Episodic Future Thinking for smoking cessation in individuals with substance use disorder: Treatment feasibility and acceptability

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Abstract

Background. Smokers with substance use disorders (SUD) smoke approximately four times more than the general population. Current efforts are focused on improving smoking cessation treatments for this population. Episodic future thinking (EFT), a novel intervention aimed at decreasing impulsive choice, has shown promising results for reducing cigarette demand in experimental settings. This feasibility study sought to examine the feasibility and preliminary EFT effects on delay discounting (DD) and nicotine intake reductions throughout treatment. **Method**. Smokers in substance use treatment (*N*=29; 75.9% males) received an 8-week cognitive-behavioral treatment (CBT)+EFT for smoking cessation. Feasibility was assessed through successful recruitment rates, retention, and adherence to treatment. Acceptability was measured as participants' satisfaction. Non-parametric range tests were computed to analyze changes in continuous variables. **Results.** Among interested individuals, 42 (43.75%) met the inclusion criteria, and 29 entered the treatment program. Rate of treatment completion was 65.5% (19/29). Mean (*SD*) sessions attended were 7(1.11), and mean patient satisfaction rating with treatment was 8.83/10. Low compliance with EFT was observed, with 15.8% (3/19) of patients practicing at least 50% of the requested times. **Conclusions.** CBT+EFT is acceptable for the SUD population. However, some adjustments should be implemented to improve the adherence and feasibility of EFT, such as reducing the number of practices and temporal intervals in EFT events. Given the low sample size, and the absence of a control group, future larger scale trials are needed to elucidate EFT effects on DD and smoking cessation.

Keywords: smoking cessation, episodic future thinking, substance use disorder, delay discounting

Highlights

- EFT for smoking cessation is acceptable for individuals with SUD but presents low feasibility with this EFT protocol.
- A larger scale study is feasible if several adjustments in the EFT component are made.
- Results showed preliminary support for the effectiveness of CBT+EFT in reducing nicotine intake by 69.34% at post-treatment.
- No pre-post changes in delay discounting were observed.

1. Introduction

Nicotine dependence (ND) and substance use disorders co-occur at strikingly high rates. Of concern is that individuals with substance use disorder (SUD) smoke at much higher rates than those without SUD (63.34% for SUD vs. 14% for non-SUD) (Wang et al., 2018; Weinberger et al., 2018), they present more severe ND, and attain poorer treatment response as evinced by low abstinence rates (8.7% for SUD vs. 34.5% for non-SUD) (Apollonio, Philipps, & Bero, 2016; Secades-Villa, López-Núñez, Weidberg, González-Roz, Alons-Pérez, 2019).

Cumulative research now recognizes the relevance of providing smoking cessation treatments to the SUD population (Derefinko, Salgado García, & Sumrok, 2018; Knudsen, 2017), especially given that smoking abstinence is related to long-lasting sobriety from alcohol and illicit drugs (McKelvey, Thrul, & Ramo, 2017; Thurgood, McNeill, Clark-Carter, & Brose, 2016). In this arena, several pharmacotherapies (e.g., varenicline and bupropion) (Stein et al., 2013; Winhusen et al., 2014) and behavioral interventions [e.g., contingency management (CM) or cognitive-behavioral therapies (CBT)] have demonstrated efficacy in facilitating smoking abstinence (Rohsenow et al., 2015; Thurgood et al., 2016).

CBT is one of the most effective psychological treatments for smoking cessation in a range of populations (see e.g., Beckham et al., 2018; Çelik & Sevi, 2020; Cooney et al., 2017; Fiore et al., 2008; Vinci, 2020). However, abstinence rates remain moderate, ranging from 6% to 28% (Stead, Carroll, & Lancaster, 2017), so including components targeted at individual markers related to onset, maintenance, and relapse might enhance treatment outcomes (Kwako, Bickel, & Goldman, 2018). One of such variables is delay discounting (DD), a measure of impulsive choice that refers to the preference of smaller, sooner rewards (e.g., smoking) over larger delayed ones (e.g., positive

abstinence effects) (Odum, 2012). Smokers with SUD excessively discount the value of rewards to a greater extent compared to non-SUD smokers (Amlung, Vedelago, Acker, Balodis, & MacKillop, 2017; Bickel et al., 2019; MacKillop et al., 2011), signifying a shortened time perspective (i.e., temporal window) during decision making (Snider, LaConte, & Bickel, 2016; Petry & Bickel, 1998).

Of note is that DD is context dependent, meaning that it can be significantly malleable (García-Pérez, Vallejo-Seco, Weidberg, González-Roz, & Secades-Villa, 2020; Koffarnus, Jarmolowicz, Mueller, & Bickel, 2013; Rung & Madden, 2018). In this scenario, the incorporation of interventions that improve the valuation of future consequences is an emerging area of research in individuals with SUD (Athamneh et al., 2019; Mellis, Snider, Deshpande, LaConte, & Bickel, 2019). A recent systematic review of behavioral DD trainings or manipulations showed that 78.8% (119/151) of studies report post-training DD decreases (Scholten et al., 2019). Amongst others, episodic future thinking (EFT), a technique that consists of vividly imagining and describing future scenes or situations (Atance & O'Neill, 2001; Schacter, Benoit, & Szpunar, 2017) seems to produce the largest effect magnitude (Scholten et al., 2019).

Previous studies have shown promising results of EFT in reducing DD in overweight patients (Daniel, Stanton, & Epstein, 2013a, 2013b), and substance use disorders (Sofis, Lemley, Lee, & Budney, 2020). In the tobacco field, experimental research has shown that EFT is effective for reducing cigarette consumption (Chiou & Wu, 2017; Stein et al., 2016) and tobacco demand (Stein, Tegge, Turner, & Bickel, 2018). So far, the study by Patel and Amlung (2020) represents the only attempt to examine the feasibility of EFT in a SUD population within a clinical context. In a sample of 28 patients, findings supported the feasibility of one sole EFT session, as it significantly reduces alcohol demand and DD.

Notwithstanding, these promising results are tempered by important limitations. Most previous studies include only one session and measure DD directly after the manipulation in the session (see e.g., Shevorykin et al., 2019), while recently the importance of repeated practice to produce changes in DD has been highlighted (Mellis et al., 2019). Furthermore, because either time frames (Stein et al., 2016) or EFT cues are typically matched with those used during DD tasks (Rung & Madden, 2019), the observed effects cannot be directly attributed to EFT.

Against this background, before EFT can be regarded as effective for promoting smoking cessation, there is a need to assess its feasibility and, more particularly, to examine whether DD changes operate in a clinical context. To address this gap in the literature, this study sought to: 1) examine the feasibility and acceptability of EFT+CBT for smoking cessation in SUD smokers, and 2) preliminarily assess its effect on post-treatment DD and cotinine changes.

2. Method

2.1. Participants and procedure

The study sample comprised smokers with SUD from four substance use treatment facilities in the local area. The treatment facilities were outpatient-based and provided psychosocial interventions. None of them addressed tobacco use, and none had smoking restriction policies (i.e., banning smoking outdoors, controlling smoking hours, or regulating how many cigarettes patients could smoke each day).

Recruitment was conducted between January and May 2019 and included formal announcement through therapist referral, and advertisements (i.e., posters, flyers, and mass media) posted around the community. All patients attended an initial motivational

(1-hour) session following the principles of motivational interviewing (MI) by Miller and Rollnick (2012). The session aimed to recruit potentially eligible patients interested in quitting, and it covered the following topics: 1) pros and cons of smoking, 2) benefits of smoking cessation, 3) fears of quitting, 4) and feedback on carbon monoxide (CO) levels through expired air monitoring.

