
Janine L. Pillitteri, Lynn T. Kozlowski and Christine T. Sweeney
The Pennsylvania State University

Some smokers are more sensitive than others to the subjective effects of cigarettes, especially the first cigarette of the day. This report explored self-reported subjective effects to the first cigarette of the day and examined the extent to which heaviness of smoking and years smoking are associated with subjective effects. In 3 independent samples (n = 254, 116, 86), self-reports of light-headedness from the first cigarette of the day decreased with increasing heaviness of smoking and increasing number of years smoking, suggesting that differences in responses were due to differences in chronic tolerance. Because measures of the subjective effects of drugs are useful in the study of drug response variability, this self-report item on light-headedness should be included in further research on individual differences in the subjective effects of cigarette smoking.

Measures of the subjective effects of drugs have provided useful tools for studying drugs such as nicotine. Researchers have traditionally used self-reported subjective effects of drugs as one of the primary means of assessing the psychoactive effects and abuse liability of drugs (Beecher, 1959; Fischman & Foltin, 1991; Jaffe & Jaffe, 1989; Jasinski & Henningfield, 1989). However, measures of subjective effects are also useful in the study of individual variability in response to drugs. Following cigarette smoking or nicotine administration (e.g., Kozlowski, Heatherton, Frecker, & Nolte, 1989; Meliska & Gilbert, 1991; West & Russell, 1987), some smokers report subjective effects that are thought to result from the pharmacological actions of cigarettes. These subjective effects are often described as a high, head rush, or buzz, or as feelings of euphoria, light-headedness, nausea, or dizziness.

Individual differences in response to smoking may be accounted for by several factors. Russell (1989) suggested that there are multiple sources of individual differences such as environmental or social factors, pharmacokinetic or pharmacodynamic factors, and conditioning or learning factors. Another possible source of individual differences is constitutional or genetic influences that predate exposure to smoking. Prior to smoking exposure, some individuals may be constitutionally more or less sensitive to the subjective effects of smoking (e.g., Kozlowski & Herman, 1984; Kozlowski & Harford, 1976; O. F. Pomerleau, Collins, Shiffman, & Pomerleau, 1993; O. F. Pomerleau, 1995). Conversely, individual differences in the subjective effects of smoking may be acquired over time as a result of smoking exposure (i.e., past smoking history). Subjective effects may also be influenced by acute or chronic tolerance, a condition of diminished responsiveness or decreased sensitivity to a drug following repeated administration (Kalant & Khanna, 1990). The attenuation of subjective effects may be the result of acquired tolerance due to repeated exposure to smoking, rather than innate differences existing prior to smoking.

Although it is not clear which factors account for the greatest amount of variation in subjective effects among smokers, some smokers are much more sensitive than others to the psychoactive effects of cigarettes, especially the first cigarette of the day (Kozlowski, Director, & Harford, 1981; Kozlowski et al., 1989). The first cigarette of the day often produces immediate effects that are not found with other cigarettes smoked in the course of a day. These effects likely occur because acute tolerance to smoking is minimized for the first cigarette of the day due to overnight abstinence. Research suggests that the average interval of time between cigarettes for smokers allowed to smoke ad lib is 36 min (Hatsukami, Pickens, Svikis, & Hughes, 1988). At this rate, acute tolerance to the subjective effects of smoking can develop after several cigarettes, but is unlikely to subside for subsequent cigarettes given the relatively brief intercigarette interval (Perkins et al., 1995; Porchet, Benowitz, & Sheiner, 1988). This suggests that cigarettes are often smoked at a time when substantial acute tolerance has developed. Therefore, it is necessary to minimize acute tolerance effects in order to study individual differences in chronic tolerance. Fortunately, because of overnight abstinence, minimal acute tolerance is present when smokers smoke the first cigarette of the day, although some acute
tolerance may be present after a night's sleep. The first cigarette of the day presents a window of opportunity to study the subjective effects of smoking with the confounding effects of acute tolerance (and those of withdrawal due to long-term abstinence) minimized.

