205

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, *107*(2), 238-246. https://doi.org/10.1037/0033-2909.107.2.238

Bertholet, N., Adam, A., Faouzi, M., Boulat, O., Yersin, B., Daeppen, J. B., & Clerc, D. (2014). Admissions of patients with alcohol intoxication in the emergency department: A growing phenomenon. *Swiss Medical Weekly*, *144*, Article w13982. https://doi.org/10.4414/smw.2014.13982

Bertholet, N., Faouzi, M., Gmel, G., Gaume, J., & Daeppen, J. B. (2010). Change talk sequence during brief motivational intervention, towards or away from drinking. *Addiction*, *105*(12), 2106-2112. https://doi.org/10.1111/j.1360-0443.2010.03081.x

Borsari, B., Apodaca, T. R., Jackson, K. M., Fernandez, A., Mastroleo, N. R., Magill, M., Barnett, N. P., & Carey, K. B. (2018). Trajectories of in-session change language in brief motivational interventions with mandated college students. *Journal of Consulting and Clinical Psychology*, *86*(2), 158-168. https://doi.org/10.1037/ccp0000255

Borsari, B., Apodaca, T. R., Jackson, K. M., Mastroleo, N. R., Magill, M., Barnett, N. P., & Carey, K. B. (2015). In-session processes of brief motivational interventions in two trials with mandated college students. *Journal of Consulting and Clinical Psychology*, *83*(1), 56-67. https://doi.org/10.1037/a0037635

Brandmaier, A. M., von Oertzen, T., Ghisletta, P., Lindenberger, U., & Hertzog, C. (2018). Precision, reliability, and effect size of slope variance in latent growth curve models: Implications for statistical power analysis. *Frontiers in Psychology*, *9*, 294. https://doi.org/10.3389/fpsyg.2018.00294

Burant, C. J. (2016). Latent growth curve models: Tracking changes over time. *The International Journal of Aging and Human Development*, *82*(4), 336-350. https://doi.org/10.1177/0091415016641692

Byrne, B. M. (1998). *Structural equation modeling with LISREL, PRELIS and SIMPLIS: Basic concepts, applications and programming*. Lawrence Erlbaum Associates. https://doi.org/10.4324/9780203774762

Byrne, B. M., & Crombie, G. (2003). Modeling and testing change: An introduction to the latent growth curve model. *Understanding Statistics*, *2*(3), 177-203. https://doi.org/ https://doi.org/10.1207/S15328031US0203_02

Campbell, S. D., Adamson, S. J., & Carter, J. D. (2010). Client language during motivational enhancement therapy and alcohol use outcome. *Behavioural and Cognitive Psychotherapy*, *38*(4), 399-415. https://doi.org/10.1017/S1352465810000263

Castro, Y., Najera, S. N., Robles, E. H., Reddy, S. M., Holcomb, B. N., & Field, C. A. (2021). Mechanisms of change in drinking following an alcohol-related injury: A qualitative examination of the sentinel event effect. *Substance Abuse*, *42*(4), 699-705. https://doi.org/10.1080/08897077.2020.1846150

Cicchetti, D. V. (1994). Guidelines, criteria, and rules of thumb for evaluating normed and standardized assessment instruments in psychology. *Psychological Assessment*, *6*(4), 284-290. https://doi.org/10.1037/1040-3590.6.4.284

Diamantopoulos, A., & Siguaw, J. A. (2000). *Introducing LISREL*. Sage Publications. https://doi.org/10.4135/9781849209359

Enders, C. K. (2001). The performance of the full information maximum likelihood estimator in multiple regression models with missing data. *Educational and Psychological Measurement*, *61*(5), 713-740. https://doi.org/10.1177/0013164401615001

Enders, C. K. (2010). *Applied missing data analysis.* Guilford Press. http://hsta559s12.pbworks.com/w/file/fetch/52112520/enders.applied

Enders, C. K., & Bandalos, D. (2001). The relative performance of full information maximum likelihood estimation for missing data in structural equation models. *Structural Equation Modeling*, *8*(3), 430-457. https://doi.org/10.1207/S15328007SEM0803_5

Field, C., Walters, S., Marti, C. N., Jun, J., Foreman, M., & Brown, C. (2014). A multisite randomized controlled trial of brief intervention to reduce drinking in the trauma care setting: How brief is brief? *Annals of Surgery*, *259*(5), 873-880. https://doi.org/10.1097/SLA.0000000000000339

Gallen, M. (1974). Toward an understanding of follow-up research with alcoholics. *Psychological Reports*, *34*(3), 877-878. https://doi.org/10.2466/pr0.1974.34.3.877

