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PSYCHOLOGICAL FUNCTIONS SERVED BY NICOTINE CHEWING GUM

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Abstract — All 43 participants in a smoking cessation study completed Russell's (1974) Smoking Motivation Questionnaire (SMQ) before quitting, and an equivalent Nicotine Gum Questionnaire (NGQ) during cessation. The profiles of SMQ and NGQ scores were very similar, showing that nicotine gum served a range of psychological functions similar to that provided by cigarettes: stress modulation, feelings of arousal and pleasure, hand/mouth activity, and nicotine dependency. Gum scores were, however, around 45% of cigarette values, as would be expected from its lower nicotine dose. Failed quitters (less than 2 weeks abstinence, $N = 15$), short-term quitters (3-12 weeks abstinence, $N = 14$), and successful quitters (+13 weeks abstinence; $N = 14$), did not differ on any SMQ subscale. However, they did differ significantly on the NGQ habit subscale. Thus the development of a regular gum-chewing habit during the first week of cessation was associated with eventual success in quitting. Sex differences were also apparent, with females reporting higher sedative, stimulant, and hand/mouth activity gum-questionnaire scores than males. These findings provide evidence for the construct and content validity of the NGQ, but further studies into its criterion validity and test-retest reliability are required.

INTRODUCTION

Nicotine polacrilex gum comprises the most widely used pharmacological aid for smoking cessation (Surgeon General, 1988; Glassman & Covey, 1990). Since its original introduction (Ferno, Lichtneckert, & Lundgren, 1973), many placebo-controlled trials have demonstrated that it improves cessation: "The invention of nicotine gum was a breakthrough in the treatment of cigarette dependence. It doubled success rates from about 15% (validated long-term abstinence) to about 30%" (West, 1992, p. 166). These cessation findings have been summarised in various reviews (Lam et al., 1987; Surgeon General, 1988, p. 473; Glassman & Covey, 1990). However, although many smokers achieve cessation with the aid of nicotine gum, an even larger number return to smoking. Thus, West, Hajek, & Belcher, (1986, p. 189) noted: "Some people find the gum more helpful than others and the question arises as to which smokers benefit most from it". Similarly, Hughes (1986, p. 144) concluded: "One of the major problems with the use of nicotine gum is the lack of empirical data about how best to use it".

The present study was designed to investigate various factors that might influence cessation while using nicotine gum: demographic variables such as age and sex; personality factors including health locus of control, need for achievement, extraversion, and neuroticism; and indices of nicotine use, such as cigarette consumption, years smoked, Fagerstrom Tolerance Questionnaire, and expired-breath CO. These

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findings are being presented elsewhere (Parrott & Craig, in preparation). The current report focuses upon two questionnaires concerned with the social, psychological, and pharmacological functions served by smoking and nicotine. The first questionnaire was the Smoking Motivation Questionnaire (SMQ), with seven subscales: hand-mouth activity, psychological image, indulgent, sedative, stimulant, addictive, and automatic (Russell, Peto, & Patel, 1974; West & Russell, 1985). The second questionnaire was derived from the SMQ; each reference to "cigarette or smoking" was edited to "gum or chewing". The aim of this Nicotine Gum Questionnaire, was to monitor the degree to which the same psychopharmacological functions were being served by the nicotine gum.

M A T E R I A L S A N D M E T H O D S

Subjects: The subjects were 43 adult volunteers, without serious illness, attending three inner-London general practitioner health centres. All cigarette smokers attending these surgeries were asked by their physicians if they would like to stop smoking, while posters advertising the study were displayed in the surgery. Those who wished to attend arranged personal appointments with the researcher. Subject characteristics were as follows: age, 38.8 years; sex, 22 female and 21 male; duration of smoking, 21.8 years; daily consumption, 20.1 cigarettes; previous quit attempts, 4.3.

Drug administration: All subjects received a free supply of 2 mg nicotine gum. The instructions for gum use were those given by the manufacturer. Subjects were advised to use the gum on a regular basis, and to reduce consumption only very gradually. Nonsmoking compliance was monitored at each meeting by an expired-breath CO monitor (Hopkins, Wood, & Sinclair, 1984). No smoking was allowed. Subjects were asked to inform the research officer if they relapsed (Parrott & Craig, in preparation).

