



Comparing different explanations of the effect of test anxiety on respondents' test scores



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ABSTRACT

Based on meta-analytic findings of a moderate negative correlation between test anxiety and test performance some researchers hypothesized that trait and/or state test anxiety may induce measurement bias. Two competing models have been advanced to account for the observed test anxiety-test performance relationship: the deficit hypothesis and the interference hypothesis. The interference hypothesis predicts that trait- and/or state test anxiety induces measurement bias. This effect has been hypothesized to be the most pronounced in items of intermediate difficulty. The deficit hypothesis, on the other hand, claims that test anxiety and test performance are correlated because less competent test-takers experience higher levels of state test anxiety in the assessment process. However, test anxiety is not assumed to have a causal effect on test performance. We tested these competing claims by means of item response theory and structural equation modeling. A total of $N = 411$ respondents first completed a measure of trait test anxiety. Afterwards respondents were administered four cognitive ability tests. Upon completing the instruction and the first three items of each test respondents filled a pre-test state test anxiety questionnaire. The same state test anxiety questionnaire was also administered after all items of a subtest had been completed. In line with the deficit hypothesis the results indicated measurement invariance across different levels of state- and trait test anxiety. Furthermore, structural equation modeling revealed that that state/trait test anxiety is most closely related to psychometric g . Most interestingly state test anxiety components specific to the post-test measurement occasion were also related to cognitive ability while state test anxiety components specific to the pre-test measurement occasion were not systematically related to cognitive ability. The present finding is therefore most consistent with a deficit account to the test anxiety-test performance relationship.

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1. Introduction

Due to the increased use of cognitive ability tests interest in research on test fairness resurged. In general, test fairness is compromised, if construct-irrelevant factors induce measurement bias and therefore lead to incorrect ability estimation. In the presence of measurement bias, respondents with the same

standing on the latent trait, who differ in construct-irrelevant factors (e.g. state- and/or trait test anxiety), do not have identical expected item- and/or test scores (e.g. Drasgow, 1987; Millsap, 1997; Mislevy et al., 2013; Rajo, Laffine, & Byrne, 2002). In consequence, differences in test performance within- and between these groups are not attributable to the same latent trait because test scores reflect individual differences in the latent ability trait(s) of interest and individual differences in construct-irrelevant variance factors (Lubke, Dolan, Kelderman, & Mellenbergh, 2003). Several authors hypothesized that test anxiety may induce measurement bias (e.g. Haladyna & Downing, 2004; Hembree, 1988). This hypothesis has been based

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on meta-analytic findings of a moderate negative (meta-analytic mean $r = -.23$ to $-.33$) correlation between test anxiety and test performance (Ackermann & Heggstad, 1997; Hembree, 1988). Despite the practical relevance of this topic only few studies directly evaluated, whether test anxiety induces measurement bias and results have been mixed thus far (Halpin, da-Silva, & De Boeck, in press; Reeve & Bonaccio, 2008). The inconsistent findings might be due to differences in research design characteristics and the psychometric methods used to test measurement bias.

1.1. Definition of test anxiety

Test anxiety refers to the situation-specific anxiety experienced in evaluative situations (Putwain, 2008; Zeidner, 1998). Researchers have found it useful to differentiate between state- and trait test anxiety, and between the different components of test anxiety.

1.1.1. Components of test anxiety

Factor analytic research (e.g. Benson & Bandalos, 1992; Englert, Bertrams, & Dickhäuser, 2011; Hodapp & Benson, 1997; Keith, Hodapp, Schermelleh-Engel, & Moosbrugger, 2003; Sarason, 1984; Wacker, Jaunzeme, & Jaksztat, 2008) revealed that test anxiety consists of cognitive components (worry and test-irrelevant thinking) and affective components (emotionality and bodily symptoms). The cognitive component worry refers to concerns about the outcome and consequences of an assessment and is characterized by distorting negative thoughts (cf. Putwain, Connors, & Symes, 2010). Task-irrelevant thinking, on the other hand, denotes interfering thoughts unrelated to the content and outcome of the assessment and has been linked to avoidance coping (Schutz, Di Stefano, Benson, & Davis, 2004). The affective component, on the other hand, comprises physiological reactions (bodily symptoms) and the feeling of being nervous and tense (emotionality).

