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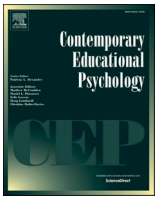

Test anxiety fluctuations during low-stakes secondary school assessments: The role of the needs for autonomy and competence over and above the number of tests

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ABSTRACT

Test anxiety poses a fundamental educational challenge as it is associated with lower academic performance and well-being. Grounded in the Self-Determination Theory, this study will focus on test anxiety fluctuations in relation to low-stakes assessments and investigates whether fluctuations in students' experiences of autonomy and competence satisfaction and frustration relate to their test anxiety. For this purpose, 253 secondary school students completed a survey at three different times throughout the second semester. Students' feelings of autonomy and competence in the classroom were administered as well as their test anxiety. Each student completed the same two test anxiety scales at each measurement occasion, with one scale consistently administered to all students and the other two scales randomly assigned between classes. Multilevel analyses revealed that students showed higher test anxiety in weeks in which their need for competence was more frustrated and when they had to take more low-stakes tests. This association was robust across the three test anxiety instruments and after considering important test anxiety covariates (e.g., gender and prior achievement). These findings imply that competence frustration is an important underlying mechanism of test anxiety that should be taken into account when designing anxiety-reducing interventions.

1. Introduction

Testing is common practice in education. Tests provide objective and reliable information that is essential to measure and make decisions about students' study progress and achievement (Jarvis, 2010). However, secondary school students differ substantially in how they deal with evaluative test settings. Some perceive assessments as a way to improve, while others fear potential failure (OECD, 2017). For the latter, the stress of being tested can be so intense, that they exhibit debilitating test anxiety. Indeed, *test anxiety* refers to a situation that evokes feelings of fear and worry about possible consequences of a negative evaluation and is manifested through cognitive, emotional, physiological, behavioral and motivational reactions (Zeidner, 1998, 2007). It is a widespread phenomenon at every educational level (Hembree, 1988; von der Embse et al., 2018). Among secondary school students, it is estimated that approximately 15–22% exhibit high test anxiety (Thomas et al., 2018).

Reducing test anxiety represents a significant challenge, as test anxiety is not only associated with lower well-being (Steinmayr et al., 2016), it is also a powerful barrier for learning and achievement (Hattie, 2009). Highly test-anxious students tend to underperform and have lower success rates, thereby increasing the likelihood of dropping out of school with significant implications for their future work careers (Lowe & Lee, 2008). Additionally, higher test anxiety is associated with lower intrinsic motivation (von der Embse et al., 2018) and decreased self-efficacy (Roick & Ringeisen, 2017). With tests still being one of the most commonly used assessment methods to gauge students' knowledge and skills (OECD, 2016), the high test anxiety prevalence is a fundamental educational issue.

To tackle this educational challenge, it remains important to uncover the underlying processes and mechanisms in order to identify antecedents of test anxiety and moments where test anxiety may arise. To do so, this study relies on self-determination theory (SDT; Ryan & Deci, 2000), a well-validated macro theory on human motivation and personality, to investigate whether the mechanisms of autonomy and competence satisfaction and frustration are applicable to test anxiety. Moreover, we

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use a repeated measures design to examine fluctuations in students' test anxiety and the factors causing these fluctuations.

While previous research often measured test anxiety in relation to high-stakes assessments (Lotz et al., 2021; Segool et al., 2013), the current study will examine these two aims in a low-stakes assessment context. Test anxiety in low-stakes settings may differ from anxiety in high-stakes assessments, as the purpose of the assessments, which largely determines students' test anxiety, is different (Reeve et al., 2008). Whereas high-stakes assessments are administered to measure students' performance and make important decisions upon that performance (e.g., college entrance exam), the purpose of low-stakes assessments is to monitor students' study progress and provide feedback (e.g., classroom test; Dixson & Worrell, 2016). However, recently, it has been shown that students do not always perceive low-stakes assessments as informational, but rather as threatening (Vaessen et al., 2017; Wenzel & Reinhard, 2021). Therefore, it is crucial to gain a deeper understanding of students' test anxiety in low-stakes testing situations to provide recommendations on what schools and teachers can do.

1.1. Trait and state test anxiety: Test anxiety fluctuations

Test anxiety results from the interplay between individual factors (e.g., study and test-taking skills, academic ability) and characteristics of the evaluative environment (e.g., test characteristics, parents' and teachers' behavior; Hong & Karstensson, 2002; Zeidner, 2007). For example, a student who is proficient in math (i.e., individual) may still experience test anxiety because of the exam's time pressure (i.e., environment). In this respect, a conceptual distinction is made between trait test anxiety and state test anxiety (Huang, 2018). Trait test anxiety refers to the degree to which individuals are predisposed to perceive evaluative situations as threatening and is therefore considered as a relatively stable personality characteristic (Hong, 1998). Individuals with high trait test anxiety are more vulnerable and prone to stress and anxiety in any test situation (Spielberger & Vagg, 1995). Contrastingly, state test anxiety is a temporary emotional state of anxiousness induced by a specific evaluative situation at a specific moment (Huang, 2018; Spielberger & Vagg, 1995). State test anxiety is considered as situational and varies therefore more over time depending on the specific testing situation (Hong, 1998, 1999).

It is especially important to focus on state test anxiety and state test anxiety fluctuations to identify contextual antecedents that trigger higher test anxiety, next to individual characteristics such as trait anxiety. While prior studies in higher education revealed that students' academic emotions can vary significantly from one moment to the next and can fluctuate over time and in different situations (Corpus et al., 2020; Ketonen et al., 2018), it is still largely unknown whether these fluctuations occur in students' test anxiety.

To date, state test anxiety has often been measured at one single (Putwain & Symes, 2018) or only two points in time (e.g., Boehme et al., 2017; Skinner & Brewer, 2002). However, this approach does not allow to examine how test anxiety fluctuates throughout the school year. Only a few studies have investigated test anxiety fluctuations (Wang et al., 2020), albeit with short time intervals (e.g., Bolger, 1990; Dimitriev et al., 2016; Lotz et al., 2021). To the best of our knowledge, only one study in higher education has examined test anxiety fluctuations over a longer period by measuring state test anxiety at four times throughout the semester (Lotz & Sparfeldt, 2017). This study demonstrated that test anxiety fluctuates substantially throughout the semester with lower test anxiety levels during mock-exams and the highest anxiety levels prior to the final end-of-term exam (Lotz & Sparfeldt, 2017). In the current study, we add to the scarcity of this literature by focusing on test anxiety fluctuations during an entire semester in secondary schools. We focus on a low-stakes assessment context and identify factors related to fluctuations in test anxiety.

1.2. Test anxiety in low-stakes assessments: The number of tests

Previous test anxiety literature predominantly focused on high-stakes assessments in higher education (Chapell et al., 2005; Lotz et al., 2021), including end-of-term course examinations, standardized national tests or exit and entrance exams, because of their strong evaluative nature (Putwain, 2008b; von der Embse & Hasson, 2012). As there are major and direct consequences attached to passing or failing these high-stakes assessments, such as not being admitted to the next year, students are likely to experience test anxiety (Ryan & Deci, 2020; Yu et al., 2018).

However, students could also experience test anxiety in low-stakes assessment contexts in which assessments have little impact on students' final grade such as classroom tests (Dixson & Worrell, 2016). In such a low-stakes context, students may be under constant pressure to perform well, may feel obligated to obtain good grades on each single test or may want to prove to the teachers or themselves they already master the learning material (OECD, 2016). Indeed, although previous research demonstrated that high-stakes assessments elicit higher test anxiety levels compared to low-stakes assessments (Bonaccio & Reeve, 2010; Putwain, 2008b; Reeve et al., 2008), students may equally perceive those low-stakes assessments as stressful and a threat to their well-being and competence (Hinze & Rapp, 2014; Wenzel & Reinhard, 2021). Consequently, this could cause higher test anxiety.

