Nicotine & Tobacco Research Volume 9, Number 3 (March 2007) 405–413

Personality and smoking status: A meta-analysis

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Received 18 August 2005; accepted 26 February 2006

We used meta-analytic techniques in an attempt to clarify the strength and direction of the association between smoking status and personality, which narrative reviews have indicated remains a largely inconsistent literature. Included were cross-sectional studies that reported personality data for healthy, adult smokers and nonsmokers using measures of personality traits derived from Eysenck's tripartite taxonomy of human personality. Of the 25 studies that contributed to the meta-analysis, 22 reported data on smoking status and extraversion and 22 reported data on smoking status and neuroticism. Meta-analysis using a fixed-effects framework indicated a significant difference between smokers and nonsmokers on both extraversion ($p<.001$) and neuroticism ($p<.001$) traits, which remained significant when a random-effects framework was used to accommodate significant between-study heterogeneity. These data from cross-sectional observational studies published between 1972 and 2001 indicate that both increased extraversion and increased neuroticism are associated with an increased likelihood of being a smoker rather than a nonsmoker, although in both cases the effect sizes indicated by the meta-analysis were small. We found no evidence that the strength of these associations varied with year of publication.

Introduction

Smoking is the major preventable cause of disease, but despite the well-known associated health risks, worldwide smoking prevalence is still increasing. If current trends continue, tobacco use will most likely become the world's leading cause of premature death in less than 30 years (Peto, Chen, & Boreham, 1999). As well as discouraging people from taking up the habit, efforts to reverse these trends must stem from improving cessation rates. However, the reinforcing and rewarding effects of nicotine present a major obstacle to effective smoking cessation (Hughes, 2001). The limited efficacy of current behavioral and pharmacological treatments for smoking cessation (Sutherland, 2002) results partly from an incomplete understanding of the biological and behavioral mechanisms of smoking initiation and persistence. Interest in individual differences in smoking behavior and response to treatment is growing (Munafò, Bradburn, Bowes, & David, 2004).

Most trait psychologists argue that a small number of factors can be used to account for individual differences in human personality, although disagreement remains over whether a trait approach can be used to adequately conceptualize personality (Cervone, Shadel, & Jencius, 2001). Nevertheless, factor analytic studies of various populations have demonstrated considerable agreement regarding major trait dimensions, typically describing five major dimensions of variation in cognitive, behavioral, and affective responding (e.g., McCrae & Costa, 1997). Causal theorists of personality have attempted to go further and associate known neurobiological mechanisms with personality dimensions, typically describing mechanisms underlying three major dimensions (e.g., Cloninger, 1987; Eysenck & Eysenck, 1991; Gray, 1970). Three fundamental behavioral dimensions have been variously proposed to correspond to differential activity in neurotransmitter systems (Ebstein, Benjamin, & Belmaker, 2000; Lesch, 1998; Mealey, 1995): Dopamine for approach behaviors; serotonin and noradrenaline for avoidance behaviors; and serotonin, noradrenaline, and GABA for aggressive or fight–flight behaviors. Both descriptive (i.e., factor analytic) and causal (i.e., neurobiological)

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ISSN 1462-2203 print/ISSN 1469-994X online

DOI: 10.1080/14622200701188851

approaches have demonstrated strong agreement that the dimensions of extraversion-introversion and neuroticism-stability are fundamental parts of any personality taxonomy, and have resulted in a substantial body of evidence relating candidate genes to a number of personality dimensions, measured using a range of instruments (Munafò et al., 2003). Therefore, even though considerable disagreement remains over what mechanisms underlie observed variation along trait dimensions, some consensus exists regarding the construct validity of the first two of these dimensions; these dimensions appear under various guises in all commonly used measurement instruments (Revelle, 1995). Considerable debate remains over the other dimensions.

