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**The effects of smoking and abstinence on experience of happiness and sadness in response
to positively-valenced, negatively-valenced and neutral film clips**

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Abstract

Incentive motivation theories of addiction suggest that behavioural concomitants of compromised mesocorticolimbic reward activity during abstinence might include decreased affective reactions to natural reinforcers. This study tested implications for hedonic reactions in abstinent smokers. It was hypothesised that positively-valenced (pleasurable) film clips would elicit lower ratings of happiness in abstinent than satiated smokers. Twenty-nine smokers, randomly assigned to either an 'abstinent' or a 'satiated' condition, and fifteen non-smokers took part in a single session in which they rated i) signs and symptoms of nicotine withdrawal and ii) affective responses to positively-valenced, negatively-valenced and neutral film clips. Compared with satiated smokers, abstinent smokers rated positive clips as eliciting significantly lower levels of happiness, and this was independent of self-reported nicotine withdrawal symptoms; the scores of non-smokers fell between those of abstinent and satiated smokers, more closely approximating those of the latter. By contrast, sadness ratings in response to negative clips were not affected by smoking status, indicating that the effect on happiness was not simply due to general emotional blunting. These results suggest that, for regular smokers, stimuli that are motivationally salient for the general population may elicit reduced positive affective responses during periods of abstinence.

Keywords

Smoking, abstinence, happiness, affective responses, incentive motivation

1. Introduction

Recent neuroimaging studies suggest that the brain's dopaminergic reward system is altered in chronic drug users (Volkow, Fowler, Wang & Goldstein, 2002). Dagher et al., (2001), for example, reported reduced DA D1 receptor binding in the nucleus accumbens in the brains of smokers compared with non-smokers. Acute drug ingestion however, continues to cause marked increases in DA neurotransmission (e.g. Di Ciano, Blaha & Philips, 1995). Since the ordinary role of this brain system is putatively to attribute incentive properties to rewarding stimuli, any dampening of activity in regular drug users is likely to be associated with decreased sensitivity to incentives of everyday life. This would be unmasked during periods of drug abstinence or during a quit attempt since the individual would no longer benefit from the short-term DA-enhancing effects of drug taking.

We have consistently found that abstinent smokers show reduced responsiveness to a financial incentive on a simple psychomotor card sorting task (Al-Adawi & Powell, 1997; Powell, Dawkins & Davis, 2002a; Powell, Pickering, Dawkins, West & Powell, 2004) and reduced allocation of attentional resources towards motivationally salient stimuli in the emotional Stroop task (Powell, Tait & Lessiter, 2002b) compared to both non-smokers and satiated smokers (smokers who have recently smoked). Paralleling these findings, abstinent smokers also report expecting to derive less enjoyment from a range of ordinarily pleasurable events and activities compared to satiated smokers on a questionnaire measure (Powell et al., 2002a; Powell et al., 2004).

Blunted emotional affect in abstinent substance users has been reported recently by both Gerra et al. (2003) and Aguilar de Arcos, Verdejo-García, Peralta-Ramírez, Sánchez-Barrera and Pérez-García (2005). In the former study, heroin users rated pleasant images as less pleasant than did healthy controls and their evaluations of both pleasant and unpleasant images did not differ from

evaluations of neutral stimuli. Aguilar de Arcos et al. (2005) reported different response profiles in emotional responses to pleasant and unpleasant images not only between abstinent substance abusers and healthy controls but also between abusers of alcohol and cocaine.

The present study aimed to examine positive and negative affective states in abstinent and satiated smokers, indexed via 'happiness' and 'sadness' ratings in response to film clips. It was hypothesised that happiness ratings to positively-valenced clips would be lower in abstinent than satiated smokers. A group of non-smokers was included as a comparison. Neutral and negatively-valenced (sad) clips were included in order to prevent participants developing a response set and to determine whether any detrimental effect of abstinence was specific to appetitive motivation or generalised across other forms of emotional reactivity.

