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Research report

Reactions to threat and personality: Psychometric differentiation of intensity and direction dimensions of human defensive behaviour

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Abstract

Gray and McNaughton [Gray JA, McNaughton N. The neuropsychology of anxiety. Oxford: Oxford University Press; 2000] predict that fear is associated with orientation *away* from threat whereas anxiety is associated with orientation *towards* threat; this first dimension of 'defensive direction' is independent of a second dimension of 'defensive intensity'. Defensive reactions were measured using a threat scenario questionnaire developed by Blanchard et al. [Blanchard DC, Hynd AL, Minke KA, Minemoto T, Blanchard RJ. Human defensive behaviours to threat scenarios show parallels to fear- and anxiety-related defence patterns of non-human mammals. Neurosci Biobehav Rev 2001;25:761–70] who found that responses paralleled the defensive reactions of rodents faced with real threats. In a sample of 141 participants we replicated Blanchard et al.'s findings as well as confirming the Gray and McNaughton hypotheses. As predicted, trait anxiety was associated with a tendency to orientate towards threat. In addition, the personality trait of psychoticism (tough-mindedness) was related to defensive intensity with low scorers on psychoticism being more sensitive to threat in general and high scorers being more threat insensitive. A well-established personality measure of general punishment sensitivity, namely the Carver and White [Carver CS, White TL. Behavioural inhibition, behavioural activation, and affective responses to impending reward and punishment: the BIS/BAS scales. J Pers Soc Psychol 1994;67:319–33] BIS scale, was positively correlated with both defensive intensity and direction. These data indicate that the threat scenario questionnaire has some validity as a measure of human reactions to threat.

Keywords: Personality; Human defensive behaviour; Threat; Anxiety; Fear; Psychoticism

1. Introduction

Psychologists have become increasingly cognizant of the power of the theory of evolution by natural selection to explain the development and nature of psychological as well as anatomical attributes. This awareness was predicted by Darwin, who stated, "Psychology will be based on a new foundation, that of the necessary acquirement of each mental power and capacity by gradation" [1, p. 458]. In this tradition, Caroline and Robert Blanchard have, over the past three decades, identified a number of innate patterns in defensive behaviour. Using rodents, they have found that high magnitude threats elicit flight, but only if an escape route is available; if an escape route is not available then freezing is elicited, which is replaced at short distances by defensive threat (such as vocalization and weapon display), followed by explosive defensive attack with zero distance to threat (e.g., when nose-to-nose with a threat) [2]. In the face of ambiguous or potential threats, such as suspicious noises or odours, rodents display a different class of behaviour that has been labelled 'risk assessment', characterized by orientation towards, and hesitant investigation of, the stimulus [2,3].

Elevated defensiveness is a key symptom in a number of human psychopathologies, such as agoraphobia [4], therefore research in rodents aimed at understanding defensive behaviour has the potential to increase understanding of the causal bases of clinical disorders. Cross-species comparability is, however, one obvious obstacle to this goal. One way of addressing this problem involves dosing rodents with drugs effective against psychiatric disorders in humans: if these drugs alter rodent defensive behaviour in ways that are consistent with reduced defensiveness then it would point to a possible link between illness and defensiveness. Studies of this type provide broad support for such a

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link, although the drugs do not affect rodent defence uniformly: drugs that are effective against generalized anxiety disorder reduce the risk assessment and defensive threat/attack aspects of rodent behaviour [5], whereas drugs effective against panic disorder reduce flight without affecting other rodent defensive behaviours [6–8]. Such results suggest that defensive reactions form two clusters, each associated with a different negative emotion.

1.1. Defensive direction

Gray and McNaughton [9] argue that the two clusters in defensive behaviour identified by the Blanchards represent the action of two brain systems, one controlling anxiety, the other fear, and that differences in the reactivity of these systems give rise to personality differences and ultimately psychopathology (for a summary of this theory, see Ref. [10]) According to this theory, the factor that determines which system is activated is 'defensive direction' (i.e., avoid/fear, or cautious approach/anxiety involving risk assessment).

