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Assessment of implicit personality self-concept using the implicit association test (IAT): Concurrent assessment of anxiousness and angriness

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This study explored the psychometric properties of the Implicit Association Test (IAT) when it is employed for the assessment of two personality traits within one sample. The sequence of an anxiousness and an angriness IAT was counterbalanced across 100 participants and the IATs' predictive validity for anxious versus angry behaviour after emotion inductions was examined and compared to direct self-report measures. The anxiousness IAT added incremental validity over direct measures for the prediction of anxious behaviour. The angriness IAT was affected by an order effect. When the angriness IAT was completed after the anxiousness IAT both tests correlated with $r = .46$ whereas they were not significantly correlated when the angriness IAT was completed first. Direct anxiousness and angriness measures were uncorrelated. Implications for the assessment of multiple implicit personality self-concept dimensions are discussed.

Probably the easiest way to find out how anxious individuals are is to ask them to report their anxiousness. Consequently, direct questionnaire measures are the most commonly used method for the assessment of personality. However, there are two reasons why direct asking does not always provide valid information (e.g. Greenwald & Banaji, 1995). First, individuals may try to present themselves in a favourable light by faking their answers. For instance, they may describe themselves as self-confident although they know that they are rather anxious. Second, individuals may not fully realize how anxious they are due to introspective limits. They may estimate themselves as self-confident although they show anxious reactions in many situations. In the last decades, social cognition research developed indirect measurement procedures that are less affected by self-presentational strategies and introspective limits, and provide complementary valid information that can help to have a more comprehensive assessment of constructs such

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as anxiousness. The most prominent of these procedures is the Implicit Association Test (IAT; Greenwald, McGhee, & Schwartz, 1998).

In the IAT, the automatic association between a bipolar target concept (such as self vs. others) and a bipolar attribute concept (such as anxious vs. self-confident) is assessed through a series of discrimination tasks that require fast responding. Participants are instructed to categorize exemplars of these concepts and to use two response keys for their categorization (e.g. left response key for self and anxious words vs. right response key for others and self-confident words). Faster responses are expected when two highly associated categories (e.g. self and anxious for an anxious individual) share the same response key than when they are assigned to different response keys.

The IAT proved to be a promising candidate to enrich the method spectrum of personality assessment because of two reasons. First, several studies showed that the IAT assesses individual differences with internal consistencies that are satisfactory and considerably higher than these of alternative indirect procedures (see Teige, Schnabel, Banse, & Asendorpf, 2004, for a more detailed discussion). Second, the IAT was shown to add incremental validity over questionnaire measures for the prediction of behaviour. Asendorpf, Banse, and Mücke (2002) showed that a shyness IAT increased significantly the prediction of spontaneous shy behaviour in a realistic social situation. Egloff and Schmukle (2002) showed that an anxiousness IAT but not direct self-report measures predicted anxious behaviour during a videotaped speech. Finally, the IAT was also shown to be useful for clinically oriented research (see De Houwer, 2002, for an overview)

Explicit versus implicit personality self-concept

The differences between questionnaire and IAT measures or between direct and indirect procedures at the empirical level are related to the distinction between the explicit and the implicit personality self-concept at the construct level. In line with a general definition of the self-concept by Greenwald *et al.* (2002), Asendorpf *et al.* (2002) defined the self-concept of personality as an associative network containing all associations of the concept of self with attribute concepts describing one's personality, thus attributes that describe individual, relatively stable, non-pathological characteristics of the person. Referring to current two system models of information processing (e.g. Strack & Deutsch, 2004), we assume the self-concept of personality to be represented in both explicit and implicit representations. *Explicit representations* of the personality self-concept are based on propositional structures that result from processing information in a controlled and reflective way. The proposition, 'I am a very anxious person'. is an example of an explicit representation of the personality self-concept. *Direct measures* (e.g. questionnaires) are an attempt to assess such explicit representations. Direct measures contain valid information as far as they refer to parts of the self-concept of personality that are introspectively accessible. They may contain invalid information due to self-presentational concerns or measurement error.

In contrast, *implicit representations* are based on associative structures that result from processing information in an automatic and impulsive way. An example for an implicit representation is the spontaneous tendency to associate the concept of the self with anxiousness. *Indirect measures* (e.g. IAT procedures) are an attempt to assess such implicit representations. Indirect measures are based on information that is not intentionally given to inform about the self. They contain valid information as far as they refer to parts of the self-concept of personality that are accessible through the particular

assessment methodology. Indirect measures may contain invalid information due to systematic biases of the assessment methodology or measurement error.

Although we conceptualized explicit and implicit representations as propositional and association representations, respectively, we do not assume that they are necessarily different. Explicit and implicit representations are related to each other because all propositional representations comprise the concepts of two or more association representations (e.g. 'me' and 'anxious'). Explicit and implicit representations are different from each other because many association representations may not become part of propositional representations due to limited introspective accessibility. This view stresses the interactions between explicit and implicit representations as components of a reflective and an impulsive system of information processing (cf. Strack & Deutsch, 2004). Consequently, there is no pure measure of the explicit or the implicit personality self-concept. However, we assume that indirect procedures like the IAT primarily involve the impulsive system (Asendorpf *et al.*, 2002) and refer only secondarily to controlled processes within the reflective system (cf. Fazio & Olson, 2003). Therefore, indirect procedures aim at measuring implicit representations and should show incremental validity over direct measures that aim at assessing explicit representations.

Goals of the present research

The main goal of the present study was to test whether the IAT allows for the assessment of more than one personality attribute within one testing session. Using the traits of anxiousness and angriness as examples, we explored whether the IAT shows potential for the assessment of multiple personality dimensions. The traits were labelled 'anxiousness' and 'angriness' rather than 'anxiety' and 'anger' to make clear that they refer to personality traits and not to emotional states. Throughout this article, we use the terms 'anxiousness' and 'angriness' when we refer to trait measures (i.e. measures that assess how people usually feel) and the terms 'anxiety' and 'anger' when we refer to state measures (i.e. measures that assess how people actually feel). Direct measures offer broad possibilities for the assessment of multiple personality traits. For instance, the Big Five measures (e.g. Costa & McCrae, 1992) allow for the assessment of five relatively independent personality dimensions. Anxiousness and angriness are differently related to the three Big Five dimensions neuroticism, extraversion, and agreeableness. Anxiousness is highly correlated with neuroticism, moderately correlated with introversion, and uncorrelated with agreeableness. In contrast, angriness is highly negatively correlated with agreeableness and is weakly positively correlated with both neuroticism and extraversion (Ostendorf, 1990). In accordance with their opposite correlation patterns, anxiousness and angriness are conceptualized as orthogonal dimensions and are uncorrelated. This pattern of relationships facilitates the study of convergent and discriminant validity between direct and indirect measures because zero correlations are expected for all correlations between anxiousness and angriness. Furthermore, a correlation between the anxiousness and the angriness IAT can be interpreted as shared method variance.

The validity of the anxiousness and the angriness IAT should not only be explored as convergent and discriminant validity with direct measures, but also as predictive validity for the prediction of anxious and angry behaviour after emotion inductions. This is especially interesting because previous research demonstrated that the anxiousness IAT shows incremental validity over direct measures for the prediction of anxious behaviour

(Egloff & Schmukle, 2002). Thus, the present study aimed to test the incremental validity of the IAT when it is used for the concurrent assessment of anxiousness and angriness. The anxiousness and the angriness IAT were applied as two consecutive tests and their sequence was counterbalanced across participants to control for order effects.

