University of Essex

Research Repository

Examining the Origins and Outcomes of Research-Related Emotions in Faculty: Developing the Research Emotions Questionnaire (REQ)

Accepted for publication in the Journal of Higher Education.

Research Repository link: https://repository.essex.ac.uk/40916/

Please note:

Changes made as a result of publishing processes such as copy-editing, formatting and page numbers may not be reflected in this version. For the definitive version of this publication, please refer to the published source. You are advised to consult the published version if you wish to cite this paper.
https://doi.org/10.1080/00221546.2025.2497222

www.essex.ac.uk

University of Essex

Examining the Origins and Outcomes of Research-Related Emotions in Faculty:

Developing the Research Emotions Questionnaire (REQ)

Robert H. Stupnisky, University of North Dakota, ORCiD 0000-0002-5391-7205

Reinhard Pekrun, University of Essex, ORCiD 0000-0003-4489-3827

Nathan C. Hall, McGill University, ORCiD 0000-0002-9734-2562

Vincent Larivière, University of Montreal, ORCiD 0000-0002-2733-0689

Muhammad Salahuddin, University of North Dakota, ORCiD 0000-0003-1205-0999

Author Note

This work was supported by the National Science Foundation under Grant 1853969.
The authors report that there are no competing interests to declare.
Correspondence concerning the article should be addressed to Robert H. Stupnisky, College of Education & Human Development, University of North Dakota, 231 Centennial Drive Stop 7189, Robert.Stupnisky@und.edu

Citation for this article:

Stupnisky, R. H., Pekrun, R., Hall, N. C., Larivière, V., & Salahuddin, M. (2025). Examining the origins and outcomes of research-related emotions in faculty: Developing the Research Emotions Questionnaire (REQ). Advance online publication. *The Journal of Higher Education,* https://doi.org/10.1080/00221546.2025.2497222

© Copyright held by Taylor & Francis. This article may not exactly replicate the authoritative document published in the Taylor & Francis journal. It is not the copy of record. Link to the final article: https://doi.org/10.1080/00221546.2025.2497222

Abstract

University faculty experience many emotions that have implications for their research success; however, previous studies on research-related emotions in faculty have consistently employed self-report measures with limited validity, reliability, and scope. The current study aimed to validate the Research Emotions Questionnaire (REQ) among STEM faculty, examine potential differences in emotions by demographic and job-related factors, and test a hypothesized model of emotions as predictors of faculty research success based on Pekrun's (2006) control-value theory (CVT). An online survey was completed by 611 STEM faculty from 10 research-intensive US universities, with the data showing the REQ to be valid and reliable. Women reported more anxiety and disappointment, underrepresented minorities reported more anxiety, and full professors reported more enjoyment and pride, as well as less anxiety and disappointment, compared to junior colleagues. Structural equation modeling results showed perceived control and value appraisals significantly predicted research emotions and, in turn, self-reported research success. Negative binomial regressions revealed enjoyment, boredom, disappointment, and frustration as significant predictors of bibliometric counts of publications and citations. The REQ is an improved tool for understanding faculty research emotions, with implications for developing targeted emotional regulation programs to enhance faculty well-being, success, and job satisfaction, particularly for underrepresented groups.

Keywords: emotion, faculty, control, value, research

Examining the Origins and Outcomes of Research-related Emotions in Faculty: Developing the Research Emotions Questionnaire (REQ)

Workers in Science, Technology, Engineering, and Mathematics (STEM) utilize a wide range of educational credentials to sustain the research enterprise in the US and other countries, drive innovation in critical and emerging technologies, and support nations' competitiveness in the global economy (NSB NSF, 2024). Studies examining the predictors of research productivity in university faculty members have primarily focused on institutional characteristics (type, size, departmental climate, funding, laboratory size), demographics (gender, age, dependents), and job characteristics (discipline, workload, student supervision; Brew et al., 2016; Valdivieso et al., 2022). Recent studies have revealed that university faculty members experience many unique emotions that have powerful implications for their research success (DeLuca & Maddox, 2016; Stupnisky et al., 2016, 2019a, 2019b). Research is a domain where faculty emotions run exceptionally high because producing scholarly products is often tied to professional advancement such as tenure and promotion (Kowai-Bell et al., 2012; Watts & Robertson, 2011), the work requires long-term passion and perseverance (i.e., grit; Jaeger et al., 2022), and research is frequently criticized such as during peer review (Fitzgerald, 2018). Paradoxically, researchers are also socialized to suppress emotions to maintain scientific objectivity (Stupnisky et al., 2016), thereby impeding emotion assessment and long-term well-being outcomes (Salimzadeh et al., 2021). Indeed, qualitative studies have found faculty to report a range of frequently occurring emotions regarding their research that significantly affect their subsequent success (Dickson-Swift et al., 2009; Stupnisky et al., 2016).

Considerable recent higher education research examined how faculty experiences affect their success (McNaughtan et al., 2021; Sabagh et al., 2021) as well as the role of emotions and mental health experienced by students in higher education (Durand et al., 2024; Pekrun & Stephens, 2010; Raposa et al., 2024). However, the role of emotions in faculty success has been less studied (Eagan & Garvey, 2015;

Gardner, 2022; Neumann & Finaly-Neumann, 1990). Rigorous multi-item emotion scales have been developed for students in elementary school (Lichtenfeld et al., 2012) and post-secondary contexts (Pekrun et al., 2011, 2023), as well as schoolteachers (Frenzel et al., 2016). In contrast, emotion measures and studies specific to faculty research are less common and have critical validity, reliability, and generalizability limitations. The purpose of this study was, therefore, to examine the reliability and validity of multi-item scales measuring seven research-related emotions among faculty members. Robust measures would allow more rigorous empirical tests of conceptual and theoretical models to understand the motivation and performance of faculty in research domains, as well as examine potential differences in their emotions and success based on demographic variables and job-related characteristics.

Emotions in Faculty Members

Emotions are a response to important events or situations that are comprised of multiple components: *affective* experiences of subjective feelings, *cognitive* mental processing of information, *physiological* body reactions, and *motivation* to engage in behavior or act (Scherer & Moors, 2019). For example, before applying for a research grant, a faculty member may experience anxiety that is comprised of nervous, uneasy feelings (affective); worry about possible rejection (cognitive); sweaty hands, increased heart rate, fidgeting (physiological); and impulses to avoid submitting the grant (motivation). Such discrete (i.e., specific) emotions have also been grouped based on whether they are positive or negative (valence: pleasant or unpleasant) and whether they increase or decrease physiological arousal (activation: arousing or deactivating). They can be further classified by what they focus on, such as future, present, or past activities in teaching versus research (Pekrun et al., 2023). For example, research-related enjoyment in faculty is typically a positive, activating emotion experienced during research activities (such as data collection); alternatively, research-related disappointment is a negative, deactivating emotion that arises after specific research events (like manuscript rejection).

How social-environmental factors and behavioral outcomes are linked to various discrete emotions in achievement settings is effectively outlined in Pekrun's (2006, 2024) Control-Value Theory of Emotions (CVT). According to this framework, individuals' appraisals of control (causal influence over actions and outcomes) and value (importance and usefulness of actions and outcomes) within a given achievement situation lead to the emotions they experience and, subsequently, their motivation and performance. For instance, when analyzing research data, faculty who perceive themselves as competent and consider the project important are more likely to experience positive, activating emotions such as enjoyment, which, in turn, should improve performance through increased focus and engagement. Alternatively, faculty with low perceived competence are more likely to experience frustration, and faculty who deem the analyses to be of limited value may feel boredom, with both emotions likely resulting in lower performance and engagement.

Faculty members' emotions concerning their research. Qualitative studies identifying *which* emotions faculty experience when conducting research have yielded a range of results. For example, Stupnisky et al. (2016) conducted focus groups with 18 pre-tenured faculty and asked them to identify factors that affect their success. Faculty spontaneously named 18 different emotions. A follow-up survey of 79 faculty revealed that enjoyment, pride, and boredom were most common regarding teaching, whereas feelings of anxiety, guilt, and helplessness were most prominent for research activities. Interviews by Stupnisky and colleagues (2019b) with 11 faculty yielded 46 discrete emotions related to teaching and research, with the most frequently mentioned emotions including enjoyment, frustration, excitement, happiness, and anxiety. Autoethnographic research similarly highlights the role of emotions in faculty research. For example, DeLuca and Maddox (2016) described experiencing guilt and anxiety when conducting qualitative ethnographies due to their position of privilege (see also Beare & Stenberg, 2020; Dickson-Swift et al., 2009; Emerald & Carpenter, 2015). Although qualitative research highlights the crucial role of emotions for faculty during research, these findings may be influenced by

interpersonal dynamics, possibly leading to an underreporting of socially undesirable emotions like guilt, shame, and relief when the interviewer is present (Stupnisky et al., 2019b).

Following the wide range of discrete emotions experienced by faculty detected using qualitative methods, researchers strived to test the generalizability of the findings by assessing the frequency of emotions quantitatively. To measure such varied emotions in surveys while avoiding survey fatigue, many past studies examined emotions with single-item measures (e.g., "Please indicate how frequently you have experienced the following EMOTIONS regarding your TEACHING/RESEARCH this academic year: Enjoyment, anxiety, boredom, etc."; Stupnisky et al., 2019b; see also Kords-Freudinger, 2017). Stupnisky et al. (2019b) measured 22 discrete emotions among 102 pre-tenured faculty using single-item measures, finding enjoyment, happiness, pride, satisfaction, and relaxation to be commonly reported regarding teaching, whereas more frustration, anxiety, worry, fear, envy, shame, loneliness, and hopelessness were reported with respect to research. These emotions were correlated in the expected directions with success (i.e., positive correlations for positive emotions and negative correlations for negative emotions). However, the validity and generalizability of these relations is questionable due to the inability to establish reliability and structural scale validity for single-item emotion measures. Although previous analyses found significant relations after collapsing measures to form internally reliable scales (Stupnisky et al., 2019b), these variables necessarily reflected more basic dimensions (e.g., positive/negative valence) and provided limited information concerning how specific discrete emotions relate to success for faculty in the research domain.