This link between defensive direction and emotion implies that the theory can be tested in a relatively straightforward manner by observing the characteristic orientation of an individual's response to threat and relating it to scores on questionnaire measures of anxiety or fear. That is, people who tend to orientate away from threat should be particularly prone to fear, whereas those who tend to orientate towards threat should be particularly prone to anxiety. The primary aim of the present study is to explore this possibility by testing the following two predictions:

1. A positive association will exist between psychometric measures of fear and orientation *away* from threat.
2. A positive association will exist between psychometric measures of trait anxiety and orientation *towards* threat.

1.2. Defensive intensity

In addition to defensive direction, a second major defensive dimension is 'defensive intensity', defined as the perceived distance from threat [9,10]. This second dimension reflects the finding that the intensity of rodent defensive responding relates to the distance between the rodent and threat, with the most intense defensive reactions, such as explosive attack, occurring at zero distance and less intense reactions, such as risk assessment, occurring at longer distances [11]. Gray and McNaughton [9] account for these data by mapping defensive distance onto neural level, such that the shortest defensive distances activate the lowest neural levels and generate the most intense responses (such as explosive attack), whereas distant or abstract threats activate the upper neural levels (especially the prefrontal cortex), generating more complex responses (such as risk assessment).

1.3. Personality

At the level of individual differences, this hierarchical view of defence implies that individuals who tend to respond with low intensity to threats perceive those threats to be relatively distant. In contrast, individuals who are prone to respond with high intensity to threats perceive those threats as relatively close. Gray and McNaughton [9] tentatively suggest neuroticism (N) as a personality construct that measures perceptions of defensive distance regardless of defensive direction. This position is sensible given that N is usually viewed as a trait tendency to experience negative emotion of all kinds [12]; however, psychoticism (P) and extraversion (E) also have a prima facie relationship to individual differences in defensive distance as high scores on both these constructs are usually associated with a general boldness and disregard for danger [13]. For this reason, measures of P, E, and N were taken alongside specific measures of fear and anxiety. In addition, well-established purpose-built psychometric measures of activity in two important brain systems (the Behavioural Inhibition System (BIS) and the Behavioural Approach System (BAS) were administered in order to determine their relation to the two dimensions of defensive direction and intensity.

1.4. Human defensive scenarios

In 2001, Blanchard et al. [14] examined the validity of the use of rodent defensive reactions to model human defensive reactions. In order to measure defensive reactions without exposing human participants to ethically prohibitive real danger, they developed a threat scenario questionnaire (Table 1). Participants (81 male and 79 female students) read the 12 threatening scenarios and chose a response to each of these scenarios from the relatively comprehensive list of 10 response options.

The scenarios were then independently rated for the five situational features that are known to alter rodent defensive behaviour: (1) magnitude of threat, (2) escapability, (3) distance, (4) ambiguity, and (5) opportunity for concealment. This procedure provided situational variables with which defensive responses could be correlated. The defensive responses were categorical (such as 'run away' or 'attack') and, as such, unsuitable for correlation with the situational ratings. Blanchard et al. [14] overcame this problem by conceptualizing the frequency of responses to the various scenarios as a continuous measure of defensive behaviour that could then be correlated with the continuous situational ratings of scenarios. For example, rodents tend to show risk assessment in ambiguously threatening situations: if human defensive behaviour is similar, Blanchard et al. [14] reasoned, the number of participants choosing risk assessment should correlate positively with ambiguity ratings of scenarios, with the highest number of 'votes' for risk assessment occurring in the scenarios with the highest ratings of ambiguity.

The main finding of Blanchard et al. [14] was that human defensive reactions varied according to situational features in a similar way to rodent defensive reactions (elicited by actual threat). Given that the participants were naïve (had no knowledge of the hypotheses nor had specialist knowledge of the way in which rodent defensive responding is organized), the strong resemblance found between the patterning of their defensive responses and rodent responses to actual threat implied that the

Table 1
The threat scenario questionnaire created by Blanchard et al. [14]

