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Toward a Laboratory Model for Psychotherapeutic Treatment Screening: Implementation intentions and incentives for abstinence in an analog of smoking relapse

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Abstract

Despite reductions in cigarette smoking in the US, approximately 40-million Americans are smokers. Innovative interventions are needed to help remaining smokers quit. In order to develop innovative interventions, precise and effective tools are needed to test interventions. Here, a laboratory model of smoking relapse is assessed for its ability detect the increased resistance to smoking across two interventions and for its sensitivity to differing degrees of effectiveness. Nicotine-deprived participants ($N = 36$) completed, in randomized order, four smoking resistance sessions with and without implementation intentions and monetary incentives. A Cox proportional hazard mixed effects model indicated significant differences between condition ($\chi^2_{(df=3)}=64.87$, $p<0.001$) and the Questionnaire on Smoking Urges ($\chi^2_{(df=1)}=4.86$, $p=0.03$). Comparisons between conditions were used to estimate the effect size of each condition on delay to smoking reinitiation. The implementation intentions intervention had a small effect ($d = 0.32$), the monetary incentives had a large effect sizes ($d = 0.89$) and the combination of both interventions had a large effect sizes ($d = 1.20$). This initial investigation of the smoking resistance paradigm showed sensitivity to smoking reinitiation times across intervention conditions. Individuals resisted smoking significantly more in the presence of monetary incentives and implementation intentions than without these interventions. These results provide support for further examination of these interventions in more translational settings and the use of this laboratory analog to screen future interventions and treatment packages.

Keywords

delay of gratification; cigarette smoking; laboratory analog; implementation intentions; contingency management

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Introduction

“Measurement is never better than the empirical operations by which it is carried out, and... no scale used by mortals is perfectly free of their taint” p. 680

(Stevens, 1946)

S.S. Stevens wisely pointed out in 1946 that our ability to measure and quantifying phenomena is fundamental to the sciences and provides directions for future work to follow. Within the field of health sciences, cigarette smoking stands out as the single leading cause of preventable death worldwide (World Health Organization, 2013). Smoking continues to kill despite seven out of ten smokers indicating a desire to quit. In fact, only 6–7% of smoking attempts result in success (CDC, 2011). The development of tools that can provide measurement of the relative efficacy of single and combined treatments in an efficient manner opens the opportunity for faster and cheaper paths to successful smoking cessation treatments. Human laboratory studies to measure key elements of treatments and systematically compare single and combined interventions are a promising means to identify highly efficacious treatments and then move those with shown efficacy on to time and resource consuming clinical trials.

Previously, laboratory models of smoking have been used to characterize smoking behavior and as analogs of smoking relapse in psychopharmaceutical evaluations. For example, a laboratory smoking paradigm characterized the effects of manipulating stress (McKee et al., 2011) and alcohol consumption (McKee, Krishnan-Sarin, Shi, Mase, & O'Malley, 2006) on frequency and intensity of cigarette smoking. In addition, models of smoking relapse have been suggested for screening tobacco cessation medications (McKee, 2009), with the laboratory smoking relapse model showing that highly dependent individuals that took varenicline or bupropion were more successful than placebo controls at resisting smoking. These findings provide binary evidence that both medications are more effective than the control condition (McKee, Weinberger, Shi, Tetrault, & Coppola, 2012). Here we extend on previous research of laboratory analogs for smoking relapse to validate a paradigm for detecting differences in efficacy between behavioral interventions associated with varying degrees of effectiveness.

The overarching goal was to develop a laboratory model that was sensitive to differences between two known and different behavioral treatments. A smoking resistance task, also called a delay of gratification task, with nicotine-deprived smokers was used as a laboratory analog, or model, of smoking relapse. Importantly, for the purpose of ascertaining the sensitivity of this laboratory analog for smoking relapse, we chose two interventions that clinical trials have shown aid in smoking cessation with differing magnitudes of effectiveness. The first intervention, a laboratory model of implementation intentions provided participants with strategies to regulate behavior through highly structured and written if-then rules (Gollwitzer, 1999). Implementation intention interventions have, to the best of our knowledge, been examined in four clinical trials to evaluate for efficacy in helping individuals to quit smoking. The individual effect sizes from these studies were $\chi^2(1, N = 90) = 3.26$, which is an approximate d equal to 0.39 (Armitage, 2007), $\eta_p^2 = 0.11$,

which is an approximate d equal to 0.70 (Armitage, 2008), $\eta_p^2=0.12$, which is an approximate d equal to 0.75 (Armitage & Arden, 2008), and $d=0.41$ (Armitage, 2016). Taken together, these studies report an average Cohen's d of 0.56 or a medium effect size (Cohen, 1992).