Several studies have demonstrated the development of acute tolerance to a variety of subjective effects of the first cigarette (or nicotine administration) of the day. A study by Hasenfraz, Nil, and Battig (1990) with 18 female smokers found a significant decrease in reports of feeling "sick" during the course of smoking the first three cigarettes of the day, suggesting the development of acute tolerance to this effect. C. S. Pomerleau and Pomerleau (1992) examined the "euphoric" effects of cigarette smoking in 22 smokers and concluded that tolerance developed to these effects because participants always reported a greater number of euphoric sensations from the first cigarette rather than the second cigarette of the day. Similar findings were reported in two other studies (Jones, Farrell, & Herning, 1978; Rosenberg, Benowitz, Jacob, & Wilson, 1980) that used intravenous nicotine injections following overnight abstinence. In the first study (Jones et al., 1978), 8 smokers reported that in comparison to the subjective effects (i.e., "dizziness," "light-headedness," "head rush") of the initial nicotine injection, the effects of the following injections were attenuated. In the second study (Rosenberg et al., 1980), 6 smokers reported "pleasurable" subjective responses only after the first and occasionally the second injections, but never for subsequent injections, suggesting the development of acute tolerance. Two studies by Perkins and his colleagues (Perkins et al., 1993; Perkins et al., 1994) examined acute and chronic tolerance to the subjective effects of nicotine nasal spray following overnight abstinence in 8 smokers and 8 non-smokers, and 17 smokers and 18 nonsmokers, respectively. Reports of "light-headedness," "dizziness," and "head rush" were significantly increased with increasing nicotine doses for both smokers and nonsmokers, but responses of smokers were significantly smaller than those of nonsmokers, reflecting chronic tolerance. Significantly smaller subjective responses were reported for challenge doses of nicotine received after previous nicotine dosing, suggesting acute tolerance.

These studies indicate that subjective effects of the first cigarette of the day, such as light-headedness and dizziness, are attenuated as a result of acute tolerance. However, some smokers report few, if any, subjective effects from the first cigarette of the day, indicative of constitutional differences in sensitivity. These constitutional or innate differences may be due to chronic tolerance that develops as a result of nicotine exposure. Measures of nicotine exposure such as number of years smoking and heaviness of smoking are closely related to chronic tolerance. Consistent with an understanding of tolerance, heavier smokers show more chronic tolerance to nicotine than lighter smokers (Perkins, 1995; Russell, 1989). It follows that greater years smoking should also influence chronic tolerance development to subjective effects. Both heavier smokers and longer term smokers should be expected to have greater chronic tolerance to the subjective effects of the first cigarette of the day than lighter or shorter term smokers (i.e., the former smokers should report fewer subjective effects). If such a relationship is found, this is a likely explanation for individual differences in sensitivity. A measure of subjective effects from the first cigarette of the day would provide a useful self-report measure of chronic tolerance to smoking, which might be especially useful if physiological measures are unavailable.

In the course of three independent studies, we asked smokers about subjective effects of the first cigarette of the day. Smokers were asked about subjective effects that are commonly reported in other studies, and those that are often referred to in anecdotal reports of smokers (e.g., light-headed, dizzy, nausea, head rush, high). In particular, we focused on light-headedness because in terms of the subjective effects of drugs, this is a relatively neutral term with few negative connotations associated with it.

We report the results of three studies. In Studies 1 and 2, we use previously unreported data from two published studies (Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991; Sweeney, Pillitteri, & Kozlowski, 1996), and in Study 3 we include data from a national probability sample of cigarette smokers in the United States. Study 1 examines the construct validity of light-headedness and high as indicators of chronic tolerance to cigarettes. Study 2 demonstrates a replication of the results in Study 1 and explores the relative merits of using additional questions on subjective responses. Study 3 explores the relationship between light-headedness and liking from the first cigarette of the day in addition to providing a further replication of the results in Studies 1 and 2. These studies provide the opportunity to confirm in independent samples the relationship between cigarette smoking, tolerance, and self-reported subjective effects from the first cigarette of the day.

Studies 1 and 2

Method

Participants for Study 1. The sample consisted of 254 adult visitors (111 men and 143 women) to the Ontario Science Centre, Toronto, Ontario, Canada. Participants were 33.5 ± 12.7 years old (mean ± SD; range = 17-77) and smoked 20.7 ± 10.5 cigarettes per day (range = 3-75). This sample had smoked for 16.7 ± 12.2 years (range < 1-61) and the time to the first cigarette of the day was 47.2 ± 86.9 min after waking (range = 0-720). Expired air carbon monoxide (CO) averaged 20.2 ± 9.9 ppm (range = 3-49 ppm), and Heavy Smoking Index (HSI; Heatherton, Kozlowski, Frecker, Rickert, & Robinson, 1989; Kozlowski, Porter, Orleans, Pope, & Heatherton, 1994) scores averaged 3.0 ± 1.6 (range = 0-6). For details on the recruitment of participants, see Heatherton et al. (1991).

