



Published in final edited form as:

Psychol Addict Behav. 2012 March ; 26(1): 157–161. doi:10.1037/a0023706.

A Test of Positive Affect Induction for Countering Self-Control Depletion in Cigarette Smokers

Dikla Shmueli, PhD and Judith J. Prochaska, PhD, MPH

Department of Psychiatry, University of California, San Francisco

Abstract

OBJECTIVE—The self-control strength model posits that exerting self-control on one task, such as resisting temptations, will deplete self-control and impair subsequent self-regulatory performance, such as controlling smoking. The current study examined interventions designed to replenish depleted self-control strength to prevent tobacco use by inducing positive affect.

DESIGN—In a 2×2 design, 200 participants were randomized to either (1) resist eating from a plate of desserts (high temptation) or from a plate of raw vegetables (low temptation) and then (2) undergo a positive or neutral affect induction. Two inductions were compared (video vs. writing technique). Participants were then given a 10-minute recess.

MAIN OUTCOME MEASURE—Whether or not participants smoked during the recess, assessed by self-report and biochemical verification, served as the primary dependent variable.

RESULTS—The interaction between depletion and exposure group was significant, *Wald's* $X^2 = 9.66$, $df = 3$, $p < .05$. Among those assigned to resist desserts, 65.5% to 85% smoked if they were in the neutral video or writing conditions versus 10.5% in the positive affect video group.

CONCLUSION—Positive affect elicited with a video was able to counteract the detrimental effects of self-control depletion on smoking behavior, while writing exercises were associated with smoking. Implications for tobacco cessation intervention are discussed.

Keywords

positive emotions; cigarette smoking; self-control; tobacco; weight management; health behavior

Introduction

The self-control strength model, proposes that self-control relies on a limited resource, akin to energy or strength, which is consumed or depleted when an individual performs any volitional activity necessitating self-control, such as resisting temptations (Baumeister, Muraven, & Tice, 2000; Muraven & Baumeister, 2000). When this resource is depleted, individuals perform more poorly on a subsequent task involving self-control. The self-control strength model is particularly useful for understanding addictive behaviors and has recently been applied to cigarette smoking. Smokers whose self-control resources were depleted by resisting a tempting plate of desserts were more likely to smoke during a

Correspondence concerning this article should be addressed to Judith J. Prochaska, University of California, San Francisco, 401 Parnassus Avenue – TRC 0984, San Francisco, CA, 94143-0984. JProchaska@ucsf.edu.

Publisher's Disclaimer: The following manuscript is the final accepted manuscript. It has not been subjected to the final copyediting, fact-checking, and proofreading required for formal publication. It is not the definitive, publisher-authenticated version. The American Psychological Association and its Council of Editors disclaim any responsibility or liabilities for errors or omissions of this manuscript version, any version derived from this manuscript by NIH, or other third parties. The published version is available at www.apa.org/pubs/journals/adb

subsequent break than smokers who resisted eating from a less tempting plate of raw vegetables (Shmueli & Prochaska, 2009). These findings support the US Tobacco Treatment Guidelines, which discourage dieting during cessation attempts (Fiore et al., 2008).

The current study builds upon previous findings and tests the efficacy of a positive affect induction intervention aimed at replenishing self-control. Research on positive emotions supports the idea that positive affect may be beneficial to self-control efforts. Studies repeatedly demonstrate that positive emotions can help undo many of the harmful effects associated with negative experiences and even create an upward spiral of positive affect (e.g., Fredrickson, 2001; Fredrickson & Levenson, 1998; Fredrickson, Mancuso, Branigan, & Tugade, 2000). Empirical evidence regarding the adaptive function of positive affect in the context of self-regulation has begun to accumulate as well. In a series of studies using the self-control replenishment paradigm, depleted participants who were induced with positive affect performed better on subsequent tasks of self-control than those who were not induced with positive affect (Tice, Baumeister, Shmueli, & Muraven, 2007). That is, positive affect appeared to counteract the effects of self-control depletion. Previous research also has shown a specific association between positive affect and cigarette smoking. In a longitudinal treatment study, higher levels of baseline positive mood were associated with an increased probability of abstinence at the 10-week follow up (Doran et al., 2006).

