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Failure to overcome 'innate' fear: a developmental test of the non-associative model of fear acquisition

Richie Poulton [a,*], Karen E. Waldie [a], Ross G. Menzies [b], Michelle G. Craske [c], Phil A. Silva [a]

[a] *Dunedin Multidisciplinary Health and Development Research Unit, Department of Preventive and Social Medicine, Dunedin School of Medicine, University of Otago, Dunedin, New Zealand*

[b] *Department of Behavioural Sciences, University of Sydney, Sydney, NSW, Australia*

[c] *Department of Psychology, University of California, 405 Hilgard Ave., Los Angeles, CA, 90095-1563, USA*

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Abstract

The non-associative, Darwinian theory of fear acquisition proposes that some individuals fail to overcome biologically-relevant fears (e.g. height) because they (1) do not have sufficient safe exposure to the relevant stimuli early in life or (2) are poor habituators who have difficulty 'learning not to fear'. These two hypotheses were tested in a longitudinal birth cohort study. Study 1 found evidence for reduced exposure to height stimuli in childhood for individuals with a fear of heights compared to study members without fear. Study 2 found evidence for higher levels of stress reactivity (a proxy for habituation) in childhood and adolescence among 18-year-old height phobics compared to study members with dental phobia and those with no fear. The results were discussed in relation to recent findings suggesting that some evolutionary-relevant fears may appear in the absence of traumatic 'learning' experiences. The merits of adding a fourth, non-associative pathway to Rachman's [Rachman, S. (1977)]. The conditioning theory of fear acquisition: a critical examination. *Behaviour Research and Therapy, 15*, 375–387) three pathways model of fear acquisition were briefly considered.

1. Introduction

Controversy continues to surround the relative merits of different models of fear acquisition (e.g. Craske, 1999; Davey, 1995; Menzies & Clarke,1995; Merckelbach & de Jong, 1997). This may be the consequence of a knowledge base that is largely derived from retrospective studies, a less than ideal methodology for etiological research of this kind (e.g. Henry, Moffitt, Caspi,

* Corresponding author. Fax: +64-3-474-0916.

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Langley & Silva, 1994; King, Eleonora & Ollendick, 1998; Menzies & Clarke, 1994; Ollendick, Hagopian & King, 1997). Consequently, many researchers have called for more longitudinal studies to help clarify the mechanisms and pathways to various types of fear (e.g. see ch. 3, 5, 6, 7, 11, Davey, 1997). In this regard, data from the Dunedin longitudinal study has recently confirmed the importance of conditioning processes in the development of dental fear (Poulton, Thompson, Davies, Kruger, Brown & Silva, 1997); provided strong evidence for a non-associative model of height fear acquisition (Poulton, Davies, Menzies, Langley & Silva, 1998) and found qualified support for a non-associative view of water fear acquisition (Poulton, Menzies, Craske, Langley & Silva, 1999).

However, it seems unlikely that these findings alone will lead to the widespread acceptance of an innate-biological explanation of fear acquisition for evolutionary-relevant stimuli (e.g. heights, separation). Clearly, questions remain that need to be answered before the non-associative model can be accepted as a legitimate pathway to fear. For example, some critics claim that the non-associative account of fear acquisition "leaves unexplained why not all people suffer from specific phobias" (Merckelbach & de Jong, 1997, p. 336). In their review, these authors rightly asked "Why, exactly, do some individuals habituate rapidly and others poorly to pre-potent fear stimuli?" (Merckelbach & de Jong, 1997, p. 336). However, they also incorrectly asserted that the non-associative account provides no direct answer to this question. Quite the opposite is true, with several hypotheses advanced to account for this phenomenon.

First, it has been suggested that some people may fail to habituate to pre-potent stimuli because they do not have sufficient exposure for habituation to occur (Clarke & Jackson, 1983; Menzies & Clarke, 1995). Second, it was hypothesised that some individuals are simply poor habituators who never grow out of their developmental fear (Menzies & Clarke, 1993, 1995; also see Rachman, 1978, p. 255). The second hypothesis is based on the assumption that the ability to habituate to various fear-arousing stimuli is normally distributed in the population (e.g. Kagan, Reznick & Snidman, 1988). This notion is incorporated in some models of anxiety disorder (e.g. Andrews, Crino, Hunt, Lampe & Page, 1994) and is central to personality trait theory where the tendency to arouse quickly and habituate slowly to a standard stimulus is variously described as neuroticism, stress reactivity or negative affectivity (Eysenck, 1967; Tellegen, 1985; Tellegen & Waller, in press; Watson & Clark, 1984; Watson, Clark & Harkness, 1994). Inability to habituate would therefore appear closely related to high levels of stress reactivity. In support, Rachman (1990, pp. 230–231) emphasised the influential role played by arousal in the habituation process (also see Lader & Matthews, 1968; Lader & Wing, 1966; Watts, 1979).

