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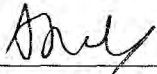
*Phone Numbers*

Commercial: 301-295-9474  
Toll Free: 800-772-1747  
DSN: 295-9474  
FAX: 301-295-6772


Title of Thesis: Effects of social desirability bias on self-report and non self-report assessments during smoking cessation

Name of Candidate: Jessica Forde  
Department of Medical and Clinical Psychology  
Master of Science  
30 September 2010


Thesis and Abstract Approved:

  
\_\_\_\_\_  
Andrew J. Waters, Ph.D.  
Department of Medical and Clinical Psychology  
Thesis Advisor

10/6/10  
Date

  
\_\_\_\_\_  
Michael Feuerstein, Ph.D., MPH, ABPP  
Department of Medical and Clinical Psychology  
Committee Member

9/30/10  
Date

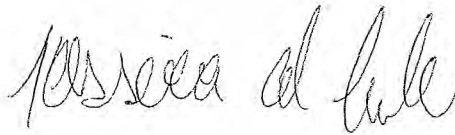
  
\_\_\_\_\_  
Neil E. Grunberg, Ph.D.  
Department of Medical and Clinical Psychology  
Committee Member

9/30/10  
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A handwritten signature in black ink that reads "Jessica Forde". The signature is written in a cursive style with a large initial 'J'.

30 SEP 10

Jessica Forde  
Medical and Clinical Psychology Graduate Program  
Uniformed Services University

TITLE: Effects of social desirability bias on self-report and non self-report  
assessments during smoking cessation

BY: Jessica Forde, B.S.

2010

DIRECTED BY: Andrew J. Waters, Ph.D.

Associate Professor, Medical and Clinical Psychology

#### ABSTRACT

Social desirability response bias (SDR) is the tendency of respondents to respond in a way that will be viewed favorably by others. Little research has examined the effect of SDR in the context of cigarette smoking cessation. Adult smokers were recruited for smoking cessation treatment. They completed self-report, biological, and implicit attitude measures. SDR scores, assessed using the Balanced Inventory of Desirable Responding (Paulus, 1991), were dichotomized by median split into LOW (0-12) and HIGH (13+). Compared to LOW participants, HIGH participants reported lower levels of cigarette craving and more negative attitudes toward smoking. The groups did not exhibit different implicit attitudes toward smoking. Averaged over sessions, the correlation between self-reported and implicit attitudes toward smoking was significant in LOW participants only. In sum, SDR may affect responses on some self-report measures used in smoking cessation research, suggesting that researchers should rely more on biological or implicit methods of assessment.

EFFECTS OF SOCIAL DESIRABILITY BIAS ON SELF-REPORT  
AND NON SELF-REPORT ASSESSMENTS DURING SMOKING CESSATION

BY

JESSICA FORDE

Thesis submitted to the Faculty of the  
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## **Introduction**

### **Response Bias**

Response bias is “the systematic tendency to respond to a range of questionnaire items on some basis other than the specific item content” (Paulhus, 1991, p. 17). Types of response bias include omission bias (Cronbach, 1946), careless response bias (Meehl & Hathaway, 1946), deviant response bias (Berg, 1967), consistent response bias (Dillehay & Jernigan, 1970), extremity response bias (tendency to use extreme ratings; Peabody, 1962), acquiescence bias (tendency to agree; Lentz, 1938), and social desirability response bias (Bernreuter, 1933; Vernon, 1934). Social desirability response bias (SDR) is the tendency of respondents to respond in a way that will be viewed favorably by the researcher, within the context of research studies. SDR can threaten validity of research results and obscure the nature of relationships between the variables of interest. The effect of SDR may be particularly impactful when assessing topics in which participants may be motivated to misrepresent self-reported information, such as racism (Sigall & Page, 1971), religious orientation (Batson, Naifeh, & Pate, 1978), sexual behaviors (Sprecher, McKinney, & Orbuch, 1987), and drug use (Mieczkowski, 1990).

### **History of Social Desirability Research**

SDR has been one of the most frequently studied response biases for over 50 years. A multitude of scales have been developed to measure SDR, from stand-alone measures of social desirability (e.g., The Marlowe-Crowne Social Desirability Scale; Crowne & Marlowe, 1960) to scales built into preexisting measures to correct for the effects of SDR. Many frequently used personality assessments have scales



built-in to detect deceptive responding, such as the Eysenck Personality Questionnaire (EPQ; Eysenck & Eysenck, 1975) and the second edition of the Minnesota Multiphasic Personality Inventory (MMPI-2; Butcher, Dahlstrom, Graham, Tellegen, & Kaemmer, 1989).

Correlations between SDR measures tend to be low. In addition, factor analyses strongly suggest that two different constructs are being measured with SDR (Edwards & Edwards, 1991; Holden & Fekken, 1989; Sackeim & Gur, 1978; Wiggins, 1964). Impression management (IM) captures the traditional notion of social desirability, which is the deliberate and intentional attempt to present oneself in a favorable way. The other construct is self-deceptive positivity (SDP), which is the unintentional but overly positive presentation of oneself (Meehl & Hathaway, 1946; Sackeim & Gur, 1978). Evidence from factor analyses provide support for two distinct constructs in SDR (Lanyon & Carle, 2007; Paulhus, 1984), however most SDR scales currently in use do not specifically distinguish between IM and SDP.

### **Balanced Inventory of Desirable Responding (BIDR)**

In the current study the Balanced Inventory of Desirable Responding (BIDR; Paulhus, 1988) was chosen to assess SDR. The BIDR was originally developed in response to the need for a scale that would directly measure both constructs of SDR. It was based on the earlier work of Sackeim and Gur (1978), who had proposed the division of the traditional concept of social desirability into conscious (“other”) deception and unconscious (“self”) deception (Gur & Sackeim, 1979; Sackeim & Gur, 1978).

The BIDR consists of two subscales of 20 items each, an Impression Management (IM) subscale and a Self-deceptive Enhancement (SDE) subscale. Sample items of the IM subscale include „I have received too much change from a salesperson without telling him or her“ and „I have some pretty awful habits.“ Sample items of the SDE subscale include „I have not always been honest with myself“ and „I never regret my decision.“ Participants rate their agreement with statements about themselves on a 7-point Likert scale, with 1 indicating not true and 7 indicating very true. The scales are counterbalanced with equal numbers of positively and negatively keyed items. The BIDR can be scored either dichotomously, with one point being given to responses of 6 or 7, or scored continuously in which the raw score is used. It can yield an IM score, an SDE score, or a combined total score of all 40 items (Paulhus, 1988).

**Relationship with other measures of social desirability.** The IM scale of the BIDR has been found to positively correlate with commonly used lie scales. Davies, French, and Keogh (1998) reported a correlation of .61 between the BIDR IM scale and the lie scale of the revised Eysenck Personality Questionnaire (EPQ-R), and the BIDR IM scale has been found to correlate highly with the MMPI-2 L Scale (Paulhus, 1991). The Marlowe-Crown Social Desirability Scale (MCSDS; Crowne & Marlowe, 1960), the most widely used measure of SDR, has been shown to correlate at a level of .71 with the overall score of the BIDR (Paulhus, 1991). The MMPI-2 K scale, which was designed as a subtle measure of SDR, is one of the few scales to correlate significantly with the SDE scale of the BIDR (Paulhus, 1991).

### **SDR and Self-report Measures**

Research suggests that SDR can affect a variety of self-report measures, such as self-reported behavior and self-reported attitudes or affect (Adams et al., 2005; Bardwell & Dimsdale, 2008; Marissen, Franken, Blanken, van den Brink, & Hendriks, 2005). Many behaviors and attitudes are socially driven, in that society is more supportive of one behavior or attitude over another. In assessing these behaviors and attitudes, self-report measures are likely to be affected by SDR and influence interpretations of responses (Paulhus, 1991).

In the review of SDR studies below (see Table 1), the focus was on those studies which examined both the relationship between SDR and self-report (SR) measures (e.g., mood, craving) and the relationship between SDR and a non self-report (NSR) measures (i.e., biological or implicit measures). These studies were chosen because they enabled a comparison of the differential effects of SDR on SR and NSR measures. Biological measures assess markers in the body and implicit measures assess automatic cognitions, both of which should be outside the conscious control of the participant. Therefore, examining these types of measures is informative to understand whether SDR has the same effect on these measures as it does on SR measures.

These articles were located through key word searches of SDR measures and through searching relevant citations from articles located. Databases included PsychInfo, Pubmed, and Google Scholar and was open to articles from 1900-current. Studies were excluded that only looked at the effect of SDR on either SR or NSR measures. To the best of the author's knowledge, the studies in Table 1

represent the extent of literature available that has compared the effect of SDR on SR and NSR measures. Some of the studies included in Table 1 also examined whether SDR moderated the association between SR and NSR measures; however this area of study is rather limited and is represented by the few studies in Table 1. Previous research on these relationships is discussed below.

### **Influence of SDR on Self-reported Behavior**

It has been long suspected that individuals are not always honest in self-reported behavior, particularly when the behavior has the potential for social disapproval (Crowne & Marlowe, 1960; Edwards, 1953, 1957). Adams et al. (2005) examined the relationship between self-reported physical activity and objective measures of physical activity to determine the role social desirability may play in moderating the relationship between the two variables (see Table 1). Their results indicated that discrepancies between the two activity reports were significantly affected by social desirability scores and resulted in over-reporting of self-reported activity energy expenditure and duration. Similarly, Ewert and Galloway (2009) suggested that inconsistencies between expressed environmental concern and actual environmental behaviors may be the result of social pressures to present a positive expressed attitude toward environmental issues. However, an empirical study has yet to be conducted to systematically examine this hypothesis. As these highlighted studies suggest, SDR can potentially affect self-reported behavior in a variety of research areas and complicate the interpretation of data. These results underscore the importance of continued study of the utility of social desirability scales.

**Influence of SDR on Self-reported Attitudes and Cognitions**

Research also suggests that SDR can have a significant effect on self-reported attitudes and thoughts, particularly ones which are driven by social approval. SDR has been reported to be associated with self-reported attitudes and cognitions, such as craving for drugs (Marissen et al., 2005; Rohsenow et al., 1992), negative affect (Bardwell & Dimsdale, 2001; Klassen, Hornstra, & Anderson, 1975), well-being (Diener, Suh, Smith, & Shao, 1995; Kozma & Stones, 1986), and self-esteem (Mesmer-Magnus, Viswesvaran, Deshpande, & Joseph, 2006; Riketta, 2005). In light of this potential bias on self-report measures, research in recent years has focused on finding measures which may be unaffected by SDR.

**Influence of SDR on Implicit Measures of Attitudes and Cognitions**

Research on the effect of SDR on self-reported behavior, attitudes, and cognitions suggests that self-report assessments are limited by susceptibility to impression management. Implicit measures are hypothesized to tap into thoughts and feelings that may not be accessible to the individual and are, theoretically, outside the realm of conscious control (Greenwald, McGhee, & Schwartz, 1998). Dual process models of information processing posit that individuals process information both in a controlled, deliberate manner as well as in a more automatic, intuitive manner. These processes are thought to occur in parallel, and automatic processes are hypothesized to occur rapidly without conscious awareness. Explicit, or traditional self-report measures, are hypothesized to assess controlled processes, whereas implicit measures are thought to assess automatic processes (Epstein,

1994; Smith & DeCoster, 2001; Wilson, Lindsey, & Schooler, 2000). Therefore, implicit measures may be less sensitive to SDR bias, particularly the conscious, impression management component of SDR.

Little research has been conducted to examine the effect of SDR on implicit measures or the effect of SDR on the relationship between self-report and implicit measures. Historically, weak correlations have been reported between implicit and explicit measures of the same constructs. One meta-analysis, which examined the relationship between the Implicit Association Test and a variety of construct-related self-report measures, reported a mean correlation ( $r$ ) of .24 between the implicit and explicit measures (Hofmann, Gawronski, Gschwendner, Le, & Schmitt, 2005). One potential reason for this discrepancy which has been suggested is the differential effect of SDR on automatic vs. controlled information processes. However, only a few studies have been conducted to directly examine this question.

Egloff and Schmukle (2003) conducted a study to examine the role of social desirability in the relationship between implicit and explicit measures of anxiety in university students. Measures used were the State-Trait-Anxiety-Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970), an Anxiety Implicit Association Test (IAT; Greenwald et al., 1998), and the revised Social Desirability Scale-17 (SDS-17R; Stoeber, 2001). As expected, SDS was not associated with the anxiety IAT effect. It was hypothesized that scores on a social desirability scale would moderate the relationship between implicit and explicit anxiety, however analyses indicated that social desirability scores did not significantly moderate the association between the implicit and explicit measures of anxiety.

In their follow-up study, Egloff and Schmukle (2003) investigated whether SDR would moderate the association between the implicit and explicit measures when the two constructs of the BIDR were analyzed separately. For this study, the STAI and explicit ratings of the IAT were used as the explicit measures, the IAT was used as the implicit measure, and the Impression Management (IM) and Self-Deceptive Enhancement (SDE) scales of the BIDR were used to measure social desirability. Again, the SDR measures were not associated with the anxiety IAT effect. In addition, the SDR measures did not significantly moderate the association between the implicit and explicit measures.

It might be suggested that the topic of anxiety may not be socially driven enough for the effects of SDR to be detected, particularly in the sample of university students used in the Egloff and Schmukle (2003) studies. Additional research is needed to examine the associations between SDR and implicit/explicit measures, using a construct in which individuals may be more motivated to skew or misrepresent their self-reported attitudes.