Threat scenarios
(1) You are walking alone in an isolated but familiar area when a menacing stranger suddenly jumps out of the bushes to attack you
(2) You are alone in an elevator late at night. As it stops and the doors open, a menacing stranger rushes in to attack you, blocking the door
(3) You are alone in a car on your way home. While stopped at a traffic signal, an angry stranger begins banging on your car window and yelling threatening things at you
(4) Driving along a two-lane road, you see in your rearview mirror that a car is dangerously tailgating you. They cannot pass and begin honking their horn aggressively at you while continuing to follow too closely
(5) It is past midnight and you are walking through an unfamiliar part of town. As you round a corner, you accidentally run into a man. He becomes angry and shoves you
(6) You and someone you do not really know that well are standing around and talking in an empty parking lot. The acquaintance begins to shove and push you. You are unsure whether s/he (same sex as you,) is serious or just kidding around
(7) You are outside in a park area at night when you see a menacing stranger with a knife about 30 ft away directly approaching you. It is obvious the person is planning to attack you
(8) You are alone as you exit an empty campus building late one night. Just as you get outside, you feel a hand grab your arm
(9) You are sleeping in bed during the night, but suddenly wake up thinking you have heard a suspicious noise. It is dark and you are alone
(10) You are alone at home one night about to go to bed when the phone rings. You answer it, and there is an unfamiliar voice on the other end. It tells you that they are right outside of your house and hangs up
(11) Coming home one day, you find an unexpected shoebox-sized package waiting for you by the mailbox. As you sit down to open it, you notice a faint ticking sound that appears to come from inside the package
(12) Alone at home one night, you have settled down to read a book when you hear some movement right outside of your window. You cannot see anything, but when you listen more closely, it sounds like people whispering
Response options
(1) Hide
(2) Freeze, become immobilized
(3) Run away, try to escape, remove self (flight)
(4) Threaten to scream or call for help
(5) Yell, scream, or call for help
(6) Threaten to attack
(7) Attack or struggle
(8) Check out, approach, or investigate (risk assessment)
(9) Look for something to use as weapon
(10) Beg, plead for mercy, or negotiate

threat scenario questionnaire is measuring actual defensive tendencies. This finding encourages the view that, despite being subject to the usual limitations that afflict questionnaires (particularly social desirability and response distortion), Blanchard et al.'s [14] threat scenario questionnaire is a sufficiently valid way to measure human defensive reactions. This conclusion is supported by Blanchard et al.'s [14] additional finding that the responses of their participants varied in a way that matched the size differences that exist between men and women (women were significantly less likely to select responses where small size was likely to be a disadvantage as in scenarios describing face to face confrontations, e.g., scenario 5 in Table 1). Blanchard et al.'s [14] study has not yet been replicated; this was the preliminary aim of the present study. The main aim was to explore the relationship between measures of defensive distance and intensity and well-established personality measures of fear, anxiety, and punishment sensitivity.

2. Methods

2.1. Participants

Participants were 141 volunteers (58 males and 83 females), aged between 18 and 77 years (mean = 29.03, S.D. = 8.40), recruited through advertisements in a college serving a mixed population of undergraduates, postgraduates, and evening class students (hence the age range is somewhat wider than usual for university based studies). Participants were paid £8 in return for their co-operation.

2.2. Threat scenarios

The threat scenario questionnaire (Blanchard et al. [14]; see Table 1) requires the participant to select one defensive reaction (such as 'run away') for each of 12 threat scenarios. In order to derive scores for defensive intensity and defensive direction, each reaction was coded according to the scheme set out in Fig. 1.

In order to maximize ecological validity, the questionnaire response options were coded for defensive intensity according to the distance graduations identified by studies of rodent defensive responding to real threats [11]. For example, 'run away' occurs in rodents at longer defensive distances than 'attack' and so, as shown in Fig. 1, was assigned a defensive intensity coding of lower

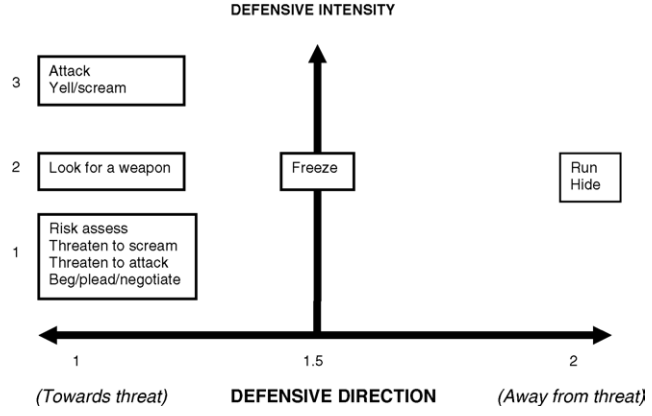

Fig. 1. Threat scenario response choices coded for defensive intensity and defensive direction.

numerical value in order to reflect this intensity. As shown in Table 1, three of the response options for the threat scenario questionnaire are not performed by rodents ('threaten to scream', 'look for a weapon', and 'beg-plead-negotiate'). These human type responses were therefore coded according to their estimated levels of defensive intensity.

