



Dental anxiety in relation to neuroticism and pain sensitivity. A twin study[☆]

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ABSTRACT

Predisposing personality traits as well as heightened pain sensitivity and fear of pain have been hypothesized as central factors in the development of dental anxiety. The aim of the study was to estimate the heritability of dental anxiety, and to investigate the genetic and environmental sources of covariance between dental anxiety on one hand, and pain sensitivity and the neuroticism trait on the other. A sample comprising 188 twins, aged 23–35 years (53 monozygotic and 39 dizygotic twin pairs, and 4 single twins whose co-twin did not participate), was included in the study. Measures of dental anxiety and personality were obtained using Corah's Dental Anxiety Scale and the NEO Personality Inventory Revised, respectively. Heat pain and cold pressor pain sensitivity were assessed using standard pain testing procedures. Bivariate Cholesky models were employed to decompose the correlations between phenotypes into genetic and environmental factors. Using models with common additive genetic (A) and individual-specific environmental (E) factors, moderate heritability (i.e., .41) for dental anxiety was demonstrated. Virtually all of the phenotypic correlation between neuroticism and dental anxiety could be accounted for by A. Furthermore, a substantial part of the variance in dental anxiety was due to specific genetic and individual environmental influences unrelated to neuroticism. The phenotypic correlations between dental anxiety and the pain sensitivity indices were close to zero. Thus, while neuroticism and dental anxiety share a sizeable proportion of genetic (but not environmental) risk factors, the results also suggest that these two attributes are distinct entities with overlapping, but not identical, etiologies.

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1. Introduction

Dental fear, anxiety, and avoidance have consistently been reported as common and persisting problems in the general population, showing no decline in prevalence over the past three or four decades (e.g., Armfield, Spencer, & Stewart, 2006; Gatchel, 1989; Lahti, Vehkalahti, Nordblad, & Hausen, 2007). Yet, in spite of extensive research efforts fundamental questions pertaining to the etiology of these conditions have not been answered. Epidemiological and clinical analyses strongly suggest that there are several underlying causal influences and developmental trajectories involved (Locker, Liddell, & Shapiro, 1999; Oosterink, de Jong, & Aartman, 2008). Three broad etiological hypotheses have been proposed (Locker, Liddell, Dempster, & Shapiro, 1999; Locker, Liddell, & Shapiro, 1999), emphasizing (1) conditioning responses to aversive

dental experiences, (2) predisposing temperamental or personality characteristics, or (3) heightened pain sensitivity and/or fear of dental pain.

Using twin methodology, the present study sought to determine to what extent the relationship between dental anxiety on the one hand, and pain sensitivity and the personality trait neuroticism on the other, results from genetic or environmental factors. However, such analyses are appropriate only if certain prerequisites are met (Waldman, Singh, & Lahey, 2006). First, it must be shown that the dispositional dimensions in question (i.e., neuroticism and pain sensitivity) are actually associated with dental anxiety. Second, it must be demonstrated that dental anxiety, as well as the dispositional dimensions, have genetic underpinnings. Both personality traits (Plomin, DeFries, McClearn, & McGuffin, 2008) and pain sensitivity (Mogil & Devor, 2004; Nielsen et al., 2008; Norbury, MacGregor, Urwin, Spector, & McMahon, 2007) have been shown to be moderately heritable, but it is not known whether this is also the case for dental anxiety. Furthermore, while there is abundant evidence for a relationship between dental anxiety and neuroticism or negative emotionality, being suggestive of a causal effect of these dispositional dimensions (see below), the etiological role of heightened pain sensitivity and conditioning is far more uncertain.

The experience of pain and discomfort in dental treatment situations is highly aversive (Munoz Sastre, Albaret, Maria Raich

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Escursell, & Mullet, 2006), and it seems plausible that conditioned fear responses may easily be triggered and reinforced in this particular context (Weiner & Sheehan, 1990). It is also believed that dental fear responses in some instances may be a result of model learning effects, i.e., fearful attitudes communicated by relatives, close friends or the mass media (Hägglin et al., 2001). Nevertheless, several lines of evidence are inconsistent with conditioning as the only or main cause of dental anxiety. While even routine restorative procedures are frequently judged as painful (Litt, 1996), most patients do not develop strong fear or phobic responses (Meng, Heft, Bradley, & Lang, 2007; Vassend, 1993). Furthermore, although the introduction of preventive measures such as the use of fluorides, increased use of anesthetics, and improved treatment procedures has reduced the pain from dental treatment, a corresponding decrease in the prevalence of dental anxiety has not been found (Klingberg & Broberg, 2007; Skaret, Raadal, Kvale, & Berg, 1999). Finally, strong dental anxiety is frequently linked to higher levels of general psychological distress and the presence of other specific fears unrelated to dental treatment (Berggren, 1992).