Participants for Study 2. This sample included 116 cigarette smokers (55 men and 61 women) recruited through posters and newspaper advertisements at Pennsylvania State University and the surrounding community. To take part in the study, participants had to meet the following screening criteria: 18 years of age or older, currently smoking at least five cigarettes daily, smoking daily for 1 year or more, and not making a serious attempt to quit smoking during the study. Participants were 22.7 ± 6.5 years of age (range = 18-62) and smoked 15.9 ± 7.3 cigarettes per day (range = 5-40). This sample smoked daily for 5.7 ± 6.6 years (range 1-45) and smoked the first cigarette of the day 46.2 ± 64.5 min after
SUBJECTIVE EFFECTS OF THE FIRST CIGARETTE

85

waking (range = 0–360). Expired air CO ranged from 0–55 ppm (M = 19.1 ± 13.8 ppm), and HSI scores ranged from 0–6 (M = 2.6 ± 1.4). Other unrelated results from this particular study are reported in Sweeney et al. (1996).

Procedure. In Study 1, participants completed a smoking survey as part of a larger study that included the following questions: “Does the first cigarette of the day make you feel light-headed?” and “Does the first cigarette of the day make you feel high?” The response categories included never (0), sometimes (1), usually (2), and always (3).

In Study 2, participants completed a smoking history form as part of a larger study. This form included seven questions pertaining to subjective effects of the first cigarette of the day. These questions all had the same response format ranging from not at all (0), slightly (1), moderately (2), to very (3) and were stated as follows: “Does the first cigarette of the day make you feel dizzy?” “Does the first cigarette of the day make you feel light-headed?” “Does the first cigarette of the day make you feel high?” “Does the first cigarette of the day give you a buzz?” “Does the first cigarette of the day make you feel ill?” “Does the first cigarette of the day make you feel nauseous?” and “Does the first cigarette of the day give you a hit?”

Participants in all three studies also answered two questions (“How many cigarettes a day do you usually smoke?” and “How soon after you wake up do you smoke your first cigarette?”) that compose the HSI, a measure of the heaviness of smoking (Heather- ton et al., 1989; Kozlowski et al., 1994). Following completion of the questionnaires, an expired air CO level was collected in Studies 1 and 2 after a 15-s breath hold using an Ecolyzer CO® (Elmsford, NY) machine (Study 1) and after a 10-s breath hold using a Vitalograph BreathCO® (Lenexa, KS) machine (Study 2).

Analyses. Multiple linear regression and multiple logistic regression were used in all three studies to examine the relationships between heaviness of smoking, years smoking, and self-reported subjective effects from the first cigarette of the day. In Study 2, a principal components analysis was done using the data from the seven subjective effects questions for the purposes of data reduction and estimation of the number of factors. Eigenvalues greater than 1 were used to indicate the number of factors to extract. Exploratory factor analysis with iterated principal factors extraction and promax rotation was then used to identify factors and salient variable loadings. Using the factor pattern matrix, each variable was assigned to a factor if it loaded 0.40 or greater on a given factor but less than 0.25 on another factor.

Results for Study 1

Light-headed question. Using multiple linear regression with light-headed (scored 0–3) as the dependent variable, HSI (β = −0.26 ± 0.03; SE, p < .0001) and years smoking (β = −0.20 ± 0.004, p < .0008) were significant independent variables (R² = .12). These results suggest that heavier smoking and greater years smoking were associated with less light-headedness from the first cigarette of the day. When added to the equation, CO was not related to light-headedness, but when substituted for HSI it was related (β = −0.15 ± 0.005, p = .01). This substitution was necessary because HSI and CO are essentially measures of the same construct (i.e., HSI is a self-report indicator of heaviness of smoking, and CO is a biochemical indicator of heaviness of smoking).