2. Methods

In this mixed design, 29 smokers were randomly assigned to either a 10-hour 'abstinent' condition, or a 'satiated' condition (smoking as usual including a cigarette within 15 minutes prior to the testing session). Fifteen non-smokers were also tested. Abstinence and non-smoking status was verified by carbon monoxide (CO) readings of ≤ 11 ppm, and 'satiated' smoking by ≥ 15 ppm, consistent with reported cut-offs (Jarvis, 1987; Jo & Oh, 2003). Participants were tested in groups of 5 or 6 (comprising combinations of non-smokers, satiated smokers and abstinent smokers) and completed the Mood and Physical Symptoms Scale (MPSS; Hughes & Hatsukami, 1986) and the Fagerström Test of Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker & Fagerström, 1991; see Powell et al., 2002a) before viewing the twelve film clips. The video sequence comprised 6 positively-valenced (happy), 3 negatively-valenced (sad), and 3 neutral (no affective content) clips. Nine of the film clips had previously been validated (Gross & Levenson, 1995); the remaining 3 replaced previously validated film clips that were considered outdated given the composition of the relatively young participant sample. Length of clip

averaged 156.6 seconds (range: 60-276 seconds) and did not differ significantly for the three clip types ($F_{2,9} = 2.92$, ns). Clips were presented on a 19 inch TV monitor in fixed quasi-random order to prevent development of a response set (see Appendix). The video was paused after each clip and participants rated the extent to which they had felt happy and sad whilst watching the clip, on an 8-point scale where '0' represented not at all happy/sad and '8' represented the happiest/saddest they had ever felt (Gross & Levenson, 1995). Mean happiness and sadness ratings were then calculated for the 3 categories of film type for each participant. Although we had planned to use 3 neutral clips, inspection of responses to individual clips revealed relatively high happiness ratings from many of the non-smokers to one of these, calling its neutrality into question. Responses to this clip were therefore excluded from analysis.

3. Results

Descriptive statistics are displayed in Table 1. One non-smoker was unwell at the time of testing, reflected in an MPSS score three SDs above the mean for the combined sample. He was therefore excluded, and analyses are based on a sample of 29 smokers and 14 non-smokers. The three groups did not differ from each other in age ($F_{2,40} < 1$, ns) or sex ratio ($\chi^2 = 0.31$, $df = 2$, ns). The two groups of smokers did not differ in terms of number of cigarettes smoked a day, number of years smoked, or FTND scores ($t_{27} < 1.5$, ns, in each case).

Insert Table 1 here

3.1. *Withdrawal symptoms (MPSS)*

Mood and physical symptom scores (MPSS) for the three groups are displayed in Table 1. One way ANOVA revealed a significant main effect of GROUP ($F_{2,40} = 6.27$, $p < 0.005$) reflecting a higher incidence of nicotine withdrawal symptoms in abstinent smokers than satiated smokers

($t_{40} = -3.52$, $p = 0.001$). The scores of non-smokers fell between the two smoking groups differing significantly from abstinent smokers ($t_{40} = -2.10$, $p < 0.05$) but not from satiated smokers ($t_{40} = 1.38$, ns).