Assessment measures: The Smoking Motivation Questionnaire (SMQ; Russell et al., 1974) was administered in its most recent version (West and Russell, 1985). The Nicotine Gum Questionnaire (NGQ) was derived from the SMQ — each reference to "cigarette or smoking" was edited to "gum or chewing". The NGQ generated scores on the same seven subscales as the SMQ: hand-mouth activity, psychological image, indulgent, sedative, stimulant, dependent, and automatic. Three further questions were added to the NGQ, to cover habitual aspects of gum use: "I take the gum according to a regular routine", "I take the gum at certain times of the day", and "I have developed a regular routine for taking the gum". The rationale for this was that while gum users are advised to take it regularly, there is no measure of smoking "regularity" in the SMQ. The new habit subscale therefore monitored whether the gum was being used on a regular basis. In order to maintain equivalence between the SMQ and NGQ, three "smoking habit" questions were added to the SMQ. The NGQ scoring system was identical to that of the SMQ, with each question scored 0–3 and subscale totals between 0–9.

Procedure: Subjects were seen at individual meetings. No advice on how to quit had been given by the physicians, but a standard package of cessation advice was given at the first meeting with the researcher. This included information about cigarette smoking, nicotine gum, and the likely effects of smoking cessation: weight gain, moodiness, cigarette craving, etc. Subjects signed an informed consent form and completed a battery of questionnaires. The initial gum supply was then given. Subsequent meetings were held after 1 week, 2 weeks, 4 weeks, 8 weeks, 12 weeks, 6

months, and 1 year. The SMQ was completed at the initial precessation meeting, while the NGQ was completed at all subsequent meetings (except that held after 2 weeks).

RESULTS

The overall SMQ and NGQ profiles are shown in Figure 1. The gum subscale scores were around 40%–50% of the values generated by the smoking questionnaire (Figure 1); while the overall NGQ mean score (1.9), was 45% of the SMQ value (4.2). Subjects were divided into three groups, depending upon their success at smoking cessation. Those achieving less than 2 weeks of abstinence, were categorised as the "fail" group ($n = 15$, 9 females, 6 males); those achieving 3–12 weeks of abstinence composed the "short-term success" group ($n = 14$, 7 females, 7 males); and those achieving more than 13 weeks composed the "long-term success" group ($n = 14$, 6 females, 8 males). Twelve of this last group remained abstinent for 6 months; thus the confirmed 6-month abstinence rate was 28%. These three cessation-success groups did not differ on any demographic or drug-related variables: age, number of years smoked, daily cigarette consumption, number of previous quit attempts, or expired breath CO (Parrott & Craig, in preparation).

The SMQ scores for males and females from the three cessation-success groups are shown in Table 1. The two-way ANOVA (sex, cessation subgroup) showed that none of the SMQ subscales differed significantly between cessation groups. Females scored significantly higher than males on SMQ hand-mouth activity, $p < 0.05$, while the sex difference for the SMQ sedative subscale was borderline in significance, $p < 0.10$, two-tail (Table 1). Group mean NGQ scores after 1 week of cessation are shown in Table 2. The three cessation success groups differed significantly on one subscale: gum-chewing habit, $p < 0.05$. The first-order polynomial was also significant, $p < 0.02$, with the "fail" group generating the lowest score, and the "long-term

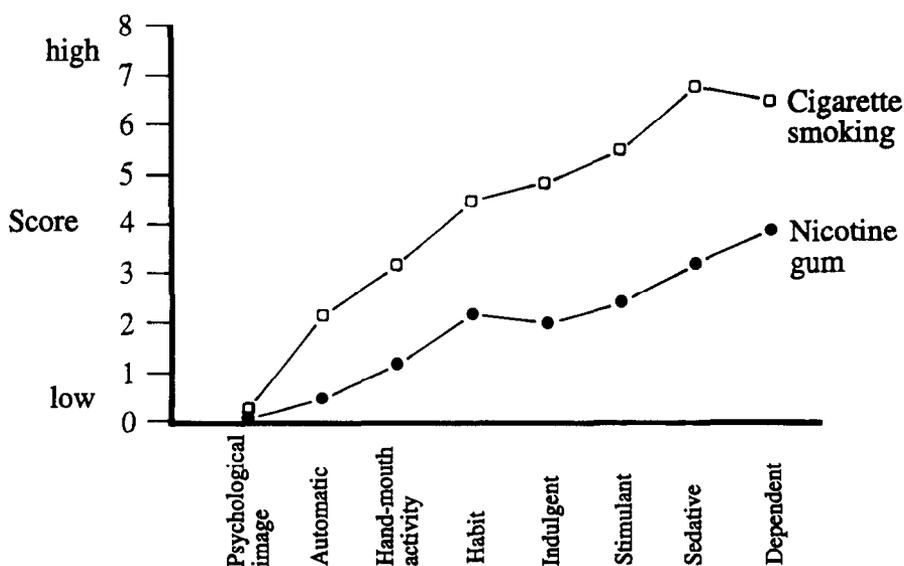


Fig. 1. Smoking Motive Questionnaire (SMQ) and Nicotine Gum Questionnaire (NGQ) subscale profiles.

