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Fear and Anxiety as Separable Emotions: An Investigation of the Revised Reinforcement Sensitivity Theory of Personality

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The Gray and McNaughton (2000) theory draws on a wide range of animal data to hypothesize that the emotions of fear and anxiety are separable. The authors tested their hypothesis in two studies. The first study examined associations between scores on questionnaire measures of fear, anxiety, and neuroticism; correlational analysis revealed that fear and anxiety are not interchangeable constructs. The second study examined associations between scores on questionnaire measures of fear/anxiety and performance in a military training setting; regression analysis revealed that fear captured significant variance in performance that was not shared with anxiety. These results imply that hypotheses derived from nonhuman animal data may hold important implications for understanding human emotion and motivation, especially in relation to fear and anxiety.

Keywords: fear, anxiety, revised reinforcement sensitivity theory of personality, tactical judgment in combat scenarios

People with a trait tendency to experience negative emotion are particularly vulnerable to psychiatric illness (Claridge & Davis, 2001). Discovering the cause of such a tendency (which is often labeled "neuroticism") is therefore a matter of considerable clinical importance. One of the most influential theories concerning the causal basis of neuroticism was published by Jeffrey Gray (1970, 1982) who proposed that neuroticism is a surface trait produced by the interplay of two more fundamental dimensions of personality, namely sensitivity to reward (labeled trait impulsivity) and sensitivity to punishment (labeled trait anxiety). According to this theory (now known as the Reinforcement Sensitivity Theory, RST, of personality; Pickering, Diaz, & Gray, 1995), high neuroticism represents a combination of both high trait impulsivity and high trait anxiety (i.e., the summation of sensitivities to reward and punishment).

In the years since 1970, a wide range of results both for and against RST have been published (e.g., Pickering et al., 1997; Corr, 2004), and the theory itself underwent a major revision in 2000 when Gray and McNaughton proposed that punishing stimuli should be subdivided into two classes, those that require approach (eliciting anxiety) and those that do not require approach, but simple avoidance (eliciting fear). This motivational direction-based distinction between classes of punishing stimuli contained in revised RST is derived mainly from a large body of findings by Caroline and Robert Blanchard that show rodent defensive behavior can be divided into two broad clusters: one associated with anxiety and the other with fear/panic (defensive behaviors are linked to emotion by dosing rodents with psychiatric drugs and observing the effects on their behavior). In particular it has been found that the class of drugs effective against generalized anxiety disorder does not affect all defensive behaviors to the same degree, but preferentially reduces those that involve orientation or approach toward threat, such as risk assessment in response to an approach/avoidance conflict (Blanchard, Griebel, Henrie, & Blanchard, 1997). In contrast, the class of drugs effective against panic disorder preferentially reduces behaviors that involve orientation away from threat (such as flight) without having the same effect on other behaviors (e.g., Blanchard, Griebel, & Blanchard, 2001; Griebel, Blanchard, Agnes, & Blanchard, 1995; Griebel, Blanchard, Jung, Masuda, & Blanchard, 1995).

As a result of such findings, Gray and McNaughton (2000) trace fear and anxiety to separate but interacting brain systems that together allow the animal to avoid threats while giving it a reasonable chance of accomplishing the appetitive acts necessary for the sustenance of life. This refinement means that the revised RST postulates the following brain systems: the fight-flight-freeze system (FFFS) which mediates fear and is activated by threatening stimuli that need not be faced, but can simply be avoided; the behavioral approach system (BAS) which is activated by appetitive stimuli and mediates the emotion of anticipatory pleasure, and the behavioral inhibition system (BIS) which mediates anxiety and is activated by goal conflicts of all kinds, paradigmatically between approach and avoidance, especially threatening stimuli that must be faced.

The key point to note is that the three systems in revised RST are based on a functional, rather than physical, analysis of emotional behavior. For example, Eilam (2005) showed how the three behaviors of fight, flight, and freeze, while physically very different and controlled by anatomically different regions of the brain, are woven into a single functional system by their service of the same function (to accomplish simple avoidance of a predator). The claim by Gray and McNaughton (2000) that threats that must be faced and threats that need not be faced are dealt with by different

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systems (the BIS and FFFS respectively) thus represents a major departure from previous analyses of emotional behavior that suggest avoidance is controlled by a single system (e.g., Miller, 1959). Moreover, by using rodent findings to explain human trait behavioral differences, Gray and McNaughton's (2000) theory of anxiety and fear supports the emerging consensus that the emotional systems of human and nonhuman animals share broad compatibilities and that research on nonhuman animals may shed light on the underpinnings of emotional disorders in humans.

Whether or not Gray and McNaughton's (2000) claim is correct remains to be determined as the test of the novel aspects of revised RST (most notably the concept of defensive direction) must await the development of new experimental paradigms (for an initial treatment of this topic, see Perkins & Corr, 2006a). There are, however, a number of well-established personality questionnaires that could be used to address the key implication contained in the revised RST that fear and anxiety can be separated. This question is likely to be of interest within the specialist domain of RST but also in emotion research more generally as it challenges the well-established view (e.g., Eysenck, 1967) that negative emotions of all kinds (including anxiety and fear) should be measured by a single dimension of personality, often labeled neuroticism (or in its reverse form, emotional stability). The limitations inherent in personality questionnaires (e.g., Hough, 1998; Rossé, Stecher, Miller, & Levin, 1998) mean that they may never provide a hard test of the revised RST; however, their scores do relate to a sufficiently wide range of important "real world" criteria (e.g., Barrick & Mount, 1991; Hough & Oswald, 2000; Barrick, Mount & Judge, 2001) to suggest that such an exercise will be an appropriate and informative step at this early stage in the exploration of the revised RST.

