Training emotion regulation processes in alcohol-abstinent individuals: A pilot study

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Title page information

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Manuscript Number: ADDICTBEH_2019_1192R3

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1. INTRODUCTION

A wide range of studies support the role of emotion regulation (ER) difficulties in developing and maintaining mental health problems, including substance use disorders (Berking & Wupperman, 2012; Berking et al., 2011; Maurage et al., 2011). In patients with alcohol use disorder (AUD), ER difficulties might reflect a global disturbance in emotional experiencing including deficits in expressing and decoding emotions (Castellano et al., 2015; Maurage et al., 2009; Cheetham et al., 2010) and difficulties in the ability to trust oneself to control emotional experiences (Berking et al., 2011). In particular, the restrained use of adaptive ER strategies such as reappraisal and the more frequent use of maladaptive ones such as rumination, avoidance or suppression (Aldao et al., 2010; Ghorbani et al., 2017) may lead to maintaining or exacerbating negative thoughts and could contribute to alcohol consumption (Kassel et al., 2007). Indeed, as alcohol may be used to alleviate negative affect in distressing situations, it is considered to have a compensatory role in the same way as emotion regulation strategies (Berking et al. 2011; Sayette, 2017).

While some emotional and cognitive difficulties associated with alcohol consumption tend to decrease with continued abstinence, some of them tend to be maintained over time (Mann et al., 1999; Le Berre et al. 2019). Concerning ER, the length of abstinence leads to more use of adaptive ER strategies (Petit et al., 2015) and to a physiological recovery of ER processes (heart rate variability) after maintained abstinence (> 6 months) (Claisse et al., 2017). Nevertheless, improvement in emotional information processing after a significant period of abstinence is only partial, with lasting difficulties in the expression (Bochand & Nandrino, 2010) and decoding (Kornreich et al., 2001; Foisy et al., 2007) of emotions, thus underlining lasting vulnerability due to alcohol use.

Furthermore, the delay in the recovery of some abilities seems to vary. Some are observable during the first year of abstinence whereas others improve slowly during the second year of abstinence (Fein & Greenstein, 2013). In parallel, reducing or stopping alcohol consumption require personal readjustment (e.g., social, professional or marital) that may be challenging for patients beyond the first year of abstinence (Bartram et al.,

2017; Satre et al., 2012). Consequently, the beginning of the abstinence period may place patients under considerable emotional duress. Therefore, both short- and long-term abstinent individuals need therapeutic approaches that seek to rehabilitate their emotional skills. It has recently been shown that the recovery of ER abilities after treatment has a mediating effect on the duration and maintenance of abstinence as well as on coping with distress (Cavicchioli et al., 2019a; Cavicchioli et al., 2019b; Maffei et al., 2018). ER abilities might predict the decrease in the severity of addiction symptoms. For this reason, the enhancement of ER skills is considered a major therapeutic target in the treatment of AUD by reducing negative affects and improving treatment outcomes (Stasiewicz et al., 2013; Glanton Holzhaver et al., 2017).

Among the emotion training programs assessed in clinical trials in various populations of patients (Berking et al., 2008), the Affect Regulation Training (ART) program developed by Berking & Whitley (2014) constitutes an efficient therapeutic approach for patients with AUD. Its objective is to enhance general ER skills either preventively for individuals at high risk of developing mental health problems or specifically in the treatment of clinical populations (Berking & Lukas, 2015). It targets several emotional skills that correspond to those conceptualized by the authors in the ACE model (Adaptative Coping with Emotions model) as underlying an adaptive ER (Berking et al., 2010). They include the ability to be aware of emotions and to identify and correctly label emotions in order to better understand what causes and maintains emotional states. The program also aims at developing both the ability to identify the targets of change to actively modify emotions in an adaptive manner and the ability to tolerate and accept distressing emotions when they cannot be changed. Finally, the ability to provide self-support when experiencing unwanted emotions is also developed.

The program was developed by integrating techniques from various therapeutic approaches (Berking & Whitley, 2014) such as emotion-focused therapies, acceptance and engagement therapies, and in particular mindfulness-based cognitive therapy (MBCT) (Segal, Williams & Teasdale, 2013). This approach is particularly relevant as many ER skills may be improved such as identification, non-judgmental awareness, tolerance and acceptance of emotions (Berking, 2014). In AUD patients, MBCT has also been used to help patients to enhance their awareness of what can trigger substance use and to better cope with the effects of craving (Marlatt, 2002; Witkiewitz et al., 2005). In men, mindfulness was found to

be negatively linked with drinking in order to cope with negative emotions (Leigh & Neighbors, 2009), and the use of MBCT in alcohol rehabilitation interventions is encouraged for patients who drink to reduce negative affect (Fernandez et al. 2010).

In AUD patients, Stasiewicz et al (2013) tested the impact of ART as an additional treatment to enhance cognitive and behavioral therapy for AUD patients (Stasiewicz et al., 2013). Beyond its good acceptance by patients and good feasibility, ART enables greater gains in treatment concerning drinking outcomes and has a positive impact on negative affects and on mindfulness abilities in patients with AUD. While the latter study showed promising results in AUD patients, further investigation of its effectiveness in a larger population is needed. Given the impact of ER difficulties on relapse and on the persistence of such difficulties even after abstinence, the aim of the present study was **(1)** to confirm the effectiveness of the ART program on emotional outcomes (ER strategies and mindfulness abilities) among abstinent AUD patients; and **(2)** to evaluate whether the ER abilities of recently abstinent patients (< 18 months) and patients with a longer period of abstinence (> 18 months) improve differently.