Table 1. Smoking Motive Questionnaire scores. precessation

	Males			Females			ANOVA		
	Fail	Short-term success	Long-term success	Fail	Short-term success	Long-term success	Sex	Success	Inter-action
Psychological image	0.5	0.1	0.4	0.4	0.3	0.3			
Hand-mouth activity	2.8	2.3	2.5	3.3	3.7	4.7	**		
Indulgent	4.7	5.3	4.4	4.4	6.0	5.0			
Sedative	6.7	5.4	6.9	6.8	7.8	7.7	*		
Stimulant	5.2	5.8	5.2	4.3	6.6	6.7			
Automatic	2.7	1.8	1.4	2.1	2.8	2.8			
Dependent	7.0	7.4	6.1	5.8	6.8	6.7			
Habit	3.7	4.3	5.3	4.8	4.6	4.2			

* $p < 0.10$, two-tailed. ** $p < 0.05$, two-tailed. *** $p < 0.01$, two-tailed.

success'' group generating the highest score (Figure 2; Table 2). Several NGQ subscales demonstrated significant sex differences, with higher female scores for hand-mouth activity, sedation, and stimulation, while the indulgent and dependent NGQ scales were borderline (Table 2). The NGQ scores for the 14 subjects who maintained cessation for 12 weeks and still used the gum are shown in Table 3. Sedative scores were significantly higher at the later sessions, $p < 0.05$, while the NGQ indulgent subscale showed a similar trend (statistically borderline, $p < 0.10$, two-tailed). Daily gum consumption decreased significantly over the same time period, $p < 0.01$ (Table 3).

DISCUSSION

Nicotine gum served a similar range of psychological functions to that provided by cigarettes: stress control, stimulation/alertness, feelings of pleasure, and psychomotor gratification. Dependency was also evident with each nicotine delivery system (Figure 1; Table 1). On both the SMQ and NGQ, the dependent, sedative, and stimulant subscales generated the highest scores; whereas, lower scores were evident on the indulgent, hand-mouth activity, and automatic scales (Tables 1 and 2).

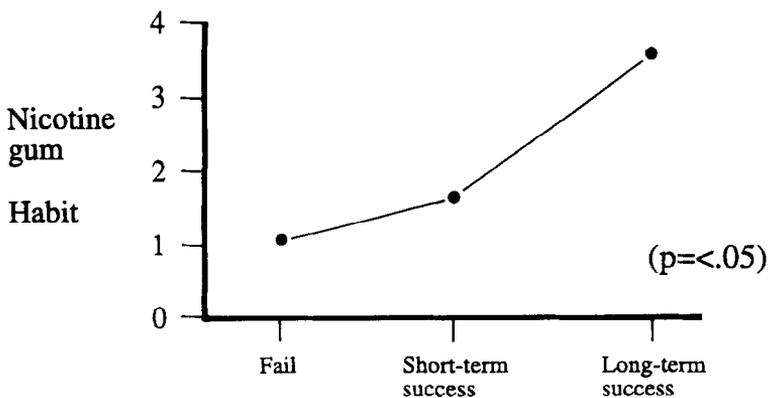


Fig. 2. Nicotine Gum Questionnaire (NGQ) habit scores for the three cessation-success groups.

Table 2. Nicotine Gum Questionnaire scores, after 1 week of cessation

	Males			Females			ANOVA		
	Fail	Short-term success	Long-term success	Fail	Short-term success	Long-term success	Sex	Success	Inter-action
Psychological image	0.0	0.3	0.0	0.0	0.0	0.0			
Hand-mouth activity	0.2	0.6	0.7	2.0	1.7	2.5	***		
Indulgent	0.4	2.7	1.2	2.6	2.0	3.2	*		
Sedative	2.4	1.3	3.0	5.0	4.1	4.0	***		
Stimulant	1.4	2.3	1.4	2.4	3.0	4.7	**		
Automatic	0.2	0.0	0.6	0.2	0.6	1.2			
Dependent	1.4	4.3	4.0	4.6	3.7	5.2	*		
Habit	0.4	2.0	2.7	1.8	1.3	4.5		**	

* $p < 0.10$, two-tailed. ** $p < 0.05$, two-tailed. *** $p < 0.01$, two-tailed.