The importance of fear and anxiety in the canon of human emotions has inevitably meant that psychometric associations between fear and trait anxiety/neuroticism have already been extensively investigated (see Table 1 for a summary): the reason why further investigation is needed is that none of these existing studies have used statistical testing to verify whether or not correlations between fear and anxiety are significantly weaker than those typically observed between personality constructs, such as neuroticism and trait anxiety, that are psychometrically interchangeable (in the sense that scores on questionnaire measures of trait anxiety tend to correlate no more strongly with each other than they do with scores on questionnaire measures of neuroticism (Hagopian & Ollendick, 1996; Diaz & Pickering, 1993; Torrubia & Tobena, 1984). Thus, at present, the kind of weak to moderate associations that are typically found between fear and trait anxiety/neuroticism (as shown in Table 1) cannot safely be regarded as providing support for fear-anxiety separability even though at first glance they appear to do so.

The aim of Study 1 in the present research was to address this limitation of existing research by testing whether or not associations between questionnaire scores on fear, trait anxiety, and neuroticism in 141 adult volunteers were significantly different in magnitude (one of the preexisting studies shown in Table 1 [Hagopian & Ollendick, 1996] also reported fear correlations for both neuroticism and trait anxiety and so its findings were therefore suitable for testing in the same way as the fresh data). If the revised RST is incorrect and fear is simply neuroticism (or its psychometric analogue, trait anxiety) under a different name, then intercorrelations between these three constructs should not be significantly different in magnitude. Conversely, if fear and anxiety are separable, as Gray and McNaughton (2000) predict, then scores on trait anxiety and neuroticism should correlate significantly more strongly with each other than with scores on fear questionnaires. Testing this prediction of Gray and McNaughton's (2000) theory will thus lay some necessary groundwork concerning its face validity.

Study 1 did, however, have a limitation of its own concerning the nature of existing fear questionnaires. This limitation arose because, although numerous well-established questionnaire measures of fear exist, they tend to have been developed for the specific purpose of discovering the focus of a patient's phobia rather than measuring general personality. These questionnaires therefore typically consist of a list of potential phobic stimuli that are rated according to how much fear they elicit from the respondent. This format differs from that of most well-known personality questionnaires (which typically ask general questions such as "are you a worrier?"), so it could be argued that the kind of moderate to weak correlations between fear and trait anxiety/neuroticism shown by most of the studies in Table 1, even if they turn out to be statistically significant, are the unsurprising artifactual by-product of such questionnaire construction and format differences. In other words, a typical fear questionnaire may simply be a dilute measure of trait anxiety/neuroticism that captures a small amount of variance relating to these constructs but also a lot of variance that does not relate meaningfully to anything outside of the realm of specific phobias.

In order to be able to determine the true meaning of fear-anxiety correlations, such as those shown in Table 1, it was therefore necessary to examine whether or not fear questionnaire scores relate meaningfully to a nonclinical or "real-world" criterion that has a face valid reason to reflect fear differences. Thus, in Study 2 of the present research, our principal aim was to examine the extent to which fear questionnaire scores account for unique variance in a military examination of tactical judgment in combat scenarios. This criterion was particularly suitable for the present research because combat readily induces in humans such extreme and clear cut fear responses (e.g., loss of bowel control; Stouffer et al., 1950) that even a comparatively mild simulation of combat, containing no actual danger, might reasonably be expected to induce enough fear to harm the performance of particularly fear-prone individuals.

Most well-known fear questionnaires have provision for two types of scoring: total fear (the sum of scores on all items in the questionnaire) and facet fear (the sum of scores on items pertaining to particular types of fear). The Fear Survey Schedule (Wolpe & Lang, 1977), for example, can be used to measure the facets of animal fear, social/interpersonal fear, tissue damage fear, fear of noise, and classic phobias. Since combat entails the specific risk of tissue damage, availability of a tissue damage fear subscale presents an opportunity to perform an additional and more detailed check on the nonclinical validity of fear scores, this time at facet level (high scores on tissue damage fear should hypothetically be more detrimental to performance in combat scenarios than high scores on, e.g., animal fear). An additional aim of Study 2 was to test this hypothesis.