Research indicated that the cognitive- and affective components of test anxiety differ in their relation to test performance. One meta-analysis (Hembree, 1988) and several independent studies (e.g. Cassady & Johnson, 2002; Hong, 1998; Hong & Karstensson, 2001; McCarthy & Goffin, 2005; Meijer & Oostdam, 2011; Oostdam & Meijer, 2003) showed that the cognitive components were more strongly correlated with test performance than the affective components. Furthermore, the correlation between the affective component and test performance decreased after controlling for the cognitive components, while the correlation coefficient between the cognitive components and test performance remained essentially unchanged after controlling for the affective component (Hembree, 1988). Thus, the cognitive components of test anxiety drive the test anxiety-test performance relationship.

1.1.2. Trait- versus state test anxiety

Researchers usually also make a distinction between state- and trait test anxiety. In general, trait test anxiety refers to the proneness to experience anxiety in different kinds of assessment situations, while state test anxiety denotes a fluctuating emotional state experienced in a particular assessment situation (Spielberger & Vagg, 1995; Zeidner, 1998). Measures of trait test anxiety have been shown to be stable across time-point of

measurement and comprised little variance attributable to the situation-specific factors (Hong, 1998; Keith et al., 2003). By contrast, state anxiety questionnaires turned out to be more variable and were affected by characteristics of the assessment situation (e.g. Hong, 1998; Meijer & Oostdam, 2011). The distinction between state- and trait test anxiety is important because state- and trait test anxiety have been shown to be clearly separable (e.g. Hong, 1998, 1999; Hong & Karstensson, 2001; Meijer & Oostdam, 2011; Paulman & Kennelly, 1984) and most theoretical explanations of the test anxiety-test performance relationship focus on state test anxiety (for an overview: Zeidner, 1998).

1.2. Factors influencing individual differences in state test anxiety

State test anxiety constitutes the result of a cognitive appraisal process which is influenced by several individual and situational factors (Davis, DiStefano, & Schutz, 2008; Schutz et al., 2004). Some of these factors have been hypothesized to be more general, while others were hypothesized to be more specific to the individual tests administered. For instance, goal relevance and goal congruence constitute more general factors that have been shown to affect respondents' level of state test anxiety (cf. Nie, Lau, & Liao, 2011; Reeve, Bonaccio, & Charles, 2008; Schutz et al., 2004). A similar argument can be made regarding achievement avoidance (e.g. Pekrun, Elliot, & Maier, 2009; Putwain & Symes, 2012), trait test anxiety (e.g. Hong, 1998; 1999; Hong & Karstensson, 2001; Meijer & Oostdam, 2011; Paulman & Kennelly, 1984) and psychometric g (Goetz, Preckel, Pekrun, & Hall, 2007), which have also been shown to affect respondents' level of state test anxiety. Other factors influencing respondents' cognitive appraisal of the test situation are more specific to the cognitive ability domain assessed. For instance, testing problem efficiency (e.g. Davis et al., 2008; Lang & Lang, 2010; Nie et al., 2011), which is defined as the judgement respondents make on their ability to manage problems arising during test-taking, is likely to be more specific to the cognitive ability domain measured. Thus, individual differences in state test anxiety experienced throughout an admission test can be decomposed into variance components specific to the individual subtests and variance components that are more general in nature.

1.3. Factors influencing the test anxiety-test performance relationship

Research also indicated that the size of the correlation coefficient between test anxiety and test performance depends on several situational factors and test characteristics (for an overview: Hembree, 1988; Zeidner, 1998).

1.3.1. Effect of test characteristics on the test anxiety-test performance relation

One meta-analysis (Hembree, 1988) and several independent studies (e.g. Chen, 2012; Hong, 1999; Kim & Rocklin, 1994) indicated that test anxiety is more closely linked to test performance for more difficult tests (meta-analytic mean $r = -.45$) than for easier tests (meta-analytic mean $r = -.07$). Furthermore, the cognitive ability domain measured has also been shown to affect the test anxiety-test

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