We are not aware of any study that has attempted to test these two hypotheses (i.e. nonexposure and differential levels of stress reactivity as a proxy for habituation) among fearful and non-fearful individuals — hence no data exist to support or refute the biological explanation of why evolutionary-relevant specific phobias are not universal in adulthood (cf. Merckelbach & de Jong, 1997). The present study addressed this issue by testing both hypotheses in the development of height fear and phobia among participants enrolled in a longitudinal birth cohort study. Study 1 addressed the issue of nonexposure to height stimuli early in life and study 2 addressed the individual differences in habituation (or reactivity) hypothesis by comparing individuals with height phobia to study members with dental phobia (the diagnostic control group) and a no-fear control group.

2. Method

2.1. Participants and general procedure

The sample consisted of members of the Dunedin Multidisciplinary Health and Development Study, a longitudinal investigation of children born in Dunedin between 1 April 1972 and 31 March 1973 (see Silva and Stanton (1996) for details). Briefly, the sample has been assessed on a wide variety of psychological and medical measures at 2-year intervals from age 3 (n=1,037), 5 (n=991), 7 (n=954), 9 (n=955), 11 (n=925), 13 (n=850), 15 (n=976), and subsequently at 18 (n=1008), 21 (n=992), and most recently at age 26 (n=980). Of particular relevance to the present report are the data from assessments conducted at ages 3, 5, 11 and 18 (study 1) and data from assessments conducted at ages 11 and 18 (study 2).

The health and development interviews were conducted within approximately one month of the study members 3rd, 5th, 11th, and 18th birthdays. Testing occurred during one half day at ages 3 and 5 (a parent accompanied their child to the Unit) and one full day at ages 11 and 18.

2.1.1. Study 1

2.1.1.1. Aim To determine if individuals with height fear (i.e. at age 11 and 18 years) had less exposure to height stimuli before age five compared to those without these fears (i.e. the control group). The relevant data were obtained from the Activities Checklist (derived from the Experiences and Activities Scale; Silva, 1978) administered at ages 3 (n=1037) and 5 (n=990) and a mental health interview at ages 11 (n=792) and 18 (n=936).

2.1.1.2. Activities at ages 3 and 5 The Experiences and Activities Scale is a checklist of common (e.g. “1istened to a radio”, “did puzzles”) and less common (e.g. “played a musical instrument”) experiences and activities (see Silva, 1980 for details on the development and stability of the Scale). The scale was administered to each study member’s parent, who was asked whether the child had (coded 1=yes) or had not (coded 0=no) participated in 30 different experiences in the past 2 years, and 30 activities at home in the six months prior to the age 3 and age 5 assessments. For the present study, eight activities were selected to represent common outdoor childhood activities: (1) “climbed trees, fences”; (2) “played on swings, bars”; (3) “swum, paddled in a pool”; (4) “dug holes”; (5) “rode on trike or similar”; (6) “played in sandpit”; (7) “played with a ball”; and (8) “went out in a car”. Examples of activities not examined included: “drew pictures”, “dressed up”, “read or was read to” and “played tables game (e.g. cards)”.

2.1.1.3. Fear of heights at age 11 and 18 As a part of the Diagnostic Interview Schedule for Children (DISC; Costello, Edelbrock, Kalas, Kessler & Klaric, 1982), 792 study members were asked “Are you afraid of heights, and if yes, do you try to stay away from heights?” Study members who responded “sometimes” (coded 1) or “always” (coded 2) to this question were classified as height fearful at age 11 (n=55, 6.9%).

At age 18, study members were administered a modified version of the Diagnostic Interview Schedule (DIS; Robins, Helzer, Croughan & Ratcliff, 1981) due to assessment time constraints. The modifications consisted of: (1) including only those questions pertaining to the assessment

of DSM-III-R criteria; (2) assessing only the symptoms that occurred within the past 12 months (rather than lifetime prevalence); (3) assessing only the more commonly occurring diagnoses for this age group; and (4) limiting response options to 'no', 'yes, sometimes' and 'yes, definitely' (see also Feehan, McGee, Nada Raja & Williams, 1994).

During the DIS interview, 936 study members were asked, "In the last year have you had a strong unreasonable fear of heights?" A response of 'yes, definitely' to this gate question resulted in the classification of a mild height fear at age 18 (n=107, 11.4%). Twelve study members (1.9% of the sample for whom data was available) reported a height fear at both 11 and at 18 years of age.

2.1.1.4. Results In order to investigate the relation between early childhood activities and self-reported fear of heights at ages 11 and 18, the number of study members who had participated in each activity were examined with respect to the following group membership: (1) no height fear at age 11 versus height fear at age 11; and (2) No height fear at ages 11 or 18 versus height fear at both 11 and 18. Data concerning the frequency of occurrence of each activity before age 3 is presented in Table 1, and data from the Activity Scale prior to age 5 is presented in Table 2.