Aside from determining whether or not fear scores have utility outside of clinical settings, Study 2 also allowed the separability of fear and anxiety to be assessed from a novel angle because,

Table 1
Summary of Studies That Correlate Measures of Fear and Trait Anxiety or Neuroticism

Author(s)	Year	Fear Scale	Anx/N Scale	Participant details	*r* between Fear and Anx/N (corrected for attenuation in parentheses)
Lang & Lazovik	1963	FSS	MAS	Snake phobics (4 M & 9 F)	.80 (.91)
Hannah et al.	1965	FSS III	MPI N	Students (1154 M & 804 F)	.41** (.45)
Geer	1965	FSS II	MAS	Students (150 M & 55 F)	.39**/.55** (.44/.62)
Grossberg & Wilson	1965	FSS III	MAS	Students (203 M & 302 F)	.42**/.45** (.46/.50)
Manosevitz & Lanyon	1965	FSS III	MAS	Students (46 M)	.27 (.30)
Scherer & Nakamura	1968	FSSC	CMAS	Children 10 yrs (59 M & 40 F)	.41**/.52** (.45/.57)
Suinn	1969	FSS (modified)	TAS	Students (67/118)	.49**/.38** (.65/.50)
Hersen	1971	FSS II	MAS	Patients (160 M & 191 F)	.46**/.60** (.51/.66)
Hersen	1971	FSS III	MAS	Patients (160 M & 191 F)	.42**/.52** (.46/.57)
Schroeder & Craine	1971	FSS III	MAS	Snake phobics (107 F)	.56** (.62)
Bates	1971	FSS III	MAS	Patients (41 M)	.57** (.63)
Kilpatrick & McLeod	1973	FSS III	STAI (1970)	Students (36 F)	.52 (.57)
Ollendick	1983	FSSC-R	STAIC	Children 8-11 yrs (57 M & 42 F)	.44**/.56** (.47/.60)
Ollendick	1983	FSSC-R	STAIC	Children 8-11 yrs (51 M & 67 F)	32**/.50** (.34/.53)
Reiss et al.	1986	FSS II	MAS	Students (49 M & 98 F)	.45/.57 (.50/.63)
Abdel-Khalek	1988	FSS III (Arabic translation)	EPQ N	Students (204 M & 201 F)	.33**/.29** (.37/.32)
Hagopian & Ollendick	1996	FQ	EPQ N	Students (25 M & 36 F)	.42** (.49)
Hagopian & Ollendick	1996	FQ	STAI (1983)	Students (25 M & 36 F)	.38** (.44)
Lerner & Keltner	2001	FSS II (12 items)	STAI (1983)	Students (20 M & 55 F)	.54** (.61)
Lerner & Keltner	2001	FSS II (12 items)	STAI (1983)	Students (281 M & 320 F)	.57** (.64)
Kogan & Edelstein	2004	FSS II (for older adults)	BAI	Senior citizens (43 M & 71 F)	.40** (.43)
Cserjesi et al.	2004	FSS III (Dutch translation)	STAI	Patients (68 M)	.46** (.52)
Wilson & Hayward	2006	FQ	STAI	Children 14-18yrs (2246)	.31** (.36)

Note. FSS = Fear Survey Schedule (Lang & Lazovik, 1963); FSS III = Fear Survey Schedule III (Wolpe & Lang, 1964); FSS II = Fear Survey Schedule II (Geer, 1965); FSSC = Fear Survey Schedule for Children (Scherer & Nakamura, 1968); FSSC-R = Revised Fear Survey Schedule for Children (Ollendick, 1978); FSS (modified) = Fear Survey Schedule (Wolpe & Lazarus, 1966); FQ = Fear Questionnaire (Marks & Mathews, 1979); MPI N = Maudsley Personality Inventory Neuroticism (Eysenck, 1959); MAS = Manifest Anxiety Scale (Taylor, 1953); CMAS = Children's Manifest Anxiety Scale (Castenada, McCandless, & Palermo 1956); TAS = Test Anxiety Scale (Sarason, 1957); STAI = Spielberger Trait Anxiety Inventory (Spielberger, Gorsuch, & Lushene, 1970; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983); STAIC = Spielberger Trait Anxiety Inventory for Children (Spielberger, 1970); EPQ N = Eysenck Personality Questionnaire Neuroticism (Eysenck & Eysenck, 1975); BAI = Beck Anxiety Inventory (Beck, Epstein, Brown & Steer, 1988).
* $p < .05$. ** $p < .01$.

whereas Study 1 and many others like it examine fear-anxiety overlap purely from the perspective of questionnaire scores, Study 2 permitted the examination of fear-anxiety overlap from the perspective of the capacity of questionnaire scores to predict unique variance in applied behavior. The applied nature of the performance criterion used in Study 2 also touches upon a broader issue that has been around since the early days of RST, namely that causal level personality traits as postulated by RST may be less effective in applied settings than conventional personality questionnaires that "cut out the middle man" and measure surface level traits directly. This state of affairs has not been helped by the fact that most RST studies have been laboratory-based (notable exceptions include McCord & Wakefield, 1981, and Avila & Torrubia, 2004) and so have done little to shed light on the capacity of RST personality constructs to predict applied performance relative to more traditional personality models.

These circumstances mean that a subsidiary goal of Study 2 was to conduct a head-to-head comparison of ability to predict applied performance between the three causal level personality constructs from revised RST (reward sensitivity, fear and anxiety) and those from a well-established model of personality as it appears at the surface (in this case, the three dimensional PEN model developed by Hans Eysenck). As noted in the Introduction, the fear and anxiety constructs proposed in revised RST in effect represent subdivisions of the construct of general punishment sensitivity advanced in the previous version of RST: as an epilogue to Study 2, we therefore assessed whether fear and anxiety relate to the construct of general punishment sensitivity proposed in the original RST (Gray, 1970) in a lawful and predictable manner (i.e., if the revised RST is correct and fear and anxiety represent subdivisions of general punishment sensitivity, then they should together account for the variance in task performance accounted for by general punishment sensitivity). In summary therefore, the aim of the present research was to explore Gray and McNaughton's (2000) hypothesis that fear and anxiety are separable: (a) by testing correlations between relevant personality questionnaire scores; (b) by determining whether fear scores account for unique variance in performance in a nonclinical setting; and (c) by assessing how fear and anxiety predict performance in comparison to other measures of personality.