Especially in secondary education, low-stakes assessments are frequently used (Smith, 2016). For example, the OECD (2016) reports that 30% of secondary school students are required to take a test once a month and up to 38% take tests more than once a month. In Belgian secondary education, the setting of the current study, more than 50% of all students have to take tests multiple times a month for different subjects (OECD, 2011, 2016).

Although it is argued that the large number of tests student have to take throughout the school year, including low-stakes, is one of the main causes of test anxiety (OECD, 2016, 2017), very little is known about how these low-stakes tests affect students' test anxiety levels (Wenzel & Reinhard, 2021), the underlying mechanism of this relation (Wenzel & Reinhard, 2021), and the influence of the number of tests on students' test anxiety levels (Eklöf & Nyroos, 2013). With the increasing tendency in higher education institutions and European countries to introduce more low-stakes tests to monitor student learning more effectively (e.g., Schüttpelz-Brauns et al., 2020), Eklöf and Nyroos (2013) call for more research on the relation between the number of tests and students' test anxiety. In this study, we respond to these authors' calls by investigating test anxiety and its underlying mechanisms in a low-stakes assessment context, while considering the number of tests as anxiety-provoking factor.

1.3. Test anxiety and students' feelings of autonomy and competence

To examine whether students feel they are under pressure to perform well in low-stakes assessment contexts and how this relates to test anxiety, the basic psychological need theory (BPNT; Ryan & Deci, 2000), one of SDT's six mini-theories, is of particular relevance. More specifically, BPNT outlines *autonomy* as one of the three universal, basic psychological needs that is essential for individuals' psychological growth and well-being. This need for autonomy refers to a sense of volition and feelings of ownership. If students, for instance, have a say in when the low-stakes test will take place or when they experience that they are in charge of their own learning trajectory, they are more likely to experience autonomy satisfaction. However, when students feel pressured and coerced by low-stakes assessments, BPNT states that students' need for autonomy is frustrated. Importantly, the frustration of the need for autonomy is said to be clearly distinct from experiencing low autonomy satisfaction (Vansteenkiste & Ryan, 2013). To illustrate, students experience high autonomy frustration when they feel pressured and coerced, yet they can also perceive little control over the situation

hereby experiencing low autonomy satisfaction. As such, it is relevant to study both autonomy satisfaction and frustration in relation to test anxiety.

Furthermore, as low-stakes assessments are used to monitor students' study progress and to provide students with feedback to help them to become more competent (Dixson & Worrell, 2016), also BPNT's need for *competence* is meaningful to understand the dynamics involved in low-stakes testing and test anxiety. The need for competence is referred to as experiencing mastery and feeling effective in interacting with the environment. When students perceive low-stakes assessments as opportunities to expand their capabilities and skills, their need for competence gets satisfied. However, it may equally be possible that in the eyes of the students, their feelings of competence may be at stake when participating in low-stakes assessments. For instance, they may experience difficulties in making classroom exercises (i.e., low competence satisfaction) or may even feel as a failure (i.e., high competence frustration). Students low on competence satisfaction or high on competence frustration may consequently experience more test anxiety. In this respect, studying the need for competence is also highly relevant for test anxiety in low-stakes assessments.

Both autonomy and competence satisfaction have been related to a wide range of adaptive outcomes. For instance, they showed a positive relation with individuals' sleep quality and quantity (Campbell et al., 2015) and positive affect (Stanley et al., 2021). Specifically in the educational context, literature has shown that students who experience both high autonomy satisfaction and high competence satisfaction are more autonomously motivated in school (Bureau et al., 2022; Standage et al., 2012; Yu & Levesque-Bristol, 2020), have a higher academic achievement (Jang et al., 2009) and experience less boredom at school (Sulea et al., 2015). In addition, high autonomy satisfaction is predictive of student self-esteem (Ümmet, 2015), classroom engagement (Jang et al., 2012; Núñez & León, 2019) and academic engagement (Buzzai et al., 2021). In relation to general anxiety, both competence satisfaction (Ng et al., 2012; Rouse et al., 2020) and autonomy satisfaction (Rouse et al., 2020) positively predicted lower general anxiety.

In addition to the satisfaction of the needs, a wealth of studies has confirmed the relation between the frustration of the needs for autonomy and competence and maladaptive outcomes. When individuals perceive their needs for autonomy and competence are both highly frustrated, they are more likely to show more externalizing problem behavior, including aggression (Vandenkerckhove, Brenning, et al., 2019), as well as to develop internalizing problems such as depression (Chen et al., 2015; Rouse et al., 2020) and stress (Campbell et al., 2017; Rouse et al., 2020). Similarly, educational studies indicate that both high autonomy frustration and competence frustration uniquely predict school-related maladjustment such as classroom disengagement (Earl et al., 2019) and attention problems (Rodríguez-Meirinhos et al., 2020). Moreover, when students' need for competence is highly frustrated, they report more fear of failure (González-Cutre et al., 2023) and are also more prone to developing symptoms of anxiety and somatization (Cordeiro et al., 2016).

Despite the rapidly evolving body of research on the relation between autonomy and competence satisfaction and frustration and various academic outcomes, little scholarly attention has been devoted to its association with *test anxiety*. To the best of our knowledge, only a few studies have specifically investigated this association. For instance, in a study with Iranian secondary school students, lower state test anxiety was reported when students perceived that their basic psychological needs were met (Maralani et al., 2016). The same authors demonstrated in a later study that high autonomy satisfaction, but not competence satisfaction, experienced by Iranian female secondary school students, was associated with lower state test anxiety levels (Maralani et al., 2018). Furthermore, Spadafora et al. (2020) investigated the unique role of need frustration, next to need satisfaction, in relation to test anxiety. The authors measured state test anxiety of Canadian first-generation secondary school students at the beginning and at the end of the semester. They provided preliminary evidence that experienced need frustration at the beginning of the semester leads to increased state test anxiety at the end of the semester (Spadafora et al., 2020). Given the paucity of research on the relation between test anxiety and students' autonomy and competence satisfaction and frustration, additional research is called for.

1.4. Fluctuations in autonomy and competence satisfaction and frustration

According to SDT, the basic psychological needs are highly dynamic in nature (Ryan & Deci, 2017). Variations in need satisfaction and need frustration exist (e.g., Gillet et al., 2019) and predict fluctuations in individuals' functioning and well-being (Ryan & Deci, 2017). Studies among university students showed that in days when their needs for autonomy and competence were relatively more fulfilled, their well-being was better (Reis et al., 2000; Sheldon et al., 1996) as they reported, among other things, less negative affect (e.g., anxiety or anger) and more positive affect (e.g., happiness and joy). Also, diary studies indicated that undergraduate students' hourly fluctuations in competence frustration were associated with changes in their hourly stress levels (Howell et al., 2011). Also, physical education students displayed semester-to-semester variations in need frustration which then related to the degree to which they were controlled motivated or amotivated (Bartholomew et al., 2018).

Furthermore, studies revealed that these fluctuations are predicted by teachers' behaviors. Need satisfaction of students in physical education fluctuated from one lesson to the other, depending on the degree to which they received motivating feedback from their teacher (Krijgsman et al., 2019). Likewise, daily fluctuations in primary school children's need satisfaction related to the degree to which they perceived their teachers as autonomy-supportive (van der Kaap-Deeder et al., 2017). Despite increased attention to short-term fluctuations in students' need-based experiences, the relation between fluctuations in autonomy and competence satisfaction and frustration, on the one hand, and test anxiety, on the other hand, remains unexplored.

1.5. The present study

The present study aims to investigate *fluctuations* in students' *state* test anxiety and its association with fluctuations in their experienced autonomy and competence satisfaction and frustration. Whereas prior test anxiety research has been mostly conducted in higher education (von der Embse et al., 2018), we chose to focus on secondary school students. This population received little scholarly attention to date, and with their regular exposure to low-stakes assessments, it provides an interesting research context to examine the *short-term variability* in students' state test anxiety and feelings of autonomy and competence. To explain this *within*-student variability, we used a repeated measures design with three measurement occasions.

The two research questions that guided this study were:

1. Does secondary school students' state test anxiety fluctuate from week to week in a low-stakes assessment context?
2. To what extent are weekly fluctuations in students' needs for autonomy and competence related to fluctuations in their weekly state test anxiety?