As shown in Table 1, χ^2 analyses (when cell sizes were small Fisher's exact tests were employed) revealed that 62.7% of study members with no reported height fear at age 11 had experience with playing on swings or bars prior to age 3 as compared with 49.1% of study members classified as having a height fear at age 11 ($\chi^2(1)=4.0$, $p=0.045$). This comparison was the only significant difference in exposure to the 8 activities between those with height fear at 11 and controls.

Playing on swing or bars also tended to differentiate between study members with height fear at both 11 and 18 and those with no height fear. Although this difference failed to reach statistical

Table 1
The relation between childhood activities before age 3 and height fear at age 11 and 18 among members of a longitudinal birth cohort study

Activity	No height fear at 11 or 18 (N=624)	Height fear at 11 and 18 (N=12)	No height fear at 11 (N=737)	Height fear at 11 (N=55)
Climbs trees, fences	N=517; 82.9%	N=10; 83.3%, p=0.965	N=609; 82.6%	N=44; 80%, p=0.621
Plays on swings, bars	N=389; 62.3%	N=4; 33.3%, p=0.067[a]	N=462; 62.7%	N=27; 49.1%, p=0.045[b]
Swims, paddles in a pool	N=500; 80.1%	N=10; 83.3%, p=1.000[a]	N=588; 79.8%	N=44; 80%, p=0.969
Digs holes or plays in dirt	N=590; 94.6%	N=11; 91.7%, p=0.496[a]	N=700; 95%	N=54; 98.2%, p=0.509[a]
Rides vehicle (e.g. tricycle)	N=612; 98.1%	N=12; 100%, p=1.000[a]	N=724; 98.2%	N=55; 100%, p= 1.000[a]
Plays in sandpit	N=399; 63.9%	N=5; 41.7%, p=0.819	N=463; 62.8%	N=31; 56.4%, p=0.340
Ball games	N=617; 98.9%	N=12; 100%, p=1.000[a]	N=728; 98.8%	N=55; 100%, p=1.000[a]
Goes out in a car	N=616; 98.7%	N=12; 100%, p=1.000[a]	N=725; 98.4%	N=52; 94.5%, p=0.079[a]

[a] Fisher's exact test.
[b] Values significant at $p<0.05$.

Table 2
The relation between childhood activities before age 5 and height fear at age 11 and 18 among members of a longitudinal birth cohort study

Activity	No height fear at 11 or 18 (*N*=624)	Height fear at 11 and 18 (*N*=12)	No height fear at 11 (*N*=737)	Height fear at 11 (*N*=55)
Climbs trees, fences	*N*=545; 87.3%	*N*=10; 83.3%, *p*=0.680	*N*=639; 86.7%	*N*=48; 87.3%, *p*=0.904
Plays on swings, bars	*N*=396; 63.5%	*N*=8; 66.7%, *p*=0.819	*N*=464; 63.0%	*N*=36; 65.5%, *p*=0.711
Swims, paddles in a pool	*N*=478; 76.6%	*N*=7; 58.3%, *p*=0.168[a]	*N*=555; 75.3%	*N*=35; 63.6%, *p*=0.055
Digs holes or plays in dirt	*N*=564; 90.4%	*N*=11; 91.7%, *p*=1.000[a]	*N*=666; 90.4%	*N*=50; 90.9%, *p*=0.895
Rides vehicle (e.g. tricycle)	*N*=606; 97.1 %	*N*=12; 100%, *p*=1.000[a]	*N*=715; 97%	*N*=53; 96.4%, *p*=0.680[a]
Plays in sandpit	*N*=351; 56.3%	*N*=8; 66.7%, *p*=0.471	*N*=396; 53.7%	*N*=26; 47.3%, *p*=0.354
Ball games	*N*=597; 95.7%	*N*=12; 100%, *p*=1.000[a]	*N*=705; 95.7%	*N*=52; 94.5%, *p*=0.729[a]
Goes out in a car	*N*=606; 97.1%	*N*=11; 91.7%, *p*=0.307[a]	*N*=712; 96.6%	*N*=51; 92.7%, *p*=0.135[a]

[a] Fisher's exact test.

significance (*p*=0.067), more than half of the control group (62.3%) experienced this activity versus only 33.3% of those with a persisting height fear.

Table 2 shows that the number of study members who played on swings or bars before the age of 5 did not differ between the experimental groups, nor were there any group differences in exposure to the other 7 activities.

2.1.2. Study 2

2.1.2.1. Aim To determine if individuals with height fear at age 11 or height phobia at age 18 years were more stress reactive (i.e. poorer habituators) compared to those with dental fear at the same ages or study members with no 'simple' fears at either age (the control group). The relevant data were obtained from the mental health interviews at age 11 (i.e. DISC) and at 18 (i.e. DIS), the Worry–Fearful subscale of the Rutter Behaviour Questionnaire (Rutter, Tizard & Whitmore, 1970) at age 11 and the Multidimensional Personality Questionnaire (MPQ; Tellegen, 1982), at age 18. The dental fear group was included to provide a more stringent test (i.e. specificity) of the non-associative hypothesis.