To determine eligibility, interested individuals were asked to contact the clinical unit by phone or e-mail to request an appointment. The eligibility criteria were: 1) being at least 18 years of age, 2) smoking at least 10 cigarettes per day in the last year, and 3) undergoing outpatient substance use treatment for opioids, stimulants, and/or alcohol use disorder. Exclusion criteria included: 1) not being able to attend the entire treatment, 2) having severe mental disorders (i.e., active psychotic disorder and/or suicidal ideation), 3) receiving pharmacological (i.e., bupropion, varenicline, NRT) or psychological smoking cessation treatment at the time of the intake assessment, and 4) self-reporting cannabis use only. Cannabis use was an exclusion criterion since both tobacco and cannabis share a route of administration, and their combined use is frequent (i.e., co-administration), so the cooximetry results could be contaminated (see e.g., Agrawal, Budney, & Lynskey, 2012). The substance use treatment and the smoking cessation intervention were delivered independently, so relapse to substances other than nicotine was not used as an exclusion criterion from the tobacco study.

All participants provided written informed consent and the study protocol was approved by the local Ethical Committee of Research of the Principality of Asturias (nº144/16) and registered in the ClinicalTrials-gov database (ref. NCT03551704).

2.2. Measures

2.2.1. Demographics and substance use-related characteristics

During the baseline assessment, which lasted for approximately one hour, the participants were asked about sociodemographic data (i.e., sex, age, monthly income, educational level, and marital status) and substance use-related variables. Smoking-related characteristics were number of cigarettes smoked per day, nicotine intake (in milligrams), age of smoking onset, years of regular smoking, number of previous 24-hour quit attempts, and current motivation to quit. The following substance use characteristics were also collected for all participants: primary and secondary substance use, length of SUD treatment, and days of abstinence from their primary substance. Also, past year SUD diagnosis was assessed using the Structured Clinical Interview for the DSM-5 (Clinical Version) (SCID-5; First, William, Karg, & Spitzer, 2016). All participants provided a urine sample for cotinine and drug testing (cocaine, opioids, amphetamine, methamphetamine, and cannabis) and a breath sample to assess carbon monoxide (CO) and alcohol concentrations.

In addition to the above, The Fagerström Test for Nicotine Dependence (FTND; (Heatherton, Kozlowski, Frecker, & Fagerström, 1991) was used to evaluate nicotine dependence. Five levels were established based on FTND scores as follows: very low (0-2), low (3-4), medium (5), high (6-7), and very high (8-10) (Fagerström & Kozlowski, 1990).

2.2.2. Feasibility and acceptability outcomes

The feasibility of EFT+CBT was informed based on: 1) recruitment success (percentage of individuals completing the baseline out of the total number of participants who met the inclusion criteria), 2) rates of treatment completion (percentage of patients that completed the treatment and attended all therapy sessions), 3) session

attendance (average number of therapy and midweek sessions attended), and 4) adherence to the EFT component (number of EFT practices during the 8-week treatment, out of a maximum of 210 times).

Acceptability was evaluated considering post-treatment patient satisfaction using an ad-hoc questionnaire based on a dichotomous (yes/no) and a 10-point scale (from totally disagree to totally agree). Participants responded on: 1) smoking cessation treatment length defined as adequacy of number, duration, and frequency of therapy sessions, 2) utility of the smoking cessation treatment components (i.e., stimulus control, problem-solving, and diaphragmatic breathing), and specifically the EFT component, 3) practice difficulty in the abovementioned components, 4) willingness to recommend this treatment to others, and 5) overall treatment satisfaction.

2.2.3. Preliminary effectiveness outcomes

Nicotine intake reductions throughout treatment were assessed by number of self-reported cigarettes per day and urinary cotinine concentrations. Samples were assessed at the time of the intake assessment and at each therapy session, using a BS-120 chemistry analyzer (Shenzhen Mindray Bio-medical Electronics CO. Ltd., Shenzhen, P. R. China). Values equal to or above 80 ng/ml indicated smoking abstinence status.

EFT effects over impulsive choice were assessed by changes in pre-post DD. Participants completed a computerized DD task and were instructed to choose between several immediate amounts of money or US$1,099 after a fixed delay (1 day, 1 week, 1 month, 6 months, 1 year, and 25 years). The immediate monetary value ranged from US$5.49 to US$1,099 and was adjusted through a titration procedure described previously (Holt, Green, & Myerson, 2012).

2.3. Intervention

The treatment was conducted by master- and doctoral-level psychologists with prior experience in smoking cessation treatments. Before the project onset, each therapist was trained on at least three cases and supervised by the principal investigator, who had expertise in clinical psychology. All sessions were audio-recorded and reviewed each week by the principal investigator to ensure that there were no deviations from the treatment protocol. The intervention was delivered across eight weekly therapy sessions lasting a maximum of 120 minutes each, in a group-based format (up to four patients). Seven mid-week additional visits were programmed to collect CO and cotinine samples. Altogether, patients were required to attend the clinic twice a week for a total of 15 visits.

The intervention included both CBT and EFT for smoking cessation and impulsivity management. The CBT was designed to provide coping skills training to effectively manage smoking withdrawal symptoms and quit smoking. Treatment components included: psychoeducation on the consequences of tobacco use, fears and myths on the smoking-substance use relationship, therapeutic commitment, self-monitoring of cigarette smoking, and feedback on smoking reduction, training in self-control strategies, stimulus control, management of craving with alternative activities, problem-solving skills, diaphragmatic breathing, and relapse prevention strategies. A nicotine fading procedure was used, which consisted of a weekly reduction in nicotine intake of 20% (based on both tobacco brands and cigarettes) from the first to the sixth session.

The EFT component was implemented from the first session onwards following prior recommendations for EFT implementation (see supplementary Table 1) (Hollis-Hansen, O'Donnell, Seidman, Brande, & Epstein, 2019; Snider et al., 2016). Patients were required to develop a total of seven future non-smoking situations occurring over

different time periods (four situations in two weeks, two in a month, and one in six months), so they had to practice a total of 210 times. EFT was delivered following a three-step procedure: 1) patients were asked to identify non-smoking positive events (e.g., an outdoor family meal, a novel activity) that they were looking forward to within the purported time periods. 2) During each therapy session, patients were asked to write down the situation on a sheet of paper (including their elected place, companion, feelings, activities, etc.), generate a short sentence that easily reminded them of the situation, and practice visualizing it for 2-3 minutes. 3) After that, patients rated the vividness on a 10-point scale. If vividness was rated below 6, therapists worked with patients in a collaborative way to identify difficulties in selecting or describing the requested situations and to help them to include more details that might facilitate the visualization. For homework during the week, patients were asked to practice the visualization twice daily and self-register the vividness of each practice from 0 to 10. The EFT compliance was based on the number of times patients had both practiced the elected situations and rated their associated vividness.

2.4. Data analyses

Descriptive statistics analyses were conducted to assess participants' baseline characteristics and provide data on feasibility and acceptability outcomes. A set of non-parametric Wilcoxon Signed-Rank tests was used to analyze preliminary effectiveness outcomes. Effect sizes were calculated as follows: $r = Z/\sqrt{n}$ (Rosenthal, 1994), with >.10 being small, >.30 medium, and >.50 large (Field, 2013).