The current analysis examined the effect of interventions designed to replenish depleted self-control strength by inducing positive affect on subsequent smoking behavior. Following the self-control strength model, and using the self-control *replenishment* paradigm, participants' self-control strength was depleted in an initial task of resisting tempting foods and then replenished by either watching a humorous film clip or writing about a positive experience. Following a brief recess in study activities, smoking behavior was biochemically confirmed. We hypothesized that positive affect induction would counteract self-depletion of self-control among participants assigned to resist tempting desserts versus raw vegetables and explored whether induction type (video or writing activity) produced different effects. If positive affect replenishes self-control and counteracts the detrimental effect of depleted self-control strength, this may have important implications for smoking cessation interventions.

Methods

Participants and Recruitment

The study sample consisted of smokers from the San Francisco Bay Area. Recruitment efforts included flyers and advertisements posted in the community section of 'Craigslist', an online classifieds internet site. Inclusion criteria were legal smoking age (at least 18 years old), smoking a minimum of 7 cigarettes a week, 8th grade education, fluency in English, having no allergies to the foods used in the study. Data from 19 individuals who did not bring cigarettes to the research session were excluded from the primary analysis (a priori decision), as smoking during the break was the primary outcome measure. Additionally, data were excluded for 6 participants who did not follow the food exposure directions (i.e., ate desserts or vegetables during the cue exposure task), and hence did not experience the appropriate manipulation, and one participant who did not receive the affect induction due to malfunction of the study computer equipment. Intent-to-treat analysis, analyzing the seven participants in their assigned condition, did not differ from analysis with these seven individuals excluded, which we believe is a more theoretically appropriate analysis. Hence, only the latter analyses are reported with a sample size of N=193.

Procedures

The procedures, described below, followed those used in our prior research (Shmueli & Prochaska, 2009). Randomized to one of four conditions (food exposure \times affect induction), participants were tested individually in sessions lasting about 1 hour.

First, participants completed a set of pre-experimental measures, including a demographic form; the Smoking Stage of Change Scale (DiClemente et al., 1991), assessing readiness to quit smoking; the Fagerström Test for Nicotine Dependence (FTND, Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991) assessing smoking behaviors indicative of physical dependence; and a Food Questionnaire (Muraven, Shmueli, & Burkley, 2006), assessing participants' current desire for desserts and vegetables. A Bedfont Smokerlyzer was then used for reading of the level of carbon monoxide (CO) in participants' lungs. This measure, used in clinical tobacco cessation trials, provides an unbiased and reliable indicator of recent smoking (e.g., Irving, Clark, Crombie, & Smith, 1988; Jarvis, Belcher, Vesey, & Hutchinson, 1986).

Participants then underwent the cue exposure phase of the study. Following standard cue reactivity procedures used in similar studies (e.g., Monti, 1993), participants were presented with a large plate of either tempting desserts (e.g., chocolate chip cookies and brownies) or raw vegetables (radishes and broccoli) and instructed to resist eating the food while the experimenter left the room. Participants followed a 5-minute prerecorded tape with a series of bell rings; every time the bell rang, they were to lift the plate and smell the food while thinking about the temptation involved in resisting eating the food.

Immediately following the cue exposure task, participants completed a manipulation check assessing perceived interest ($\alpha=.70$), difficulty ($\alpha=.93$), and pleasantness of the task ($\alpha=.75$), 2-items each. Participants then underwent the affect induction portion of the study using one of two procedures – video or writing exercise – allowing for examination of the impact of different forms of positive affect induction.

The positive video induction was a 5-minute comedy clip stand-up routine, which has shown to induce a happy mood in a college sample in a previous study involving mood induction (Tice, Baumeister, Shmueli, & Muraven, 2007). The neutral video induction was a 5-minute documentary on building bridges. The positive and neutral writing exercises had been used in previous studies of mood and physical health, but had not been tested as part of the self-control strength model (Burton & King, 2004; Pennebaker & Beall, 1986). The positive writing exercise instructed participants to think of the happiest experience or moment in their life and write about it in detail, while trying to re-experience the emotions involved. The neutral writing exercise instructed participants to write a detailed description of a room in their house.

