

# Euphoriant effects of nicotine in smokers: fact or artifact?

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## Abstract

**Rationale** The claim that nicotine in cigarettes is euphoriant to smokers is largely based on two studies (Pomerleau and Pomerleau, *Psychopharmacology*, 108:460–465, 1992; *Tobacco Control*, 3:374, 1994) in which smokers were instructed to respond to sensations of rush, buzz, or high while smoking low-nicotine or regular cigarettes. However, the assumption that these sensations are pleasurable was not tested and may have biased the results.

**Objectives** The aim of this study was to re-examine the claim that smoked nicotine is euphoriant to smokers.

**Methods** Study 1 surveyed the frequency and pleasantness of the smoking-related sensations of rush, buzz, and high in a sample of smokers. Study 2 replicated Pomerleau and Pomerleau (*Psychopharmacology*, 108:460–465, 1992) with two sets of instruction. One set, as in the original study, defined these sensations as pleasurable, whereas the other defined them as unpleasant.

**Results** Study 1 found that whereas rush and high were perceived as pleasant, buzz was unpleasant to most smokers. Study 2 found that under both sets of instructions, smokers reported more sensations when smoking the regular, as compared to the low-nicotine cigarette. Additionally, the sensations of rush, buzz, and high were rated as more pleasant under the pleasant instructions as compared to the unpleasant instructions. Finally, in the pleasant

instructions condition, many participants reported having pressed the button to indicate a pleasurable sensation despite having actually experienced that sensation as unpleasant.

**Conclusions** Our results suggest that the findings of Pomerleau and Pomerleau (*Psychopharmacology*, 108:460–465, 1992; *Tobacco Control*, 3:374, 1994) may have been biased by the experimental instructions and cannot be taken as evidence that smoked nicotine is euphoriant to smokers.

**Keywords** Euphoriant effect · Nicotine · Sensation

Most current theories of smoking assign a principal role to nicotine, which is believed to reinforce smoking behavior through its psychoactive effects (e.g., Stolerman and Jarvis 1995; Rose 1996; Soria et al. 1996; Donny et al. 1998; Benowitz 1999; Kozlowski et al. 2001; Le Foll and Goldberg 2006). Official reviews by the US Surgeon General (US Department of Health and Human Services 1988) and the British Royal College of Physicians (Tobacco Advisory Group of The Royal College of Physicians 2000) concluded that nicotine is as addictive as heroine and cocaine. Several differences, however, have been noted between the effects of nicotine and those of drugs of abuse such as alcohol, opiates, or cocaine [for a recent review, see Hughes (2006)]. In contrast to the latter, for example, nicotine does not cause intoxication and is not self-administered, other than in tobacco, even by deprived smokers (Dar and Frenk 2004).

More specifically, the reinforcing effects of drugs are generally attributed to their subjective positive effects, especially at the early stages of use (Falk et al. 1982; Stewart et al. 1984; Glautier 2004). In contrast, most smokers do not report pleasant mood states as a principal cause of smoking (Hughes 2006), and laboratory studies

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typically do not find that nicotine produces positive mood effects. A review by Gilbert (1995) concluded that “with few exceptions, nicotine has consistently failed to increase pleasantness and euphoria in experimental studies” (p. 114). Frenk and Dar (2000) reported that, lumping across various modes of delivery, nicotine was found to be pleasurable for smokers in only 7 out of 22 studies. In a more recent review, Kalman and Smith (2005) found only weak evidence for mood effects of nicotine, which appear to be relatively small and subtle. They concluded that “taken together, the evidence that the subjective effects of nicotine directly mediate its reinforcing effects is quite modest.” Whereas several studies reported significant positive mood effects with intravenous nicotine (e.g., Chausmer et al. 2003; Jones and Griffiths 2003; Harvey et al. 2004), smokers in these studies were past or current users of other drugs, which precludes generalization to the general population of smokers (Dar and Frenk 2005; Kalman and Smith 2005).

One prominent exception to the failure to demonstrate significant positive subjective effects of nicotine was a research article titled “Euphoriant effects of nicotine in smokers” (Pomerleau and Pomerleau 1992). The article reported the results of two studies in which smokers were asked to smoke cigarettes differing in nicotine/tar yield and to depress a button when they experienced euphoric sensations. Specifically, participants received the following instructions: “People sometimes report experiencing pleasurable sensations when they smoke that might be described as a rush, a buzz, or a high. Not everybody experiences these, and not all cigarettes produce these sensations. If you happen to experience any of these pleasurable sensations while smoking today, please depress the button and hold it down for the duration of the sensation” (p. 461).