The subscale profiles were therefore very similar on both questionnaires (Figure 1), although absolute scores for the gum questionnaire were around 40%–50% of SMQ values, consistent with its lower nicotine delivery (Benowitz, Jacob, & Savanapridi, 1987; Surgeon General, 1988, pp. 471–72). These findings are consistent with previous data on the psychopharmacological effects of nicotine gum. Thus Russell (1987) noted that nicotine gum can alleviate many of the psychological changes which occur during smoking cessation: feelings of irritability and tension, reduced arousal, and impaired concentration. The high NGQ sedative score (Figure 1), also supports West's (1992) suggestion that nicotine gum facilitates quitting by aiding with mood control. However, the present data extended the list of functions subserved by nicotine gum. For instance, Russell (1988, p. 68) suggested a low rate of gum dependence: "Some 7% of recruits to treatment trials transfer their nicotine dependence from cigarettes to the gum". The high NGQ dependency score here (Figure 1) demonstrated that transference is not restricted to those who find eventual gum-quitting difficult. Instead, all smokers were able to transfer some of their nicotine dependence to the gum. Indeed, the rationale for nicotine substitution is based upon the transference of nicotine dependence (Ferno et al., 1973). Russell (1988, p. 69) also suggested that the gum "Fails to provide the positive pleasure or satisfaction obtained from smoking"; a conclusion partially contraindicated by the indulgent scale findings (Figure 1). The psychomotor functions provided by chewing gum

Table 3. Nicotine Gum Questionnaire scores over time, for 14 subjects maintaining abstinence and still using gum at week 12

	Week 1	Week 4	Week 8	Week 12	ANOVA
Psychological image	0.1	0.1	0.0	0.0	
Hand-mouth activity	1.4	1.8	1.7	1.2	
Indulgent	2.1	2.6	2.6	3.1	*
Sedative	3.3	4.8	5.3	4.8	**
Stimulant	3.2	4.1	3.8	3.8	
Automatic	0.9	1.1	1.3	0.6	
Dependent	4.8	5.0	4.6	4.0	
Habit	3.7	3.3	3.6	3.1	
Gum consumption (self-reported pieces/day)	8.8	7.6	7.8	5.3	***

* $p < 0.10$, two-tailed. ** $p < 0.05$, two-tailed. *** $p < 0.01$, two-tailed.

(hand-mouth activity), have also not featured in discussions of its psychological uses.

None of the SMQ factors differentiated the three quitting-success groups (Table 1). This cannot be attributed to low statistical power, since significant differences were evident elsewhere (see below). The SMQ profiles of successful/unsuccessful gum users have not been previously reported, although West et al. (1986) did administer the SMQ to 77 clients who had achieved two weeks of cessation with 2 mg nicotine gum. The "urge to smoke" correlated significantly with the indulgent, stimulant, automatic, and dependent SMQ subscales, while "difficulty not smoking" showed the same broad pattern of SMQ correlations. Those smokers who experienced the strongest psychological motives for smoking, also reported the greatest difficulty in going without cigarettes. However, the "relief of craving by nicotine gum" also correlated positively with the dependent and stimulant SMQ subscales. Therefore, while dependent smokers suffered most without their cigarettes, they also benefited most from the gum. This may explain why there was no difference in SMQ dependency between the three success groups here (Table 1). There may be a balance between the loss of nicotine from cigarettes and the gain of nicotine from the gum, with the most dependent smokers gaining the most from *both* nicotine delivery systems (note: highly dependent smokers have also been shown to benefit more from the 4 mg gum; Tønnesen, Frid, & Hansen, 1988). The only NGQ measure to differentiate the three cessation success groups was the habit subscale. The "fail" group reported the lowest gum-chewing habit scores at Week 1, whereas the "long-term success" group reported the highest habit scores (Figure 2; Table 2). Thus the early development of a regular gum-use habit constituted a predictive index for long-term abstinence. Killen, Fortmann, and Newman, (1990) noted similar findings in a comparison of four treatment groups: 2 mg nicotine gum on a fixed-regimen schedule, 2 mg nicotine gum on an ad-lib schedule, placebo gum, and no gum. While cessation rates were significantly higher in both nicotine-gum groups, the fixed-regimen nicotine-gum group was more successful than the ad-lib nicotine-gum group. Smokers planning to quit should therefore be counselled to develop a regular gum-chewing routine from the outset.