The first hypothesis was that after participation in an ART program, AUD patients would be more able to use some adaptive ER strategies such as acceptance, positive centration, centration on action, positive reappraisal and putting into perspective, and would have less recourse to non-adaptive strategies such as self-blame, rumination, catastrophizing and blaming others. We also wondered whether their mindfulness abilities such as observing, describing, acting with awareness, non-judging and non-reactivity to inner experience would be enhanced. The second hypothesis was that recently abstinent patients (< 18 months) would be more able to use these adaptive ER strategies and mindfulness skills than patients with long-term abstinence (>18 months), and that they would show a greater decrease in the use of non-adaptive ER strategies.

2. METHOD

Participants

Initially, 128 AUD patients who had been abstinent from three weeks to several years were recruited from the Alcoholics Anonymous association and from the addictology department at Hénin-Beaumont Hospital in France. The inclusion criteria were a diagnosis of AUD (DSM5,

American Psychiatric Association, 2013), age between 18 and 65 years, successful completion of withdrawal, and an intended treatment duration of a maximum of one month. All participants gave their written informed consent to participate after a thorough explanation of the study procedures. They were assessed for inclusion by a psychologist. All participants with delusional psychiatric disorders, with bipolar disorders and individuals with active co-dependence (except tobacco) were excluded from the study. Among the 128 AUD participants, a first group of 88 patients were offered the ART program and 40 were randomly assigned to the control group (see figure 1). In the ART group, 72 participants met all inclusion criteria and accepted to participate in the program. Sixty participants fully completed the sessions of the training and were assessed at the end of it (7 participants missed more than two sessions and 6 did not perform the post-test evaluations). Concerning the evaluation six months after the end of the program, 2 patients did not respond fully to the questionnaires and were excluded from the analysis. In addition, 40 AUD patients in usual care (UC) who did not participate in the program constituted the control group and were tested twice with an 8-week interval (corresponding to the time of the training sessions) (see table 1).

----------Insert Table 1 and figure 1 about here----------

Experimental procedure

After collecting socio-demographical and alcohol use history data (number of withdrawals, age at first consumption, length of abstinence, quantity of alcohol consumed before abstinence, subjective well-being of abstinence), participants completed questionnaires on ER strategies and mindfulness abilities. For the ART group, evaluations were performed before (T0), after the ART program (T1) and six months later (T2). In the UC group, the evaluation was performed twice: once at (T0) and 8 weeks later (T1).

Emotion regulation strategies were measured with the Cognitive Emotion Regulation Questionnaire (CERQ) (Garnefski, Kraaij & Spinhoven, 2001; French validation by Jermann et al., 2006) composed of 36 self-reported items rated on a 5-point Likert scale ranging from 1 (*almost never*) to 5 (*almost always*). A score for each strategy is obtained with higher scores indicating a greater use of the strategies. An “adaptive strategies” score is computed by

adding the different sub-scales: acceptance, positive centration, refocus on action, positive evaluation, putting into perspective. A second sub-score corresponding to "non-adaptive strategies" is computed by adding the scores of the sub-scales: self-blame, rumination, catastrophizing, blaming others. Regarding the French validation, acceptance and catastrophizing had acceptable internal reliability (.68), and the other subscales had good (> .70) to very good (> .80) internal reliability (Jermann et al., 2006). In our sample, internal reliability was good (>.70) to very good (> .80) for all the subscales except for the acceptance dimension with a score of .56. The internal reliability was .93 for the adaptive dimension and .86 for the non-adaptive dimension.

Mindfulness was assessed with the Five Facets Mindfulness Questionnaire (FFMQ) (Baer et al., 2008; French validation by Heeren et al., 2011). The FFMQ is a self-reported questionnaire composed of 39 questions rated on a 5-point Likert scale ranging from 1 (*never or rarely true*) to 5 (*very often or always true*). Five dimensions are measured: observing, describing, acting with awareness, non-judging, and non-reactivity to inner experience. Higher scores indicate greater mindfulness abilities and a total score is computed by adding the scores of the five dimensions. The French validation (Heeren et al., 2011) demonstrated that the global scale and each subscale have a good internal validity (alpha comprised between .76 and.89), and that the global scale and each subscale exhibit good test-retest reliability. In our sample, the internal reliability was .78 for the observation dimension, .86 for the description dimension, .88 for the acting with awareness dimension, .68 for the non-reactivity dimension and .82 for the non-judging dimension.

Affect Regulation Training: In the ACE model, adaptive emotion regulation was conceptualized as a situation-dependent interaction between seven emotion regulation abilities: 1) *to be consciously aware of emotions,* 2) *to identify and correctly label emotions,* 3) *to identify what causes and maintains an emotion,* 4) *to actively modify emotions in an adaptive manner,* 5) *to accept and tolerate negative emotions when necessary,* 6) *to approach and confront situations likely to trigger negative emotions, and 7) to provide effective self-support in distressing situation.*

We proposed six training modules to develop these emotion regulation abilities: 1) psycho-education, muscle and breathing relaxation; 2) non-judgment and awareness; 3) acceptance and tolerance; 4) compassionate self-support; 5) analyzing emotions; 6) modifying emotions

(for their description see fig1). Based on the scientific literature to describe the rationale for each emotion regulation ability, the therapist used skill-building exercises during the sessions and an audio sequence was proposed at the end of the session. Participants received six weekly 3-hour ART therapy sessions in a group of 6 to 8 persons. Each participant had paper and digital media on a USB drive at their disposal. Between each weekly session, exercises were proposed daily by email and with a paper support. The aim consisted in making participants autonomous in their use of tools.

Statistical analyses

Statistical analyses were performed using the SPSS software package (version 25). Comparisons of demographic and clinical characteristics between ART and UC groups were conducted using *t* tests for quantitative measures and Pearson χ^2 tests for categorical variables.