The AUC_{log} was computed as a measure of DD by calculating the log of each delay and dividing each logged delay by the longest one (25 years) (see Borges, Kuang, Milhorn, & Yi, 2016). This index is a newly proposed indicator of discounting that corrects the unbalanced contribution of each indifference point (Myerson, Green, &

Warusawitharana, 2001). It varies between 0 and 1, with lower values indicating higher levels of impulsive choice (i.e., steeper discounting). Data were analyzed with the statistical package SPSS for Windows (version 24, SPSS, Inc., Chicago IL, USA).

3. Results

3.1. Feasibility outcomes

3.1.1. Recruitment success

Figure 1 displays the participant flowchart. Among the 147 patients who attended the MI session, 51 did not meet the inclusion criteria, and 54 were not interested in participating after further study details were provided. Therefore, the recruitment success was 43.75% (42/96). Of the 42 participants that completed the intake assessment, 13 were discarded due to time constraints or self-initiated quit attempts. This left 29 participants that were allocated to the CBT+EFT intervention (see Table 1 for participant characteristics).

3.1.2. Treatment completion and session attendance

A total of 65.5% (19/29) completed the treatment. The percentage of patients attending all therapy sessions was 42.1% (8/19). The participants underwent an average of seven therapy (*SD* = 1.11) and 5.53 mid-week sessions (*SD* = 1.5). Of the 29 patients that were enrolled in treatment, ten patients dropped the treatment because they reported no motivation to quit smoking (*n* = 7) or they discontinued attendance to the SUD treatment facility (*n* = 3). Completers and withdrawals did not significantly differ in any baseline characteristics (all *p* values >.148, see Table 1).

3.1.3. Adherence to episodic future thinking (EFT)

Of the 210 required EFT practices, participants reported a mean of 51.11 (*SD* = 61.16). The average vividness in visualization was 8.44 (*SD* =1.04). A percentage of

15.8% (3/19) of patients practiced at least 50% of the requested times, whereas 26% did not accomplish any visualizations at all.

3.2. Acceptability outcomes

Treatment satisfaction was high (8.83/10). Most patients were in total agreement that they would recommend the treatment to other SUD patients (9.17/10) and reported a mean of 8.61 (SD = 1.69) of perceived treatment utility for the SUD population.

In relation to treatment length, 66.7% of patients reported that 8 weeks of treatment were sufficient for quitting smoking. A total of 94.4% considered that the length of therapy sessions (i.e., 2 h/session) was appropriate, and 88.9% indicated that two sessions per week was adequate.

Perceived utility of treatment components was high. Stimulus control was rated as the most helpful for smoking cessation (8.72/10), followed by problem-solving (7.78/10), diaphragmatic breathing (7.39/10), and EFT (6.11/10). As regards to perceived practice difficulty, EFT was regarded as the least demanding of the treatment components (3.56/10), followed by problem-solving (4.22/10), diaphragmatic breathing (3.72/10), and stimulus control (4.83/10).

3.3. Preliminary effectiveness outcomes

Number of self-reported cigarettes per day decreased significantly at the post-treatment [$Mdn_{\text{pre-treatment}}$ = 20 (IQR, 20 – 30); $Mdn_{\text{post-treatment}}$ = 6 (IQR, 0 – 6); Z = -3.825, $p < .001$, r = .87]. Congruently, there was a statistically significant reduction in cotinine levels (see Figure 2): [$Mdn_{\text{pre-treatment}}$ = 1,832 (IQR, 1,435.4 – 2,252); $Mdn_{\text{post-treatment}}$ = 1,299.5 (IQR, 83.9 – 2,251.7); Z = -2.093, p = .036, r = .48]. At treatment termination, 31.57% of participants (6/19) reached cotinine levels below 80 ng/ml.

A total of 42.11% (8/19) of participants increased their DD. The mean percentage of increase was 14.29% (ranging from 0.12% to 41.48%), and the mean percentage of decrease was 28.04% (from 6.84% to 54.93%). Taken together, there were no significant pre-post changes in AUC_{log} [$Mdn_{pretreatment}$ = .571 (IQR, .477, .778); $Mdn_{post\text{-}treatment}$ = .565 (IQR, .369, .792); Z = -1.046, p = .295, r = .24].

4. Discussion

This is the first clinical study to examine the feasibility and acceptability of EFT for smoking cessation in smokers with substance use disorder. Three results are highlighted: 1) CBT+EFT for SUD smokers was acceptable and potentially feasible for individuals in SUD treatment if several adjustments are made, 2) CBT+EFT showed preliminary effectiveness for facilitating nicotine intake reductions, and 3) no significant pre-post-treatment changes were observed in DD.

The 43.75% (42/96) recruitment rate is substantially higher than the rates in other studies with smokers with SUD (0-26%) (Gass, Morris, Winters, VanderVeen, & Chermack, 2018). However, it remains considerably low compared to non-SUD populations (Ebbert et al., 2015; Hickman, Delucchi, & Prochaska, 2015; López-Núñez, Martínez-Loredo, Weidberg, Pericot-Valverde, & Secades-Villa, 2016). The largest portion of recruitment is observed when online methods (Watson, Mull, Heffner, McClure, & Bricker, 2018; Whitaker, Stevelink, & Fear, 2017) or low-magnitude incentives (Brueton et al., 2013; Cheung et al., 2017) are used. Thus, after motivational sessions, sending reminder emails or mobile messages in combination with vouchers, to be received once enrolled, might represent a feasible plan to enhance recruitment (Treweek et al., 2018).

Findings also showed that treatment was feasible according to the completion rates (65.5%) and treatment attendance. This rate is within the average range shown in the field of substance use treatment (46.5%-74.9%; Lappan, Brown, & Hendricks, 2020), and particularly for other smoking cessation treatments in this population (17%-100%; Prochaska et al., 2004). Other studies with smokers with SUD using CM attain excellent retention rates, ranging from 80% to 98% (Cooney et al., 2017; Dunn et al., 2010; Winhusen et al., 2014). Delivering vouchers that reinforce retention or attendance, could enhance treatment abstinence rates and produce fewer dropouts (López-Núñez, et al., 2016; Notley, Gentry, Bauld, & Perera, 2019).

Participants rated CBT+EFT as acceptable, with regards to treatment length, session duration, and frequency. Although the EFT component was rated as the least demanding, the adherence, in line with recent studies (Patel & Amlung, 2020), was considerably low. Thus, the low compliance with the practice suggests that several adjustments should be adopted for improving its effectiveness and its feasibility to be implemented in clinical contexts. Firstly, individuals with SUD present severe limitations in future thinking and self-projection (El Haj et al., 2019; Mercuri et al., 2018; Moustafa et al., 2018), so visualizing a distant personal future (i.e., 6 months) might be difficult. One way to solve this may be to reduce the number of required practices and to practice with shortened temporal windows (e.g., from one week to three months). On the other hand, although it was not assessed, patients' low perceived utility of EFT might be explained by a low ability to understand the treatment rationality. Perceiving that the task is worthwhile sets the framework for all sessions and is essential for patients' adherence to homework assignments (Hopko, Magidson, & Lejuez, 2011). In this sense, introducing EFT early in motivational sessions or baseline assessments might be critical to increase patients' understanding of EFT rationale and

prevent treatment failure. Finally, regarding practical issues related to EFT, it is worth noting the lack of commitment to providing self-reports. This could be solved by explaining their rationale as discussed above, by computerizing EFT self-reports (see e.g., Cebolla et al., 2010; Graham et al., 2017), or by using ecological momentary assessment (see e.g., Shiffman, Stone, & Hufford, 2008). These proposals should be considered in future clinical studies that include EFT.