The authors found that the number and duration of euphoric sensations reported with “ultra-low nicotine” cigarettes were significantly lower than with medium- and high-nicotine cigarettes. Moreover, the number of button presses was related to plasma nicotine levels. Pomerleau and Pomerleau (1992) concluded that their studies “support the existence of dose–response relationships for nicotine-induced euphoric sensations” (p. 460). This conclusion, however, may be premature. A potential problem in the study was that the instructions given to participants *defined* the sensations related to nicotine’s central effects—i.e., buzz, rush and high—as pleasurable. Consequently, participants experiencing these sensations, even if they would not have otherwise experienced them as pleasurable, may have pressed the button in line with the instructions. As high-nicotine cigarettes produce more of these sensations than low-nicotine ones, this could result in the erroneous conclusion that nicotine produces euphoria.

The authors attempted to respond to this potential problem in a later study (Pomerleau and Pomerleau 1994). In this study, participants were provided with two foot pedals. In relation to the first (the “accelerator”), marked with a smiling face, participants received the same instructions as in the previous study (Pomerleau and Pomerleau 1992). In addition, participants were told to press second pedal (the “brake”) marked with a frowning face, if they experienced any unpleasant sensations. In this study, 80% of the participants reported pleasurable sensations, whereas 40% reported unpleasant sensations. However, a potential problem with this study is that just like in the original one, the nicotine-related sensations of rush, buzz, and high were defined as pleasurable, creating a conflict for participants who experienced any of these sensations as unpleasant.

Obviously, there is no a priori reason to assume that smokers experience the sensations of buzz, rush, and high as pleasurable, and smoking researchers do not share a consistent position on this matter. For example, Kalman (2002), in his review of the subjective effects of nicotine, considered head rush as one of the positive effects of nicotine. Conversely, Perkins et al. (1994) suggested that head rush may reflect an aversive effect of nicotine. The latter position was corroborated in a factor analysis of the subjective effects of nicotine nasal spray (Perkins et al. 2003), in which the head rush factor was positively correlated with a negative affect factor and negatively correlated with a positive affect factor. We are not aware of any study that asked smokers directly to rate the subjective valence of specific nicotine-related sensations that occur during smoking.

We conducted two studies to re-examine the conclusions reached by Pomerleau and Pomerleau (1992, 1994) and specifically whether nicotine in cigarettes produces euphoria in smokers. The first study was a survey designed to assess the extent to which the sensation studies by Pomerleau and Pomerleau—rush, buzz, and high—are actually pleasurable to smokers. The second was an experiment similar to the ones reported in the original study (Pomerleau and Pomerleau 1992) but with two instruction conditions. The first set of instructions replicated that of the original study, whereas the second defined the sensations of rush, buzz, and high as *unpleasant* rather than pleasant.

## Study 1

As mentioned above, the instructions given in the two studies by Pomerleau and Pomerleau assumed that the sensations associated with the central effects of nicotine and specifically those of rush, buzz, and high are pleasurable.

The validity of this assumption is crucial for a correct interpretation of their results. Therefore, the goal of Study 1 was to survey smokers in regard to their actual experience of these sensations.

## Materials and methods

### Participants

Two hundred smokers (110 men and 90 women) participated in the survey. Their mean age was 27.4 (SD=8.3), and they smoked on average for 9.3 years (SD=7.1). The mean Fagerström test for nicotine dependence (FTND) score (see below) was 3.37 (SD=2.41). Participants were recruited at several locations, including university campuses, train stations, and municipal buildings.

### Measures

*The smoking-related sensations questionnaire* This questionnaire was constructed for the present study and focused on the sensations of rush, buzz, and high. It assessed the frequency, intensity, and affective valence of these sensations on 7-point scales (e.g., “how would you rate the sensation of rush in terms of pleasantness?” with “1” labeled “very unpleasant” and “7” labeled “very pleasant”).