Study 1: Correlational Differences

Method

Participants. One-hundred and 41 members of the general public (58 males and 83 females), aged between 18 and 77 (M = 29.03; SD = 8.40) were recruited through advertisements in a college serving a mixed population of undergraduates, postgraduates, and evening class students, hence the relatively wide age range for a university based study (the age of 77 years is an extreme outlier in the age profile of participants: the next oldest participant was 52, and the majority of participants were under 30 years old). All participants gave informed consent prior to commencing the study.

Measures. Personality scales that, at face value, match the fear and anxiety constructs in revised RST were administered: anxiety was assessed by the Y2 (trait) scale of the Spielberger State–Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983), and fear by the Fear Survey Schedule (FSS; Wolpe & Lang, 1977). In selecting these questionnaires effort was made to choose measures of fear and anxiety that were not only well established but also designed completely independently of RST so that, if results fit the revised RST, they cannot be explained as an artifact of the questionnaire designer's intention to make them fit the theory.

The STAI Y2 scale is a fairly typical personality questionnaire that asks respondents the extent to which they agree with 20 statements such as "I feel nervous and restless" and is a well-established measure of anxiety. It has been used in hundreds of studies over the last three decades and is known to be reliable and valid (e.g., Barnes, Harp, & Jung, 2002; its Cronbach's alpha in the present research was .87). The STAI is so well used that almost any other questionnaire will appear to be less well established in comparison, and the FSS is no exception; nevertheless, the FSS has still been used in scores of studies over the last three decades that point to it being the most reliable and valid measure of fear available (e.g., Oei, Cavallo, & Evans, 1987; its Cronbach's alpha in the present research was .97). The long form version of the FSS used here consists of a list of 108 items representing specific aversive stimuli such as "worms" or "angry people." FSS respondents indicate, using a scale of 0 (*no fear*) to 4 (*very much fear*), how much they would be disturbed by each item.

One of the best-known neuroticism scales is that created by Hans Eysenck, so the Eysenck Personality Questionnaire Revised (short scale; Eysenck, Eysenck, & Barrett, 1985) was also administered. This questionnaire is designed to sample the personality factor space in the form of three fundamental dimensions: psychoticism (high scorers are typically characterized as being tough-minded, aggressive, masculine, nonconformist, inconsiderate, reckless, hostile, angry and impulsive); extraversion (high scorers are typically characterized as being outgoing, talkative, high on positive affect and prone to seeking stimulation); and neuroticism (high scorers are typically characterized as being anxious, depressed, prone to guilt, tense, moody and obsessive). The personality constructs measured by the EPQ-R short scale display acceptable levels of internal consistency: .73 to .88, except for the P scale of the EPQ-R which has a reliability of around .6 for both males and females (the P scale is not central to the hypotheses of the present study, so its lower reliability was not anticipated to be a problem. Cronbach's alpha for the N scale in the present research was .84).

Statistical analysis. Pearson's product-moment correlations were used to assess associations between personality constructs. Differences in magnitude between correlation coefficients were evaluated using the Z_1* statistic (Dunn & Clark, 1969; see Meng, Rosenthal, & Rubin, 1992), with the null hypothesis being that the magnitude of the correlation coefficient between the first (e.g., trait anxiety) and second (e.g., fear) variables is equal in size to the magnitude of the correlation coefficient between the first and third variables (e.g., neuroticism).[1] Because both the relationship between fear and trait anxiety and the relationship between fear and neuroticism were of interest, the Z_1* statistic was calculated twice for each sample. In addition, in order to ensure that any significant differences in correlation coefficient magnitude were not an artifact of differential nonperfect reliability of the questionnaire measures used in the present study, all correlations were corrected for attenuation (Spearman, 1907) prior to being tested for differences in strength.

Results

Table 2 presents descriptive statistics for the questionnaire measures, both for the whole sample and for the two sexes separately. Consistent with previous research (e.g., Diaz & Pickering, 1993; Geer, 1965), there were significant ($p < .001$) differences between males and females on psychoticism and fear. Table 3 presents correlations between personality variables and shows that, again consistent with previous research, trait anxiety and neuroticism were strongly related. Fear scores showed a weaker and similar association with both these constructs.

Statistical testing showed that the association between trait anxiety and neuroticism was significantly stronger than that between fear and trait anxiety or fear and neuroticism (fear-trait anxiety coefficient vs. trait anxiety-neuroticism coefficient, Z_1* = −6.02 [males] and −8.00 [females; both $p < .000$, two-tailed]; and fear-neuroticism coefficient versus trait anxiety-neuroticism coefficient, Z_1* = −6.10 [males] and −6.87 [females; both at $p < .000$, two-tailed]). Statistical testing was also applied retrospectively to data from the earlier study by Hagopian and Ollendick (1996) that reported fear correlations for both neuroticism and trait anxiety. This confirmed that, as with the freshly gathered data, the difference between the fear and anxiety/neuroticism correlations was highly significant (trait anxiety-fear coefficient vs. trait anxiety-neuroticism coefficient, Z_1* = −21.23; fear-neuroticism coefficient vs. trait anxiety-neuroticism coefficient, Z_1* = −17.10, both $p < .000$, two-tailed).