We expected that students' state test anxiety would fluctuate in a low-stakes assessment context (Hypothesis 1), as the number of tests

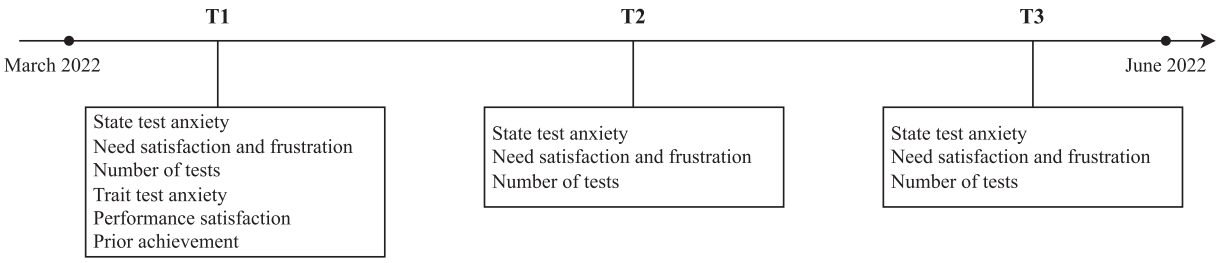

Fig. 1. Overview of the variables per measurement occasion.

students take varies per week. Following SDT and its BPNT, we expected that autonomy and competence satisfaction would be mainly and negatively associated with test anxiety (Hypothesis 2a) and that autonomy and competence frustration would be mainly but positively associated with test anxiety (Hypothesis 2b). Moreover, we investigated the robustness of the second hypotheses by examining if the psychological needs of autonomy and competence provide an additional explanation for students' test anxiety over and above the range of well-established test anxiety covariates.

This study contributes to the existing literature in several ways. *First*, most previous test anxiety literature focused on high-stakes assessments, such as end-of-term examinations or standardized tests (e.g., Lotz et al., 2021). By contrast, we focus on test anxiety in *low-stakes* assessment contexts in which students take multiple tests on a weekly basis. As such, this study provides insights into the effect of low-stakes test frequency on students' test anxiety.

Second, this study investigates *fluctuations* in students' state test anxiety. Previous test anxiety research measured test anxiety at only one or two moments (e.g., Putwain et al., 2010; Spadafora et al., 2020). As far as we know, it remains unexplored whether these fluctuations would also be observed with secondary school students who are exposed to low-stakes assessments.

Third, this study relies on self-determination theory to investigate whether week-to-week fluctuations in students' experienced autonomy and competence satisfaction and frustration are related to fluctuations in their state test anxiety. As such, we provide insights as to whether students' experiences of autonomy and competence satisfaction and frustration can serve as additional underlying mechanisms of test anxiety.

Fourth, students' state test anxiety is measured with three different test anxiety scales, of which each student filled out two, to ensure test robustness. Although many well-validated test anxiety scales exist (see von der Embse et al., 2018), there is still no consensus on which scale encompasses the multidimensional test anxiety concept best. Some scales (e.g., Cognitive Test Anxiety Scale of Cassady and Johnson (2002)) predominantly focus on the cognitive component of test anxiety (e.g., thinking about how difficult the test or exam is). Others also take the affective (e.g., feeling uneasy or tense) and physiological components (e.g., having an increased heart rate) into account (e.g., Hagtvet and Benson's (1997) Revised Test Anxiety scale), or consider the motivational component of test anxiety (e.g., wanting to escape test situations and to avoid failure) as well (e.g., the anxiety subscale of the Test Emotions Questionnaire of Pekrun et al. (2004)). By using three different scales that differ in their specific areas of focus, we consider the multidimensional nature of test anxiety and applied data source *triangulation* (Cohen et al., 2000), which will increase the results' validity, reliability and generalizability.

2. Materials and method

2.1. Participants

Participants were 253 students enrolled in year 11 and 12 and came from thirty classes out four secondary education schools in Flanders (Belgium). Schools were selected based on three preconditions to obtain a representative sample of the Flemish education system. These preconditions were school size (i.e., large versus small), educational type (i.e., general, technical or vocational) and the education network around the school (i.e., publicly funded or privately managed).

The sample included 112 (44.6%) male and 139 (55.4%) female students[1] who were aged 16–18 years ($M_{age} = 16.97$, $SD_{age} = 0.79$). The average number of students per class was 8.43 and students within each class followed the same major (e.g., economics, Latin, mathematics).

Students were asked to complete questionnaires three times throughout the semester (see the *Procedure* section), yet not all participants completed all measurements. On average, 8.17% of missing data existed per measurement, with 244 students completing the first, 228 students the second and 225 students the third questionnaire. This study was approved by the ethics committee of the researcher's university.

2.2. Procedure

A stepwise procedure was followed to recruit students. First, we contacted principals of secondary education schools by sending emails with information letters. Principals who agreed to participate signed an informed consent form and contacted their teachers. When teachers were interested to participate with their classes, both teachers and students were provided with information letters and asked to give their active informed consent.

Students who gave active consent were asked to complete paper-and-pencil questionnaires at three times throughout the semester during a regular class hour, which lasted 50 min, at the end of a school week (i.e., on a Friday; see Fig. 1). The first and second questionnaire were administered during two consecutive weeks. The time lag between the second and the third measurement occasion was, on average, four school weeks. Completing the questionnaires took approximately 10 min each. Data collection took place during spring 2022 and all data was anonymized by a third party based on students' ID-number.

In advance, all teachers received clear and detailed instructions of the specific moments at which each questionnaire would be administered. The schools in this study used an assessment policy in which teachers announced the upcoming tests to students in advance to allow students to prepare. Thus, students only had to take expected tests and were not exposed to unexpected tests. For this study, teachers were asked to survey either the first or the second questionnaire during one week with many expected tests. Teachers were asked to administer the third questionnaire during a school week with relatively fewer expected tests. In other words, at least one questionnaire was administered in one week with many expected tests (T1 or T2), and at least one questionnaire was administered in one week with few expected tests. This was to ensure sufficient variability in the number of tests taken across measurement weeks. Supplementary analyses revealed that this imposed requirement was successful, as for 50% of the classes, T1 was the week with the highest number of tests, while for other classes, T2 represented the week with the highest number of tests. For all classes, the lowest number of tests were found at T3 (see online supplementary file for

[1] Two students answered 'X'.

detailed information).

At each measurement occasion, students reported on the number of tests they had taken in the last week, their feelings of autonomy and competence in class and their state test anxiety during the last week. Students' state test anxiety was measured with three different test anxiety scales that were shown to be psychometrically different (see the *Measures* section). All students filled out two state test anxiety scales at each measurement moment. Those two scales were the same for students from the same class. More specifically, one test anxiety scale (Test Emotions Questionnaire) was completed by all students. The two additional test anxiety scales (Revised Test Anxiety Scale and Cognitive Test Anxiety Scale-Revised) were randomly assigned across classes, meaning that 50% of the classes (i.e., 15 classes) received the Revised Test Anxiety Scale on top of the Test Emotions Questionnaire and the other 15 classes were given the Cognitive Test Anxiety Scale-Revised in combination with the Test Emotions Questionnaire. The same two test anxiety scales (i.e., either TEQ-RTAS or TEQ-CTAR) were administered to each student at each measurement moment. This procedure resulted in three repeated measurements of two state test anxiety scales per student. By measuring state test anxiety with three different scales (i.e., data source triangulation), it becomes possible to investigate whether the results cross-validate across all three test anxiety scales.

Although we randomized the RTAS and CTAR between classes, supplementary analyses revealed that there was a difference in the testing schedule between the two groups. Classes completing the RTAS-instrument had a statistically significant lower number of tests at T1 but a statistically significant higher number of tests at T3 compared to classes completing the CTAR-instrument (see the online supplementary file).

In addition, at the first measurement moment, students provided information about their gender, prior achievement and satisfaction with their prior achievement, as these test anxiety antecedents were taken into account as control variables in the multilevel analyses.