*The Hebrew version of the Fagerström test for nicotine dependence* (Heatherton et al. 1991) The FTND is the most commonly used test for nicotine dependence and includes six items, with a total score ranging between 0 and 10.

### Procedure

The survey was conducted by graduate students who approached individuals who were smoking with the survey forms and asked them to respond to a short survey about smoking. Participants were asked to answer all questions and were debriefed after completing the two measures.

## Results

Table 1 presents the frequency distribution of reported sensations of rush, buzz, and high during smoking in our smoker sample. The proportion of smokers ever experiencing these sensations was 60% for rush, 63% for buzz, and 41.5% for high. Notably, very few smokers reported experiencing rush, buzz, or high in the majority of cigarettes that they smoke.

Table 2 presents the surveyed smokers’ evaluations of the pleasantness of rush, buzz, and high during smoking. Most responders liked the sensation of rush and high but disliked the sensation of buzz. Specifically, 59.2% of the participants found rush pleasant, whereas only 15% found it unpleasant. The sensation of high was rated positively by 66.3% of the smokers and negatively by only 9.6%. Conversely, buzz, which was the most frequent sensation associated with smoking in this survey, was rated as unpleasant by 68.5% of the smokers and as pleasant by only 21.2%. Buzz, but not the other sensations, was reported somewhat more frequently in smokers of regular cigarettes ( $M=2.20$ ;  $SD=1.16$ ) as compared to smokers of “light” cigarettes ( $M=1.84$ ;  $SD=0.73$ ),  $t(185)=2.23$ ,  $p=.027$ ,  $d=0.32$ . There were no sex differences on any of the dependent measures and no correlations with age, years of smoking, or FTND scores.

## Discussion

In the studies by Pomerleau and Pomerleau (1992, 1994), approximately 80% of the participants smoking a regular nicotine cigarette reported at least one sensation of rush, buzz, or high when this was their first cigarette of the day. This finding appeared at first glance to be at odds with the results of our survey, in which most smokers reported experiencing rush, buzz, and high in a small minority of the cigarettes they smoke. Several explanations may account for this apparent discrepancy. First, participants in Pomerleau and Pomerleau’s studies were deprived of smoking for at least 8 h, which may have decreased tolerance to the central effects of nicotine. Second, participants’ awareness of these sensations may have been

**Table 1** Reported frequency of rush, buzz, and high during smoking in a smoker sample ( $N=200$ )

Sensations	Percent of cigarettes in which sensations are experienced						
	1 Never (%)	2 10%	3 25%	4 50%	5 75%	6 90%	7 Always (%)
Rush	40	24.5	15.5	14.5	2.5	2	1
Buzz	27	52.5	12	5	1	1	1.5
High	58.5	26.5	9.5	2.5	2.5	0	0.5

**Table 2** Distribution of rated pleasantness of rush, buzz, and high among smokers reporting ever experiencing these sensations

Sensations	1 Very unpleasant (%)	2 Unpleasant (%)	3 Somewhat unpleasant (%)	4 Neutral (%)	5 Somewhat pleasant (%)	6 Pleasant (%)	7 Very pleasant (%)
Rush ( <i>N</i> =120)	3	5	6.7	25.8	26.7	25.8	6.7
Buzz ( <i>N</i> =146)	16.4	28.8	23.3	10.3	17	6.2	0.7
High ( <i>N</i> =83)	2.4	2.4	4.8	24.1	41	16.9	8.4

heightened by the requirement to monitor them during the experiments. Third, the high proportion of reported sensations may also reflect a reporting bias in response to the experimental demands implied in the instructions. Fourth, the sensations of buzz, rush, and high may be most prominent in the first cigarette of the day, as was the case in Pomerleau and Pomerleau's studies. Finally, the retrospective nature of our survey may have resulted in an underestimation of the actual frequency of smoking-related sensations.

With the above caveats, the results of Study 1 undermine the implicit assumption in the studies by Pomerleau and Pomerleau, namely, that buzz, rush, and high are pleasurable sensations. The sensation of buzz, specifically, was rated as unpleasant by most of the smokers in our sample. Together with the fact that buzz was reported more frequently in smokers of regular cigarettes, as compared to smokers of light cigarettes, this finding suggests that at least in regard to buzz, the instructions provided in the two studies by Pomerleau and Pomerleau were problematic. Our findings suggest that participants in these studies indeed experienced more buzz while smoking the regular or high nicotine cigarettes as compared to the low-nicotine ones. Our findings also suggest that this sensation was unpleasant to most of the participants in Pomerleau and Pomerleau's studies. At the same time, these participants were expressly instructed that buzz was an example of a pleasurable sensation to which they should respond accordingly.