Study 2: Military Performance

Method

Participants. One hundred and one members of the U.K. University Officer Training Corps (UOTC), aged between 18 and 23

[1] More than one test statistic is available for comparing the magnitude of correlation coefficients, so in the present research we checked results obtained with the Dunn and Clark (1969) procedure using two other well-known tests (Williams, 1959; Steiger, 1980). Results obtained using all three procedures were closely comparable in magnitude and significance.

Table 2
Descriptive Statistics (Means and Standard Deviations) for Psychometric Measures in Study 1

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. Total fear	112.60 (59.74)*	91.45 (52.57)	127.56 (60.26)

Note. $N = 141$ (58 males, 83 females).
* A significant difference between the sexes, $p < .001$.

years (60 male, 41 female), with an average age of 20 ($SD = 0.87$). The UOTC is an organization run by the British Army that enlists volunteers into the Territorial Army (Britain's equivalent to the National Guard) while they are at university. Recruits typically train one evening a week (supplemented by one full weekend a month and a two week long annual camp) and are paid a starting salary of £32.40 per day as well as enjoying various perks such as subsidized adventure training and social events. The British Army funds the UOTC to promote understanding of the army among undergraduates (who are likely to be the employers and managers of the future) as well as to boost recruitment among students who had not thought of joining the army but who may be attracted into the UOTC by the pay and social life only to find that they enjoy the soldiering aspects as well. All participants gave informed consent prior to commencing the study.

Predictors. The same questionnaires were used as in Study 1. In addition, the BIS/BAS scales (Carver & White, 1994) were administered. These are a well-validated questionnaire measure of the personality dimensions of punishment (Behavioral Inhibition System: BIS) and reward sensitivity (Behavioral Approach System: BAS), postulated in the original version of RST—the reward sensitivity aspects of RST are essentially unaltered by Gray and McNaughton's (2000) revision (although the BAS scale was created before the revised version of RST, it theoretically represents an up-to date measure of revised RST reward sensitivity). Internal consistency coefficients (Cronbach's alpha for the BIS/BAS scales lie in the region of .8; e.g., Gomez, Cooper, & Gomez, 2005): test-retest reliabilities are slightly lower (between .59 and .69; Carver & White, 1994).

Table 3
Correlations Between Psychometric Measures in Study 1

Variable	1	2	3	4	5	6
1. Trait anxiety	—	−.033	−.216	.761**	−.069	.291**
2. Psychoticism	−.311*	—	.204	−.125	.013	.017
3. Extraversion	−.241	.131	—	−.234*	−.023	.023
4. Neuroticism	.741**	−.183	−.074	—	−.019	.352**
5. Lie	−.097	−.213	−.044	−.180	—	.324**
6. Total fear	.205	−.209	−.066	.212	.041	—

Note. $N = 141$ (correlations for 58 males in lower half of matrix, 83 females in upper half of matrix).
* $p < .05$. ** $p < .01$.

Performance criterion. UOTC members have to pass a first-year foundation course on basic soldiering skills (e.g., camouflage and marksmanship) in order to begin a training course (known as the military training qualification level two or MTQ2 for short) in the second year of their UOTC membership that is intended to teach the skills required of an army officer. This nationally recognized course is equivalent to the civilian National Vocational Qualification level 4 in organizational management and culminates in a 3-day examination of map-reading, radio knowledge, communication ability, and tactical judgment in combat scenarios.

Performance on the latter assessment module was chosen as the performance criterion in the present study because, unlike the other aspects of the examination, it has clear cut face validity as a variable likely to be sensitive to fear due to its simulation of dealing with combat.

The assessment of tactical judgment consisted of combat estimate and order-extraction exercises. In the combat estimate exercises, each candidate was taken individually to a suitable outdoors location (such as a hilltop), given command of a hypothetical unit (of platoon size; approximately 40 soldiers), presented with a combat scenario (such as an attack by enemy infantry toward the hilltop), and given 30 minutes to come up with a detailed battle plan. The order extraction exercises required each candidate to construct a set of orders pertaining to a hypothetical combat scenario in the appropriate need to know manner (i.e., matching the complexity of their orders to the level of the audience), also within a time limit of 30 minutes. These tasks are likely to engage a broad range of cognitions pertaining to actual combat and are designed to be as realistic as possible.

The tactical judgment performance of each candidate was graded by two independent assessors, both of whom were territorial or regular army officers ranging in rank from lieutenant to colonel, according to a predefined marking scheme in order to minimize subjectivity. Scores on the tactical judgment assessment module strongly influence the outcome of the MTQ2 examination as a whole, most likely reflecting a belief in the British Army that sound tactical judgment in combat is the most important attribute of all for officers (scores on tactical judgment typically correlate $>.8$ with overall scores on MTQ2).

Statistical analysis. A similar analysis to Study 1 was conducted. In the case of the secondary aim, multiple regression was also used to reveal their relative capacity to predict performance. Hierarchical multiple regression was used to test the overlap in predictive power between the previous RST constructs of general punishment sensitivity and fear and anxiety, with general punishment sensitivity being entered in the first step, and fear and anxiety being entered in the second step.