The second intervention, a laboratory model of contingency management, provided monetary incentives as reinforcers for resisting smoking. Contingency management interventions have received robust clinical support as a treatment to reduce health risk behaviors including cigarette smoking (Cooney et al., 2016; Correia & Benson, 2006; Higgins & Solomon, 2016; Ram, Tuten, & Chisolm, 2016; Roll, 2005). Clinical trials of contingency management show reliable and robust efficacy. A meta-analysis by Prendergast (2006) reported an effect size across seven monetary-incentive contingency management studies for tobacco cessation to be an average of d equal to 0.71, which is in the medium to large effect range (Cohen, 1992).

In the current study, the goal was to determine the sensitivity of a candidate experimental analog of smoking relapse when used with behavioral interventions. If this laboratory method was adequately sensitive, then it should demonstrate not only that these interventions are effective in delaying laboratory lapses to cigarette smoking but also should be able to distinguish between the effectiveness of these two interventions.

Methods

Participants

The Virginia Polytechnic Institute and State University Institutional Review Board approved all procedures and practices implemented in this experiment. Thirty-seven adults from Roanoke, Virginia and surrounding areas completed the study. One participant was excluded due to completing a different monetary incentive schedule, leaving a sample of 36 participants. Given the within-participants design, 36 participants provide adequate power to detect medium effect sizes based on Cohen's d conventions of 0.2, 0.5, and 0.8 corresponding to small, medium, and large, respectively (Cohen, 1992; Faul, Erdfelder, Lang, & Buchner, 2007). Given the prior estimates of effect size from clinical trials of implementation intentions ($d=0.54$) and contingency management ($d=0.71$), the study was adequately powered to detect these effects if the analog design was associated with comparable effects. Volunteers were recruited via flyers, online advertisements, and by contacting past participants through the Addiction Recovery Research Center database. Eligible participants (a) were between the ages of 18 and 65; (b) smoked an average of 10 cigarettes a day or more; (c) were not using prescription medications that might affect smoking or nicotine metabolism; and (d) were not using smokeless tobacco or alternative products regularly, as defined as 10 or more times in the past month. Additionally, potentially eligible participants were excluded if they were pregnant, had immediate plans to move away from the area, or if they had an unmanaged medical or psychiatric condition. Participants were invited to attend five sessions, including a consent session and four experimental sessions for which a period of smoking abstinence prior to the sessions was required. Participants were allocated preceding the first experimental session to a

randomized sequence of the four sessions to control for order effects. The four conditions comprised all combinations of control or active implementation intentions and control and active monetary incentive conditions.

To evaluate the efficacy of the interventions, the laboratory-based smoking resistance task was used to measure smoking relapse, as defined by the time of smoking initiation after a period of smoking abstinence. A customized USB-compatible 5v/16MHz board and breadboard (Sparkfun, Niwot, CO) attached by tubing to a mouthpiece (Salem Precision Machine, Salem, VA) that held the participant's usual brand of cigarette was used to automatically trigger the apparatus when smoking behavior occurred. The participant was trained on how to use the mouthpiece prior to the first experimental session and smoked cigarettes using the mouthpiece throughout the experimental sessions.

Procedure

Data collection took place across five sessions (i.e. consent/baseline and four experimental sessions) in the Addiction Recovery Research Center. Compensation for completion of all five sessions was \$130 plus earnings from the monetary incentive conditions. Following informed consent, participants provided a satiated, baseline measure of breath carbon monoxide (CO; collected with a hand-held monitor; Bedfont Scientific Ltd, Kent, England), completed baseline smoking measures (discussed below), a completed a brief familiarization exercise with the behavioral smoking rooms and the smoking mouthpiece that was used for smoking during the experimental sessions. Following the first session, participants were instructed to abstain from smoking at least 10 hours prior to coming in for the experimental sessions and informed that nicotine deprivation would be assessed as less than half of the baseline CO taken during the consent session. Participants were instructed that experimental sessions had to be separated by at least 24 hours. The duration of the four experimental sessions was, on average, 11.64 ($SD=7.87$) days. During the experimental sessions, participants were seated in a negative airflow behavioral smoking room. After CO deprivation assessment, participants completed the Questionnaire of Smoking urges (QSU), followed by appropriate intervention worksheets (discussed below).