Gaume, J., Bertholet, N., Faouzi, M., Gmel, G., & Daeppen, J. B. (2013). Does change talk during brief motivational interventions with young men predict change in alcohol use? *Journal of Substance Abuse Treatment*, *44*(2), 177-185. https://doi.org/10.1016/j.jsat.2012.04.005

Gaume, J., Bertholet, N., McCambridge, J., Magill, M., Adam, A., Hugli, O., & Daeppen, J. B. (2022). Effect of a novel brief motivational intervention for alcohol-intoxicated young adults in the emergency department: A randomized clinical trial. *JAMA Network Open*, *5*(10), Article e2237563. https://doi.org/10.1001/jamanetworkopen.2022.37563

Gaume, J., Grazioli, V. S., Paroz, S., Fortini, C., Bertholet, N., & Daeppen, J. B. (2021). Developing a brief motivational intervention for young adults admitted with alcohol intoxication in the emergency department - Results from an iterative qualitative

design. *PLoS One*, *16*(2), Article e0246652. https://doi.org/10.1371/journal.pone.0246652

Gaume, J., Magill, M., Mastroleo, N. R., Longabaugh, R., Bertholet, N., Gmel, G., & Daeppen, J. B. (2016). Change talk during brief motivational intervention with young adult males: Strength matters. *Journal of Substance Abuse Treatment*, *65*, 58-65. https://doi.org/10.1016/j.jsat.2016.01.005

Gex, K. S., Acuff, S. F., Campbell, K. W., Mun, E. Y., Dennhardt, A. A., Borsari, B., Martens, M. P., & Murphy, J. G. (2022). Change in alcohol demand following a brief intervention predicts change in alcohol use: A latent growth curve analysis. *Alcohol: Clinical and Experimental Research*, *46*(8), 1525-1538. https://doi.org/10.1111/acer.14887

Herbert, A., Gilbert, R., Gonzalez-Izquierdo, A., Pitman, A., & Li, L. (2015). 10-y risks of death and emergency re-admission in adolescents hospitalised with violent, drug- or alcohol-related, or self-inflicted injury: A population-based cohort study. *PLoS Medicine*, *12*(12), Article e1001931. https://doi.org/10.1371/journal.pmed.1001931

Hooper, D., Coughlan, J., & Mullen, M. R. (2008). Structural equation modelling: Guidelines for determining model fit. *Electronic Journal of Business Research Methods*, *6*(1), 53-60. https://doi.org/10.21427/D7CF7R

Houck, J. M., Moyers, T. B., Miller, W. R., Glynn, L. H., & Hallgren, K. A. (2014). *Motivational interviewing skill code (MISC) 2.5*. University of New Mexico. https://casaa.unm.edu/download/misc25.pdf

Hoy, A. R. (2017). Which young people in England are most at risk of an alcohol-related revolving-door readmission career? *BMC Public Health*, *17*(1), 185. https://doi.org/10.1186/s12889-016-3891-2

Kazak, A. E. (2018). Editorial: Journal article reporting standards. *American Psychologist*, *73*(1), 1-2. https://doi.org/10.1037/amp0000263

Longabaugh, R., Donovan, D. M., Karno, M. P., McCrady, B. S., Morgenstern, J., & Tonigan, J. S. (2005). Active ingredients: How and why evidence-based alcohol behavioral treatment interventions work. *Alcohol: Clinical and Experimental Research*, *29*(2), 235-247. https://doi.org/10.1097/01.alc.0000153541.78005.1f

Longabaugh, R., Minugh, P. A., Nirenberg, T. D., Clifford, P. R., Becker, B., & Woolard, R. (1995). Injury as a motivator to reduce drinking. *Academic Emergency Medicine*, *2*(9), 817-825. https://doi.org/10.1111/j.1553-2712.1995.tb03278.x

Longabaugh, R., Woolard, R. E., Nirenberg, T. D., Minugh, A. P., Becker, B., Clifford, P. R., Carty, K., Licsw, Sparadeo, F., & Gogineni, A. (2001). Evaluating the effects of a brief motivational intervention for injured drinkers in the emergency department. *Journal of Studies on Alcohol*, *62*(6), 806-816. https://doi.org/10.15288/jsa.2001.62.806

Magill, M., Apodaca, T. R., Borsari, B., Gaume, J., Hoadley, A., Gordon, R. E. F., Tonigan, J. S., & Moyers, T. (2018). A meta-analysis of motivational interviewing process: Technical, relational, and conditional process models of change. *Journal of Consulting and Clinical Psychology*, *86*(2), 140-157. https://doi.org/10.1037/ccp0000250