Following the affective induction, participants were asked to leave the room for a 10-minute intermission so that the experimenter could prepare the next phase of the study. Participants were given no instructions as to what to do during the break. The testing room was located on the ground floor of a medical center with a large lobby and easy access to the sidewalk outside. Thus, participants' potential alternatives were to remain in the indoor lobby waiting area or go outside. Unbeknownst to the participants, whether or not they chose to smoke during the break was the primary dependent variable of the study. Upon their return to the room, participants were asked to provide another expired CO sample. The primary dependent variable of the study was change in CO levels from baseline to the reading taken after the break. A CO change score greater than zero was used to indicate smoking during the break. Participants also were asked to self-report whether or not they smoked during the break. The proportion of agreement between self-reported smoking and categorization of

smoking based on change in CO level was $\kappa=.98$, $p < .001$. The two discrepant cases were categorized according to their CO levels. Participants also completed an affect induction manipulation check. Finally, participants were debriefed, paid \$30 for their time, thanked for their participation, and provided a referral list for smoking cessation programs.

Results

Sample Characteristics

A total of 193 participants brought cigarettes with them to the session and completed the study procedures as designed. The participants were 118 men, 67 women, and 8 transgender-identified ethnically diverse smokers: 36% Caucasian, 44% African American, and 20% reporting another racial category, including multi-racial. In addition, 10% reported being Hispanic. The sample mean age was 41.9 years ($SD=10.3$). FTND scores averaged 4.1 ($SD = 2.5$); 40% reported no intention to quit smoking in the next 6 months (i.e., precontemplation stage), 44% intended to quit in the next 6 months (i.e., contemplation), and 14% were preparing to quit in the next 30 days (i.e., preparation). There were no statistically significant differences in the demographic or tobacco use characteristics of participants assigned to the four cells of the 2×2 factorial design, nor differences by affect induction type with the exception that by chance, there was a greater proportion of men who completed the writing task (68% male) compared with the video induction (49% male), $X^2 = 9.44$, $df = 2$, $p < .01$. As such, gender was entered as a covariate in analyses with induction type.

Cue Exposure Manipulation Check

Participants assigned to resist the desserts perceived the food exposure task as more difficult, $t(191) = 5.86$, $p < .001$, less pleasant, $t(191) = -4.69$, $p < .001$, more interesting, $t(191) = 2.82$, $p < .01$, and more tempting $t(191) = 7.29$, $p < .001$, compared with participants who were assigned to resist the vegetables.

Affect Induction Manipulation Check

Participants exposed to a video affect induction reported no difference compared with those who completed a writing task affect induction in how interesting, $t(165) = 0.33$, *ns*, enjoyable, $t(165) = 0.76$, *ns*, or boring $t(165) = 1.68$, they found the affect induction or in how happy they felt after the task, $t(165) = 0.92$, *ns*. However, those who completed a writing task rated the cue exposure as more difficult than those who watched a video, $t(191) = 2.02$, $p = .046$. Additionally, and as designed, participants in the two positive affect conditions reported being happier ($M=7.39$, $SD= 2.01$) after the task than participants in the neutral affect conditions, ($M=6.45$, $SD=1.99$), $t(165) = 3.03$, $p < .05$.

Smoking Behavior

To test the primary hypothesis, a 4-level categorical group variable was created for each of the affect (positive or neutral) by induction type (film or writing) conditions. A logistic regression model, controlling for gender (dichotomized as male versus nonmale), indicated a significant interaction between depletion (food) and group, *Wald's* $X^2 = 9.66$, $df = 3$, $p < .05$, while the two-way interactions for male gender with depletion (*Wald's* $X^2 = 2.86$, $df = 1$, *ns*) and group (*Wald's* $X^2 = 1.33$, $df=3$, *ns*) were nonsignificant, as was a model testing a three-way interaction for gender with depletion and group, *Wald's* $X^2 = 2.73$, $df=3$, *ns*. Examination of the interaction demonstrated that it was specifically the positive video condition that counteracted the effects of depletion (Figure 1). Individuals exposed to desserts (10.5%) or vegetables (0%) that received the positive video condition were less likely to smoke relative to the other groups, range 20% to 85%.

Examination of additional interactions demonstrated that neither smoking variables nor demographic characteristics moderated the results. Regardless of experimental condition, a logistic regression analysis indicated a statistically significant relationship between smoking dependency and likelihood of smoking during the break, $X^2 = 6.49$, $df = 1$, $p < .05$. Additionally, smokers in the pre-contemplation and contemplation stages were more likely to smoke (55%) during the break compared with smokers in preparation (33%), $X^2 = 1.82$, $df = 1$, $p < .05$.