Limitations of existing research on faculty emotions. The primary limitation of most prior studies examining faculty research emotions is that they utilized single-item measures that may have low validity (AERA, APA, NCME, 2014). For instance, one faculty member may have a very different view of what the single word "anxiety" means compared to another faculty member. Simply put, single items provide limited information as to how faculty members more fully experience specific emotions of

interest (i.e., content-related validity). Alternatively, multi-item measures have superior validity by collecting different data points regarding the target construct, which is particularly important for assessing the theoretically proposed components of faculty members' emotional experiences, including affective, cognitive, physiological, and motivational aspects (Pekrun, 2006).

A second disadvantage of single-item measures is their questionable reliability (Blair et al., 2014; Warner, 2013). According to classical test theory, item responses reflect both true score variance and random measurement error, and it is by aggregating multiple indicators of a single construct that random error can be gauged and potentially accounted for. The use of single items to measure psychological constructs, such as emotions, is typically discouraged due to their inability to be assessed for internal reliability. Instead, multi-item measures allow for tests of reliability in terms of internal consistency, such as Cronbach's alpha or McDonald's omega, which typically produce greater scale variability and consistently yield data that is more normally distributed.

As noted, some prior studies of faculty emotions have combined single items of discrete emotions into summative variables measuring basic dimensions of positive or negative affect (Kords-Freudinger, 2017; Stupnisky et al., 2019b) or assessed general emotion constructs such as mood (Kowai-Bell et al., 2012) or emotional exhaustion (Navarro et al., 2010). However, such approaches also lack validity when attempting to assess specific discrete emotions due to collapsing across single-item measures to create simplified variables. To address the limitations of prior research on faculty emotions due to single-item measures or suboptimal composite measures, the current study adapted an existing multi-item measure of emotions designed for students (Pekrun et al., 2011) to improve the validity and reliability of faculty emotion measures.

Recent work by Stupnisky et al. (2019a) initiated the use of multi-item scales to study discrete emotions experienced by faculty regarding their research activities. Findings based on a sample of 312 North American assistant professors showed that multi-item measures of faculty enjoyment, anxiety,

and boredom (four items each) concerning their research demonstrated good reliability as well as convergent and discriminant validity. Furthermore, a structural equation model highlighted faculty perceptions of both control and value pertaining to their research as important antecedents of their research-related emotions. Bibliometric indictors of research success were positively predicted by research enjoyment and negatively predicted by research anxiety. However, the study was limited in that faculty were recruited via social media, thus potentially excluding faculty members who avoid social media use. Furthermore, only a limited range of three emotions were assessed.

Recent studies have also examined the relationships between faculty emotions and self-reported research performance measures (Stupnisky et al., 2016; 2019b). Although findings show strong positive correlations between self-report and objective success outcomes (Hall et al., 2006; Ruthig et al., 2007), such measures may be inaccurate due to memory errors and/or social desirability bias. Researchers and bibliometricians generally agree that publications in peer-reviewed scientific journals remain a reliable indicator of research productivity (Hardré et al., 2011; Javitz et al., 2010; Walker & Fenton, 2013), particularly in STEM disciplines. However, it is often argued that measures of faculty research productivity should also include indicators of research impact, such as article citation counts (Moed, 2005). Accordingly, the current study built upon prior research by complementing multi-item self-report measures of research success in faculty members with bibliometric Web of Science data on publications and citation counts.

Demographic differences in faculty emotions. Pekrun's (2006, 2024) control-value theory posits that the general functional mechanisms of human emotions are universal, whereas emotions' contents, frequency, and intensity differ by culture, gender, and individuals. To date, many studies have examined how demographic and job characteristics affect research experiences and performance, but not many studies have examined individual differences in faculty research emotions.

Regarding gender, it is well documented that fewer women are employed as faculty in STEM fields than men (NCES, 2023). Research by Mardani et al. (2023) with 651 US STEM faculty at research institutions found that 86.6% of women reported experiencing gender discrimination from a superior or colleague, with 80.7% indicating being excluded from opportunities based on their gender. Sugimoto and colleagues (2013) further showed that women produce fewer scholarly publications than their male peers and that their work is less cited regardless of authorship order, countries, collaborative practices, and discipline. Beaudry and Larivière (2016) similarly discovered that women faculty receive less funding for research than their male colleagues, and Meho (2022) found that women faculty represent only 14% of the world's highly cited researchers, reflecting a persistent gender gap. Hunter and Leahey (2010) also demonstrated that women faculty are more likely to experience a decline in research productivity and visibility after having a child. Overall, research shows that numerous factors, from personal choices to institutional barriers, limit the participation and success of women faculty in STEM fields (Ceci & Williams, 2010). Despite these well-documented gender differences in research experiences and productivity, findings show no gender differences in research-related emotions for faculty members (Stupnisky et al., 2016).

Underrepresented minority (URM) individuals are those whose representation is smaller than in the general population, typically based on race and/or ethnicity. Among university faculty, URMs are particularly rare, and therefore visible, in STEM fields (NSF NCSES, 2020). Results from empirical studies reveal that URM faculty are more likely to experience bias, discrimination, and stress that impact multiple aspects of their work, including their research performance (O'Meara et al., 2020; Stolzenberg et al., 2019; Stupnisky et al., 2015). Indeed, a study by Mardani et al. (2023) with non-white URM STEM faculty found 77.6% to have been discriminated against by superiors or colleagues based on their race or ethnicity, with 66.7% reporting being left out of opportunities. Workplace discrimination faced by URM faculty has also been suggested to further manifest in depression, isolation, and lessened relatedness to

colleagues (Zambrana et al., 2017; 2021), all of which are reasonably expected to impact their emotions while conducting research. Accordingly, O'Meara et al. (2020) found that URM faculty reported spending more time on teaching, mentoring, and advising activities at the expense of their research endeavors.

Also critical to examining the development of faculty research emotions and productivity are job characteristics such as rank and career age. Junior faculty consistently score lower on scholarly productivity than associate or full professors (Eagan et al., 2014). For example, Beare and Stenberg (2020) interviewed 10 faculty members in rhetoric and composition at research-intensive institutions and revealed that career stage or rank significantly influenced their emotions regarding publishing. Interestingly, Stupnisky et al. (2016) found that first-year faculty members felt significantly less helplessness and guilt than more senior faculty regarding their research, contrary to some expectations that junior faculty would experience more detrimental emotions due to their lesser experience. Overall, many potential differences in research-related emotions and perceptions (e.g., control, value) among faculty may exist based on personal background variables and job characteristics that have important implications for their research performance. However, to date, few of these group comparisons have been conducted, likely due to the limited availability of robust self-report measures.

The Current Study

Given the pivotal role of faculty research in generating new knowledge to advance society (NSB NSF, 2024), it is essential to explore how faculty emotions influence their research success. In the current study, we examined the reliability and factorial validity of newly developed multi-item scales measuring faculty members' discrete emotions concerning their research activities. We further explored faculty differences in research-related emotions based on gender, URM status, and rank. Finally, in line with the Control-Value Theory (Pekrun, 2006, 2024), we investigated relations between research-related emotions and proposed antecedents of perceived control and value among university faculty, and

additionally evaluated both self-report and objective indicators of research success as critical outcome variables.

Methods

Procedure and Participants

In Spring 2021, 611 STEM faculty members (Granovskiy, 2018; Hasanah, 2020; NSB, 2015) completed an online survey approved by the Institutional Review Board from the first author's institution.[1] The number of institutions recruited was based on estimates of the number of STEM faculty members in the institutions, survey participation rate, statistical power, and the availability of participant incentives. In exchange for their participation, faculty were offered entry into drawings for gift cards and a summary of the study results. Faculty participants were recruited from 10 US Doctoral Universities (R2 Higher Research Activity Carnegie Classification) located throughout the US. In the US, R2 institutions have historically experienced an "upward drift" (i.e., striving for higher Carnegie Classification to gain prestige; Aldersley, 1995), typically resulting in imbalanced faculty workloads marked by high research demands (Greene et al., 2008; O'Connor et al., 2011). As such, emotions pertaining to research activities were expected to particularly salient among these faculty. Participants were 56.8% male, predominantly white (80.5%) and non-Hispanic (92.6%), had an average age of 47.9 years (*SD* = 11.4), employed at various ranks (34.1% full, 25.6% associate, 30.3% assistant, 10.0% other, including research professors, postdocs, etc.), and had average contractually expected efforts or workloads of 36.3% teaching, 40.1% research, and 12.5% service (other = 7.9%; see Table 1 for full sample profile).

Measures

Emotions. The *Research Emotions Questionnaire* (REQ) contains seven multi-item scales assessing discrete, research-related emotions previously established as commonly experienced by faculty members: enjoyment, pride, relief, anxiety, frustration, boredom, and disappointment (Stupnisky

et al., 2019b; Appendix A). The measured emotions captured the dimensions of both valence (positive/negative) and activation (activating/deactivating), thereby expanding on the three research-related emotions previously assessed in faculty members by Stupnisky et al. (2019a). The emotion scales each contained four items, and each item uniquely measured one component of the multi-component processes of emotions proposed in Pekrun's (2005) control-value theory (affective, cognitive, physiological, motivational).

Control and value. Four items from Stupnisky et al. (2019a; adapted from Perry et al., 2001) measured faculty participants' perceived control concerning their research activities (e.g., "I have a great deal of control over my performance"; 1 = *Strongly disagree*, 5 = *Strongly agree*). Adapted from Stupnisky et al. (2019b), faculty members' perceived value of research was assessed with four items reflecting the facets of positive task value proposed by Eccles (2005; intrinsic, attainment, utility, cost, e.g., "It is important to me that I do well in my research"; 1 = *Strongly disagree*, 5 = *Strongly agree*).

Research success. Faculty reported their perceived success over the last three academic years in three areas: conducting research activities (e.g., literature reviews, study design, data collection, analysis, writing, etc.), publishing research, and securing external grant funding for research. In each of the three areas, faculty compared their perceived success to four criteria: "Your own standards," "Your department's standards for tenure and promotion," "Colleagues in your department," and "Colleagues in your field(s)" (1 = *Well below average*, 3 = *Average*, *5 = Well above average*; Stupnisky et al., 2023).