Magill, M., Apodaca, T. R., Karno, M., Gaume, J., Durst, A., Walthers, J., Stout, L. R., & DiClemente, C. (2016). Reliability and validity of an observational measure of client decision-making: The client language assessment - proximal/distal (CLA-PD). *Journal of Substance Abuse Treatment*, *63*, 10-17. https://doi.org/10.1016/j.jsat.2015.12.006

Magill, M., Bernstein, M. H., Hoadley, A., Borsari, B., Apodaca, T. R., Gaume, J., & Tonigan, J. S. (2019a). Do what you say and say what you are going to do: A preliminary meta-analysis of client change and sustain talk subtypes in motivational interviewing. *Psychotherapy Research*, *29*(7), 860-869. https://doi.org/10.1080/10503307.2018.1490973

Magill, M., Gaume, J., Apodaca, T. R., Walthers, J., Mastroleo, N. R., Borsari, B., & Longabaugh, R. (2014). The technical hypothesis of motivational interviewing: A meta-analysis of MI's key causal model. *Journal of Consulting and Clinical Psychology*, *82*(6), 973-983. https://doi.org/10.1037/a0036833

Magill, M., Janssen, T., Mastroleo, N., Hoadley, A., Walthers, J., Barnett, N., & Colby, S. (2019b). Motivational interviewing technical process and moderated relational process with underage young adult heavy drinkers. *Psychology of Addictive Behaviors*, *33*(2), 128-138. https://doi.org/10.1037/adb0000440

McCambridge, J., & Kypri, K. (2011). Can simply answering research questions change behaviour? Systematic review and meta analyses of brief alcohol intervention trials. *PLoS One*, *6*(10), Article e23748. https://doi.org/10.1371/journal.pone.0023748

McCambridge, J., McAlaney, J., & Rowe, R. (2011). Adult consequences of late adolescent alcohol consumption: A systematic review of cohort studies. *PLoS Medicine*, *8*(2), Article e1000413. https://doi.org/10.1371/journal.pmed.1000413

Mello, M. J., Nirenberg, T. D., Longabaugh, R., Woolard, R., Minugh, A., Becker, B., Baird, J., & Stein, L. (2005). Emergency department brief motivational interventions for alcohol with motor vehicle crash patients. *Annals of Emergency Medicine*, *45*(6), 620-625. https://doi.org/10.1016/j.annemergmed.2005.01.026

Miller, W. R., & Moyers, T. B. (2015). The forest and the trees: Relational and specific factors in addiction treatment. *Addiction, 110*(3), 401-413. https://doi.org/10.1111/add.12693

Miller, W. R., Moyers, T. B., Ernst, D., & Amrhein, P. (2008). *Manual for the motivational interviewing skill code (MISC) 2.1.* University of New Mexico. https://casaa.unm.edu/download/misc.pdf

Miller, W. R., & Rollnick, S. (2013). *Motivational interviewing: Helping people change* (3rd ed.). Guilford Press.

Miller, W. R., & Rose, G. S. (2009). Toward a theory of motivational interviewing. *American Psychologist, 64*(6), 527-537. https://doi.org/10.1037/a0016830

Monti, P. M., Colby, S. M., Barnett, N. P., Spirito, A., Rohsenow, D. J., Myers, M., Woolard, R., & Lewander, W. (1999). Brief intervention for harm reduction with alcohol-positive older adolescents in a hospital emergency department. *Journal of Consulting and Clinical Psychology, 67*(6), 989-994. https://doi.org/10.1037//0022-006x.67.6.989

Moos, R. H. (2007). Theory-based active ingredients of effective treatments for substance use disorders. *Drug and Alcohol Dependance, 88*(2-3), 109-121. https://doi.org/10.1016/j.drugalcdep.2006.10.010

Mullins, P. M., Mazer-Amirshahi, M., & Pines, J. M. (2017). Alcohol-related visits to US emergency departments, 2001-2011. *Alcohol and Alcoholism, 52*(1), 119-125. https://doi.org/10.1093/alcalc/agw074

Muthén, L. K., & Muthén, B. O. (1998-2017). *Mplus user's guide* (8th ed.). Muthén & Muthén. https://www.statmodel.com/download/usersguide/MplusUserGuideVer_8.pdf

Newton, A. S., Dong, K., Mabood, N., Ata, N., Ali, S., Gokiert, R., Vandermeer, B., Tjosvold, L., Hartling, L., & Wild, T. C. (2013). Brief emergency department interventions for youth who use alcohol and other drugs: A systematic review. *Pediatric Emergency Care*, *29*(5), 673-684. https://doi.org/https://doi.org/10.1097/PEC.0b013e31828ed325

Pace, B. T., Dembe, A., Soma, C. S., Baldwin, S. A., Atkins, D. C., & Imel, Z. E. (2017). A multivariate meta-analysis of motivational interviewing process and outcome. *Psychology of Addictive Behaviors*, *31*(5), 524-533. https://doi.org/10.1037/adb0000280

