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## Craving to smoke in orthodox Jewish smokers who abstain on the Sabbath: a comparison to a baseline and a forced abstinence workday

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**Abstract** *Rationale:* Previous studies suggest that craving for cigarettes is substantially influenced by non-nicotine mechanisms such as habits, cues, and expectations. As orthodox Jews must refrain from smoking during the Sabbath, examining their craving levels during this habitual abstinence may be informative in separating smoking deprivation from other determinants of craving and withdrawal. *Objective:* To examine the extent to which the habitual abstinence of Orthodox Jews during the Sabbath is associated with craving to smoke and with other reactions to smoking abstinence. *Methods:* Twenty orthodox Jewish heavy smokers were assessed three times: on a workday when smoking as usual, on a Sabbath when they never smoke, and on a forced abstinence workday. Craving, irritability, and other commonly reported smoking withdrawal symptoms were assessed retrospectively at several time points during the preceding 24 h. *Results:* Craving to smoke, and to a lesser extent, irritability, was lower during the Sabbath than during the two other test days. Self-reported difficulty in abstaining was also lower on the Sabbath than on the workday. Craving in the evening preceding the test day was always significantly higher than in the next morning, despite the overnight abstinence before

the morning assessment. *Conclusions:* These results support previous findings in showing that craving to smoke is determined to a large extent by smoking-related habits, cues, and expectations.

**Keywords** Smoking abstinence · Craving · Cues · Expectancy · Habit

When habitual smokers attempt to abstain from smoking, they often experience a variety of uncomfortable reactions. These reactions, according to the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (American Psychiatric Association 1994), include dysphoric or depressed mood, insomnia, irritability, frustration or anger, anxiety, difficulty concentrating, restlessness, decreased heart rate, and increased appetite or weight gain. While these symptoms are believed to contribute to the maintenance of the smoking habit and to the relapse to smoking from abstinence (Willner et al. 1995), they tend to be relatively short-lived. In contrast, many smokers who attempt to abstain continue to experience a strong craving to smoke long after other withdrawal symptoms have passed. Indeed, craving to smoke has been described as “potentially the most important feature of cigarette withdrawal” (West and Schnieder 1987) and “the most fundamental and difficult problem for smokers who are trying to quit” (Russel 1988).

While craving to smoke typically increases in response to smoking deprivation, it also depends on a variety of other factors, including habits, cues, and expectations. The role of habit in determining craving to smoke and other smoking parameters was demonstrated in a study by Jacober et al. (1994). Smokers were asked to smoke ad lib, abstain, and finally oversmoke in three consecutive afternoons. While abstinence increased craving prior to the first cigarette, it had no effect on craving (or any other smoking parameter) for the rest of the evening. Furthermore, craving peaked at the end of the 4–5 h of forced abstinence period to a level that was much higher than the craving reported in the morning, despite the fact that the latter was assessed

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after much longer (but usual) abstinence period. The authors concluded that the subjective perception of craving to smoke reflects primarily craving for the habituated behavior.

Numerous studies have shown that smoking-related cues, including manipulation of cigarettes and smoking-related objects, can provoke powerful craving responses in smokers (e.g., Juliano and Brandon 1998; Sayette and Hufford 1994; Sayette et al. 2001, 2003). Smoking-related cues appear to operate by evoking expectancy to smoke, which increases craving (Wertz and Sayette 2001). In two studies by Dols et al. (2000, 2002), smokers were exposed to smoking cues in two contexts: one predicting smoking and the other predicting no smoking. In each context, smokers rated craving before and during the presentation of smoking cues. Smoking cues elicited less craving in a non-smoking context compared to a smoking context. Moreover, the contexts themselves were the main generators of craving, being better predictors than the smoking cues of smoking or nonsmoking. The authors concluded that smoking cues elicit craving mainly by generating expectation of the occurrence of smoking. Similar results were recently reported by Thewissen et al. (2005).

The smoking practices of orthodox Jews provide a natural laboratory for examining the role of habits, cues, and expectations as determinants of craving to smoke. Orthodox Jews are forbidden by their faith to light fire, hence to smoke, on the Sabbath. The period during which smoking is disallowed starts on Friday evening at sundown and ends on Saturday evening at about the same time. The ability of at least some orthodox Jewish smokers to abstain from smoking during the Sabbath without apparent difficulty was noted by Schachter et al. (1977) and later by Warburton (1990) as an anomaly that challenges the view of smoking as equivalent to nicotine addiction. However, as Stolerman and Jarvis (1995) noted, no study has documented this form of weekly smoking abstinence in orthodox Jewish smokers and specifically the extent to which this abstinence is accompanied by craving or by symptoms that have been associated with smoking withdrawal.