Discussion

The current study investigated two potential strategies to counteract the effect of self-control depletion by inducing positive affect. Findings demonstrated that smokers who were depleted (by resisting tempting desserts) but then experienced a positive affect induction by watching a humorous video were less likely to smoke compared with depleted smokers who watched a neutral affect video or completed a writing exercise. Further, among participants assigned to a video affect induction, depleted smokers who watched the positive video were nearly as unlikely to smoke during the break (10.5% smoked) as smokers who were not depleted in the first place (who resisted vegetables; 0% smoked). The effect, however, was not found with the writing exercise induction. There was a high likelihood of smoking among participants in the writing conditions, regardless of affect valence (positive or neutral), even when exposed to only vegetables. Further, participants who completed a writing task rated the cue exposure as more difficult than participants assigned to a video condition, range of 50% to 69.7% smoked.

The reason for the disparate finding by induction type is unknown, but intriguing. Both induction formats elicited ratings of happiness greater than the neutral comparison conditions. It appears that the cognitive demands of the active process of writing versus the passive process of watching a video clip may have elicited the desire to smoke. Alternatively, it could be that degree of arousal, not just emotional valence, is influential. Additionally, it is quite possible that the experiences participants recalled in the writing activity (i.e., happy moment, image of their home environment) involved tobacco.

The study findings have both theoretical and practical importance. Self-regulation is a construct fundamental to successful human functioning, and self-control failures underlie a host of personal and social problems including substance use, obesity, aggression, and criminal behavior (Baumeister, Heatherton, & Tice, 1994). The Self-Control Strength Model offers a theoretical explanation for potential failures of self-regulation, suggesting that when a limited resource for volitional activities is depleted, people are less effective at self-regulating and more likely to exhibit automatic behaviors or habits. In the current study, having to resist the tempting desserts depleted participants' self-control strength, leading to an increased likelihood of their automatic behaviors or habit (i.e., smoking). The findings suggest self-control depletion can influence smoking even in the absence of an active goal to inhibit or control smoking behavior.

Study findings extend the self-control model and demonstrate that replenishing one's self-control resource can offset the effects of depletion and counteract the tendency to fall back on automatic behaviors (e.g., smoking) and fail at self-regulation. The findings have practical implications for smokers who are trying to quit and who have other self-control demands. The Self-Control Strength Model and our own previous research demonstrate that exerting self-control on one task may impair attempts to control smoking behavior (Muraven & Baumeister, 2000; Shmueli & Prochaska, 2009). This is particularly concerning since studies have shown that most tobacco users (92%) engage in at least one additional self-control related risk behavior such as poor diet and physical inactivity, excessive alcohol

consumption, or illicit drug use (Fine, Philogene, Gramling, Coups, & Sinha, 2004; Pronk et al., 2004). Even for smokers who are not actively trying to quit smoking, but are dealing with other self-control demands (e.g., resisting alcoholic beverages), the study findings have practical implications. Incorporating a video-based positive affect intervention may increase or replenish self-control strength and help to reduce the effect of self-control depletion.

Limitations of the study include methodological and measurement issues. The study involved a between-subjects design because of the necessity to ensure participants naiveté regarding the smoking outcome measured immediately after the break in the study. Self-control strength was manipulated throughout the study, but not measured directly. With advances in research technology it may be possible to assess self-control in more direct ways in the future (e.g., via neuroimaging). Another limitation of the study involves potential confounding variables, such as arousal and distraction, and other alternative explanations to the self-control depletion model. It should be noted that although this model is robust and has been supported by considerable research, other studies have failed to replicate these findings. In particular, O'Connell and colleagues (O'Connell, Schwartz, & Shiffman, 2008) found that the number of resisted temptations to smoke surprisingly predicted a lower risk of lapsing. Future studies should investigate these variables and others in order to rule out alternative explanations and further elucidate the effect of positive affect on self-control.