The psychological functions subserved by nicotine gum were largely established by the end of the first week. Most NGQ subscales then showed little variation over the following 12 weeks of gum use (Table 3). However, the sedative and indulgent NGQ scores did increase over time, showing that the skill of using the gum for mood control developed gradually (Table 3). Sex differences were apparent on both questionnaires, with females reporting higher scores on several subscales (Tables 1, 2). Females have been reported to smoke more for mood control than males (Frith, 1971; Russell et al., 1974), agreeing with their significantly higher sedative subscale scores on both questionnaires here. Similarly, Frith (1971) noted that females used the sensorimotor ritual of cigarettes more than males, agreeing with the hand-mouth activity findings here (Tables 1, 2). There were more significant sex differences on the NGQ than on the SMQ (Tables 1, 2), which may reflect pharmacokinetic factors. Females have a lighter average body weight than males and can therefore achieve similar levels of plasma nicotine while smoking fewer cigarettes (Creighton & Lewis, 1978; Mangan & Golding, 1984). When males and females use similar amounts of gum, females may attain a higher plasma nicotine concentration and experience stronger psychological effects (Table 2).

The core form of validity required by any questionnaire is construct validity, an

index of its theoretical coherence and integrity (Cronbach, 1987). The Nicotine Gum Questionnaire findings fit meaningfully with the literature on the psychological/physiological effects of nicotine (summarised in the earlier paragraphs), thus providing evidence for its construct validity (Cronbach, 1987; Parrott, 1991c). Content validity is a reflection of whether the questionnaire covers all relevant aspects of the domain of interest. The NGQ was directly based upon the SMQ, a questionnaire designed with high content validity (see Russell et al., 1974, for its theoretical origins and development). Moreover, habit, the one aspect of nicotine-gum use not covered by the SMQ, was shown to be empirically useful as an additional subscale (Figure 2). Overall therefore, the content validity of the NGQ was also shown to be high. The third aspect of validity that needs to be assessed is criterion validity (Cronbach, 1987; Parrott, 1991b). This was investigated by comparing NGQ scores across quitting-success groups, but the predicted subscale differences were not generally found (Table 2; although see Figure 2). The SMQ also failed to differentiate between subgroups (Table 1), and these negative findings may reflect the difficulty of demonstrating *any* psychological/physiological factor that consistently predicts quitting-success, in heavy smokers (Parrott & Craig, unpublished). The present sample of dependent smokers may therefore have been too homogeneous, and future studies should compare more clearly differentiated criterion groups, such as heavy-dependent smokers with light-social smokers. SMQ and NGQ scores would then be expected to differ between such groups. With reference to reliability, group mean scores were generally stable over successive weeks (Table 3), thus indicating broad response consistency. However the present study was not designed to assess reliability formally. The NGQ, therefore, needs to be used in a large-scale cessation trial, with the questionnaire administered on two occasions a few days apart; this would enable test-retest reliability to be calculated (Parrott, 1991a). It should also be noted that although the SMQ has been widely used, formal reliability data for the SMQ is also required. Lastly, the other psychometric index of reliability (split-half) is not appropriate here, since each subscale has only three questions. Overall therefore, while the present findings provide evidence for the construct and content validity of the NGQ, further data on its criterion validity and reliability are required.

The current findings have a number of practical implications. Those using nicotine gum should be advised to use it for clear psychological reasons: mood control when feeling stressed, alertness when feeling bored, and pleasure when seeking relaxation. They may also be advised to practice these skills over time (Table 3). Furthermore, they should also be advised to take the gum on a regular basis. Finally, it should be noted that the apparent psychological gains of smoking/nicotine gum, probably represent the reversal of deprivation effects. Nicotine deprivation leads to psychological impairments (reduced feelings of alertness and increased feelings of stress), and smoking often restores normal functioning by reversing these deprivation effects (West, 1992, 1993; Parrott, 1994a,b). The current findings therefore do not indicate that nicotine gum generates real psychological gains. Instead, using gum enables the former smoker to modulate the deleterious consequences of nicotine withdrawal.