Certain personality dimensions drawn from personality trait theory have been associated with aspects of addictive behaviors in general and with cigarette smoking behaviors specifically (Munafò, Johnstone, Murphy, & Walton, 2001), and theories of the role of underlying trait factors specific to drug use also have been developed (e.g., Gilbert, 1997). The most widely and consistently reported associations between smoking behavior and personality relate to approach-related traits (variously described also as extraversion, novelty seeking, impulsivity, and the like) and avoidance-related traits (variously described also as neuroticism, harm avoidance, etc.). Individual differences in these traits may therefore represent important risk factors for smoking initiation and subsequent persistence. Such risk factors, which may not be unique to nicotine addiction, may interact with individual differences unique to nicotine addiction, such as individual differences in nicotine metabolism that may enhance or diminish the reinforcing properties of nicotine.

Approach-related traits comprise facets of sociability, sensation seeking, and impulsivity. Individuals who score highly on measures of approach-related traits might be more likely to smoke because the reinforcing properties of nicotine exert a proportionately greater effect than the aversive properties (Glautier, 2004). That is, the association between these traits and smoking behavior may be mediated primarily by biological mechanisms associated with dopaminergic neurotransmission. Alternatively, the effect might be mediated by increased sociability of those who score highly on these traits. That is, the association between these traits and smoking behavior may be mediated primarily by behavioral mechanisms related to the facets of sensation seeking and sociability associated with these traits. Both hypotheses would predict a positive association between high extraversion and smoking behavior, and evidence supports this relationship (e.g., Reuter, Netter, Toll, & Hennig, 2002).

The evidence for a positive relationship between avoidance-related traits and smoking behavior is more equivocal, but some evidence indicates that smokers who smoke to control negative affect report higher levels of neuroticism (e.g., Lerman et al., 1998). Avoidance-related traits such as neuroticism comprise facets of anxiety, negative affect (i.e., depression), and anger. One possibility is that individuals who score highly on measures of avoidance-related traits smoke to self-medicate high basal levels of anxiety, negative affect, or anger with nicotine (Eysenck, Grossarth-Maticek, & Everitt, 1991), and evidence indicates that smoking cessation is a risk factor for relapse to depression (Covey, Glassman, & Stetner, 1998). Individual differences in serotonergic neurotransmission associated with avoidance-related traits (Munafò et al., 2003) may account for this propensity among certain individuals to self-medicate with nicotine.

A further possibility is that relevant personality traits and smoking behaviors share a common genetic basis, for which some evidence is found in data from twin studies (Heath & Madden, 1995). This possibility is supported by evidence that both Eysenck's personality dimensions and smoking behavior are highly heritable, with heritability coefficients of .50 or greater typically reported (Floderus-Myrhed, Pedersen, & Rasmuson, 1980; Li, Cheng, Ma, & Swan, 2003).

Despite an extensive literature on the association between personality and smoking behavior, however, narrative reviews (e.g., Gilbert, 1995) indicate that this literature is largely inconsistent with respect to the strength and direction of any relationship. Moreover, the prevalence of smoking among the general population in developed countries has declined from a peak of over 50% in the 1950s to a current level of approximately 25% (Mendez & Warner, 2004), although considerable variation remains across countries (Kubik & Plesko, 1998). As smokers have, by definition, become less representative of the general population as smoking prevalence has declined, the association between personality traits and smoking behavior may have changed. For example, if smoking behavior is regarded in part as a function of rebellious or sensation-seeking behavior that is better represented at the extremes of certain personality dimensions, smokers may now be more extreme on this dimension than they were in the past. Alternatively, if personality traits are associated with smoking cessation, then as smokers have made the transition to becoming ex-smokers, the personality trait characteristics of the group of remaining smokers will change.

We therefore sought to expand on previous narrative attempts to review the literature on the association between smoking status and personality (Gilbert, 1995), using more rigorous quantitative methods and

incorporating recent studies. The primary purpose of the present study was to attempt to clarify the strength and direction of the association between smoking status and personality using a meta-analytic study design. The secondary purpose was to investigate whether any relationship between smoking status and personality has changed as smoking prevalence has declined in the general population over time. Specifically, we hypothesized that the difference between smokers and nonsmokers on measures of extraversion and neuroticism would increase over time as smokers have come to be increasingly unrepresentative of the general population.