2.3. Measures

The questionnaires included four parts: (1) test anxiety covariates, (2) trait test anxiety, (3) state test anxiety and (4) students' experienced autonomy and competence satisfaction and frustration. The items and factorial validity of each scale are presented in the online supplementary file.

2.3.1. Test anxiety covariates

Well-established test anxiety antecedents such as gender, prior achievement and performance satisfaction were surveyed to be included as covariates in the analyses. Students' prior achievement was objectively measured by their final percentage at the end of the first semester (i.e., combined percentage of low-stakes assessments and end-of-semester exam). Performance satisfaction, or the extent to which students were satisfied with their prior achievement, was rated on a 5-point Likert scale (1 = "*Not at all satisfied*"; 5 = "*Completely satisfied*"). Students also reported on their gender (male, female or X) and the number of tests they had taken during the previous week in class.

2.3.2. Trait test anxiety

Trait test anxiety was only administered at T1, as this variable is a personality trait and thus assumed to be stable. Trait test anxiety was assessed with a short nine-item version of the Test-Anxiety-Inventory (TAI; Spielberger, 1980; Wacker et al., 2008). The TAI assesses how students *generally* feel during and about assessments. All items were answered on a 4-point Likert scale, ranging from 1 ("*Almost never*") to 4 ("*Almost always*"). An exemplary item was "I feel anxious." To compute internal consistency, both coefficient omega and alpha were used. When compared to coefficient alpha, coefficient omega has less risk of underestimating or overestimating reliability (Dunn et al., 2014). The TAI showed good internal consistency ($\omega = 0.89$; $\alpha = 0.90$).

2.3.3. State test anxiety

Three state test anxiety scales, of which each student had to complete only two, were surveyed: *Test Emotions Questionnaire* (TEQ; Pekrun et al., 2004), *Revised Test Anxiety Scale* (RTAS; Hagtvet & Benson, 1997) and *Cognitive Test Anxiety Scale-Revised* (CTAR; Cassady & Finch, 2015). The TEQ was consistently administered to all students at each measurement occasion, while the RTAS and CTAR were randomly assigned across classes (see the *Procedure* section).

The anxiety subscale of the *TEQ*-instrument comprises twelve items that were divided into four subscales (i.e., cognitive, affective, physiological and motivational subscale). All items were rated on a 5-point Likert scale (1 = "*Strongly disagree*"; 5 = "*Strongly agree*"). An exemplary item was "I felt panicky when making the tests." A composite test anxiety score was computed by averaging all items. Over the three measurements, coefficient omega and alpha were satisfactory ($0.92 \leq \omega, \alpha \leq 0.95$) and comparable to previous research ($\alpha = 0.90$; Pekrun et al., 2011). Across the three measurement moments, confirmatory factor analysis (CFA) also indicated good fit (Hu & Bentler, 1999; Kline, 2011) with $96.16 < \chi^2(50) < 114.59$, $p < .001$, $0.96 < \text{CFI} < 0.97$, $0.07 < \text{RMSEA} < 0.08$, $0.04 < \text{SRMR} < 0.05$.

The *RTAS* consists of 20 items that were rated on a 4-point Likert scale (1 = "*Almost never*"; 4 = "*Almost always*"). The RTAS has four subscales: worry (i.e., cognitive test anxiety component), tension (i.e., affective component), bodily symptoms (i.e., physiological component) and test-irrelevant thinking. An exemplary item was "While taking the tests, I often thought about how difficult it was." By averaging all items, students' total test anxiety score was computed. The RTAS has shown strong psychometric properties in previous studies (e.g., $\alpha = 0.81$; Benson & El-Zahhar, 1994; Putwain & Symes, 2012) and over the three measurements, the scale was internally consistent ($0.90 \leq \omega \leq 0.93$; $0.91 \leq \alpha \leq 0.93$). Also, results of the CFA indicated acceptable to good fit: $251.20 < \chi^2(166) < 295.66$, $p < .001$, $0.91 < \text{CFI} < 0.93$, $0.06 < \text{RMSEA} < 0.08$, $0.07 < \text{SRMR} < 0.08$.

The *CTAR* is a shortened version of the Cognitive Test Anxiety Scale (Cassady & Johnson, 2002) and consists of 17 items that were scored on a 4-point Likert scale (1 = "*Not at all typical of me*"; 4 = "*Very typical of me*"). The CTAR has no subscales. An exemplary item was "During the tests, I found myself thinking of the consequences of failing." Internal reliability was good and similar to previous studies ($\alpha = 0.96$; Cassady & Finch, 2015) with coefficient omega and alpha varying per time point: $0.91 \leq \omega, \alpha \leq 0.96$. Over the three measurement moments, CFA indicated acceptable fit with $267.27 < \chi^2(50) < 317.72$, $p < .001$, $0.87 < \text{CFI} < 0.89$, $0.08 < \text{RMSEA} < 0.10$, $0.08 < \text{SRMR} < 0.08$. Moreover, psychometric analyses confirmed that these three scales measure different components of test anxiety, as results of the CFAs pointed towards better model fit when the scales were separated[2] (see online supplementary file).

2.3.4. Autonomy and competence satisfaction and frustration

Guided by the theory and because of practical reasons (e.g., to reduce students' cognitive overload, the burden for students of repeatedly being questioned, the questionnaire length limit, the estimated time to complete it and the short class time), we focused on autonomy and competence in this study. To measure students' autonomy and competence satisfaction and frustration, a school-specific version of the Basic Psychological Need Satisfaction and Frustration Scale (BPNSFS; Chen et al., 2015) was used. The scale included eight items (i.e., two for the satisfaction and two for the frustration of each need). An exemplary item for autonomy satisfaction was "I felt a sense of choice and freedom in the things I did", for competence satisfaction "I felt competent in what I

[2] Two-factor model of TEQ and RTAS (n = 169): $\chi^2(455) = 792.54$, $p < .000$; CFI = 0.88; RMSEA = 0.068; SRMR = 0.084. Two-factor model of TEQ and CTAR (n = 75): $\chi^2(372) = 717.97$, $p < .000$; CFI = 0.86; RMSEA = 0.062; SRMR = 0.113.

did", for autonomy frustration "Most of the things I did felt like 'I had to'" and for competence frustration "I felt insecure about my abilities". Items were scored on a 5-point Likert scale (1 = "*Totally disagree*"; 5 = "*Totally agree*"). BPNSFSs internal consistency was measured with the average inter-item correlations (AIIC) that were satisfactory over the three measurements: $0.36 \leq \text{AIIC} \leq 0.68$.

2.4. Plan of analyses

Since we followed students from different classes at three different moments, data were hierarchically structured with three measurement occasions (i.e., Level 1) being nested in students (i.e., Level 2) which were nested in classes (i.e., Level 3). Therefore, multilevel regression analyses (MLwiN Version 3.02; Rasbash et al., 2017) were conducted.

To test our hypotheses, we set up four models for each state test anxiety instrument separately. First, variance component models without explanatory variables (M0) were fitted to justify the three-level structure. Second, the main variables, autonomy and competence satisfaction and frustration, were entered in model M1. Third, model M2a included test anxiety covariates such as the number of tests, students' trait test anxiety, gender and performance satisfaction. Last, in the final model (M2b), we entered students' prior achievement separately as for this variable there was a low response rate.

The Level-1 variables (i.e., the occasion-level), autonomy and competence satisfaction and frustration and the number of tests, were entered student-mean centered at the occasion-level, class-mean centered at the student-level and grand-mean centered at the class-level (Brincks et al., 2017; Enders & Tofighi, 2007; Lüdtke et al., 2009), as we are only interested in the within-student variability and to facilitate interpretation. At the between-student level (i.e., Level-2 variables), students' trait test anxiety, performance satisfaction and prior achievement were entered grand-mean centered (i.e., around the overall mean) and students' gender was entered uncentered (Brincks et al., 2017).