3.2. Effect of smoking status on happiness ratings in response to positive, negative and neutral film clips

Mean happiness ratings for the three groups in response to positive, negative and neutral film clips are illustrated in Figure 1. A mixed 3 X 3 ANOVA revealed a near significant effect of GROUP ($F_{2,40} = 3.01$, $p = 0.06$), reflecting higher overall happiness ratings by non-smokers; a highly significant main effect of CLIPTYPE ($F_{2,80} = 234.52$, $p < 0.0001$), reflecting higher ratings of happiness in response to positive clips; and a significant GROUP x CLIPTYPE interaction ($F_{4,80} = 2.47$, $p = 0.05$). A 2 X 3 ANOVA with *a priori* contrasts comparing happiness responses to positive clips by comparison with neutral clips revealed a highly significant GROUP X CLIPTYPE interaction for satiated versus abstinent smokers ($F_{1,40} = 3.45$, $p < 0.001$). Post hoc t-tests reveal that abstinent smokers reported less happiness in response to positive clips than did satiated smokers ($t_{27} = 2.16$, $p < 0.05$). Although there was also a trend for satiated smokers to report less happiness in response to neutral clips, this fell short of significance ($t_{27} = -1.81$, $p = 0.08$). The GROUP X CLIPTYPE interaction for satiated smokers versus non-smokers was also significant ($F_{1,40} = -2.35$, $p < 0.05$); reflecting lower happiness ratings to neutral clips in satiated smokers ($t_{27} = 2.53$, $p < 0.05$) but no difference in response to positive clips ($t_{27} < 1$, ns). There was no GROUP X CLIPTYPE interaction for abstinent smokers versus non-smokers ($F_{1,40} < 1$, ns). In order to explore whether symptoms of nicotine withdrawal (MPSS scores) might account for the differences in happiness ratings between abstinent and satiated smokers, correlations between MPSS score and happiness ratings to a) neutral clips and b) positive clips were conducted. MPSS scores were not significantly correlated with happiness ratings to either neutral ($r = 0.30$, ns) or positive clips ($r = 0.03$, ns).

Insert
Figures 1 and 2 here

3.3. Effect of smoking status on ratings of sadness in response to positive, negative and neutral film clips

Sadness ratings in response to positive, negative and neutral clips for the 3 groups are presented in Figure 2. A mixed 3 X 3 ANOVA revealed no main effect of GROUP ($F_{2,40} < 1$, ns).

Consistent with expectations, sadness ratings were significantly higher in response to negative clips (main effect of CLIPTYPE: $F_{2,80} = 272.66$, $p < 0.0001$) but these ratings did not differ according to smoking status (GROUP X CLIPTYPE interaction: $F_{4,80} < 1$, ns).

4. Discussion

The three groups showed comparably low happiness ratings in response to the negatively-valenced film clips. However, as predicted, and consistent with our previous findings, by comparison with their responses to neutral clips, abstinent smokers' ratings of happiness to positively-valenced clips were significantly lower than those of satiated smokers. This effect is unlikely to be mediated by the general malaise associated with acute withdrawal from nicotine since happiness ratings showed virtually no correlation with self-reported symptoms of withdrawal. By contrast, although negative clips elicited significantly greater sadness than neutral clips, sadness ratings did not differ between groups. Thus the blunted 'happiness' response of abstinent smokers here was specific rather than part of a general dampening of emotional response. Although others have reported effects on negatively valenced cues (Aguilar de Arcos et al, 2005; Gerra et al, 2003; Powell et al., 2002b), discrepancies may be due to the nature of the paradigms used and/or responses assessed. For example, whereas the present study used sadness ratings in response to 'sad' clips, Gerra et al. and Aguilar de Arcos et al. used

ratings of ‘unpleasantness’ in response to aversive or anxiety-provoking pictures (such as mutilated bodies); similarly the negative words in the Powell et al. (2002b) study using the Stroop paradigm were threat-related rather than sad.

The lowered happiness ratings in response to positively valenced film clips reported here by abstinent smokers by comparison with satiated smokers parallel our previous findings in which abstinent smokers reported lowered expectations of enjoyment on the Snaith Hamilton Pleasure Scale (Powell et al., 2002a; Powell et al, 2004) in parallel with reduced responsiveness to salient incentive stimuli (e.g. money). These data suggest that positive affective reactions of smokers in response to ordinarily pleasant experiences (not related to drug use) are influenced by recency of tobacco smoking. If smokers do indeed experience reduced enjoyment of naturally reinforcing stimuli during abstinence then this could contribute to risk of relapse as ‘quitters’ seek to combat this anhedonia. In terms of helping smokers to remain abstinent, these and similar findings suggest that treatment interventions might usefully focus on augmenting the value and salience of natural (non-drug) reinforcers via either pharmacological interventions, cognitive techniques or social reinforcement.