We restricted our analyses to personality data on two widely agreed personality dimensions (i.e., approach-related and avoidance-related traits), collected using instruments derived from Eysenck's personality taxonomy, including the Maudsley Personality Inventory (MPI; Eysenck, 1959), the Eysenck Personality Inventory (EPI; Eysenck & Eysenck, 1964), the Eysenck Personality Questionnaire (EPQ; Eysenck & Eysenck, 1975), and the Eysenck Personality Questionnaire–Revised (EPQ-R; Eysenck & Eysenck, 1991). This approach was used explicitly to retain comparability with ongoing studies (Munafò & Black, 2007).

Method

Study selection

Included were cross-sectional studies that reported personality data for healthy, adult (aged 16 or over) smokers and nonsmokers using validated, standardized, self-report questionnaire measures of personality traits derived from Eysenck's tripartite taxonomy of human personality. Studies reporting data on male and female participants of any ethnic origin, and studies that reported data on subtypes of smokers (e.g., ''dependent'' and ''nondependent'') and nonsmokers (e.g., ''never-smoker'' and ''ex-smoker'') were retained. Data from psychiatric populations were excluded.

The principal outcome measure was the mean score on each subscale of a given personality questionnaire, grouped by smoking status (smokers, nonsmokers). Only data pertaining to extraversion and neuroticism as measured by instruments derived from Eysenck's tripartite taxonomy (MPI, EPI, EPQ, EPQ-R) were included in the subsequent meta-analysis.

Search strategy

The literature search was performed on three databases: Embase, MEDLINE, and PsycInfo. These databases were searched up to the end of June 2004. Bibliographies also were hand-searched for additional references. Search strategies were tailored to the individual databases using keywords such as *personality, extraversion, neuroticism, tobacco, cigarette, nicotine*, and *smoking*. Abstracts of studies identified by the search strategies were then examined by two authors (JZ and MM) with reference to the inclusion and exclusion criteria. Discrepancies were resolved by mutual consent.

Data extraction

Data were extracted from papers by two authors (JZ and MM) using a standardized data extraction form. Discrepancies were resolved by mutual consent. Reasons for the subsequent exclusion of studies that had been identified as relevant during the initial abstract searches were noted.

For each study the following data were extracted: Author(s) and year of publication; methods: Country of origin, whether the study was cross-sectional or prospective, dominant ethnicity of sample, method of recruitment, participants, and personality measure used; data: personality scale and subscale (mean, standard deviation, and number of participants) grouped by smoking status; and additional notes.

When a paper reported data from multiple groups, data were combined by one author (MM) to provide summary data for smokers and nonsmokers. For example ''dependent'' and ''nondependent'' smokers would be combined as ''smokers.'' This approach resulted in two comparison groups: Smokers and nonsmokers.

Data analyses

Funnel plots of effect-size estimates against individual study accuracy ($1/SE$) and normal-quantile plots were used to assess ascertainment (i.e., publication) bias, with the Kolmogorov goodness-of-fit test used in the latter case to assess normality (Munafò, Clark, & Flint, 2004). Ascertainment bias would be evidenced by asymmetry in the funnel plot or by nonlinearity in the normal-quantile plot.

For each study, the standardized mean differences (and standard deviations) between smokers and nonsmokers were calculated using Cohen's d method (Egger, Davey-Smith, & Altman, 2001). Overall differences were obtained by pooling the individual study differences within inverse variance fixed-effects and, when appropriate, Der-Simonian and Laird random-effects frameworks (Egger et al., 2001). A fixed-effects framework considers the variability between study results as exclusively related to random variation, and individual studies are simply weighted by their precision. The validity of this assumption was assessed using a chi-square test, under the null hypothesis of effect homogeneity, and

Table 1. Characteristics of studies included in meta-analysis.