Linear mixed-effect models (using individuals as a random effect and groups and time as fixed effects) compared the means between the two groups on ER strategies and mindfulness ability across the two times (T0, T1). The main feature of a random effects model for longitudinal data is that there is a natural heterogeneity between individuals in their response over time, which can be represented by an appropriate probability distribution. Mixed models consider the fact that in the event where there are several measures per subject, the errors are not independent. Moreover, the method is suitable when participants occasionally have missing data. The quality of the mixed model analyses was compared to repeated measures ANOVA analyses and was systematically superior (see details in the supplementary tables). Our mixed models were computed as a random intercept model. We compared different types of variance/covariance matrix in the model. When comparing two different types of matrix (AR1, CS and Diagonale) and in all the cases, the Diagonale structure was the most robust and was used for all the analyses.

Regarding the conditions of application, we also controlled the linearity of the longitudinal data. We compared a linear and a quadratic fit (for details see supplementary tables). For most of the variables, the linear fit was better except for a few variables, where the quadratic fit appeared better. In a parsimony procedure, we performed a quadratic fit in these rare cases. Moreover, as there was a difference between our groups (UC or affect regulation training) on abstinence duration, we included this variable as a co-variable in our

models. Concerning the ART group, we evaluated the effects of time on psychological measures in the participants using a mixed model (at three time points: before (T0), at the end (T1) and three months after (T2) training). When the time effect was significant, we used analysis by contrast using T2 as the reference. Finally, to study ART response patterns by duration of abstinence, we constructed two subgroups from the participants who received training: individuals with short-term abstinence of 1 to 18 months (STA, n=31) and those with long-term abstinence greater than 18 months (LTA, n=41). Using a linear mixed-effects model, we compared the scores of the STA and LTA groups at the three time points (T0, T1 and T2) on psychological measures and clinical outcomes, incorporating age as a co-variate (the variable differentiating the two populations of abstinent patients).

3. RESULTS

3.1. Group comparisons between T0 and T1

There was a significant interaction effect between groups and times on the subscales *Positive centration, centration on action and self-blame* of the CERQ. The scores on these subscales evolved more in the ART group. Concerning mindfulness, there was a significant effect on the *total mindfulness score* and on the sub-scales *Non-reactivity to inner experience, observing and describing.* Scores evolved towards an increase in mindfulness (see table 2 and figure 2).

----------Insert Table 2 and Figure 2 about here----------

3.2. Scores at three timepoints for whole group receiving ART

Linear mixed models showed a time effect for the ART group on the CERQ dimensions *Putting into perspective* ($F(2,76)=7.1$, $p=.001$), *Positive centration* ($F(2,73)=13.6$, $p<.001$), *Action centration* ($F(2,77)=6.9$; $p=.002$, *Dramatization* ($F(2,76)=5.4$; $p=.006$), *Self-Blame* ($F2,75)=9.94$; $p<.001$), and *Rumination* ($F(2,74)=6.1$, $p=.003$) but not on *Acceptation* ($F(2,80)=1.8$) or *Blame of others* ($F(2,76)=1.8$). Adaptive and non-adaptive strategies changed significantly over time (respectively $F(2,73)=11.2$ and $p<.001$ and $F(2,66)=12.9$, $p<.001$)).

The analysis of ART participants showed a difference between T0 and T1 for all CERQ scores except Acceptation, Positive evaluation and Blame of others, for which there was no change

over time. Interestingly, there were no differences between T1 and T2 on all scores. Concerning the total FFMQ score and its five sub-dimensions (*observing, describing, acting with awareness, non-reactivity to inner experience and non-judging*), there was a significant time effect (total score $F(2,75)=16$, $p<.001$, and sub-dimensions $F(2,77)=4.47$, $p=.015$; $F(2,63)=6.9$, $p=.002$; $F(2,65)=8.7$, $p<.001$; $F(2,83)=13.2$, $p<.001$; $F(2,88)=9.5$, $p<.001$, respectively). The analysis by contrast showed significant differences between T0 and T1 for all dimensions and the total score. Again, there were no differences between T1 and T2 for all dimensions.

3.3 Emotion regulation changes at three time points in the short- (STA) and long-term (LTA) abstinence groups

The mixed-effects analyses of the sub-groups (STA and LTA, see table 3) at T0, T1 and T2 showed significant interaction effects on *adaptive* and *non-adaptive strategies* and on five sub-scales: *Positive centration*, *Positive Evaluation, Dramatization, Self-blame and Rumination (table 4)*. There was a greater decrease in the use of *non-adaptive strategies* and a greater increase in *Adaptive strategies* in the STA group *(figure 3)*. Nevertheless, there was no significant interaction on the sub-scales *Acceptation*, *Putting into perspective*, *Action centration*. Concerning FFMQ scores, there were no significant effects on *total mindfulness score* and on the sub-scales *Observing*, *Describing*, *Acting with awareness,* but a significant difference on the subscales *Non-reactivity to inner experience* and *Non-judgment*.

The mixed-effects analyses of the sub-groups (STA and LTA, for a description see table 3) at T0, T1 and T2 showed significant interaction effects on *adaptive and non-adaptive strategies and* on five sub-scales: *Positive centration, Positive Evaluation, Dramatization, Rumination and Self-blame (table 4)*. There was a greater decrease in the use of *Self-blame* and *Non-adaptive strategies* and a greater increase in *Positive Evaluation* in the STA group *(figure 3)*. Nevertheless, there was no significant interaction on the sub-scales *Acceptation*, *Putting into perspective*, *Action centration*, and *Blame of others*. Concerning FFMQ scores, there were no significant effects on *Total mindfulness score* or on the sub-scales *Observing*, *Describing* and *Acting with awareness, but there was a significant effect on Non-reactivity to inner experience and Non-judgment*.