Methods

Participants

A total of 103 university students were recruited as participants on the campus of Humboldt University, Berlin, none of whom were psychology students or had participated in the laboratory's previous studies. Most participants were directly approached by an experimenter (not identical with the experimenter at the laboratory). Some participants were recruited using postings at the university buildings. Participants were asked to take part in a study on concentration and personality. As a compensation, participants were offered €10 (approximately £7 at the time) for completing a questionnaire of about 15 minutes duration at home and for participating in a laboratory experiment of about one hour duration. In addition, they could receive individual feedback on their results after the study was complete. All participants claimed to be native German speakers. Three female participants refused to complete the speaking task during the laboratory session, and were therefore excluded from analysis. This led to a final sample of 100 participants (50 male, 50 female; age M = 24.0 years, range 19–32 years).

Assessments and measures

Overall procedure and design

All participants (a) judged themselves on several personality measures at home one week before the laboratory session. After arrival at the laboratory, they (b) completed a short form of the d2 Attention-Stress Test, (c) completed the anxiousness IAT and the angriness IAT, (d) indicated their state anxiety and state anger on bipolar items, (e) received instructions for an anxiety-inducing speech, (f) completed a retest of (d), (g) prepared their speech, (h) were videotaped during their speech, (i) were videotaped during an anger-inducing computer crash, (j) completed a retest of (d), (k) were interviewed about the experiment, and (l) were completely debriefed.

The anxiousness and angriness items of the two IATs were included as direct self-ratings in step (a), (d), (f) and (j). The order of the anxiousness IAT and the angriness IAT in step (c) was varied between participants such that half of the participants completed the anxiousness IAT first and the other half completed the angriness IAT first. The assignment to the two orders was balanced for gender and alternated between successive participants. In contrast, the order of the anxiety and the anger induction was fixed, such that the anxiety induction always came first, because it seemed difficult to successfully induce anxiety after the faked computer crash.

Finally, the participants were thanked and asked to give their consent for the evaluation of the videotapes (all agreed). They were also paid and promised individual feedback about their results. Four months after finishing data collection, participants received a letter containing the principal findings of the study along with an invitation for an individual feedback session, in which interested participants were informed about their personal results.

Trait measures

In order to minimize transfer effects between direct and indirect measures, direct trait measures were mailed to the participants at least 1 week before the laboratory session. The instructions explained to participants that the study was about concentration and personality and consisted of two parts: a set of questionnaires concerning several personality attributes, that was attached and had to be completed at home, and a subsequent laboratory session assessing attention and concentration. We avoided telling participants that the study was about anxiousness and angriness because we (a) did not want anxious persons to avoid participation in the study, and (b) wished keep participants naive about the anger induction, as most people would not get angry knowing that it was intended to provoke their anger (Stemmler, Heldmann, Pauls, & Scherer, 2001).

The mailed questionnaire contained the following measures (test references list the used German version first, and the English equivalent second, if such equivalent existed). The questionnaire started with the trait forms of the State Trait Anxiety Inventory (STAI; Laux, Glanzmann, Schaffner, & Spielberger, 1981; Spielberger, Grousch, & Lushene, 1970) and the State Trait Anger Expression Inventory (STAXI; Schwenkmezger, Hodapp, & Spielberger, 1992; Spielberger, 1988) together with the subscales 'interference' and 'lack of confidence' (without the item 'Ich bin überzeugt, dass ich gut abschneiden werde' ['I am sure, that I will receive good marks']) of the Test Anxiety Inventory (TAI-G; Hodapp, 1991; expanded German version of the TAI, Spielberger, 1980). These questionnaires assess enduring symptoms of anxiousness, angriness, and test anxiousness on a 4-point scale (1 = almost never, 4 = almost always) with 20, 10, and 11 items, respectively. The TAI-G subscales were added, and all scales were mixed in a fixed random order, because some participants in a pilot study became suspicious about the cover story when the STAI and the STAXI were presented in separate blocks. When both scales were mixed with the TAI-G, the STAI, and the STAXI were less salient, and the true content of the experiment was much less apparent.

The trait measures proceeded with the second series of the Speaking anxiety scale (Spitznagel, Schlutt, & Schmidt-Atzert, 2000). This questionnaire assesses habitual emotionality (e.g. 'I am quite nervous') and worries (e.g. 'I fear negative consequences') immediately before giving a speech with 8 items each. Items were presented on a 4-point scale (1 = I do not agree at all, 4 = I agree completely).

Subsequently, participants had to rate their conscientiousness, intellect, attentiveness, anxiousness and angriness on 33 bipolar adjective pairs (e.g. 'self-confident 1-2-3-4-5-6-7 anxious'). The pairs were mixed in a fixed random order and presented with a trait instruction. The 10 intellect and 10 conscientiousness pairs were the same as in Asendorpf *et al.*'s Study 1 (2002). We further added 3 attentiveness pairs to make the cover story more plausible. The first pair was 'aufmerksam' ['attentive'] versus 'durcheinander' ['jittery'] that was adapted from the positive and negative affect schedule (PANAS; Krohne, Egloff, Kohlmann, & Tausch, 1996; Watson, Clark, & Tellegen, 1988). Two additional pairs were synonymous.

The five anxiousness pairs (anxious vs. self-confident) and the five angriness pairs (angry vs. self-controlled) were constructed on the basis of 430 unipolar and 179 bipolar adjective items provided by Ostendorf (1990). He had factor analysed these adjective items and reported their loadings on the first five factors that could be interpreted as the factors of the five-factor model of personality. For the anxiousness pairs, we selected adjective items that were strongly correlated with neuroticism, moderately correlated with introversion, and uncorrelated with agreeableness. For the angriness pairs, we

selected items that were weakly correlated with neuroticism and extraversion, and strongly negatively correlated with agreeableness. These items were pre-tested in a student sample ($N = 42$; age $M = 22.6$ years, range 19–39 years). The resulting 5-item bipolar anxiousness scale showed acceptable internal consistency ($\alpha = .84$), correlated strongly with neuroticism ($r = .82$; $p < .001$), intermediately with extraversion ($r = -.45$; $p = .003$), and non-significantly with agreeableness ($r = -.19$). The resulting 5-item bipolar angriness scale showed acceptable internal consistency, $\alpha = .77$ and correlated marginally with neuroticism ($r = .21$; $p = .18$) and extraversion ($r = .22$; $p = .17$), highly with agreeableness ($r = -.78$; $p < .001$), and was not correlated with the 5-item anxiousness scale ($r = .01$). All items of the bipolar anxiousness and angriness scale were used as stimulus words for the IATs and are listed in Table 1.

Finally, the questionnaire concluded with the social desirability scales by Lück and Timaeus (1969; Crowne & Marlowe, 1960) and Stöber (1999; without the item, 'Have you ever consumed drugs'). These scales contain 16 and 23 items, respectively, and measure socially desirable responding by asking for socially desirable but infrequent or socially undesirable but frequent behaviours on a true-false format. Items of both scales were presented in a fixed random order together with the Manifest anxiety scale (MAS; Lück & Timaeus, 1969; Taylor, 1953). The 23 items of this scale assess various symptoms of anxiousness (e.g. 'I work under a great deal of tension'). The reliability of all trait measures was satisfactory and is reported in Table 3 of the Results section.