Faculty bibliometric indicators of research publications and citations over the three years prior to the completion of the survey were collected from the Web of Science. Participants were matched with the publications indexed in the Web of Science based on their family name and first name, with each publication portfolio manually curated to remove papers authored by homonyms. Confirmation of publications was performed by contrasting with participants' CVs available online and other heuristics, such as the institutional affiliation indicated on the paper and the consistency between the discipline of

the publication and participants' departmental affiliation. The coverage of bibliometric databases varies by country and discipline (Mongeon & Paul-Hus, 2016); however, for U.S. authors, the coverage of the Web of Science database is extensive due to primarily indexing papers published in English. For the publication count and citation variables, outliers were identified as those scores falling outside 97.5% of all scores and were trimmed (specifically, we removed the data of 11 faculty with 25+ publications and 12 with 233+ citations).

Covariates. As covariates in the analysis, we included faculty career age ("How many years have you been working as a faculty member at your current [at another] institutions?", summed to get total age) and research effort percentage on contract ("As stated in your contract for the current academic year, please specify your expenditure of time using percentages into the categories below: Teaching, Research, Service, Other"). Job satisfaction was measured with a 10-item scale from the National Science Foundation's 2003 Survey of Doctorate Recipients, which asked, "How satisfied are you with the following aspects of your job over the last year?" with items referring to aspects such as "Salary" and "Intellectual Challenge" (1 = *Very dissatisfied*, 5 = *Very satisfied*; $M = 3.63$, $SD = 0.64$, Cronbach's $\alpha = .86$). Cohen et al.'s (1983) perceived stress scale measured thoughts and concerns participants had since they began their current position. The scale consisted of seven items, such as "How often have you felt nervous and 'stressed'?" (1 = *Never*, 5 = *Very often*; $M = 3.04$, $SD = 0.80$, Cronbach's $\alpha = .89$).

Rationale for Analysis

Descriptive statistics and reliability analyses were conducted for all study variables to examine if the data sufficiently met statistical assumptions, such as normality and internal scale consistency. The items of the emotion, control, value, success, job satisfaction, and stress scales were then averaged into sum scores representing their respective constructs. Group differences in emotions based on demographics and job characteristics were assessed with *t*-tests (gender, URM) and ANOVAs (rank). We calculated correlations to examine bivariate relationships among all study variables.

To estimate measurement models and structural models, we used structural equation modeling (SEM; Rousseel, 2012) with the R latent variable analysis (lavaan) package. SEM was chosen for these analyses because it incorporates latent variables that robustly reflect theoretical constructs and account for measurement error, and models complex relationships among variables that are tested using a confirmatory approach (i.e., pre-specified hypothesizes) based on overall model fit to the data (Hair et al., 2009). First, a confirmatory factor analysis (CFA) was conducted to test the relations between the observed/measured variables and the latent/unmeasured variables (Marsh et al., 1999). This measurement model included latent variables for control, value, all seven emotions, and perceived success. Second, once the measurement model was found to have a suitable fit and sufficient loadings, we used it to estimate structural models.

The structural models tested predictive hypotheses that faculty's perceived control and value would predict their emotions, which, in turn, would predict their perceived self-reported research success. Bootstrapping was used to test mediation, that is, the indirect effects of control and value on success via each emotion, as well as their total effects (control and value did not directly predict success in these models). The structural model also included covariates predicting research success, specifically career age (years since PhD), contract time spent on research, job satisfaction, and stress. Job satisfaction and stress were each calculated as averaged item scores to reduce model complexity. The criteria used to assess model fit included the standardized root mean square error (SRMR < .05 indicates a well-fitting model, Byrne, 2010; < .08, Hu & Bentler, 1999; < .10, Kline, 2005), the comparative fit index (CFI > .95 indicates a well-fitting model, < .90 requires respecification; Bentler, 1990; Hu & Bentler, 1999), and the root mean square error of approximation (RMSEA < .08 indicates an acceptable-fitting model, Browne & Cudeck, 1992; < .10 MacCallum et al., 1996).

As number of publications and citations represents count data, such variables are often positively skewed, yielding a Poisson distribution (i.e., most values are relatively low, few are high, and

the variance may be larger than the mean). Typical linear regression and structural equation models assume a normal distribution of the outcome variable (e.g., self-reported research success on a Likert scale). Thus, applying linear regression methods to count data can lead to biased parameter estimates (Beaujean & Grant, 2016). Whereas analytical strategies such as dichotomizing responses or nonlinear transformations (e.g., square root) are often adopted to make the variable more closely approximate to normal, such approaches have significant limitations (Dawson & Weiss, 2012). In contrast, as negative binomial regression models assume a non-normal distribution and link predictor variables to the outcome via a natural log transformation, this analytical approach was used in the present study to assess the bibliometric indicators of research productivity. This method is better suited to account for distributions showing an overdispersion of scores (i.e., when the variance is larger than the mean).

Results

Preliminary Analyses

Descriptive statistics on individual self-report survey items found no significant departures from normality (skewness $\pm$1.0 to $\pm$2.3 = moderately nonnormal, $\pm$2.3 = severely non-normal; Lei & Lomax, 2005; kurtosis > $\pm$ 7.0 = non-normal; Byrne, 2010). The bibliometric data was non-normal, as expected, and thus was analyzed using negative binomial regressions. Tests of reliability showed that each of the multi-item scales demonstrated internal consistency based on Cronbach's alpha (.78 to .92) and McDonald's omega (.76 to .85). We averaged items to form summative variables for the respective scales and reconfirmed normal distributions (Table 2), with the summative variables subsequently assessed in the correlational and group difference analyses.

Emotion Mean Levels and Group Differences

The violin plot in Figure 1 illustrates that faculty reported the highest levels of pride and enjoyment regarding their research (positive, activating), followed by relief (positive, deactivating). Anxiety was the most frequently reported negative emotion, followed by frustration (both activating),

whereas disappointment and boredom were the least reported emotions for research (negative, deactivating).

Group difference tests (Table 3) showed that women reported more anxiety and disappointment regarding their research activities compared to men. Faculty who self-reported as an underrepresented minority (URM based on gender, race, and/or ethnicity) conveyed more anxiety concerning their research than those who did not identify as URM. Finally, full professors reported the most enjoyment and pride, as well as the least anxiety and disappointment, compared to associate and assistant professors.

Correlations

Correlations among study variables revealed significant relationships supporting the validity of the emotion scales and the control-value theory. Emotion intercorrelations (Table 4) were as expected, with positive and negative emotions relating according to valence. Evidence of external validity included positive emotions positively relating and negative emotions negatively relating to perceived control and value (Table 5). All the emotions correlated significantly with the self-rated research success measure (ranging from r = .21 for relief to r = -.42 for disappointment), reinforcing the importance of emotions to faculty members' perceived research performance. Also, modest correlations were observed between the emotions and the bibliometric number of faculty publications and citations, with the relatively low magnitude of relations likely due to the non-normal distribution of the bibliometric variables.

Measurement Models

A CFA with all seven emotion scales loading onto their respective, emotion-specific latent variables supported the scales' structural validity based on an acceptable goodness of fit (Table 6). Convergent validity of the scales (i.e., that the items suitably shared common variance) was supported as many of the items loaded strongly onto their respective latent variables (above .70) with the average variance extracted (AVE; average of item R^2) for latent variables being above or approaching .50 (except

for anxiety and disappointment that were .48; Hair et al., 2009). Support for discriminant validity (i.e., that each emotion latent construct is significantly unique from the others) was provided by results showing the average AVEs between pairs of latent emotion constructs to be greater than the square of the correlation between those constructs (all except frustration-disappointment: Avg. AVE = .53 < R^2 = .59; Hair et al., 2009). Finally, a competing model was analyzed in which all positive emotion items loaded onto one latent variable, and all negative emotions onto a separate latent variable. The positive/negative emotion model had a worse fit than the seven-emotion model, thus providing further support for the model that conceptualized discrete emotions.

Structural Models

Seven structural equation models were analyzed to test the relations of perceived control and value with each discrete emotion and, in turn, self-reported research success (Figure 2). Each model assessed had sufficient fit to the data and showed each discrete emotion to predict research success significantly. Positive emotions positively predicted success, whereas negative emotions negatively predicted success. It is important to note that these relations were observed over and above the effects of career age, research time, job satisfaction, and stress covariates. Disappointment was the strongest predictor of research success among the emotions assessed, followed by pride. The models also supported Pekrun's (2006, 2024) theory as perceived control and positive value appraisals positively predicted positive emotions and negatively predicted negative emotions. Furthermore, 10 of 14 indirect effects on perceived success were statistically significant. More specifically, the relationship between perceived value and research success was significantly mediated by enjoyment and boredom, whereas the path from perceived control to research success was mediated by relief and anxiety.

Predicting Bibliometric Success Outcomes

Table 7 reports the results of the hierarchical negative binomial regressions, which evaluated mean-centered predictors predicting faculty publication and citation counts. In Step 1, we included

faculty appraisals of research-related control and value as predictors, as well as all covariates (career age, research effort % on contract, job satisfaction, stress). In Step 2, we added the emotions individually as predictors in seven separate regression models. Goodness of fit was assessed with the Akaike information criterion (AIC) for which smaller values typically indicate a better model. All the AIC values of the negative binomial regressions that included emotions (Step 2) were smaller than the values for the models without emotions (Step 1), suggesting that emotions are important to understanding faculty production of publications and citations.

For the analyses predicting number of publications, the Step 1 results showed research value, career age, research effort on contract, and to a lesser extent job satisfaction to be significant predictors (perceived control and stress were not significant predictors). On average, these variables predicted that faculty would produce 5.55 publications every 3 years. In Step 2, enjoyment was the strongest predictor among the positive emotions. A one-standard deviation increase in enjoyment (0.71, or a little more than half a response increase on a 5-point Likert scale) predicted a 21.13% increase in publications produced over 3 years, which translates to 7.21 total publications on average (i.e., almost two publications more than with average enjoyment). The inclusion of enjoyment also resulted in value becoming non-significant, suggesting that enjoyment mediated the effect of value on faculty publications. Boredom was the strongest predictor among the negative emotions, with a one-standard deviation increase (0.69) predicting a 15.84% decrease in publications over 3 years, yielding 4.21 total publications on average. Value also decreased in strength with the inclusion of boredom, suggesting a mediational effect. Relief (7.37%), disappointment (-10.34%), and frustration (-9.37%) were also significantly related to publication count, albeit to a lesser extent.