One research area that does have significant risk of SDR bias, the reporting of drug use behavior, attitudes, and cognitions, has been examined in one study. Marissen et al. (2005) examined the relationship between self-reported craving and physiological responses to heroin cues in abstinent heroin abusers. Previous research has reported low correlations between these two cue reactivity measures (Robbins, Ehrman, Childress, & Obrien, 1997; Tiffany, 1990), which is similar to low reported correlation between implicit and explicit measures. In this study, three self-report measures of drug craving were utilized and compared with a measure of skin

conductance to assess physiologic reactivity. The data indicated an association between SDR and self-reported drug craving, revealing that social desirability influences explicit measures of drug craving. Participants who had higher scores on the SDR scale had significantly lower self-reported drug craving ratings, suggesting that those individuals higher in SDR may underreport their true levels of drug craving. While physiological measures are not implicit measures, in the traditional definition of such, they are measures which should be outside the individual's control and, therefore, should be less susceptible to conscious manipulation. Marissen et al. (2005) did not find an association between SDR and the physiologic measure of craving (i.e., skin conductance), indicating that the physiological measures used in the study did not appear to be affected by SDR. As in the Egloff and Schmukle (2003) study, SDR did not moderate the association between SR and NSR measures (in this study, the self-reported craving and physiologic response). Marissen et al. (2005) emphasized the importance of future research to further illuminate the role that SDR may have in information reporting, particularly in socially unacceptable behavior such as drug use.

### **SDR in Cigarette Smoking Cessation Research**

Issues related to SDR are relevant in cigarette smoking research as well. As smoking becomes less and less socially accepted, the incentive to misreport smoking status or under-report use increases (Swanson, Rudman, & Greenwald, 2001; Sherman, Rose, & Koch, 2003). It has been suggested in previous studies that the weak relationship between implicit and explicit attitudes toward cigarette smoking is a result of efforts to consciously control explicit attitudes because of the



stigmatization of smoking behavior in modern society (Swanson et al., 2001; Sherman et al., 2003). Little research, however, has directly examined this hypothesis. One area in smoking research for which SDR is particularly relevant is tobacco use in pregnant women.

In a study by Boyd, Windsor, Perkins, and Lowe (1998), self-reported smoking status was compared with status determined by salivary cotinine levels to evaluate misclassification rates of smoking status. Cotinine is the primary metabolite of nicotine (the primary drug of addiction in tobacco), and therefore allows for a physiologic measure of nicotine intake. Salivary cotinine is commonly used in smoking research to validate self-reported use and abstinence, because it provides an accurate measure of cigarette smoking (Ossip-Klein, et al., 1996). In the Boyd et al. (1998) study, the misclassification rate for self-reported nonsmokers was 26.2% based on cotinine levels. This value was compared to the 0-9% misclassification rate found in the general public. Although SDR was not measured in this study, the authors' interpretation of these results was that the significant increase in misclassification might have been the result of social desirability bias, considering the presence of strong negative societal opinions toward smoking during pregnancy (Boyd et al., 1998). Presumably, those individuals who score highest on a measure of SDR would be those who would be most likely to misreport their smoking.

Similarly, in a meta-analysis of assessment accuracy in adolescent smoking conducted by Dolcini, Adler, and Ginsberg (1996), the authors examine factors that might potentially influence the correlation between self-reported smoking and biological markers of tobacco use in an adolescent population (e.g., cotinine, breath

CO). Again, SDR was not directly measured but was hypothesized to be a significant influencing factor in discrepancies typically found between self-report and other measures of cigarette smoking in this population. The obvious limitation in this area, however, is that no study has been conducted that has directly investigated the effect of SDR on SR and NSR measures in smoking research.

The current study examined the effect of SDR on responses during smoking cessation. SDR may be important in all stages of smoking cessation. For example, even prior to making a quit attempt, smokers who express a desire to quit may be motivated to under-report their smoking. Also, they may be motivated to under-report their craving (see Marissen et al., 2005) and to over-report their negative attitudes to smoking. This under- and over-reporting may be particularly marked for individuals with higher SDR scores. On the day of a quit attempt, smokers may similarly be motivated to under-report lapses and craving. In the current study, smokers were assessed on two occasions prior to quitting and on the quit day itself. Assessing at these time points afforded an investigation of the effects of SDR both prior to quitting and at the early stages of a quit attempt.

It is important to understand the effect of SDR on different types of assessments during smoking cessation to more adequately control for this effect, to increase the accuracy of information obtained from participants, and to understand more fully which assessments are most at risk for manipulations due to SDR. In addition, it is essential to examine if the effect of SDR differs across time points within a quit attempt so that assessments and methods of control can be utilized most effectively.

### **Possible Effects of SDR on Self-report Measures in Smoking Cessation**

While it is not currently known what effect SDR has on SR measures in smoking cessation research, it is useful to consider the general manner in which SDR may influence self-reports, as well as how SDR may affect the association between self-report and implicit measures (Figures 1-3). These figures are models regarding the potential effect of SDR on measures in smoking cessation research and have not yet been examined specifically in research. First, as illustrated in Figure 1, the effect of SDR may be similar across all participants who are high in SDR (i.e., those individuals who are most likely to manipulate responses based on social desirability). The top left-hand graph represents individuals low in SDR who would not be expected to manipulate their responses at all. The bottom left-hand graph is the same as the top left-hand graph because the responses of individuals low in SDR would not be expected to show an effect due to SDR. (The dot is the centroid of the data). The top right-hand graph represents individuals high in SDR, expected to manipulate their responses (in this case, to report more negative attitudes), and the bottom right-hand graph illustrates the changes in mean, correlation between implicit and explicit attitudes, and slope due to the effect of SDR. As can be seen in these graphs, explicit attitudes shift down with high SDR participants reporting more negative attitudes but there is no difference in implicit attitudes. Under these circumstances, because the effect of SDR is similar across all high SDR participants, the correlation and slope would not be expected to change.

Second, as illustrated in Figure 2, the effect of SDR could vary randomly across all participants who are high in SDR. In this case, it would also be expected that the mean of the explicit attitudes would be shifted down, with high SDR participants reporting more negative attitudes. The scatter of responses would likely weaken the correlation between explicit and implicit attitudes, and because the variance would be randomly distributed across the respondents it would be expected that the slope of the regression line would not change significantly.

Third, as illustrated in Figure 3, the effect of SDR could be greatest for respondents with the most positive “true” responses. For example, due to floor effects, individuals who have the most positive “true” explicit attitudes would be expected to distort their responses more than those with less positive “true” explicit attitudes (individuals with very negative attitudes would be unable to make their responses much more negative because they are already at the bottom of the scale). Under these conditions, the mean explicit attitude would likely decrease, the slope of the regression line would flatten, and the correlation would likely weaken due to the decreasing slope.

In sum, in all three scenarios individuals with higher SDR scores would report more negative attitudes. Under some conditions, the correlation between self-report attitudes and implicit attitudes would be expected to weaken in high SDR participants. When floor effects are present, the slope of the regression line (relating self-report attitudes and implicit attitudes) would be expected to flatten in the high SDR participants.

## **Rationale**

The literature review above highlights the lack of adequate study in the area of SDR and cigarette smoking cessation. While social desirability has been commonly hypothesized to affect certain types of measures, such as self-reported smoking, mood, and craving, few studies have directly examined the effect of SDR on different measures in smoking cessation. To the best of the author's knowledge, no studies have examined these associations in the context of smoking cessation. It is important to understand the types of measures that might be affected by SDR to minimize the effect of SDR on smoking measures and to control for the potential inaccuracy that SDR may create within assessment data. The over-arching goal of this study was to more fully understand the influence that SDR may exert on commonly used smoking cessation assessments and examine the potential moderation effect of SDR on SR and NSR measures in smoking cessation research. The specific aims are listed below.

## **Specific Aims and Hypotheses**

**Specific Aim 1:** A primary aim of the current study was to examine the association between SDR and implicit and explicit attitudes toward smoking.

**Hypothesis 1A:** There will be a negative association between BIDR scores and self-reported attitudes toward smoking. Individuals with higher BIDR scores will report more negative attitude ratings.

**Hypothesis 1B:** The IAT should be relatively unaffected by conscious attempts at control, so BIDR scores will not be associated with implicit attitudes toward smoking.

**Hypothesis 1C:** Scores on the explicit and implicit measures of attitudes toward smoking will be weakly associated, and this association will be moderated by scores on the BIDR. Specifically, as BIDR scores increase, the association between explicit and implicit attitudes will weaken.

**Specific Aim 2:** A secondary aim of the current study was to examine the association between SDR and reported smoking.

**Hypothesis 2A:** A negative association will be found between BIDR scores and self-reported smoking. Individuals with higher BIDR scores will report that they have smoked less.

**Hypothesis 2B:** Biological measures of smoking are not within the control of participants. Therefore, BIDR scores will not be associated with cotinine levels in saliva.

**Hypothesis 2C:** Self-reported smoking and biological measures of smoking will be associated and this association will be moderated by BIDR scores. Specifically, as BIDR scores increase, the association between self-reported use and salivary cotinine will weaken.

**Specific Aim 3:** A tertiary aim of the current study was to examine the association between SDR and self-reported craving for cigarettes at the time of the assessment.

**Hypothesis 3A:** There will be a negative association between BIDR scores and self-reported craving. Individuals with higher BIDR scores will report lower craving ratings.

The literature has suggested that SR measures may be more susceptible to the effects of SDR than biological or implicit measures; however no studies have

directly examined this relationship within the context of smoking cessation. It is hypothesized that individuals higher in SDR will be motivated to under-report levels of craving and rates of smoking and over-report negative attitudes toward smoking because that would be most socially desirable within the context of smoking cessation. However, individuals should not have control over implicit or biological measures, so these measures should be unaffected by level of SDR. Also, previous studies have failed to find a moderation effect of SDR on the relationship between SR and NSR measures, so it is important to determine if there is such an effect of SDR and if SDR is a potential explanation for the low levels of association sometimes found between SR and NSR measures.

## **Methods**

### **Parent study**

The current study conducted analysis of adult smokers, recruited from the Houston, Texas, metropolitan area, who were enrolled in a smoking cessation study. The over-arching goal of the parent study is to examine the associations between performance on cognitive assessments and subsequent relapse to smoking. The parent study was approved by the Institutional Review Board of The University of Texas, M. D. Anderson Cancer Center and by the USUHS IRB (see Appendix A for IRB approval documents from M. D. Anderson and USUHS).

### **Participants**

Participants for the parent study were 183 adult community-based cigarette smokers in the Houston metropolitan area recruited via advertisements for smoking cessation treatment. Participants were paid \$25 for an orientation session, \$50 for

five laboratory sessions, and \$15 for two phone assessments. Participants could also optionally participate in a week-long ancillary study following their quit day in which they completed daily random assessments on a personal digital assistant (PDA). For these assessments, participants received \$2.50 for each assessment they completed. To qualify for the parent study, participants had to be 18-65 years old; be a current smoker with a history of at least 10 cigarettes per day for the last year; be motivated to quit within the next four weeks; have a home address and a functioning home telephone number; be able to speak, read, and write in English at an eight-grade literacy level; and have English as the first language.

Exclusion criteria included active substance abuse or dependence (other than cigarettes); regular use of tobacco products other than cigarettes (cigars, pipes, smokeless tobacco); use of nicotine replacement products; another household member enrolled in the study; self-reported color-deficiency; breath CO < 10 ppm (standard cut-off level indicating regular cigarette use; SRNT, 2002); pregnant or breast feeding; indication of a current suicidal ideation or depression, as defined by endorsement of at least "Several Days" for the item assessing suicidal ideation (item 2i) on the Patient Health Questionnaire (PHQ; Spitzer, Kroenke, Williams, 1999) or endorsement of at least "More than half the days" on at least five of the PHQ items which assess depressive symptoms (2a-h); or any other factor that, in the judgment of the investigators, would likely preclude completion of the protocol (e.g., a physical limitations that would hinder participant's ability to complete computerized tasks). These criteria are based on prior research in smoking cessation (e.g., Waters et al., 2007).



Participants averaged 43.39 years of age ( $SD = 11.60$ ), and 51 percent were women. They smoked an average of 20.65 cigarettes per day ( $SD = 8.85$ ) at enrollment. Mean level of nicotine dependence, as assessed by scores on the Fagerstrom Test of Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991), was 5.37 out of a possible 10 ( $SD = 2.28$ ) indicating medium to high nicotine dependence by standard cut-off scores (Heatherton et al., 1991). Mean baseline breath CO level was 23.80 ppm ( $SD = 10.83$ ), indicating that these participants were heavy smokers, by the standard cut-off score of 10 ppm for a regular smoker (SRNT, 2002).

### **Procedure**

Participants were first screened via a phone interview in which a tobacco history and demographic information were obtained and it was determined whether they met inclusion/exclusion criteria. Upon preliminary qualification, participants were asked to come in for the orientation session in which breath CO was measured with a CO monitor and they completed the following measures to assess qualification for enrollment in the study: the Rapid Estimate of Adult Literacy in Medicine (REALM; Davis et al., 1991), the Shipley Institute in Living Scale (SILS; Shipley, 1940), the Patient Health Questionnaire (PHQ; Spitzer, Kroenke, Williams, 1999), Section K (Non-alcohol psychoactive substance use disorders) of the Mini International Neuropsychiatric Interview (MINI; Sheehan, et al., 1998), and the Alcohol Use Disorders Identification Test (AUDIT; Saunders, Aasland, Babor, de la Fuente, & Grant, 1993) to assess for alcohol use.