REFERENCES

- Benowitz, N. L., Jacob, P., & Savanapridi, C. (1987). Determinants of nicotine intake while chewing nicotine polacrilex gum. *Clinical Pharmacology and Therapeutics*, **41**, 467-473.
- Creighton, D. E. & Lewis, P. H. (1978). The effect of different cigarettes on human smoking patterns. In R. E. Thornton (Ed.), *Smoking behaviour: Physiological and psychological influences*. Edinburgh: Churchill-Livingstone.

- Cronbach, L. J. (1987). Five perspectives on validity argument. In H. Wainer, & H. I. Braun (Eds.), *Test validity*. New Jersey: Erlbaum.
- Ferno, O., Lichtneckert, S., & Lundgren, C. (1973). A substitute for tobacco smoking. *Psychopharmacologia*, **31**, 201–204.
- Frith, C. D. (1971). Smoking behaviour and its relation to the smoker's immediate experience. *British Journal of Social and Clinical Psychology*, **10**, 73–78.
- Glassman, A. H. & Covey, L. S. (1990). Future trends in the pharmacological treatment of tobacco dependence. *Drugs*, **40**, 1–5.
- Hopkins, R., Wood, L. E., & Sinclair, N. M. (1984). Evaluation of methods to estimate cigarette smoke uptake. *Clinical Pharmacology and Therapeutics*, **36**, 788–795.
- Hughes, J. R. (1986). Problems of nicotine gum. In *The pharmacologic treatment of tobacco dependence*. J. K. Okene (Ed.), Institute for the Study of Smoking Behavior and Policy, Cambridge, MA.
- Killen, J. D., Fortmann, S. P., & Newman, B. (1990). Evaluation of a treatment approach combining nicotine gum with self-guided behavioral treatments for smoking relapse prevention. *Journal of Consulting and Clinical Psychology*, **58**, 85–92.
- Lam, W., Sacks, H. S., Sze, P. C., & Chalmers, T. C. (1987). Meta-analysis of randomised controlled trials of nicotine chewing gum. *Lancet* *ii*, 27–30.
- Mangan, G. L. & Golding, J. F. (1984). *The psychopharmacology of smoking*. Cambridge, UK: Cambridge University Press.
- Parrott, A. C. (1991a). Performance tests in human psychopharmacology (1): Test reliability and standardisation. *Human Psychopharmacology*, **6**, 1–9.
- Parrott, A. C. (1991b). Performance tests in human psychopharmacology (2): II. Content validity, criterion validity, and face validity. *Human Psychopharmacology*, **6**, 91–98.
- Parrott, A. C. (1991c). Performance tests in human psychopharmacology (3): Construct validity and test interpretation. *Human Psychopharmacology*, **6**, 197–207.
- Parrott, A. C. (1994a). Individual differences in stress and arousal during cigarette smoking. *Psychopharmacology*, **115**, 389–396.
- Parrott, A. C. (1994b). Does cigarette smoking cause stress? *Addiction*, **89**, 142–144.
- Parrott, A. C. & Craig, D. (in preparation). Factors affecting the successful use of nicotine polacrilex gum in smoking cessation.
- Russell, M. A. H. (1988). Nicotine replacement: The role of blood nicotine levels, their rate of change, and nicotine tolerance. In Pomerleau, O. F. & C. S. Pomerleau (Eds.), *Nicotine replacement: A critical evaluation* (pp. 63–94). New York: Alan Liss.
- Russell, M. A. H., Peto, J., & Patel, V. A. (1974). The classification of smoking by a factorial structure of motives. *Journal of the Royal Statistical Society*, **137**, 313–346.
- Surgeon General (1988). *Nicotine addiction: The health consequences of smoking*. Washington DC: US Government Printing Office.
- Tønnesen, P., Fryd, V., Hansen, M. (1988). Two and four mg. nicotine chewing gum and group counseling in smoking cessation. *Addictive Behaviors*, **13**, 17–27.
- West, R. J. (1992). The nicotine replacement paradox in smoking cessation: How does nicotine gum really work? *British Journal of Addiction*, **87**, 165–167.
- West, R. J. (1993). Beneficial effects of nicotine: fact or fiction? *Addiction*, **88**, 589–590.
- West, R. J., Hajek, P., & Belcher, M. (1986). Which smokers report most relief from craving when using nicotine gum? *Psychopharmacology*, **89**, 189–191.
- West, R. J. & Russell, M. A. H. (1985). Pre-abstinence smoke intake and smoking motivation as predictors of severity of smoking withdrawal symptoms. *Psychopharmacology*, **87**, 334–336.