----------Insert Tables 3 & 4, and Figure 3 about here----------

4. DISCUSSION

Following completion of the ART program, participants demonstrated improvements in some ER outcomes. Concerning ER strategies, the CERQ results revealed a greater use of the strategies *Centration on action* and *Positive centration*, which are considered adaptive strategies, and a decrease in the use of the non-adaptive strategy *Self-blame* for the ART patients as a result of the training. Furthermore, the ART program also led to an increase in the use of mindfulness abilities in the abstinent AUD participants, in particular an enhancement of the *describing*, *observing* and *nonreactivity* skills, as indicated by the FFMQ results. All these improvements in ER abilities are consistent with the content of the specific modules of the program, which includes mindfulness training and the development of skills such as acceptance and modification of emotions, which may induce less self-blame and lead to the use of adaptive strategies such as centration on action or positive centration.

Regarding the evolution of their emotional abilities over time, patients who received ART used some adaptive strategies better except Acceptation and Positive evaluation and had less recourse to non-adaptive strategies except Blame of others. This effect was still observable at T3. In addition, their mindfulness skills increased significantly.

Concerning this impact on mindfulness, our results are in line with those of Stasiewicz et al. (2013), who also demonstrated the benefits of ART mainly on mindfulness rather than on ER strategies in a sample of AUD patients. These benefits were particularly evident for observing and describing emotions. In addition, the use of several other ER strategies improved over time as a result of receiving ART. These improvements in mindfulness are consistent with the content of ART programs. Among the seven emotional skills they focus on, most of them include mindfulness techniques. For example, mindfulness techniques are used with regard to *Nonjudgmental Awareness* to help patients to observe what they feel without interpreting, judging or reacting. Moreover, the skill of *Acceptance and Tolerance* aims at helping patients to cope with undesired emotions when they cannot be changed, an area where mindfulness-based techniques have already demonstrated their efficacy (Wupperman et al., 2012). Furthermore, while ART skills are presented independently from

each other, the exercises proposed at the end of each session and in homework concern the skill worked on in the current session in addition to those already addressed. Consequently, the earlier a skill is addressed, the more the therapeutic techniques related with this skill are worked on, given that mindfulness is introduced early in the program. By contrast, emotion-modifying strategies are the focus of the last session which is centered on *Modification of Emotion*. In this session, a step-by-step process based on problem-solving techniques is presented to the patients to guide them in choosing strategies to modify their emotions. The development of this skill is particularly reflected by CERQ scores as it is the least consolidated skill, which may explain why only some strategies are improved. This view was also posited by Stasiewicz et al (2013) who underlined that active behavioral techniques targeting ER occupy less of a focus in ART programs than the skills of identification, awareness and acceptance of undesired emotions. Like us, they also found a lack of significant improvement in several ER strategies.

Concerning the second aim of the study which was to compare the effectiveness of the program in STA and LTA individuals, we found specific emotional and mindfulness outcomes according to the duration of abstinence. CERQ scores indicated a more significant decrease in using non-adaptive strategies, and in particular self-blame, dramatization and rumination, in STA patients than in LTA patients. However, at baseline, STA patients reported a greater use of these strategies, yet their score was not more different from that of LTA patients after 6 months of treatment. Similarly, a more significant increase in the use of adaptive strategies was found for STA patients, especially positive evaluation and positive centration. While STA patients reported a lower use of these strategies at baseline than LTA patients, the difference between them had decreased after 6 months of treatment. Concerning mindfulness scores, STA patients showed a higher increase in the dimensions Non-reactivity to inner experience and Non-judgement.

The significant results observed with the different ER strategies and mindfulness dimensions imply that STA patients might be more receptive to the training of these abilities. A complete session is focused on self-compassion, during which the patient is encouraged to adopt actions of self-soothing and self-encouragement instead of self-criticism. It is possible that early abstinence is often followed by a feeling of guilt so this session may have special relevance for STA patients, as reflected by the greater modifications in self-blame or non-judgement dimensions. Furthermore, early abstinence can also trigger many disruptions in

life such as divorce and reduced social interaction. Consequently, ART may help STA patients to cope better with unpleasant emotions that they likely experience more frequently at this key moment, and it might allow them easier access to positive emotions, resulting in a greater increase in positive evaluation and positive centration and a lower use of rumination or dramatization than is the case for LTA patients. It is as if ART accelerates the rehabilitation of ER abilities in early abstinent individuals, so it should be offered at the beginning of the period of abstinence.

Despite these promising results, our results must be considered in the light of some limitations. First, there was a difference in the length of abstinence of ART and UC patients. However, as ART patients reported a shorter duration of abstinence than UC patients and were also those who showed a better emotional improvement, the efficacy of the program may have been underestimated. Second, physiological effects related to withdrawal (e.g. modification of the responses of the hypothalamic-pituitary-adrenal axis, of the sympathetic and parasympathetic systems, and of sleep activity) may also be involved in the greater improvement observed in the STA group than in the LTA group. Third, another variable that may have influenced the benefits of the program is the intensity or the frequency of personal emotional training between the different sessions and evaluations. While the program provided participants with a wide range of exercises that they could use autonomously to consolidate the benefits of the group sessions, their use was not controlled. Fourth, the evaluation of abstinence maintenance was self-reported. The absence of an objective measure of alcohol consumption may have impacted the robustness of the results. Fifth, despite the randomization of inclusions, there was a difference before treatment between the two groups with ART and the control participants concerning the duration of abstinence. Future studies should investigate whether this initial difference alters the observed effects. Finally, the use of self-report questionnaires to evaluate emotion abilities among participants who may have difficulty in recognizing and expressing their emotions is another limitation. This study may be seen as assessing rather the subjective impact of ART. The administration of performance tasks would help to confirm these observations.