Laboratory session

Upon arrival at the laboratory participants were reminded that the experiment was about attention and concentration. The experimenter briefly explained that the laboratory session contained different concentration tests, two of which were on the computer, and one being a paper-and-pencil test, as well as a situation demanding attention and concentration that would be videotaped. Subsequently, participants received instructions for the first concentration test. Because men might repress their anger facing a woman, and women might avoid getting angry with a physically superior man, the experimenter was always of the same gender as the participant.

d2 test

As first test, participants completed a shortened two-minute version of the d2 Test of Attention (d2 Test; Brickenkamp, 1994). The d2 Test is a paper-and-pencil test that asks participants to perform a simple discrimination task by crossing out as fast as possible relevant stimuli (the letter *d* with two lines above or below it) while ignoring irrelevant stimuli (the letter *d* with more or fewer than two lines as well as the letter *p*). We used the d2 Test to give a better justification for the cover story; therefore, results will not be reported here.

Anxiousness and angriness IAT

Task sequence and stimuli of the anxiousness and the angriness Implicit Association Test (IAT) are depicted in Table 1. Since this study focused on inter-individual differences, and because we did not want to confound person variance with method variance, the task sequence and the stimulus order was fixed within both IATs. Both IATs were the same, except for the attribute dimension, being anxious versus self-confident within

Table 1. Implicit Association Tests for anxiousness and angriness: Task sequence and stimuli

			Response key assignment	
Sequence	*N* of trials	Task	Left key	Right key
1	40	Target discrimination	Me	Others
2	40	Attribute discrimination	Anxious (angry)	Self-confident (self-controlled)
3	80	Initial combined task	Me, anxious (angry)	Others, self-confident (self-controlled)
4	40	Reversed target discrimination	Others	Me
5	80	Reversed combined task	Others, anxious (angry)	Me, self-confident (self-controlled)

		Stimuli			
		Anxiousness IAT		Angriness IAT	
Me	Others	Anxious	Self-confident	Angry	Self-controlled
I	They	anxious	self-confident	angry	self-controlled
Self	Them	timid	daring	hot-tempered	thoughtful
My	Your	insecure	secure	undercontrolled	self-disciplined
Me	You	worried	unconcerned	hot-headed	adaptable
Own	Other	overly cautious	carefree	Irritable	calm

Note. IAT = Implicit Association Test. The procedures of the anxiousness and the angriness IAT were identical. Words in parentheses refer to the task sequence within the angriness IAT. The original German stimuli are depicted in Table 4.

the anxiousness IAT, and angry versus self-controlled within the angriness IAT. Each IAT consisted of five different blocks of discrimination tasks. On each trial, a stimulus word was displayed in the centre of the screen. Participants were instructed to categorize the stimulus as quickly and accurately as possible according to the category labels that were displayed in the right or left upper screen corner. The category labels were assigned to the right (the number '5' of the numeric keypad) or left (the letter 'a') response key, respectively. Responses were recorded using ERTS software (Behringer, 1994). After correct responses, the inter-stimulus interval was 300 ms. After incorrect responses, the stimulus was immediately replaced by the word *febler* (German for error) for 1,000 ms, resulting in a 1,300 inter-stimulus interval. In the combined tasks, the stimuli alternated between target (me, others) and attribute (anxious, self-secure or angry, self-controlled) discrimination.

Data reduction procedure followed Greenwald, Nosek, and Banaji (2003) and IAT scores were computed as D measures with an error penalty of 600 ms, and without the exclusion of trials below 400 ms (for details on the complete algorithm, see Greenwald *et al.*, 2003). As with conventional scores, D measures were based on the difference between mean response latencies in the combined blocks (Sequence 5 and Sequence 3; see Table 1), but were scaled in units of the individuals' standard deviations and included an error penalty for incorrect responses. High scores represented quicker associations of me-anxious and others-self-confident relatively to me-self-confident and others-anxious, or of me-angry and others-self-controlled relatively to me-self-controlled and others-angry, respectively. In contrast to Greenwald *et al.*, all trials were considered equally and the first 20 trials were not weighed as more important as the succeeding trails, because we (a) did not declare the first 20 trials as training trials and (b) had 60 instead of 40 succeeding trials. (Different procedures of weighing the first 20 trials more than the succeeding trials did only minimally change the results). Internal consistencies were evaluated across test halves and are reported in the Results section.

State measures

As a manipulation check for the emotion inductions, we used bipolar items for anxiousness and angriness together with a *state* instruction. These items were mixed in a fixed random order with 3 out of 10 attentiveness and 7 out of 10 conscientiousness items. The items were presented in a paper-pencil version, and were identical to those completed as a trait measure at home. Three conscientiousness items were dropped, because we expected them not to match the state instruction (e.g. 'fleiβig' ['industrious'] vs. 'faul' ['lazy']). State measures were presented after the IATs (baseline), the instructions for the speech (anxiety induction), and after the computer crash (anger induction). Reliabilities for the state measures were satisfactory, internal consistencies were for the anxiety scale $\alpha = .89$, for the change in anxiety (speech minus baseline) $\alpha = .78$, for the anger scale $\alpha = .80$, and for the change in anger (computer crash minus baseline) $\alpha = .74$.

Anxiety induction

Participants received instructions for the speech on a piece of paper. The paper informed participants that they should give a speech that would be videotaped and later on analysed by experts. The requested duration of the speech was 5 minutes. Directly after this announcement, participants completed the state measures. Subsequently, they were told about the subject of the speech (terminal illness and euthanasia: immoral or humane; adapted from Egloff, Schmukle, Burns, & Schwerdtfeger, in press, Study 3) and were given

3 minutes for preparation. Participants were allowed to make notes during preparation, but the speech was supposed to be given without notes. Then, participants gave their speech directly in front of the video-camera that was operated by the experimenter from a nearby room. After exactly 5 minutes, the experimenter thanked the participants and informed them that this was enough. When participants stopped talking before the 5 minutes were over, the experimenter prompted them to continue talking until full 5 minutes were up. The time period before participants continued their speech was defined as missing. For the judgments and codings of anxious behaviour, secondary tapes were prepared that contained the first 3 minutes of noninterrupted speech. The speech task was followed by the anger induction.

Anger induction

The general procedure was adapted from Wiedig (2004) and is similar to a procedure used by Bargh, Chen, and Burrows (1996, Experiment 3). Participants completed a STROOP-Test on the computer. Again, participants were videotaped and were told that this was to evaluate their eye-blink-rate as an indicator of concentration. In fact, this was to give good reason for videotaping the interaction with the experimenter. Three minutes after starting the STROOP, the screen froze and the words 'FATAL ERROR' appeared in the centre of the screen. In addition, a short but intensive error sound was given, whenever a key was pressed. The experimenter then approached the participant and pretended to be astonished by the accident. The subsequent interaction between experimenter and participant comprised three different provocations. First, the experimenter accused the participant of causing the crash by incorrectly using the *enter* key. Second, she or he said that all computer-based data of the participant were now destroyed. Third, due to loss of data, participants could not receive any money for the experiment. After this, participants were asked to complete the state measures, waiting for a computer expert who may help to save the data. For the judgments and codings of angry behaviour, secondary tapes were prepared. The recording started when the computer crashed and ended when participants began completing the state measures. For the anger judgments, a 3-second blue screen interval was inserted after the end of each of the three provocations to enable separate ratings for each provocation.

Interview

The aim of the interview was to identify participants who doubted the alleged computer crash. Participants were asked the following questions: (1) 'Did you have difficulties with any part of the experiment?', (2) 'Did you notice anything remarkable during the experiment?', (3) 'Did anything in the experiment seemed strange to you?' (4) 'What did others tell you about the experiment?' and (5) 'What do you think the experiment was about?' All participants (11 female and 12 male) who mentioned in response to any of these questions that the computer crash was part of the experiment were excluded from the analysis of the anger induction. These participants did not differ significantly from the remaining participants on any of the anxiousness and angriness measures.