The codings for defensive direction were accomplished by assigning the value of 1 to reactions that entail orientation towards threat and the value of 2 to reactions that entail orientation away from threat. One of the response options (freeze) was directionally neutral and so was assigned a coding of 1.5 for defensive direction.

Participants' overall scores for defensive direction and defensive intensity were obtained by totalling the relevant codings: higher scores on 'defensive direction' represent a greater tendency to orientate away from threat and higher scores on 'defensive intensity' represent a greater tendency to respond intensely. Thus, for example, if a participant responded with 'freeze' to the first six threat scenarios and with 'attack/struggle' to the last 6, that person's overall defensive direction score would be: $(6 \times 1.5) + (6 \times 1) = 15$; and their overall defensive intensity score would be: $(6 \times 2) + (6 \times 3) = 30$.

2.3. Personality questionnaires

Trait anxiety was assessed by the Spielberger State-Trait Anxiety Inventory (STAI) [15], and fear by the Fear Survey Schedule (FSS) [16]. These questionnaires were selected because they are arguably the best-established measures of their respective constructs. The FSS contains 108 items representing a range of aversive stimuli such as "worms" or "angry people". Participants indicate, using a scale of 0 (no fear) to 4 (very much fear), how much they would be disturbed by each item. The FSS has been found to have utility as a tool for psychiatric evaluation [17].

In order to explore possible associations between defensive reactions and personality traits other than those involving anxiety and fear, two additional broader spectrum questionnaires were administered: the Eysenck Personality Questionnaire Revised (short scale) [18] and the BIS/BAS scales [19].

The EPQ-R (short scale) is a well-known general measure of personality and consists of 48 items that measure three dimensions of personality: psychoticism (P; high scorers are typically characterized as being tough-minded, aggressive, non-conformist, inconsiderate, reckless, and impulsive); extraversion (E; high scorers are typically characterized as being outgoing, talkative, high on positive affect, and prone to seeking external stimulation); and neuroticism (N; high scorers are typically characterized as being anxious, depressed, prone to guilt, tense, moody, and obsessive).

The BIS/BAS scales contain 24 items that assess individual differences approach and avoidance tendencies. High scorers on the BIS scale are seen as having high levels of sensitivity to aversive stimuli, whereas high scorers on the BAS scale are seen as having high levels of sensitivity to appetitive stimuli. This questionnaire is the best-established measure of the traits outlined in the original version of Gray's theory of personality [20].

2.4. Procedure

All the personality questionnaires as well as the threat scenario questionnaire were administered to participants on the same occasion and scored according to the keys provided in their respective manuals; the threat scenario questionnaire was scored using the scheme set out in Fig. 1. Space was provided in the threat scenario questionnaire for participants to write in supplementary information or response choices not covered by the list in Table 1.

Replicating Blanchard et al.'s [14] methodology, the threat scenarios were then rated by a group ($N = 28$) of hypotheses-naïve social sciences postgraduates separate to the main participant group for the five situational features that are known to alter rodent defensive behaviour: (1) magnitude of threat, (2) escapability, (3) distance, (4) ambiguity, and (5) opportunity for concealment (these data are not reported here). This procedure provided situational variables with which defensive responses could be correlated.

2.5. Statistics

The relationship between personality scores and defensive reactions was assessed using Pearson's correlations. Multiple regression was also used to reveal the ability of different personality variables to predict defensive responding with predictive power being determined by inspection of the β coefficients. As with Blanchard et al. [14], the relationship between defensive responding (rated by the participants) and situational features (rated by the separate group of social sciences postgraduates) was assessed by correlating the ratings of the situational features of the 12 scenarios with the frequency of particular defensive responses.

Hierarchical multiple regression was used to test for an interaction that was suggested post hoc by Blanchard et al. [14] (that flight is most likely in the face of threats that are both escapable and clearly dangerous), with additive effect predictor variables entered in step 1 and the interaction term in step 2. Prior to analysis all data were standardized [21] and so predictive power relative to the main effects was determined by inspection of the B coefficients instead of the more usual standardized β coefficients. Independent samples t-tests were used to compare means between sexes.