To examine differences in light-headedness among heavier and lighter smokers, we recoded the light-headed variable and the HSI variable into dichotomous variables (0 = never or not at all light-headed, 1 = ever light-headed or any degree of light-headedness; 0–3 = lighter smokers, 4–6 = heavier smokers, respectively). Light-headedness (coded 1) was reported by 49% (n = 50 out of 101) of lighter smokers and 27% (n = 41 out of 153) of heavier smokers.

High question. Reports of feeling high were less likely as HSI increased, but years smoking was not associated with the high variable. With high (scored 0–3) as the dependent variable, years smoking was unrelated (β = −0.02 ± 0.003, p = .72), but HSI (−0.16 ± 0.02, p = .01) or CO (−0.18 ± 0.004, p = .004) was related. Sex was not a significant predictor when added to the models specified above, and no interactions were found between HSI and years smoking.

Response scales used to measure subjective effects. Additional analyses were done to determine whether it was possible to use a recoded two-level dependent variable that assessed simply the presence versus absence of subjective effects rather than the four-level dependent variable that assessed the intensity or extent of subjective effects. The dependent variables (light-headed, high) were recoded such that responses of “never” or “not at all” were treated as the absence of the subjective effect (scored 0), and any positive response (i.e., the remaining three levels of the scale) was treated as the presence of the subjective effect (scored 1). The results of multiple logistic regression indicated that the two-level dependent variables worked as well as their four-level counterparts. The same pattern of results was found for the recoded light-headed variable, HSI (estimate = −0.31 ± 0.09), years smoking (estimate = −0.06 ± 0.01), and CO (estimate = −0.03 ± 0.01), ns(250) > 3.35, ps < .001, constant = 2.3 ± 0.42, variance explained = 15%. With the recoded high variable, years smoking was unrelated (estimate = −0.002 ± 0.02, p = .86), but HSI (estimate = −0.23 ± 0.10, p = .02) or CO (estimate = −0.05 ± 0.02, p = .004) was related.

Results for Study 2

Replication of the light-headed effect. Multiple linear regression indicated that HSI (−0.29 ± 0.04, p < .0001) and years smoking (β = −0.30 ± 0.01, p < .0007) were associated with light-headedness (R² = .17). When added to the equation, CO was not related to light-headedness, but when substituted for HSI it was related (β = −0.20 ± 0.004, p < .02). These results are parallel to those of Study 1. However, no relevant variables were associated with reports of feeling high in Study 2.

The same pattern of results was found with multiple logistic regression using the recoded, two-level light-headed variable: HSI (estimate = −0.49 ± 0.20) and years smoking (estimate = −0.19 ± 0.07; ts(109) > 2.5, ps ≤ .01; constant = 2.9 ± 0.80; variance explained = 21%). When added to the equation, CO was not related to light-headedness, but when substituted for HSI it was marginally related (estimate = −0.03 ± 0.02, p = .09). Using the same recoding for the light-headed (0, 1) and HSI (0–3, 4–6) variables
described above, the results indicated that light-headedness was reported by 74% (n = 60 out of 81) of lighter smokers and 36% (n = 31 out of 87) of heavier smokers.

** Exploration of multi-item scales.** Factor analysis indicated that six of the seven subjective effects questions formed two distinct factors. Factor 1 was defined by the following four variables: light-headed, high, dizzy, and buzz. The Factor 2 was defined by the remaining two variables: ill and nauseous. The two factors were only moderately correlated (.34). One variable, hit, did not load on either factor. The variables defining each factor were then combined into two linear composites by taking the average of the raw scores for the four and two variables, respectively. Composite scores had high internal consistency (coefficient alpha = .85 for each).

In comparison to reports of light-headedness or dizziness, fewer participants reported feeling slightly (16%) or moderately (3%) ill and slightly (15%) or moderately (2%) nauseous to the first cigarette of the day, and no relevant variables were found to predict this second factor. However, the majority of participants (62%) reported feeling light-headed from the first cigarette of the day. Factor 1 was associated with years smoking (β = -0.27 ± 0.009, p < .004) and marginally associated with HSI (β = -0.20 ± 0.04, p < .03). In other words, light-headedness to the first cigarette of the day was predicted by fewer years smoking and lighter smoking.