The goal of the present study was to assess levels of craving to smoke in a group of Orthodox Jews during the Sabbath and compare them to craving levels reported during an equal period of forced abstinence on a weekday. As these smokers habitually abstain on the Sabbath, are exposed to fewer smoking cues, and have no expectation to smoke, we predicted that craving to smoke would be lower on the Sabbath than on a forced abstinence weekday. In addition to craving, we assessed the degree of several smoking withdrawal symptoms, including irritability, depression, hunger, and sleep problems.

## Methods

### Overview

Twenty orthodox Jewish smokers rated their craving and other subjective states associated with smoking withdrawal

under three conditions: on a weekday of smoking ad lib; on the Sabbath, in which they never smoke; and on a weekday in which they abstained from smoking to comply with the study requirements.

### Participants

Participants were 20 orthodox Jews, 10 of each gender. They were solicited by advertisements posted on the bulletin boards on the campus of Bar-Ilan University in Ramat Gan, Israel, in which the majority of students are religious Jews. The advertisements specified that participants had to be religious, smoke at least 20 cigarettes per day, and strictly adhere to the practice of not smoking during the Sabbath. Participants who contacted the experimenters were informed over the phone about the procedure of the experiment but were not told about its purpose. Specifically, they were told that they would be asked to complete a set of questionnaires three times, one of which following 24 h of required abstinence on a weekday, and that abstinence would be verified by carbon monoxide (CO) measurement. They were promised 100 new Israeli shekels (about US \$25 US) for participating in the 3 days of the experiment if they complied with the abstinence requirements. Twenty-two participants completed the baseline procedure, but two chose not to continue further because they were reluctant to go through the weekday abstinence procedure. Demographic and smoking information of the 20 participants who completed the study is provided in Table 1.

### Procedure

The first meeting with each participant was set for an evening following a workday in which they could smoke ad libitum. The time of the meeting was set to match the time in which the next Sabbath would end (following sunset). This meeting and the two subsequent ones were held at the participants' homes, and the participants were reminded about the upcoming meeting by a telephone call on the previous evening. At the outset of the visit, participants read and signed informed consent and completed

**Table 1** Characteristics of participants

	Mean	SD	Range
Age (years)	22.77	7.17	17–47
Education (years)	12.35	1.34	10–16
Number of cigarettes per day	21.85	3.16	20–33
Tar yield of cigarettes	9.75	1.99	6–14
Nicotine yield of cigarettes	0.82	0.12	0.6–1.0
Smoking (years)	6.42	7.05	2–33
Number of family members who smoke	1.25	1.16	0–3
Number of quitting attempts	1.4	2.11	0–6
Fagerström score	5.6	1.69	3–8
Level of religiosity (1–7)	4.9	1.16	4–7

the CO measurement. Subsequently, they completed the baseline questionnaires as well as the craving and symptom ratings for the past day (see below). At the end of the meeting, the experimenter scheduled the next two meetings with the participants.

The subsequent two meetings were held at least a week apart. One was held following the Sabbath, and the other following a weekday during which participants were required to refrain from smoking for the same interval as they did on the Sabbath. The order of the two meetings was counterbalanced among the 20 participants. On each testing, participants first performed the CO measurement and then completed the measures referring to the past 24 h (see below). On the final test, participants received the 100 NIS reward and were fully debriefed on the purpose of the experiment.

## Measures

Two questionnaires were administered at the baseline assessment:

1. The Hebrew version of the Fagerström Test for Nicotine Dependence (FTND; Heatherton et al. 1991). This is the most commonly used test for nicotine dependence and includes six items, with a total score ranging between 0 and 10.
2. A detailed smoking history questionnaire, which assessed the number of years participants have smoked, the number of family members and colleagues at work that smoked, how many times and how they had tried to quit, how many times they had quit for as long as 3 months, what brand of cigarette they smoked, and how many cigarettes they smoked on a weekday. Participants were also asked to rate their degree of religiosity (“How religious do you view yourself?”) on a 1–7 scale and to indicate whether they smoked on the Sabbath and whether they used any nicotine replacement products during the Sabbath. Finally, participants were then asked to describe, in their own words, their reasons for smoking.