Pek, J., Wong, O., & Wong, A. C. M. (2018). How to address non-normality: A taxonomy of approaches, reviewed, and illustrated. *Frontiers in Psychology*, *9*, 2104. https://doi.org/10.3389/fpsyg.2018.02104

Piccioni, A., Tarli, C., Cardone, S., Brigida, M., D'Addio, S., Covino, M., Zanza, C., Merra, G., Ojetti, V., Gasbarrini, A., Addolorato, G., & Franceschi, F. (2020). Role of first aid in the management of acute alcohol intoxication: A narrative review. *European Review for Medical and Pharmacological Sciences*, *24*(17), 9121-9128. https://doi.org/10.26355/eurrev_202009_22859

Rehm, J. (2011). The risks associated with alcohol use and alcoholism. *Alcohol Research and Health*, *34*(2), 135-143.

Shryane, N. (2021). Reliability in latent growth curve models. In A. Cernat & J. W. Sakshaug (Eds.), *Measurement error in longitudinal data* (pp. 195-210). Oxford University Press.

Smith, A. J., Hodgson, R. J., Bridgeman, K., & Shepherd, J. P. (2003). A randomized controlled trial of a brief intervention after alcohol-related facial injury. *Addiction*, *98*(1), 43-52. https://doi.org/10.1046/j.1360-0443.2003.00251.x

Sobell, L. C., & Sobell, M. B. (1995). Alcohol consumption measures. In J. P. Allen & M. Columbus (Eds.), *Assessing alcohol problems: A guide for clinicians and researchers* (pp. 55-73). National Institute on Alcohol Abuse and Alcoholism.

StataCorp. (2021). *Stata statistical software: Release 17.* StataCorp LLC.

Steiger, J. H. (1990). Structural model evaluation and modification: An interval estimation approach. *Multivariate Behavioral Research, 25*, 173-180. https://doi.org/10.1207/s15327906mbr2502_4

Steiger, J. H., & Lind, J. C. (1980). *Statistically-based tests for the number of common factors.* Paper presented at the Psychometric Society Annual Meeting, Iowa City, IA.

Taggart, I. H., Ranney, M. L., Howland, J., & Mello, M. J. (2013). A systematic review of emergency department interventions for college drinkers. *The Journal of Emergency Medicine*, *45*(6), 962-968. https://doi.org/10.1016/j.jemermed.2013.05.065

Tanner-Smith, E. E., & Lipsey, M. W. (2014). Brief alcohol interventions for adolescents and young adults: A systematic review and meta-analysis. *Journal of Substance Abuse Treatment*, *51*, 1-18. https://doi.org/10.1016/j.jsat.2014.09.001

Vader, A. M., Walters, S. T., Prabhu, G. C., Houck, J. M., & Field, C. A. (2010). The language of motivational interviewing and feedback: Counselor language, client language, and client drinking outcomes. *Psychology of Addictive Behaviors, 24*(2), 190-197. https://doi.org/10.1037/a0018749

Wicki, M., & Stucki, S. (2014). *Hospitalisierungen aufgrund von Alkohol-Intoxikation oder Alkoholabhängigkeit bei Jugendlichen und Erwachsenen - Eine analyse der*

*Schweizerischen "Medizinischen Statistik der Krankenhäuser“ 2003 bis 2012 [Hospitalizations due to alcohol intoxication or alcohol dependence among adolescents and adults - An analysis of the Swiss "Medical Statistics of Hospitals" from 2003 to 2012].* Addiction Suisse. https://www.addictionsuisse.ch/fileadmin/user_upload/DocUpload/Alkoholintoxikationen-Wicki-2014.pdf

Wicki, M., Wurdak, M., & Kuntsche, E. (2014). *Effektivität psychosozialer Interventionen im Spital bei Alkohol-Intoxikation: Eine systematische Literaturübersicht [Effectiveness of psychosocial interventions in the hospital for alcohol intoxication: A systematic literature review].* Addiction Suisse. http://www.addictionsuisse.ch/fileadmin/user_upload/DocUpload/SUCHT-SCHWEIZ-Effektivitaet-psychosozialer-Interventionen-im_Spital-bei-Alkohol-Intoxikation-FB69.pdf

World Health Organization. (2018). *Global status report on alcohol and health 2018.* https://www.who.int/publications/i/item/9789241565639

World Health Organization. (2021). *Adolescent and young adult health.* https://www.who.int/news-room/fact-sheets/detail/adolescents-health-risks-and-solutions