Participants were provided with a pack of their usual brand of cigarettes and one of the cigarettes was preloaded into the mouthpiece of the smoking device. If or when the participant chose to smoke, the smoking apparatus detected airflow and triggered the end of the smoking resistance task. All participants remained in the smoking booth with *ad libitum* access to their usual brand of cigarettes until the end of the two-hour session. During all experimental sessions the smoking resistance task was on the computer screen and displayed the available incentives (which incentive structure was determined by individual session allocation to active or control monetary incentive condition) for resisting smoking in two minute increments. In addition, during all sessions participants completed an implementation intention worksheet (which worksheet was determined by individual session allocation to active or control implementation intention condition).

Interventions

Implementation Intentions—Gollwitzer (1999) proposed an automated method, implementation intentions, to effectively narrow the gap between goal setting and attainment. Implementation intentions involve linking a critical situation with an immediate, appropriate response, and have been used across multiple health-related situations to overcome various habits, including smoking (Armitage, 2007, 2016; Armitage & Arden, 2008; Conner & Higgins, 2010). While goal intentions specify an endpoint (“I intend to reach Y”), implementation intentions specify the when, where, and how (“If I encounter situation X, then I will immediately respond with planned reaction Y”). When goal pursuit is simple and planned, a critical situation can be recognized and immediately countered with a fixed response as opposed to a habitual behavior.

The active implementation intentions analog used in this study followed the “if-then” format and related a critical smoking situation to a relevant response. Participants were first presented with seven critical situations (e.g., “I am tempted to smoke when I am craving a cigarette”) and 11 appropriate responses (e.g., “I will do other things with my hands instead of smoking”). Participants were asked to link as many or as few appropriate responses that applied to them by drawing a line between the critical situation and response. Finally, participants were instructed to pick three of the situation-response pairs, or as many as chosen if less than three, and write them word-for-word in sentence form, including the “if” at the beginning, and the “then” before the response (e.g., “If I am tempted to smoke when I am craving a cigarette, then I will do other things with my hands instead of smoking.”).

During the control condition, participants were asked to check as many critical situations and responses that applied to them without drawing any line or link between the two. Participants were then instructed to pick three situations *or* responses and write them as incomplete statements (e.g., “I am tempted to smoke when I think about a cigarette”). Whereas during the active sessions lines were drawn to link the two, the control sessions required only a check mark.

Monetary Incentives—Contingency management is widely accepted as an efficacious treatment in the field of substance abuse (Lussier et al., 2006; Prendergast et al., 2006). Mueller et al. (2009) tested numerous monetary incentive schedules as a method to promote sustained cigarette abstinence in a controlled lab setting that modeled real-world smoking relapse. In the current study, the active monetary incentive condition used an already validated (Mueller et al., 2009) linear reinforcement schedule while the control condition provided no monetary incentive for delaying smoking initiation.

The active monetary incentive condition provided money to the participant for resisting smoking. The initial incentive was \$0.15 and the available amount to be earned for each two-minute interval of smoke resistance decreased by \$0.002 every two minutes. The amount of the incentive received was rounded to the nearest cent for every two-minutes waited to smoke (functionally reducing by one cent every 10 minutes). The amount of the current incentive available for not smoking for two minutes was displayed on the computer screen where the participant was seated, and the screen stated “Smoke using the cigarette holder if you wish.” The amount earned for each two-minute interval of smoking resistance

accumulated throughout the session so if the participant did not smoke for the entire two-hour session, the monetary incentive received was \$5.46. If the participant chose to smoke at any time during the session, the amount of incentive they received during the time they waited was shown on the screen and no additional incentives were accrued. Specifically, the screen stated “Final earnings: \$X.XX. Staff will notify you when the session is over.”

Alternatively, the control monetary incentive condition did not offer any money for the duration of the two-hour session. The amount available for every two minutes (i.e. \$0.00) was displayed on the computer screen, and similar to the active condition, the screen changed once the participant decided to initiate smoking (e.g., “Finals earnings: \$0.00”). In the control monetary incentive condition, the participant did not receive any money for delaying smoking.

Measures

Questionnaire on Smoking Urges - Brief (QSU)—The QSU is a 10-item self-report questionnaire that assesses cigarette craving. The QSU was administered at the beginning of each experimental session using the Qualtrics survey platform (Provo, UT). Each question applied a seven-point Likert scale (1=strongly disagree; 7=strongly agree) and participants were asked to indicate their level of agreement with each statement. The total score on the QSU was calculated for each session.