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Legend for figures:

Figure 1: Mean happiness ratings to neutral, positively-valenced and negatively-valenced film clips by the three groups of participants.

Figure 2: Mean sadness ratings to neutral, positively-valenced and negatively-valenced film clips by the three groups of participants.

Table 1**Basic demographic and smoking-related information for the three groups of participants**

	Non-Smokers (N = 14)	Satiated Smokers (N = 15)	Abstinent Smokers (N = 14)
Age			
Mean (SD)	23.79 (5.71)	24.93 (5.60)	25.86 (6.04)
Range	18-32	19-39	20-38
Sex Ratio (M:F)	5:9	4:11	4:10
No. smoked/day			
Mean (SD)	0	18.73 (3.45)	20.07 (3.83)
Range	0	15-25	15-30
No. of years smoked			
Mean (SD)	0	8.67 (4.48)	10.14 (5.90)
Range	0	3-20	5-25
FTND			
Mean (SD)	n/a	4.53 (1.30)	3.71 (1.77)
Range		3-8	1-7
CO level (ppm)			
Mean (SD)	1.21 (0.43)	20.60 (2.26)	7.71 (1.44)
Range	1-2	17-24	6-11
MPSS:			
Mean (SD)	3.64 (2.68)	2.53 (1.64)	5.36 (2.06)
Range	0-10	1-7	1-8