Debriefing

Finally, participants were completely and thoroughly debriefed about the true purpose of the study. It was ensured that participants had an opportunity to relax after the disturbing computer crash, and would not leave the laboratory angry or upset. In the beginning of debriefing, the participants were offered some sweets by the experimenter

as a compensation for a rather harsh preceding interaction. Then, participants were informed that the study was not on concentration and attention but on anxiousness and angriness, and aimed to validate new computer-based measures for these traits. Thereby, the experimenter went through the crucial parts of the study (direct and indirect measures, emotion inductions) and explained why these procedures were designed to assess anxiousness and angriness. In order to keep the true purpose of the study undisclosed for the subsequent participants, the experimenter asked the participants to keep the information about the study confidential until they received a letter from the experimenter. This letter was sent out 4 months after finishing data collection and comprised the main findings of the study together with an invitation for an individual feedback session.

Judgments of anxious and angry behaviour

Four student judges who were unfamiliar with the participants and blind to their data independently rated their overall impression of the participants' anxiety (1 = 'not at all anxious', 7 = 'very anxious') and anger (1 = 'very angry', 7 = 'not at all angry') on 7-point scales. For the anxiety judgment, three consecutive 1-minute intervals of the 3-minute speech were rated. For the anger judgment, each of the three provocations after the computer crash (alleged misuse of the *enter* key, loss of data, no money) was judged separately. The resulting 12 anxiety and 12 anger judgments were averaged for each participant. The anxiety ratings were anchored by a female and a male example of extremely anxious and extremely nonanxious participants from the study by Egloff and Schmukle (2002). In the same way, the anger judgments were anchored by extremely angry and non-angry examples from the study by Wiedig (2004). Inter-rater reliability was satisfactory for all judgments (see Results section).

Results

Efficacy of emotion inductions

To investigate whether the speech and the computer crash were apt to observe anxious and angry behaviour, we first examined the efficacy of these emotion inductions. One-way ANOVAs for repeated measures were conducted to estimate differences of self-reported state anxiety and state anger across the three measurement points (baseline, announcement of the speech, computer crash). Results showed that state anxiety differed significantly, $F(2, 198) = 14.12$, $p < .001$) and state anger differed marginally, $F(2, 152) = 2.77$, $p < .10$) across the three situations. (The degrees of freedom were smaller for anger because we had to exclude participants who were suspicious about the computer crash). Single comparisons (one-sided tests) showed that participants reported more state anxiety after the announcement of the speech ($M = 3.39$, $SD = 1.04$) than at the beginning of the experiment ($M = 3.02$, $SD = 0.81$), $t(99) = 4.11$, $p < .001$, $d = .58$, and more state anxiety after the announcement of the speech than after the computer crash ($M = 2.92$, $SD = 0.84$), $t(99) = 4.67$, $p < .001$, $d = .66$. Baseline anxiety and state anxiety after the computer crash did not differ significantly from each other, $t(99) = 1.14$, *ns*. Concerning changes in state anger, participants reported more state anger after the computer crash ($M = 2.53$, $SD = 0.75$) than at the beginning of the experiment ($M = 2.35$, $SD = 0.71$), $t(76) = 1.98$, $p < .05$, $d = .31$. However, state anger was also higher after the announcement of the speech than at baseline, $t(76) = 2.37$, $p < .05$, $d = .38$, and participants did not report more

state anger after the computer crash than after the announcement of the speech ($M = 2.49$, $SD = .71$), $t(76) = .50$, *ns*. Thus, only the announcement of the speech, but not the computer crash, increased self-reported state anxiety, whereas both the computer crash and the announcement of the speech tended to increase self-reported state anger. Because we did not counterbalance the sequence of the emotion inductions, and the speech situation was always before the faked computer crash (see Methods section), we could not examine whether state anger would have been increased by the computer crash alone. Even though the anger induction effect was relatively small, the significant correlations between direct angriness measures and the observer judgments of angry behaviour (see below) are an indicator for the validity of the anger induction.

Descriptive statistics for the anxiousness IAT, the angriness IAT, and the observer judgments

The descriptive statistics of the IATs and the observer judgments are presented in Table 2. As can be seen in the table, the mean raw scores were negative for both IATs. In the anxiousness IAT, only 9 (6 female, 3 male) out of 100 participants had positive IAT scores. Thus, most of the participants were quicker to combine me + self-confident and others + anxious than for the reverse mapping. In the angriness IAT, only 4 (1 female, 3 male) out of 100 participants had positive scores. Thus, most of the participants were quicker to combine me + self-controlled and others + angry than for the reverse mapping. Mean error rates were for the anxiousness IAT, $M = 4.2\%$, $SD = 2.6\%$, and for the angriness IAT, $M = 3.6\%$, $SD = 2.3\%$. In any IAT, no participant had error rates higher than 15% or more than 10% of the latencies faster than 300 ms. The distributions of the improved and individually standardized D measures were not even marginally different from a normal distribution in both IATs, $Z < 1$. Internal consistency (see Table 2) for the IATs was computed across the two test halves and was acceptable for the anxiousness IAT but somewhat unsatisfactory for the angriness IAT. Internal consistency was satisfactory for the observer anxiety and angry judgments.

Convergent and discriminant validity of direct measures

This section inspects the convergent and discriminant validity of the bipolar anxiousness and angriness self-ratings that were also used as word material within the

Table 2. Descriptive statistics of the IATs and the observer judgments

Variables (range of scores)	N[a]	M	SD	Range	Reliability[b]
Anxiousness IAT[c]	100	−171.1	156.9	−641–179	.72
Angriness IAT[c]	100	−186.6	133.2	−533–161	.66
Observer anxiety judgment (1–7)	100	3.27	1.06	1.33–6.42	.89
Observer anger judgment (1–7)	77	3.80	.83	1.75–6.08	.87

Note. IAT = Implicit Association Test.
[a]Sample size is smaller for the observer anger judgment because participants, who realized that the anger induction was part of the experiment, had to be excluded from the analyses of the anger induction.
[b]Internal consistency alpha for IATs; agreement α of four observers for observer judgments.
[c]In milliseconds except for reliability.

IATs. The reliabilities and correlations of all direct trait measures are depicted in Table 3. Reliability (Cronbach's α) was satisfactory for all measures, in particular, it was .84 for the bipolar anxiousness and .80 for the bipolar angriness self-rating. As can be seen in the first two rows of Table 3, the bipolar *anxiousness* self-rating correlated highly with the Manifest anxiety scale and the trait form of the STAI, and intermediately with the subscales of the Speaking anxiety scale. These subscales assess habitual emotionality and worries immediately before giving a speech and, in contrast to general anxiousness questionnaires, are more situation-specific. The bipolar anxiousness self-rating also showed a low correlation with the trait form of the STAXI.

In contrast, the bipolar *angriness* self-rating did not even marginally correlate with any direct anxiousness measure and correlated intermediately with the trait form of the STAXI. Thus, the correlation for the angriness self-rating with the corresponding trait measure was somewhat lower than for the anxiousness self-rating. Nevertheless, a Steiger's (1980) test of correlation differences revealed that the bipolar angriness self-rating correlated marginally higher with the trait form of the STAXI, $r = .45$, than the bipolar anxiousness self-rating, $r = .23$, $t(97) = 1.65$, $p = .05$ (one-tailed). Moreover, the trait form of the STAXI did not only correlate with the bipolar anxiousness self-rating, but also with other direct anxiousness measures. This replicated the results of previous studies (Schwenkmezger *et al.*, 1992) showing that the STAXI was correlated with anxiousness because individuals high in neuroticism were more concerned with their anger expression than those individuals who were emotionally stable. The lack of discriminant validity of the trait form of the STAXI may further account for the intermediate correlation between this scale and the bipolar angriness self-rating. Thus, convergent and discriminant validity with established measures were shown for the bipolar anxiousness and angriness self-ratings. This validated the word material we used as attributes within the IATs, at least at the level of direct measures. Importantly, bipolar anxiousness and angriness self-ratings were uncorrelated ($r = .08$, *ns*) as it was expected because they were conceptualized as orthogonal dimensions.