3. Results

Table 2 shows descriptive statistics for personality measures and indices of defensive responding for the whole sample

Table 2
Descriptive statistics (means and standard deviations) for psychometric measures and measures of defensive responding

Variable	Overall	Males	Females
1. Trait anxiety	39.95 (9.30)	40.64 (9.60)	39.47 (9.11)
2. Psychoticism	3.29 (1.99)***	4.12 (1.95)	2.70 (1.80)
3. Extraversion	8.44 (3.05)**	7.59 (3.30)	9.05 (2.72)
4. Neuroticism	5.95 (3.48)	5.79 (3.57)	6.06 (3.43)
5. Lie	3.31 (2.26)	3.17 (2.16)	3.41 (2.33)
6. BAS (drive)	10.79 (2.56)	10.74 (2.69)	10.82 (2.48)
7. BAS (fun)	11.89 (2.14)	11.95 (2.21)	11.84 (2.10)
8. BAS (reward)	16.99 (2.05)**	16.40 (2.17)	17.41 (1.86)
9. BIS	21.12 (3.61)*	20.34 (3.75)	21.66 (3.44)
10. Fear	112.60 (59.74)***	91.45 (52.57)	127.56 (60.26)
11. Defensive orientation (high = responses oriented away from threat)	16.21 (1.54)***	15.61 (1.52)	16.63 (1.42)
12. Defensive intensity (high = intense responses)	20.92 (3.12)***	19.47 (3.06)	21.94 (2.75)

Note: $N = 141$ (58 males, 83 females).
* Significant difference between the sexes: $p < .05$.
** Significant difference between the sexes: $p < .01$.
*** Significant difference between the sexes: $p < .001$.

Table 3
Summary of Blanchard et al.'s [14] specific findings alongside those of this study

Predictions by Blanchard et al. [14]	Findings of Blanchard et al. [14]	Findings of present study
1. The frequency with which risk assessment is selected will relate positively to ambiguity of threat stimuli	.89**/.86**	.89**/.85**
2. The frequency with which flight is selected will relate negatively to ambiguity of threat stimuli	−.50/−.63*	−.56/−.59*
3. The frequency with which defensive attack is selected will relate negatively to ambiguity of threat stimuli	−.53/−.29	−.54/−.44
4. The frequency with which flight is selected will relate positively to escapability of threat	.10/.04	.12/.13
5. The frequency with which defensive attack is selected will relate negatively to escapability of threat	−.76*/−.65*	−.87**/−.89**
6. The frequency with which defensive attack is selected will relate negatively to distance of threat stimuli	−.59*/−.64*	−.62*/−.69*
7. The frequency with which hiding is selected will relate positively to availability of a hiding place	.59*/.63*	.33/.30
8. Flight is most likely in the face of threats that are escapable and clearly dangerous	Suggested post hoc	$B = -.325/-.414$**

Note: $N = 141$ (58 males, 83 females).
* $p < .05$.
** $p < .01$.

and for each sex separately. Several clear differences were found between the sexes on personality, most notably women scored significantly lower on EPQ psychoticism and significantly higher on fear. Clear differences were also observed between men and women on both defensive intensity and defensive direction: women generally responded with significantly greater defensive intensity and were significantly more likely to orientate away from a threat.

Turning to the replication of Blanchard et al. [14], Table 3 summarizes the specific predictions derived from the animal

Table 4
Percentage of participants selecting each response to threat in each threat scenario