The significant nicotine intake reductions observed throughout treatment further support the feasibility of CBT+EFT for facilitating smoking abstinence in this difficult-to-treat population. Despite the fact that 5/19 patients successfully quit smoking, cessation rates remain considerably low, suggesting the usefulness of integrating CM to extend CBT+EFT effects. Providing incentives to reinforce abstinence may be a suitable aim, especially considering findings that indicate not only improved abstinence outcomes but also significantly better attendance and full retention in treatment (Cooney et al., 2017; Winhusen et al., 2014).

Taking into account all participants, our findings did not evidence a significant change in DD rates overall, although over half the participants (11/19; 57.89%) did reduce their DD rates. These outcomes are contrary to previous studies in individuals with alcohol use disorder (see e.g., Patel & Amlung, 2020; Snider et al., 2016). This might be explained by several factors. Unlike previous studies, in the present study participants were not presented with EFT cues when doing the DD task at treatment termination (Rung & Madden, 2019), and the time frames in the EFT practices were not matched with those presented during the completion of the DD task (see e.g., O'Donnell, Hollis-Hansen, & Epstein, 2019; Patel & Amlung, 2020), in order to prevent participants from guessing the study hypotheses. In this sense, results suggest that the laboratory-based EFT effects might not generalize to a real-world context, such as SUD

treatment facilities. Nonetheless, not enough research has been carried out to address these issues to date (see e.g., Rung & Madden, 2019), and more adequate control trials are needed to clarify this.

Secondly, findings may also be related to the low patient compliance with EFT, especially given that larger DD decreases are observed with repeated practice (Mellis et al., 2019). Finally, pre-treatment DD rates were very high (i.e., low impulsive choice), as compared to non-SUD smokers (González-Roz, García-Pérez, Weidberg, Aonso-Diego, & Secades-Villa, 2019; Weidberg et al., 2015), probably as a result of abstinence from non-nicotine substances and SUD treatment, which typically includes impulsivity-targeted components (e.g., problem solving). This ceiling effect may be a limitation for detecting significant reductions in the outcome. The screening processes might help us to determine which patients would be best suited to EFT training, in that shallow discounters may benefit more from less intensive impulsivity-targeted treatments, such as CBT treatments.

Findings should be interpreted in the light of several limitations. First, the relatively small sample size may have led us to obtain insufficient statistical power to detect significant differences, so definite conclusions on EFT effectiveness for reducing DD cannot be yielded. Second, no control or comparison arm was included, and a larger scale randomized controlled trial will be warranted to examine EFT efficacy in real-world contexts. Third, the causality of DD cannot be determined, since it was only assessed at the baseline assessment and at the end of treatment, and using only two assessments does not enable us to establish potential changes in DD. Finally, cannabis users were discarded from participating in this study, and findings may not generalize to the entire population of smokers with SUD. Notwithstanding these limitations, because

this study was designed as a feasibility study, it allows us to identify barriers and difficulties to the effective implementation of EFT in clinical contexts.

Conclusion

In conclusion, this is the first study to assess EFT for smoking cessation in a real-world context (i.e., substance abuse treatment facilities). Integrating EFT into a CBT program for smoking cessation was feasible and acceptable to smokers with SUD. Participants reported that EFT was useful for facilitating nicotine intake reductions and easy to practice; however, no changes in DD rates were observed. The low compliance with EFT practices suggests the need to incorporate a number of adjustments such as shortened time periods and a reduced number of practices. Future large-scale clinical trials should evaluate whether EFT facilitates smoking abstinence and decreases DD more than a comparison or control condition does.

Author disclosures

Role of Funding Source

This research was supported by the Spanish National Plan on Drugs (Ref. MSSSI-17-2017I036), a grant from the Council for Economy and Work of the Principality of Asturias (Ref. FC-GRUPIN-IDI/2018/000137) and by two Predoctoral Grants from the National Agency of Research of the Spanish Ministry of Science, Innovation and Universities (FPU17/00659 and BES-2016-076663).

Contributors

Conceptualization (AGR, RSV, GAD), funding acquisition (RSV), project administration (GAD, AGR, RSV), writing the first draft (AGR, GAD), formal analyses

(GAD, VML), study design (AGR, RSV, GAD), data collection (GAD, AGR, VML, AK). All authors contributed to and approved the final manuscript.

Declaration of Competing Interest

No conflict declared.

References

Agrawal, A., Budney, A. J., & Lynskey, M. T. (2012). The co-occurring use and misuse of cannabis and tobacco: a review. *Addiction, 107*(7), 1221-1233. https://doi.org/10.1111/j.1360-0443.2012.03837.x

Amlung, M., Vedelago, L., Acker, J., Balodis, I., & MacKillop, J. (2017). Steep delay discounting and addictive behavior: a meta-analysis of continuous associations. *Addiction, 112*(1), 51–62. https://doi.org/10.1111/add.13535

Apollonio, D., Philipps, R., & Bero, L. (2016). Interventions for tobacco use cessation in people in treatment for or recovery from substance use disorders. *Cochrane Database Systematic Reviews*, (11). https://doi.org/10.1002/14651858.CD010274.pub2

Atance, C. M., & O'Neill, D. K. (2001). Episodic future thinking. *Trends in Cognitive Sciences, 5*(12), 533–539. https://doi.org/10.1016/S1364-6613(00)01804-0

Athamneh, L. N., Dehart, W. B., Pope, D., Mellis, A. M., Snider, S.E., Kaplan, B. A., & Bickel, W. K., (2019). The phenotype of recovery III: delay discounting predicts abstinence self-efficacy among individuals in recovery from substance use disorders. *Psychology of Addictive Behaviors, 33,* 310-317. https://doi.org/10.1037/adb0000460

Beckham, J. C., Adkisson, K. A., Hertzberg, J., Kimbrel, N. A., Budney, A. J., Stephens, R. S., ... & Calhoun, P. S. (2018). Mobile contingency management as an adjunctive treatment for co-morbid cannabis use disorder and cigarette smoking. *Addictive behaviors, 79,* 86-92. https://doi.org/10.1016/j.addbeh.2017.12.007

Bickel, W. K., Athamneh, L. N., Basso, J.C., Mellis, A. M., DeHart, W. B., Craft, W. H., & Pope, D., (2019). Excessive discounting of delayed reinforcers as a trans-disease process: Update on the state of the science. *Current Opinion in Psychology, 30,* 59–64. https://doi.org/10.1016/j.copsyc.2019.01.005

Borges, A. M., Kuang, J., Milhorn, H., & Yi, R., (2016). An alternative approach to calculating Area-Under-the-Curve (AUC) in delay discounting research. *Journal of the Experimental Analysis of Behavior, 106,* 145–155. https://doi.org/10.1002/jeab.219

Brueton, V. C., Tierney, J. F., Stenning, S., Meredith, S., Harding, S., Nazareth, I., & Rait, G., (2013). Strategies to improve retention in randomised trials. *Cochrane Database Systematic Review.* https://doi.org/10.1136/bmjopen-2013-003821

Cebolla, A., Oliver, E., Baños, R., Botella, C., Zaragozá, I., Alcañiz, M., Moliner, R., Marco, J. H., Jonquera, M., & Guillen, V. (2010). PDA self-register system for eating disorders: a study on acceptability and satisfaction. *Studies in health technology and informatics, 154,* 50–52.

