



## Text anxiety on cognitive ability test can result in differential predictive validity of academic performance

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### ABSTRACT

This paper investigates whether test anxiety leads to differential predictive validity in academic performance. Our results show that the predictive validity of a cognitive ability test, using final exam performance as a criterion, decreased a small amount as Worry (the cognitive aspect of anxiety) increased but was unaffected by Emotionality (the physiological aspect of anxiety). These results suggest that cognitive ability tests may be more useful as predictors of performance for low anxiety test-takers. These findings are discussed in the context of the interference and deficit perspectives of test anxiety.

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### 1. Introduction

Several meta-analyses have documented that self-reported test anxiety correlates negatively with test performance (Ackerman & Heggstad, 1997; Hembree, 1988; Seipp, 1991). In addition to work conducted in educational settings, negative correlations between test anxiety and test performance have also been shown in real and simulated employee selection contexts (Fletcher, Lovatt, & Baldry, 1997; McCarthy & Goffin, 2005; Schmit & Ryan, 1992). Professionals who use aptitude tests in research and practice have the ethical responsibility to ensure that all test-takers have an equal opportunity to demonstrate their abilities. Thus, the persistent finding of a negative relation between test anxiety and test performance understandably creates concern that test anxiety might result in biased or inaccurate predictions (Haladyna & Downing, 2004; Zeidner, 2007). Indeed, some have argued that “the IQs, aptitudes, and progress of test-anxious students are consistently misinterpreted” and consequently “the validity of the entire testing process is challenged” (Hembree, 1988, p. 75).

However, that test anxiety is negatively associated with test scores does not by itself indicate bias (Reeve & Bonaccio, 2008; Sarason, 1972). Indeed, there are multiple perspectives concerning the nature of the relation between test anxiety and test performance (e.g., Reeve, Heggstad, & Lievens, 2009; Tobias, 1985;

Wicherts & Zand Scholten, 2010; Wine, 1971; see Zeidner, 1998, chap. 3 for a review). In contrast to those who posit anxiety as a direct cause of poor test performance, Eysenck and Eysenck (1985) warned, “it must not be forgotten that we are dealing with correlational evidence, that is, those people who report worried and self-evaluative thoughts tend to be the same people who exhibit poor levels of performance. Even if it turns out that there is a causal relationship . . . it may well be that the direction of causation is, in fact, the opposite of that usually envisaged” (p. 294).

Because understanding whether test anxiety influences the validity of aptitude tests is a necessary requirement for their ethical use, several researchers (e.g., Haladyna & Downing, 2004; Reeve et al., 2009; Schmitt, 2002) have called for more work directly examining predictive bias. Although prior work has examined whether anxiety creates measurement bias (e.g., Reeve & Bonaccio, 2008), little research examined whether and to what extent anxiety can lead to predictive bias. It is particularly important to study test anxiety in relation to predictive bias given the prevalent use of aptitude tests in high stakes contexts, most notably to make education and employment decisions. Thus, our purpose is to investigate whether test anxiety can induce differential predictive validity when using cognitive ability tests (CATs) to predict academic outcomes.

#### 1.1. The nature and consequences of test anxiety

Test anxiety refers to the “phenomenological, physiological and behavioral responses” (Zeidner, 2007, p. 166) that accompany test-

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ing. It is a subjective emotional state experienced before or during a specific evaluation relating to the act of completing the evaluation itself, the threat of failing, and perceived negative consequences. Thus, test anxiety is conceptualized as the manifestation of a situation-specific trait (Zeidner, 1998). Modern views of test anxiety conceptualize it as having two major components: Worry and Emotionality (Cassady & Johnson, 2001; Spielberger & Vagg, 1995; see also Liebert & Morris, 1967). Worry is the cognitive component of test anxiety reflecting the debilitating thoughts and concerns the test-taker has before or during the test. The Emotionality component (sometimes called Tension) refers to the heightened physiological symptoms stemming from arousal of the autonomic nervous system and associated affective responses.

As mentioned above, the negative correlation between test anxiety and various evaluative outcomes has been found across several domains. For example, Hembree's (1988) meta-analysis showed negative correlations between test anxiety and performance on IQ, aptitude, memory and problem-solving tests. He also found negative correlations for several school-related outcomes such as overall grades, and performance in language and mathematics tests, among other outcomes. Similar results are comprehensively reviewed by Zeidner (1998, 2007). Given these findings, it is not surprising that test anxiety has been posited as a potential biasing factor in test performance. Below we review the concept of differential predictive validity, and we integrate it with two perspectives of test anxiety and test performance—the deficit and the interference perspectives.