**Table 1**

*Participants' Baseline Characteristics*

| Characteristics | Participants included in secondary analysis | Participants having received bMI but not included | *p* |
|---|---|---|---|
| | Median [*Q1*-*Q3*] / *N* (%) | Median [*Q1*-*Q3*] / *N* (%) | |
| Age | 23 [20–27] | 23 [21–26] | .99 |
| Sex | | | .02 |
| Female | 38 (27.1%) | 2 (6.7%) | |
| Male | 102 (72.9%) | 28 (93.3%) | |
| Citizenship | | | .23 |
| Swiss | 91 (65.0%) | 16 (53.3%) | |
| Other | 49 (35.0%) | 14 (46.7%) | |
| Highest education level | | | .07 |
| Obligatory school | 35 (25.0%) | 8 (26.7%) | |
| Professional diploma | 26 (18.6%) | 11 (36.6%) | |
| High School diploma | 53 (37.9%) | 5 (16.7%) | |
| University degree | 26 (18.5%) | 6 (20.0%) | |
| HDD per month[a] | 2 [1–4] | 2 [1–4] | .74 |
| AUDIT score | 13.5 [10–19] | 11.5 [9–17] | .29 |

*Note.* *N*=140 participants included in the analysis compared to *N*=30 participants having received bMI but who were not included in the analysis. bMI = brief motivational intervention; HDD = heavy drinking days; AUDIT = alcohol use disorder identification test.

[a] Baseline measure of HDD using single item (see Participants' Baseline Characteristics section).

**Table 2**

*Participants' CT Effects on HDD*

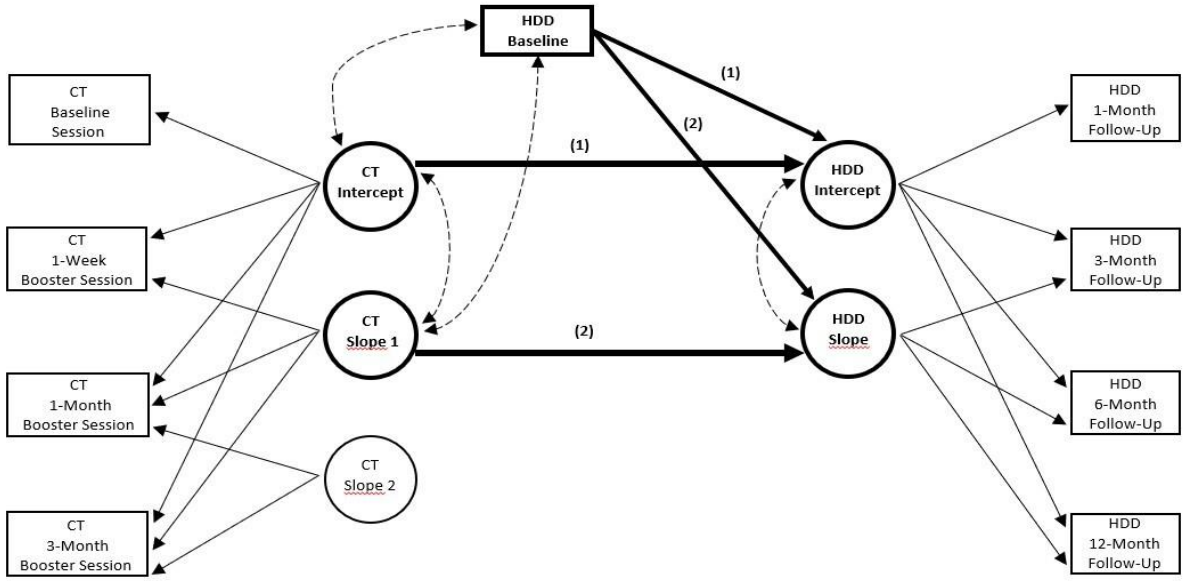
| Effect | Estimate | *SE* | [95% CI] | *p* |
|---|---|---|---|---|
| Model 1: Percent CT | | | | |
| HDD intercept on Percent CT intercept | -0.04 | 0.01 | [-0.06 to -0.01] | .01 |
| HDD slope on Percent CT slope 1 | -0.08 | 0.03 | [-0.14 to -0.03] | .002 |
| Model 2: CT Average Strength | | | | |
| HDD intercept on CT Average Strength intercept | -0.99 | 0.35 | [-1.67 to -0.31] | .005 |
| HDD slope on CT Average Strength slope 1 | -2.29 | 0.63 | [-3.52 to -1.07] | <.001 |

*Note.* Regressions are computed with MLR analysis, intercepts and slopes of the latent growth curve of corresponding variable, and adjusted for baseline measure of HDD (see Participants' Baseline Characteristics section). The intercept of CT measures corresponds to CT measure at baseline session. CT measures slope 1 corresponds to CT measure from baseline to 1-week booster session. The intercept of HDD corresponds to HDD at 1-month follow-up. The slope of HDD corresponds to the linear slope of HDD from 1- to 12-month follow-up. Standardized association between intercept and slope (*SE*) was -0.59 (0.09) for Percent CT ($p$<.001) and -0.43 (0.36) for HDD ($p$=.234) in Model 1, and -0.61

(0.08) for CT Average Strength ($p$<.001) and -0.48 (0.35) for HDD ($p$=.164) in Model 2. CT = change talk; HDD = heavy drinking days over the past 30 days; CI = confidence interval; MLR = maximum likelihood estimation with robust standard errors.