At each assessment, participants completed questions assessing the degree of craving, irritability, depression, hunger, and sleep problems during the preceding 24 h (we could not administer these questions during the Sabbath, as writing or recording information in any other way is considered work and is therefore forbidden). Participants were asked to rate the level of their craving for a cigarette, irritability, depression, and hunger on a 1–7 scale (1=not at all, 7=very much) for the following time points in the past 24 h: the previous evening at 2200 hours, first waking hour of the morning, 10:30 a.m., after lunch, 1600 hours, 1900 hours, and at the present moment. Two additional questions were presented to the participants in the evening ending their abstinence days. These questions were answered on the same 7-point scale and included: “Overall, how much did you crave to smoke during the past 24 h?”

and “Overall, how difficult was it to not smoke during the past 24 h?”

## Carbon monoxide metering

The CO metering device (“The Smoke Check”, Micro Medical Limited, Rochester, England) was a handheld, battery-operated instrument measuring the concentration of CO in the breath. A level of 11–20 ppm on this instrument is typical of a heavy smoker, whereas levels higher than 20 ppm are typical of very heavy smokers. Levels lower than 6 ppm indicate that the smoker did not have a cigarette within the preceding 24 h.

## Results

### Baseline values and compliance with experimental demands

The mean FTND score of the participants was 5.60 (range 3–8). The mean CO level on the non-abstinence day was 17.00 (range 10–45). Other baseline values are detailed in Table 1. The CO measurement confirmed that all participants refrained from smoking during the Sabbath (mean=3.20, range 1–6) as well as on the abstinence workday (mean=2.15, range 1–6). All participants denied consumption of nicotine from other sources at any time during the experiment. Two participants reported that they chewed confectionary chewing gum during the abstinence periods.

### Outcome analysis

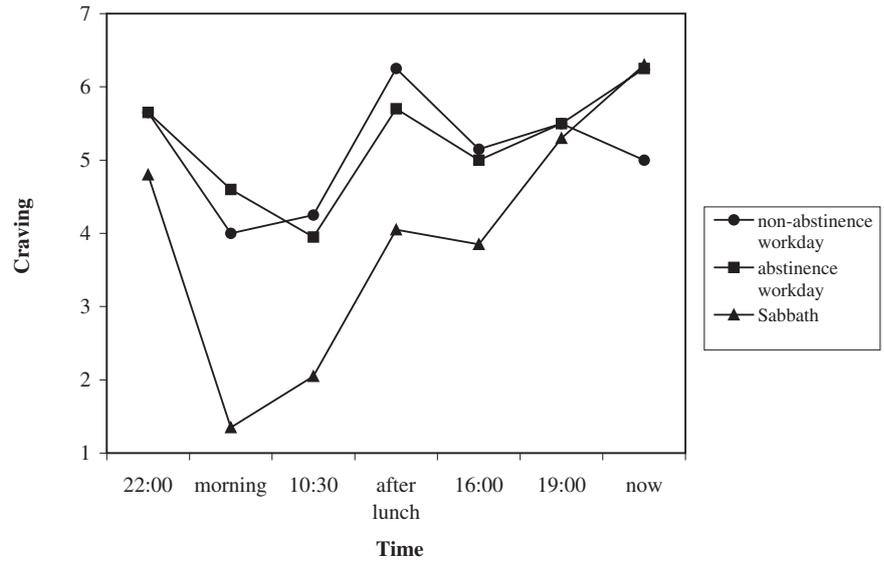
We compared the degree of craving and withdrawal during the baseline day and the two abstinence days. As mentioned above, the order of the abstinence days was counterbalanced, so that ten participants were assessed first on the abstinence weekday and then on the Sabbath, and for the other ten, the order was reversed. Preliminary analysis showed that there were no order effects on any of the dependent measures; therefore, subsequent analysis was collapsed across order.

For each dependent measure, we conducted a 3×7 repeated measures analysis of variance (ANOVA) with measurement day (baseline, Sabbath, and workday abstinence) and time (previous evening at 2200 hours, first waking hour of the morning, 10:30 a.m., after lunch, 1600 hours, 1900 hours, and at present) as the independent factors.

### Craving

There was a significant main effect of day on craving (Fig. 1),  $F(2, 38)=18.12$ ,  $p<.001$ . Pairwise contrasts showed that craving during the Sabbath was significantly lower than on the abstinence workday,  $F(1, 19)=24.33$ ,