Study	Country	Participants	Measure	Subscales
Arai et al. (1997)	Japan	6,377 current smokers	EPQ-R	E
		14,161 non-smokers		N
Augustine & Mrinal (1996)	India	30 current smokers	EPI	E
		30 non-smokers		N
Bass (1988)	U.K.	107 current smokers	EPQ	E
		102 non-smokers		N
Brackenridge & Bloch (1972)	Australia	27 current smokers	EPI	E
		51 non-smokers		N
Breslau et al. (1993)	U.S.	292 current smokers	EPQ-R	N
		715 non-smokers		
Breslau et al. (1994)	U.S.	394 current smokers	EPQ	E
		619 non-smokers		N
Canals et al. (1997)	Spain	126 current smokers	EPQ	E
		164 non-smokers		N
Cherry & Kiernan (1976)	U.K.	1,151 current smokers	MPI	E
		1,602 non-smokers		N
Degenhardt & Hall (2001)	Australia	2,767 current smokers	EPQ	N
		7,874 non-smokers		
Forgays, Bonaiuto et al. (1993)	U.S., Italy, Poland	131 current smokers	EPI	E
		465 non-smokers		N
Forgays, Forgays et al. (1993)	U.K., India	36 current smokers	EPQ	E
		103 non-smokers		N
Golding et al. (1983)	U.K.	56 current smokers	EPQ	E
		122 non-smokers		N
Gupta et al. (1976)	India	100 current smokers	EPI	E
		448 non-smokers		N
Jorm et al. (1999)	Australia	549 current smokers	EPQ-R	E
		2,171 non-smokers		N
Kassel et al. (1994)	U.S.	137 current smokers	EPI	E
		70 non-smokers		
Kreitler et al. (1993)	Israel	48 current smokers	EPQ	N
		48 non-smokers		
McCrae et al. (1978)	U.S.	629 current smokers	EPI	E
		1,705 non-smokers		N
Parkes (1984)	U.K.	92 current smokers	EPQ	E
		178 non-smokers		N
Rae (1975)	U.K.	63 current smokers	EPI	E
		137 non-smokers		N
Rustin et al. (1978)	Belgium	4,801 current smokers	EPI	E
		1,773 non-smokers		N
Spielberger & Jacobs (1982)	U.S.	240 current smokers	EPQ	E
		622 non-smokers		N
Spielberger et al. (1995)	U.S.	267 current smokers	EPQ	E
		209 non-smokers		N
Surawy & Cox (1987)	U.K.	24 current smokers	EPQ	E
		12 non-smokers		N
von Knorring & Oreland (1985)	Sweden	601 current smokers	EPI	E
		481 non-smokers		
Wijatkowski et al. (1990)	Poland	96 current smokers	MPI	E
		876 non-smokers		N

Note. E, extroversion; N, neuroticism; EPI, Eysenck Personality Inventory; EPQ, Eysenck Personality Questionnaire; EPQ-R, Eysenck Personality Questionnaire–Revised; MPI, Maudsley Personality Inventory; U.K., United Kingdom; U.S., United States.

in cases of assumption violation ($p<.05$), a random-effects framework was adopted (Egger et al., 2001). A random-effects framework assumes a different underlying effect for each study and takes this into account as an additional source of variation. In this setting, effects are assumed to be randomly distributed and the central point of this distribution is the focus of the combined effects estimate. In general, the random-effects model leads to relatively more weight being given to smaller studies, and to wider confidence intervals.

Time trends, using year of publication, in the standardized differences were assessed graphically with time-series plots, and generalized additive models were used to assess whether the slope deviated from zero and, if so, whether evidence of nonlinearity was present.

Data were analyzed using the S-Plus (version 6.1) statistical software package. An alpha value of .05 was retained for all analyses.

Results

Characteristics of included studies

Over 100 studies were identified by the search strategy, of which 25 studies conducted between 1972 and 2001 met the inclusion criteria and