To conclude, ART leads to a greater improvement in ER strategies and in some mindfulness skills in comparison to the delivery of UC alone in abstinent AUD patients. The importance of enrolling patients in follow-up programs (such as Alcoholics Anonymous programs) after the

withdrawal cure has already being highlighted, as it helps them to maintain the benefits of the treatment and prevents them from relapsing (Gossop et al., 2008; Proctor & Herschman, 2014). The ART program shares some commonalities with other programs such as group format or emotion expression facilitation and may consequently provide similar clinical benefits. However, the specific content of ART, which is centered on emotional skills training and not only on relapse prevention, may explain the better enhancement in ER abilities observed in patients who were in the ART group.

Furthermore, while ART seems to potentiate the efficacy of UC whatever the duration of abstinence, it seems to accelerate ER rehabilitation in recently abstinent subjects. Consequently, early delivery of the program after alcohol cessation may be particularly relevant. Finally, as the program was developed as a transdiagnostic intervention whose efficacy has been proved in several clinical populations (Berking et al., 2006), another way to improve its benefits in AUD patients would be to integrate additional modules specific for targeted populations such as those focused on developing self-control strategies and drink refusal skills (Stasiewicz et al., 2018).

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Figure 1. Structure of intervention for ART and control groups and description of ART sessions.