Light-headed is the question responsible for the associations with the composite score. The question on light-headedness was responsible for the association of the composite score with HSI or years smoking. When light-headed was dropped from the composite, no statistically significant associations were found between the revised composite and HSI and years smoking. None of the other three questions in the composite showed a significant association with HSI or years smoking. There were no indications of sex differences or interactions between HSI and years smoking in any of the above analyses. Table 1 shows the participant responses to the subjective effects questions that were included in the respective studies.

**Discussion**

These two independent samples allowed us to assess subjective effects across a broad spectrum of smokers. These results should be representative of the behavior of smokers across a broad age range and a broad range of heaviness of smoking. The results of these studies provided evidence in support of our hypothesis that greater years smoking and heavier smoking (indicated by HSI or CO) would be associated with less subjective effects from the first cigarette of the day. This relationship suggests that individual differences in the subjective effects of smoking may be in part due to chronic tolerance development to such effects.

An alternative explanation for the pattern of results obtained in these studies focuses on innate differences in sensitivity to smoking. For example, some individuals are relatively insensitive to nicotine because of constitutional or genetic differences existing before smoking exposure. Such individuals may therefore become heavier smokers to obtain doses of nicotine that produce discernable effects. In such

<table>
<thead>
<tr>
<th>Subjective effect</th>
<th>Response</th>
<th>Study 1 (N = 254)a</th>
<th>Study 2 (N = 116)b</th>
<th>Study 3 (N = 86)c</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Never</td>
<td>Sometimes</td>
<td>Usually</td>
<td>Always</td>
</tr>
<tr>
<td>Light-headed</td>
<td>n</td>
<td>%</td>
<td>n</td>
<td>%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>101</td>
<td>40</td>
<td>122</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>183</td>
<td>72</td>
<td>62</td>
<td>25</td>
</tr>
<tr>
<td>Light-headed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>77</td>
<td>66</td>
<td>32</td>
<td>28</td>
</tr>
<tr>
<td>Dizzy</td>
<td>56</td>
<td>48</td>
<td>44</td>
<td>38</td>
</tr>
<tr>
<td>Buzz</td>
<td>66</td>
<td>57</td>
<td>36</td>
<td>31</td>
</tr>
<tr>
<td>Ill</td>
<td>94</td>
<td>81</td>
<td>19</td>
<td>16</td>
</tr>
<tr>
<td>Nauseous</td>
<td>97</td>
<td>84</td>
<td>17</td>
<td>15</td>
</tr>
<tr>
<td>Hit</td>
<td>62</td>
<td>53</td>
<td>42</td>
<td>36</td>
</tr>
<tr>
<td>Light-headed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liking</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

aHeatherton et al. (1991). bSweeney et al. (1996). cIn response to the question "How much do you like the way the first cigarette of the day makes you feel?", 11 participants (15%) responded "don't know" and 1 (1%) refused to answer.
cases, the same relationship as found in the results of Studies 1 and 2 between light-headedness and heaviness of smoking could also apply. However, this explanation is inconsistent with the sensitivity model of tolerance proposed by O. F. Pomerleau et al. (1993). According to this model, exposure to nicotine in individuals with low innate sensitivity to nicotine leads to minimal change in sensitivity. Therefore, this model suggests that these individuals are likely to become nonsmokers or light or intermittent smokers (i.e., "chippers"), rather than heavy smokers.