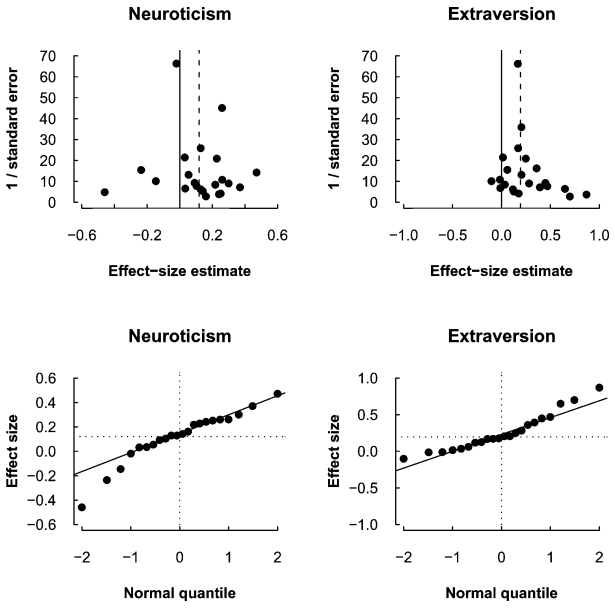

Figure 1. Funnel and normal-quantile plots for ascertainment bias.

contributed to the review. Study characteristics are described in Table 1.

Of the 25 studies that contributed to the meta-analysis, 22 reported data on smoking status and extraversion and 22 reported data on smoking status and neuroticism.

Publication bias

A visual inspection of funnel plots, and a visual inspection and Kolmogorov goodness-of-fit tests of normal-quantile plots, did not indicate any evidence of ascertainment bias. These plots are presented in Figure 1.

Meta-analysis

Meta-analysis using a fixed-effects framework indicated a significant difference between smokers and nonsmokers on both extraversion (d=.17, 95% CI=0.15–0.20, Z=16.34, p<.001) and neuroticism (d=.08, 95% CI=0.06–0.10, Z=8.13, p<.001) traits.

In both cases, however, evidence indicated significant between-study heterogeneity: $\chi^2(21)=75.81$, p=.009, and $\chi^2(21)=203.17$, p=.027, respectively. Analyses were therefore performed again using a random-effects framework. This approach indicated a significant difference between smokers and nonsmokers on both extraversion (d=.19, 95% CI=0.14–0.25, Z=6.79, p<.001) and neuroticism (d=0.12, 95% CI=0.04–0.20, Z=2.81, p=.005) traits. These results are presented in Figure 2.

No severe outliers were present. Of the 22 studies included in the extraversion analysis, only 3 had negative Cohen's d coefficients. Removing the study with the largest coefficient (Augustine & Mrinal, 1996) did not substantively alter the results within a random-effects framework (d=.19, 95% CI=0.13–0.24). Of the 22 studies included in the neuroticism analysis, only 4 had negative Cohen's d coefficients. Removing the study with the largest coefficient (Breslau, Kilbey, & Andreski, 1993) did not substantively alter the results within a random-effects framework (d=.10, 95% CI=0.02–0.18).

For the association between date of publication and standardized mean difference in extraversion between smokers and nonsmokers, we found no evidence of nonlinearity (p>.2) and no evidence to reject the null hypothesis that the slope deviated from zero (p>.5). A similar analysis for neuroticism indicated no evidence of nonlinearity (p>.4) and no evidence to reject the null hypothesis that the slope deviated from zero (p>.8). These results did not change substantively when the analysis was adjusted for study country and personality measure. These results are presented in Figure 3.

Discussion

These data from cross-sectional observational studies published between 1972 and 2001 indicate that both increased extraversion and increased neuroticism are associated with an increased likelihood of being a smoker rather than a nonsmoker, although in both cases the effect sizes indicated by the meta-analysis were small. We did not find any evidence that date of publication was associated with the standardized mean difference in either extraversion or neuroticism between smokers and nonsmokers. We were unable to reject the null hypothesis that the association between both extraversion and neuroticism (as measured by instruments developed from Eysenck's taxonomy) and smoking behavior has not changed between 1972 and 2001. To the best of our knowledge, this is the first attempt to use meta-analytic techniques to quantitatively combine what narrative reviews have suggested is a largely inconsistent literature. Although our analysis was restricted to a related family of instruments, the extraversion and neuroticism subscales we investigated share substantial common variance with the corresponding subscales of the NEO-PI (Costa & McCrae, 1992; Draycott & Kline, 1995).