At each of the five sessions, participants completed a battery of computerized cognitive tasks and questionnaires, including both self-report measures and explicit and implicit cognitive tasks. Of interest in the current study are the Semantic differential scale (SDS; Swanson et al., 2001), the Questionnaire of Smoking Use (QSU; Cox, Tiffany, & Christen, 2001), and the Implicit Association Test (IAT; Greenwald et al., 1998), all of which were administered at each of the laboratory sessions. The sessions consisted of two pre-quit sessions (once when overnight deprived of smoking and once when smoking normally), the quit day, one week after the quit day, and at the end of treatment (one month). Biological measures of smoking, cotinine and breath CO, were also collected at each of these sessions. Table 2 shows the schedules for those assessments that were analyzed in the current study.

Of the 183 individuals who attended an orientation session, 146 completed the BIDR. The majority (n=120) completed the BIDR during one of the lab sessions. Twenty-four completed the BIDR through the online survey tool or the mail after they had concluded participation in the study. Two participants completed the BIDR but the method of administration could not later be verified. Of the 146 participants who completed the BIDR, 113 were eligible for the study (i.e., completed the orientation session and signed the informed consent) and 33 were ineligible. The final sample included 103 participants who had completed the BIDR and at least one laboratory session (not including the orientation) (see Figure 4). Participants included in the final sample were not significantly different from excluded individuals on any of the baseline or demographic variables, including age, gender, race, nicotine

dependence, motivation to quit smoking, or confidence in quitting smoking (all ps > .10).

### **Treatment**

Treatment consisted of self-help materials and smoking cessation counseling. All participants received the same treatment.

**Self-help materials.** Participants received a standardized self-help manual that utilizes a standard relapse prevention/coping skills approach. It is written at a sixth grade reading level (U.S. Department of Health and Human Service, 2000).

**Smoking cessation counseling.** Counseling was based on standard and recommended smoking cessation/relapse prevention procedures as described in Treating Tobacco Use and Dependence Clinical Practice Guideline (Fiore et al., 2006) and provided by one of two of the study's licensed, Master's-level counselors. Counseling included: identifying high risk situations; coping with negative affect/stress; weight management; techniques for obtaining social support; coping with a partner/spouse who smokes; keys to success; relaxation techniques; and coping with a lapse. Counselors integrated these topics into an overarching coping skills/problem solving framework that was guided by each individual's unique barriers and high-risk situations. Counseling sessions lasted approximately 10-20 minutes and occurred during the laboratory sessions.

**Pharmacotherapy.** Participants were instructed that they should not take any pharmacotherapy during the course of the study.

## Measures

### Orientation measures

**The Rapid Assessment of Adult Literacy in Medicine.** The REALM is a screening instrument that assesses the ability to pronounce 66 common medical words and body parts. It takes approximately 2-3 minutes to administer and score, is highly correlated with other diagnostic literacy instruments, and has high validity and reliability, with a test-retest reliability of .99 (Davis et al., 1991).

**The Shipley Institute in Living Scale.** The SILS is a widely used measure that provides an estimate of a participant's IQ. It is composed of a vocabulary test in which participants must identify out of a list of words which one means “the same or nearly the same” as a target word. It also has an Abstract Thinking Test in which participants must logically complete the provided sentence with numbers or letters. It takes approximately 15-20 minutes to complete and 5 minutes to score (Shipley, 1940). Reliability is high with coefficients above .80 (Shipley, 1940), and it has predictive validity with other measures of intelligence (Zachary, Paulson, & Gorsuch, 1985).

**The Patient Health Questionnaire.** The PHQ is a self-administered diagnostic instrument that assesses mood, anxiety, alcohol, and recent psychosocial stressors using the diagnostic criteria of the DSM-IV. The PHQ has diagnostic validity and has high levels of agreement with independent diagnoses made by mental health professionals (Spitzer et al., 1999).

**The Mini International Neuropsychiatric Interview.** The MINI is a brief, self-report measure of psychiatric symptoms. Section K was used to assess non-

alcohol drug abuse/dependence. It has good interrater reliability (kappas of .79 to 1.00 across scales) and test-retest reliability (kappas of .52 to 1.00 across scales), as well as strong validity with other structured psychiatric interviews and high levels of agreement with independent diagnoses made by mental health professionals (values of .50 to .90 across scales) (Sheehan et al., 1998).

**The Balanced Inventory of Desirable Responding.** The BIDR is a 40-item questionnaire that assesses Self-deceptive Enhancement (the tendency to give self-reports that are honest but positively biased; SDE), and Impression Management (deliberate self-presentation to an audience; IM) (Paulhus 1988). The BIDR can be scored either dichotomously, with one point being given to responses of 6 or 7, or scored continuously in which the raw score is used. It can yield an IM score, an SDE score, or a combined total score of all 40 items. Research suggests that the continuous scoring system yields higher validity and reliability, as well as convergent validity with other SDR measures (Stober et al., 2002). Paulhus (1988) reported coefficient alpha values of internal consistency ranging from .68 to .80 for SDE, .75 to .86 for IM, and .83 for the summed SD score. Test-retest correlations were reported as .69 (SDE) and .65 (IM) over a 5-week period (Paulhus, 1988). Validity correlates reported by Lanyon and Carle (2007) ranged from .30 to .58 and suggest the scales have moderate divergent validity. In another study, a correlate of .18 was reported, suggesting even stronger divergence (Davies et al., 1998). In a reliability generalization study, Li and Bagger (2007) reported mean reliability estimates of .68 for SDE scores, .74 for IM scores, and .80 for overall scores; these estimates are

comparable to those reported of other commonly used social desirability scales (Beretvas, Meyers, & Leite, 2002).

### **Self-report Measures of Nicotine Use**

**Smoking diary.** Self-reported smoking rate (number of cigarettes per day) was recorded daily by participants on a smoking diary and was reported each week at the laboratory session.

### **Biological Measures of Nicotine Use**

**Salivary cotinine.** Cotinine is the primary metabolite of nicotine, and because of cotinine's long half-life (approximately 17 hours), it can measure the intake of nicotine over 2-3 days prior to collection. It is a common measure used to validate self-reported abstinence and is considered the "gold standard" for measuring nicotine exposure, with sensitivity and specificity levels over 90% (Ossip-Klein, et al., 1996; SRNT Subcommittee for Biochemical Verification, 2002). Salivary cotinine levels were measured through an enzyme immunoassay conducted by Salimetrics, LLC in State College, PA.

**Breath CO.** Exhaled carbon monoxide (CO) levels were measured with a CO monitor (Vitalograph, Lexena, KS) and were obtained at the beginning of each experimental session. On the experimental session that required overnight tobacco abstinence, participants had to have a CO level of less than or equal to 10 ppm, because this level distinguishes between regular smokers and non-smokers (SRNT, 2002). Standard procedures were followed for maintenance of the CO monitor. The monitor was calibrated from a cylinder of research gas with a known CO concentration (about 50 ppm) every month (SRNT, 2002). Breath CO is a reliable

and inexpensive measurement of smoke exposure (SRNT, 2002; Stewart, Stewart, Stamm, & Seclen, 1976).

### **Explicit Cognitive Tasks**

**Semantic differential scale.** The SDS is a measure of self-reported attitudes to smoking. The measure consists of six semantic differential items which polar-opposite adjective pairs (e.g., good-bad, ugly-beautiful) are presented to participants. Items are rated for the concept of smoking on a 7-point scale, and composite scores are calculated by scoring the 7-point scale from -3 to +3 and summing the ratings (Swanson et al., 2001). SDS scales are reasonably accurate and have strong associations with other measures that assess the same attitude construct (Heise, 1969).

**The Questionnaire of Smoking Urges.** The QSU-Brief is a 10-item measure of self-reported craving and was used to assess craving at the time of the test. It provides two factor scores. Factor 1 reflects the participant's intention and desire to smoke and anticipation of pleasure from smoking, and Factor 2 is indicative of the participant's anticipation of relief from negative affect and nicotine withdrawal and urgent need to smoke. A total score of the two factors can also be computed, and this value was used in the current analyses (Cox et al., 2001). The QSU is sensitive to abstinence and exposure to smoking-related cues (Morgan, Davies, & Willner, 1999), and has strong internal consistency (alpha of .97 for the total score) (Cox et al., 2001).

## Implicit Cognitive Tasks

**Implicit Association Task.** The IAT is an implicit measure of attitude, as measured through the strength of mental associations between two concepts. Recent research has examined implicit attitudes of adult smokers and suggests that implicit attitudes vary between smokers and non-smokers (Swanson et al. 2001), as well as between smokers with different levels of nicotine dependence (Sherman et al., 2003; Waters et al., 2007). Smokers with higher levels of nicotine dependence have a less negative implicit attitude toward smoking (weaker association between smoking and bad) than smokers with lower levels of nicotine dependence or non-smokers (Waters et al., 2007). There is substantial support for the validity and reliability of the IAT across multiple constructs, including smoking cessation (Cunningham, Preacher, & Banaji, 2001).

Description of the IAT is taken from previous studies that have used the IAT in smoking cessation research (Waters et al., 2010; Waters et al., 2007; Swanson et al., 2001). In the current study, associations between smoking/not smoking and good/bad were examined. The IAT consisted of seven blocks: (B1) Practice of single categorization for the target concept (e.g., smoking / not smoking); (B2) Practice of single categorization for the attribute concept (e.g., positive / negative); (B3) Practice of combined categorization task (e.g., smoking + positive / not smoking + negative); (B4) Critical trials for the block 3 combined categorization; (B5) Practice of single categorization for the target concept but with the response keys reversed from the B1 assignment (e.g., not smoking / smoking); (B6) Practice of combined categorization task (e.g. not smoking + positive / smoking + negative); (B7) Critical



trials for the block 6 categorization task. The order of completion of the combined categorization blocks (i.e., B3, B4, and B6, B7) was counterbalanced across participants.

Following Swanson et al. (2001), pictures were used to capture the target concepts of smoking vs. not smoking (see Appendix B for sample pictures used in this study). For example, a smoking picture depicted cues for smoking (e.g., an adult smoking), whereas a not smoking picture depicted the same scene but without the smoking cues (e.g., an adult who is not smoking). Words were used to capture positive and negative categories (Swanson et al., 2001). Positive words included nice, pleasant, good; negative words include nasty, unpleasant, and bad. On each trial, a stimulus (word or picture) was presented in the center of a computer monitor. On the top of the screen were labels (on each side of the screen) to remind participants of the categories assigned to each key for the current task. Participants responded to the categorization task by pressing either an “R” key or the “L” key on a computer keyboard. They were instructed to respond as quickly and as accurately as possible.

In B1, B2, and B7, the program randomly selected items from the stimulus lists. In B3, B4, B6, and B7, the program randomly selected items while alternating trials that presented a smoking or a not smoking picture with trials that presented either a positive or a negative word. If the participant responded correctly, then the program proceeded to the next trial after an inter-trial interval of 150ms. If the participant made an error, then a red “X” appeared below the stimulus and remained

on the screen until the participant responded correctly. Participants were instructed to correct their errors as quickly as possible by pressing the other key.

The scoring algorithm recommended by Greenwald and colleagues (2003) was used to derive the IAT effect (Table 4). Data from all four combination blocks (B3, B4, B6, B7) were used to compute the IAT effect. All response times > 10,000 msec were eliminated (< 0.1% of datapoints). The algorithm eliminates assessments on which a participant had response times of less than 300 msec on more than 10% of the trials (4 assessments in the current dataset). The computed IAT effect,  $D$ , is similar to an effect-size measure (Greenwald, et al. 2003). The internal (split-half) reliability of the IAT effect ( $D$  score) is adequate in a laboratory (e.g.,  $r = .91$  in Waters et al., 2007) and EMA settings (e.g.,  $r = 0.70$  in Waters et al., 2010).

### **Data Analysis**

Two analytic strategies were used in the current study. In Strategy 1, BIDR was coded as a dichotomous variable (Participants were split into 2 groups - “low” BIDR scorers and “high” BIDR scorers - based on the median value). In Strategy 2, the BIDR was coded as a continuous variable (Participants were not split into “low” and “high”). BIDR scores were split into two groups (Strategy 1) to facilitate presentation and interpretation of data. For example, by splitting participants into two groups it is easy to visualize how the strength of association between SR and NSR measures varies as a function of BIDR status (Figures 1-3).

The scores could also be split into 3 groups (a tertiary split would be a third strategy). To investigate the potential utility of a tertiary split, a simulation study was

conducted that assumed equal-sized groups, that the dependent variable was normally distributed in the population, and that there was a linear relationship between the two variables (dependent variable and BIDR scores) in the population. This simulation suggested that there was little difference in power between a binary and tertiary split (C. Olsen, personal communication, September 13, 2010). Given that there is likely little to be gained from using a tertiary split (from the perspective of statistical power), a binary split was preferred. This split (Strategy 1), in conjunction with the use of continuous variables (Strategy 2), provides a comprehensive analysis of the data.

To address hypotheses 1A, 1B, 2A, 2B, and 3A, planned t-tests were used to examine if “low” and “high” BIDR scorers differed on self-report, biological, and implicit measures (Strategy 1). Pearson’s  $r$  was used to examine if BIDR was associated with self-report, biological, and implicit measures (Strategy 2)

To address hypotheses 1C and 2C, Pearson’s  $r$  was used to examine if self-reported and biological/implicit measures were correlated within the “low” and “high” groups (Strategy 1). In supplemental analyses, the two correlation coefficients (derived from the two groups) were compared for significant difference from each other, using the methods described in Howell (2010).