Çelik, Z. H., & Sevi, O. M. (2020). Effectiveness of cognitive behavioral therapy for smoking cessation: a Systematic Review. *Current Approaches in Psychiatry/Psikiyatride Guncel Yaklasimlar, 12,* 54-71. https://doi.org/10.18863/pgy.534638

Cheung, Y. T. D., Wang, M. P., Li, H. C. W., Kwong, A., Lai, V., Chan, S. S. C., & Lam, T., (2017). Effectiveness of a small cash incentive on abstinence and use of cessation aids for adult smokers: a randomized controlled trial. *Addictive Behaviors, 66,* 17–25. https://doi.org/10.1016/j.addbeh.2016.11.006

Chiou, W. B., & Wu, W. H., (2017). Episodic future thinking involving the nonsmoking self can induce lower discounting and cigarette consumption. *Journal of Studies on Alcohol and Drugs 78*, 106–112. https://doi.org/10.15288/jsad.2017.78.106

Cooney, J. L., Cooper, S., Grant, C., Sevarino, K., Krishnan-Sarin, S., Gutierrez, I. A., & Cooney, N. L., (2017). A randomized trial of contingency management for smoking cessation during intensive outpatient alcohol treatment. *Journal of Substance Abuse Treatment 72*, 89–96. https://doi.org/10.1016/j.jsat.2016.07.002

Daniel, T. O., Stanton, C. M., & Epstein, L. H., (2013a). The future is now: reducing impulsivity and energy intake using episodic future thinking. *Psychological Science, 24*, 2339–2342. https://doi.org/10.1177/0956797613488780

Daniel, T. O., Stanton, C. M., & Epstein, L. H., (2013b). The future is now: comparing the effect of episodic future thinking on impulsivity in lean and obese individuals. *Appetite 71*, 120–125. https://doi.org/10.1016/j.appet.2013.07.010

Derefinko, K. J., Salgado García, F. I., & Sumrok, D. D., (2018). Smoking cessation for those pursuing recovery from substance use disorders. *Medical Clinics of North America, 102*, 781–796. https://doi.org/10.1016/j.mcna.2018.02.014

Dunn, K., Sigmon, S., Reimann, E., Badger, G., Heil, S., & Higgins, S., (2010). A contingency-management intervention to promote initial smoking cessation among opioid-maintained patients. *Experimental and Clinical Psychopharmacology, 18*, 37–50. https://doi.org/10.1037/a0018649

Ebbert, J. O., Hughes, J. R., West, R.J., Rennard, S. I., Russ, C., McRae, T. D., ..., & Park, P. W., (2015). Effect of varenicline on smoking cessation through smoking reduction: a randomized clinical trial. *JAMA – Journal of the American Medical Association, 313*, 687–694. https://doi.org/10.1001/jama.2015.280

El Haj, M., Moustafa, A. A., Perle, A., Tison, P., Cottencin, O., & Nandrino, J. L. (2019). Impaired Specificity of Future Thinking in Alcohol Use Disorders. *Alcoholism: Clinical and Experimental Research, 43*(5), 945–951. https://doi.org/10.1111/acer.13993

Fagerström, K., & Kozlowski, L., (1990). Nicotine addiction and its assessment. *Ear, Nose, and Throat Journal, 69*, 763–765.

Field, A. (2013). *Discovering statistics using IBM SPSS statistics*. Sage.

Fiore, M.C., Jaén, C. R., Baker, T. B., Bailey, W. C., Bennett, G., Benowitz, N. L., …, & Williams, C. (2008). A clinical practice guideline for treating tobacco use and dependence: 2008 update. *American Journal of Preventive Medicine, 35*, 158–176. https://doi.org/10.1016/j.amepre.2008.04.009

First, M., William, J., Karg, R., & Spitzer, R., (2016). *User's guide for the SCID-5-CV Structured Clinical Interview for DSM-5® disorders: clinical version*. American Psychiatric Publishing. Arlington, VA.

García-Pérez, Á., Vallejo-Seco, G., Weidberg, S., González-Roz, A., & Secades-Villa, R. (2020). Long-term changes in delay discounting following a smoking cessation treatment for patients with depression. *Drug and Alcohol Dependence*, 108007. https://doi.org/10.1016/j.drugalcdep.2020.108007

Gass, J. C., Morris, D. H., Winters, J., VanderVeen, J. W., & Chermack, S., (2018). Characteristics and clinical treatment of tobacco smokers enrolled in a VA substance use disorders clinic. *Journal of Substance Abuse Treatment, 84*, 1–8. https://doi.org/10.1016/j.jsat.2017.10.006

González-Roz, A., García-Pérez, Á., Weidberg, S., Aonso-Diego, G., & Secades-Villa, R., (2019). Reinforcer pathology and response to contingency management for smoking cessation. *Psychology of Addictive Behaviors, 34*(1), 156-163. . https://doi.org/10.1037/adb0000500

Graham, A. L., Papandonatos, G. D., Cha, S., Erar, B., Amato, M. S., Cobb, N. K., Niaura, R. S., & Abrams, D. B. (2017). Improving adherence to smoking cessation treatment: intervention effects in a web-based randomized trial. *Nicotine & Tobacco Research, 19*(3), 324-332. https://doi.org/10.1093/ntr/ntw282

Heatherton, T., Kozlowski, L., Frecker, R., & Fagerström, K., (1991). The Fagerström Test for Nicotine Dependence: a revision of the Fagerström Tolerance Questionnaire. *British Journal of Addiction, 86*, 1119–1127. https://doi.org/10.1111/j.1360-0443.1991.tb01879.x

Hickman, N., Delucchi, K., & Prochaska, J., (2015). Treating tobacco dependence at the intersection of diversity, poverty, and mental illness: a randomized feasibility and replication trial. *Nicotine and Tobacco Research. 17*, 1012–1021. https://doi.org/10.1093/ntr/ntv034

Hollis-Hansen, K., O'Donnell, S. E., Seidman, J. S., Brande, S. J., & Epstein, L. H., (2019). Improvements in episodic future thinking methodology: Establishing a standardized episodic thinking control. *PLoS One. 14*, 1-13. https://doi.org/10.1371/journal.pone.0214397

Holt, D., Green, L., & Myerson, J., (2012). Estimating the subjective value of future rewards: comparison of adjusting-amount and adjusting-delay procedures. *Behavior Processes, 90*, 302–310. https://doi.org/10.1016/j.beproc.2012.03.003

Hopko, D. R., Magidson, J. F., & Lejuez, C. W., (2011). Treatment failure in behavior therapy: focus on behavioral activation for depression. *Journal of Clinical Psychology, 67,* 1106–1116. https://doi.org/10.1002/jclp.20840

Knudsen, H. K., (2017). Implementation of smoking cessation treatment in substance use disorder treatment settings: a review. *American Journal of Drug and alcohol Abuse, 43,* 215–225. https://doi.org/10.1080/00952990.2016.1183019

Koffarnus M. N., Jarmolowicz D. P., Mueller E. T., & Bickel W. K. (2013) Changing delay discounting in the light of the competing neurobehavioral decision systems theory: a review. *Journal of the Experimental Analysis of Behavior, 99,* 32-57. https://doi.org/10.1002/jeab.2

Kwako, L. E., Bickel, W. K., & Goldman, D., (2018). Addiction biomarkers: dimensional approaches to understanding addiction. *Trends in Molecular Medicine, 24,* 121–128. https://doi.org/10.1016/j.molmed.2017.12.007

Lappan, S. N., Brown, A. W., & Hendricks, P. S. (2020). Dropout rates of in-person psychosocial substance use disorder treatments: a systematic review and meta-analysis. *Addiction, 115*(2), 201–217. https://doi.org/10.1111/add.14793