For the analyses predicting citations, in Step 1 the results showed research value, career age, research effort on contract, and stress to be significant predictors of citations (perceived control and job satisfaction were not significant predictors). These variables collectively predicted that faculty would, on

average, obtain 24.48 citations every 3 years. In Step 2, when the emotions were added individually, enjoyment was again the strongest predictor with a one-standard deviation increase (0.71) predicting a 23.74% increase in citations over 3 years, or 32.82 total citations on average. The inclusion of enjoyment again resulted in value becoming non-significant, suggesting that enjoyment mediates the effect of value on faculty citations. Turning to negative emotions, boredom was again the strongest predictor, with a one-standard deviation increase (0.69) predicting a 29.66% decrease in citations over 3 years, yielding 14.15 total citations on average. The inclusion of boredom also resulted in the value effect decreasing in strength, suggesting mediation. Disappointment (-23.29%), and frustration (-19.86%) were also significantly related to citation counts. Overall, the detrimental relation of negative emotions to faculty citations on citation counts was notably stronger than the positive relations of positive emotions.

Discussion

The current study aimed to validate the Research Emotions Questionnaire (REQ) among US STEM faculty, examine emotion differences in demographic and job characteristics, and test a hypothesized model of emotions as key predictors of faculty research success based on Pekrun's (2006, 2024) control-value theory. The predictive analyses included both structural equation models of self-reported faculty research success and negative binominal regression models including bibliometric measures of faculty publications and citations.

Central to the purpose of the current study, findings showed the emotion scales to be reliable and valid. The new multi-item scales modified from the Achievement Emotions Questionnaire (AEQ; Pekrun et al., 2011, 2023) and expanded from Stupnisky et al. (2019a) demonstrated superior construct and content validity as compared to single-item measures of discrete emotions used in past studies with faculty (e.g., Stupnisky et al., 2016, 2019b). CFA results confirmed internal reliability and convergent s validity of the items, suggesting that the items were strongly related to each other while assessing the multiple dimensions of each emotion. The emotion scales also showed divergent validity, indicating they

were unique despite being significantly intercorrelated. Furthermore, results revealed the measures to have good criterion-related validity as emotions showed logical inter-correlations (i.e., positive with positive, negative with negative emotions) and expected associations with success. Overall, findings suggest that the REQ is an improved tool, one that is more accurate and nuanced, for researchers and administrators to examine the emotions experienced by faculty in relation to their research activities. Understanding how specific emotions relate to faculty research success could inform emotional regulation programs or workshops. For example, interventions could be designed to help faculty or students manage negative research emotions like frustration and anxiety, while promoting positive emotions such as enjoyment or pride, which are linked to greater success.

The data analyses unveiled several group differences in research emotions that were expected given the literature on the demographic and job characteristics of faculty. Women reported more anxiety and disappointment regarding their research compared to men, which was understandable given that women have been found to be underemployed as STEM faculty (NCES, 2023), produce fewer scholarly products that are less cited (Sugimoto et al. 2013), be awarded less funding (Beaudry & Lariviere, 2016), and be less likely to be highly cited researchers (Meho, 2022). Similarly, faculty who self-identified as an underrepresented minority reported more anxiety pertaining to their research than those who did not identify as URM, a finding likely related to more frequent experiences of bias, discrimination, and stress in the academic workplace (O'Meara et al., 2020; Stolzenberg et al., 2019 Zambrana et al., 2017, 2021). Finally, full professors reported the most enjoyment and pride, as well as the least anxiety and disappointment, compared to their associate and assistant professor colleagues. This set of findings aligns with past studies documenting the challenges experienced by new faculty (Beare & Stenberg, 2020; Eagen et al., 2014). The practical implications of these findings suggest that higher education institutions need to consider the emotional well-being of their faculty, particularly women, underrepresented minorities, and early-career scholars. By providing targeted support,

addressing systemic biases, and fostering inclusive, supportive environments, academic institutions can reduce anxiety and disappointment while enhancing job satisfaction, productivity, and career success for faculty across different demographic and professional groups. Future studies may also examine if the structures and policies of colleges and universities contribute to the observed differences in the emotions of women and URM faculty relative to others.

Study findings further supported the application of Pekrun's (2006, 2024) control-value theory to understand how perceptions of control and value correspond with emotions in the context of faculty research (Stupnisky et al., 2016, 2019a, 2019b). The results supported the hypothesis that faculty positive emotions relate to increased and negative emotions to decreased research success. The analysis of bibliometric research outputs was also a significant contribution beyond studies that relied on self-report measures of success, which are more susceptible to response bias (Stupnisky et al., 2016, 2019b). An unexpected finding was that several emotions were predicted only by a single appraisal (SEMs: value paths to enjoyment and boredom, control paths to relief and anxiety; negative binomial regression models: value paths to enjoyment and boredom). This set of results suggests that value and control appraisals may have differential effects on research emotions, which has implications for diagnosis and appraisal-focused interventions. For example, if a faculty member is experiencing high research anxiety, faculty development administrators might best be encouraged to focus on improving perceived control, whereas if faculty report research to be boring, the focus should likely instead be on highlighting the personal value attached to their research-related activities and outcomes. Recently, shifts in the political climate—particularly in the United States—have led to an emotional impact faculty. Federal research grants are increasingly being scrutinized or reduced, particularly those studying diversity, equity, and inclusion (DEI). These changes can diminish faculty members' sense of control and the perceived value of their research, leading to reduced enjoyment and heightened feelings of disappointment, frustration, and anxiety, ultimately reducing productivity.

The current study improves upon past studies by recruiting a larger, more diverse sample of faculty from various STEM disciplines, evaluating robust outcome variables, and controlling for critical research-related covariates. However, there are multiple limitations to consider prior to generalizing the study findings, as well as potentially fruitful areas for future research. First, the sample is specific to STEM faculty at R2 institutions. Future studies may seek to examine a broader population of faculty from other institution types, such as R1 (highest research activity) and R3 (moderate research activity) universities. Disciplinary differences in faculty emotions could also be examined, such as within the sciences comparing hard sciences versus social sciences, but also compared to the humanities. Second, future studies are encouraged to evaluate faculty perceptions and emotions regarding more specific components and activities of research, such as the emotions experienced by faculty during grant writing, data collection, data analysis, writing results for publication, and the interpersonal dynamics in a research team or when presenting at conferences. The impact of faculty research emotions on job satisfaction, student mentorship, tenure and promotion, and retention could also be explored. Third, other strategies for measuring emotions should still be considered. For example, a study on German academics by Thies and Kordts-Freudinger (2019) used an experience sampling method to evaluate momentary (state) teaching-related emotions and appraisals five times daily for two weeks, yielding results that also supported the control-value theory. Whereas that study employed single-item measures, expanding such research to include more reliable multi-item scales and also to consider research, as highlighted in the present study, could help to understand the real-time antecedents of faculty emotions better when engaged in both research and teaching.

In summary, the present study findings provide clear empirical support for the utility of the Research Emotions Questionnaire to assist researchers in better evaluating faculty emotions in terms of how they predict research success and are impacted by cognitive appraisals of control and value pertaining to their research. The findings offer valuable insights adding to recent higher education

research, particularly studies exploring how faculty experiences influence their success (McNaughtan et al., 2021; Sabagh et al., 2021), as well as the pivotal role of emotions and mental health in academic settings (Durand et al., 2024; Raposa et al., 2024). The findings inform potential administrative interventions for faculty to improve not only their research output but also their lived experiences when conducting research.

Footnote

[1] In this study, we aimed to analyze a large group of faculty members who could be classified as STEM in order to make the findings applicable to a broader population, yet still be covered within the Web of Science. There are differing opinions on the definition of "Science, Technology, Engineering, and Math" (STEM) and what disciplines are included in that classification (Hasanah, 2020). The current study sample included 16.06% social science and 8.38% psychology faculty, which are sometimes not considered STEM, while 75.56% of the faculty sampled came from other STEM disciplines. As "STEM" was developed by the National Science Foundation (NSF) in 1990 (Sanders, 2009), and the NSF funded the current study, we recruited faculty from all fields designated as STEM by the NSF at the time this data collection recruitment began, which included psychology and social science (NSF, 2015; Granovskiy, 2018).

References

Aldersley, S.F. (1995). “Upward drift” is alive and well: Research/doctoral model still attractive to institutions. *Change: The Magazine of Higher Learning*, *27*(5), 51-56.

American Educational Research Association, American Psychological Association, & National Council on Measurement in Education. (2014). *Standards for educational and psychological testing*. American Educational Research Association.

Beare, Z.C., & Stenberg, S.J. (2020). "Everyone thinks it's just me": Exploring the emotional dimensions of seeking publication. *College English*, *83*(2), 103-126.

Beaudry, C., & Larivière, V. (2016). Which gender gap? Factors affecting researchers’ scientific impact in science and medicine. *Research Policy*, *45*(9), 1790-1817.

Beaujean, A.A., & Grant, M.B. (2016). Tutorial on using regression models with count outcomes using R. *Practical Assessment, Research, and Evaluation, 2*(2). https://doi.org/10.7275/pj8c-h254

Bentler, P.M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, *107*(2), 238.

Blair, J., Czaja, R.F., & Blair, E.A. (2014). *Designing Surveys: A Guide to Decisions and Procedures* (3rd Ed.). Los Angeles: Sage. ISBN: 978-1-4129-9734-8

Brew, A., Boud, D., Namgung, S.U., Lucas, L., & Crawford, K. (2016). Research productivity and academics’ conceptions of research. *Higher Education*, *71*, 681-697.

Browne, M.W., & Cudeck, R. (1992). Alternative ways of assessing model fit. *Sociological Methods & Research*, *21*(2), 230-258.

Byrne, B.M. (2010). *Structural Equation Modeling With AMOS: Basic Concepts, Applications, and Programming* (2nd ed.). New York: Routledge.

Ceci, S.J., & Williams, W.M. (2010). *The mathematics of sex: How biology and society conspire to limit talented women and girls*. Oxford, England: Oxford University Press.

Cohen, S., Tamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior 24*(4), 385–96.

Dawson, N.V., & Weiss, R. (2012). Dichotomizing continuous variables in statistical analysis: A practice to avoid. *Medical Decision Making*, *32*(2), 225-226.

DeLuca, J.R., & Maddox, C.B. (2016). Tales from the ethnographic field: Navigating feelings of guilt and privilege in the research process. *Field Methods*, *28*(3), 284-299.

Dickson-Swift, V., James, E.L., Kippen, S., & Liamputtong, P. (2009). Researching sensitive topics: Qualitative research as emotion work. *Qualitative Research,* 9(1), 61–79.