**Fig. 1** Craving levels by condition and time



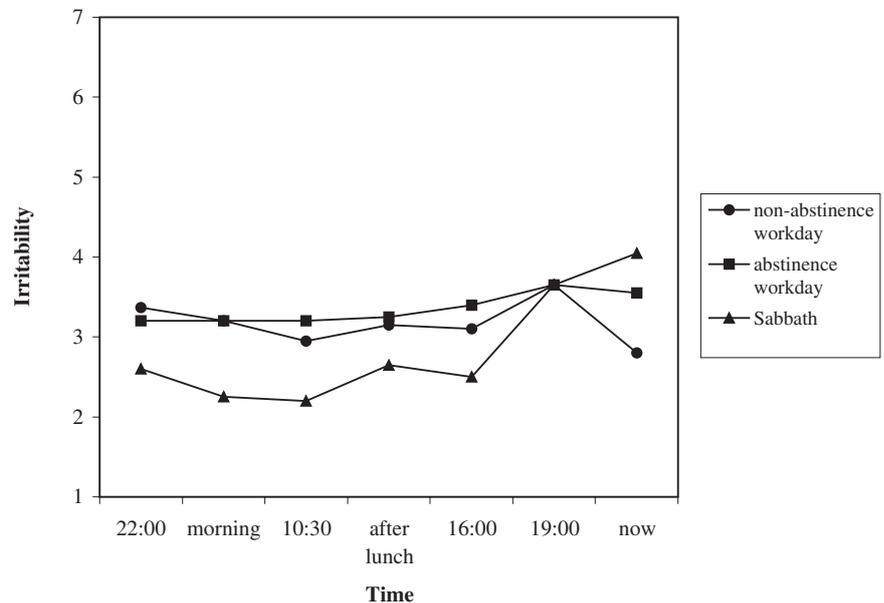
$p < .001$ , as well as on the non-abstinence workday,  $F(1, 19) = 19.57$ ,  $p < .001$ , whereas the difference between the two workdays was not significant,  $F(1, 19) = 0.50$ ,  $p = .48$ . There was also a significant main effect of time,  $F(6, 114) = 29.33$ ,  $p < .001$ . Specifically, in all three conditions, craving in the evening preceding the test day was significantly higher than in the next morning,  $t(19) = 6.11$ ,  $p < .001$ ;  $t(19) = 2.58$ ,  $p = .018$ ; and  $t(19) = 3.38$ ,  $p = .003$  for the Sabbath, the abstinence workday, and the non-abstinence workday, respectively. Finally, the Time  $\times$  Day interaction was significant,  $F(12, 228) = 8.83$ ,  $p < .001$ . Bonferroni pairwise contrasts showed that craving was significantly lower on the Sabbath than the other two days at all time points from the morning until 1600 hours. In fact, only 3 out of the 20 participants reported any craving at all during the first hour of the morning on the Sabbath. As Fig. 1 shows, the

difference in craving gradually decreased during the day, disappearing entirely by 1900 hours.

**Irritability**

As Fig. 2 shows, the pattern for irritability was similar to the one observed for craving, but the main effect of day on irritability was not significant,  $F(2, 36) = 1.43$ ,  $p = .25$ . The main effect of time was significant,  $F(6, 108) = 2.21$ ,  $p = .048$ , as was the Time  $\times$  Day interaction,  $F(12, 216) = 2.32$ ,  $p = .008$ . As seen in Fig. 2, this interaction is very similar to the one found for craving—irritability on the Sabbath was lower than the two other conditions until 1600 hours, rising at 1900 hours to the same level as the other two conditions. To confirm this pattern, we performed the repeated mea-

**Fig. 2** Irritability levels by condition and time



tures ANOVA on the first five-time points only (2200 hours through 1600 hours), which resulted in a significant main effect of condition,  $F(2, 36) = 4.31, p = .02$ . However, unlike in the case of craving, none of the differences between specific time points were significant.

#### Other withdrawal symptoms

There were no significant differences between conditions on ratings of depression or concentration difficulties. Similarly, there was no effect of condition on self-reported sleep difficulties. There was a significant main effect of time on hunger, but this was clearly related to reductions in hunger after lunch and dinner. Finally, following the two abstinence days, participants were asked how difficult it had been for them to abstain. As predicted, abstinence on a workday was significantly more difficult (mean = 4.9, SD = 1.55) than abstinence on a Sabbath (mean = 3.5, SD = 1.82),  $t(19) = 2.75, p < .001$ .

#### Fagerström scores and craving levels in the morning

Given that participants reported their lowest craving before or at 10:30 a.m., we tested the correlation between the degree of “nicotine dependence” as measured by the FTND and the magnitude of craving in the morning. The correlation was positive on the non-abstinence workday,  $r(18) = .66, p < .001$ , as well as on the abstinence workday,  $r(18) = .51, p = .02$ . The correlation between the FTND and craving on the morning of the Sabbath was not significant,  $r(18) = .21, p = .36$ , probably due to the lack of variation in the latter variable.