Results

Table 4 presents descriptive statistics for the whole sample and each sex separately. Mean fear scores for male and female participants in Study 2 were significantly lower ($p < .05$) than those found in Study 1 suggesting that military volunteers may, on average, be less fearful than the general population. The two personality variables that usually show significant sex differences (psychoticism and fear, with males scoring higher and lower than women, respectively) also showed none in this sample: this might be attributed to the fact that military work would seem likely to

Table 4
Descriptive Statistics (Means and Standard Deviations) for Psychometric Measures in Study 2

Variable	Overall	Males	Females
1. Trait anxiety	36.37 (8.99)	35.48 (8.07)	37.66 (10.18)
2. Psychoticism	3.70 (3.01)	3.90 (3.06)	3.41 (2.80)
3. Extraversion	8.44 (3.19)	8.18 (3.11)	8.80 (3.30)
4. Neuroticism	4.84 (2.97)	4.47 (2.83)	5.39 (3.12)
5. Lie	3.11 (2.67)	3.35 (2.89)	2.74 (2.27)
6. BAS (total)	40.74 (6.16)	40.78 (6.15)	40.68 (6.24)
7. BAS (drive)	11.95 (2.43)	11.95 (2.52)	11.95 (2.31)
8. BAS (fun)	12.59 (2.64)	12.88 (2.21)	12.17 (3.14)
9. BAS (reward)	16.20 (2.36)	15.95 (2.45)	16.56 (2.20)
10. BIS	18.79 (4.39)	18.28 (4.37)	19.54 (4.38)
11. Total fear	76.90 (39.00)	74.35 (39.12)	80.63 (38.99)
12. Animal fear	4.98 (5.35)	4.00 (4.86)	6.41 (5.77)
13. Social fear	31.78 (15.60)	31.18 (15.04)	32.66 (16.54)
14. Tissue damage fear	23.55 (15.15)	21.73 (13.42)	26.22 (17.20)
15. Noise fear	1.95 (1.90)	2.05 (2.10)	1.80 (1.57)
16. Classic phobias	9.95 (6.78)	10.23 (7.30)	9.54 (6.05)
17. Performance	150.64 (34.44)	154.04 (34.16)	145.67 (34.68)

Note. $N = 101$ (60 males, 41 females).

appeal to women who are more masculine (i.e., bolder) than average in their personality profile.

Table 5 presents intercorrelations for personality and performance variables. The correlations between fear and trait anxiety/neuroticism were of modest magnitude, whereas trait anxiety and neuroticism were strongly related. Statistical testing showed that the association between trait anxiety and neuroticism was significantly stronger than that between fear and trait anxiety or fear and neuroticism (fear-trait anxiety coefficient vs. trait anxiety-neuroticism coefficient, $Z_1^* = -6.89$; fear-neuroticism coefficient vs. trait anxiety-neuroticism coefficient, $Z_1^* = -6.80$; both $p < .000$, two-tailed). Trait anxiety and neuroticism were significantly ($p < .01$) correlated with extraversion and BAS, but in a negative direction. Fear scores were also significantly negatively related to extraversion and BAS scores as well as positively related to BIS scores. With regard to performance, the BAS fun subscale of the Carver and White questionnaire was the personality score most strongly positively associated with performance ($p < .01$). Extraversion and the other BAS scales were also positively and significantly associated with performance ($p < .01$). Trait anxiety was the personality score most strongly negatively associated with performance ($p < .01$). Neuroticism and fear were also significantly negatively associated with performance ($p < .01$), with tissue damage fear showing the strongest (negative) correlation to performance of all the fear subscales.

Table 6 presents the results of four different regression models of personality scales as predictors of performance. The best predictor of performance within the RST model was BAS (positively, $p < .01$) with fear also predicting performance significantly (negatively, $p < .05$)—trait anxiety narrowly failed to reach significance as a predictor of performance ($p < .05$). The second regression model that included fear subscales showed that tissue damage fear was by some distance the best (negative) predictor of combat scenario performance—in this model trait anxiety reached formal significance (negatively, $p < .05$). Within the third model, Eysenck's EPQ, extraversion was the most significant positive predictor of performance ($p < .01$) with neuroticism also reaching significance (negatively, $p < .05$). The adjusted R^2 values show that the RST personality constructs account for 12% more variance in performance than Eysenck's EPQ three personality dimensions and would seem to be better applied predictors: a fact confirmed in the combined RST/EPQ regression where both the constructs that emerged as significant predictors were from the RST model (BAS and Fear, $p < .05$). Finally, Table 7 indicates that general punishment sensitivity (BIS) is a highly significant negative predictor of combat scenario performance in its own right (as might be expected) but that the variance that it contains is better accounted for

Table 5
Correlations Between Psychometric Measures and Performance Criterion in Study 2