Durand, T. M., Faszewski, E. E., Murphy, K. L., & Villegas-Reimers, E. (2024). "It Wasn't What I Expected": Students' Perspectives and Experiences on a Higher Education Merger. *The Journal of Higher Education*, 1–26. https://doi.org/10.1080/00221546.2024.2431465

Eagan, M. K., & Garvey, J. C. (2015). Stressing Out: Connecting Race, Gender, and Stress with Faculty Productivity. *The Journal of Higher Education*, *86*(6), 923–954. https://doi.org/10.1080/00221546.2015.11777389

Eagan, K., Stolzenberg, E.B., Lozano, J.B., Aragon, M.C., Suchard, M.R., & Hurtado, S. (2014). Undergraduate teaching faculty: The 2013–2014 HERI faculty survey. *Higher Education Research Institute, UCLA*.

Eccles, J. S. (2005). Subjective Task Value and the Eccles et al. Model of Achievement-Related Choices. In A. J. Elliot & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 105–121). Guilford Publications.

Emerald, E., & Carpenter, L. (2015). Vulnerability and emotions in research: Risks, dilemmas, and doubts. *Qualitative Inquiry*, *21*(8), 741-750.

Fitzgerald, S.R. (2018). The role of affect in the information seeking of productive scholars. *The Journal of Academic Librarianship*, *44*(2), 263-268.

Frenzel, A.C., Pekrun, R., Goetz, T., Daniels, L.M., Durksen, T.L., Becker-Kurz, B., & Klassen, R.M. (2016). Measuring teachers' enjoyment, anger, and anxiety: The teacher emotions scales (TES). *Contemporary Educational Psychology*, *46*, 148-163.

Gardner, S. K. (2022). In the seventh year you will not rest: Faculty members' sensemaking of productivity during the sabbatical. *The Journal of Higher Education*, *93*(6), 847–872. https://doi.org/10.1080/00221546.2022.2036033

Granovskiy, B. (2018). Science, Technology, Engineering, and Mathematics (STEM) education: An overview. CRS Report R45223, Version 4. Updated. *Congressional Research Service*.

Greene, H.C., O'Connor, K.A., Good, A.J., Ledford, C.C., Peel, B.B., & Zhang, G. (2008). Building a support system toward tenure: Challenges and needs of tenure-track faculty in colleges of education. *Mentoring & Tutoring: Partnerships in Learning, 16*(4), 429-447. doi: 10.1080/13611260802433791

Hardré, P.L., Beesley, A.D., Miller, R.L., & Pace, T.M. (2011). Faculty motivation to do research: Across disciplines in research-extensive universities. *The Journal of the Professoriate, 5*(1), 35-69.

Hasanah, U. (2020). Key definitions of STEM education: Literature review. *Interdisciplinary Journal of Environmental and Science Education*, *16*(3), e2217.

Hair, J.F., Black, W.C., Babin, B.J., & Anderson, R.E. (2009). *Multivariate data analysis* (7th ed.). Upper Saddle River, NJ: Prentice Hall.

Hall, N.C., Perry, R.P., Chipperfield, J.G., Clifton, R.A., & Haynes, T.L. (2006). Enhancing primary and secondary control in achievement settings through writing-based attributional retraining. *Journal of Social and Clinical Psychology, 25*, 361–391.

Hu, L., & Bentler, P.M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives, *Structural Equation Modeling, 6*(1), 1-55.

Hunter, L.A., & Leahey, E. (2010). Parenting and research productivity: New evidence and methods. *Social Studies of Science*, *40*(3), 433-451.

Jaeger, J., Chang, C.L., & Stupnisky, R. (2022). How does counseling psychology faculty members' grit relate to their emotions and success in teaching and research? *Innovative Higher Education*, *47*(5), 775-792.

Javitz, H., Grimes, T., Hill, D., Rapoport, A., Bell, R., Fecso, R., & Lehming, R. (2010). *U.S. Academic Scientific Publishing.* Working paper SRS 11-201. Arlington, VA: National Science Foundation, Division of Science Resources Statistics.

Kline, R.B. (2005). *Methodology in the social sciences. Principles and practice of structural equation modeling* (2nd ed.). Guilford Press.

Kordts-Freudinger, R. (2017). Feel, think, teach – Emotional underpinnings of approaches to teaching in higher education. *International Journal of Higher Education, 6*(1), 217-229. doi: 10.5430/ijhe.v6n1p217

Kowai-Bell, N., Guadagno, R.E., Little, T.E., & Ballew, J.L. (2012). Professors are people too: The impact of informal evaluations of professors on students and professors. *Social Psychology of Education*, *15*, 337-351.

Lei, M., & Lomax, R.G. (2005). The effect of varying degrees of nonnormality in structural equation modeling. *Structural Equation Modeling*, *12*(1), 1-27.

Lichtenfeld, S., Pekrun, R., Stupnisky, R.H., Reiss, K., & Murayama, K. (2012). Measuring students' emotions in the early years: the achievement emotions questionnaire-elementary school (AEQ-ES). *Learning and Individual Differences*, *22*(2), 190-201.

Mardani, M., Salahuddin, M., Stupnisky, R.H. (2023). Examining underrepresented minority STEM faculty members' motivation for research. *Interdisciplinary Education and Psychology*. 2023; *3*(1):4.

Marsh, H.W., Byrne, B.M., & Yeung, A.S. (1999). Causal ordering of academic self-concept and achievement: Reanalysis of a pioneering study and... *Educational Psychologist*, *34*(3), 155-167.

MacCallum, R.C., Browne, M.W., & Sugawara, H.M. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological Methods, 1*(2), 130-149.

McNaughtan, J., Eicke, D., Thacker, R., & Freeman, S. (2021). Trust or Self-Determination: Understanding the Role of Tenured Faculty Empowerment and Job Satisfaction. *The Journal of Higher Education*, *93*(1), 137–161. https://doi.org/10.1080/00221546.2021.1935601

Meho, L.I. (2022). Gender gap among highly cited researchers, 2014–2021. *Quantitative Science Studies, 3*(4), 1-21.

Neumann, Y., & Finaly-Neumann, E. (1990). The Support-Stress Paradigm and Faculty Research Publication. *The Journal of Higher Education*, *61*(5), 565–580. https://doi.org/10.1080/00221546.1990.11780736

Moed, H.F. (2005). *Citation Analysis in Research Evaluation*. Dordrecht: Springer.

Mongeon, P., & Paul-Hus, A. (2016). The journal coverage of Web of Science and Scopus: a comparative analysis. *Scientometrics*, *106*, 213-228.

National Center for Science and Engineering Statistics (NCSES) (2023). *Diversity and STEM: Women, Minorities, and Persons with Disabilities 2023. Special Report NSF 23-315*. Alexandria, VA: National Science Foundation. Available at https://ncses.nsf.gov/wmpd.

National Science Board. 2015. Revisiting the STEM Workforce, A Companion to Science and Engineering Indicators 2014, Arlington, VA: National Science Foundation (NSB-2015-10)

National Science Board, National Science Foundation. 2024. *Science and Engineering Indicators 2024: The State of U.S. Science and Engineering*. NSB-2024-3. Alexandria, VA. Available at https://ncses.nsf.gov/pubs/nsb20243.

National Science Foundation, National Center for Science and Engineering Statistics. (2020). Women, Minorities, and Persons with Disabilities in Science and Engineering: Special Report NSF https://ncses.nsf.gov/pubs/nsf19304/digest/introduction

National Science Foundation, National Opinion Research Center (2003). *2003 Survey of Doctorate Recipients*. https://www.nsf.gov/statistics/srvydoctoratework/survey2003/sdr_2003.pdf

Navarro, M.L.A., Mas, M.B., & Jiménez, A.M.L. (2010). Working conditions, burnout and stress symptoms in university professors: Validating a structural model of the mediating effect of perceived personal competence. *The Spanish Journal of Psychology*, *13*(1), 284-296.

O'Connor, K., Green, H.C., Good, A.J., & Zang, G. (2011). Finding balance: A challenge for untenured faculty. *International Education Studies, 4*(4), 3-12. doi: 10.5539/ies.v4n4p3

O'Meara, K., Sayer, L., Nyunt, G., & Lennartz, C. (2020). Stressed, Interrupted, and Under-Estimated: Experiences of Women and URM Faculty During One Workday. *Journal of the Professoriate*, *11*(1).

Pekrun, R. (2006). The control-value theory of achievement emotions: Assumptions, corollaries, and implications for educational research and practice. *Educational Psychology Review, 18*, 315-341. doi: 10.1007/s10648-006-9029-9

Pekrun, R. (2024). Control-value theory: From achievement emotion to a general theory of human emotions. *Educational Psychology Review, 36*, Article 83. https://doi.org/10.1007/s10648-024-09909-7

Pekrun, R., Goetz, T., Frenzel, A.C., Barchfeld, P., & Perry, R.P. (2011). Measuring emotions in students' learning and performance: The Achievement Emotions Questionnaire (AEQ). *Contemporary Educational Psychology*, *36*(1), 36-48.

Pekrun, R., Marsh, H.W., Elliot, A.J., Stockinger, K., Perry, R.P., Vogl, E., ... & Vispoel, W.P. (2023). A three-dimensional taxonomy of achievement emotions. *Journal of Personality and Social Psychology*, *124*(1), 145-178.

Pekrun, R., & Stephens, E. J. (2010). Achievement emotions in higher education. In J. C. Smart (Ed.), *Higher education: Handbook of theory and research* (Vol. 25, pp. 257–306). Springer.

Perry, R.P., Hladkyj, S., Pekrun, R.H., & Pelletier, S.T. (2001). Academic control and action control in the achievement of college students: A longitudinal field study. *Journal of Educational Psychology*, *93*(4), 776-789.

Raposa, E. B., Bartolotta, K., Forbes, N., Monjaras-Gaytan, L. Y., Garcia, Y., Ulerio, G., … Salusky, I. (2024). Emotional distress and access to mental healthcare among first-generation college students during the onset of the COVID-19 pandemic. *The Journal of Higher Education*, 1–29. https://doi.org/10.1080/00221546.2024.2378641

Rosseel, Y. (2012). lavaan: An R package for structural equation modeling. *Journal of Statistical Software*, *48*, 1-36.