2.1.2.2. Height and dental fear at age 11 and at 18 In addition to being asked if they were afraid of heights (see study 1) at age 11, study members were asked "In the last year, have you worried about things before they happened (like going to the doctor or having a test at school)?" If study members replied that they "always" worry about going to the dentist, they were classified as having a dental fear (*n*=26, 3.3%). Sixty-six percent of the study members (*n*=521) did not report having any simple fear at age 11.

During the DIS interview at age 18, study members were asked, "In the last year have you

had a strong unreasonable fear of going to the dentist?" A response of 'yes, definitely' to this gate question resulted in the classification of a mild dental fear (*n*=96, 10.3%).

A positive response to the gate question also led to four supplementary questions: (1) "Have you been very upset with yourself for having that fear of (e.g. heights)?"; (2) "Has an unreasonable fear of (e.g. heights) interfered with your ability to do your work?"; (3) "When you have to approach (e.g. height) does it almost always make you extremely nervous or panicky?"; and (4) "Has the unreasonable fear of (e.g. heights) kept you from going to a party, social events or meeting?"

Study members who also responded 'yes, definitely' to at least two of these questions and reported that the fear had been present for at least 1 month or more were classified as having a phobia. These criteria led to the assignment of 13 study members (1.4%) as height phobic and 14 study members as dental phobic (1.5%) at age 18. Sixty-two percent of the study members (*n*=580) did not report having any simple fear at age 18.

2.1.2.3. Stress reactivity measures

Multidimensional personality questionnaire (MPQ). As part of the age 18 assessment, study members completed a modified version (Form New Zealand (NZ)) of the MPQ (Tellegen, 1982). Rationale and description of the modifications of the MPQ for use in NZ were approved by Tellegen and have been described elsewhere (Krueger, Caspi, Moffitt, Silva & McGee, 1996). Briefly these included a reduction in length of the scale and rewording some items to aid poor readers and ensure cultural relevance (Tellegen's Absorption scale was not included in MPQ Form NZ). The MPQ is a self-report personality instrument designed to assess a broad range of individual differences in affective and behavioural style. The 177-item version of the MPQ (Form NZ) yielded 10 different scales (Tellegen, 1982, pp. 7–8): (1) Well being (11 items), (2) Social Potency (18 items), (3) Achievement (17 items), (4) Social Closeness (19 items), (5) Stress Reaction (14 items), (6) Alienation (17 items), (7) Aggression (18 items), (8) Control (20 items), (9) Harm Avoidance (22 items) and (10) Traditionalism (22 items, see Table 3 for a brief description of

Table 3
Multidimensional Personality Questionnaire (MPQ) scale descriptions and internal consistency coefficients

MPQ Scale	α	Description of a high scorer
Traditionalism	0.63	desires a conservative social environment; endorses high moral standards
Harm avoidance	0.71	avoids excitement and danger; prefers safe activities even if they are tedious
Control	0.79	is reflective, cautious, careful, rational, planful
Aggression	0.78	hurts others for own advantage; will frighten and cause discomfort for others
Alienation	0.76	feels mistreated, victimized, betrayed, and the target of false rumors
Stress reaction	0.80	is nervous, vulnerable, sensitive, prone to worry
Achievement	0.69	works hard; enjoys demanding projects and working long hours
Social potency	0.76	is forceful and decisive; fond of influencing others; fond of leadership roles
Well-being	0.67	has a happy, cheerful disposition; feels good about self and sees a bright future
Social closeness	0.75	is sociable; likes people and turns to others for comfort

each subscale). They have been shown to possess good psychometric properties in this population (Krueger et al., 1996). As can be seen in Table 3, the internal consistency coefficients (α) ranged from 0.63 to 0.80, with an average value of 0.73. The scale intercorrelations for male study members ranged from −0.30 to 0.50, with a mean absolute value of 0.16. The scale intercorrelations for female study members ranged from −0.38 to 0.41, with a mean absolute value of 0.17. The low magnitudes of these intercorrelations are similar to those obtained with the original instrument and illustrate the relative independence of the 10 MPQ scales (cf. Tellegen et al., 1988).

2.1.2.3.2. Rutter anxiety–fearful subscale At the age 11 assessment, parents and teachers independently completed the Rutter Child Behaviour Scale (Rutter et al., 1970). This questionnaire inquired about the major areas of a child's behavioural and emotional functioning during the previous 12 months and was rated on a three-point scale: does not apply (0), applies somewhat (1) and certainly applies (2). These items have been previously shown to identify four behavioural dimensions (McGee, Williams, Bradshaw, Chapel, Robins & Silva, 1985). We selected for this study the five-item subscale measuring the "Anxiety–Fearful" dimension: "often worried, worries about many things", "tends to be fearful or afraid of new things or new situations", "tends to do things on his own — rather solitary", "often appears miserable, unhappy, tearful or distressed", "fussy or overparticular child". Due to the significant correlation between the parent and teacher ratings at age 11 ($p<0.001$; McGee et al., 1985), we averaged the data from the two Anxiety–Fearful subscales to create one overall Anxiety–Fearful age 11 score.