Convergent and discriminant validity of indirect measures

As can be seen in Table 3, the anxiousness IAT correlated significantly with the bipolar anxiousness self-rating and the Manifest anxiety scale, and marginally with the worries subscale of the Speaking Anxiety Questionnaire and the trait form of the STAI. The anxiousness IAT did not correlate with the bipolar angriness self-rating or the trait form of the STAXI. The angriness IAT, in contrast, correlated neither with direct angriness nor with direct anxiousness measures. Thus, discriminant and convergent validity with direct measures was shown for the anxiousness IAT but not for the angriness IAT.

Surprisingly, the correlation between the anxiousness and the angriness IAT was significantly positive ($r = .32$, $p < .01$), although direct anxiousness and angriness measures as well as the observer anxiety and anger judgments were uncorrelated (see Table 3). Moreover, the presentation order of the IATs moderated the correlation between the IATs. In the group that completed the anxiousness IAT first, both IATs were substantially correlated, $r = .49$, $p < .001$, whereas they were not even marginally correlated in the group that completed the angriness IAT first, $r = .17$, *ns*. This correlation difference was marginally significant, $z = 1.77$, $p < .10$ (two-tailed) and should not be attributed to sample effects, because direct anxiousness and angriness were uncorrelated in both groups of different IAT order.

Table 3. Correlations between the main variables

	1	2	3	4	5	6	7	8	9	10	11	12[a]	13	14[a]
1. Bipolar anxiousness self-rating	*.84*	−.08	.30**	.35***	.72***	.73***	.23*	−.08	.25*	−.04	.22*	−.04	.56***	.02
2. Bipolar angriness self-rating		*.80*	−.05	−.05	.12	.07	.45***	−.30**	−.03	.11	−.01	.38**	−.02	.18
3. Speaking anxiety emotionality			*.88*	.72***	.36***	.28**	.13	−.16	−.01	−.03	.29**	.03	.52***	−.06
4. Speaking anxiety worries				*.84*	.44***	.40***	.23*	−.23*	.17^{+}	.05	.15	.02	.40***	.03
5. Manifest anxiety scale					*.82*	.78***	.39***	−.30**	.21*	.00	.19^{+}	.04	.47***	.13
6. State trait anxiety inventory[b]						*.90*	.37***	−.25*	.17^{+}	.02	.19^{+}	.06	.45***	.09
7. State trait anger expression inventory[b]							*.78*	−.34***	−.01	.03	.00	.33**	.09	.17
8. Social desirability								*.81*	.02	−.08	.06	−.05	−.18^{+}	−.06
9. Anxiousness IAT									*.72*	.32**	.26**	−.09	.11	.16
10. Angriness IAT										*.66*	−.07	−.11	−.08	−.06
11. Observer anxiety judgment											*.89*	.00	.38***	−*.01*
12. Observer anger judgment[a]												*.87*	−.12	.14
13. State anxiety after emotion induction													*.89*	−.07
14. State anger after emotion induction[a]														*.80*

Note. IAT = Implicit Association Test. $N = 100$. Internal consistencies (Cronbach's α) are printed in *italics* along the diagonal.
$^{+}p < .05$; $*p < .05$; $**p < .01$; $***p < .001$.
[a]$N = 77$.
[b]Trait form.

Importantly, this order effect was recently replicated in an independent study (Teige *et al.*, 2004).

A possible explanation for this asymmetrical effect (the IATs were correlated when the anxiousness IAT was the first test but not when the angriness IAT was the first test) might be that a positive-negative or valence dimension was stronger in the anxiousness IAT than in the angriness IAT. Working on the anxiousness IAT, participants could have possibly developed a classification heuristic, discriminating anxious versus self-confident as positive versus negative attributes. In other words, participants may have recoded the IAT task, because a discrimination of positive versus negative is easier than a discrimination of anxious versus self-confident (cf. De Houwer, 2001). This *task-recoding* was salient during the anxiousness IAT. After completion of the anxiousness IAT, the task recoding could have been transferred onto the angriness IAT, which would have lead to a positive correlation between both IATs. In contrast, the angriness IAT was less likely to elicit a positive-negative task recoding, because angry versus self-controlled is less associated with a positive-negative dimension. Consequently, when the angriness IAT was the first test, the participants did not spontaneously use a positive-negative recoding of the task, and the IATs did not correlate with each other.

To examine whether the anxiousness and the angriness IAT differed with respect to a positive-negative dimension, 41 undergraduate psychology students rated the valence of the IAT stimuli on a 7-point scale (negative [− − −] [− −] [−] [0] [+] [++] [+++] positive). Answers were coded such that higher values indicated more positive valence. Means and standard deviations of the valence ratings are shown in Table 4. Results showed that the five self-confident attributes were judged more positively than the five self-control attributes, $t(40) = 6.82$, $p < .001$, $d = 1.50$, whereas the five anxious attributes were not judged more negatively than the five angry attributes, $t(40) = 1.35$,

Table 4. Valence ratings of the IAT stimuli

Attributes	*M*	*SD*	Range	Attributes	*M*	*SD*	Range
Anxious (ängstlich)	2.68	1.15	1–6	Angry (ärgerlich)	3.07	1.27	1–6
Timid (furchtsam)	2.49	1.08	1–5	Hot-tempered (aufbrausend)	2.34	1.28	1–6
Insecure (unsicher)	2.20	0.84	1–4	Undercontrolled (unbeherrscht)	1.88	0.87	1–4
Worried (besorgt)	3.78	1.44	1–6	Hot-headed (hitzköpfig)	2.83	1.30	1–7
Overly cautious (übervorsichtig)	2.17	1.00	1–5	Irritable (motzig)	1.95	1.09	1–6
Mean anxious attributes	2.66	0.83	1.2–5.0	Mean angry attributes	2.41	0.70	1.4–4.6
Self-confident (sicher)	6.02	0.82	4–7	Self-controlled (kontrolliert)	4.76	1.37	2–7
Daring (wagemutig)	4.85	1.20	3–7	Thoughtful (bedächtig)	4.73	0.92	3–7
Secure (selbstvertrauend)	6.37	0.66	5–7	Self-disciplined (selbstbeherrscht)	4.98	1.19	3–7
Unconcerned (sorglos)	4.24	1.56	1–7	Adaptable (fügsam)	2.46	1.16	1–6
Carefree (unbeschwert)	5.44	1.23	2–7	Calm (friedlich)	5.54	1.05	3–7
Mean self-confident attributes	5.39	0.69	3.6–6.6	Mean self-controlled attributes	4.49	0.61	3.4–6.0

Note. IAT = Implicit Association Test. The scale format was a 7-point scale with 1 indicating negative, 4 indicating neutral, and 7 indicating positive valence.