Ruthig, J.C., Haynes, T.L., Perry, R.P., & Chipperfield, J.G. (2007). Academic optimistic bias: Implications for college student performance and well-being. *Social Psychology of Education, 10*, 115–137. doi: 10.1007/s11218-006-9002-y

Sabagh, Z., Hall, N. C., Saroyan, A., & Trépanier, S. G. (2021). Occupational Factors and Faculty Well-Being: Investigating the Mediating Role of Need Frustration. *The Journal of Higher Education*, *93*(4), 559–584. https://doi.org/10.1080/00221546.2021.2004810

Salimzadeh, R., Hall, N.C., & Saroyan, A. (2021, September). Examining academics' strategies for coping with stress and emotions: A review of research. In *Frontiers in Education* (Vol. 6, p. 660676). Frontiers Media SA.

Sanders, M. (2009). STEM, STEM education. STEMmania. *The Technology Teacher, 68*(4), 20-26.

Stolzenberg, E.B., Eagan, M.K., Aragon, M.C., Cesar-Davis, N.M., Jacobo, S., Couch, V., & Rios-Aguilar, C. (2019). *The American freshman: National norms fall 2019*. Higher Education Research Institute, UCLA.

Scherer, K.R., & Moors, A. (2019). The emotion process: Event appraisal and component differentiation. *Annual Review of Psychology*, *70*, 719-745.

Stupnisky, R.H., Hall, N.C., & Pekrun, R. (2019a). Faculty enjoyment, anxiety, and boredom for teaching and research: Instrument development and testing predictors of success. *Studies in Higher Education, Special Edition on Emotions in Higher Education*, 44(10), 1-11. doi: https://doi.org/10.1080/03075079.2019.1665308

Stupnisky, R.H., Hall, N.C., & Pekrun, R. (2019b). The emotions of pretenure faculty: Implications for teaching and research success. *The Review of Higher Education, 42*(4), 1489-1526. doi: DOI: https://doi.org/10.1353/rhe.2019.0073

Stupnisky, R.H., Larivière, V., Hall, N.C., & Omojiba, O. (2023). Predicting research productivity in STEM faculty: The role of self-determined motivation. *Research in Higher Education*. https://doi.org/10.1007/s11162-022-09718-3

Stupnisky, R.H., Pekrun, R., & Lichtenfeld, S. (2016). New faculty members' emotions: A mixed method study. *Studies in Higher Education, 41*(7), 1167-1188. doi: 10.1080/03075079.2014.968546

Stupnisky, R.H., Weaver-Hightower, M.B., & Kartoshkina, Y. (2015). Exploring and testing the predictors of new faculty success: A mixed methods study. *Studies in Higher Education*, *40*(2), 368-390.

Sugimoto, C.R., Larivière, V., Ni, C., Gingras, Y., & Cronin, B. (2013). Global gender disparities in science. *Nature*, *504*(7479), 211-213.

Thies, K., & Kordts-Freudinger, R. (2019). German higher education academic staff's positive emotions through work domains. *International Journal of Educational Research*, *98*, 1-12.

Valdivieso, P.A., Alecchi, B.A., & Arévalo-Avecillas, D. (2022). Factors that influence the individual research output of university professors: The case of Ecuador, Peru, and Colombia. *Journal of Hispanic Higher Education*, *21*(4), 450-468.

Watts, J., & Robertson, N. (2011). Burnout in university teaching staff: A systematic literature review. *Educational Research*, *53*(1), 33-50.

Walker, G.J., & Fenton, L. (2013). Backgrounds of, and factors affecting, highly productive leisure researchers. *Journal of Leisure Research*, *45*(4), 537.

Warner, R.M. (2013). *Applied Statistics: From Bivariate Through Multivariate Techniques* (2nd ed.). Los Angeles, CA: Sage.

Zambrana, R.E., Harvey Wingfield, A., Lapeyrouse, L.M., Davila, B.A., Hoagland, T.L., & Valdez, R.B. (2017). Blatant, subtle, and insidious: URM faculty perceptions of discriminatory practices in predominantly White institutions. *Sociological Inquiry*, *87*(2), 207-232.

Zambrana, R.E., Valdez, R.B., Pittman, C.T., Bartko, T., Weber, L., & Parra-Medina, D. (2021). Workplace stress and discrimination effects on the physical and depressive symptoms of underrepresented minority faculty. *Stress and Health*, *37*(1), 175-185.

Appendix: Emotion Scales

The following statements represent some of the ways your **RESEARCH** may make you FEEL in your academic position over the last year: *1 = Strongly disagree, 5 = Strongly agree*

Name	Items
	Enjoyment (positive/activating)
enjoyAr1_1	13. I enjoy research.
enjoyCr1_1	26. I look forward to conducting research
enjoyMr1_1	3. My enjoyment of research makes me want to do it more.
enjoyPr1_1	17. I enjoy conducting research so much that I feel energized.
	Pride (positive/activating)
PrideAr1_1	1. I am proud of my research.
PrideCr1_1	30. I take pride in the quality of research I do.
PrideMr1_1	5. The pride I feel in my research accomplishments motivates me to continue.
PridePr1_1	12. When I do well in research, my heart beats with pride.
	Anxiety (negative/activating)
anxietyAr1_1	4. Conducting research makes me feel uneasy.
anxietyCr1_1	19. I often worry about my research.
anxietyMr1_1	21. I get nervous that I might make serious mistakes while conducting research.
anxietyPr1_1	24. I get tense while conducting research.
	Frustration (negative/activating)
frustAr1_1	9. I often feel annoyed while conducting research.
frustMr1_1	14. I wish I did not have to do research because of how irritating it can be.
frustPr1_1	31. When conducting research I frequently feel aggravated.
frustGr1_1	29. Research frustrates me.
	Boredom (negative/deactivating)
boredAr1_1	8. I get bored while conducting research.
boredCr1_1	18. I get so bored while conducting research that my mind begins to wander.
boredMr1_1	27. Because time seems to move more slowly while conducting research, I frequently look at the time.
boredPr1_1	23. I have problems staying alert due to feeling bored while conducting research.
	Disappointment (negative/deactivating)
disapAr1_1	11. I often feel disappointed by my research.
disapCr1_1	25. Thinking about my research makes me disappointed.
disapMr1_1	16. Because I do not want to be disappointed, I often avoid conducting research.
disapPr1_1	2. Research sometimes is so disappointing it drains my energy.
	Relief (positive/deactivating)
reliefAr1_1	28. Conducting research brings me a feeling of relief.
reliefCr1_1	20. I find research to be a source of comfort.
reliefMr1_1	6. I try to spend time conducting research because it eases tension.
reliefPr1_1	32. Conducting research is a chance for me to feel relief.

Note. In variable names, A = Affective, C = Cognitive, M = Motivational, P = Physiological.

Table 1

Sample Demographics

Baseline characteristic	***N***	%
Gender		
Man	347	56.79
Woman	254	41.57
I prefer not to respond	8	1.31
Other gender identity	2	0.33
Race		
White	484	80.53
Asian	84	13.98
Multiple	18	3.00
Black	12	2.00
American Indian or Alaska Native	3	0.50
Ethnicity		
Non-Hispanic Or Latino Or Spanish Origin	560	92.56
Hispanic Or Latino Or Spanish Origin	45	7.44
International status		
No (domestic)	442	72.82
Yes (international)	165	27.18
Underrepresented minority		
No	373	61.25
Yes	236	38.75
Field		
Life sciences	150	26.18
Social sciences	92	16.06
Engineering	85	14.83
Psychology	48	8.38
CISE	36	6.28
Geoscience	34	5.93
Mathematical sciences	32	5.58
Physics and astronomy	32	5.58
Chemistry	30	5.24
STEM ed and learning research	27	4.71
Materials research	7	1.22
Rank		
Full professor	208	34.10
Assistant professor	185	30.33
Associate professor	156	25.57
Other	41	6.72
Instructor or teaching professor	15	2.46
Research scientist or analyst	5	0.82
Tenure status		
Tenured	353	57.87
On tenure track, but not tenured	174	28.52
Not on tenure track	77	12.62
Other	6	0.98

Table 2

Descriptive Statistics and Reliabilities

	Range	*M* (*SD*)	Skew	Kurtosis	Cron's α	McD's ω
Positive						
Activating						
Enjoyment	1.00-5.00	4.04(0.71)	-0.87	-0.87	.90	.90
Pride	1.50-5.00	4.05(0.63)	-0.64	0.76	.78	.79
Deactivating						
Relief	1.00-5.00	3.15(0.79)	0.06	-0.03	.82	.76
Negative						
Activating						
Anxious	1.00-5.00	2.61(0.85)	0.19	-0.43	.78	.78
Frustration	1.00-5.00	2.11(0.82)	0.82	-0.27	.85	.85
Deactivating						
Disappointment	1.00-4.75	2.19(0.78)	0.41	-0.37	.79	.79
Boredom	1.00-5.00	1.80(0.69)	1.03	1.58	.85	.85
Perceived control	1.00-5.00	4.01(0.64)	-0.78	1.50	.76	
Value	1.00-5.00	4.12(0.67)	-0.68	0.77	.85	
Perceived success						
Activity	1.00-5.00	3.32(0.85)	-0.19	-0.44	.85	
Publishing	1.00-5.00	3.16(0.94)	-0.10	-0.10	.89	
Grants	1.00-5.00	3.05(0.98)	0.05	-0.56	.90	
Overall	1.00-5.00	3.18(0.78)	-0.09	-0.32	.92	
Bibliometrics						
Number publications	1-25	6.04(5.19)	1.49	1.93		
Number citations	0-233	28.67(40.93)	2.44	6.32		

Note. All scales were comprised of 4 items, except for overall perceived success which combined the 12 items of the three other perceived success scales and the single item bibliometric items. All item response scales were 1 = *Strongly Agree*, 5 = *Strongly Disagree*. AVE = Average variance explained from CFAs. Descriptive statistics are regarding averaged multi-item scales.