Timeline Follow-Back (TLFB)—The TLFB is a retrospective calendar-based measure of daily substance use, previously used and validated in cigarette smoking populations (Robinson, Sobell, Sobell, & Leo, 2014; Sobell & Sobell, 1995). Participants were provided with a calendar and asked to report number of cigarettes smoked per day for the 30 days prior to the consent session. Participants also reported cigarettes smoked for days in between each subsequent session to establish that participants had not quit smoking mid-study. Additionally, participants were asked about the frequency of use of any other tobacco products such as cigars, e-cigarettes, and chew, and about products potentially used to help quit or cut down on smoking, such as nicotine patches or nicotine gum.

Statistical Analysis

Demographic characteristics were reported. To address the possibility that other variables might affect the association between condition and time to smoking reinitiation, an exhaustive model selection routine, the Bayesian Information Criterion (BIC; Schwarz, 1978), was used to determine which covariates should be modeled alongside the condition variable. The purpose was to determine what characteristics were associated with delay to smoking reinitiation, statistically adjust for those, and then compare task condition (active or control implementation intentions, and active or control monetary incentives) to time to reinitiation after accounting for other characteristics. The BIC uses an exhaustive search to weigh the likelihood of a model for a given set of data with a penalty term for complexity, such that a model with fewer candidate variables will be chosen over a more complex model if the predictive ability of both models is similar. The *bestglm* package in R (McLeod & Xu, 2010) was used to assess the candidate models and the model with the lowest BIC was then extended to include the variable of interest, condition. Covariates included in the model

selection routine were: age, years of education, gender, income, average cigarettes smoked over the last 30 days from TLFB, QSU at start of each experimental session, and CO level at start of each experimental session.

The primary outcome measure, time to smoking reinitiation, was defined as the time of initial inhalation from the cigarette. To account for censored values, a Cox proportional hazards mixed effects regression model was conducted using the *coxme* package in R (Therneau, 2012). The Cox mixed effects model was fit to the time to smoking reinitiation across conditions and model selected covariates to obtain hazard ratios with adjustment for model selected covariates and random effects.

A linear mixed effects model using the *lme4* package in R (Bates, Sarkar, Bates, & Matrix, 2007) followed by a one-way, four level analysis of variance of condition was used to estimate effect sizes of interventions alone and in conjunction. Censored data points were entered as if the participant had smoked at the conclusion of the two-hour session. Effect sizes of the comparisons were reported using a variation of Cohen's *d* where the contrast estimates from the two conditions being compared were divided by the mean square error, which was 30.74. Conventions for interpreting these effect sizes are 0.20, 0.50, and 0.80, and are small, medium, and large, respectively (Cohen, 1992).

Results

The participants ($n = 36$) had the following characteristics (mean $\pm$ sd): age (years): 40.69 ± 10.62 , education (years): 12.53 ± 1.88 , average number of cigarettes smoked per day over the past 30 days: 22.70 ± 12.04 , average QSU at start of each session: 5.01 ± 1.37 , average CO during the consent session (satiated): 23.86 ± 9.38 , and average CO level at start of each experimental session (deprived): 8.08 ± 3.88 . The sample included 23 males (63.89%). Income was skewed (skew = 1.17) with median monthly income of \$375 and interquartile range \$0–\$850.

The BIC model selection routine included QSU at the start of each experimental session in the best fitting model. See Table 1 for summary of top ten selected models. QSU at the start of each experimental session was included alongside condition and participant (the random effect) as predictors of time to smoking reinitiation in the Cox proportional hazard mixed effects model. Both the QSU ($\chi^2_{(df=1)}=4.86, p=0.03$) and condition ($\chi^2_{(df=3)}=64.87, p<0.001$) were significantly associated with time to smoking reinitiation. Higher QSU score was associated with decreased time to smoking reinitiation (adjusted hazard ratio=1.39, $p=0.02$). The percent change in the hazard when the QSU increases by one unit can be estimated as $100(\exp(\beta)-1)$, indicating that for every unit increase in QSU score before a smoking resistance session, the hazard for smoking increased by an average of about 39%. The active implementation intention, active monetary incentive condition was associated with a decrease in the hazard for smoking reinitiation of about 73.67% compared to the control implementation intentions, control monetary incentive condition (adjusted hazard ratio=0.26, $p<0.001$). The control implementation intention, active monetary incentive condition was associated with a decrease in the hazard for smoking reinitiation of about 59.25% compared to the control implementation intention, control monetary incentive