After smoking for several years, one might expect that few smokers would report subjective effects from cigarette smoking. However, 60% of participants in Study 1 and 62% in Study 2 reported feeling light-headed from the first cigarette of the day. This finding is striking in that the participants reported smoking for an average of 17 years (range = 1–61) and 6 years (range = 1–45), respectively, yet the majority still reported feeling this particular subjective effect. The data indicated that those with greater years smoking continued to show decreases in reported light-headedness. In other words, it appears not to be the case that smoking continued to show decreases in reported light-headedness from the first cigarette of the day. This finding is striking in that the participants in Study 2 reported feeling light-headed from the first cigarette of the day. This may be related to the phenomenon described by Becker (1953). Drug users go through a process of learning how to use a drug and label the subjective effects of that drug. Illness is not a label generally applied to the subjective effects of smoking in continuing smokers, whereas light-headedness is used by a noteworthy percentage of smokers. Perhaps smokers have learned to avoid any ill effects from the drug by delaying smoking for some time after waking (cf. Kozlowski et al., 1981). Kozlowski et al. found that "late" smokers (i.e., those who delay smoking for several hours after waking) reported delaying their smoking not because they were restraining themselves, but rather because they found the first cigarette of the day to be noxious. Although it is possible that cause and effect were reversed by the respondents in this study, the data do not support this interpretation (i.e., noxious effects were experienced because smoking was delayed resulting in greater sensitivity due to increased abstinence interval and decreased tolerance). Rather, the study by Kozlowski et al. suggested that late smokers may be more responsive to the subjective effects of the first cigarette of the day. In fact, the present data support this conclusion. When time to the first cigarette of the day was substituted for HSI in the regression equation including years smoking, the results indicated that greater time to the first cigarette and fewer years smoking were associated with light-headedness in both Study 1 (p < .002) and Study 2 (p < .02). Because greater light-headedness was predicted by fewer years smoking, lower HSI, and greater time to the first cigarette—characteristics of less dependent smokers—it follows that less dependent smokers experienced greater light-headedness from the first cigarette of the day. Conversely, more dependent smokers experienced less light-headedness from the first cigarette of the day.

Some research on individual differences in subjective effects has used manipulations of nicotine administered via injection or nasal spray rather than manipulations with cigarettes (e.g., Perkins, 1995; Rosenberg et al., 1980). Both types of manipulations are valid and can be useful in exploring specific research questions; however, there are certain situations in which one manipulation may be superior to the other. For example, it is not possible to administer precise doses of nicotine through cigarette smoking because of differences in puffing topography (which varies not only between smokers but within the same smoker). The subjective effects of nicotine alone are likely to be more relevant in studies of nicotine replacement therapies. The novel aspects of nicotine replacement therapies may impair generalizability and possibly result in very different subjective effects in comparison to cigarette smoking. Cigarette smoke contains more than 4,000 compounds in addition to nicotine, many of which are biologically active (U.S. Department of Health and Human Services, 1988) and may contribute to the subjective effects of smoking. Because nicotine is not the sole compound in cigarette smoke, those studies that examine the subjective effects of nicotine alone may be limited in their generalizability. It is possible that at least some of the biologically active compounds in cigarette smoke contribute to subjective effects.

Study 3

C. S. Pomerleau and Pomerleau (1992) conducted a study of euphoriant effects from cigarette smoking. Twenty-two male smokers participated in three different sessions during which the first and second cigarettes of the day were smoked (each day either ultra-low nicotine, high nicotine, or usual brand cigarettes were smoked). The participants were given 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. We are currently testing different blends of tobacco to determine how likely they are to 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. (C. S. Pomerleau & Pomerleau, 1992, p. 461)
The results of this study indicated that the first cigarette of the day always produced the greatest number of euphoric reports regardless of the nicotine yield of the cigarette, suggesting tolerance development to euphoric effects for subsequent cigarettes. This finding is consistent with that of the studies mentioned earlier (e.g., Hasenfatz et al., 1990; Jones et al., 1978; Perkins et al., 1993; Perkins et al., 1994; Rosenberg et al., 1980).

C. S. Pomerleau and Pomerleau (1992) found that older participants and those who had smoked for more years reported more euphoric effects than did younger participants or those who had not smoked as long. We wondered how the “euphoria” from this study was related to the “light-headedness” in our research. Given that euphoria increased (C. S. Pomerleau & Pomerleau, 1992) and light-headedness decreased (Studies 1 and 2) with years smoking and heaviness of smoking, one might expect that euphoria and light-headedness themselves are negatively correlated.

We conducted Study 3 to explore the relationship between light-headedness and euphoria and to try to replicate our earlier findings and those of C. S. Pomerleau and Pomerleau (1992). A question about “liking” for the first cigarette of the day was used to measure euphoria, consistent with procedures developed at the Addiction Research Center (Jasinski & Henningfield, 1989; Jasinski, Johnson, & Henningfield, 1984).