López-Núñez, C., Martínez-Loredo, V., Weidberg, S., Pericot-Valverde, I., & Secades-Villa, R., (2016). Voucher-based contingency management and in-treatment behaviors in smoking cessation treatment. *International Journal of Clinical and Health Psychology, 16,* 30–38. https://doi.org/10.1016/j.ijchp.2015.05.003

MacKillop, J., Amlung, M. T., Few, L. R., Ray, L. A., Sweet, L. H., & Munafo, M. R., (2011). Delayed reward discounting and addictive behavior: a meta-analysis. *Psychopharmacology, 216,* 305–321. https://doi.org/10.1007/s00213-011-2229-0

McKelvey, K., Thrul, J., & Ramo, D. (2017). Impact of quitting smoking and smoking cessation treatment on substance use outcomes: An updated and narrative review. *Addictive Behaviors, 65*, 161–170. https://doi.org/10.1016/j.addbeh.2016.10.012

Mellis, A. M., Snider, S. E., Deshpande, H. U., LaConte, S. M., & Bickel, W. K., (2019). Practicing prospection promotes patience: repeated episodic future thinking cumulatively reduces delay discounting. *Drug and Alcohol Dependence, 204*, 107507. https://doi.org/10.1016/j.drugalcdep.2019.06.010

Mercuri, K., Terrett, G., Henry, J. D., Curran, H. V., Elliott, M., & Rendell, P. G., (2018). Episodic foresight deficits in regular, but not recreational, cannabis users. *Journal of Psychopharmacology, 32(8)*, 876–882. https://doi.org/10.1177/0269881118776672

Miller, W. R., & Rollnick, S., (2012). *Motivational Interviewing: helping people change*. The Guilford Press.

Moustafa, A. A., Morris, A. N., Nandrino, J. L., Misiak, B., Szewczuk-Bogusławska, M., Frydecka, D., & El Haj, M., (2018). Not all drugs are created equal: impaired future thinking in opiate, but not alcohol, users. *Experimental Brain Research, 236*, 2971–2981. https://doi.org/10.1007/s00221-018-5355-7

Myerson, J., Green, L., & Warusawitharana, M., (2001). Area under the curve as a measure of discounting. *Journal of the Experimental Analysis of Behavior, 76*, 235–243. https://doi.org/10.1901/jeab.2001.76-235

Notley, C., Gentry, S., Bauld, L., & Perera, R., (2019). Incentives for smoking cessation. *Cochrane Database Systematic Review*. https://doi.org/10.1002/14651858.CD004307.pub6

O'Donnell, S., Hollis-Hansen, K., & Epstein, L., (2019). Mix and Match: an investigation into whether episodic future thinking cues need to match discounting delays in order to be effective. *Behavioral Science. 9,* 9. https://doi.org/10.3390/bs9010001

Odum, A. L., (2012). Delay Discounting: I'm a k, You're a k. *Journal of the Experimental Analysis of Behavior, 96,* 427–439. https://doi.org/10.1901/jeab.2011.96-423

Patel, H., & Amlung, M. (2020). Acute and extended exposure to episodic future thinking in a treatment seeking addiction sample: a pilot study. *Journal of Substance Abuse Treatment,* 108046. https://doi.org/10.1016/j.jsat.2020.108046

Petry, N. M., & Bickel, W. K. (1998). Polydrug abuse in heroin addicts: a behavioral economic analysis. *Addiction, 93,* 321-335.

Rohsenow, D. J., Tidey, J. W., Martin, R. A., Colby, S. M., Sirota, A. D., Swift, R. M., & Monti, P. M., (2015). Contingent vouchers and motivational interviewing for cigarette smokers in residential substance abuse treatment. *Journal of Substance Abuse Treatment, 55,* 29–38. https://doi.org/10.1016/j.jsat.2015.02.010

Rosenthal, R., (1994). Parametric measures of effect size, in: H. Cooper, L. V. Hedges (Ed.), *The Handbook of Research Synthesis*. New York: Russell Sage Foundation. pp. 231–244.

Rung, J., & Madden, G., (2019). Demand characteristics in episodic future thinking II: the role of cues and cue content in changing delay discounting. *Experimental and Clinical Psychopharmacology, 14,* 1–14. https://doi.org/10.1037/pha0000260

Rung, J., & Madden, G., (2018). Experimental reductions of delay discounting and impulsive choice: a systematic review and meta-analysis. *Journal of Experimental Psychology: General, 147,* 1349–1381. https://doi.org/10.1037/xge0000462

Secades-Villa, R., López-Núñez, C., Weidberg, S., González-Roz, A., & Alonso-Pérez, F. (2019). A randomized controlled trial of contingency management for smoking abstinence versus contingency management for shaping cessation: One-year outcome. *Experimental and Clinical Psychopharmacology, 27,* 561-568. https://doi.org/10.1037/pha0000269

Schacter, D. L., Benoit, R. G., & Szpunar, K. K. (2017). Episodic future thinking: mechanisms and functions. *Current Opinion in Behavioral Sciences, 17,* 41–50. http://dx.doi.org/10.1016/j.cobeha.2017.06.002

Scholten, H., Scheres, A., de Water, E., Graf, U., Granic, I., & Luijten, M., (2019). Behavioral trainings and manipulations to reduce delay discounting: a systematic review. *Psychonomic Bulletin and Review, 26,* 1803-1849. https://doi.org/10.3758/s13423-019-01629-2

Shevorykin, A., Pittman, J. C., Bickel, W. K., O'Connor, R.J., Malhotra, R., Prashad, N., & Sheffer, C. E., (2019). Primed for health: future thinking priming decreases delay discounting. *Heath Behavior and Policy Review, 6,* 363–377. https://doi.org/10.14485/hbpr.6.4.5

Shiffman, S., Stone, A., & Hufford, M. (2008). Ecological Momentary Assessment. *Annual Review of Clinical Psychology, 4,* 1–32. https://doi.org/10.1146/annurev.clinpsy.3.022806.091415

Snider, S.E., LaConte, S.M., & Bickel, W.K., (2016). Episodic future thinking: expansion of the temporal window in individuals with alcohol dependence.

Alcoholism: Clinical and Experimental Research, 40, 1558–1566. https://doi.org/10.1111/acer.13112

Sofis, M. J., Lemley, S. M., Lee, D. C., & Budney, A. J. (2020). A web-based episodic specificity and future thinking session modulates delay discounting in cannabis users. *Psychology of Addictive Behaviors, 34*(4), 532. https://doi.org/10.1037/adb0000557

Stead, L. F., Carroll, A. J., & Lancaster, T. (2017). Group behaviour therapy programmes for smoking cessation. *Cochrane Database Systematic Reviews,* (2). https://doi.org/10.1002/14651858.CD001007.pub3

Stein, J., Tegge, A., Turner, J., & Bickel, W., (2018). Episodic future thinking reduces delay discounting and cigarette demand: an investigation of the good-subject effect. *Journal of Behavioral Medicine, 41*, 269–276. https://doi.org/10.1007/s10865-017-9908-1

Stein, J., Wilson, A., Koffarnus, M., Daniel, T., Epstein, L., & Bickel, W., (2016). Unstuck in time: episodic future thinking reduces delay discounting and cigarette smoking. *Psychopharmacology, 233*, 3771–3778. https://doi.org/10.1007/s00213-016-4410-y