**Figure 1**

*Conceptual Model of CT Effects on HDD*




*Note.* CT (i.e., Percent CT and CT Average Strength) is estimated by a linear-linear piecewise LGCM. CT at baseline session corresponds to CT intercept; CT trajectory from baseline to the 1-week booster session corresponds to CT slope 1, and CT trajectory from 1-week to 3-month booster sessions corresponds to slope 2. HDD is estimated by a linear LGCM. HDD at 1-month follow-up corresponds to HDD intercept; HDD from 1-month to 12-month follow-up corresponds to HDD slope. Bolded paths are regressed pathways:

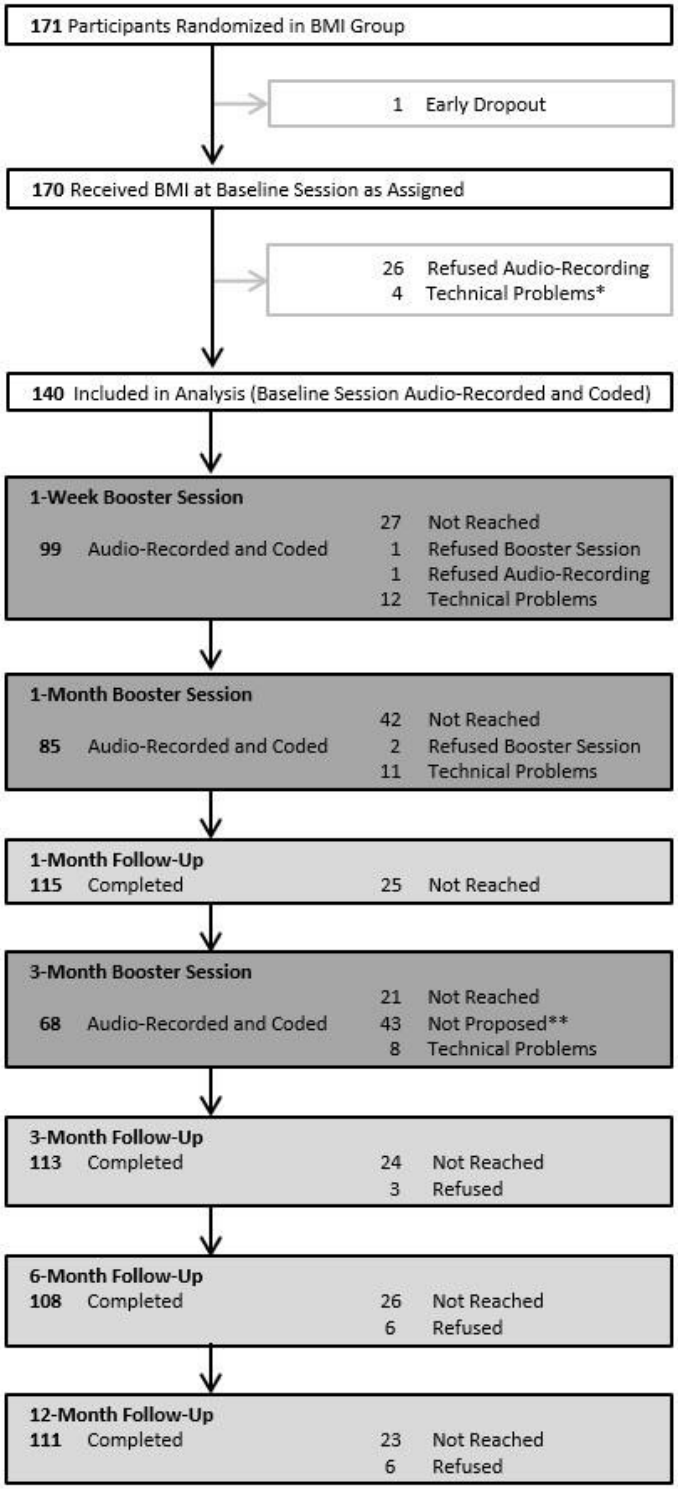
1. Effects of CT intercept (at baseline session) on HDD intercept (at 1-month follow-up), adjusted for baseline measure of HDD.
2. Effects of CT slope 1 (from baseline to the 1-week booster session) on HDD slope (from 1-month to 12-month follow-up), adjusted for baseline measure of HDD.