condition (adjusted hazard ratio=0.41, $p<0.001$). The active implementation intention, control monetary incentive condition was associated with a non-significant decrease in the hazard for smoking reinitiation of about 32.60% compared to the control implementation intention, control monetary incentive condition (adjusted hazard ratio=0.67, $p=0.13$, *ns*). More people resisted smoking throughout the entire session in the monetary incentive conditions (12 participants in the active implementation intentions, active monetary incentive condition and 11 participants in the control implementation intention, active monetary incentive condition) than in the conditions without monetary incentives (eight participants in the active implementation intention, control monetary incentive condition and six participants in the control implementation intention, control monetary incentive condition). The survival analysis is visually depicted using Kaplan-Meier curves in Figure 1; however, note that these curves are not adjusted for QSU scores. The average time to smoking reinitiation by condition are shown in Figure 2.

As a secondary analysis, a mixed effect model was used to estimate the effect sizes (Cohen's *d*). The comparisons between the active implementation intention, active monetary incentive condition and active implementation intention, control monetary incentive condition ($d=0.85$) and the control implementation intention, active monetary incentive condition and control implementation intention, control monetary incentive condition ($d=0.93$) both provide an estimate of the effect size of the monetary incentive condition (average $d = 0.89$). The comparison between control implementation intentions, active monetary incentives and active implementation intentions, active monetary incentives ($d=0.28$) and the comparison of control implementation intentions, control monetary incentives and active implementation intentions, control monetary incentives ($d=0.36$) provide estimates of the effect size of the implementation intention intervention alone (average $d = 0.32$). The control implementation intention, control monetary incentive condition and active implementation intention, active monetary incentive condition ($d=1.20$) comparison gives an estimate of the combined effect of implementation intentions and monetary incentives (see Figure 3).

Discussion

The current study aimed to assess the smoking resistance paradigm as an experimental analog for behavioral smoking cessation treatments and, further, to test the ability of the laboratory model to measure the relative effectiveness of the selected treatments. Efficient and effective mediums for testing candidate treatments are necessary to identify those treatments that should be tested in more costly and large scale clinical trials. This initial assessment of a smoking resistance task as a laboratory-based analog for behavioral interventions for smoking cessation sets the stage for future work testing additional treatments and treatment packages. The smoking resistance paradigm provides an efficient modality to examine potential interventions and this study provides the first evidence that the smoking resistance paradigm could be used to compare relative efficacy of single and combined psychotherapeutic treatment packages.

Implementation intentions and monetary incentives have differing degrees of efficacy in clinical trials. Previous studies have found implementation intentions and monetarily-incentivized contingency management to be effective in the treatment of cigarette smoking

with medium effect sizes reported for implementation intentions and medium to large effect sizes reported for monetarily-incentivized contingency management. By testing two interventions with different prior evidence of effect sizes in clinical settings, we were able to assess if this paradigm is in fact sensitive to the magnitude of the effect of the intervention. Importantly, the effect sizes observed using the laboratory versions of implementation intentions (average $d = 0.32$) and monetarily-incentivized contingency management (average $d = 0.89$) are comparable, at least in order of magnitude, to those effect sizes estimated from clinical trials of these interventions ($d = 0.56$ and 0.71 , respectively; see the introduction for estimation of clinical trial effect sizes). Furthermore, given the sensitivity of this laboratory-based analog to measure the magnitude of effects of different behavioral interventions, it could also be used to evaluate treatment packages to assess for improvements in treatment efficacy when treatments are delivered in conjunction. Indeed, in the current study, implementation intentions in conjunction with monetary incentives was associated with the greatest effect size ($d = 1.20$), indicating that the combined treatment delivery may result in greater efficacy for smoking cessation than either treatment delivered alone (see Figure 3).

Specific to the interventions assessed in this proof of concept study, time to smoking reinitiation was significant after adjusting for unique participant characteristics and the QSU score from the start of each experimental session in the Cox mixed effects models. The exhaustive BIC variable selection routine indicated QSU score at the start of each experimental session as best accounting for variance, after the penalty for model complexity, of the candidate covariates. Given the QSU is a molar measure of overall craving and urge to smoke, the relationship with smoking resistance is intuitive. Indeed, early and consistent work has found that subjective experiences of craving are associated with increased smoking behavior (Droungas, Ehrman, Childress, & O'Brien, 1995; Killen & Fortmann, 1997).