3. Results

3.1. Descriptive statistics and correlations

Table 1 displays the descriptive statistics. Students reported, on average, moderate test anxiety levels of 2.64 on a scale of five (TEQ) and 2.03 (RTAS) and 2.09 (CTAR) on a scale of four. Students also reported, on average, moderate levels of autonomy and competence satisfaction with scores of 3.16 and 3.35 on a scale of five, respectively. The frustration of these needs was rated 3.36 for autonomy and 2.90 for competence on a five-point scale, indicating moderate experienced need frustration. In addition, the number of low-stakes tests students had to take varied per week. On average, they had to complete 3.27 tests at T1, 4.08 tests at T2 and 1.87 tests at T3.

Pearson correlations, averaged over all measurement occasions, are shown in Table 2. In line with expectations based on SDT, students' state test anxiety correlated negatively with their autonomy satisfaction ($-0.30 \leq r \leq -0.24$, $p < .01$) and competence satisfaction ($-0.59 \leq r \leq -0.46$, $p < .001$) and positively with their autonomy frustration ($0.19 \leq r \leq 0.34$, $p < .001$) and competence frustration ($0.64 \leq r \leq 0.75$, $p < .001$).

In addition, as the number of tests fluctuates between the measurement occasions (see the *Procedure* section), we tested for a timing effect. That is, we tested whether the number of tests, and more specifically the sequence of the number of tests (i.e., high in T1 and low in T2 or vice versa), had an impact on students' feelings of autonomy and competence that in turn could relate to higher test anxiety. Supplementary analyses revealed only a timing effect in students' autonomy and competence satisfaction and frustration expressed as a within-person stability, but did not show a statistically significant relation between the number of tests taken and students' feelings of autonomy or competence. Thus, the within-person stability is independent of the number of tests in the week before, meaning that the relation between feelings at T1 and feelings at

Table 1
Descriptive statistics at each measurement occasion and averaged over all measurement occasions.

	T1			T2			T3			T_{avg}
	n	**M**	**SD**	**n**	**M**	**SD**	**n**	**M**	**SD**	**M**
TEQ	244	2.76	0.87	228	2.74	0.92	223	2.28	0.96	2.64
RTAS	169	2.08	0.51	154	2.10	0.56	151	1.85	0.57	2.03
CTAR	75	2.23	0.58	74	2.19	0.66	72	1.77	0.67	2.09
Autonomy satisfaction	242	3.22	0.71	228	2.99	0.76	223	3.28	0.82	3.16
Competence satisfaction	244	3.36	0.75	228	3.19	0.74	223	3.51	0.72	3.35
Autonomy frustration	244	3.39	0.95	228	3.51	0.90	223	3.17	1.01	3.36
Competence frustration	244	2.88	0.97	228	3.06	0.97	223	2.66	0.88	2.90
Number of tests	243	3.27	2.17	226	4.08	1.44	221	1.87	1.37	3.14
Trait test anxiety	236	2.30	0.69	–	–	–	–	–	–	2.30
Performance satisfaction	231	3.42	1.08	–	–	–	–	–	–	3.42
Prior achievement[1]	182	69.13	8.75	–	–	–	–	–	–	69.13

[1] The lower response rate was due to the response option 'I do not know/I do not wish to answer'.

Table 2
Pearson correlations between the variables averaged over all measurement occasions.

	1.	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**	**11.**	**12.**
1. TEQ												
2. RTAS	0.84***											
3. CTAR	0.85***	–										
4. Autonomy satisfaction	−0.24***	−0.27***	−0.30**									
5. Competence satisfaction	−0.46***	−0.46***	−0.59***	0.60***								
6. Autonomy frustration	0.26***	0.34***	0.19	−0.52***	−0.36***							
7. Competence frustration	0.64***	0.67***	0.75***	−0.40***	−0.69***	0.35***						
8. Number of tests	0.20**	0.26***	0.02	−0.10	−0.13*	0.10	0.15*					
9. Trait test anxiety	0.75***	0.72***	0.70**	−0.31***	−0.52***	0.25***	0.62***	0.11				
10. Gender	0.30***	0.14	0.36***	−0.08	−0.20**	−0.01	0.30***	0.01	0.35***			
11. Performance satisfaction	−0.16*	−0.38***	−0.20	0.10	0.25***	−0.15*	−0.30***	−0.11	−0.22***	0.08		
12. Prior achievement	−0.15*	−0.26**	−0.32**	0.16*	0.20***	−0.12	−0.22**	−0.08	−0.18*	0.11	0.53***	

Note: *p <.05; **p <.01; ***p <.001.

T2 holds true for every student, irrespective of the number of tests they had taken in the week before (see the online supplementary analyses). Therefore, the results from the multilevel analyses below are robust to the sequence of the number of tests.

Furthermore, the three-level model (TEQ-M0) was valid since the variance partition coefficients at each level were significant (Table 3). There was significant variance (12%) at the class-level. Yet, most of the variance resided at the student- (50%) and occasion-level (38%). The significant variance at the occasion-level (TEQ-M0) indicated that students' state test anxiety fluctuates over time, hereby providing support for the first hypothesis (H1).

3.2. The relation between test anxiety and autonomy and competence satisfaction and frustration

When adding autonomy and competence satisfaction and frustration to the model (M1), the three-level structure, using the TEQ-instrument, remained valid (Table 3). At the occasion-level, only competence frustration was significantly and positively associated with test anxiety over all three test anxiety scales. With the TEQ-instrument, autonomy frustration was also positively, but less strongly, related to students' state test anxiety.

When entering the number of tests, students' trait test anxiety, gender and performance satisfaction in model M2a, competence frustration remained positively associated with each test anxiety scale. Autonomy and competence satisfaction and autonomy frustration were still unrelated to students' test anxiety at the occasion-level. These results suggest that in weeks in which students felt their need for competence was more frustrated, they experienced higher test anxiety. Next, the number of tests was significantly and positively associated with test anxiety, a result that cross-validated across all three test anxiety scales. At occasions in which students had to take more tests, they reported higher state test anxiety levels. At the student-level, a positive, significant association between students' trait and state anxiety was observed, implying that students with high trait test anxiety also reported heightened state test anxiety. Concerning gender, the effect did not cross-validate across the three scales. We only found a significant, positive association between gender and state test anxiety with the TEQ-instrument in the full sample. Furthermore, the degree to which students were satisfied with their prior achievement was not significantly related to their test-anxious behavior, based on the TEQ- and CTAR-instrument. For the RTAS-instrument, performance satisfaction was negatively associated with test anxiety. The more satisfied students were with their prior achievement, the lower their state test anxiety. Despite this inconsistency, no other significant differences between the RTAS- and CTAR-instrument were found at the occasion- and student-level. The main findings of this study remain solid across measurements because the relation between test anxiety and competence frustration is consistent across the three test anxiety scales.

In the final model (M2b), we also added prior achievement in this separate step because of its low response rate resulting in a smaller sample size. Results indicated that competence frustration continued to be significantly and positively related to state test anxiety across all three scales. Autonomy and competence satisfaction and autonomy frustration remained insignificant. In terms of students' prior achievement, no association was observed between prior achievement and students' state test anxiety in all three cases. This final model explained 61% of the total variance in students' state test anxiety (with the TEQ-instrument).

4. Discussion

The present study examined (1) whether students' state test anxiety fluctuates in a low-stakes assessment context with weekly tests and (2) whether week-to-week fluctuations in students' satisfaction and frustration with their needs for autonomy and competence, as derived from self-determination theory, were related to fluctuations in their state test anxiety. This allowed us to determine whether autonomy and competence satisfaction and frustration can separately and complementary contribute to students' test anxiety in addition to known test anxiety antecedents.

4.1. Fluctuations in students' state test anxiety

Students in our sample who were regularly exposed to low-stakes assessments throughout the semester reported moderate to high test anxiety levels, depending on the measurement occasion. While evidence suggests that high-stakes assessments elicit higher test anxiety compared to low-stakes assessments (Reeve et al., 2008), the state test anxiety levels of the students in our sample are comparable to that of students who only had to take one final end-of-term, high stakes assessment (e.g., Putwain et al., 2010; Putwain & Daly, 2014). It might be that the low-stakes tests are perceived by students as high-stakes or threatening, which possibly leads to stress experiences (Wenzel & Reinhard, 2021). As such, our results imply that test anxiety in evaluative settings with regular low-stakes assessments is a significant educational issue that teachers must be aware of.