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## Discussion

In this study of orthodox Jewish smokers, craving levels on the Sabbath, when abstinence is habitual for these participants, were very low in comparison to a forced abstinence workday as well as to a normal, non-abstinence workday. These differences diminished gradually toward the end of the Sabbath when expectations to smoke presumably began to increase. In addition, as reported also by Jacober et al. (1994), craving levels in the first evening, when smokers were not deprived at all, were consistently higher than in the next morning after a substantial interval of smoking deprivation. These findings suggest that craving levels in this study were affected by habits, cues, and expectations more than by smoking deprivation.

Our findings are consistent with previous evidence that smoking urges are significantly determined by smoking-related habits (e.g., Jacober et al. 1994), cues (Juliano and Brandon 1998; Sayette and Hufford 1994; Sayette et al. 2001, 2003), and expectations (Dols et al. 2000, 2002; Thewissen et al. 2005). For Jewish orthodox smokers, abstinence on the Sabbath is a weekly routine, and therefore habitual. Smoking cues are much less frequent

than on a workday, as these smokers spend most of their time at home and at the synagogue, do not work or drive, and are unlikely to encounter others who smoke. Finally, the Sabbath is a day in which these orthodox Jews do not expect to smoke. All of these factors have probably contributed to the low levels of craving and irritability on the Sabbath.

An unexpected finding in this study was that urges to smoke on a normal workday were not significantly lower than on the forced abstinence workday. There are several possible explanations for this finding. First, the lack of expectancy to smoke during the abstinence day may have offset the craving provoked by smoking deprivation. Second, smoking not only relieves craving but is also a conditioned cue that predicts and triggers craving for more smoking. Finally, the high levels of craving during the non-abstinence day may be partially due to the fact the participants could not smoke freely during the day. Most were students and could not smoke during lectures, which may have created some deprivation and thus increased craving levels, despite the fact that the CO levels indicated heavy smoking during that day.

As mentioned above, craving is a fundamental problem for smokers trying to quit and one of the most important causes of relapse (e.g., West and Schnieder 1987; Russel 1988). Understanding the determinants of craving, and specifically the role of cues and expectations, is of utmost importance not only in relation to smoking but also in relation to other unwanted drug and nondrug habits. Indeed, many models of craving (e.g., Tiffany 1990) are relevant not only to drug urges but also to craving in relation to strong appetitive habits, such as binge eating, or in impulse control disorders, like trichotillomania and pathological gambling. The social-learning model of Marlatt (1985), for example, focuses on “addictive behavior”, and craving is defined as a subjective state motivated by the incentive properties of positive-outcome expectancies. The primary determinant of craving is the anticipation of euphoria, excitation, or stimulation—states which are just as relevant to gambling as they are to drug use. Consistent with this general view, the effects of cues on craving have been demonstrated not only in regard to a variety of substances (e.g., Sherman et al. 1989; Modesto-Lowe et al. 1997) but also in relation to food (e.g., Fedoroff et al. 1997), gambling (e.g., Blanchard et al. 2000), and other impulse-control and obsessive-compulsive spectrum disorders (e.g., Mackenzie et al. 1995; Ristvedt et al. 1993).

In summary, the results of the present study accord with recent research which has underscored the importance of psychological factors such as habits, cues, and expectations in determining craving. However, the present study has several potential limitations. First, because of religious laws, craving and withdrawal were assessed retrospectively rather than in real time. This may have biased the results, though there is no a priori reason to expect that this bias would interact with abstinence condition and thereby invalidate the main conclusion of the study. Moreover, ongoing assessment of craving may be no less problematic, as drawing participant’s attention repeatedly to their urge to

smoke could well affect their experience of craving. Second, there are differences between the Sabbath and a workday, which may compromise the interpretation of our results as reflecting the effects of cues and expectations. For one, the Sabbath is a day of rest and is likely to be less stressful than a workday. As smoking has been associated with stress (see Kassel et al. 2003 for a review), the reduction of craving on the Sabbath may be partially a result of lowered stress. Third, the participants were young and were not very heavy smokers, so these results may not be generalized to older and heavier smokers. Garvey et al. (1992) reported that approximately 13% of smokers attempt to quit on their own relapse in the first day, so not every smoker would be able to comply with the demand of a 24-h abstinence on a weekday. Finally, as the baseline workday condition was always run first, this may compromise its comparability to the other two days. Future studies can improve on the present one by using designs which allow real-time assessment of craving and withdrawal and by attempting to minimize potential confounds.

Potential conflict of interests statement:

Dr. Dar and Dr. Frenk have received fees for consulting to lawyers working with tobacco companies. However, the work associated with this study was supported exclusively by Tel Aviv University funds.

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