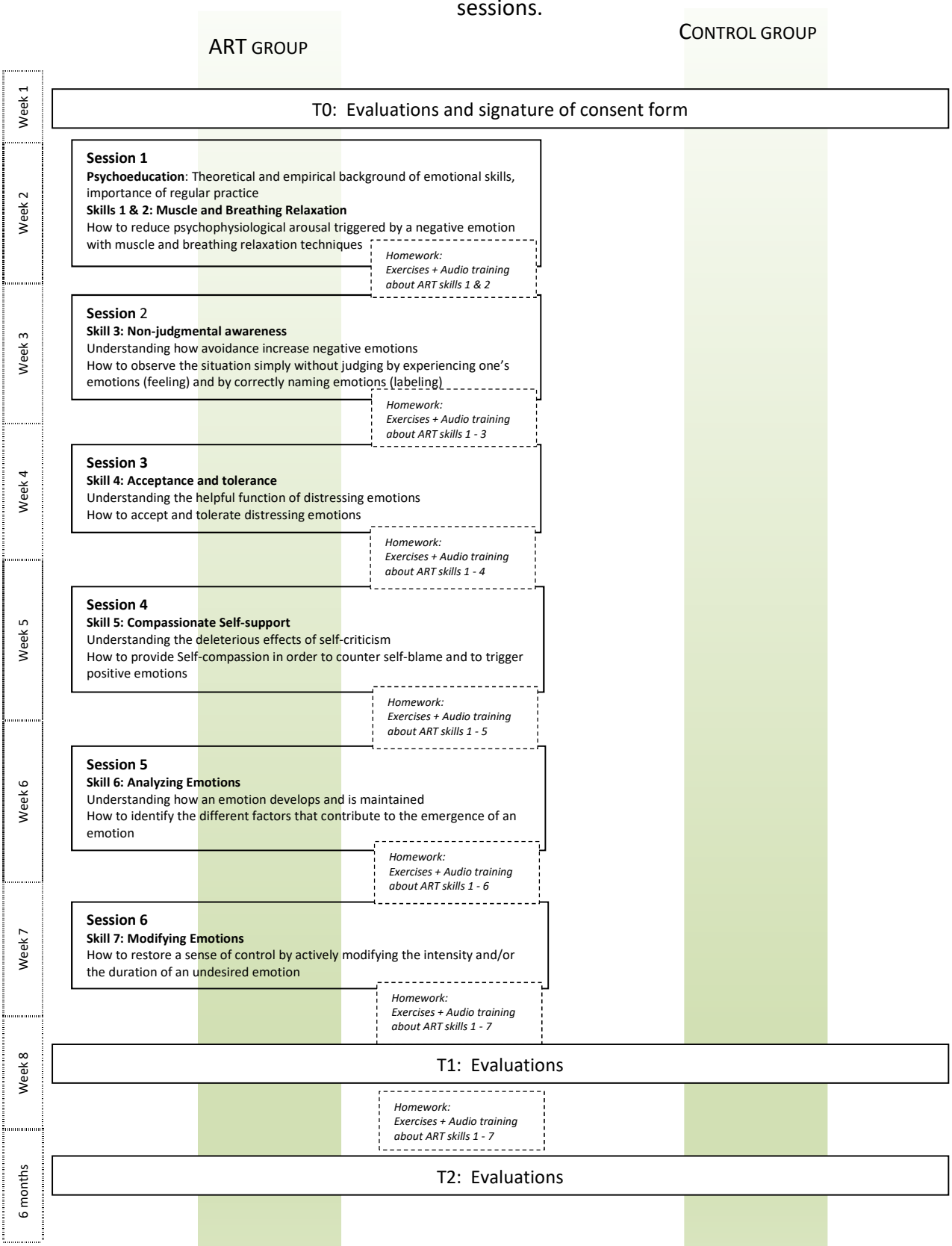


Figure 2: Effects of affect regulation training

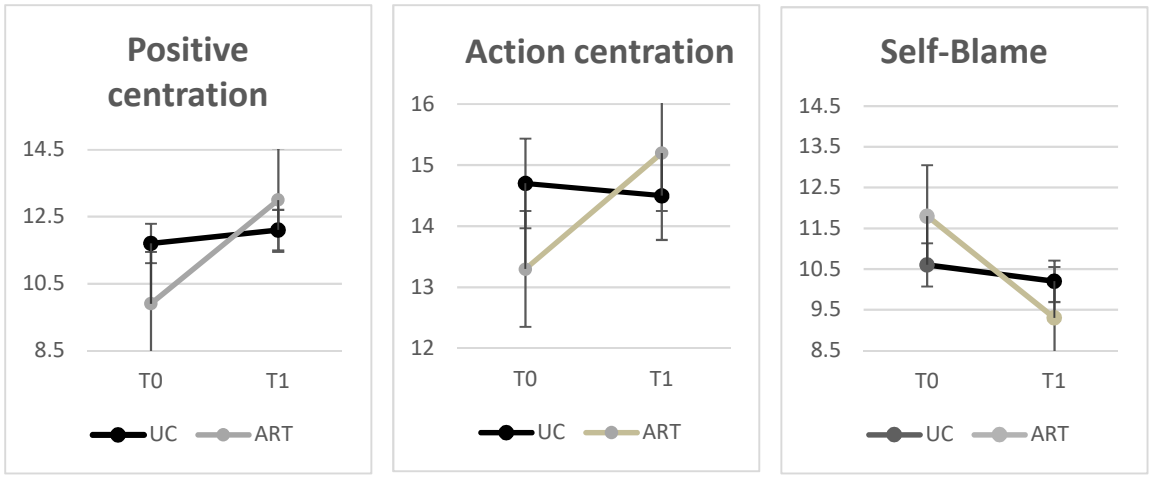


Figure 2a: Effect on action centration, positive centration and self-blame (CERQ) for ART (Affect Regulation Training) and UC (usual care) groups before (T0) and after training sessions (T1).

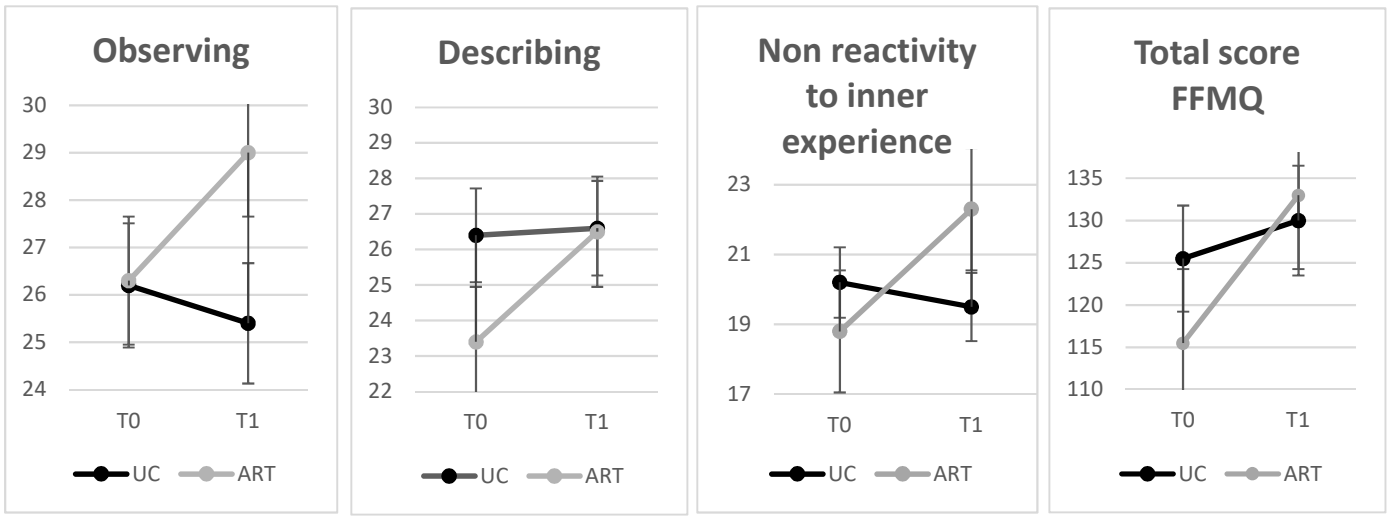
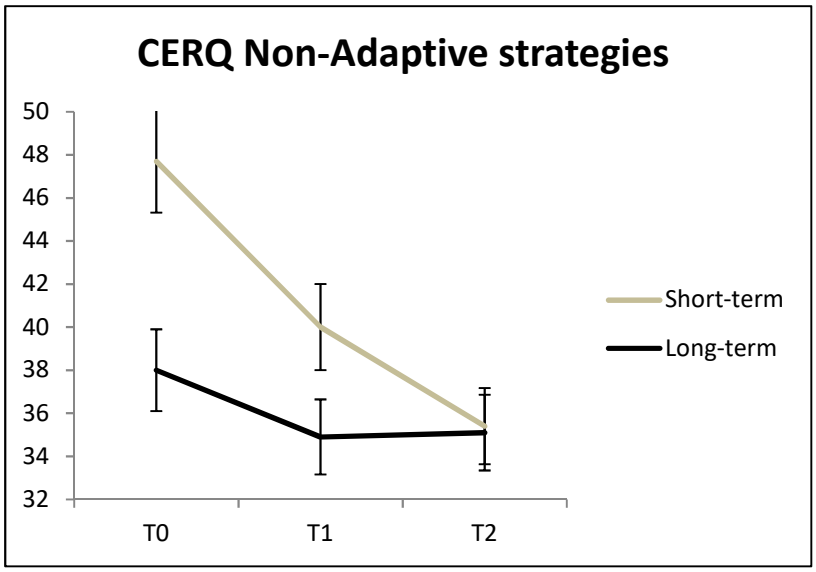


Figure 2b: Effect on observing, describing, non-reactivity to inner experience and on total mindfulness score (FFMQ total score) for ART (Affect Regulation Training) and UC (usual care) groups before (T0) and after training sessions (T1).