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Trait anxiety	—																
2. Psychoticism	−.115	—															
3. Extraversion	−.516**	−.033	—														
4. Neuroticism	.622**	−.140	−.464**	—													
5. Lie	−.028	.425**	−.161	.119	—												
6. BAS (total)	−.547**	.156	.542**	−.481**	−.041	—											
7. BAS (drive)	−.405**	.193	.334**	−.323**	.015	.845**	—										
8. BAS (fun)	−.538**	.213*	.518**	−.475**	−.106	.831**	.552**	—									
9. BAS (reward)	−.409**	−.028	.492**	−.392**	−.007	.811**	.560**	.482**	—								
10. BIS	.478**	−.380**	−.420**	.489**	−.033	−.547**	−.472**	−.612**	−.258**	—							
11. Total fear	.335**	−.148	−.198*	.334**	−.107	−.393**	−.415**	−.299**	−.265**	.517**	—						
12. Animal fear	.224**	−.092	−.107	.252*	−.087	−.176	−.099	−.228*	−.101	.366**	.726**	—					
13. Social fear	.228*	−.133	−.092	.204*	−.072	−.304**	−.420**	−.138	−.207*	.451**	.841**	.392**	—				
14. Tissue damage fear	.294**	−.107	−.244*	.369**	−.076	−.374**	−.300**	−.370**	−.254*	.443**	.846**	.738**	.501**	—			
15. Noise fear	.269**	.141	−.188	.055	−.075	−.118	−.122	−.054	−.123	.210*	.504**	.372**	.400**	.325**	—		
16. Classic phobias	.368**	−.224*	−.159	.321**	−.165	−.337**	−.365**	−.289**	−.180	.442**	.803**	.529**	.601**	.590**	.471**	—	
17. Performance	−.399**	−.009	.373**	−.351**	−.115	.480**	.356**	.511**	.314**	−.332**	−.386**	.185	−.313**	−.391**	.065	−.266**	—

Note. $N = 101$.
* $p < .05$. ** $p < .01$.

Table 6
Multiple Regressions of Predictor Variables With Combat Scenario Performance in Study 2

	β coefficients			
Predictor of performance	Model 1	Model 2	Model 3	Model 4
Trait anxiety	−.193	−.213*		−.152
BAS	.310**	.249*		.271*
Total fear	−.198*			−.215*
Animal fear		−.138		
Social fear		−.159		
Tissue damage fear		−.329*		
Noise fear		.113		
Classic phobias		.060		
Psychoticism			−.033	.122
Extraversion			.297**	−.009
Neuroticism			−.215*	−.102

Note. $N = 101$. Model 1 contains RST variables only; Model 2 contains RST variables, but with fear split into facets; Model 3 contains EPQ variables only; Model 4 contains RST and EPQ variables. A blank space in the table indicates that the predictor in question was not part of the model being tested and therefore was not entered in the regression. Adjusted R^2 for Model 1 = .291, adjusted R^2 for Model 2 = .284, adjusted R^2 for Model 3 = .168, adjusted R^2 for Model 4 = .292.
* $p < .05$. ** $p < .01$.

by fear and anxiety, each of which makes a unique and significant negative contribution to predicting performance.

General Discussion

The overall aim of the present research was to explore Gray and McNaughton's (2000) assertion that fear and anxiety are separable. Statistical testing showed the correlations between fear and trait anxiety/neuroticism were significantly smaller in magnitude than the correlations found between trait anxiety and neuroticism in both Studies 1 and 2. Given that trait anxiety and neuroticism are, for most practical purposes, interchangeable at the psychometric level (e.g., Hagopian & Ollendick, 1996; Diaz & Pickering, 1993; Torrubia & Tobena, 1984) this finding provides prima facie support for the claim made by Gray and McNaughton (2000) that fear and anxiety are separable, but it only takes on theoretical significance if fear scores have validity outside clinical settings. Study 2 addressed this issue and found that, far from being irrelevant in applied settings, fear scores accounted for more unique variance in performance than four other personality constructs, including anxiety.

Table 7
Hierarchical Regression of RST Punishment Sensitivity Variables (Original and Revised) With Performance Criterion in Study 2

Predictor of performance	β coefficients
Step 1	
BIS	−.332** (reducing to −.064 upon the introduction of Step 2 variables)
Step 2	
Trait anxiety	−.282**
Fear	−.258*

Note. $N = 101$. Adjusted R^2 for Step 1 = .101, adjusted ΔR^2 for Step 2 = .108 ($p < .01$).
* $p < .05$. ** $p < .01$.

The finding that military participants of both sexes in Study 2 possessed average fear scores significantly lower than those of the civilian participants in Study 1 also provides supplementary evidence for the validity of fear scores in nonclinical settings: at face value, the danger that is generally inherent in military activity would seem likely to deter especially fearful people from volunteering for UOTC service (in the event of a major war UOTC members are drafted before ordinary civilians so this danger is real, if unlikely). Additional finer grained support for the validity of fear scores in nonclinical settings was also provided on two counts: (a) scores on tissue damage fear related in a predictable and face valid way to performance in combat scenarios; and (b) scores of other fear subscales that have no face valid reason to relate to performance in combat scenarios (such as animal fear) turned out to show no significant relationship to performance.

Explanation of the nonsignificant association between social fear and performance shown in Table 6 is less straightforward given that the assessment setting was inherently evaluative and many of the items in the FSS that measure social fear are, at face value, concerned with fear of negative evaluation (e.g., item 49 "Being criticized"; item 61 "Feeling rejected by others," "Feeling disapproved of"; item 76 "Looking foolish"). Participants who scored high on social fear would thus seem likely, at first glance, to be more distracted from the task at hand by fear of appearing incompetent than their less socially fearful peers and consequently be at a performance disadvantage relative to them. The reason why this did not occur is unclear. One tentative post hoc explanation could be that social fear is elicited more strongly by the evaluations of one's peers than by the evaluations of strangers because it discourages behavior that will erode a person's standing in the eyes of their particular social group.