Next, we found support for the first hypothesis by demonstrating that there exists substantial variability in students' state test anxiety over time (38% of variance including error with the TEQ-instrument, 39% with the RTAS-instrument and 45% with the CTAR-instrument). This result indicates that secondary school students' state test anxiety showed week-to-week fluctuations. Such fluctuations were also found in prior studies in higher education showing that students' emotions (Ketonen et al., 2018), and in particular their test anxiety levels (Lotz & Sparfeldt, 2017), fluctuate substantially throughout the semester. Hence, our finding illustrates that secondary school students' test anxiety is also highly dynamic and especially in those school contexts with multiple low-stakes assessments on a weekly basis.

4.2. Students' feelings of autonomy and competence in relation to their state test anxiety

Because students might perceive little control over the low-stakes test situation, feel coerced to take these tests, feel pressured to do well or feel that the low-stakes tests undermine their sense of competence rather than boosting it, we examined the role of autonomy and competence satisfaction and frustration in relation to students' test anxiety. We hypothesized that autonomy (i.e., experiencing a sense of volition and psychological freedom) and competence satisfaction (i.e., feeling effective and successful) would be negatively related to students' state test anxiety (Hypothesis 2a) and that autonomy (i.e., feeling pressured or coerced) and competence frustration (i.e., experiencing failure) would be more strongly, but positively associated with test anxiety (Hypothesis 2b).

Our results were only partially in line with these hypotheses. *First*, although autonomy and competence satisfaction correlated strongly and negatively with test anxiety in the univariate analyses, these relations did no longer emerge in the multilevel analyses, when accounting for the frustration of autonomy and competence. Thus, our results do not support the first sub-hypothesis (Hypothesis 2a). *Second,* we did find a significant and positive relation between students' *competence frustration* and their state test anxiety. Thus, the second sub-hypothesis (Hypothesis 2b) was only partially supported. This positive association also held true when key test anxiety antecedents (e.g., gender, trait test anxiety and prior achievement) were accounted for. Moreover and more importantly, the positive relation between competence frustration and state test anxiety was cross-validated on all three state test anxiety scales. In weeks in which students felt that their need for competence was more frustrated, they also reported higher test anxiety. As students' competence is being judged during tests, they might feel ineffective and experience failure. Yet, given that our data are correlational, it could

Table 3
Students' state test anxiety: Variance component models (M0) and conditional models including autonomy and competence satisfaction and frustration (M1) and covariates (M2a & M2b).

Parameter	TEQ				RTAS				CTAR			
	M0	M1	M2a	M2b	M0	M1	M2a	M2b	M0	M1	M2a	M2b
	$n = 253$ b (S.E.)	$n = 253$ b (S.E.)	$n = 228$ b (S.E.)	$n = 176$ b (S.E.)	$n = 174$ b (S.E.)	$n = 174$ b (S.E.)	$n = 153$ b (S.E.)	$n = 101$ b (S.E.)	$n = 79$ b (S.E.)	$n = 79$ b (S.E.)	$n = 75$ b (S.E.)	$n = 75$ b (S.E.)
Fixed part												
Intercept	2.58 (0.09)	2.62 (0.07)	2.50 (0.07)	2.45 (0.07)	1.98 (0.06)	2.05 (0.04)	2.02 (0.04)	1.97 (0.06)	2.02 (0.11)	1.91 (0.09)	2.00 (0.10)	2.03 (0.05)
Occasion-level												
Autonomy satisfaction		−0.07 (0.05)	−0.03 (0.04)	−0.04 (0.05)		−0.04 (0.03)	−0.01 (0.03)	−0.02 (0.04)		−0.03 (0.06)	−0.00 (0.05)	−0.00 (0.05)
Competence satisfaction		−0.05 (0.05)	0.01 (0.05)	0.04 (0.05)		0.02 (0.04)	0.04 (0.04)	0.08 (0.05)		−0.11 (0.06)	−0.04 (0.05)	−0.04 (0.05)
Autonomy frustration		0.08 (0.04)*	0.05 (0.04)	0.02 (0.04)		0.05 (0.03)	0.03 (0.03)	0.03 (0.03)		0.09 (0.05)	0.07 (0.04)	0.07 (0.04)
Competence frustration		0.24 (0.04)***	0.15 (0.04)***	0.17 (0.04)***		0.18 (0.03)***	0.11 (0.03)***	0.11 (0.04)**		0.18 (0.05)***	0.10 (0.04)**	0.10 (0.04)**
Number of tests			0.08 (0.01)***	0.11 (0.01)***			0.03 (0.01)**	0.05 (0.01)***			0.10 (0.01)***	0.10 (0.01)***
Student-level												
Autonomy satisfaction		0.20 (0.10)*	0.13 (0.07)	0.11 (0.08)		0.08 (0.07)	0.06 (0.06)	0.07 (0.07)		0.12 (0.10)	0.04 (0.09)	0.04 (0.09)
Competence satisfaction		−0.21 (0.11)*	−0.10 (0.08)	−0.05 (0.09)		−0.13 (0.08)	−0.07 (0.06)	−0.11 (0.08)		−0.02 (0.11)	0.05 (0.11)	0.06 (0.11)
Autonomy frustration		0.05 (0.06)	−0.02 (0.05)	−0.05 (0.05)*		0.08 (0.05)	0.04 (0.04)	0.05 (0.05)		0.02 (0.07)	0.01 (0.06)	0.01 (0.06)
Competence frustration		0.46 (0.07)***	0.14 (0.06)*	0.16 (0.07)*		0.26 (0.05)***	0.09 (0.05)	−0.00 (0.07)		0.51 (0.08)***	0.35 (0.09)***	0.35 (0.08)***
Number of tests			0.14 (0.05)**	0.11 (0.05)**			0.04 (0.03)	0.06 (0.04)			−0.00 (0.08)	0.00 (0.08)
Gender[a]			0.18 (0.07)**	0.22 (0.07)**			0.01 (0.05)	0.03 (0.06)			−0.03 (0.10)	−0.03 (0.10)
Trait anxiety			0.70 (0.05)***	0.69 (0.06)***			0.37 (0.04)***	0.36 (0.05)***			0.34 (0.08)***	0.35 (0.08)***
Performance satisfaction			0.03 (0.03)	0.02 (0.04)			−0.07 (0.02)**	−0.08 (0.03)**			0.04 (0.04)	0.06 (0.04)
Prior achievement				0.00 (0.01)				−0.00 (0.00)				−0.01 (0.01)
Class-level												
Autonomy satisfaction		−0.31 (0.36)	−0.16 (0.13)	−0.20 (0.27)		−0.36 (0.30)	−0.46 (0.23)*	−0.54 (0.27)*		−0.32 (0.33)	−0.59 (0.23)**	−0.46 (0.26)
Competence satisfaction		0.27 (0.66)	−0.62 (0.55)	−0.95 (0.50)		0.53 (0.67)	0.54 (0.50)	0.32 (0.64)		−0.31 (0.51)	−0.93 (0.41)*	−0.80 (0.42)
Autonomy frustration		−0.13 (0.29)	−0.28 (0.24)	−0.22 (0.21)		−0.23 (0.19)	−0.27 (0.14)	−0.21 (0.14)		−1.17 (0.49)*	−1.34 (0.37)***	−1.12 (0.42)**
Competence frustration		0.93 (0.34)**	0.27 (0.30)	−0.03 (0.28)		0.63 (0.28)***	0.39 (0.21)	0.19 (0.27)		0.71 (0.39)	0.43 (0.32)	0.40 (0.32)
Number of tests			−0.01 (0.08)	0.08 (0.07)			0.05 (0.04)	0.07 (0.04)			−0.17 (0.07)**	−0.16 (0.07)*
Random part												
σ^2_e(Time)	0.34 (0.02)***	0.31 (0.02)***	0.29 (0.02)***	0.26 (0.02)***	0.12 (0.01)***	0.12 (0.01)***	0.12 (0.01)***	0.11 (0.01)***	0.21 (0.02)***	0.15 (0.02)***	0.10 (0.01)***	0.10 (0.01)***
σ^2_u(Student)	0.45 (0.06)***	0.24 (0.03)***	0.07 (0.02)***	0.06 (0.02)***	0.08 (0.02)***	0.09 (0.02)***	0.03 (0.01)**	0.03 (0.01)**	0.21 (0.05)***	0.06 (0.02)**	0.05 (0.01)**	0.05 (0.01)**
σ^2_v(Class)	0.11 (0.05)*	0.07 (0.03)*	0.05 (0.02)*	0.03 (0.02)	0.03 (0.02)	0.01 (0.01)	0.00 (0.00)	0.00 (0.00)	0.04 (0.04)	0.02 (0.02)	0.00 (0.00)	0.00 (0.00)
% variance time-level (VPC_e)	0.38***				0.39***				0.45***			
% variance student-level (VPC_u)	0.50***				0.51***				0.46***			
% variance class-level (VPC_v)	0.12*				0.10				0.09			