2.1.2.4. Results Four study members who were classified as height phobic at age 18 were also classified as height fearful at age 11. However, none of the study members who were classified as having a dental phobia at age 18 reported a dental fear at age 11. To make comparisons standard, study members who were classified as having a height or dental phobia at age 18 only (i.e. no reported fear at age 11) were included in all analyses.

Of those study members who were administered the MPQ at the Dunedin Unit at age 18 (n=862), 545 did not report any simple fear, nine reported a height phobia at age 18 only and 10 reported a dental phobia at age 18 only. Six study members with dental phobia were not included in the analysis because they had (i) not completed the MPQ at age 18 (n=4) or (ii) had a comorbid height phobia (n=2).

Data at age 18 were subjected to a three (No simple fear, Height phobia, Dental phobia) by 10 (MPQ subscales) ANOVA, with the MPQ subscales scores as repeated measures. The analysis revealed a significant main effect of MPQ ($F(9, 5049)=37.25$, $p<0.001$), and the group×MPQ interaction approached significance ($F(18, 5049)=1.57$, $p=0.055$ (see Fig. 1). Further, for each subscale, Levene's Test of Equality of Error Variance was not significant ($0.17>P<0.95$). Post-hoc comparisons Tukey HSD) revealed significant group differences for the Stress Reaction and

Harm Avoidance MPQ subscales only.

At age 18, the group identified with a dental phobia (S.D.=20.58) did not significantly differ in their Stress Reaction scores from the control group (i.e. those who did not report a simple fear), (S.D.=26.77), p=0.498 or those with a height phobia at 18 only (S.D.=23.30), p=0.134. There was a trend for study members with height phobia to have higher stress reaction scores than dental phobic study members. However, this finding may have failed to reach statistical significance because of the small groups used in this particular analysis. The comparison between the height

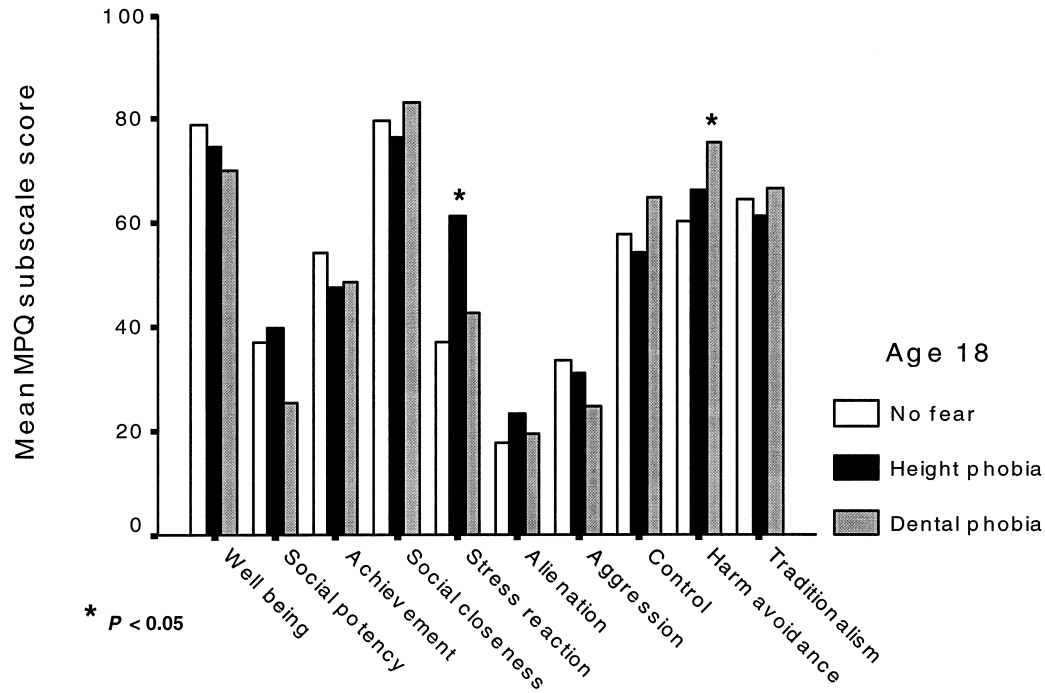

Fig. 1. Multidimensional Personality Questionnaire (MPQ) subscale scores and their relation with height and dental phobia at age 18 among members of a longitudinal birth cohort study.

phobia group at 18 only and controls was statistically significant ($p<0.01$). For the total sample at age 18, the mean Stress Reaction score was 41.98 (S.D.=27.88) (see Fig. 2).