Taken together, these findings suggest that dental anxiety could be regarded primarily as a constitutional vulnerability to anxiety disorders and multiple fears, thus being part of a person's general temperament or personality. Dental anxiety in childhood appears to be related to particular temperamental traits like negative emotionality, shyness, and inhibition (Arnrup, Broberg, Berggren, & Bodin, 2007; Klingberg & Broberg, 2007), whereas dental behavior management problems are more closely associated with impulsivity, activity, and general behavioral problems. Negative emotionality, which seems to be of special significance in the context of dental anxiety (Arnrup et al., 2007), is described as the frequent, intense, and disproportionate experience and expression of negative emotions (Waldman et al., 2006). The negative emotionality dimension is included in all major temperament and personality measures, but in the adult personality literature the terms neuroticism (Costa & McCrae, 1992; Eysenck, 1947; Goldberg, 1993) or negative affectivity (Watson, Clark, & Tellegen, 1988) are preferred. Consistent with its unspecific nature, negative emotionality is associated with a broad range of psychological disorders, including both internalizing (e.g., depression and anxiety) and externalizing (e.g., antisocial behavior) problems in childhood, adolescence, and adulthood (Kendler, Prescott, Myers, & Neale, 2003; Plomin et al., 2008).

In adult individuals, disproportionate dental anxiety has been found to be associated with higher levels of neuroticism (Frazer & Hampson, 1988; Hägglin et al., 2001; Klepac, Dowling, & Hauge, 1982), general anxiety (Schuurs, Duivenvoorden, Makkes, Thoden van Velzen, & Verhage, 1988), negative mood (Hakeberg, Hägglin, Berggren, & Carlsson, 2001), and psychiatric symptoms (Locker, Liddell, Dempster, et al., 1999). High dental anxiety is also linked to irregular dental utilization behaviors (Hägglin, Hakeberg, Ahlqwist, Sullivan, & Berggren, 2000), reduced oral health status (Hakeberg, Berggren, & Gröndahl, 1993), and poorer oral health-related quality of life (McGrath & Bedi, 2004).

With respect to the third etiological hypothesis, studies in both general population samples as well as clinical samples have consistently found substantial correlations between dental anxiety and ratings of pain and discomfort associated with dental treatment (Maggirias & Locker, 2002; Vassend, 1993). A frequent observation is that dental fear patients are particularly prone to anticipate as well as recall more pain than they actually experience during treatment (Arnzt, van Eeck, & Heijmans, 1990; Kent, 1985). Although such anxiety-related expectancies can be changed by experience, quite a number of disconfirmative experiences are necessary, and with the elapse of time old cognitive schemas have a tendency to become restored (Arnzt et al., 1990). More recent research has

also found evidence of heightened experienced pain, in addition to expected and recalled pain, in dentally anxious patients, particularly during stressful treatment procedures (Klages, Ulusoy, Kianifard, & Wehrbein, 2004). It is believed that people with this pain response liability are at increased risk of ending up in a vicious circle of anxiety, fear of pain, and avoidance of dental treatment (Maggirias & Locker, 2002; Van Wijk & Hoogstraten, 2005). However, we are aware of just two studies in which measurements of general pain sensitivity were actually performed on dental anxiety patients (Klepac et al., 1982; Klepac, McDonald, Hauge, & Dowling, 1980). These studies showed that avoidant dental patients had higher state anxiety and lower tolerance for dental pain (electrical tooth pulp stimulation), but not non-dental pain (electrocutaneous stimulation of the left forearm), compared to patients with low levels of fear. There were no differences in pain threshold between the two groups.

Overall, the literature reviewed above seems to converge on a recurrent set of findings, suggesting that personality dispositions, and their temperamental forerunners in childhood (Caspi, 2000), are linked to dental anxiety and dental behavior management problems in important ways. Possibly, personality traits are also involved in pain responses and fear of pain associated with dental treatment. However, as we have seen there is an almost complete lack of studies examining the relationship between dental anxiety and measures of pain sensitivity, i.e., pain measures that are largely unconfounded by personality factors and that are obtained in standardized and non-dental settings. A fundamental question in the present context is whether the connections between dental anxiety and the neuroticism trait are mediated genetically. Thus, both personality and its correlates may be conceived as alternate manifestations of linked, underlying genetic processes. Parallel analyses of dental anxiety and pain sensitivity, using genetically informative designs, are also needed.

The aims of the study were (1) to investigate to what extent dental anxiety is related to neuroticism and pain sensitivity; (2) to determine the heritability of dental anxiety; and (3) to investigate to what extent genetic and environmental factors in neuroticism and pain sensitivity account for individual differences in dental anxiety.

2. Methods

2.1. Participants

This study is part of a larger project in which genetic and environmental causes of individual differences in pain sensitivity and pain regulation are explored. The sample used was drawn from the twin registry at the Norwegian Institute of Public Health (Harris, Magnus, & Tambs, 2002), and recruitment procedures and sample characteristics have been described in detail elsewhere (Nielsen, Price, Vassend, Stubhaug, & Harris, 2005; Nielsen et al., 2008). Briefly, the sample included 53 identical (MZ) twin pairs, 39 fraternal (DZ) twin pairs, and 4 single twins whose co-twin did not participate (110 women and 78 men, aged 23–35 years). Twins born between 1967 and 1979, where both co-twins were registered as living in the greater Oslo area, were asked to participate. Initial mailings included a health questionnaire used to exclude subjects with neurological disorders, psychotic disorders, and drug or alcohol abuse. Six twin pairs were excluded for medical reasons (neurological disorders, drug abuse) at this stage of the investigation (an overview of the recruitment process is given in Nielsen et al., 2008). The study was approved by the regional Medical Ethics Committee and by the Norwegian Data Inspectorate. All subjects gave written consent prior to participation.

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