Table 3

Group Differences

Measure	Men	Women	Majority	URM[1]	Assist	Assoc	Full
Enjoyment	4.08	3.99	4.03	4.06	4.05	3.95[a]	**4.14[b]**
Pride	4.03	4.08	4.07	4.03	4.06	3.93[a]	**4.11[b]**
Relief	3.20	3.08	3.14	3.17	3.14	3.05	3.21
Anxiety	2.49	**2.78*** **	2.54	**2.70***	**2.81[a]**	**2.63[b]**	2.41[c]
Frustration	2.06	2.16	2.11	2.09	2.18	2.14	1.99
Disappointment	2.12	**2.28***	2.16	2.22	**2.34[a]**	**2.25[b]**	2.02[c]
Boredom	1.78	1.82	1.77	1.83	1.85	1.82	1.70
Control	4.05	3.96	**4.07***	3.93	3.97	**3.90[a]**	**4.12[b]**
Value	4.13	4.12	4.12	4.12	4.21	4.04	4.09

Note. Statistically significant *t*-test differences indicated by * and ANOVA post-hoc comparisons by differences in superscript letters.
[1]URM = Underrepresented Minority in the STEM fields based on gender, race, and/or ethnicity; Majority = Male, white, not of Hispanic/Latinx/Spanish ethnicity

* $p \leq .05$, ** $p \leq .01$, *** $p \leq .001$

Table 4

Correlations among Emotions

	1	2	3	4	5	6	7
1. Enjoyment	-						
2. Pride	.76	-					
3. Relief	.62	.51	-				
4. Anxiety	-.42	-.27	-.22	-			
5. Frustration	-.66	-.51	-.39	.65	-		
6. Disappointment	-.61	-.53	-.32	.68	.77	-	
7. Boredom	-.65	-.48	-.31	.43	.63	.60	-

Note. All correlations are statistically significant at $p \leq .05$.

Table 5

Correlations of Emotions with Control, Value, and Success

	Appraisals		Self-reported Success				WOS Bibliometrics	
	Control	Value	Activity	Publishing	Grants	Overall	Publications	Citations
Enjoyment	.45	.79	.32	.30	.24	.33	.26	.22
Pride	.47	.72	.33	.29	.25	.34	.17	.18
Relief	.26	.54	.20	.23	.12	.21	.20	.13
Anxiety	-.36	-.23	-.26	-.25	-.11	-.24	-.10	-.11
Frustration	-.42	-.53	-.28	-.29	-.17	-.28	-.21	-.20
Disappointment	-.53	-.48	-.43	-.41	-.26	-.42	-.22	-.21
Boredom	-.28	-.55	-.24	-.22	-.15	-.23	-.24	-.24

Note. All correlations are statistically significant at $p \leq .05$.

Table 6

Goodness of Fits

	Chi-square	df, *p*	RMSEA(90% CI)	CFI	SRMR	AVE
CFA – 7 Emotions	1127.52	326, <.001	.067(.062, .071)	.92	.07	
CFA – 1 Positive, 1 Negative Emotion	2469.77	349, <.001	.105(.101, .109)	.78	.09	
SEM – Enjoyment	968.48	298, <.001	.065(.060, .069)	.94	.09	.70
SEM – Pride	1104.31	298, <.001	.071(.066, .075)	.92	.09	.50
SEM – Relief	1064.73	298, <.001	.069(.065, .074)	.92	.11	.50
SEM – Anxiety	1249.45	298, <.001	.077(.073, .082)	.89	.12	.48
SEM – Frustration	974.93	273, <.001	.069(.064, .074)	.92	.11	.58
SEM – Disappointment	1097.25	298, <.001	.071(.066, .075)	.91	.09	.48
SEM – Boredom	975.52	298, <.001	.065(.060, .070)	.93	.10	.60

Table 7

Negative Binomial Regressions on Bibliometric Research Outcomes

	Step 1	Step 2						
PUBLICATIONS	No Emotion	Enjoyment	Pride	Relief	Anxiety	Frustration	Disappoint	Boredom
Intercept	1.71*** (5.55)	1.70*** (5.50)	1.71*** (5.54)	1.71*** (5.54)	1.71*** (5.53)	1.71*** (5.54)	1.71*** (5.53)	1.70*** (5.47)
Control	.02 (1.03)	.02 (1.02)	.03 (1.03)	.02 (1.02)	.02 (1.02)	.02 (1.02)	.01 (1.01)	.02 (1.10)
Value	.07*** (1.08)	.03 (1.03)	.09*** (1.09)	.06** (1.06)	.07*** (1.08)	.06** (1.06)	.07*** (1.07)	.04* (1.20)
Career age	.01 * (1.01)	.01 (1.01)	.01* (1.01)	.01* (1.01)	.01† (1.01)	.01† (1.01)	.01† (1.01)	.01 (1.01)
Research effort %	.005* (1.005)	.004* (1.004)	.005** (1.005)	.005** (1.005)	.005** (1.005)	.005** (1.005)	.005* (1.005)	.005** (1.005)
Job satisfaction	.12† (1.13)	.13† (1.14)	.12† (1.13)	.12† (1.12)	.11† (1.12)	.13† (1.14)	.12† (1.13)	.11† (1.11)
Stress	.08 (1.08)	.08 (1.09)	.09† (1.09)	.08 (1.08)	.10† (1.09)	.12* (1.13)	.12* (1.13)	.08† (1.09)
Emotion	-	.27** (1.31)	-.07 (0.94)	.09† (1.10)	-.03 (0.96)	-.13* (0.88)	-.15** (0.86)	-.26*** (0.77)
Expected % pub change with +1 *SD* emotion	0.00%	+21.13%	-4.31%	+7.37%	-2.52%	-9.37%	-10.34%	-15.84%
Expected # pub count with +1 *SD* emotion	5.55	7.21	5.21	6.09	5.31	4.88	4.76	4.21
AIC	2358.03	2325.75	2337.26	2320.49	2313.98	2328.69	2322.63	2316.79
Δ AIC	-	32.28	20.78	37.54	44.05	29.35	35.40	41.24
CITATIONS	No Emotion	Enjoyment	Pride	Relief	Anxiety	Frustration	Disappoint	Boredom
Intercept	3.20*** (24.48)	3.19*** (24.31)	3.19*** (24.52)	3.18*** (24.03)	3.19*** (24.38)	3.19*** (24.31)	3.18*** (24.09)	3.16*** (23.58)
Control	.04 (1.04)	.04 (1.04)	.04 (1.04)	.04 (1.04)	.03 (1.03)	.02 (1.02)	.00 (1.00)	.04 (1.04)
Value	.10*** (1.11)	.04 (1.04)	.09* (1.10)	.10** (1.10)	.10** (1.10)	.07* (1.07)	.07* (1.08)	.04 (1.04)
Career age	.01* (1.01)	.01* (1.01)	.02* (1.02)	.01* (1.01)	.01* (1.01)	.01† (1.01)	.01* (1.01)	.01† (1.01)
Research effort %	.01*** (1.01)	.01*** (1.01)	.02*** (1.01)	.01*** (1.01)	.01*** (1.01)	.01*** (1.01)	.01*** (1.01)	.01*** (1.01)
Job satisfaction	.17 (1.19)	.18 (1.19)	.15 (1.16)	.19† (1.21)	.19† (1.21)	.20† (1.23)	.20† (1.22)	.16 (1.18)
Stress	.20* (1.22)	.22** (1.25)	.21* (1.24)	.20* (1.22)	.27** (1.31)	.27** (1.31)	.31*** (1.36)	.20* (1.22)
Emotion	-	.30† (1.35)	.09 (1.01)	.11 (1.12)	-.14 (0.87)	-.27** (0.76)	-.35** (0.71)	-.51*** (0.60)
Expected % cite change with +1 *SD* emotion	0.00%	+23.74%	+5.86%	+9.07%	-11.22%	-19.86%	-23.29%	-29.66%
Expected # cite count with +1 *SD* emotion	24.48	32.82	24.77	26.91	21.21	18.48	17.10	14.15
AIC	3667.41	3625.57	3635.72	3590.65	3594.37	3623.34	3612.12	3604.68
Δ AIC	-	41.84	31.68	76.76	73.03	44.07	55.29	62.72

† $p < .10$, * $p < .05$, ** $p < .01$

Note. Negative binomial analyses replicated SEMs with each emotion analyzed individually in its own model. Top coefficients are standardized regression weights and lower coefficients in parentheses are exponentiated coefficients for interpretation. Expected percent change is calculated as 100 × [exp((standardized regression weight × standard deviation)-1], which is translated as for every one standard deviation increase in a particular emotion there is % increase in publications or citations. Expected publication or citation count is calculated as the exponentiated intercept multiplied by the exponentiated emotion coefficient.