Stein, M., Caviness, C., Kurth, M., Audet, D., Olson, J., & Anderson, B., (2013). Varenicline for smoking cessation among methadone-maintained smokers: A randomized clinical trial. *Drug and Alcohol Dependence, 133*, 486–493. https://doi.org/10.1016/j.drugalcdep.2013.07.005

Thurgood, S. L., McNeill, A., Clark-Carter, D., & Brose, L. S., (2016). A systematic review of smoking cessation interventions for adults in substance abuse treatment

or recovery. *Nicotine and Tobacco Research, 18*, 993–1001. https://doi.org/10.1093/ntr/ntv127

Treweek, S., Pitkethly, M., Cook, J., Fraser, C., Mitchell, E., Sullivan, F., …, & Gardner, H., (2018). Strategies to improve recruitment to randomised trials. *Cochrane Database Systematic Review*. https://doi.org/10.1002/14651858.MR000013.pub6

Vinci, C. (2020). Cognitive Behavioral and Mindfulness-Based Interventions for Smoking Cessation: a Review of the Recent Literature. *Current Oncology Reports, 22*, 1-8. https://doi.org/10.1007/s11912-020-00915-w

Wang, T. W., Asman, K., Gentzke, A. S., Cullen, K. A., Holder-Hayes, E., Reyes-Guzman, C., ..., & King, B.A., (2018). Tobacco product use among adults - United States, 2017. *Morbidity and Mortality Weekly Report, 67*, 1225–1232. https://doi.org/10.15585/mmwr.mm6744a2

Watson, N. L., Mull, K. E., Heffner, J. L., McClure, J. B., & Bricker, J. B., (2018). Participant recruitment and retention in remote eHealth intervention trials: methods and lessons learned from a large randomized controlled trial of two web-based smoking interventions. *Journal of Medical Internet Research, 20*, 1–16. https://doi.org/10.2196/10351

Weidberg, S., Landes, R. D., López-Núñez, C., Pericot-Valverde, I., González-Roz, A., Yoon, J. H., & Secades-Villa, R. (2015). Contingency management effect on delay discounting among patients receiving smoking cessation treatment. *Psicothema 27*, 309–316. https://doi.org/10.7334/psicothema2015.184

Weinberger, A. H., Gbedemah, M., Wall, M. M., Hasin, D. S., Zvolensky, M. J., & Goodwin, R.D. (2018). Cigarette use is increasing among people with illicit

substance use disorders in the United States, 2002-14: emerging disparities in vulnerable populations. *Addiction 113*, 719-728. https://doi.org/10.1111/add.14082

Whitaker, C., Stevelink, S., & Fear, N., (2017). The use of Facebook in recruiting participants for health research purposes: a systematic review. *Journal of Medical Internet Research, 19*, 1–11. https://doi.org/10.2196/jmir.7071

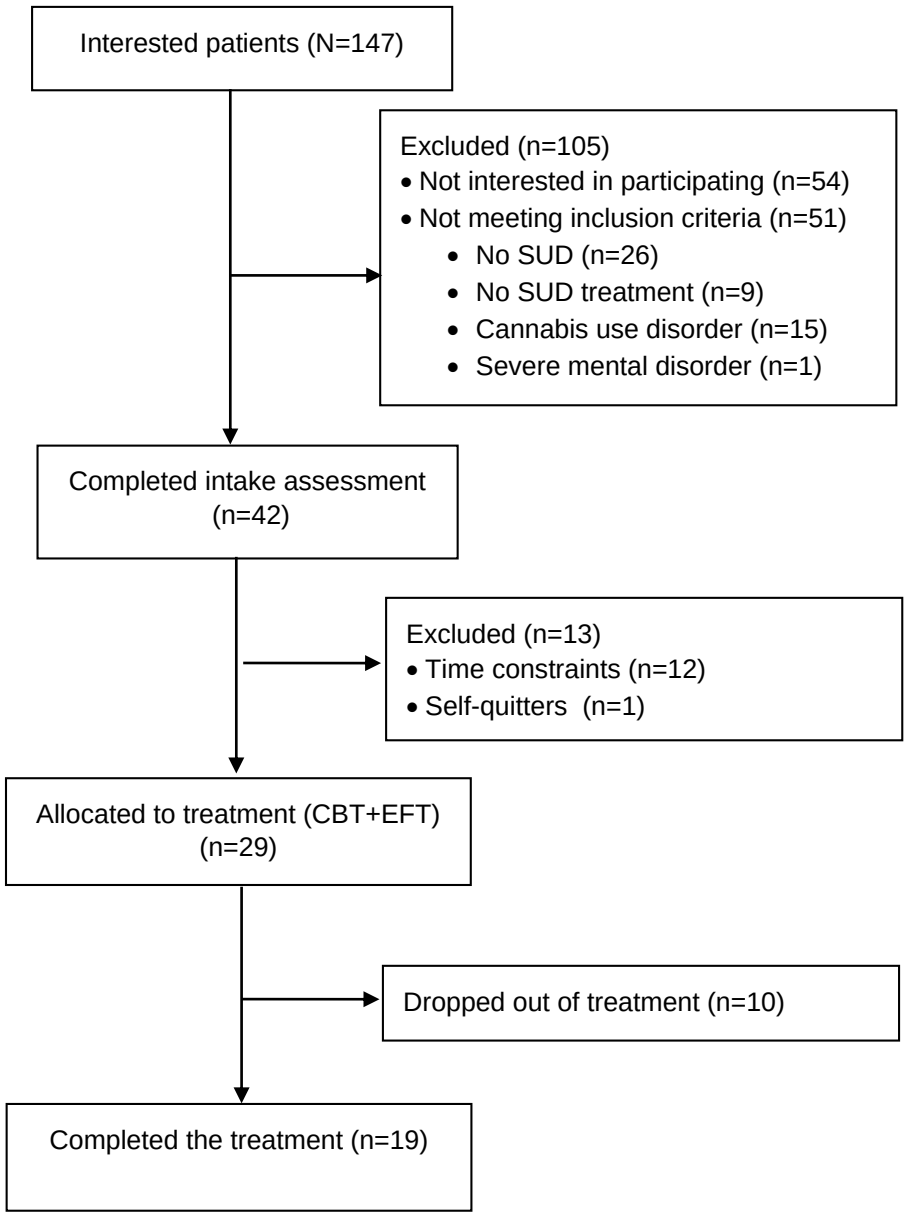
Winhusen, T. M., Brigham, G. S., Kropp, F., Lindblad, R., Gardin, J. G., Penn, P., …, & Ghitza, U., (2014). A randomized trial of concurrent smoking-cessation and substance use disorder treatment in stimulant-dependent smokers. *Journal of Clinical Psychiatry, 75*, 336–343. http://doi.org/10.4088/JCP.13m08449