Hierarchical regression analyses also were conducted in which the SR measure served as the dependent (criterion) variable and the NSR measure and BIDR score served as predictor variables. The interaction term between the two predictor variables, entered in a second step, tested whether a moderation effect was present (Strategy 2). The interaction term assesses whether the regression

coefficient,  $b$  (or slope), relating the NSR and SR measures is dependent on BIDR scores (coded as a continuous variable). The null hypothesis is that the  $b$  value does not vary by BIDR score. If the null hypothesis is rejected (i.e., there is a significant interaction), then it can be concluded that the relationship (slope) between the NSR and SR measures does vary according to BIDR score. This is the preferred method of moderation analyses in this area of research (see Table 1), so these regression analyses were chosen to maintain consistency and comparability with the available studies that have examined the moderating role of SDR on the relationship between SR and NSR measures. In addition, regression analysis has been cited as a reliable and appropriate method to test for moderation effects (McClelland & Judd, 1993).

Each hypothesis was examined for each of the three smoking states, when smoking normally (NON session), when 12-hour abstinent but not trying to quit (AB session), and when trying to quit (Quit Day; QD). Sixty-three participants were abstinent at the QD session and 29 were coded as non-abstinent (Figure 4); in the current analyses, the QD data was not broken down by whether or not participants were able to achieve abstinence on that day, due to sample size concerns. In addition, each hypothesis was examined for the mean of the three smoking statuses, and this was the primary focus of the data analyses. For each participant, mean scores were computed using data from completed sessions. In supplemental analyses, correlations between BIDR scores and SR measures also were examined to determine if they differed significantly between the states (i.e., AB, NON, and QD), using methods described in Howell (2010).

Previous studies have suggested that demographic variables such as age, sex, and ethnicity, may be associated with socially desirable responding, suggesting that there may be underlying cultural or cohort effects on rates of SDR (Warnecke et al., 1997). Therefore, the analyses examined whether age, sex, and ethnicity were associated with BIDR scores. If one of these variables was significantly associated with BIDR scores, then it was to be included as a covariate in analysis.

There was no correction for multiple tests for two reasons. First, adjusting alpha would reduce power to detect real differences in the population and increase the probability of type II errors (i.e., failing to reject a false null hypothesis). A reduction in power could not be offset by increasing the sample size because the data were archival. Second, alpha was not adjusted to maintain consistency and increase comparability with other studies. Specifically, investigators in previous studies examining the relationship between SR, NSR, and SDR measures did not adjust alpha for multiple tests (e.g., Adams et al., 2005; Egloff & Schmukle, 2003; Marissen et al., 2005). This issue is addressed further in the discussion.

### **Power Analysis**

Power analyses were computed using nQuery Advisor 6.01. All tests were 2-tailed (alpha = .05). With the sample size, and taking into account attrition over time (i.e., drop-out), using a t-test we had 80% power to detect a between-group effect size (in the population) of  $d_s = .56$  to  $.59$  (depending on state). Using Pearson's  $r$  we had 80% power to detect a correlation in the population ( $\rho$ ) of  $.28$  to  $.29$  (depending on state). The study also has 80% power to detect an  $\Delta R^2$  for the interaction of  $.066$  to  $.073$  (in the population) (hypotheses 1C, 2C, 3C) (see Table 3).

## Results

### Baseline and Demographic Variables

Across all participants ( $N = 146$ ) the mean BIDR total score was 13.3 ( $SD = 6.2$ ), which is comparable to research averages reported in Paulhus (1991) (total score range of 11.7-16.2). BIDR total scores were dichotomized by median split into a LOW group (0-12) ( $n = 72$ ,  $M = 8.2$ ,  $SD = 2.6$ ) and a HIGH group (13+) ( $n = 74$ ,  $M = 18.2$ ,  $SD = 4.3$ ). The LOW and HIGH groups did not differ significantly for any of the baseline variables assessed, including age ( $M = 42.1$ ,  $SD = 12.6$  vs.  $M = 43.1$ ,  $SD = 11.0$ ;  $t(144) = -.48$ ,  $p > .10$ ), gender (56.6% male vs. 43.2% male;  $\chi(1) = 2.20$ ,  $p > .10$ ), race distribution (White vs. Non-White) (69.4% White vs. 58.1% White;  $\chi(1) = 1.05$ ,  $p > .10$ ), breath CO levels at Orientation visit ( $M = 23.6$  ppm,  $SD = 11.3$  vs.  $M = 24.0$  ppm,  $SD = 10.4$  ppm;  $t(111) = -0.21$ ,  $p > .10$ ), or FTND scores ( $M = 5.3$ ,  $SD = 2.3$  vs.  $M = 5.7$ ,  $SD = 2.4$ ;  $t(143) = -1.12$ ,  $p > .10$ ). Because demographic variables were not associated with BIDR scores, these variables were not included as covariates in later analyses.

### Association Between SDR and Attitudes Toward Cigarette Smoking (Strategy 1)

Table 4 reports analyses conducted for Specific Aim 1, which concerned the association between BIDR scores and attitudes to smoking. Significant differences were found on SR attitudes toward smoking between LOW and HIGH groups (e.g.,  $t(102) = 2.24$ ,  $p = .03$  for the mean of the three sessions). These findings support hypothesis 1A that more negative attitudes toward smoking would be reported by participants with higher BIDR scores. There were no significant between-group (LOW vs. HIGH) differences on the IAT effect (e.g.,  $t(103) = 0.46$ ,  $p > .10$  for the

mean of the three sessions). These findings support hypothesis 1B that BIDR scores would not be associated with IAT effect. These findings are illustrated in Figure 5.

Table 4 reveals that significant correlations were found between SR and NSR measures in the LOW group (e.g.,  $r(53) = .29$ ,  $p = .03$  for mean of three sessions). No significant correlations were found in the HIGH group (e.g.,  $r(49) = .02$ ,  $p > .10$  for the mean of the three sessions). These data support hypothesis 1C that the association between implicit and explicit attitudes is weaker in individuals with high BIDR scores. This finding is illustrated in Figure 6.

Additional analyses were conducted to determine whether the correlations (between SR and NSR measures) in the two groups were significantly different from one another. These analyses test the null hypothesis that the correlations between SR and NSR measures are equal in the two underlying populations (i.e., in the LOW group and the HIGH group). Using a standard critical value of  $z = 1.96$  (for a 95% confidence interval), correlations between the LOW and HIGH groups were significantly different at QD ( $z = 2.35$ ,  $p = .02$ ) but did not reach significance at the mean of the three sessions ( $z = 1.91$ ,  $p > .05$ ).

### **Association Between SDR and Cigarette Smoking Rate and Intake (Strategy 1)**

Table 5 reports analyses conducted for Specific Aim 2, which concerned the association between BIDR scores and smoking rate and intake. There were no significant between-group (LOW vs. HIGH) differences found for SR smoking (e.g.,  $t(100) = -0.4$ ,  $p > .10$  for the mean of the three sessions). This finding did not support hypothesis 2A that there would be a significant association between

reported smoking and BIDR scores. There also were no significant differences for cotinine levels between LOW and HIGH (e.g.,  $t(103) = -1.57$ ,  $p > .10$  for the mean of the three sessions). These findings support hypothesis 2B that BIDR scores would not be associated with biological markers of smoking.

Table 5 reveals that several significant correlations were found between SR smoking and cotinine levels in the LOW group (e.g.,  $r(50) = .39$ ,  $p = .08$  for the mean of the three sessions), but no significant correlations were found in the HIGH group (e.g.,  $r(49) = .16$ ,  $p > .10$  for the mean of the three sessions). These data support hypothesis 2C that the association between SR and biological measures of smoking is weaker in individuals with high BIDR scores. These findings are illustrated in Figure 7.

Additional analyses were conducted to test whether the correlations (between SR and NSR measures) were significantly different from one another. Although correlations were significant in the LOW group at NON, AB, and at the mean of the three sessions (Table 5), using a standard critical value of  $z = 1.96$  (for a 95% confidence interval) the correlations (between SR and NSR measures) were not significantly different in the two groups (LOW and HIGH) at NON ( $z = 1.89$ ,  $p > .05$ ), AB ( $z = 1.42$ ,  $p > .1$ ), or for the mean of the three sessions ( $z = 1.72$ ,  $p > .05$ ).

### **Association Between SDR and Craving for Cigarettes (Strategy 1)**

Table 6 illustrates analyses conducted for Specific Aim 3, which concerned the association between BIDR scores and craving. There was a significant between-group (LOW vs. HIGH) difference found for SR craving (e.g.,  $t(102) = 2.13$ ,



$p = .04$  for the mean of the three sessions). This finding supports hypothesis 3A that individuals with higher BIDR scores would report significantly less craving.

### **SDR Scores as a Continuous Variable (Strategy 2)**

Specific Aims 1-3 also were examined with the BIDR total score as a non-dichotomized variable (i.e., not split into LOW and HIGH groups) (Tables 7-9).

Results were similar to those achieved through median split of the BIDR scores. For example, for mean scores there was a significant association between BIDR and SR attitudes toward smoking ( $r(102) = -.25$ ,  $p = 0.01$  for the mean of the three sessions) but not for the IAT effect ( $r(103) = 0.00$ ,  $p > .10$  for the mean of the three sessions) (Table 7). No significant association was found between BIDR and reported smoking ( $r(100) = .07$ ,  $p > .10$  for the mean of the three sessions), and the association between BIDR and cotinine levels approached significance ( $r(104) = .19$ ,  $p = .06$  for the mean of the three sessions) (Table 8). There was a significant association between BIDR and SR craving ( $r(102) = -.21$ ,  $p = .03$ ) (Table 9).

The hypothesis that BIDR scores would moderate the relationship between SR and NSR measures was examined using regression analyses. In these analyses, all variables were continuous variables. The SR scores were entered as the criteria. The implicit/biological scores and the BIDR score were entered as predictors in the first step. In step two, the interaction term between both variables was included in the equation. These analyses were conducted at each of the three sessions and the mean of the three sessions. Tables 7 and 8 present the unstandardized regression coefficients for the interaction terms. There was no significant increment in explained variance from step 1 to step 2 for any of the

analyses (i.e., no significant interactions). For example, when the mean explicit attitude was the dependent variable, there was no significant increment in explained variance from step 1 to step 2,  $\Delta R^2 = .01$ ,  $F(1,100) = 1.11$ ,  $p > .10$  (IAT x BIDR:  $\beta = -.29$ ). When the mean SR smoking was the dependent variable, there was no significant increment in explained variance from step 1 to step 2,  $\Delta R^2 = .00$ ,  $F(1, 98) = 0.31$ ,  $p > .10$  (Cotinine x BIDR:  $\beta = -.16$ ).

### **Between-State Differences in Associations**

Additional analyses were conducted to determine if correlations between BIDR scores and SR measures, some of which were found to be significant during initial analyses (Tables 7, 9), were significantly different across states. These analyses tested the null hypothesis that the correlations between BIDR scores and SR measures were equal in the two states. Because sample sizes varied across states, the smaller of the two sample sizes was used when conducting these analyses. For explicit attitudes, there was a significant difference in the correlations between BIDR and explicit attitude for the NON vs. AB comparison ( $n = 99$ ;  $t(96) = -2.31$ ,  $p = .02$ ) but not for the AB and QD comparison ( $n = 92$ ;  $t(89) = 1.49$ ,  $p > .10$ ), or the NON and QD comparison ( $n = 92$ ;  $t(89) = -0.56$ ,  $p > .10$ ). For self-reported craving, there was a significant difference in the correlations between BIDR and craving for the AB vs. QD comparison ( $n = 92$ ;  $t(89) = -2.48$ ,  $p = .02$ ). The other between-state comparisons did not reveal significant differences: NON vs. AB ( $n = 99$ ;  $t(96) = -1.66$ ,  $p > .10$ ); NON vs. QD ( $n = 92$ ;  $t(89) = -.70$ ,  $p > .10$ ).

## Discussion

The primary aim of this study was to examine the effect of socially desirable responding (SDR) on self-report (SR) and non self-report (NSR) measures in smoking cessation. A secondary aim was to examine whether or not SDR, as measured by the Balanced Inventory of Desirable Responding, moderated the relationship between these SR and NSR measures. The purpose of the study was to more fully understand the influence of SDR on cigarette smoking cessation assessments with the future goal of implementing ways to control for and to minimize the effect of SDR on research assessments. Participants were assessed twice prior to their quit day, once when 12-hours abstinent and once when smoking as normally, as well as on their quit day. Primary outcome measures were smoking rate, attitudes toward smoking, and craving.

The most interesting finding was that individuals with higher BIDR scores reported more negative (less positive) attitudes and lower craving ratings than individuals with lower BIDR scores. However, the same high BIDR individuals did not exhibit a more negative IAT effect (Figure 5). Confidence in these findings is increased by the fact that they were consistent across analyses (i.e., they were observed when BIDR scores were coded as both dichotomous and continuous variables). In addition, the LOW and HIGH group did not differ on any of the baseline or demographic variables measured. The HIGH participants exhibited slightly higher (non-significant) levels of nicotine self-administration (as assessed through salivary cotinine levels), but they reported significantly lower levels of craving at the NON and QD sessions. Because the two groups did not differ on

nicotine use (i.e., cotinine level) or level of nicotine dependence (i.e., FTND scores), they should be similarly addicted to nicotine and should be experiencing similar levels of craving. This finding suggests that self-report measures in smoking cessation may be sensitive to social desirability bias and that an implicit measure (IAT effect) may be less sensitive to this bias.