In the Cox mixed effects analysis, the greatest differences were observed when the monetary incentive was present in one condition and not in the other. Consistent with laboratory findings of Mueller et al. (2009) and contingency management trials by Higgins et al. (2000) and Preston et al. (2002), these results support the use of linear and descending monetary incentives to lengthen the time to smoking reinitiation after a period of abstinence. As indicated in Figure 1 and Figure 2, greater time to smoking reinitiation was evident in both the conditions that included monetary incentives when compared to those without monetary incentives.

Several weaknesses warrant discussion. First, the sample size of the current study was only powered to detect medium to large effects and, as such, was not powered to detect differences in interventions with smaller effects. To this end, the implementation intention intervention on its own did not significantly increase time to smoking reinitiation in this proof of concept study. The effect sizes for implementation intentions alone estimated in the current study (between $d = .28$ and $.36$) are less than the medium effect sizes observed in previous clinical trials of implementation intentions (Armitage, 2007, 2008, 2016; Armitage & Arden, 2008). Future studies may wish to enroll larger samples in order to be better powered to detect small, though potentially clinically relevant, effects.

With regard to the monetary incentive intervention, the control condition did not provide non-contingent monetary compensation. This may indicate that the effectiveness of monetary incentives is, in part, attributable to the additional money available to participants during active monetary incentive conditions and not due to the contingent nature of the monetary incentive on smoking resistance. Similarly, the control monetary incentive condition included explicit denotation on the computer screen that no money was available for resisting smoking during the two-minute intervals. The explicit nature of the control condition may have had influenced smoking behavior. In addition, future studies may wish to use longer laboratory sessions to provide more sensitivity in screening candidate interventions by reducing the number of individuals that resist smoking for the entire session. Future assessments of this laboratory analog of smoking relapse may also incorporate other potentially important variables such as individual motivation to quit to see if some interventions are effective regardless of motivation or intention to quit while others may be selectively effective for individuals that are more ready for change. Finally, future studies may wish to provide follow-up sessions to assess for possible prolonged effects of interventions on real world smoking behavior.

As Stevens articulated decades ago, developing measurement tools with increasing sensitivity helps to advance science (Stevens, 1946). The current study aimed to validate a smoking resistance paradigm to measure relative efficacy of various psychotherapeutic interventions and intervention packages. If future evaluations of this paradigm show continued sensitivity to treatment efficacy that approximates the effectiveness of interventions observed in clinical trials and clinics, then this type of laboratory analog could become an early screener for candidate psychotherapeutic treatments and could save time and money in the efforts to help individuals to quit smoking.

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Public Significance Statement

Cigarette smoking is the leading cause of preventable death worldwide. Methods to quickly and efficiently test candidate psychotherapeutic treatments for cigarette cessation are needed. The current study tests a laboratory analog of smoking relapse for its sensitivity and accuracy in screening treatments and treatment packages.

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Figure 1.

Kaplan-Meier curves of each condition.

CC = control implementation intentions, control monetary incentive, CA = control implementation intention, active monetary incentive, AC = active implementation intention, control monetary incentive, AA = active implementation intention, active monetary incentive. ■ indicates a censored data points.

Figure 2.

Time to smoking reinitiation by condition.

Average time to smoking reinitiation by condition. * indicates significance at $p < 0.05$. CC = control implementation intentions, control monetary incentive, CA = control implementation intention, active monetary incentive, AC = active implementation intention, control monetary incentive, AA = active implementation intention, active monetary incentive.

Figure 3.

Effect size estimates by intervention.

Effect size estimates by intervention (i.e., implementation intentions, monetary incentives, or the combination of both) + SEM. Effect sizes were calculated for each comparison between conditions and depicted using bar graphs. Implementation intentions and monetary incentives are comprised of the average of the two effect size estimates for each of these conditions alone and the combined plot is from the single estimate of the effects of both monetary incentives and implementation intentions on delay to smoking reinitiation. Note, for the single observation that made up the combined effect no standard error is provided.

Table 1

Top 10 Bayesian Information Criterion (BIC) models selected

Model	Age	Education	Gender	Income	Avg. Cigarettes	pre-session QSU	pre-session CO	Criterion
1						+		2278.91
2					+	+		2282.87
3			+			+		2282.91
4				+		+		2283.33
5	+					+		2283.82
6						+	+	2283.85
7		+				+		2283.88
8				+		+	+	2286.44
9								2286.90
10				+	+	+		2287.28

⁺ indicates the candidate variable was included in the model. The lower the criterion score the better the model fit. The first model, indicating best fit, was selected to be included in the subsequent analyses.