$p = .18$, $d = .31$. Thus, we found the expected difference between the stimuli of the anxiousness and the angriness IAT with respect to valence, but it was true only for the positive attributes (i.e. the self-confident and the self-control attributes) and not for the negative attributes (i.e. the anxious and the angry attributes). Importantly, one attribute (adaptable) within the self-control attributes was judged negatively when it was tested against the neutral scale mid-point, $t(40) = 8.45$, $p < .001$, whereas none of the anxious attributes was judged positively, and none of the self-confident attributes was judged negatively. In sum, an underlying positive-negative dimension was less apparent in the angriness IAT than in the anxiousness IAT. Consequently, there might have been the transfer of a positive-negative dimension from the anxiousness IAT on the angriness IAT, but not vice versa.

Predictive validity of direct and indirect measures

In this section, we report the results of hierarchical regression analyses that explored whether the observer anxiety and anger judgments were predicted by direct and indirect measures. Because we wanted to study the incremental validity of the IATs over and above direct measures, we entered the anxiousness or angriness IAT after the direct measures. We also performed preliminary tests and explored whether the order of the IATs moderated the predictive validity of the IATs, entering both the order main term and the interaction terms into the regressions. Neither the order main term nor the interaction terms were significant. Thus, we did not introduce the interaction terms in the final regressions but we entered the order main term in Step 1 to covariate order effects from the results. To examine the prediction of the observer anxiety judgment, we entered the order effect in Step 1, all direct anxiousness and anxiety measures (the bipolar anxiousness self-rating, the subscales emotionality and worries of the Speaking Anxiety Questionnaire, the trait form of the STAI, the Manifest anxiety scale, and the bipolar state anxiety self-rating) in Step 2, and the anxiousness IAT in Step 3. The direct measures contributed significantly to the prediction of the observer anxiety judgment when entered in Step 2, $R^2 = .142$, $p < .05$, and the anxiousness IAT showed an independent contribution when entered in Step 3, $R^2_{\text{change}} = .064$, $p < .01$. When all variables were entered into the equation in Step 3, the bipolar state anxiety self-rating and the anxiousness IAT were significant predictors, $\beta = 0.28$, $t = 2.28$, $p < .05$, $\beta = 0.27$, $t = 2.81$, $p < .01$, the emotionality subscale was a marginal predictor, $\beta = 0.29$, $t = 1.96$, $p < .10$, and all other predictors were not significant.

To examine the prediction of the observer *anger* judgment, we carried out the same hierarchical regressions. Again, the presentation order of the IATs was entered in Step 1, direct measures (the bipolar angriness self-rating, the trait form of the STAXI, and the bipolar state anger self-rating) were entered in Step 2, and the angriness IAT was entered in Step 3. The direct measures contributed significantly to the prediction of the observer anger judgment when entered in Step 2, $R^2 = .180$, $p < .01$. However, the angriness IAT did not show an independent contribution when entered in Step 3, $R^2_{\text{change}} = .017$, *ns*. When all variables were entered into the equation in Step 3, the bipolar angriness self-rating was a significant predictor, $\beta = 0.30$, $t = 2.60$, $p < .05$, the trait form of the STAXI was a marginally significant predictor, $\beta = 0.20$, $t = 1.69$, $p < .10$, and the state anger self-rating and the angriness IAT did not significantly account for the observer anger judgment, $\beta = 0.05$, $t = .40$, *ns*, $\beta = 0.13$, $t = -1.24$, *ns*.

In order to explore whether the lack of predictive validity of the angriness IAT may be attributed to the relatively small anger induction effect ($d = .31$) we conducted

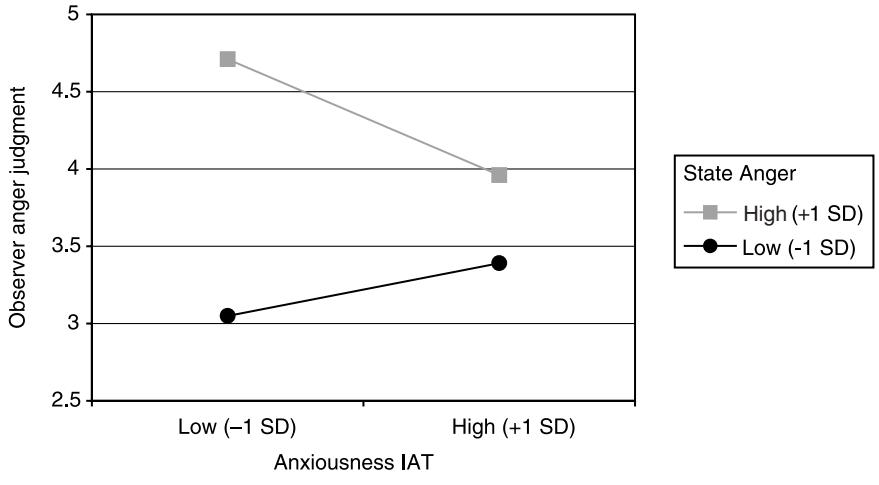

Figure 1. Graphical representation of the interaction effect between the angriness IAT and self-reported state anger in predicting angry behaviour.

a moderator analysis. We regressed the observer anger judgment on the angriness IAT, on self-reported state anger after the computer crash (residuals of a simple regression on baseline anger), and on the interaction term of both variables. The statistic of interest was the regression weight of the interaction term. Surprisingly, it was negative, $\beta = 0.28, t = -2.49, p < .05, R^2_{\text{change}} = .075$. The interaction is displayed graphically in Figure 1. As indicated by the regression slopes, the correlation between the angriness IAT and the observer anger judgment tended to be positive for participants reporting low (median split) state anger and negative for participants reporting high state anger, $r = .12$, *ns*, $N = 38$ and $r = -.28$, $p < .10$, $N = 39$, respectively.

We have no plausible explanation why the IAT-behaviour correlation tended to be negative for participants reporting high state anger. Additionally, this moderation effect was not true for the direct angriness measures. Thus, we refrain from over-interpreting this result. Future research should elucidate the reasons why IAT measures fail to show predictive validity even if the IATs use the same stimuli as direct self-reports that significantly predict behaviour. Valence influences, which we consider in the Discussion, are one possible factor that may confound IAT effects and that may represent a threat to the validity of IAT measures.

Discussion

This study explored the psychometric properties of an anxiousness and an angriness IAT. The sequence of the IATs was counterbalanced and their predictive validity for anxious versus angry behaviour after emotion inductions was examined. The anxiousness IAT correlated with direct anxiousness measures and added incremental validity over direct measures for the prediction of anxious behaviour. The angriness IAT neither correlated with direct angriness measures nor did it show predictive validity for angry behaviour. Additionally, there was an unexpected order effect on the correlation between the IATs. In the next sections, we discuss order effects on IAT correlations and explore possible reasons why the angriness IAT failed to show predictive validity.

Order effects on IAT correlations

In this study, we counterbalanced the order of an anxiousness and an angriness IAT and found that both tests were, like the direct anxiousness and angriness measures, not even marginally correlated when the anxiousness IAT was completed after the angriness IAT. In contrast, the IATs were significantly correlated when the anxiousness IAT was completed before the angriness IAT. The difference between the two correlations was marginally significant and was attributed to the transfer of a positive-negative self-dimension from the anxiousness IAT to the angriness IAT. Valence ratings of the IAT stimuli corroborated the hypothesis that a positive-negative dimension was more salient in the anxiousness IAT than in the angriness IAT. Recently, the order effect on the correlations between the IATs was replicated in an independent study (Teige *et al.*, 2004).