Although, as noted above, hypotheses 1A, 1B and 3A were confirmed, there was no evidence to support hypothesis 2A that individuals with higher BIDR scores would under-report their smoking. The meaning of this null finding is not clear. It is possible that some high BIDR participants may be inclined to exaggerate, rather than under-report, their smoking; they may have thought that the experimenters expected reports of heavy smoking, because participants were told not to quit until quit-day, and therefore reported high levels of smoking. Alternatively, it is possible that, in the context of smoking cessation, self-reported attitudes and craving are more sensitive to social desirability bias than self-reported behaviors. Further research examining the differential effect of SDR across a variety of constructs may help to clarify this type of finding.

### **Moderation Effect of SDR**

In contrast to the clear and consistent results reported above concerning the associations between SDR and self-report/implicit measures, the study provided mixed evidence that the associations between SR and NSR are dependent on BIDR scores. For example, the correlations between explicit and implicit attitudes were significant in LOW BIDR participants, but were not significant in HIGH BIDR participants (see Figure 7). This result is consistent with hypotheses, as it was

expected that higher levels of SDR would weaken the association between SR and NSR measures due to deviance in the self-reported information. Moreover, Figure 7 appears to suggest that the sizes of the correlations are different in the two groups (smaller in the HIGH BIDR group), and that the regression line is flatter in the HIGH BIDR group (similar to the pattern depicted in Figure 3).

However, supplemental analyses revealed that the magnitude of the two correlations was not significantly different (i.e., the null hypothesis that the correlations were equal in two groups could not be rejected). Moreover, using regression analysis there is no evidence that BIDR moderates the relationship between the IAT and self-reported attitudes. The regression analysis tests whether the slope between the IAT effect and self-reported attitude varies by the level of BIDR scores. In sum, there is some evidence that the association between SR and NSR measures is dependent on level of social desirability, given the significance of correlations between SR and NSR measures in the LOW group but non-significance of these correlations in the HIGH group. However, because these correlations were not significantly different from each other and because regression analyses failed to find any significant results, further research is required to confirm this finding and conclude that SDR has any moderation effect on the relationship between SR and NSR measures.

There are several explanations for why a clear-cut moderation effect may not have been detected in this study. It has been suggested that statistically significant interactions may be difficult to detect in moderation analyses due to lower levels of statistical power, particularly when conducting non-experimental field studies using

non-manipulated variables (McClelland & Judd, 1993). Similarly, large sample sizes are often required to detect significant differences between two correlation coefficients (Howell, 2010). These explanations suggest that future analyses utilizing a larger sample size may be required to detect potential moderation effects. In this respect, it is noteworthy that previous studies have similarly been unable to detect robust moderation effects when assessed using multiple regression analysis (Table 1). Perhaps there are other unidentified variables that may moderate this relationship more robustly. In addition, it is possible that utilization of a SDR measure less dependent on self-report may prove to be a stronger moderator of this relationship.

### **Between-state Differences**

As discussed previously, SDR may be important in all stages of smoking cessation. It is therefore important to understand the effect of SDR both prior to quitting and at the early stages of a quit attempt. While the effect of SDR at different stages in the cessation process has not previously been examined in research, preliminary analyses of these data indicate that the effect of SDR may vary prior to quitting and during early stages of the quit attempt. These analyses suggest that the association between SDR and self-reported attitudes was (significantly) stronger in the NON session than the AB session. Perhaps high BIDR participants are less likely to misrepresent their attitudes when abstinent because the impairment in cognitive processing impairs the operation of the bias. The correlation between SDR and craving is higher at quit day than when compared to abstinent (but pre-quit), suggesting that individuals may be more inclined to misrepresent self-reported

information during a quit attempt. This finding may be due to participants' assumptions that they would be expected to report lower levels of craving once they have quit. However, additional studies are required to confirm these results.

### **Implications**

The most important implication of the study is that self-report data in smoking cessation research, specifically craving and attitudes toward smoking, may be more valid in low SDR participants. This finding is particularly important for craving because this measure is such a widely used assessment in cigarette smoking, and other addiction, research. These results suggest that researchers should assess and control for the effect of SDR if possible, something that has not been consistently done in past research. The need to assess and control for SDR is likely to apply in other clinical domains as well, in which individuals would be motivated to misrepresent self-report information. The results of this study also suggest that increased use of implicit assessments may be particularly useful in individuals high in SDR. It may be potentially useful for those individuals low and high in SDR to receive different assessments to maximize accuracy of data obtained through assessment measures. In addition, future research examining the relationship between implicit and explicit cognition to risk of relapse should consider the role of SDR and control for its potentially misleading effect on assessment data.

It is also possible that tailoring the way self-report information is gathered could be helpful in additionally controlling the degree of SDR. Richman, Kiesler, Weisband, and Drasgow (1999) conducted a meta-analysis to examine the effect of SDR across different types of assessment administration, including computer-

administered questionnaires, traditional questionnaires, and interviews. They found that individuals appeared less likely to distort their responses on computer-administered questionnaires than in face-to-face assessments, particularly when anonymity was stressed. The Richman et al. (1999) study suggests that administration method should be considered, particularly for individuals higher in SDR who may be more prone to misrepresent information, and that providing anonymity and less face-to-face time during assessments may be beneficial to help control the effect of SDR on self-report data.

### **Limitations**

There are several limitations of the present study that should be noted. The BIDR was not included in the initial research protocol, therefore not all participants completed this measure and the sample size for this study was decreased. However, according to power analyses conducted, the study was reasonably powered to detect significant differences in both the correlational and moderation analyses. In addition, there was modest attrition over time in the study leading to different sample sizes at each session (approximately 1-10% across sessions). Non-random attrition may lead to subtly different subsections of the sample at different states which may complicate direct between-state comparisons. Likewise, the degree of practice on the assessments is confounded by state (e.g., the QD session is always the third session), so this difference may also complicate direct between-state comparisons.

There was no control for multiple tests, and therefore the familywise error rate is elevated above .05. However, two observations argue against the notion that the



results are predominantly type I errors (a type I error occurs when the researcher rejects the null hypothesis when the null hypothesis is, in reality, true). First, the pattern of results obtained was consistent across the two analytic strategies (e.g., significant differences on SR measures but not NSR measures). For example, four significant  $p$  values ( $p < .05$ ) were found from the 10 tests that evaluated hypotheses 1A, 1B, 2A, 2B, and 1C for the mean data. The probability of obtaining two or more significant results if all 10 null hypotheses were true is about 8% (using the binomial distribution), and so it is unlikely that the majority of the observed findings (relating to these hypotheses) are type I errors. Second, the results exhibited conceptual consistency. That is, associations between SDR and other variables were only found for SR measures in a manner that was consistent with hypotheses. Nonetheless, these findings should be treated with caution pending replication.

Lastly, it is not easy to measure social desirability bias, so there have been concerns as to whether a questionnaire measure, such as the BIDR, can truly capture SDR. While the present data indicates that SDR was being measured in this study, it is important to continually evaluate the validity and reliability of such measures and continue to develop even more sophisticated measures to tap into SDR.

### **Strengths**

The study also had some notable strengths. This study is the first study, to the best of the author's knowledge, to assess SDR and a battery of self-report and implicit assessments in a smoking cessation context. Similarly, to the best of the author's knowledge, it is the first study to provide evidence that explicit attitudes

toward smoking are more sensitive to SDR (as assessed by BIDR) than implicit attitudes within a cigarette smoking cessation context. Moreover, some study measures (craving, attitudes, IAT effect) were assessed in both laboratory and field settings (on a PDA). Therefore, in future research the generalizability of these results to other settings can be examined.

### **Future Directions**

As discussed previously, the BIDR can be scored using a continuous scoring method (continuous in the sense that individual items on the BIDR are not dichotomized but rather retained as numbers of a 1-7 scale, not in the sense that the total score is a continuous variable) in addition to the dichotomous scoring (used in this study). Little research has examined the difference between these two scoring algorithms, however one study does suggest increased reliability and convergence with other SDR measures using the continuous scoring method (Stober, Dette, & Musch, 2002). Therefore, it may be useful to examine differences in the results obtained with the continuous scoring method. In addition, it may be interesting to examine the results if three dichotomized BIDR groups were to be used (i.e., low, medium, and high BIDR).

Also, little research has examined the IM, SDE, and BIDR total scores separately to assess how these different constructs of SDR may affect assessment data differently. In the current study, the focus was on the BIDR total score, because the BIDR is most often scored in this way. However, it will be interesting to examine the differences among these three scores, particularly across different measures and across the three smoking states examined in the current study.

The data for the implicit measure of craving (e.g., attentional bias) have not yet been examined, as it was outside the scope of the current study. This examination will provide additional information to study the effect of SDR on implicit cognitive measures.

Future research should examine if the effect of SDR is different across measures and states, such as before and after a smoking quit attempt. The results from this study suggest that the effect of SDR varies by assessment construct and smoking status, so this is an important relationship that should be further explored and elucidated. In addition, future research should examine if associations between self-report measures and relapse are stronger in low SDR. Understanding this relationship may aid in increasing researchers' ability to accurately assess risk of relapse and predict relapse. Lastly, future research should examine if associations between BIDR and self-report measures exist in settings more useful for predicting real-world behaviors such as relapse (i.e., outside of the laboratory). Research on assessment setting suggests that differences in the effect of SDR may occur in other settings, so it would be important to understand how SDR is differentially effective in the laboratory vs. the real world.

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Table 1

## Summary of Literature on Associations Between SDR and Self-Report/Non Self-Report Measures

Study	N	SDR Measure	SR measure (Use or Cognition)	Correlation (r) of SDR with SR measure	NSR measure (Use or Cognition)	Correlation (r) of SDR with NSR measure	Moderation effect	Notes
Rohsenow et al. (1992) Study 2	60 alcoholic males in first week of detox 28 alcoholic males in 4th week of inpatient VA tx	MCS D	Cue-provoked craving (urge to drink)	-.07 (ns)	Change in physiological response (salivation)	<b>-.19*</b>		Significant correlation between SDR and outcome variable lost when ADS scores were added as a covariate
Rohsenow et al. (1992) Study 3	34 alcoholics in first week of inpatient VA tx	MCS D	Cue-provoked craving (urge to drink)	-.12 (ns)	Change in physiological response (salivation)	-.09 (ns)		
Egloff & Schmucke (2003) Exp. 1	145 students (106 female, 39 male)	SDS-17R	Self-reported anxiety (STAI)	-.01 (ns)	Anxiety IAT	-.05 (ns)	$\Delta R^2 = .003$ (ns)	
Egloff & Schmucke (2003) Exp. 2	62 students (35 female, 25 male)	BIDR (IM, SDE)	Self-reported anxiety (STAI & IAT-e)	<b>SDE &amp; STAI: -46**</b> <b>SDE &amp; IAT-e: -.36* (p&lt;.01)</b> IM & STAI: .09 (ns) IM & IAT-e: .09 (ns)	Anxiety IAT	SDE & IAT: -.14 (ns) IM & IAT: .16 (ns)	STAI : IAT x SDE: $\Delta R^2 = .001$ (ns) IAT x IM: $\Delta R^2 = .007$ (ns)  IAT-e: IAT x SDE: $\Delta R^2 = .00$ (ns) IAT x IM: $\Delta R^2 = .008$ (ns)	



Adams et al. (2005)	81 participants	MCSD	a) PAEE assessed by PAR (7 day PAR 1, 7 day PAR 2, 24 hour PAR)  b) Duration of Light, Moderate, Vigorous activity assessed by PAR	a) 7 day PAEE assessed by PAR 1: .12 (ns); 7 day PAEE assessed by PAR 2: .21 (ns);  24 hour PAEE assessed by PAR: .06 (ns)  (Correlations between MCSD and reported durations not reported)	a) PAEE assessed from doubly labeled water  b) Duration of Light, Moderate, Vigorous activity assessed by Actigraph	a) PAEE assessed from doubly labeled water: -.02 (ns)  (Correlations between MCSD and activity durations recorded by Actigraph not reported)	a) Difference score between PAEE assessed by PAR minus PAEE assessed by doubly labeled water <sup>1</sup>  7 day PAR 2: B=.65 (CI: .06, 1.25)  b) Difference score between activity duration assessed by PAR minus activity duration assessed by Actigraph <sup>1</sup>  7 day PAR 2 and Light activity: B=11.30 (CI: 1.87, 20.73); 7 day PAR 1 and Moderate activity: B=4.81 (CI: .90, 8.73) 7 day PAR 2 and Moderate activity: B=4.15 (CI: .10, 8.21)
Marissen et al. (2005)	76 heroin-dependent participants in inpatient substance abuse tx	Lie scale (EPQ-RSS)	Cue provoked craving ( $\Delta$ VAS, OCDUS-TI, OCDUS-DC, $\Delta$ DDQ-DI)	OCDUS-TI: -.20 (ns) <b>OCDUS-DC: -.29**</b> $\Delta$ VAS: -.25* $\Delta$ DDQ-DI: -.26*	Change in physiological response ( $\Delta$ SCL, $\Delta$ SCR)	$\Delta$ SCL: .11 (ns) $\Delta$ SCR: -.11 (ns)	OCDUS-DC x $\Delta$ SCR: $\Delta R^2 = .01$ (ns)

Table Note: Only studies in which a socially desirable responding (SDR) measure was administered are included (see text for details). The moderation effect (assessed using multiple regression analysis) tested whether SDR moderates the association between the self-report measures and the outcome variable. SR = Self-report measure (Use or Cognition);