The finding that smokers demonstrate elevated levels of extraversion compared with nonsmokers is consistent with both the possibility that increased sociability is associated with increased likelihood of smoking and the possibility that increased dopaminergic activity, which is hypothesized to constitute the neurobiological substrate of extraversion, is associated with increased likelihood of smoking. Either or both of these mechanisms may account

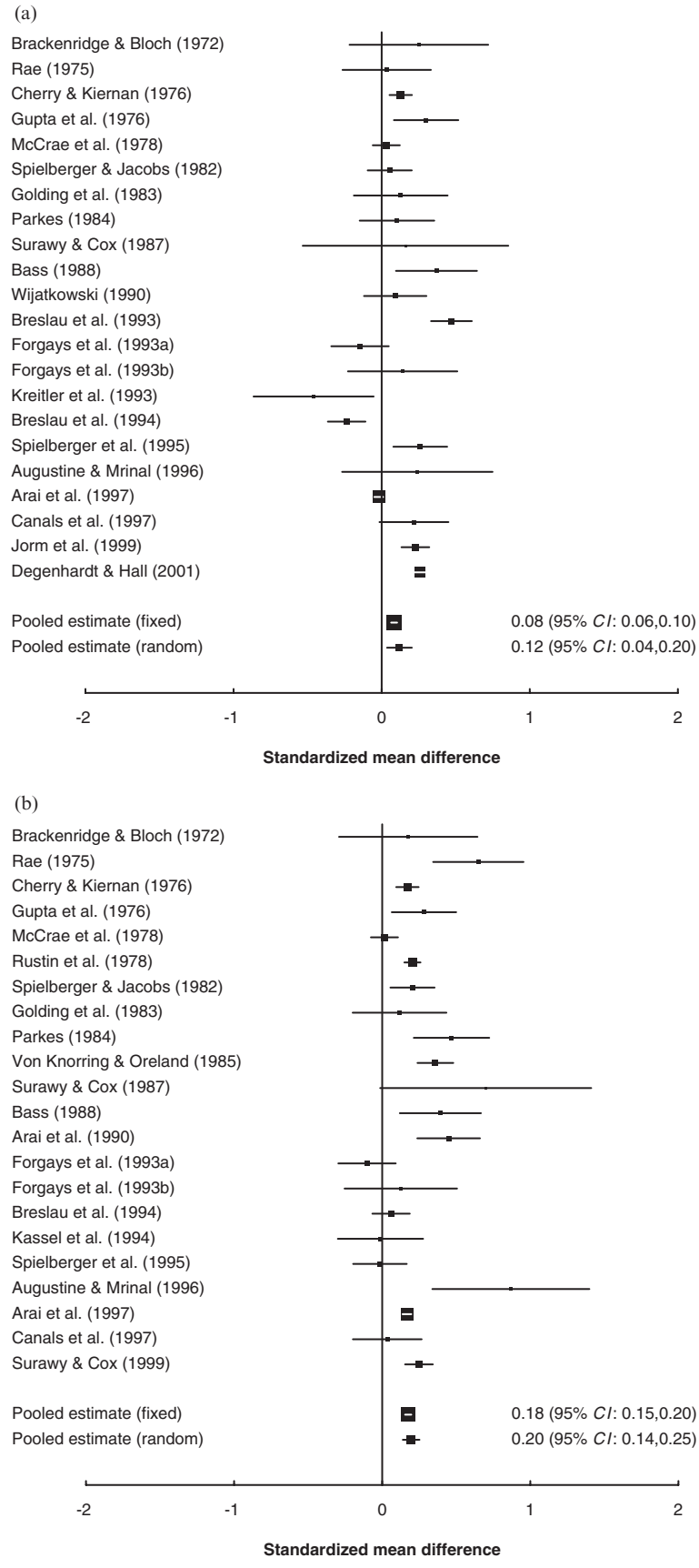

Figure 2. Meta-analysis of association of extraversion and neuroticism with smoking status.