Table 1
Demographics, smoking, and drug-related characteristics

	Overall *N*=29	Completers *n*=19	Withdrawals *n*=10	*p*
Age(years)[a]	45.21 (10.23)	46.26 (10.04)	43.20 (10.83)	.565
Sex (n/% males)	22 (75.9%)	15 (78.9%)	7 (70%)	.593
Educational level (n/%)				.705
< High school	23 (79.3%)	10 (52.63%)	6 (60%)	
≥High school	6 (20.7%)	9 (47.36%)	4 (40%)	
Monthly income (US$)[a]	1514.50 (1734.06)	1700.66 (2031.59)	1160.77 (942.37)	.730
Marital status (n/% married)	7 (24.1%)	3 (15.8%)	4 (40%)	.148
Primary drug use (n/%)				.578
Cocaine	11 (37.9%)	6 (31.6%)	5 (50%)	
Alcohol	11 (37.9%)	7 (36.8%)	4 (40%)	
Opioids	6 (20.7%)	5 (26.3%)	1 (10%)	
Others	1 (3.4%)	1 (5.3%)	0 (0%)	
Secondary drug use (n/%)				.527
Cocaine	2 (6.9%)	2 (10.5%)	0 (0%)	
Alcohol	5 (17.2%)	2 (10.5%)	3 (3%)	
Cannabis	4 (13.8%)	3 (15.8%)	1 (10%)	
Benzodiazepines	1 (3.4%)	1 (5.3%)	0 (0%)	
Dependence[a]				
CPD[a]	23.69 (9.67)	22.26 (7.45)	26.4 (12.94)	.571
Years smoking	28.16 (10.21)	29.98 (10.13)	24.7 (9.94)	.269
Days at drug treatment	496.14 (973.11)	590.79 (1154.26)	316. 3 (218.4)	.630
Previous attempt to quit substance use	3.41 (5.89)	2.57 (2.98)	5.00 (9.27)	.740
CO (ppm)[a]	21.9 (15.28)	23.16 (18.39)	19.5 (6.32)	.800
Cotinine (ng/ml)[a]	1,895.1 (653.42)	1,828.04 (630.6)	2,022.5 (719.5)	.491
FTND[a]	7 (1.604)	7.11 (1.37)	6.8 (2.044)	.742
Quit attempts	1.52 (2.18)	1.05 (1.268)	2.4 (3.2)	.249
Stage of change (n/%)				.755
Pre-contemplation	1 (3.4%)	1 (5.3%)	0 (0%)	
Contemplation	20 (69%)	13 (68.4%)	7 (70%)	
Preparation	8 (27.6%)	5 (26.3%)	3 (30%)	
Impulsive choice[a]				
DD ($AUC_{log d}$)[a]	0.564 (0.172)	0.605 (0.162)	0.4869 (0.171)	.169

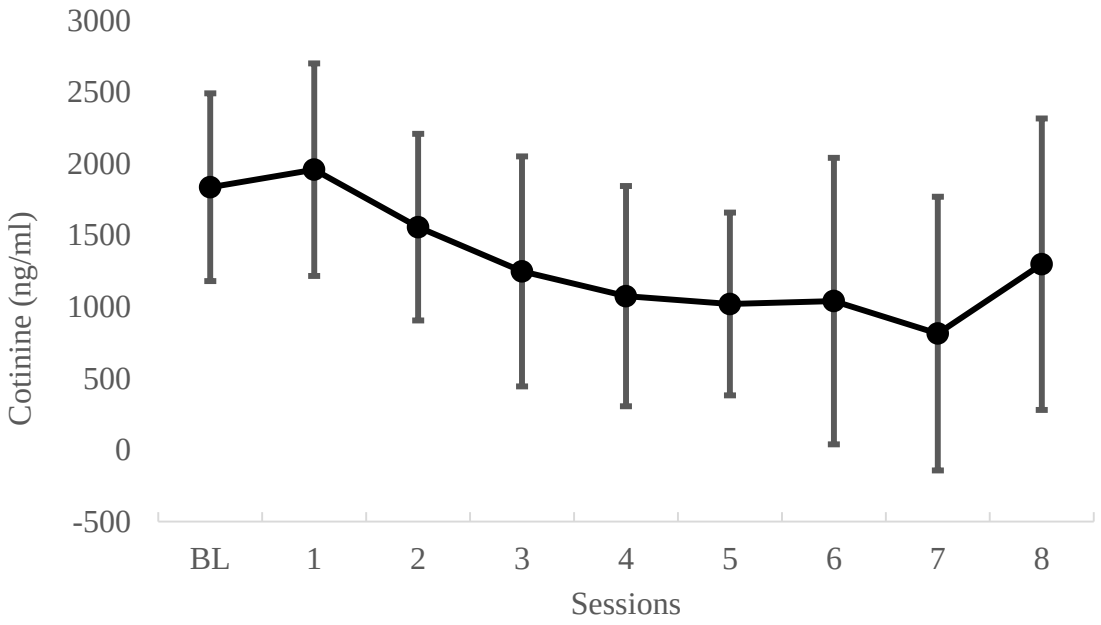
Note. [a] Mean (standard deviation); CPD = cigarettes per day; CO (ppm) = carbon monoxide in parts per million; ng/ml = nanograms/milliliter; FTND = Fagerström Test for Nicotine Dependence; DD = Delay Discounting; $AUC_{log d}$ = base-10 logarithmic transformation of the area under the curve.

Figure 1. CONSORT flow-chart of participants



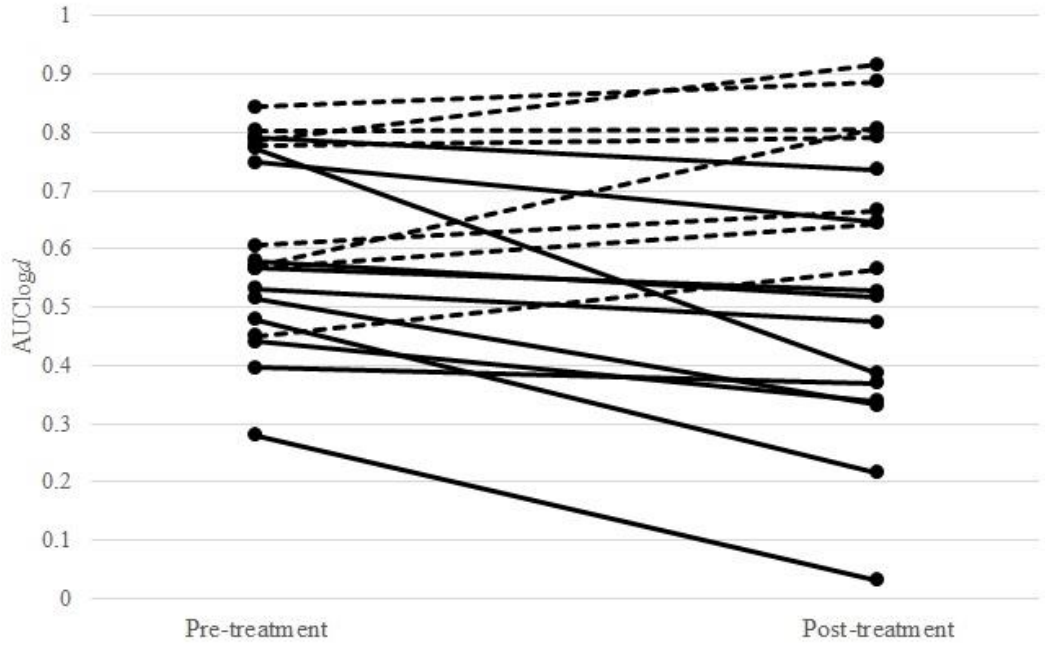
Note. SUD = substance use disorder, CBT = cognitive-behavioral treatment; EFT = episodic future thinking.

Figure 2. Mean and standard deviation of urine cotinine reduction throughout treatment.



Note. ng/ml = nanograms per milliliter; BL = baseline session.

Figure 3. Delay discounting rates at pre- and post-treatment for each participant.



Note. Participants who decreased their delay discounting rate are shown with a solid line. Participants who increased their delay discounting rate are indicated by a dashed line. AUClog*d* = base-10 logarithmic transformation of the area under the curve.