The account of the order effect in terms of a positive-negative task recoding is somewhat related to the salience asymmetries account that was recently used to explain IAT effects (Rothermund & Wentura, 2004; but see also, Greenwald, Nosek, Banaji, & Klauer, 2005). According to the salience asymmetries account, participants base their categorization of the bipolar IAT concepts primarily on the salient category (the 'figure') and neglect the non-salient category (the 'ground'). The salience asymmetries account also proposes that negative IAT categories are more salient than positive ones (Rothermund & Wentura, 2004). At least for the direct valence ratings, only the positive but not the negative categories of the anxiousness and the angriness IAT were rated differently. Consequently, the salience asymmetries account cannot explain why the transfer effect was asymmetrical (from the anxiousness IAT to the angriness IAT, but not vice versa) because the salience asymmetries account refers to the negative category, and the valence-ratings of the anxiousness and the angriness IAT stimuli differed only with respect to the positive category. Importantly, the salience asymmetries account attempts to explain IAT effects for particular IATs and does not explain context or transfer effects in multiple assessment. We assume that both IAT categories (e.g. 'self-confident' and 'anxious') contribute to IAT effects and that concept discriminations within the IAT are based on the valence or semantic contrasts between these concepts (cf. Greenwald *et al.*, 2005; Mierke & Klauer, 2003).

There are several other studies that employed more than one IAT within one sample and counterbalanced the IAT presentation order (e.g. Greenwald *et al.*, 2002, 2003; Teachman, Gregg, & Woody, 2001; Teachman & Woody, 2003; Wiers, van Woerden, Smulders, & de Jong, 2002). Many of these studies do not report order effects, or they report complex interaction effects with order and other variables (e.g. gender or drinker type, Wiers *et al.*, 2002) on mean IAT effects. In many cases, sample sizes are too small ($ns < 30$) to explore order effects on correlations, and none of these studies used more than one self-concept IAT. The only study that used more than one self-concept IAT (one anxiety and one extraversion IAT) is, to our knowledge, a study by Schmukle and Egloff (2005) that does not report any effects of IAT order. At the present level of knowledge, it seems reasonable to assume that there are order effects on IATs, especially on the size of IAT effects (Nosek, Greenwald, & Banaji, in press) that may also affect the assessment of multiple personality attributes. However, to what extent and why presentation order affects the correlations of the IATs remains a question for future research. Because order effects seem to be strongest from the first to the second IAT, future research designs may include neutral control IATs (e.g. a geometrical objects IAT, Mierke & Klauer, 2003) as the first IAT in order to reduce effects of presentation order (Nosek *et al.*, in press).

Correlations of IAT measures may be influenced not only by the order of the IATs but also by whether direct measures are presented before or after the IATs. In a recent meta-analysis, Hofmann, Gawronski, Gschwendner, Le, and Schmitt (2005) found no consistent effects of the measurement order of direct and indirect measures on the correlations between these measures. In order to sidestep possible transfer effects from direct measures on the IATs we asked participants to complete direct self-ratings at home within one week before the IAT assessments at the laboratory. Directly before the IATs, participants completed a short concentration test (shortened version of the d2 test) as a justification of the cover story ('personality and concentration'). This concentration test took only 100 seconds to be completed. Nevertheless, it may have produced subtle effects on the IAT scores. It is, therefore, important that the order effect on the IAT correlations was replicated in another study that did not employ the d2 test and presented direct self-report measures before the IATs.

Semantic meaning and valence

Assuming that participants have recoded the IAT task in terms of a positive-negative self-evaluation, the present findings raise a question about the extent to which IAT measures are driven by the semantic meaning as opposed to the positive or negative valence of the stimuli. If IATs mainly reflect the ease with which one combines positive versus negative stimuli with me, then the IATs represent self-esteem IATs (e.g. Greenwald & Farnham, 2000), rather than indirect measures of different personality attributes. Can the empirical findings of different self-concept IATs be reinterpreted in terms of implicit measures of self-esteem?

Concerning the anxiousness IAT, the answer might be 'yes'. In the studies by Egloff and Schmukle (2002), the anxiousness IAT predicted performance decrement due to failures in a concentration test, and anxious behaviour during an evaluative speech task. Both behaviours may also be predicted by a 'pure' self-esteem IAT that does not directly refer to anxiousness (cf. Greenwald & Farnham, 2000). The results from the anxiousness IAT of the present research may be reinterpreted using the same logic. The same reasoning can be applied to the shyness IAT (Asendorpf *et al.*, 2002) as well, such that shy behaviour could be related to low self-esteem. Already at the level of direct measures, shyness and anxiousness are negatively correlated with self-esteem (Cheek & Melchior, 1990; Judge, Erez, Bono, & Thoresen, 2002). Thus, it is difficult to disentangle valence and specific semantic meaning in anxiousness and shyness because a valid portion of these attributes already contains negative self-evaluation.

Some studies have attempted to separate valence from semantic effects on IAT measures. For instance, Rudman, Greenwald, and McGhee (2001) showed that the positive or negative valence of stimuli affected the IAT in addition to the relevant attribute dimension. In their studies, female participants showed no IAT effect in a gender stereotype IAT when stereotypically female attributes (e.g. weak) were negative and stereotypically male attributes (e.g. powerful) were positive. This was explained by a tendency of the female participants not to combine their own gender with negatively valenced attributes. Females showed the expected stereotypic gender associations in the IAT only when the gender attributes were balanced for valence. Thus, the valence of the gender attributes influenced the gender IAT even if participants did not categorize the stimuli according to their positive or negative valence. On the other hand, results from Steffens and Plewe (2001) show that the stereotypic gender association of pleasant (e.g. empathic, gentleman-like) and unpleasant (e.g. bitchy, violent) attributes has an effect

on the gender attitude IAT. Female participants showed stronger associations between female names and positive attributes and between male names and negative attributes when the positive attributes were stereotypically female and the negative attributes were stereotypically male. Thus, even if participants had to categorize the stimuli according to their positive or negative valence, the semantic meaning of the attributes (i.e. stereotypically male or female) influenced the IAT effect. Teachman *et al.* (2001) employed a valence IAT (bad-good) and two fear-specific IATs (afraid-unafraid, danger-safety) to assess associations with spiders and snakes in a group of participants that were either spider or snake phobic. Analyses of covariance showed that the fear-specific IATs yielded different effects for spider- versus snake-phobic participants, even after controlling for the impact of the valence IAT. In summary, IATs are probably affected by both specific semantic and evaluative information and context effects seem to play an important role; for example, whether the semantic or evaluative dimension of the attributes is made salient. Although it may be difficult to separate semantic meaning and valence because valence information is an important part of the semantic information, future research should examine to which extent the IAT is influenced by the positive and negative valence or by the specific semantic meaning of the stimuli. One possibility to circumvent the problem of valence confoundings is to balance the IAT attribute categories for valence.

Behaviour prediction through direct and indirect measures

The observer judgments of anxious behaviour during the speech and the observer judgments of angry behaviour during the computer crash were predicted by the direct anxiousness and angriness self-ratings, respectively, that participants completed at home 1 week before the laboratory experiments. Additionally, the anxiousness IAT added incremental validity over direct measures for the prediction of the observer anxiety judgment thereby replicating results from Egloff and Schmukle's (2002) Study 4. In contrast to Egloff and Schmukle's results, the observer anxiety judgments were also predicted by the direct measures in our study. This might be due to the fact that we included several direct measures in addition to the trait form of the STAI. The situation-specific direct measures (i.e. the emotionality subscale of the Speaking Anxiety Questionnaire and the bipolar state anxiety items) were particularly strong predictors for the observer anxiety judgment in the present study. Yet, the trait form of the STAI also correlated marginally with the observer anxiety judgment, $r = .19, p < .10$, whereas this was not true for Egloff and Schmukle's study, $r = .12$, *ns*. However, this correlation difference was only small, and the lack of predictive validity of the direct anxiousness measure in Egloff and Schmukle's Study 4 might also be attributed to the small sample size ($N = 33$). Thus, the present study is in line with the expectation that direct measures show small to moderate validity for the prediction of behaviour (Funder, 1999).