Response option	Threat scenario												
	1	2	3	4	5	6	7	8	9	10	11	12	Mean (%)
Hide	0	0	0	0	0	0	1.7	0	3.4	0	1.7	3.4	.85
	0	0	0	2.4	0	0	7.2	0	9.6	6	1.2	4.8	2.6
Freeze, become immobilised	13.8	6.9	8.6	8.6	1.7	3.4	0	15.5	10.3	0	1.7	3.4	6.16
	15.7	7.2	3.6	3.7	2.4	4.8	4.8	18.1	20.5	2.4	3.6	6	7.73
Run away, try to escape, remove self (flight)	34.5	1.7	51.7	39.7	19	3.4	91.4	8.6	0	0	44.8	3.4	24.85
	56.6	7.2	65.1	47.6	49.4	8.4	77.1	7.2	2.4	3.6	43.4	2.4	30.87
Threaten to scream or call for help	0	1.7	1.7	0	0	0	0	0	0	1.7	1.7	0	.57
	2.4	3.6	1.2	2.4	1.2	3.6	0	0	0	8.4	1.2	6	2.5
Yell, scream, or call for help	0	8.6	1.7	0	0	0	0	8.6	0	12.1	8.6	8.6	4.02
	14.5	32.5	9.6	2.4	14.5	2.4	6	31.3	1.2	27.7	15.7	7.2	13.75
Threaten to attack	10.3	8.6	8.6	6.9	17.2	10.3	0	12.1	0	0	0	0	6.17
	2.4	0	7.2	3.7	7.2	9.6	0	2.4	0	0	0	1.2	2.81
Attack or struggle	19	58.6	1.7	1.7	1.7	1.7	0	15.5	0	0	0	0	8.33
	6	34.9	0	0	1.2	6	2.4	15.7	0	1.2	0	0	5.62
Check out, approach or investigate (risk assessment)	13.8	3.4	10.3	22.4	10.3	63.8	0	39.7	58.6	51.7	37.9	69	31.74
	1.2	1.2	3.6	19.5	6	43.4	0	24.1	42.2	31.3	33.7	60.2	22.2
Look for something to use as a weapon	5.2	1.7	12.1	1.7	1.7	1.7	6.9	0	25.9	29.3	1.7	10.3	8.18
	0	6	2.4	0	0	1.2	2.4	0	24.1	18.1	0	10.8	5.42
Beg, plead for mercy, or negotiate	3.4	8.6	1.7	1.7	46.6	15.5	0	0	0	0	0	0	6.46
	1.2	7.2	1.2	2.4	15.7	18.1	0	1.2	0	0	0	0	3.92
Ignore	0	0	1.7	17.2	1.7	0	0	0	2	5.2	1.7	1.7	2.6
	0	0	6	15.9	2.4	2.4	0	0	0	1.2	1.2	1.2	2.53

Note: Percentages for males ($n = 58$) in upper row for each response option and percentages for females ($n = 83$) in lower row for each response option. 28% of choices were accompanied by extra information and 10% of choices were not from the list of response options provided.

literature that were tested by Blanchard et al. [14] along with their results and the results of the present study: both studies support all but prediction number 4. The post hoc speculation made by Blanchard et al. [14], that flight is most likely in the face of threats that are both escapable and clearly dangerous, was partially supported, with the *B* coefficient for the escapability × ambiguity interaction term reaching significance in females but failing to do so in males.

Table 4 summarizes defensive responses in terms of the percentage of participants selecting each response in each threat scenario and shows that the most popular defensive reactions by some distance for both men and women were the animal parallel responses of flight and risk assessment, with females favouring flight slightly more than risk assessment and males vice versa. The third most popular responses varied substantially with sex, being attack/struggle (for males) and yell/scream/call for help (for females). In comparison, human specific defensive reactions, such as look for a weapon or beg/plead/negotiate, were rarely selected.

Examination of supplementary information showed that 28% of responses to the 12 threat scenarios included some form of additional information such as "what I did in a similar situation" or "it has actually happened". Ten percent of responses were not from the list of 10 response options provided: some of these non-standard responses were re-wordings of existing response choices and others were non-sensical, however a third of them pertained to ignoring the threat suggesting that 'ignore' should be added to the list of response options for any future administrations of the threat scenario questionnaire. Indeed, 'ignore' was more commonly selected than two of Blanchard et al.'s [14] original list of 10 response options (hide and threaten to scream). Therefore, given its apparent importance, 'ignore' was added retrospectively to the coding scheme for defensive direction and intensity. The codings for 'ignore' were as follows: defensive direction = 1.5 (ignore by definition is directionally neutral) and defensive intensity = 0 (ignore by definition is devoid of defensive intensity).