Figure 3: Changes in adaptive and non-adaptive emotion regulation strategies (CERQ) at three measurement times (T0, T1, T2) in short- or long-term abstinence duration groups



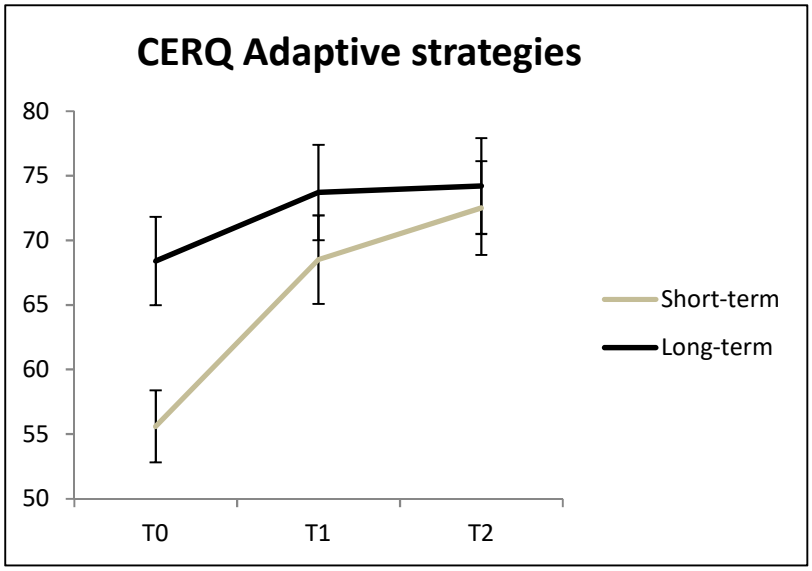


Table 1. Comparison of clinical characteristics (mean and standard deviation) between group with affect regulation training (ART) and control participants with usual care (UC)

Variables	Abstinent control participants (UC, N=40)	Abstinent with affect regulation training (ART, N=72)	*t*	*p*
Age (years)	54.6 (13.7)	53 (11.8)	.7	.5
Education (number of school years)	13.73 (2.9)	13.35 (3)	.65	.38
Age at first consumption	14.85 (4.3)	14.4 (5.3)	.5	.63
Age at problematic consumption	30.5 (10.9)	31.7 (10.3)	.58	.56
Actual abstinence duration (in months)	106 (118)	62.4 (77)	2.4	**.02**
Subjective experience of abstinence	6.9 (2.7)	7.5 (2.7)	1.2	.23

Table 2. Group comparisons for emotion regulation strategies and mindfulness skills before and after emotion regulation training between group with affect regulation training (ART) and control participants with usual care (UC)

	Abstinent control participants (UC)		**Abstinent with ART**				
	Baseline (N=40) ***Mean (sd)***	***After*** **(N=40)** ***Mean (sd)***	**Baseline (N=72)** ***Mean (sd)***	***After (N=60)*** ***Mean (sd)***	***Group Effect***	***Time effect***	***Interaction Groups X Time***
CERQ adaptive	68.2 (17.8)	70.6 (15.8)	62.9 (16.2)	72 (15.5)	F = .67 P = .42	F = 8.3 P = .005	F(1,198) = 2.4 P = .13
CERQ Non-adaptive	37.8 (12.4)	36 (10.1)	42.2 (11.6)	36.4 (8.6)	F = .26 P =.61	F = 11.2 P = .001	F(1,202) = 3 P = .09
CERQ Acceptation	14 (4)	14.8 (3.9)	14.3 (3)	14.6 (3.8)	F = .02 P =.88	F = 1.27 P = .26	F(1,180) = .39 P = .53
CERQ Putting into perspective	13.8 (4.6)	14.3 (3.9)	12.9 (3.8)	14.5 (3.6)	F = .47 P =.49	F = 4.7 P = .03	F(1,199) = .76 P = .38
CERQ Positive centration	11.7 (4.4)	12.1 (4.4)	9.9 (4.5)	13 (4.3)	F = 0.63 P =.43	F = 11.6 P = .001	**F(1,195) = 5.2** **P = .03**
CERQ Action centration	14.7 (4)	14.5 (3.9)	13.3 (4)	15.2 (3.5)	F = .32 P =.57	F = 2.91 P = .09	**F(1,199) = 5.1** **P = .03**
CERQ Positive evaluation	14 (4.3)	14.9 (3.7)	12.5 (4.7)	14.8 (3.8)	F = 1.1 P =.29	F = 9 P = .003	F(1,202) = 2 P = .16
CERQ Dramatization	8.6 (4.2)	7.7 (3.5)	9 (4)	7.8 (3.6)	F = .01 P =.96	F = 4.5 P = .04	F(1,201)= .16 P = .69
CERQ Self-Blame	10.6 (4.3)	10 .2 (3.5)	11.8 (4)	9.3 (3.1)	F = .4 P =.55	F = 8.7 P = .004	**F(1,202) = 4.8** **P = .03**
CERQ Rumination	11.5 (4.1)	11 (4.3)	11.1 (4.1)	11.7 (3.5)	F = 1 P =.31	F = 4.9 P = .03	F(1,198) = 1.1 P = .29
CERQ Blame of others	7.2 (3.3)	7.1 (2.7)	8.3 (3.9)	7.6 (2.8)	F = 1.1 P =.31	F = 1.5 P = .22	F(1,201) = .5 P = .48
FFMQ Total	125.5 (17.6)	130.2 (15)	115.5 (22.2)	132.8 (21.6)	F = .8 P =.39	F = 22.2 P = .001	**F(1,197) = 7.5** **P = .007**
FFMQ Observation	26.2 (5.8)	25.4 (6.6)	26.3 (6.7)	29 (6.2)	F = 3.2 P =.08	F = .9 P = .35	**F(1,193) = 5.4** **P = .02**
FFMQ Description	26.4 (5.9)	26.6 (4.2)	23.4 (7.1)	26.5 (6.1)	F = 2.3 P =.13	F = 5.6 P = .02	**F(1,202) = 5.3** **P = .02**
FFMQ Acting with awareness	28.2 (7.3)	30.3 (5.9)	24.3 (6.9)	28.1 (6.3)	F = 5.9 P =.02	F = 17.5 P = .001	F(1,201) = 1.2 P = .27