At age 18 study members with a dental phobia obtained the highest mean score on the Harm Avoidance subscale. This group (S.D.=16.34) significantly differed from those in the sample who did not have a simple fear at age 18 (S.D.=21.57), $p<0.05$. No other comparison reached or approached statistical significance.

Finally, we attempted to replicate these findings using a similar measure of stress reactivity obtained when our sample were age 11 years. As noted, due to the significant correlation between the parent and teacher ratings at age 11 ($p<0.001$; McGee et al., 1985), we averaged the data from the two Anxiety–Fearfulness ratings and subjected this new variable to nonparametric analyses. In accord with our previous MPQ Stress Reaction findings, a χ^2 analysis revealed significant differences in Anxiety–Fearfulness ratings between study members with no simple fear, height phobia at 18 only and dental phobia at 18 only ($\chi^2(2)=5.7$, $p<0.05$). Pairwise comparisons (Mann–Whitney U) revealed that those with height phobia at 18 had significantly higher Anxiety–Fearful scores as compared to both the no fear group ($U=13.9$, $p<0.03$) and the dental phobia group ($U=19.0$, $p<0.02$) (see Fig. 3). There were no significant differences between the no fear group and the study members with a dental phobia at 18.

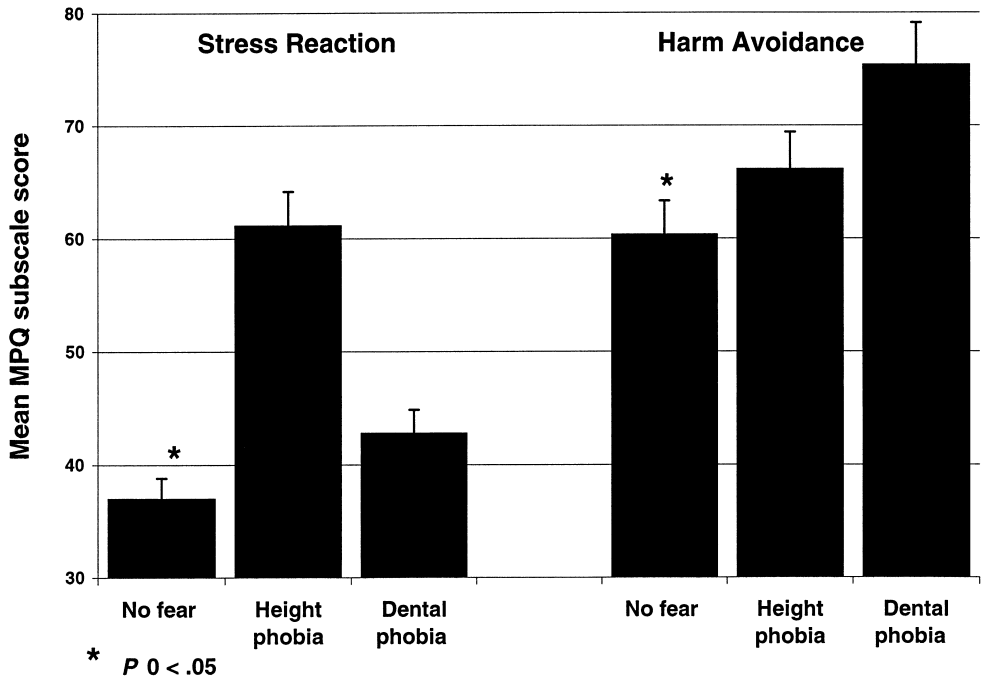

Fig. 2. The relation of MPQ Stress Reaction and Harm Avoidance subscale scores and height and dental phobia at age 18 among members of a longitudinal birth cohort study.

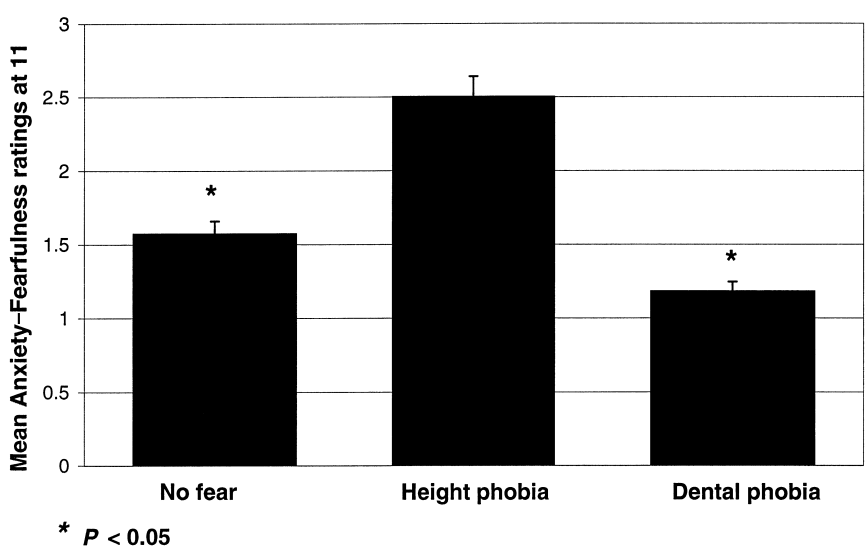

Fig. 3. The relation between Anxiety–Fearfulness at age 11 and height and dental phobia at age 18 among members of a longitudinal birth cohort study.