Study strengths include the ethnically and socioeconomically diverse sample, more representative of today's smoker. Notably, the findings were invariant across demographic and tobacco use characteristics suggesting generalizability of study findings. The results of this controlled randomized experiment demonstrate that self-control is a mechanism underlying smoking behavior and that inducing positive affect with a humorous video may be a helpful tool for smokers who desire to quit. The particular distinction in our research is the emphasis on the potential benefit of increasing positive affect rather than reducing negative affect and the specific utility of exposure to a comedic film. Additional research is required to better elucidate the role of positive affect. Future studies may wish to examine additional instances of co-occurring self-regulation demands, such as desires to quit concurrent smoking and alcohol or other substance use. Positive affect may be able to counteract the effects of self-control depletion occurring from the exertion of self-control on more than one task simultaneously.

Acknowledgments

This research was supported by the State of California Tobacco-Related Disease Research Program (#16FT-0050 and #17RT-0077) and the National Institute on Drug Abuse (#T32 DA007250, #K23 DA018691 and #P50 DA09253). We thank Emma Lucas and Elizabeth Meade for assistance with recruitment and data collection and Maya Donahue, Steffany Farros, and Max Orozco for assistance with data entry. The authors do not have any conflicts of interest related to the conduct and reporting of research.

References

- Baumeister, RF.; Heatherton, TF.; Tice, DM. Losing control: How and why people fail at self-regulation. San Diego, CA: Academic Press; 1994.
- Baumeister RF, Muraven M, Tice DM. Ego depletion: A resource model of volition, self-regulation, and controlled processing. *Social Cognition Special Issue: Social ignition: The interplay of motivation and social cognition.* 2000; 18(2):130–150.
- Burton CM, King LA. The health benefits of writing about intensely positive experiences. *Journal of Research in Personality.* 2004; 38:150–163.

- DiClemente CC, Prochaska JO, Fairhurst SK, Velicer WF, Velasquez MM, Rossi JS. The process of smoking cessation: An analysis of precontemplation, contemplation, and preparation stages of change. *Journal of Consulting and Clinical Psychology*. 1991; 59(2):295–304. [PubMed: 2030191]
- Doran N, Spring B, Borrelli B, McChargue D, Hitsman B, Niaura R, Hedeker D. Elevated positive mood: A mixed blessing for abstinence. *Psychology of Addictive Behaviors*. 2006; 20:36–43. [PubMed: 16536663]
- Fine LJ, Philogene GS, Gramling R, Coups EJ, Sinha S. Prevalence of Multiple Chronic Disease Risk Factors: 2001 National Health Interview Survey. *American Journal of Preventive Medicine Special Issue: Addressing Multiple Behavioral Risk Factors in Primary Care*. 2004; 27(2,Suppl):18–24.
- Fiore, MC.; Jean, CR.; Baker, TB.; Bailey, WC.; Benowitz, NL., et al. *Treating Tobacco Use and Dependence: 2008 Update*. Rockville, MD: US Department of Health and Human Services. Public Health Service; 2008.
- Fredrickson BL. The role of positive emotions in positive psychology: The broaden-and-build theory of positive emotions. *American Psychologist*. 2001; 56:218–226. [PubMed: 11315248]
- Fredrickson BL, Levenson RW. Positive emotions speed recovery from the cardiovascular sequelae of negative emotions. *Cognition & Emotion*. 1998; 12(2):191–220. [PubMed: 21852890]
- Fredrickson, Mancuso, Branigan, & Tugade. 2000
- Fredrickson BL, Mancuso RA, Branigan C, Tugade MM. The undoing effect of positive emotions. *Motivation and Emotion*. 2000; 24:237–258. [PubMed: 21731120]
- Hayes, SC.; Gifford, EV.; Ruckstuhl, LEJ., editors. *Relational frame theory and executive function: A behavioral analysis*. Baltimore: Brookes; 1996.
- Heatherton TF, Kozlowski LT, Frecker RC, Fagerstrom KO. The Fagerstrom Test for Nicotine Dependence: A revision of the Fagerstrom Tolerance Questionnaire. *British Journal of Addiction*. 1991; 86(9):1119–1127. [PubMed: 1932883]
- Irving JM, Clark EC, Crombie IK, Smith WC. Evaluation of a portable measure of expired-air carbon monoxide. *Preventative Medicine*. 1988; 17:109–115.
- Jarvis MJ, Belcher M, Vesey C, Hutchinson DCS. Low cost carbon monoxide monitors in smoking assessment. *Thorax*. 1986; 41:886–887. [PubMed: 3824275]
- Monti PM, Rohsenow DJ, Rubonis AV, Niaura RS, Sirota AD, Colby SM, Abrams DB. Alcohol cue reactivity: Effects of detoxification and extended cue exposure. *Journal of Studies on Alcohol*. 1993; 54:235–245. [PubMed: 8384678]
- Muraven M, Baumeister RF. Self-regulation and depletion of limited resources: Does self-control resemble a muscle? *Psychological Bulletin*. 2000; 126(2):247–259. [PubMed: 10748642]
- Muraven M, Shmueli D, Burkley E. Conserving Self-Control Strength. *Journal of Personality and Social Psychology*. 2006; 91(3):524–537. [PubMed: 16938035]
- Muraven M, Tice DM, Baumeister RF. Self-control as a limited resource: Regulatory depletion patterns. *Journal of Personality and Social Psychology*. 1998; 74:774–789. [PubMed: 9523419]
- O’Connell KA, Schwartz JE, Shiffman S. Do resisted temptations during smoking cessation deplete or augment self-control resources? *Psychology of Addictive Behaviors*. 2008; 22:486–495. [PubMed: 19071973]
- Pennebaker JW, Beall S. Confronting a traumatic event: Toward an understanding of inhibition and disease. *Journal of Abnormal Psychology*. 1986; 95:274–281. [PubMed: 3745650]
- Pronk NP, Anderson LH, Crain AL, Martinson BC, O’Connor PJ, Sherwood NE, Whitebird RR. Meeting recommendations for multiple healthy lifestyle factors. Prevalence, clustering, and predictors among adolescent, adult, and senior health plan members. *American Journal of Preventative Medicine*. 2004; 27:25–33.
- Shmueli, D.; Muraven, M. Depletion of Self-Control Strength Leads to Increased Deviance. In: Froeling, K., editor. *Criminology: Research Focus*. Nova Science Publishers; 2007.
- Shmueli D, Prochaska JJ. Resisting tempting foods and smoking behavior: Implications from a self-control theory perspective. *Health Psychology*. 2009; 28:300–306. [PubMed: 19450035]
- Tice DM, Baumeister RF, Shmueli D, Muraven M. Restoring the self: Positive affect helps improve self-regulation following ego-depletion. *Journal of Experimental Social Psychology*. 2007; 43:379–384.