If this assumption concerning the functional significance of social fear is valid, then the evaluations of people from outside the participants' peer group, such as the assessors in Study 2, would not be particularly effective in eliciting social fear, especially since participants were tested alone and had no means of knowing how their performance compared to the group reference norm until after the assessment was finished. An interesting extension of the present study would, therefore, be to examine the effect of social fear on tactical judgment in combat scenarios under two different assessment conditions: first by strangers and second by peers, with the hypothesis being that social fear would correlate significantly (negatively) with performance in the second condition but not the first.

Taken as a whole, these findings suggest that fear scores (and especially scores on the tissue damage subscale of the Fear Survey Schedule) are tapping a personality construct of fearfulness in a sensible and face valid manner. Concerns that fear scores measure nothing of relevance beyond the psychiatric consulting room would, therefore, seem to be unfounded, and consequently the plethora of weak to moderate correlations found between fear and trait anxiety/neuroticism in previous studies (see Table 1) can, after all, be taken as evidence in support of Gray and McNaughton's (2000) assertion that fear and anxiety are distinct. Given that this theory is directly based on rodent research (e.g., Blanchard et al., 1997; Griebel, Blanchard, Agnes et al., 1995; Griebel, Blanchard, Jung et al., 1995), the findings of the present investigation provide further empirical evidence in support of the relevance of nonhuman animal data and theory for

human beings. This extensive body of research seems especially promising in addressing problems concerning human emotion and motivation.

The secondary aim of Study 2 was to explore the combined ability of the three personality constructs in revised RST to predict performance in comparison to a more traditional personality model (in this case Hans Eysenck's PEN model). Results suggest that the RST constructs have considerable utility: they all made separate contributions to the prediction of performance and together accounted for 12% more variance in performance than Eysenck's three personality dimensions. This apparent higher utility of the revised RST personality constructs relative to those proposed by Eysenck was confirmed in a third multiple regression containing all six personality constructs from both models: the only personality constructs to emerge as significant predictors of performance from this combined regression were both from RST (BAS and fear). This result does not, however, mean that surface level personality traits are redundant because it is plausible that different applied settings require different levels of analysis for optimal prediction of performance. It is to be hoped that future research will explore this issue.

An interesting aspect of these regressions is the way in which the predictive power of extraversion disappeared when BAS was introduced into the regression (extraversion's β coefficient declined from .297 to −.009 with the introduction of the RST constructs). This finding suggests that extraversion may be substantially underpinned by reward sensitivity, as Gray proposed over 30 years ago. Assessing the effects of reward sensitivity on performance was not an aim of the present research but, given that those who passed the MTQ2 examination received a substantial financial reward (a 13% pay rise) and those who failed were dismissed from the UOTC (effectively suffering a 100% pay cut), it is reassuring for the general validity of RST that performance correlated positively with sensitivity to reward (if we consider scores on the BAS scale to be a reasonable index of this trait). Results also suggest that general punishment sensitivity (as measured by the BIS scale) is in turn underpinned by separate contributions of fear and anxiety, a finding that brings the present research full circle by to some extent reconciling the revised version of RST with the original.

Moving beyond the immediate topic of interest, a range of previous studies suggests that cognitive ability may buffer the performance damaging effects of general negative emotionality in military settings (e.g., Macklin et al., 1998; McNally & Shin, 1995; Perkins & Corr, 2006b; Pitman, Orr, Lowenhagen, Macklin, & Altman, 1991; Watson, Davenport, Anderson, Mendez, & Gearhart, 1998). These findings raise the interesting possibility that, in Study 2 of the present research, the negative impact of fear on performance may have been lower for high ability participants than their less cognitively able peers. Standardized ability scores were not available for the participants in the present research; therefore, this issue could not be empirically addressed. Future research could also examine the influence upon combat judgment of openness to experience/intellect as, although this construct has been found to have little bearing on occupational performance in general (Barrick, Mount, & Judge, 2001), an analysis of its effects on combat judgment relative to fear would provide a interesting supplement to the present research.

In summary, the present findings support the revised reinforcement theory of personality (Gray & McNaughton, 2000; McNaughton & Corr, 2004). Not only was fear found to be psychometrically separable from anxiety but it also accounted for a significant amount of unique variance in applied performance that was not captured by any of the other personality constructs measured in the present research. Results also point to the efficacy of basic reinforcement sensitivities as predictors of applied performance as these turned out to have greater utility than traditional constructs that measure surface personality traits. Two kinds of support were found for the persistent criticism of the original RST that trait anxiety and neuroticism are similar constructs (e.g., Eysenck & Eysenck, 1985). They showed similar (and weak) correlations to fear and showed similar (and weak) ability to predict applied performance. These results overall raise the surprising possibility that existing personality models have somehow overlooked the importance of fearfulness as a personality trait and might be usefully supplemented by such a construct, both to provide a more comprehensive sampling of the personality factor space and also improve their capacity to predict applied performance.

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