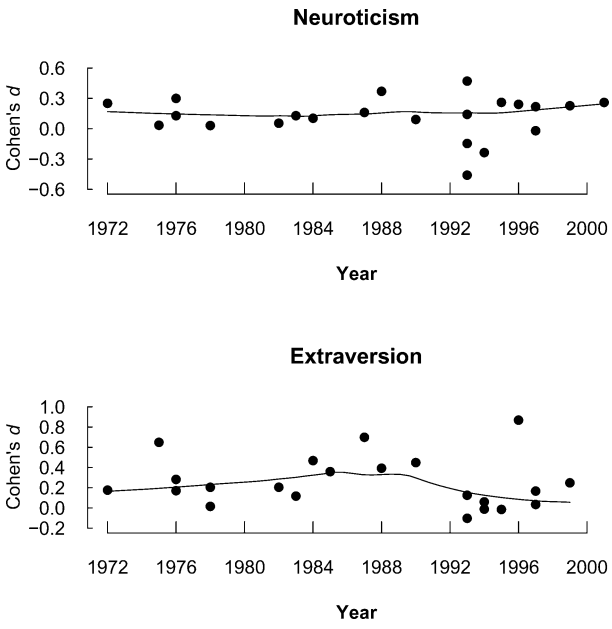

Figure 3. Association of extraversion and neuroticism with smoking status by publication date.

for the observed association, although the effect sizes we observed suggest that these effects are small. However, the lack of association between date of publication and the magnitude of the difference in extraversion between smokers and nonsmokers suggests that changing social pressures have not resulted in smokers becoming more extreme on this personality dimension as they have become less representative of the general population.

The finding that smokers demonstrate elevated levels of neuroticism compared with nonsmokers is consistent with both the possibility that increased neuroticism is associated with self-medication of negative affect with nicotine and the possibility that decreased serotonergic activity, which is hypothesized to constitute the neurobiological substrate of neuroticism, is associated with increased likelihood of smoking. Either or both of these mechanisms may account for the observed association, and the latter may mediate the former. As in the case of extraversion, our data suggest that changing social pressures have not resulted in smokers becoming more extreme on this personality dimension as they have become less representative of the general population.

Several limitations to this study should be noted. First, because of variation in the categorization of smoking status used across the studies included in the meta-analysis, we had to combine groups along relatively crude lines and categorize groups as either smoker or nonsmoker. This approach necessarily leads to a loss of information and removes the possibility of studying differences between, say, dependent and nondependent smokers. Second, and a related point, the crude definition of smoking status, allied to the cross-sectional nature of the data, precludes the possibility of examining important transitions within smokers, such as that from current smoker to ex-smoker (i.e., smoking cessation). Third, our data were drawn from different study samples assessed at different points in time, rather than from a single cohort followed over time. This approach is likely to have introduced error variance that may have obscured any change over time of the association between personality traits and smoking behavior. Supporting this possibility is the evidence we found for significant between-study heterogeneity, which did not appear to be accounted for by either measurement instrument or country of study. More important, the nature of these data precludes any strong conclusions regarding causation. Fourth, although we included personality measures derived from a single taxonomy, these measures were published at different points in time, which confounds personality measures and time in our data. Fifth, date of publication is a weak proxy for the change in social pressures over the time period reported. Nevertheless, in the context of a meta-analytic study, it is the only measure available that allows for the analysis of the kind reported here, and it is unlikely that an error of greater than 2 years or so would be included in the measure of publication date. Moreover, because the error will necessarily be in a consistent direction (i.e., it is not possible for data to be collected *after* publication), this index may be appropriate for detecting a trend over time. Nevertheless, our analysis assumes that the direction of social pressure has remained constant over time, an assumption we were unable to test. It is possible that the social pressure on smoking behavior has reversed in *direction* over this time period but remained of equal *magnitude*.

Our data indicate that both increased extraversion and increased neuroticism are modestly associated with an increased likelihood of being a smoker rather than a nonsmoker. We found no evidence to reject the null hypothesis that these associations have changed over time. To address the limitations of cross-sectional data, in particular the inability to address change in smoking status within individuals over time as a function of personality, and to measure change over time more accurately within a single cohort using a single personality measure, an analysis of data on a cohort of individuals followed longitudinally from birth to late adulthood would be desirable.

Acknowledgments

This work was supported by a Cancer Research UK Programme Grant.

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