Effects of CT slope 2 were not computed as Models 1 and 2 did not converge when including a regression of HDD on CT slope 2 (nearly flat slope from the 1-week to the 3-month booster sessions). Dashed paths are correlated pathways. Ovals indicate latent variables. Rectangles

indicate observed variables. CT = change talk; HDD = heavy drinking days over the past 30 days; LGCM = latent growth curve model.

**Figure 2**

*Flow Chart Diagram*

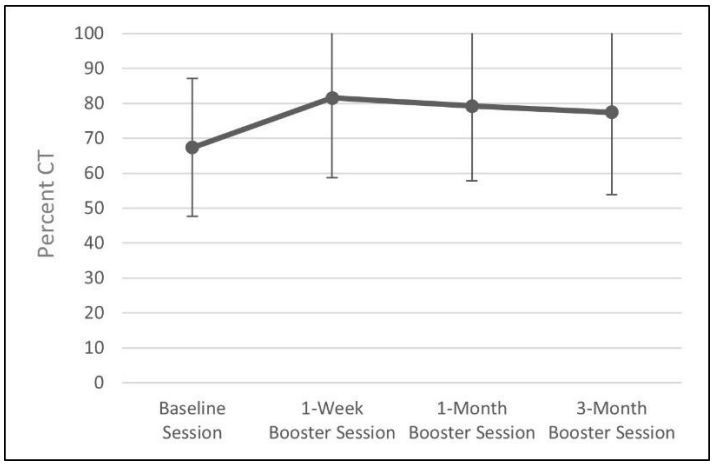



*Note*. bMI = brief motivational intervention.

* No coded session due to technical problems with the audio-recording. ** Participants refused or were not reachable at 1-month booster session.

**Figure 3**

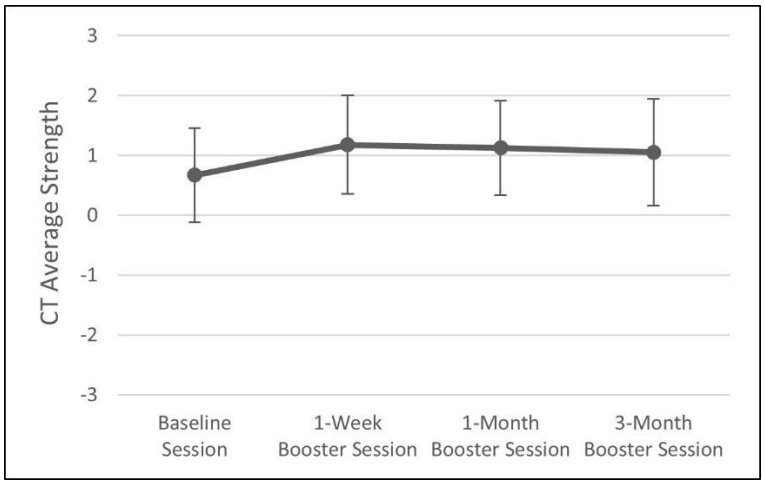
*Percent CT Across Sessions*




*Note.* Values are presented as mean ± 1 *SD*. CT = change talk.