With regard to personality and defence (Table 5) personality scores most significantly associated with defensive intensity were psychoticism (negatively) and BIS (positively). Defensive direction (with high scores representing greater tendency to orientate away from threat) was also associated with psychoticism (negatively) and BIS (positively), as well as with fear (positively). The direction of these correlations show that high BIS/low psychoticism/high fear scorers were more likely to

Table 5
Correlations between psychometric measures of personality and defensive responding (direction and intensity) for the whole sample as well as males and females separately

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. Trait anxiety	–	−.311*	−.241	.741**	−.097	.109	.026	.131	.612**	.205	.252	.073
		−.033	−.216	.761**	−.069	−.226*	−.107	.030	.545**	.291**	−.178	−.114
2. Psychoticism	−.124	–	.131	−.183	−.213	.053	.303*	−.074	−.381**	−.209	−.203	−.024
			.204	−.125	.013	.223*	.265*	−.107	−.278*	.017	−.096	−.363**
3. Extraversion	−.235**	.069	–	−.074	−.044	.349**	.268*	.383**	−.112	−.066	−.235	−.080
				−.234*	−.023	.367**	.330**	.122	−.087	.023	.022	−.173
4. Neuroticism	.748**	−.154	−.145	–	−.180	.122	.003	.133	.590**	.212	.226	−.047
					−.019	−.129	.007	.049	.600**	.352**	−.004	.067
5. Lie	−.083	−.094	−.018	−.081	–	−.152	−.145	−.101	−.124	.041	−.177	.070
						−.110	−.078	.080	−.150	.324**	−.040	−.048
6. BAS (drive)	−.078	.132	.351**	−.017	−.126	–	.605**	.613**	.066	.110	−.252	−.107
							.595**	.378**	−.077	.080	.071	−.025
7. BAS (fun)	−.048	.273*	.285**	.004	−.106	.599**	–	.491**	−.152	.105	−.136	.017
								.434**	−.120	.058	−.077	−.052
8. BAS (reward)	.059	−.173*	.298**	.094	.015	.477**	.440**	–	.283*	.028	−.117	.120
									.195	.171	.127	.091
9. BIS	.553**	−.364**	−.050	.592**	−.126	−.010	−.137	.269**	–	.142	.244	.088
										.350**	.188	.180
10. Fear	.226**	−.172*	.059	.294**	.226**	.092	.069	.174*	.301**	–	.101	−.009
											.132	−.047
11. Defensive direction (high = away)	−.009	−.244**	−.014	.104	−.073	−.064	−.105	.092	.257**	.203**	–	.228
												.340**
12. Defensive intensity	−.052	−.319**	−.020	.029	.023	−.051	−.029	.189*	.195*	.088	.380**	–

Note: Correlations for whole sample ($n = 141$) in lower left half of matrix, correlations for males ($n = 58$, upper) and females ($n = 83$, lower) in upper right half of matrix.

* $p < .05$.

** $p < .01$.

Table 6
Multiple regression of personality variables onto defensive responding

Predictor variables	β Coefficients for defensive direction	β Coefficients for defensive intensity
FSS total fear	.146	.028
Spielberger trait anxiety	−.206*	−.202*
Carver and White BIS	.276**	.200
EPQ psychoticism	−.124	−.260**

Note: $N = 141$ (58 males, 83 females).
* $p < .05$.
** $p < .01$.

orientate away from threat than low BIS/high psychoticism/low fear scorers.

Table 6 presents the results of multiple regressions of fear, trait anxiety, BIS, and psychoticism onto the two defensive variables. BIS (positively) and trait anxiety (negatively) were both significant predictors of defensive direction, but in opposite directions: BIS predicted orientation away from threat, whereas trait anxiety predicted orientation towards threat. Along with psychoticism, trait anxiety was additionally a significant predictor of defensive intensity: in this case the β coefficients show that high scorers on both traits were likely to respond with lower defensive intensity than low scorers.

4. General discussion

The main aim of this study was to test Gray and McNaughton's [9] prediction (a) that a positive association would exist between fear and orientation *away* from threat and (b) that a positive association would exist between trait anxiety and orientation *towards* threat. Results show correlation-based support for the first hypothesis and regression-based support for the second.

This second result represents a striking cross-species validation of Gray and McNaughton's [9] directional theory of anxiety as the responses that are reduced in rodents by anxiolytic drugs (e.g., risk assessment and defensive threat) turned out to be rarely selected by participants in the present study who scored low on trait anxiety (and who represent an approximate human analogue to rodents dosed with anxiolytic drugs). The fact that these anxiolytic-sensitive responses differ in almost every way other than their orientation towards threat is an endorsement of the directional criterion used by Gray and McNaughton [9] to define anxiety. This result also represents a validation of the threat scenario approach to measuring human defensive reactions because threat responses varied according to individual differences in anxiety in much the same way as the responses of rodents to real threats vary according to whether or not they have been dosed with anxiolytic drugs.