The potential conflict between actual experience and experimental demands could invalidate the results of the studies by Pomerleau and Pomerleau in two ways. First, it could distort the subjective experience of the sensation, causing buzz or other sensations to be perceived as more pleasant than they would otherwise be experienced. Second, the conflict between the instructions participants were trying to follow and their actual experience of the sensations could result in pressing for sensations participants did not actually experience as pleasurable. As the sensations of rush, buzz, and high are related to the nicotine yield of cigarettes, this scenario could erroneously lead to the conclusion reached by Pomerleau and Pomerleau (1992, 1994) that nicotine is euphoriant to smokers.

## Study 2

The findings of Study 1 suggest that Pomerleau and Pomerleau's findings may have been influenced by the instructions given to participants, which defined buzz, rush, and high as pleasurable sensations. We examined this possibility by repeating the authors' original experiment (Pomerleau and Pomerleau 1992) using two instruction conditions. The first set of instructions replicated that of the original study, whereas the second defined the sensations of rush, buzz, and high as *unpleasant* rather than pleasant. We expected to replicate the findings of Pomerleau and Pomerleau (1992) using their original instructions. In addition, we predicted that under the second set of instructions, participants smoking high-nicotine/tar cigarettes would report more unpleasant sensations than those smoking low-nicotine/tar cigarettes.

## Materials and methods

### Overview

Smokers participated in two morning sessions, each after an 8-h abstinence period. In each session, they smoked one cigarette, either regular or "light", and were instructed to report their sensations during smoking. Participants were randomly assigned to receive either pleasant or unpleasant instructions in both sessions, generating a 2×2 design with cigarette type (regular and "light") as a within-subject variable and instructions (pleasant or unpleasant) as a between-subject variable. The pleasant instructions were identical to those used in the original Pomerleau and Pomerleau studies, defining the sensations associated with nicotine as pleasant. The unpleasant instructions, in contrast, defined the same sensations as unpleasant.

### Participants

Participants were selected based on the same criteria used in Pomerleau and Pomerleau (1992). We recruited male smokers who smoked at least 3 years and at least 15

cigarettes per day and whose regular brand was not the one used as the experimental cigarette (Kent). We excluded smokers with a history of hypertension and those who were taking medications regularly. The study was publicized by ads posted in the Tel Aviv University campus and in nearby neighborhoods. After a preliminary telephone interview assessing fit with the study criteria, participants were told that the study was about smoking habits and were given an explanation about the study requirements and about the payment for participation.

Twenty-eight smokers participated in the study. Their age ranged from 20 to 40 ( $M=24.1$ ,  $SD=2.9$ ). They smoked on average 19.4 cigarettes per day ( $SD=4.5$ ) for a mean of 6.5 years ( $SD=3.4$ ). The mean nicotine yield of their usual brand cigarettes was 0.8 ( $SD=0.2$ ), and the mean tar yield was 10.1 ( $SD=2.4$ ). The mean FTND score of the participants was 4.9 ( $SD=1.9$ ), indicating a moderate level of smoking dependence.

The study was approved by the human subjects committee of the Department of Psychology. Participants signed an informed consent before the beginning of the first session and were fully debriefed at the end of the study. Participants were paid 100 NS (approximately \$22) for their participation.

#### Apparatus and measures

The experiment took place in an isolated, well-ventilated room. Participants set facing a desk with a computer monitor. An ashtray was placed on the desk within reach. Two commercial filtered cigarette brands were used, one regular and one low-nicotine/tar. The regular cigarette was Kent (0.9 mg nicotine, 12 mg tar), and the low-nicotine cigarette was Kent 1 (0.1 mg nicotine, 1 mg tar; both manufactured by British American Tobacco, Louisville, KY, USA). Identification of the cigarette brand was prevented by covering the printed labels with a tape.

Compliance with the abstinence requirement was assessed by a hand-held, battery-operated device for measuring the concentration of carbon monoxide (CO) in the breath (Smoke Check, Micro Medical, Kent, UK). As in Study 1, smoking dependence was assessed with the Hebrew version of the FTND.