(*continued on next page*)

Table 3 (*continued*)

Parameter	TEQ				RTAS				CTAR			
	M0	M1	M2a	M2b	M0	M1	M2a	M2b	M0	M1	M2a	M2b
−2*loglikelihood (df)	1636.83	1469.65 (12)	1158.62 (5)	834.46 (1)	630.72	536.85 (12)	375.68 (5)	218.27 (1)	389.30	266.57 (12)	176.45 (5)	175.28 (1)

Note: *p <.05; **p <.01; ***p <.001. Reference category = 0: [a] 0 = male, 1 = female.

also be the case that higher test anxiety explains higher levels of competence frustration. That is, when students are highly test-anxious for a low-stakes test, they may feel more ineffective (i.e., high competence frustration). Based on our results, we can only state that students' perceived competence frustration and experienced state test anxiety levels co-vary. Thus, the results suggest that particularly experiences of inferiority and ineffectiveness (i.e., competence frustration), and not experiences of pressure or coercion (i.e., autonomy frustration), impacted students' test anxiety in low-stakes testing situations.

Overall, our findings confirm the dual pathway model in the SDT literature (Vansteenkiste & Ryan, 2013; Haerens et al., 2015; Jang et al., 2016). Whereas need satisfaction primarily relates to adaptive outcomes including autonomous motivation and positive affect (i.e., bright pathway), need frustration would relate more strongly to maladaptive outcomes such as anxiety and disengagement (i.e., dark pathway; Vansteenkiste & Ryan, 2013). This is because psychological need frustration represents a stronger threat to individuals' well-being compared to a lack of need fulfillment (Vansteenkiste & Ryan, 2013). Test anxiety, as a negative emotion, would therefore be more strongly related to need frustration when compared to need satisfaction. Indeed, previous studies found that relations with general anxiety were much more pronounced for autonomy and competence frustration than for the satisfaction of those two needs (Rouse et al., 2020). The present study results support this assumption as only actively undermining students' needs (i.e., need frustration), rather than the absence of need satisfaction, showed a relation with test anxiety. Moreover, several studies in the educational domain have shown that need frustration in general relates positively to negative affect including anxiety (Vandenkerckhove, Soenens, et al., 2019) and to test anxiety in high-stakes assessments (Spadafora et al., 2020). The current study extends these studies by demonstrating that, on the one hand, the dark pathway, more so than the bright pathway, is relevant to a specific form of anxiety, that is, test anxiety in a *low-stakes*, evaluative classroom and that, on the other hand, it is students' need for competence that is most closely and strongly related to their test anxiety.

The outcomes of this study also broaden the scope of earlier test anxiety literature. Our results relate to Lazarus and Folkman's (1984) model of coping and stress and its corresponding concept of controllability. In this model, the concept of controllability is closely related to individuals' perception of their ability to effectively cope with stressful events (i.e., competence), such as a testing situation. That is, if students perceive the upcoming test as a threat to their well-being, but do not believe they have the skills to pass the test (i.e., SDT's low competence satisfaction and/or high competence frustration) and therefore do not believe they have some degree of control over the test situation (i.e., controllability from Lazarus' model), they are more likely to experience higher stress and test anxiety levels. By contrast, those students who view the stressful testing situation as within their control (i.e., controllable stressor) and feel competent in making the test (cf. competence satisfaction), will experience lower levels of stress and test anxiety. In other words, the way in which individuals interpret and subsequently cope with the situation is more important than the event itself (Lazarus & Folkman, 1984). When people have a sense of competence, they tend to interpret stressors as more controllable and tend to be better equipped to cope effectively, resulting in lower stress and anxiety levels and improved overall well-being.

By including the three test anxiety instruments, our measures incorporated not only the cognitive aspect of test anxiety, but also the affective, physiological and motivational components, hereby accounting for the multidimensional nature of test anxiety. However, we found some particularities with the use of the RTAS- and CTAR-scales, being that performance satisfaction at the student-level was significantly and negatively related to test anxiety only when using the RTAS-instrument. Despite this particularity and the fact that the three different test anxiety scales each primarily focus on a different test anxiety component (see e.g., Pekrun et al., 2004) and each student filling out two of the three scales at each measurement occasion, results were consistent across the measures with significant variance at the occasion-level in the multilevel analyses being found for all instruments and relations with competence frustration being consistent. The CTAR, with its specific focus on the cognitive processes, displayed the highest variance at the occasion-level, while the TEQ and RTAS showed approximately equal, yet high (Lüdtke et al., 2009), variance at the occasion-level. Therefore, differentiating between the components and using different scales to measure test anxiety is recommended in future test anxiety research (e.g., Putwain, 2008a; Putwain et al., 2010; Putwain & Daly, 2014).

Through integrating the literature on SDT and test anxiety, our results extend previous research in both fields of study. Overall, the key finding of the present study is that students' experiences of competence frustration is a central underlying mechanism of test anxiety that educators and psychologists should consider when designing anxiety-reducing interventions.

4.3. The number of tests in relation to students' state test anxiety

Our supplementary results show that the number of tests have no cumulative effect on students' test anxiety, as we did not find a statistically significant relation between the number of tests taken at T1 and students' feelings of autonomy and competence at T2. Our findings further suggest that more tests relate to higher test anxiety as students reported higher test anxiety levels during weeks in which they had to take more tests. Our findings therefore do not corroborate with prior studies showing that students who are tested regularly report similar test anxiety levels than students who are assessed less frequently (OECD, 2017). One explanation for this contrasting finding might be the low-stakes context in which this study took place and the underlying mechanism of competence frustration identified in this study. Although low-stakes tests are designed to monitor students' study progress, if students perceive these tests as a threat to their feelings of competence and well-being, rather than perceiving the test as informational and an opportunity to expand their capabilities and strengthen their competence, they will more likely experience high test anxiety levels. It is therefore possible that students' perceptions of the tests (Leenknecht et al., 2021; Vaessen et al., 2017), and in particular their perceptions of the tests' instrumentality or purpose (Bonaccio & Reeve, 2010; Vaessen et al., 2017), are more determinant in the likelihood of experiencing heightened state test anxiety. When many low-stakes tests are scheduled, students might want to do their best on every single test, which can result in higher test anxiety levels. Yet, our results suggest that overexposure to tests negatively affects students' test anxiety, hereby answering the call of Eklöf and Nyroos (2013) who asked for more research on the influence of the number of tests students have to take on their test anxiety. Thus, teachers and school boards should pay attention to the number of tests when designing their assessment policy.

4.4. Prior test anxiety antecedents

Consistent with prior research on gender differences in test anxiety (Putwain & Daly, 2014), our results showed that, in the full sample with the TEQ-instrument, female students reported higher test anxiety compared to male students. However, in the subsamples, we did not find significant differences, which might be due to the test anxiety instruments or the sample size.