FFMQ Non-reactivity to inner experience	20.2 (4.3)	19.5 (4.2)	18.8 (5)	22.3 (5)	F = .8 P =.37	F = 6.1 P = .015	**F(1,193) = 12.8 P = .001**
FFMQ Non-judging of inner experience	24.5 (6.5)	28.3 (6.1)	22.7 (6.7)	26.9 (6.3)	F = 1.1 P =.28	F = 28.4 P = .000	F(1,197) = .01 P = .96

CERQ, Cognitive Emotion Regulation Questionnaire; FFMQ, Five Facets Mindfulness Questionnaire

Table 3. Comparison of clinical characteristics (mean and standard deviation) between short- and long-term abstinent groups

Variables	Short-term abstinence (N=31)	Long-term abstinence (N=41)	*t*	*p*
Age (years)	46.5 (11.7)	57.9 (9.4)	4.6	**.001**
Education (number of school years)	13.3 (2.8)	13.4 (3.1)	.06	.95
Age at first consumption	15.2 (7)	13.8 (3.5)	1.2	.24
Age at problematic consumption	29.7 (9.6)	33.2 (10.6)	1.4	.15
Abstinence duration (in months)	4.8 (3.5)	105.9 (77.4)	7.2	**.001**
Number of withdrawals	2.77 (3.6)	2.22 (3)	.7	.48

Table 4. Group comparisons for emotion regulation strategies and mindfulness skills before, after emotion regulation training and six months later between the short- and long-term abstinence groups

	Short-term abstinence participants			**Long-term abstinence participants**			**Interaction Groups x Times**	
	Baseline (N=31) Mean (sd)	***End of training Mean (sd)***	***6 months Mean (sd)***	***Baseline (N=41) Mean (sd)***	***End of training Mean (sd)***	***6 months Mean (sd)***	***F***	***p***
CERQ adaptive	55.6 (16.7)	68.5 (22.2)	72.5 (17.3)	68.4 (13.5)	73.7 (10.9)	74.1 (11.5)	**F(2,125)=2.59**	**.011**
CERQ Non-adaptive	47.7 (12.1)	39.6 (11.4)	35.4 (10.6)	38 (9.4)	34.9 (6.5)	35.1 (7.9)	**F(2,121)=3.14**	**.002***
CERQ Acceptation	13.8 (2.8)	14.2 (4.4)	15.8 (3.9)	14.7 (3)	14.8 (3.5)	15.1 (3.5)	F(2,119)=-1.53	.13
CERQ Putting into perspective	12.2 (4.4)	14.5 (4.4)	15.4 (3.5)	13.4 (3.5)	14.5 (3.2)	14.9 (3.1)	F(2,125)=-1.5	.12
CERQ Positive centration	7.7 (3.9)	11.8 (5.7)	12.5 (4.7)	11.5 (4.2)	13.6 (3.3)	13 (3.9)	**F(2,119)=-2.4**	**.016***
CERQ Action centration	11.7 (4)	14.1 (4.9)	14.3 (4.2)	14.5 (3.5)	15.7 (2.4)	15.8 (2.8)	F(2,121)=1.05	.31*
CERQ Positive evaluation	10.1 (5)	14 (5.1)	14.5 (4.1)	14.3 (3.6)	15.2 (3)	15.4 (3.3)	**F(2,123)=2.98**	**.004**
CERQ Dramatization	10.6 (4.1)	8.3 (3.8)	7.4 (2.9)	7.9 (3.4)	7.6 (3.5)	7.5 (3.5)	**F(2,124)=2.95**	**.004**
CERQ Self-Blame	13.8 (4.2)	10.1 (4)	9.5 (4.1)	10.2 (3.2)	9 (2.6)	9.2 (3.7)	**F(2,110)=5.9**	**.016***
CERQ Rumination	14.5 (3.5)	12.4 (4.1)	10.8 (3.5)	12.1 (4.2)	11.3 (3.2)	11.3 (3.7)	**F(2,118)=2.37**	**.019**
CERQ Blame of others	8.9 (4.2)	8.8 (2.3)	7.6 (3.1)	7.9 (3.6)	7 (2.3)	7.2 (3.1)	F(2,123)=.50	.61
FFMQ total	110.4 (24.9)	127.6 (24.7)	136.4 (20.9)	119.3 (19.4)	135.4 (19.7)	131.4 (18.8)	F(2,122)=-1.92	.057*
FFMQ Observation	24.9 (6.5)	26.5 (7.4)	29.7 (5.9)	27.4 (6.7)	30.1 (5.3)	29.1 (5.9)	F(2,118)=1.3	.20
FFMQ Description	21.4 (7.4)	25.8 (6.8)	25.3 (5.9)	24.8 (6.5)	26.9 (5.7)	27.7 (5.4)	F(2,123)=.74	.46
FFMQ Acting in awareness	24.6 (7.3)	27.1 (6)	29.7 (7.4)	24 (6.7)	28.6 (6.4)	27.5 (5.9)	F(2,116)=.61	.54
FFMQ Non-reactivity to inner experience	18.3 (5.7)	22.8 (5.6)	24.1 (2.9)	19.2 (4.4)	22.1 (4.8)	21.4 (4.7)	**F(2,128)=2.4**	**.019***

FFMQ	Non-judging of inner experience	21.2 (7.8)	25.5 (6.4)	27.6 (5.3)	23.9 (5.5)	27.6 (6.2)	25.7 (4.8)	**F(2,131)=2.04**	**.04**

CERQ, Cognitive Emotion Regulation Questionnaire; FFMQ, Five Facets Mindfulness Questionnaire

in bold, significant interaction effects are shown.

the * corresponds to condition where quadratic fit was applied