#### Procedure

Participants were invited for two individual sessions, scheduled 2–3 days apart. The sessions took place at approximately 8:00 A.M., and participants were asked to refrain from smoking for 8 h and to have their usual breakfast before coming to the sessions. At the beginning of each session, they were asked whether they have complied with these requirements, and their CO level was measured.

All reported that they had complied with the abstinence requirement, and none exceeded the cutoff point of 20-ppm CO level used by Pomerleau and Pomerleau (1992). In each session, participants smoked one cigarette, either the regular or the low nicotine. The order of the cigarettes was counterbalanced, and both participants and experimenter were blind as to which cigarette was used in each session.

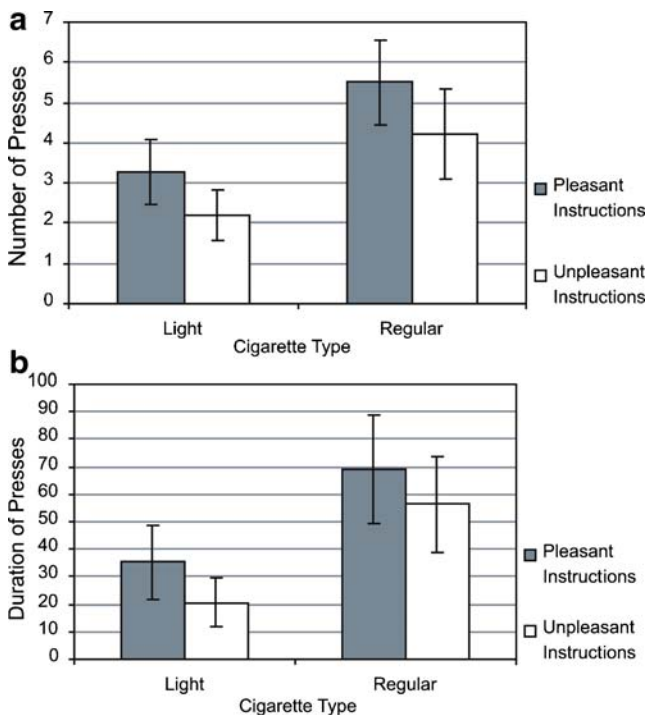
At the beginning of each session, half of the participants (pleasant instructions condition) received the same instructions used in the original study by Pomerleau and Pomerleau (1992): “People sometimes report experiencing pleasurable sensations when they smoke that might be described as a rush, a buzz, or a high. Not everybody experiences these, and not all cigarettes produce these sensations. If you happen to experience any of these pleasurable sensations while smoking today, please depress the button and hold it down for the duration of the sensation.” The other half of the participants (unpleasant instructions condition) received the same instruction, with the word “pleasurable” replaced with “unpleasant.” After delivering the instructions, the experimenter left the room.

After the smoking procedure, participants rated the cigarettes they had just smoked in terms of taste and strength on a 7-point scale. At the end of the first session, participants also completed the FTND, and at the end of the second session, they also responded to several questions related to both sessions. Specifically, in the pleasant instruction condition, participants were asked whether they had reported as pleasant sensations that had actually been unpleasant. The opposite question was presented to the participants in the unpleasant condition. Participants were also asked to rate the pleasantness of each sensation—rush, buzz, and high—on a scale of 1 (very unpleasant) to 7 (very pleasant).

In analyzing the data, we treated them as two different experiments, one replicating Pomerleau and Pomerleau (1992; pleasant instructions) and the second testing whether the same effects would be obtained with the opposite (unpleasant) instructions. The effects of cigarette type on number and duration of presses were therefore tested using two-tailed paired *t* tests within each condition. In addition, we examined the effects of instructions on the number and duration of presses for each cigarette using unpaired *t* tests.