3. Discussion

3.1. Study 1: summary and methodological considerations

Study 1 found support for the hypothesis that individual's with height fear at age 11 and 18 had less exposure (and presumably less opportunity for habituation) to height stimuli up to the age of three. Importantly, differential exposure was specific to height stimuli. Further, significant differences were found for the activity of 'plays on swings/bars' but not for 'climbs trees/fences'. Ceiling effects may have made group differences more difficult to detect for the latter variable. That is, almost 90% of the total sample had climbed trees and fences at age 5, whereas just over 60% had been exposed to swings and bars (Silva, 1980). The finding that group differences were slightly weaker for the persistent height fear group (n=12) compared to the age 11 height fear group (n=55) may have been partly due to the comparatively smaller numbers available for analysis. Indeed, in terms of raw percentage values, the persistently height fearful group appeared to have less exposure to swings and bars (33.3%) than the age 11 height fearful group (49.1%).

The measurement of life experiences among this general population sample at a young age and the subsequent assessment of fear outcomes (via a structured diagnostic interview) 15 years later represents a strength of study 1. However, the simple yes/no format for assessing exposure to various activities at age 3 and 5 was less than ideal. With hindsight, we should have used a more sensitive measure of exposure frequency, one which may have resulted in even stronger findings.

There remain a number of possible explanations for why those with height fear at age 11 and at 18 had reduced exposure to swings and bars earlier in life. These include: (1) limited access to such equipment in the local area, (2) absence of such equipment at the child's preschool/school, (3) limited interest of the child in such outdoor activities, (4) limited parental interest in such outdoor activities, (5) high levels of 'innate', non-associative fear of heights resulting in avoidance of such equipment and (6) a history of early falls producing fear of such equipment. However, what is critical in the present study is that, in support of the non-associative model, height-fearful study members *did have* less exposure and *did* display fear at a later age. This finding alone supports the 'insufficient opportunity to habituate' hypothesis of the non-associative model. Of course, if the reduced exposure was due to a history of relevant falls, the non-associative model is not needed to explain either avoidance or fear of height stimuli at age 11 and 18. This possibility, however, seems unlikely since Poulton et al. (1998) have previously shown that height fear in adolescence was associated with a reduced (rather than increased) history of early childhood falls.

It was of interest that we found no group differences in exposure to height stimuli at age five. This finding suggests that it may be lack of exposure to height stimuli very early in life that is most relevant to the development of intractable fear. In support, there is evidence that many behaviours are more easily modified in very early childhood before becoming more 'hard-wired' with age (e.g. stuttering). It may also be that by age five, bars and swings were no longer sufficiently threatening to produce avoidance. Alternatively, it might be that concomitant with the onset of schooling, more opportunities were available for height fearful children to have at least some 'safe' exposure to height stimuli (e.g. observation of peers playing on bars or swings). Notwithstanding, it is likely that those children who gained exposure between ages three and five still had less overall exposure (i.e. less total hours) to swings and bars than children who had

been exposed by age three. The differences between groups at age three would therefore appear critical because it suggests that children who get early (and probably greater) exposure to relevant stimuli manage to 'habituate', whereas those without sufficient exposure do not.

3.2. Study 2: summary and methodological considerations

In general study 2 found support for the hypothesis that individuals with height phobia at age 18 would be more stress reactive (i.e. poorer habituators) than those with dental fear or study members who did not report any fears. This finding applied only to phobia (as opposed to mild fear) and was specific to the stress reactivity scale insofar as comparisons using the MPQ Negative Emotionality superfactor failed to reveal group differences (data not shown). Thus, the data provided support for the non-associative hypothesis as applied to height phobia only — poor habituation as measured by stress reactivity was not related to the subclinical variant of height fear.

Strengths of study 2 include the use of a well-validated measure of stress reactivity (Krueger et al., 1996; Tellegen et al., 1988). Individual differences in these personality traits are known to be partly heritable (Tellegen et al., 1988), predictable from early childhood (Caspi & Silva, 1995) and stable over adulthood (McGue, Bacon & Lykken, 1993). Further, we were able to replicate this finding using a similar measure of reactivity obtained when this cohort were aged 11 via the Worry–Fearful subscale of the Rutter Child Behaviour Questionnaire (Rutter et al., 1970). Thus, our results were consistent across time and method. However, our proxy measure of habituation was based on self-report and the addition of appropriate physiological measures may have been of benefit. Further, our reliance on a proxy measure for dental fear at age 11 was less than ideal. To guard against the inclusion of false positives in our dental fear group, we adopted a particularly conservative criterion for group membership resulting in a slightly lower prevalence rate of dental fear (i.e. 3.3%) than is typically reported for this age group (Kent, 1997). It was intended that this approach help minimise type 1 errors by making group differences more difficult to detect.