**Figure 4**

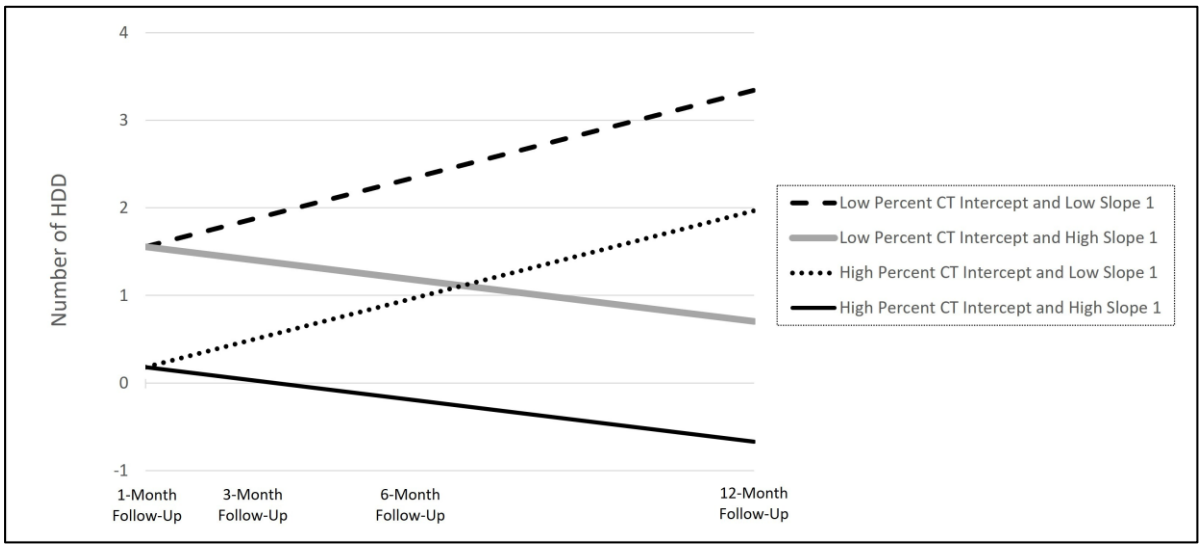
*CT Average Strength Across Sessions*




*Note.* Strength of change talk ranges on a scale of -3 to 3 depending on whether it reflects inclination *toward* (+) or *away from* (-) the targeted behavior change. Strength intensity of change talk is rated as *high* (3), *medium* (2), or *low* (1). Values are presented as mean ± 1 *SD.* CT = change talk.

**Figure 5**

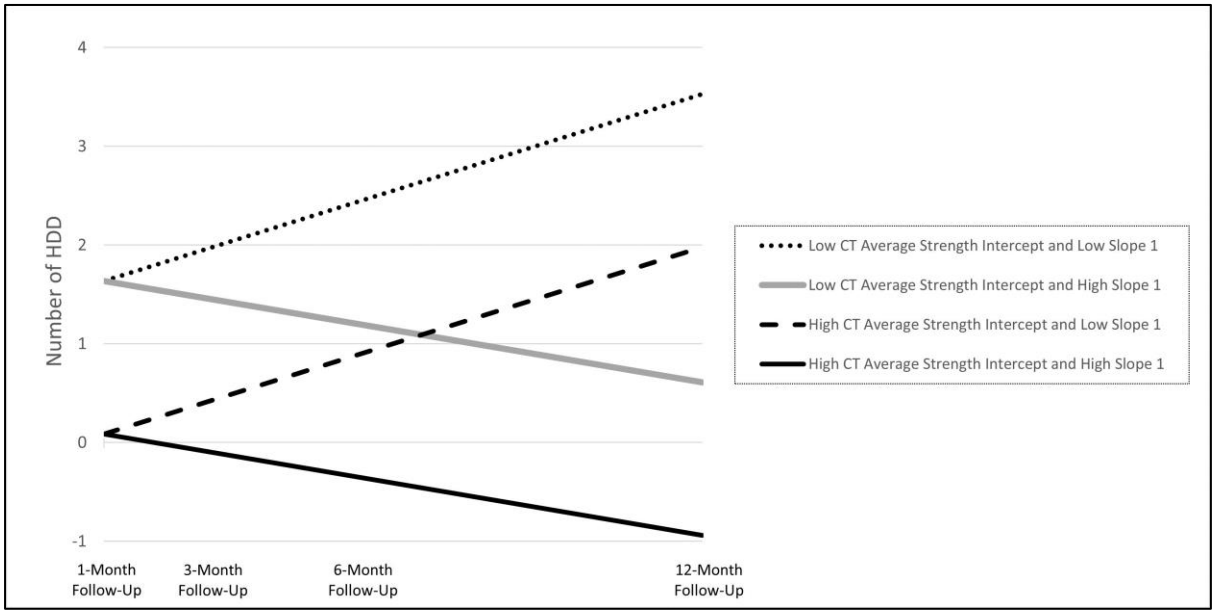
*Predicted Change in HDD Across Follow-Ups According to Percent CT Growth Parameters*




*Note.* Percent CT intercept corresponds to Percent CT at baseline session, and Percent CT slope 1 corresponds to Percent CT trajectory from baseline to the 1-week booster session. High levels of Percent CT intercept and slope 1 were defined by adding 1 *SD* to the intercept and slope 1 means, while low levels were defined by subtracting 1 *SD* to intercept and slope 1 means. HDD= heavy drinking days over the past 30 days; CT= change talk.

**Figure 6**

*Predicted Change in HDD Across Follow-Ups According to CT Average Strength Growth Parameters*




*Note*. CT Average Strength intercept corresponds to CT Average Strength at baseline session, and CT Average Strength slope 1 corresponds to CT Average Strength trajectory from baseline to the 1-week booster session. High levels of CT Average Strength intercept and slope 1 were defined by adding 1 *SD* to the intercept and slope 1 means, while low levels were defined by subtracting 1 *SD* to intercept and slope 1 means. HDD= heavy drinking days over the past 30 days; CT= change talk.