NSR = Non Self-report measure (Use or Cognition); MCSD = Marlowe-Crowne Social Desirability Scale; SDS-17R = Revised Social Desirability Scale-17; BIDR = Balanced Inventory of Desirable Responding (IM = Impression management; SDE = Self-deception enhancement); EPQ-RSS = Eysenck Personality Questionnaire Revised Short Scale; STAI = State-Trait Anxiety Inventory; IAT = Implicit Association Test; IAT-e = Explicit rating of the IAT stimuli; PAR = Physical Activity Report; VAS = visual analog scale; OCDUS-TI = Thoughts and Interference subscale of the Obsessive-Compulsive Drug Use Scale; OCDUS-DC = Desire and Control subscale of the Obsessive-Compulsive Drug Use Scale; DDQ-DI = Desire and Intention subscale of the Desire for Drug Questionnaire; PAEE = physical activity energy expenditure; SCL = skin conductance level; SCR = skin conductance responses; ADS = Alcohol Dependency Scale;  $\Delta$  = change scores; <sup>1</sup>Reported B values derive from regression analysis in which the difference score is the dependent variable and Social Desirability and Social Approval are the independent variables. \*p < .05; \*\* p < .01 (Significant effects are bolded)

Table 2

*Study Assessment Timeline*

Assessment	Orientation (lab)	Wk -2 (lab)	Wk -1 (lab)	Wk 0 (lab)
<b>Smoking Behavior</b>				
Breath CO	X	X	X	X
Cotinine (saliva)		X	X	X
Smoking status (in lab)		X	X	X
Smoking rate (diaries)		X	X	X
<b>Implicit Assessments</b>				
IAT		X	X	X
<b>Self-report Assessments</b>				
QSU		X	X	X
Semantic differential scale		X	X	X
BIDR	X			

Table Note: Wk -2 = lab visit two weeks before quit-day; Wk -1 = lab visit one week before quit-day; Wk 0 = lab visit on quit-day; CO = carbon monoxide; IAT = Implicit Association Test; QSU = Questionnaire of Smoking Urges; BIDR = Balanced Inventory of Desired Responding

Table 3

*Power Calculations*

	Correlation in population (rho)	$\Delta R^2$ for interaction
NON session (n = 102)	.28	.066
AB session (n = 99)	.28	.068
QD (n = 92)	.29	.073

Table Note: Table shows the smallest correlation in the population and the smallest  $\Delta R^2$  for the interaction (i.e., NSR x BIDR interaction) in the population for which the study had 80% power to reject the null hypothesis

Table 4

*Differences in Explicit and Implicit Attitudes Toward Smoking for Low and High BIDR Participants (Strategy 1)*

	SR	Low BIDR M (SD)	High BIDR M (SD)	t-test: Low and High BIDR (t value)	NSR	Low BIDR M (SD)	High BIDR M (SD)	t-test: Low and High BIDR (t value)	Correlation	
									between SR and NSR (r)	between SR and NSR (r)
									Low BIDR	High BIDR
NON	Explicit Attitudes	-1.56 (1.12)	-2.15 (1.00)	<b>2.83**</b>	IAT effect	-0.95 (0.51)	-1.02 (0.46)	.71	.05	.13
AB	Explicit Attitudes	-1.85 (1.11)	-1.92 (1.13)	.31	IAT effect	-0.91 (0.53)	-0.95 (0.52)	.33	.18	.06
QD	Explicit Attitudes	-2.39 (0.82)	-2.68 (0.61)	<b>1.90*</b>	IAT effect	-0.79 (0.59)	-0.93 (0.49)	1.23	<b>.32*</b>	-.02
Mean	Explicit Attitudes	-1.93 (0.75)	-2.26 (0.78)	<b>2.24**</b>	IAT effect	-0.89 (0.45)	-0.94 (0.45)	.46	<b>.29*</b>	.02

Table Note: SR = Self-report measure; NSR = Non Self-report measure; BIDR = Balanced Inventory of Desirable

Responding; IAT = Implicit Association Test; Explicit Attitudes = Semantic Differentiation Scales (Range -3 to +3); Ns vary

from 102 (NON) to 92 (QD); \*p<.05, \*\*p<.01

Table 5

*Differences in Self-Report and Biological Measure of Smoking for Low and High BIDR Participants (Strategy 1)*

SR	Low BIDR M (SD)	High BIDR M (SD)	t-test: Low and High BIDR (t value)	NSR	Low BIDR M (SD)	High BIDR M (SD)	t-test: Low and High BIDR (t value)	Correlation between SR and NSR (r)	Correlation between SR and NSR (r)	
								Low BIDR	High BIDR	
NON	Reported Smoking	17.40 (6.44)	18.12 (10.68)	- .41	Cotinine	342.07 (185.32)	383.40 (202.45)	-1.07	<b>.38**</b>	.13
AB	Reported Smoking	17.77 (6.45)	18.59 (11.57)	- .44	Cotinine	225.16 (121.00)	259.29 (134.18)	-1.34	<b>.44**</b>	.26
QD	Reported Smoking	15.48 (8.32)	15.64 (10.75)	- .07	Cotinine	280.56 (177.34)	301.44 (180.47)	-.56	.27	.05
Mean	Reported Smoking	17.05 (6.28)	17.76 (10.6)	- .41	Cotinine	281.73 (145.48)	332.50 (183.92)	-1.57	<b>.39**</b>	.16

Table Note: SR = Self-report measure; NSR = Non Self-report measure; BIDR = Balanced Inventory of Desirable Responding; Reported Smoking = Mean cigarettes smoked per day in the 7-days prior to the laboratory visit as recorded in smoking diaries; Ns vary from 100 (NON) to 92 (QD); \*p<.05, \*\*p<.01

Table 6

*Differences in Self-Reported Craving for Low and High BIDR Participants (Strategy 1)*

	SR	Low BIDR M (SD)	High BIDR M (SD)	t-test: Low and High BIDR (t value)
NON	Reported Craving	4.34 (2.28)	3.37 (2.83)	<b>1.91*</b>
AB	Reported Craving	6.01 (2.28)	5.75 (2.45)	0.55
QD	Reported Craving	3.55 (1.82)	2.35 (2.33)	<b>2.75**</b>
Mean	Reported Craving	4.34 (2.28)	3.37 (2.83)	<b>2.13**</b>

Table Note: SR = Self-report measure; NSR = Non Self-report measure; BIDR = Balanced Inventory of Desirable Responding; Reported Craving = QSU Ratings; Ns vary from 102 (NON) to 92 (QD); \* p<.1; \*\*p<.05, \*\*\*p<.01

Table 7

*Correlations Between BIDR Scores and Explicit and Implicit Attitudes Toward Smoking (Strategy 2)*

	SR	Correlation between BIDR and SR (r)	NSR	Correlation between BIDR and NSR (r)	Moderation Effect Regression (b value)
NON	Explicit Attitudes	<b>-.28**</b>	IAT effect	-.02	b = .000 (SE = .032) $\Delta R^2 = .000$
AB	Explicit Attitudes	-.06	IAT effect	-.02	b = .011 (SE = .032) $\Delta R^2 = .001$
QD	Explicit Attitudes	<b>-.22*</b>	IAT effect	-.15	b = -.039 (SE = .021) $\Delta R^2 = .035$
Mean	Explicit Attitudes	<b>-.25*</b>	IAT effect	-.00	b = -.024 (SE = .023) $\Delta R^2 = .010$

Table Note: SR = Self-report measure; NSR = Non Self-report measure; BIDR = Balanced Inventory of Desirable Responding; Explicit Attitudes = Semantic Differentiation Scales (-3 to +3); Ns range from 102 to 92; \*p<.05, \*\*p<.01. r values are Pearson correlation coefficients; b values for moderation effect are unstandardized regression coefficients for the interaction between BIDR scores and NSR measures in regression analysis (see text)



Table 8

*Correlations Between BIDR Scores and Self-Report and Biological Measures of Smoking (Strategy 2)*

	SR	Correlation between BIDR and SR (r)	NSR	Correlation between BIDR and NSR (r)	Moderation Effect Regression (b value)
NON	Reported Smoking	.04	Cotinine	.12	b = -0.076 (SE = .058) $\Delta R^2 = .017$
AB	Reported Smoking	.06	Cotinine	.09	b = -0.048 (SE = .099) $\Delta R^2 = .002$
QD	Reported Smoking	.04	Cotinine	.07	b = -.057 (SE = .093) $\Delta R^2 = .001$
Mean	Reported Smoking	.07	Cotinine	.19	b = -.065 (SE = .063) $\Delta R^2 = .003$

Table Note: SR = Self-report measure; NSR = Non Self-report measure; BIDR = Balanced Inventory of Desirable Responding; Cotinine = Cotinine levels in saliva; b values for moderation effect are unstandardized regression coefficients in regression analysis (to facilitate data presentation cotinine values were divided by 100 prior to analysis); Ns range from 102 to 92; \* $p < .05$ , \*\* $p < .01$

Table 9

*Correlations Between BIDR and Self-Reported Craving (Strategy 2)*

	SR	Correlation between BIDR and SR (r)
NON	Reported Craving	<b>-.21*</b>
AB	Reported Craving	-.04
QD	Reported Craving	<b>-.28**</b>
Mean	Reported Craving	<b>-.21*</b>

Table Note: SR = Self-report measure; NSR = Non Self-report measure; BIDR = Balanced Inventory of Desirable Responding; Reported Craving = Questionnaire of Smoking Urges (0 – 10); Ns range from 102 to 92; \*p<.05, \*\*p<.01

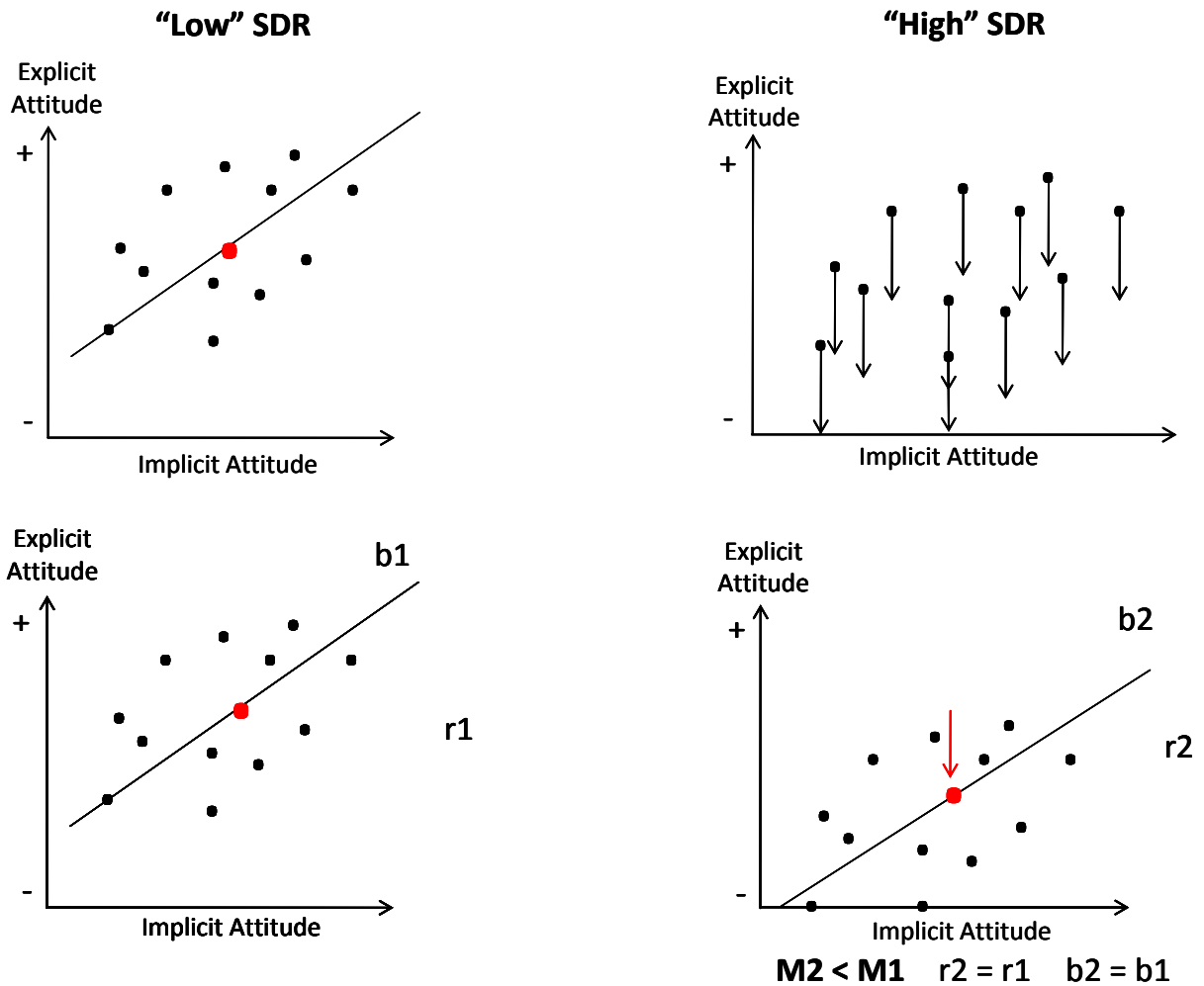


Figure 1. Possible effect of SDR on self-report measures and the association between self-report and implicit measures. The Figure assumes that the effect of SDR is similar across all participants high in SDR (see text for details).  $b_1$  = original slope;  $b_2$  = slope adjusted for the effect of SDR;  $r_1$  = original correlation between implicit and explicit attitudes;  $r_2$  = correlation adjusted for the effect of SDR;  $M_1$  = original mean value (centroid) of implicit and explicit attitudes;  $M_2$  = mean value adjusted for the effect of SDR