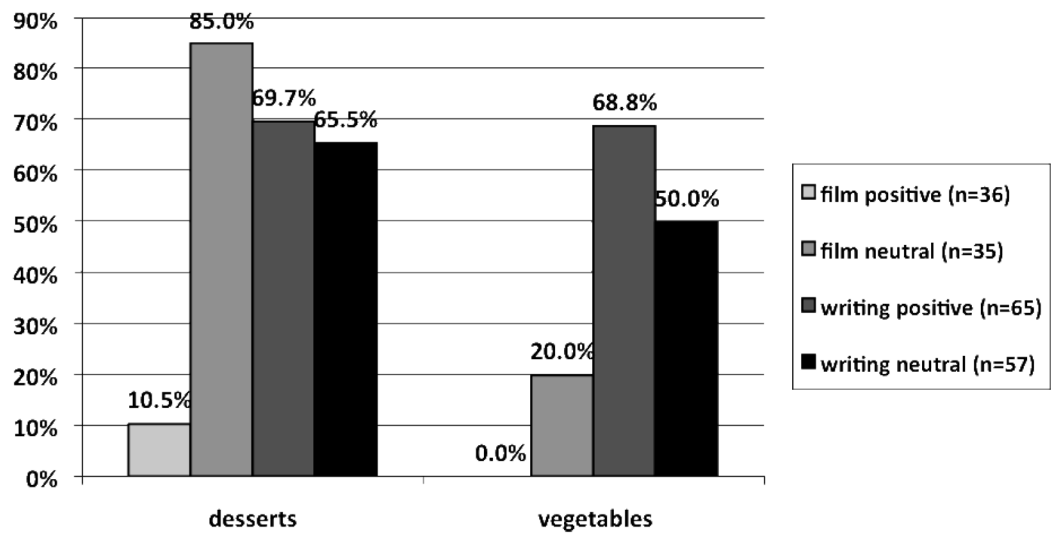


Figure 1. Smoking (%) during the break by condition, affect valence and method of affect induction (N=193)