The reason why trait anxiety was significantly associated with orientation towards threat in regression but not in correlation may be that fear, BIS and psychoticism were themselves significant predictors of defensive direction (as shown in Table 5) and when included in regression with trait anxiety they simply reduced the error variability in the defensive scores, making for a more sensitive test that is capable of detecting a subtle effect of trait anxiety.

A subsidiary aim of this study was to explore associations between personality traits and perceptions of defensive distance (as indexed by the intensity of defensive reactions). Results suggested that the leading candidate for an "off-the-peg" personality scale that taps into perceptions of defensive distance is EPQ psychoticism, which showed a significant negative relationship to defensive intensity in both correlation and regression, such that high psychoticism scorers reacted as if they perceived threats as further away than low psychoticism scorers. EPQ psychoticism does not feature in Gray and McNaughton's [9] theory; however, such a result is consistent with the general tenets of the theory as high scorers on this trait are generally characterized as being tough-minded, aggressive, and bold [13]: by definition such people should be less reactive to threat.

Table 5 showed that psychoticism correlates significantly (negatively) with BIS and consequently BIS should also relate to defensive intensity. This was the case, suggesting that both these traits capture variance in perceptions of defensive distance. The BIS scale is a well-validated measure of general punishment sensitivity as conceptualized by the previous version of Gray's personality theory [20] – indeed, it was developed to measure a broader class of avoidance behaviour than that implied by Gray's definition of the BIS – and so these results are reassuring for the validity of the threat scenario approach even if this interpretation of the BIS has been superseded by the fear/anxiety distinction of the revised theory [9].

The finding that high scorers on trait anxiety responded to threat less intensely than low scorers is not concordant with rodent data showing that anxiolytics reduce defensive attack; however, on closer scrutiny, this finding is in line with Gray and McNaughton's [9] view of anxiety as a product of the Behavioural Inhibition System which, when activated, inhibits all pre-potent responses. Such inhibition would apply to defensive behaviour and might reasonably be expected to reduce the overall physical intensity of responding.

The preliminary aim of this study was to replicate the findings of Blanchard et al. [14] with a view to revealing the extent to which the threat scenario questionnaire constitutes a valid measure of human defensive. Results suggest a replication has occurred, both with respect to Blanchard et al.'s [14] specific hypotheses shown in Table 3 as well as the general patterns in defensive responding that were identified by Blanchard et al. [14]. For example, Blanchard et al. [14] found that animal parallel responses emerged as first choice for both men and women in 11 out of the 12 threat scenarios and the present study showed similar dominance by animal parallel responses: 'run away' emerged as first choice, for both men and women, in 5 out of the 12 scenarios (1, 3, 4, 7, and 11).

The sex differences identified by Blanchard et al. [14] were also broadly confirmed: they found that female participants had a greater propensity to select yell/scream/call for help in scenarios where men were more likely to select attack/struggle. This sex difference also showed up in the present study, most vividly in scenario 2 "You are alone in an elevator late at night. As it stops and the doors open, a menacing stranger rushes in to attack you,

blocking the door." This scenario was rated as most threatening and succeeded in eliciting intense defensive responses from both sexes, but as can be seen in Table 4, whereas 58.6% of men opted to attack only 34.9% of women did, with almost as many of the latter preferring yell/scream/call for help (32.5%).

These sex differences could reflect social desirability in that men may be reluctant to select yell/scream/call for help. A second explanation for sex differences in defensive reactions (especially the general tendency of women to respond as if they felt more threatened than men, as shown in Table 2) could be the significant size differences between men and women (on average male participants were 15 cm taller and almost 20 kg heavier than their female counterparts).

In summary, the responses of participants to a written threat questionnaire parallel the defensive responses of rodents faced with real threats in the same way as originally reported by Blanchard et al. [14]. This finding implies that the observed significant associations between personality scores and defensive reactions may, indeed, represent causal factors in personality as suggested by Gray and McNaughton [9]. Except for FSS fear, the personality scales did not map cleanly onto the two dimensions of defensive direction and intensity: defensive-specific variance was spread across psychoticism, trait anxiety and the BIS scale. Further behavioural and psychometric work will be needed to clarify the precise mapping of defensive dimensions and personality.

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