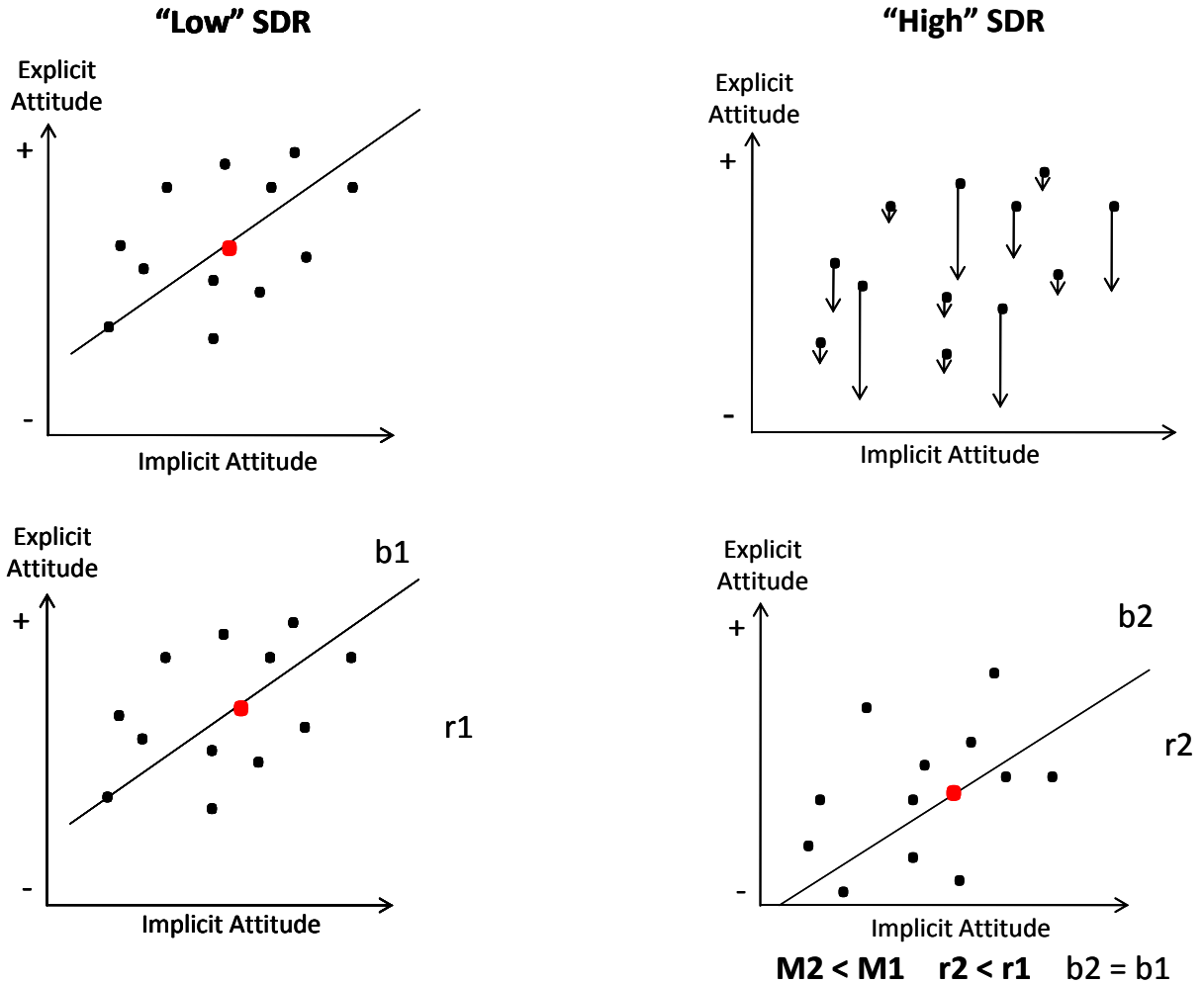


Figure 2. Possible effect of SDR on self-report measures and the association between self-report and implicit measures. The Figure assumes that the effect of SDR varies across all participants high in SDR (see text for details).  $b_1$  = original slope;  $b_2$  = slope adjusted for the effect of SDR;  $r_1$  = original correlation between implicit and explicit attitudes;  $r_2$  = correlation adjusted for the effect of SDR;  $M_1$  = original mean value (centroid) of implicit and explicit attitudes;  $M_2$  = mean value adjusted for the effect of SDR

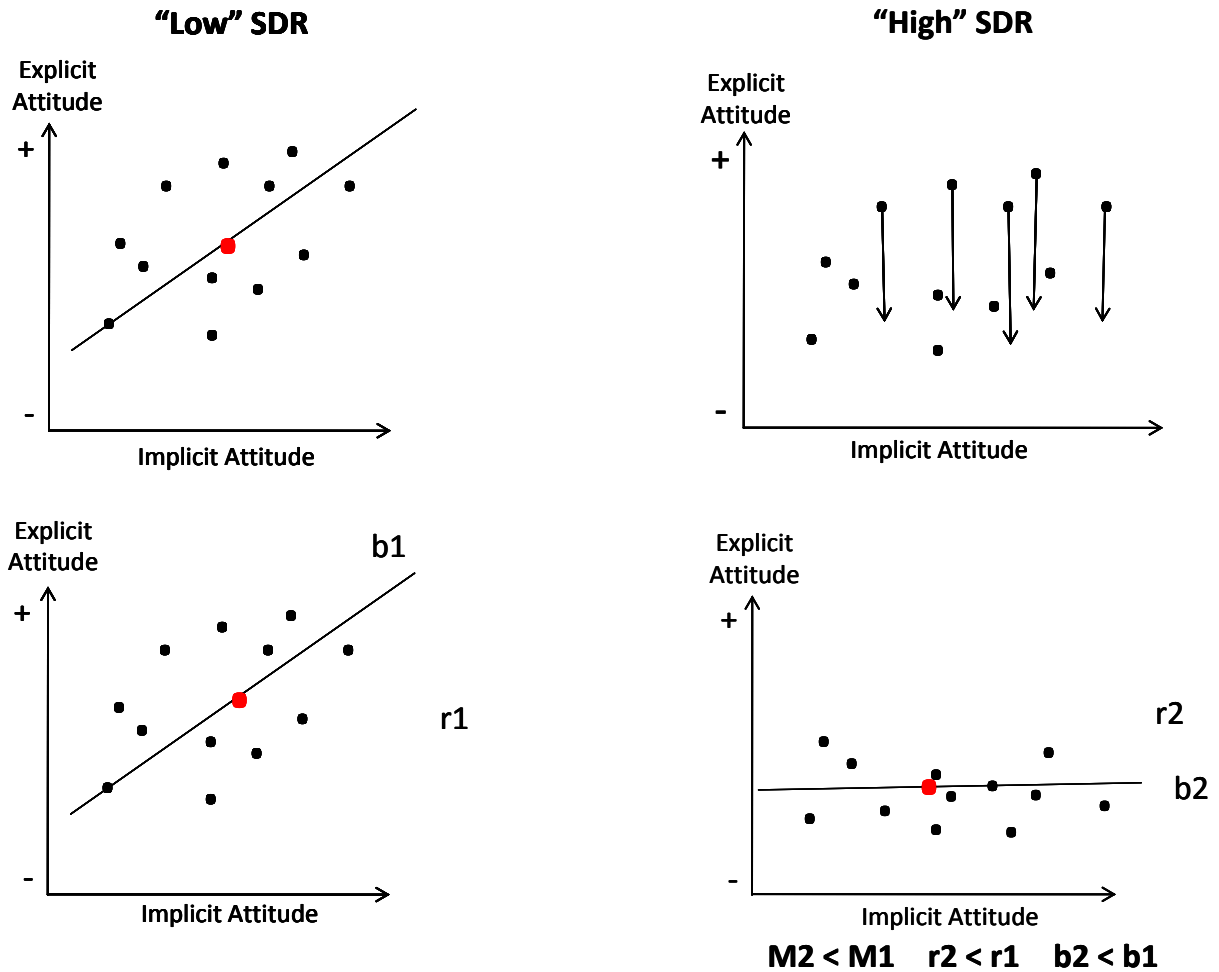


Figure 3. Possible effect of SDR on self-report measures and the association between self-report and implicit measures. The Figure assumes that the effect of SDR is largest in individuals with the most positive “true” attitudes (see text for details).  $b_1$  = original slope;  $b_2$  = slope adjusted for the effect of SDR;  $r_1$  = original correlation between implicit and explicit attitudes;  $r_2$  = correlation adjusted for the effect of SDR;  $M_1$  = original mean value (centroid) of implicit and explicit attitudes;  $M_2$  = mean value adjusted for the effect of SDR

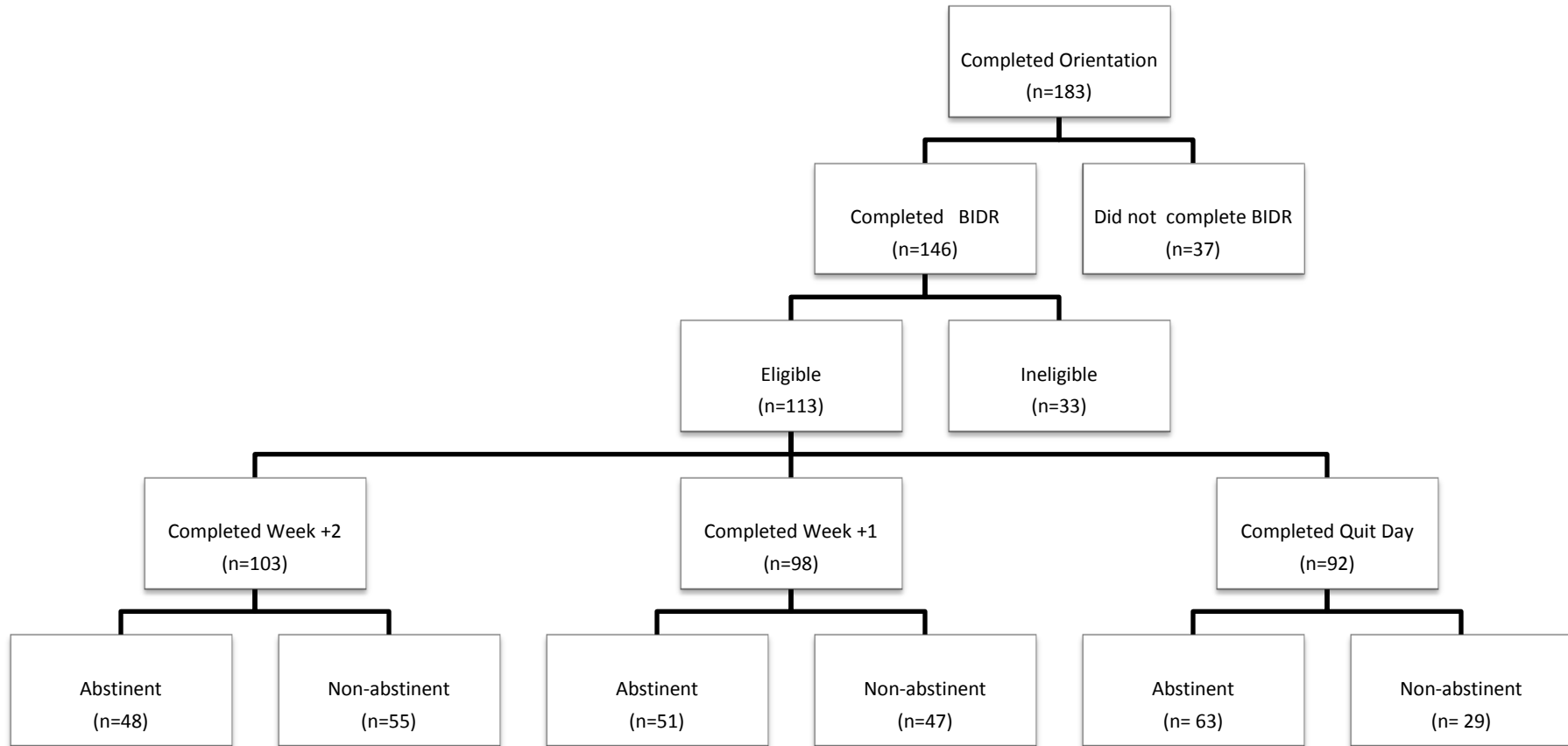
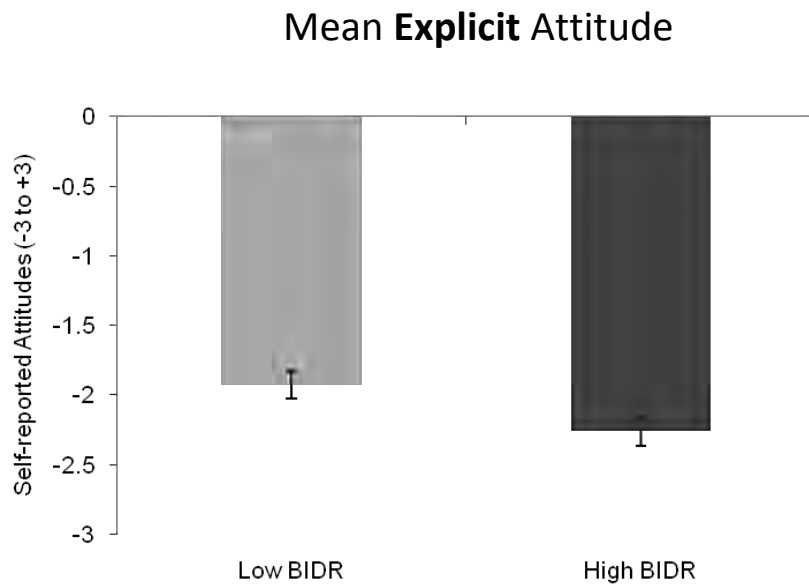
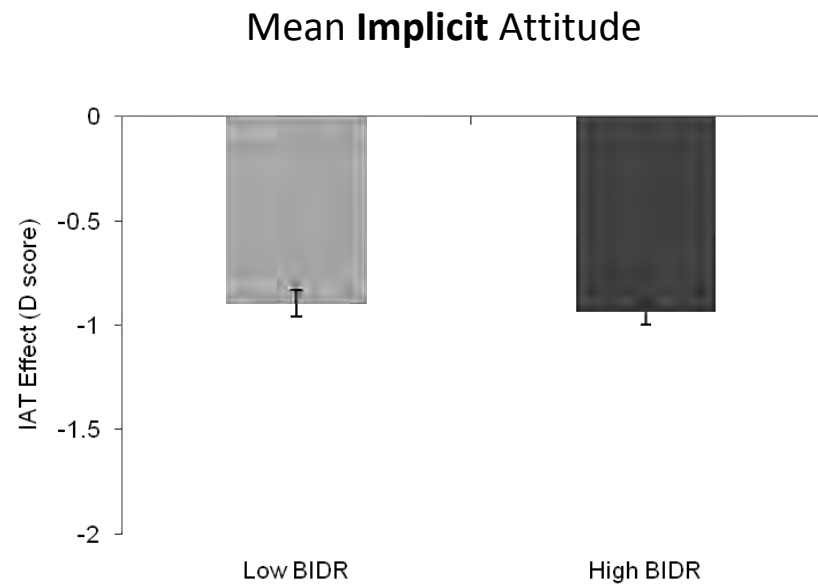