#### Results

Figure 1 shows the number and duration of key presses as a function of instructions (pleasant vs unpleasant) and cigarette type (regular and light). We analyzed these dependent measures separately in the pleasant instruction condition and in the unpleasant instruction condition. As the order of the cigarette types did not have any effect on

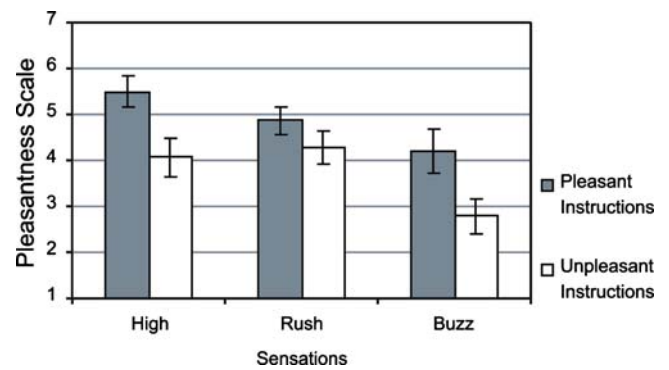


**Fig. 1** Number (a) and duration in seconds (b) of key presses for buzz, rush, or high as a function of instructions (pleasant vs unpleasant) and cigarette type (regular vs light)

the dependent measures and did not interact with cigarette type, it was not entered into the analyses.

Figure 1 depicts the number and duration of key presses for sensations while smoking a regular and a low-nicotine cigarette in the two instruction conditions. In the pleasant instructions condition, participants pressed more frequently when smoking the regular cigarette as compared to the low-nicotine cigarette,  $t(13)=2.75$ ,  $p=.017$ ,  $d=0.63$ , replicating Pomerleau and Pomerleau's findings (Fig. 1a). The difference in duration of presses (Fig. 1b), which was not significant in the original study, was nearly significant,  $t(13)=2.03$ ,  $p=0.063$ ,  $d=0.54$ . As predicted, very similar results were also obtained in the unpleasant instruction condition. Participants pressed more frequently when smoking the regular cigarette as compared to the low-nicotine cigarette,  $t(13)=2.20$ ,  $p=0.048$ ,  $d=0.62$ . In this condition, the difference in duration of presses was also significant,  $t(13)=3.16$ ,  $p=0.008$ ,  $d=0.73$ . None of the differences between instruction conditions were significant (all  $t$ 's < 1.05).

Figure 2 shows the ratings participants gave at the end of the study to each of the three sensations—rush, buzz, and high—as a function of instruction condition. The ratings were given on a scale of 1 (very unpleasant) to 7 (very pleasant). Both buzz and high were rated as significantly more pleasant under the pleasant instructions as compared to the unpleasant instructions condition,  $t(26)=2.61$ ,  $p=0.015$ ,



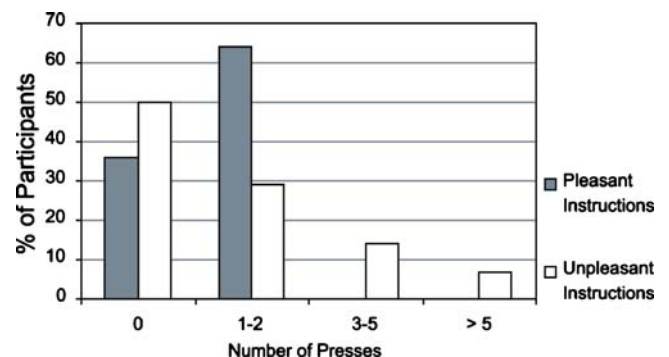
**Fig. 2** Pleasantness ratings of buzz, rush, and high as a function of instructions

$d=0.88$  and  $t(26)=2.33$ ,  $p=0.028$ ,  $d=0.99$ , respectively. Note that as 4 was labeled “neutral” on the scale, buzz was rated as marginally pleasant ( $M=4.21$ ) under the pleasant instructions condition but as unpleasant ( $M=2.79$ ) under the unpleasant instructions condition. The differences in regard to rush were in the same direction but were not statistically significant,  $t(26)=1.28$ ,  $p=0.21$ ,  $d=0.48$ .

As mentioned above, participants were also asked at the end of the study to indicate whether they had pressed the key for certain sensations although these sensations did not match the instructions in terms of actual pleasantness. Figure 3 shows that in the pleasant instructions condition, 64% of the participants pressed at least once for sensations that they actually experienced as unpleasant. Similarly, in the unpleasant instructions condition, 50% of the participants pressed at least once for sensations that they actually perceived as pleasant.