Next, our results indicated that students with high trait test anxiety also experienced high state test anxiety, confirming prior literature (Hong, 1998; Spielberger & Vagg, 1995). By including trait anxiety as covariate, we considered individuals' predisposition to feel anxious in stressful conditions. Based on our findings, it can be stated that the short-term variability in state test anxiety is only partially due to individuals' higher trait anxiety. This finding is meaningful because it implies that students' test anxiety can still be influenced by teachers, parents and other key social agents.

In contrast to earlier research (Hembree, 1988; von der Embse et al., 2018), we only found one significant and negative relation between performance satisfaction and test anxiety, using the RTAS-instrument. When using the TEQ-instrument or CTAR-instrument, this relation was not observed. One might expect that students who are more satisfied with their prior performance or who performed better in the past, and thus have more positive appraisals about their own ability, would be less anxious (Raufelder & Ringeisen, 2016). Yet, this was not consistently found in the current sample. Despite this particularity with the RTAS- and CTAR-scales, our main conclusion, that is competence frustration consistently co-varies with test anxiety, remains robust and consistent across the three scales. As such, this difference between RTAS and CTAR is not a substantial concern.

When considering the full models, no association was observed between prior achievement and test anxiety. This finding is not in line with abundant research that did consistently show a negative relation between prior achievement and test anxiety (see *meta*-analyses: Hembree, 1988; von der Embse et al., 2018). This inconsistency might be due to the test anxiety instruments or the sample size.

4.5. Educational implications

The present results suggest that if teachers create classroom environments that do not actively undermine students' psychological need for competence, test anxiety may be reduced. Therefore, teachers can be informed about the detrimental effects of a need-thwarting and particularly a chaotic teaching style as this style is known to be most closely related to competence frustration (Bartholomew et al., 2018). A chaotic teaching style, which did not yet receive much empirical attention (but see Aelterman et al., 2019), is characterized by a laissez-faire attitude in which students are left on their own. Consequently, students do not know what is expected from them and how they should behave to meet the teachers' expectations (Aelterman et al., 2019). The few studies addressing a chaotic style showed that it is associated with more passive student engagement (Cents-Boonstra et al., 2021) and procrastination (Opdenakker, 2021).

In assessment contexts, teachers could easily fall into chaotic teaching. This occurs when the test questions or expectations of upcoming assessments are unclear, when students do not know in advance what learning material needs to be known or when students receive negative, confusing or no feedback at all. Instead, it is recommended that teachers pay attention to factors that may reduce competence frustration. For example, goal clarification and providing students with sufficient formative feedback have been shown to negatively relate to competence frustration (Krijgsman et al., 2019). Moreover, teachers' classroom language and messages about upcoming assessments can exert a powerful influence on students' emotions, including test anxiety (Putwain et al., 2021; Putwain & Best, 2011), and their feelings of competence. Therefore, teachers can be made aware of the instructions they rely on during the entire assessment process. On the other hand, we can also speculate that if students prepare better or put more effort into a test, they may experience less test anxiety as they may feel less ineffective. Future research would do well to unravel the dynamics of the number of tests and students' effort in the relation between competence and test anxiety.

This study also showed that when students have to take more tests in one week, they also report heightened test anxiety. School boards and teachers can consider these findings when (re)designing their assessment policy. It is recommended that teachers find a balance in how frequent they give low-stakes tests. As such, teachers are encouraged to critically reflect on their own classroom assessment practices and the school's assessment policy. School boards could, for instance, facilitate a meeting between teachers to minimize or balance the number of tests throughout the year.

4.6. Limitations and future directions

The present study has some limitations, which, in turn, provide opportunities for future research. *First*, we relied on self-reported measures for students' state test anxiety. Self-reported measures for students' emotions are commonly used but may be biased by individuals' subjective beliefs or social desirability (Pekrun & Bühner, 2014). Physiological measures of test anxiety, such as heart rate or cortisol sampling, may provide more objective information (Roos et al., 2021). Future research could include both self-reported and physiological measures to gain a deeper understanding of students' test anxiety. However, we measured students' state test anxiety and experiences of autonomy and competence at three different moments, which reduced the risk of measurement error.

Second, the TEQ-scale was consistently administered to all students, while the other two scales (RTAS and CTAR) were randomly assigned across classes. That is, some classes were given the RTAS and other classes were given the CTAR. However, this randomization across classes implies a form of planned missing. Given that these classes differ in their testing schedule, we should be cautious when comparing the results of the RTAS-instrument with the results of the CTAR-instrument. Future research could accommodate this limitation by randomizing between students.

Third, because we were interested in feelings of pressure and coercion as well as (in-)effectiveness during low-stakes testing, we considered the needs for autonomy and competence in the current study. Another need that is distinguished within SDT is the need for relatedness (i.e., experiences of warmth and mutual care). In this regard, it might be a fruitful opportunity to expand this work by investigating how relatedness is associated with test anxiety and by differentiating between relatedness towards the teacher, the peers and their parents. It might be that students with a good bound with the teacher experience less test anxiety but it is also equally possible that those students who feel connected to their teacher feel more pressured to live up to the teacher's expectations (Aunola & Nurmi, 2004, 2005). In addition, not only the teacher but also parents and classmates play important roles in students' lives, raising the question of which type of relatedness is most strongly related to test anxiety. As such, future research can unravel the complex dynamics between relatedness in pressuring environments such as assessment contexts.

Fourth, this study analyzed variations in the study variables across the three measurement occasions. Therefore, it was not possible to fully establish causality. Future studies should endeavor to conduct longitudinal studies to observe if changes in autonomy and competence satisfaction and frustration predict changes in students' self-reported test anxiety and vice versa. However, the relation between competence and the level of test anxiety could be explained as well by, for example, the high volume of tests (OECD, 2016), students' study effort (Eklöf & Nyroos, 2013) or the perceived difficulty of the tests (Pekrun et al., 2023). To illustrate, the high number of tests can discourage students as

they might lack the confidence to successfully handle such a high volume of tests. Similarly, students may put less effort due to the sheer number of tests. Yet, another option could be that students who put less effort during some school weeks may feel both less competent and more test-anxious (Eklöf & Nyroos, 2013). Also, the difficulty level of the tests may trigger test anxiety directly but also indirectly through its negative effect on students' perceived competence (Pekrun et al., 2023). Examining how these variables work together in relation to test anxiety might be a great avenue for future research.

Fifth, when recruiting schools, we considered the school size, educational type and the education network around the school. Yet, our sample only included four secondary schools located in a limited geographic area. Therefore, the findings of this study should be replicated in future studies with a larger, more stratified sample.

Sixth, students reported on their general feelings of autonomy and competence during class. However, the degree to which students' needs for autonomy and competence are satisfied or frustrated may be teacher- or lesson-specific (Krijgsman et al., 2019; Tsai et al., 2008). Similarly, test anxiety was assessed across all subjects but may differ between subjects. Future work could take this lesson-to-lesson variability and subject-specific test anxiety into account when investigating the association between students' test anxiety and need-based experiences.

5. Conclusion

Our results indicated that students' test anxiety in evaluative settings with regular low-stakes assessments fluctuates from week to week. Moreover, week-to-week fluctuations in students' competence frustration consistently related to week-to-week fluctuations in their test anxiety, even after considering well-established test anxiety antecedents. Especially when students perceive their need for competence is more frustrated, which is the case when they feel ineffective and experience failure, they also report higher test anxiety. Therefore, it is recommended to teachers and school psychologists to pay attention to students' feelings of competence and especially focus on factors that may reduce competence frustration. Such factors may include a teacher's (de)motivating teaching style, their communication style about tests and the number of scheduled low-stakes tests.

CRediT authorship contribution statement

Stefanie De Jonge: Writing – review & editing, Writing – original draft, Visualization, Software, Resources, Methodology, Investigation, Formal analysis, Conceptualization. **Evelien Opdecam:** Writing – review & editing, Validation, Supervision, Methodology, Data curation, Conceptualization. **Leen Haerens:** Writing – review & editing, Validation, Supervision, Methodology, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.cedpsych.2024.102273.

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