### 1.2. The nature of differential validity

Educational institutions routinely use scores on cognitively-loaded exams like the SAT, or the Graduate Record Examination to select students given their predictive validity vis-à-vis educational outcomes (Kuncel, Hezlett, & Ones, 2001; Sackett, Kuncel, Arneson, Cooper, & Waters, 2009). Similarly, employers often use CATs as part of a selection system given their robust predictive validity vis-à-vis job performance (Schmidt & Hunter, 1998). Thus, a key concern is whether test scores demonstrate differential prediction as a function of some personal or social factor. For example, differential prediction by race and gender has been investigated with respect to CATs (e.g., Dunbar & Novick, 1988; Schmidt, Pearlman, & Hunter, 1981). However, differential prediction due to psychological factors such as test anxiety, though often discussed, has not been as frequently examined empirically.

Often discussed under the broader label of predictive bias, differential prediction occurs when a third variable (such as test anxiety) influences the predictor–criterion relationship (such as the relationship between CAT scores and job performance). Consequently, predictive bias is commonly assessed within a moderated multiple regression framework, where bias is said to exist if any coefficients within the regression equation relating the predictor and criterion differ across subgroups. The issue of *differential validity*, which is our focus, is tested by examining the interaction of the predictor (e.g., test scores) and a potential biasing variable (e.g., anxiety) (Sackett, Laczko, & Lippe, 2003). A significant interaction term indicates that the predictive relationship with the criterion (i.e., the slope) differs across sub-groups defined by the biasing variable (e.g., high and low anxiety test-takers). If only *intercept* differences are present (indicated by a significant regression coefficient associated with the biasing variable but no significant interaction), this indicates that the predictor test has equal validity across groups but that the use of a single regression line would over-predict performance of the lower scoring group. Although this can lead to *selection bias* if a common regression line is used, we do not focus on this issue given that few real-world settings would

consider using test anxiety as a protected class of information by which to define groups.

### 1.3. Test anxiety and differential validity

The deficit perspective specifies that anxiety results from the test-taker being aware of a skills deficit which will be (accurately) reflected by poor test performance (Covington & Omelich, 1987; Tobias, 1985). According to this perspective, “anxiety in the test situation has no causal status, but is simply an epiphenomenon reflecting students’ lack of preparation for the test and their meta-cognitive awareness of their low probability of succeeding on the exam” (Zeidner, 1998, p. 70). Test anxiety occurs as a byproduct of a true ability deficit, which the test accurately measures. Thus, the deficit perspective would not predict any form of differential validity due to anxiety.

Conversely, the interference perspective implies that test anxiety should result in differential validity. This perspective posits that anxiety interferes with a person’s test performance by competing for cognitive resources. Specifically, cognitive resources are spent on off-task processing such as worrying, managing immediate physiological reactions, or focusing on negative self-evaluations (Eysenck, 1973; Spielberger & Vagg, 1995). These off-task cognitions prevent the test-taker from focusing solely on the actual test, and require them to spend valuable resources on managing divergent thoughts. Thus, interference models state that ability test scores should be less predictive of criterion performance (i.e., have lower criterion-related validity) for high test anxiety test-takers compared to low anxiety ones.

However, a framework proposed by Reeve et al. (2009) suggests that test anxiety will only decrease the criterion-related validity of predictor tests to the degree that anxiety is not found in the criterion as well. Given the evaluative nature of performance appraisals, it is likely that they evoke the same situation-specific trait (i.e., test anxiety) as do other testing situations. Thus, people may experience anxiety during the evaluation of criterion performance in much the same way they do during the predictor assessment. Hence, test anxiety may not result in differential validity if anxiety experienced during the criterion is included in the model. Rather, test anxiety would actually aid in the prediction of criterion performance because the criterion would now share an additional source of systematic variance with the predictor.

Given the nature of these two perspectives, two competing hypotheses can be generated. According to the interference perspective, we would expect to find evidence of differential validity due to individual differences in test anxiety (*Competing Hypothesis 1a*). However, the Reeve et al. (2009) framework suggests that test anxiety may simply be an additional predictor to the extent it is experienced at the time of criterion assessment and would not be expected to result in differential validity (*Competing Hypothesis 1b*). The latter conclusion of no differential validity would also be consistent with the deficit perspective of test anxiety.

## 2. Method

### 2.1. Sample

Undergraduate students enrolled in a mid-size south-eastern US university participated in this study in exchange for course credit. As explained below, data was collected across two time points but not all students participated in both sessions. Only data from the 124 participants who completed both sessions were analyzed. A majority of the operational sample was female (75.8%); 50% self-reported being White, 30.6% Black, 11.3% Asian, 5.6% Hispanic, and 2.4% self-classified as other. The average age

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