Figure 1

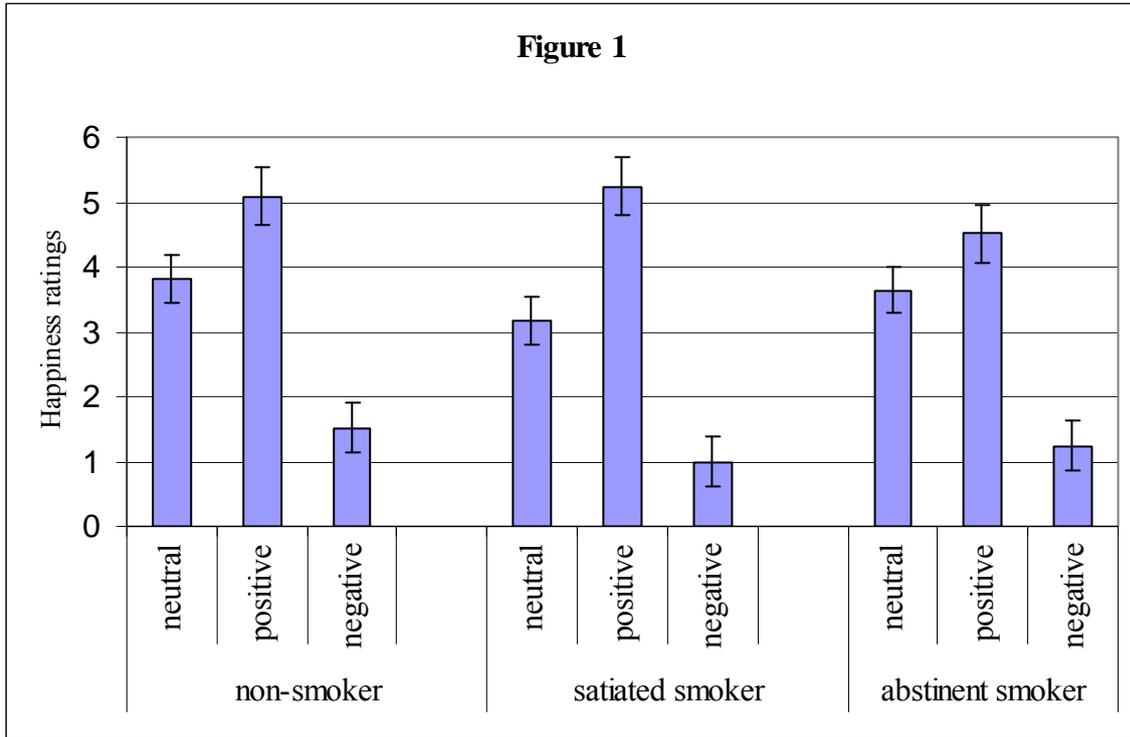
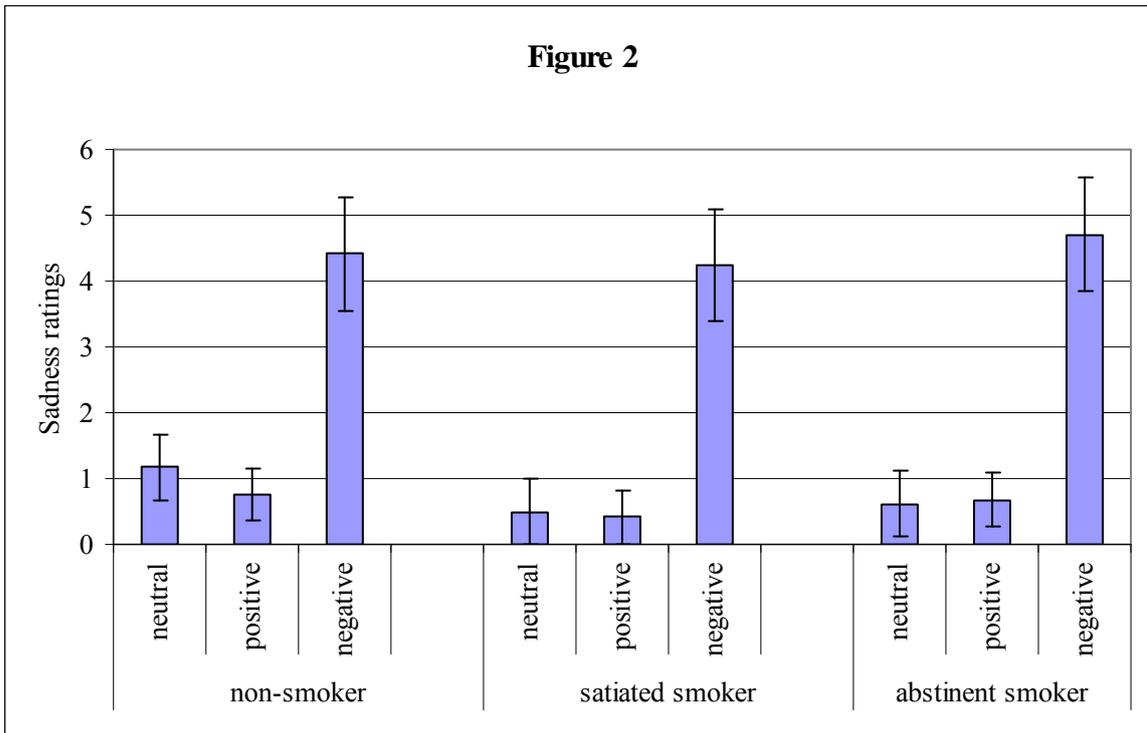


Figure 2



Appendix

Name Of Film	Description	Target Emotion	Time (secs)
Eddie Izzard	Stand – up comedy	Positive	128
Bambi *	Death of mother	Negative	157
River – boat *	River boat ride	Neutral	97
Shawshank Redemption	Red’s happy ending	Positive	264
Play It Again Sam *	Man nervous on first date	Positive	209
The Champ *	Death of Champ	Negative	196
Shrek	Making animal balloons	Positive	83
When Harry Met Sally *	Faking an orgasm in diner	Positive	146
Waves *	Waves	Neutral	60
Four Weddings & A Funeral *	Poem at the funeral	Negative	165
Pretty Woman *	Woman goes shopping	Positive	276
The Big Blue *	Dolphins swimming	Neutral	98

* Validated clip