The finding of higher Harm Avoidance scale scores among study members with dental phobia was intriguing. Harm Avoidance is associated with the tendency to avoid situations in which physical harm is possible (Tellegen & Waller, in press). Hence, one might reasonably expect height fearful individuals to score highly on this measure also. That they did not was consistent with our habituation hypothesis predicting differences for stress reactivity only. The lack of difference on the Harm Avoidance scale among normal (no reported fears) and height fearful study members was also consistent with the specificity of avoidance for height stimuli observed in study 1. That is, the MPQ Harm Avoidance subscale measures the propensity to avoid *all* situations in which physical harm is possible (ibid). Additionally, this finding raises the interesting possibility that there may be different personality correlates for different subtypes of specific fear — an issue to be investigated in future research.

4. Conclusion and implications

Together, the results are consistent with Rachman (1978, p. 255) who entertained the view that "the predisposition to develop the most common fears is innate and universal, or nearly so, and that what we learn is how to overcome our existing predisposition". The present findings illustrate

the mechanisms by which this may fail to occur. That is, some people do not overcome their fear of heights because of limited opportunities to do so (nonexposure) or because a small percentage of individuals are simply at the high end of the normal distribution in terms of arousal or reactivity and have difficulties overcoming their highly reactive dispositions. The findings were consistent with other recent work demonstrating fear dishabituation for height but not dental fear (Poulton, Waldie, Craske, Menzies & McGee, in press), and provide the first indirect test of these hypotheses described in the non-associative model of fear acquisition (Menzies & Clarke, 1995). The question remains as to why some individuals have limited exposure to height stimuli or are poor habituators. It seems likely that familial and/or genetic influences are important in this regard (Marks, 1969).

Can these findings be reconciled with the neo-conditioning model of fear acquisition? This model posits that fear acquisition can involve learning between non-contiguous events. Further, proponents of this position describe a number of mechanisms by which fear can arise in the absence of actual trauma (e.g. vicarious learning, information, sensory preconditioning) or conversely, why fear does not always follow trauma (i.e. latent inhibition). However, this model "…lacks limits and there is little it disallows… almost any stimulus or past stimulus or event can become a signal for fear, but in practice, people are found to have comparatively few fears. The fears that we do acquire are confined to a handful of stimuli: fears are not normally distributed" (Rachman, 1990, p. 11).

The non-random distribution of common fears may be partially explained by the processes examined in this study. Of course, this does not imply that neo-conditioning models are wrong, but rather that they remain incomplete accounts of a commonly observed fear phenomenon. In this regard, an expansion of Rachman's (1977) three pathways of fear acquisition to include a fourth, non-associative pathway may be indicated. This may result in a more comprehensive theory of fear acquisition and generate a number of interesting possibilities. For example, the four pathways might be best thought of interactively, whereby conditioning processes are held to be the primary source of fear development for evolutionary-neutral fear, and non-associative or biological processes are viewed as the primary determinants of the development of evolutionary-relevant fear. These primary routes do not exclude secondary (or tertiary) paths and should be regarded as complementary, rather than antithetical in nature.

Acceptance of the fourth pathway as a possible route to fear would help to address the "associative-learning bias" described by Menzies and Clarke (1994). These authors argued that most retrospective studies of the origins of phobias have imposed preliminary constraints upon their possible results by limiting pathway options to various conditioning-based alternatives. For example, in one of the earliest retrospective studies of the etiology of human fear, Rimm, Janda, Lancaster, Nahl and Dittmar (1977) revealed their leaning to the conditioning account early in their paper when they stated that "learning plays a necessary role in the acquisition of phobias" (p. 231). This bias is further evident in the four categories typically chosen for the classification of phobic onsets: (1) direct experience akin to classical conditioning, (2) vicarious experience, (3) verbal instruction and (4) inability to recall a pertinent experience. The first three categories are learning-based explanations and even the fourth category, as Menzies and Clarke (1994) point out, suggests a bias to the learning model since it implies a failure to recall, rather than an absence of an assumed traumatic experience involving the feared stimulus. These categories simply do not cover all major theoretical positions.

Similar categories have been adopted by Ost and colleagues (e.g. Ost & Hugdahl, 1983, 1985) in their well-cited work. Not surprisingly, Ost and Hugdhal's (1981) Phobia Origins Questionnaire has been subsequently criticised for leading to a systematic and substantial overestimate of the relevance of associative-learning pathways in the development of fear (see Menzies, Kirkby & Harris (1998) for a discussion of these issues). In sum, it is the present authors view that the addition of a fourth, non-associative pathway strengthens Rachman's model by providing a more complete account of the possible developmental routes to fear.

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