Figure 4. Breakdown of study sample from eligibility to laboratory sessions (Week -2 through Quit Day) divided by abstinence and non-abstinence status

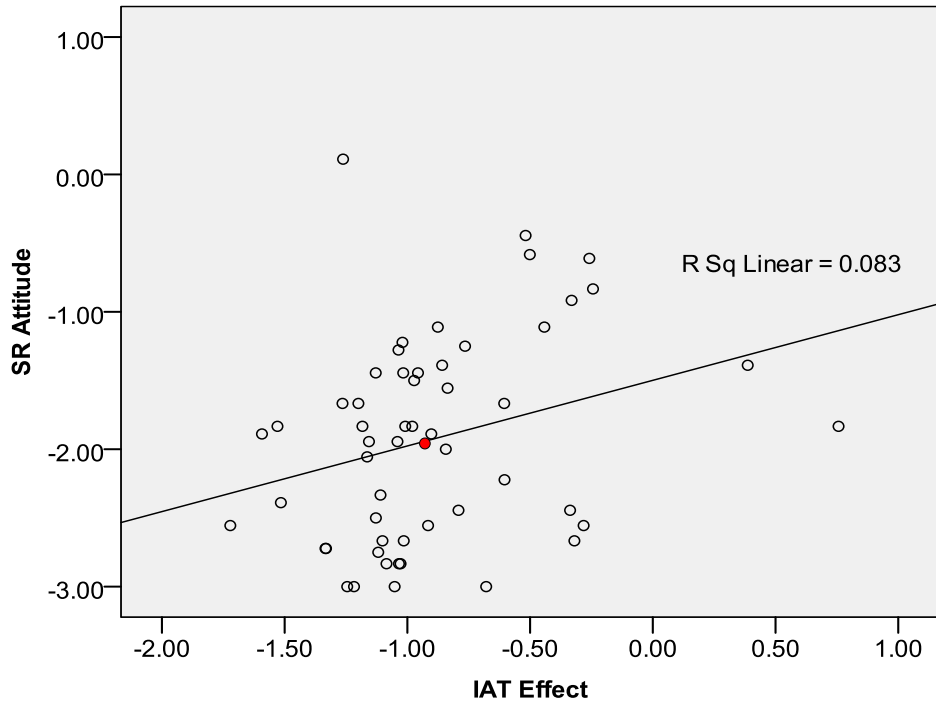


**t = 2.24**  
**p < .05**

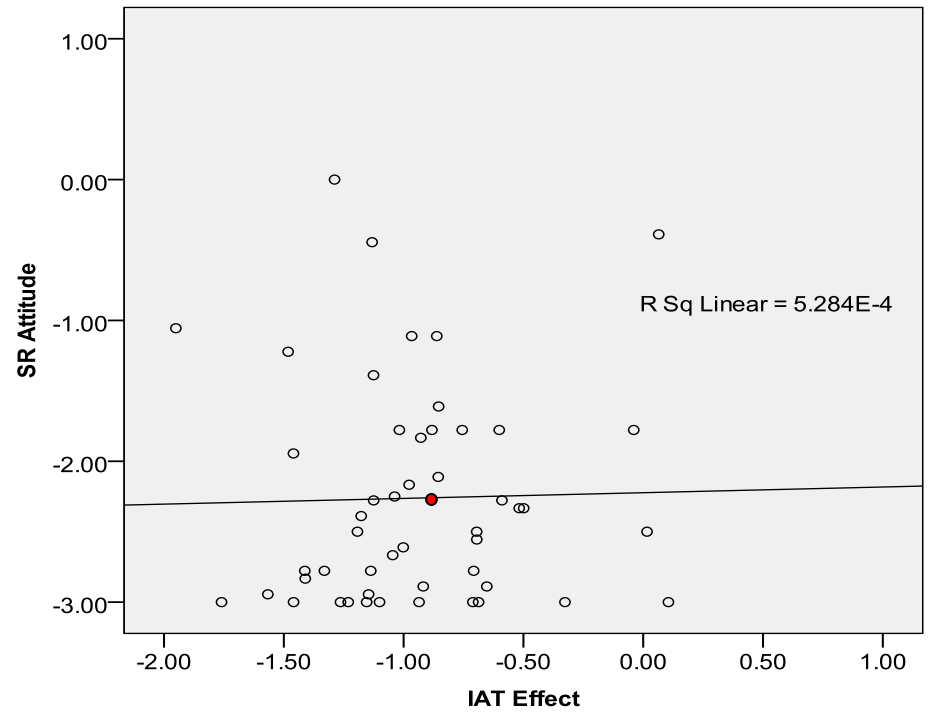


t = .46  
ns, p > .6

Figure 5. Differences in explicit and implicit attitudes for low and high BIDR participants (strategy 1); mean explicit attitudes were significantly different between low and high BIDR participants, however mean implicit attitudes did not differ significantly between these two groups.



“Low” BIDR

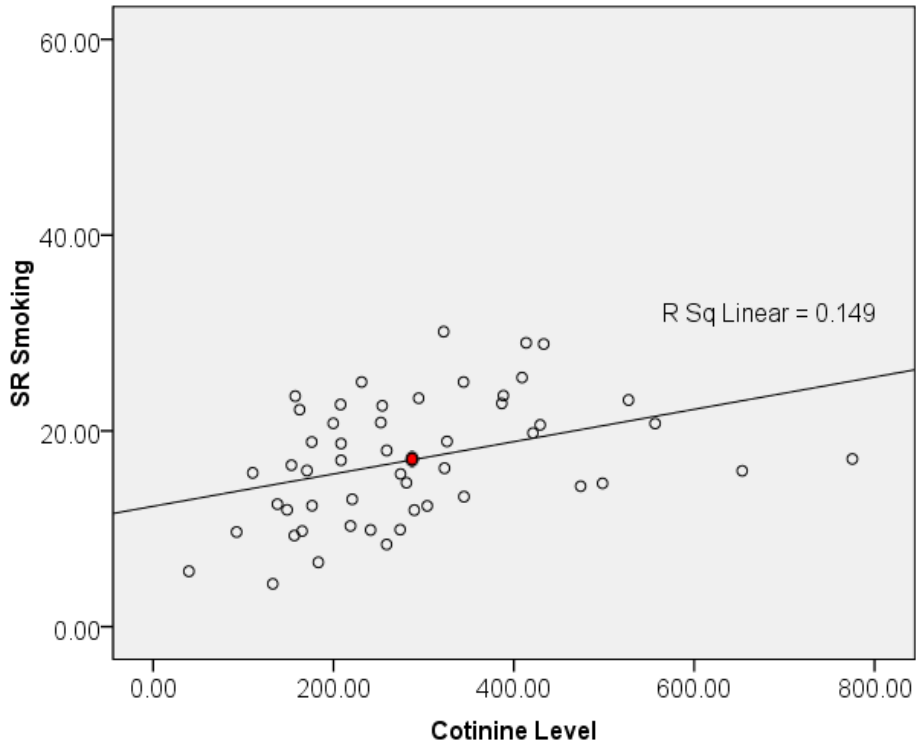


“High” BIDR

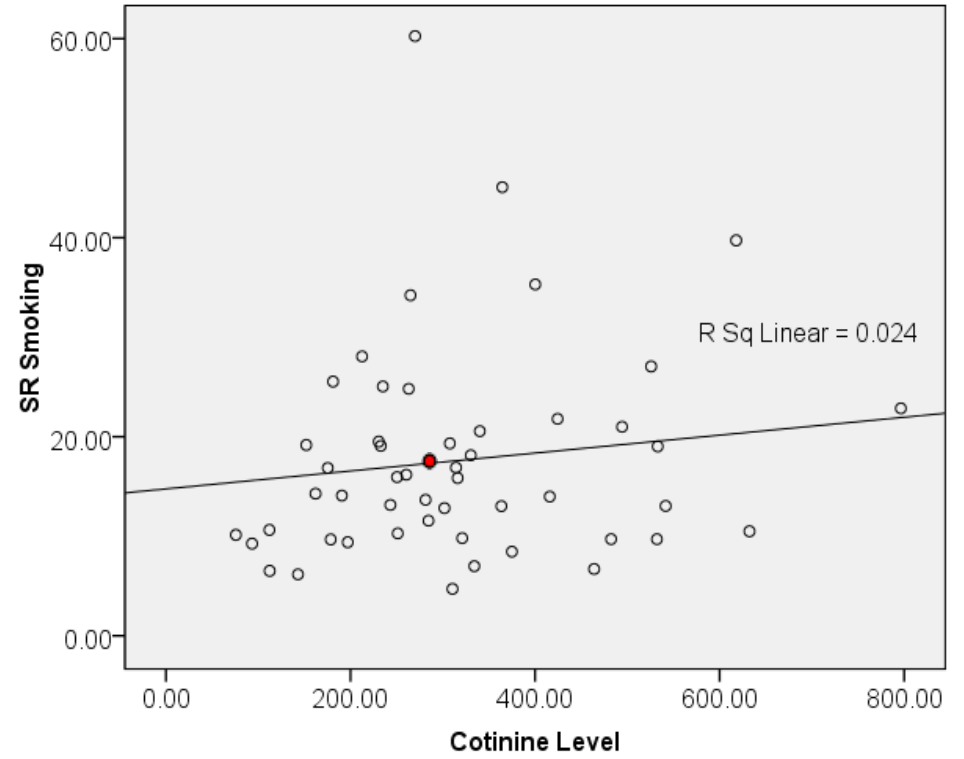
Figure 6. Relationship between mean explicit and implicit attitudes toward smoking for low and high BIDR

(strategy 1)





“Low” BIDR



“High” BIDR

Figure 7. Relationship between mean self-reported smoking and biological measure of smoking for low and high BIDR

(strategy 1)

Appendix A: IRB approval paperwork from M. D. Anderson Cancer Center



**Office of Protocol Research**

Institutional Review Board (IRB)  
Unit 1437  
Phone 713-792-2933  
Fax 713-794-4589

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To: Paul Cinciripini 03/31/2009  
From: Marion B. Olson  
CC: Sunetra Martinez, Victoria L. Brown, Evanna L. Thompson, Veronica Roberts  
MDACC Protocol ID #: 2005-0741  
Protocol Title: Cognitive Processes in Smoking Cessation  
Version: 13  
  
Subject: Administrative IRB Approval – Protocol 2005-0741

On Tuesday, 03/31/2009, the Institutional Review Board (IRB) 4 chair or designee reviewed and approved your revision dated 03/27/2009 for Protocol 2005-0741

These Pages Include:

· Protocol Body – Document header Date: 03/27/2009

Revision included the following changes:

Clarifying that the de-identified data will be sent to Dr. Andrew Waters and his statistical team at the Uniformed Services University of the Health Sciences.

Additional Revision History:

Please note that along with this revision the M. D. Anderson IRB approves the transfer of de-identified study data for analysis to Dr. Andrew Waters, collaborator on this study, and his statistical team at the Uniformed Services University of the Health Sciences.

The revision can now be implemented. Please inform the appropriate individuals in your department or section and the collaborators of these changes.

Please inform the appropriate individuals in your department/section and your collaborators of these revisions.

Please Note: This approval does not alter or otherwise change the continuing review date of this protocol.

In the event of any questions or concerns, please contact the sender of this message at (713) 792-2933.

Marion B. Olson 03/31/2009 10:02:17 AM

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**This is a representation of an electronic record that was signed electronically and below is the manifestation of that electronic signature:**

**Marion B. Olson**  
**03/31/2009 09:51:14 AM**

Appendix B: Sample pictures from the smoking IAT

Nonsmoking object (top left), smoking object (bottom left), nonsmoking human (top right), and smoking human (bottom right).