## Discussion

The results of Study 2 corroborate the hypothesis that responses of participants in the studies by Pomerleau and Pomerleau (1992, 1994) may have been influenced by the way nicotine-related sensations were defined. When we



**Fig. 3** Percent of participants in each instruction condition reporting having responded despite a mismatch between instructions and actual experience of sensations

defined rush, buzz, and high as pleasurable, replicating the instructions used in the original studies (Pomerleau and Pomerleau 1992, 1994), smokers pressed more frequently and for longer duration when smoking the regular, as compared to the low-nicotine cigarette. These results are the same as those obtained by Pomerleau and Pomerleau (1992), which these authors interpreted as demonstrating euphoriant effects of nicotine. In Study 2, however, the same pattern of results were obtained when the nicotine-related sensations were defined as *unpleasant*. Interpreted naively, this finding could have led to the erroneous conclusion that nicotine is *dysphoriant* to smokers.

Further results from Study 2 support the inference that instructions can shape the way smokers respond in this paradigm. The sensations of rush, buzz, and high were rated as more pleasant in the pleasant instructions as compared to the unpleasant instructions condition. Moreover, in the pleasant instructions condition, nearly two thirds of the participants reported having pressed the button on one or two occasions to signify a pleasurable sensation despite having actually experienced the sensation as unpleasant. This finding indicates that the procedure used by Pomerleau and Pomerleau (1992) cannot unequivocally lead to the conclusion that nicotine in cigarettes is euphoriant.

## General discussion

The assertion that smoked nicotine has euphoriant effects for smokers relies to a large extent on the original article by Pomerleau and Pomerleau (1992), which is sometimes cited as its sole reference in scientific publications (e.g., Waters and Sutton 2000; Glautier 2004; Haro and Drucker-Colin 2004). However, the studies comprising that article and the subsequent report (Pomerleau and Pomerleau 1994) relied on the assumption that nicotine-related sensations and specifically rush, buzz, and high are pleasurable to smokers. The results of the present studies challenge this assumption and suggest that the findings of Pomerleau and Pomerleau (1992, 1994) could have resulted, at least partially, from a bias inherent in their experimental instructions.

The same potential bias may have influenced the results of a recent study by the same group (Pomerleau et al. 2005), which used the same instructions with a group of smokers deprived of smoking for 5 days. Smokers who had experienced a buzz when they smoked their first cigarette were more likely to endorse at least one sensation of buzz while smoking a cigarette in the laboratory. Endorsement of buzz was again interpreted by these authors as evidence for pleasurable sensations from smoking, an interpretation that the present results call into question.

Some limitations of the present research should be noted. First, our studies were conducted in Hebrew and with

Israeli smokers. Although we always provided the original English term together with the Hebrew equivalent, we cannot be certain that the words “buzz,” “rush,” and “high” were perceived to have the exact same meaning as in the original USA sample. Moreover, these words may be associated with different connotative meaning and cultural mores in the two countries. Second, Study 2 employed different cigarettes than those used in the original study. Pomerleau and Pomerleau (1992) used three types of cigarettes, with 2.4-mg, 1.3-mg, and 0.2-mg nicotine yield, whereas we used two types of cigarettes, with a 0.9-mg and a 0.1-mg nicotine yield. This difference does not seem to have had significant consequences, however, as our results very closely replicated those of Pomerleau and Pomerleau (1992). Finally, we should stress that our results should not be interpreted as demonstrating that smoking cannot sometimes be euphoriant; smokers cite the pleasure involved in smoking as a major reason for maintaining the habit (Glautier 2004). Our findings suggest only that the effects of nicotine in cigarettes are not necessarily pleasurable. Specifically, the results of the two studies indicate that, whereas the sensation of high is pleasant to most smokers and rush is somewhat pleasant or neutral, the sensation of buzz is generally perceived as unpleasant.

The results of Study 2 show that defining the nicotine-related sensations as pleasant (or as unpleasant) introduces a potential bias into the procedure used by Pomerleau and Pomerleau (1992, 1994). One way to correct this in future studies would be to specify nicotine-related sensations using neutral terms and to ask participants to respond to any of these sensations during the experiment on buttons labeled pleasurable, neutral, or dysphoric. Such a procedure would allow an unbiased evaluation of the extent to which the pleasure smokers derive from their cigarettes is related to the psychoactive effects of nicotine.

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