Figure 1

Violin Plot of Faculty Emotions for Research

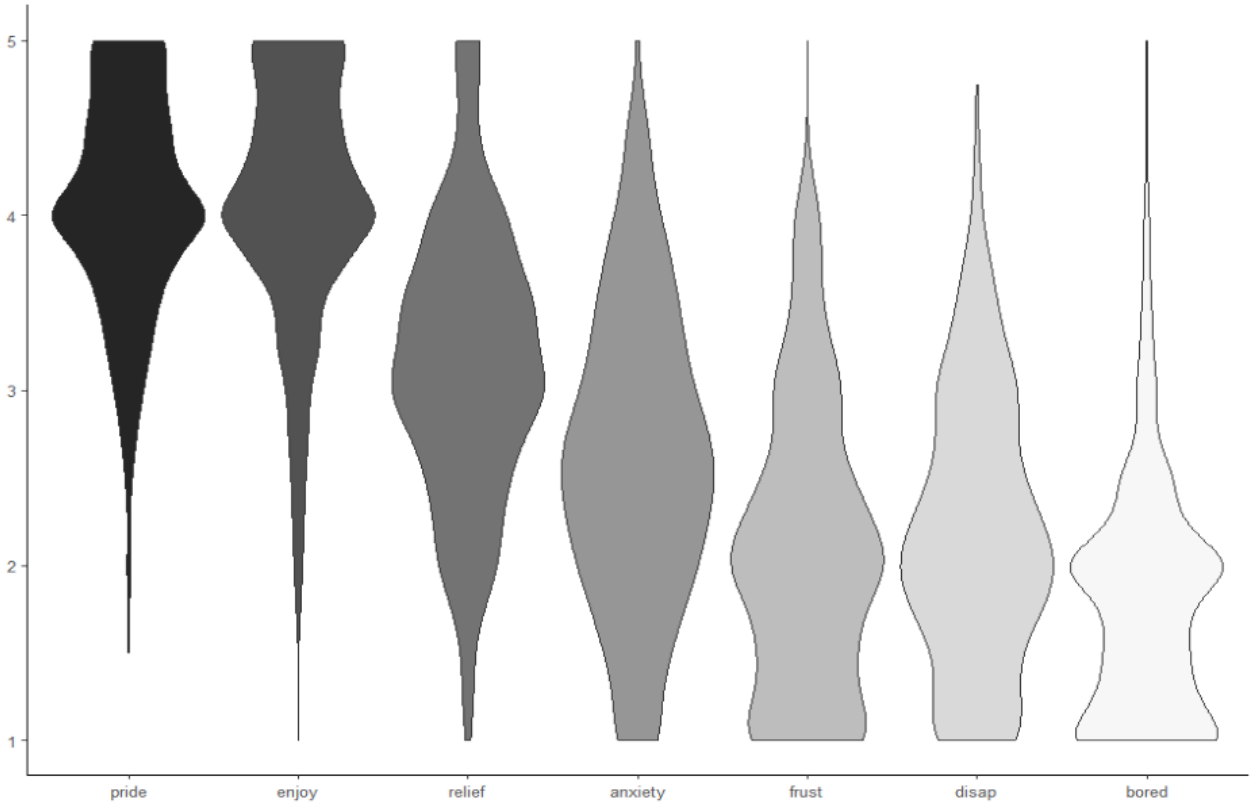


Figure 2

Structural Equation Models Based on Pekrun's Control-Value Theory of Emotions

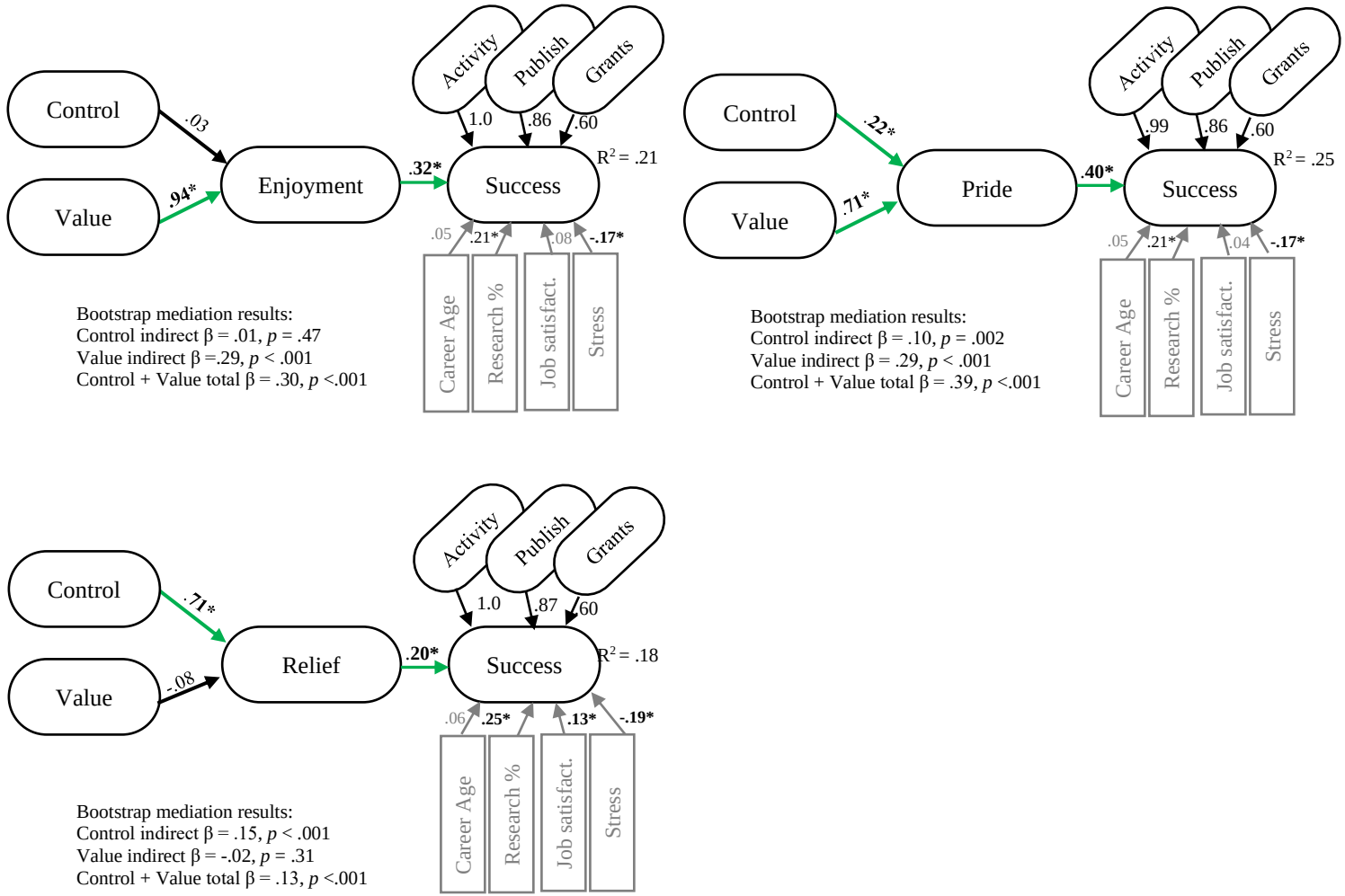
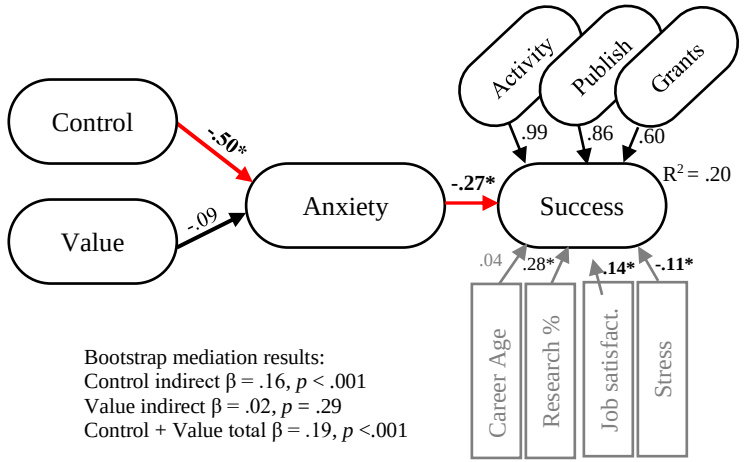
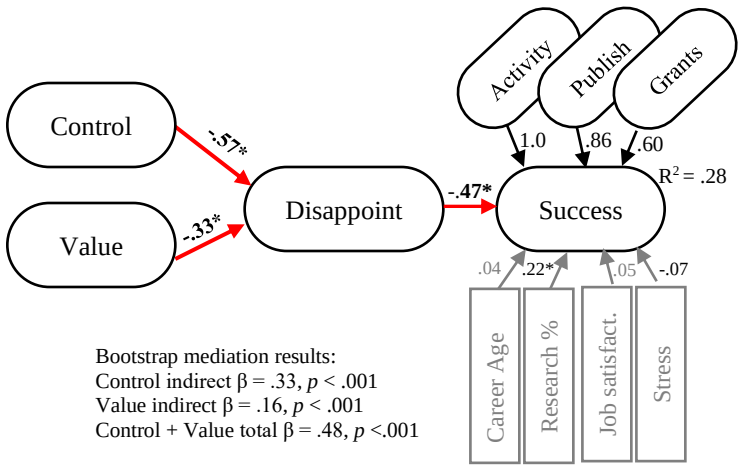


Figure 2 continued…

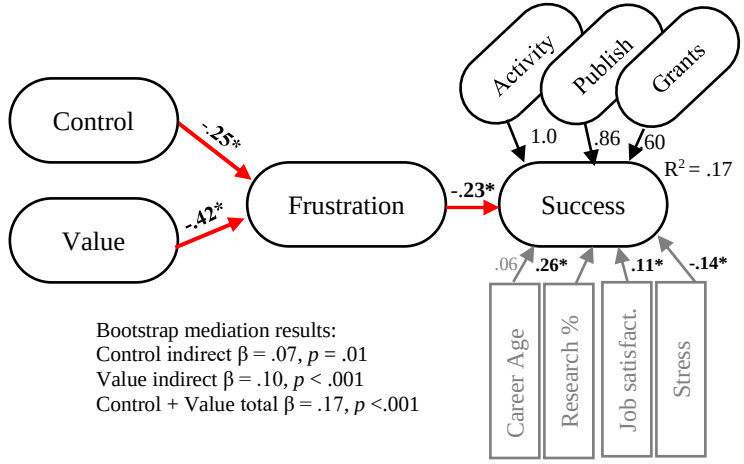
Structural Equation Models Based on Pekrun's Control-Value Theory of Emotions



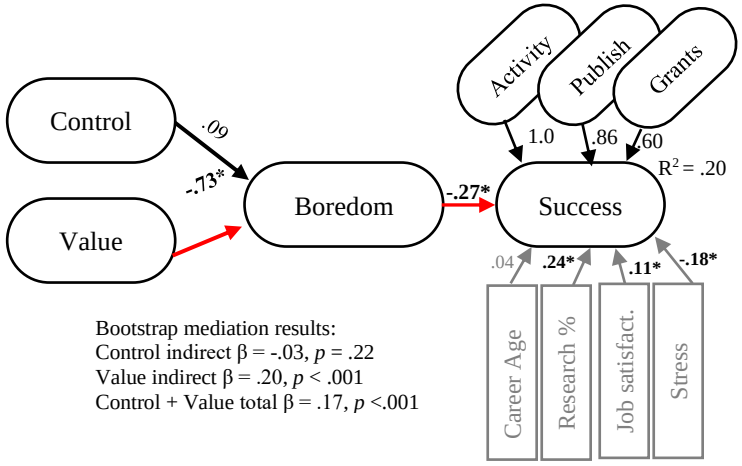
Bootstrap mediation results:
Control indirect β = .16, p < .001
Value indirect β = .02, p = .29
Control + Value total β = .19, p <.001



Bootstrap mediation results:
Control indirect β = .33, p < .001
Value indirect β = .16, p < .001
Control + Value total β = .48, p <.001



Bootstrap mediation results:
Control indirect β = .07, p = .01
Value indirect β = .10, p < .001
Control + Value total β = .17, p <.001



Bootstrap mediation results:
Control indirect β = -.03, p = .22
Value indirect β = .20, p < .001
Control + Value total β = .17, p <.001