Method

Participants. A representative sample of 86 cigarette smokers (30 men and 56 women) within the continental United States was contacted through a random-digit dialing, computer-assisted telephone interview. The response rate was 66%, which has become state-of-the-art and should provide a sufficiently representative sample of smokers (cf. Groves et al., 1988). Participants were 43.2 ± 14.5 years of age (range = 20-82) and smoked 20.8 ± 12.3 cigarettes per day (range = 1-70). The time to the first cigarette of the day was 39.3 ± 40.4 min after waking (range = 1-120) and HSI scores were 2.9 ± 1.6 (range = 0-6). Of the sample, 85% were Caucasian, 5% were African American, 5% were Hispanic, 3% were Native American, 2% were Asian Pacific, 3% were categorized as other, and 1% refused to answer this question. In terms of education, 15% had not finished high school, 28% had finished high school, and 57% had studied beyond high school. Only those who reported smoking daily were interviewed.

Procedures. In Study 3, participants took part in a 15-min telephone survey on smoking habits. The key questions had the same response format of not at all (1), slightly (2), somewhat (3), and very (4) and were stated as follows: “Does the first cigarette of the day make you feel very light-headed, somewhat light-headed, slightly light-headed, or not at all light-headed? and “How much do you like the way the first cigarette of the day makes you feel? Do you very much, somewhat, slightly, or not at all like the way the first cigarette of the day makes you feel?” Age was used as a proxy for years smoking in this sample. Analyses of data from Studies 1 and 2 support this assumption.

Results

Regression models indicated that HSI and age, respectively, were significant predictors of both light-headedness and age were significant predictors of both light-headedness and 2 support this assumption. For years smoking in this sample. Analyses of data from Studies 1 and 2. In addition, heavier smokers and older smokers reported greater liking of the first cigarette of the day. The variables of liking and light-headedness were negatively correlated, indicating that as reports of liking for the first cigarette of the day increased, reports of light-headedness decreased (r = - .32, p < .006).

Using the dichotomous coding for the light-headed (0, 1) and HSI (0-3, 4-6) variables, light-headedness was reported by 25% (n = 14 out of 55) of lighter smokers and 4% (n = 1 out of 27) of heavier smokers. When the liking variable was recoded into a two-level variable (0 = not at all like the way the first cigarette of the day makes you feel, 1 = any degree of liking), the results indicated that 86% (n = 43 out of 50) of the lighter smokers and 91% (n = 21 out of 23) of the heavier smokers reported liking of the first cigarette of the day.

Discussion

Study 3 provides a further replication of the results in Studies 1 and 2. This study is the most representative of the three studies because it includes a national probability sample. Our earlier samples, and that of C. S. Pomerleau and Pomerleau (1992), should be viewed as convenience samples. The results of Study 3 indicated that heavier smokers and older smokers reported greater liking of the first cigarette of the day. This finding is consistent with the results of C. S. Pomerleau and Pomerleau (1992), which showed that these same smokers reported greater pleasurable effects from the first cigarette of the day. The present results are also consistent with another study of the “favorite cigarette of the day” in a sample of 5,124 smokers (Jarvik, Killen, Varady, & Fortmann, 1993). Heavier smokers, as measured by a modified version of the Fagerstrom Tolerance Questionnaire (Fagerstrom, 1978), were more likely to choose the first cigarette of the day as the one that would be most missed, whereas lighter smokers were more likely to choose the cigarette following dinner.

Additional research is needed to identify more precisely what smokers mean by “pleasurable effects” from drugs and to explore the relationship between the subjective effects of smoking and measures of liking or euphoria. One possible explanation for the increased liking of the first cigarette in longer term, heavier smokers is that they may be liking the sense of withdrawal relief they feel from the first cigarette of the day (cf. West & Russell, 1988). Alternatively, there may be a partitioning taking place in regard to the same underlying subjective effect such that shorter term, less dependent smokers are likely to label their feelings as more light-headed than euphoric and the longer term, more dependent smokers as more euphoric than light-headed.

A reliable relationship between light-headedness, heaviness of smoking, and years smoking is demonstrated in these three independent studies. Reports of light-headedness from...
the first cigarette of the day may provide a useful self-report measure of chronic tolerance to cigarette smoking. As such a measure, they are a practical means of studying individual differences in responses to smoking. It would be useful to have a measure of light-headedness from the first cigarette of the day included in longitudinal research on smoking. Additional research including repeated measures of light-headedness from the first cigarette of the day could determine whether this measure shows stability over time. Such a measure would be a useful tool in survey research in the absence of physiological measures of tolerance.

References


Received July 8, 1996
Revision received September 10, 1996
Accepted September 12, 1996