One could argue that the anxiousness IAT showed incremental validity only because it was completed within the laboratory experiment that also explored the anxious behaviour, whereas the direct anxiousness measures were completed at home. Therefore, the anxiousness IAT might capture situational or occasion-specific effects that are not reflected by the direct anxiousness measures. Importantly, the anxiousness IAT explained unique portions of variance even if the direct state anxiety measure was included into the regression analysis. Thus, it seems reasonable that the anxiousness IAT assesses aspects of the personality self-concept that are valid for the prediction of behaviour but that are not captured by direct measures.

Compared with the anxiousness IAT, the angriness IAT did not add incremental validity over direct measures for the prediction of behaviour and did not even correlate with the observer anger judgment. We explored whether this lack of predictive validity was moderated by the relatively small anger induction effect. Contrary to expectations, the IAT-behaviour correlation was even lower for participants that reported high state anger. Additional analyses showed that the results were the same if the state anger raw scores (rather than the residuals of a regression on baseline anger) or the difference measure of the induction effect (state anger minus baseline anger) were induced as moderator variables. In contrast, the correlation between direct angriness measures and the observer anger judgment was not moderated by self-reported state anger. We do not want to over-interpret this result, and most probably, it is simply one indicator of the lack of validity of the angriness IAT.

Another problem of the anger induction was that some participants became suspicious about the computer crash as being part of the experiment. In contrast to anxiety, it is hard to induce anger in participants if they realize that it was intended to provoke their anger. We pre-tested another paradigm to induce anger (i.e. the hot sauce paradigm; cf. Harmon-Jones, & Amodio, in press) and found the computer crash to be both more suitable for the observation of angry behaviour and less transparent for participants. On the other hand, it is possible that, although they were mixed with conscientiousness items, the state measures for anxiety and anger made the participants more aware of the experimental manipulations. We wanted to include the state measures because of two reasons. First, we wanted to check whether the emotion inductions were successful at least at the explicit level. Second, we wanted to explore the incremental validity of the IAT measures over both direct trait and state measures. The good predictive validity of the direct anxiousness and angriness measures and of the anxiousness IAT demonstrates that the anxiety and anger induction were successful despite the presentation of the direct state measures.

Because we conceptualized the anxiousness and the angriness IAT as trait measures, we acknowledge that it would have been desirable to validate them with more than one situation. If we aggregated anxious and angry behaviour across multiple situations, then we certainly would have obtained higher correlations at least with the anxiousness IAT. However, this would have been extremely difficult because it requires that participants comply with similarly long laboratory sessions on multiple days (to minimize transfer effects from one situation to another). However, our 1-day approach did not fare too badly as was indicated by the correlations between the direct anxiousness measures and anxious behaviour during the speech, and between the direct angriness measures and angry behaviour during the computer crash.

Angriness, agreeableness, anger expression and approach behaviour

This study explored implicit and explicit representations of the personality self-concept of anxiousness and angriness. Explicit representations were assessed with bipolar anxiousness and angriness self-ratings. Implicit representations were assessed by using the same words as stimuli within the IATs. The convergent validity of the bipolar anxiousness self-ratings with widespread anxiousness scales was high, $r > .70$. In contrast, the correlation between the bipolar angriness self-ratings and the trait form of the STAXI was only moderate, $r = .45$. This might be due to the conceptualization of anxiousness and angriness in the present study as orthogonal factors within the Big Five model of personality.

Conceptually and empirically, anxiousness versus self-confidence was strongly related to neuroticism, and unrelated to agreeableness. Angriness versus self-control was weakly related to neuroticism, and strongly related to agreeableness. In contrast, the trait form of the STAXI is intermediately related with emotional instability or neuroticism (Spielberger, 1988), and was also significantly correlated with all direct anxiousness measures in the present study. In contrast with the trait form of the STAXI, the present conceptualization of angriness refers more to agreeableness and less to emotional instability or neuroticism. This may account for the moderate correlation between the bipolar angriness self-ratings and the trait form of the STAXI. Nevertheless, the scale was labelled *angriness* because it is less broad than the Big Five dimension of agreeableness.

Alternatively, angriness versus self-control may be considered as a combination of high anger-out and low anger-control, which are strongly negatively correlated. Moreover, anger-out and anger-control show the same intermediate correlations with the trait form of the STAXI as the bipolar angriness self-ratings (Schwenkmezger *et al.*, 1992). Thus, the bipolar angriness self-ratings may more directly refer to styles of anger expression than the trait form of the STAXI. A more direct relation to angry behaviour within the bipolar angriness self-ratings is also suggested by the somewhat higher correlations with the observer anger judgment than those obtained for the trait form of the STAXI (see Table 3).

Anger is a negative emotion that is related to approach behaviour (e.g. Lazarus, 1991). In contrast, anxiety is related to avoidance behaviour that is true for most of the negative emotions (e.g. sadness, disgust). Owing to the relation of state anger to approach motivation, anger is associated with different EEG activation than anxiety (Harmon-Jones & Sigelman, 2001). Possibly, the automatic categorization of stimuli within the angriness IAT was somehow obstructed because angry versus self-control combines approach-related words (e.g. angry) with negative valence, and avoidance-related words (e.g. self-control) with positive valence. In contrast, avoidance-related words (e.g. anxious) are combined with negative valence, and approach-related words (e.g. self-confident) with positive valence in the anxiousness IAT. Generally, positive valence is more strongly associated with approach motivation, whereas negative valence is more strongly associated with avoidance motivation (e.g. Neumann, Förster, & Strack, 2003). However, within the angriness IAT, motivational direction and valence of the stimuli are inversely related. This might distort the automatic categorization of angry versus self-controlled, and further accounts for (a) the lower internal consistency within the angriness IAT (.66) than within the anxiousness IAT (.72), (b) the lack of convergent validity of the angriness IAT, and (c) the susceptibility of the angriness IAT to the transfer effect from the anxiousness IAT.

Conclusion

The present study replicated findings from Egloff and Schmukle (2002) by showing that an anxiousness IAT added incremental validity over and above direct measures for the prediction of anxious behaviour. These results illustrate that the IAT is able to assess inter-individual differences that are valid for the prediction of behaviour but that are not accessible with direct measurement procedures. On the other hand, the IAT's potential for the assessment of multiple personality dimensions seems to be restricted. The angriness IAT showed somewhat unsatisfactory internal consistency and seemed to be affected by the transfer of a positive-negative self-dimension from the anxiousness IAT. Importantly, this transfer effect was recently replicated (Teige *et al.*, 2004). Future

research should explore the circumstances under which the IAT is affected by the valence or by the specific semantic meaning of the stimuli and to what extent. As long as these questions remain unsolved, it is unclear whether self-concept IATs assess inter-individual differences in self-representations over and above self-evaluation. The exciting potential offered by the IAT is that this measurement procedure assesses valid implicit self-representations that are different from, and not accessible with, conventional self-report measures (Asendorpf *et al.*, 2002; Egloff & Schmukle, 2002). However, the IAT's susceptibility to context effects, the unresolved issue of effects of valence or specific semantic meaning, and the partially low reliability show that the IAT is not ready to be used as a standard procedure for individual diagnosis.

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