



HIGHER EDUCATION RESEARCHERS' VIEWS OF SCIENCE AS A VOCATION AND ITS RELATIONSHIP TO PSYCHOLOGICAL DISTRESS DURING THE COVID-19 PANDEMIC

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Abstract:

Introduction: Science has often been perceived as a vocation rather than simply a job or even a stable career, and is therefore understood as driven primarily by intrinsic motivation. **Objective:** This study examines the extent to which scientists at higher education institutions from diverse regions of the world perceive science as a vocation, and how these perceptions of work are related to mental health outcomes. **Method:** We address these questions using survey data from natural scientists in the USA, UK, India, and Italy, collected during the COVID-19 pandemic (total N = 3,442). Regression models were used to assess associations between scientists' perceptions of work meaning, calling, extrinsic professional rewards, and self-reported psychological distress. **Results:** Results suggest that most physicists and biologists across these countries view their work as a meaningful vocation rather than "just a job." Scientists who view their professions as providing little meaning in their lives have higher odds of self-reported psychological distress than those who disagree with this view. Those who find meaning in their work and see it as a "calling" have somewhat lower odds of reporting psychological distress. In contrast, the value scientists place on extrinsic aspects of their work, such as tenure, promotions, and professional advancement, has no significant effect on psychological distress. **Conclusion:** These findings suggest that scientists' perceptions of work meaning

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and vocation are associated with psychological distress during the COVID-19 pandemic, whereas extrinsic professional rewards appear unrelated to distress. We discuss the theoretical and policy implications of these findings, along with study limitations and avenues for further research.

Keywords: faculty stress; psychological distress; workplace motivation; science as vocation; COVID-19 pandemic; self-determination theory; higher education

Résumé :

Introduction: La science a souvent été perçue comme une vocation plutôt que comme un simple emploi, voire comme une carrière stable, et elle est donc généralement considérée comme étant principalement guidée par une motivation intrinsèque. **Objectif:** Cette étude examine dans quelle mesure les scientifiques travaillant dans des établissements d'enseignement supérieur situés dans diverses régions du monde perçoivent la science comme une vocation, ainsi que la manière dont ces perceptions du travail sont associées à des indicateurs de santé mentale. **Méthode:** Nous examinons ces questions à partir de données d'enquête recueillies pendant la pandémie de COVID-19 auprès de scientifiques des sciences naturelles aux États-Unis, au Royaume-Uni, en Inde et en Italie (N total = 3 442). Des modèles de régression ont été utilisés afin d'évaluer les associations entre les perceptions des scientifiques concernant le sens du travail, la vocation professionnelle, les récompenses professionnelles extrinsèques et la détresse psychologique autodéclarée. **Résultats:** Les résultats indiquent que la majorité des physiciens et des biologistes de ces pays considèrent leur travail comme une vocation porteuse de sens plutôt que comme « un simple emploi ». Les scientifiques qui estiment que leur profession confère peu de sens à leur vie présentent une probabilité plus élevée de déclarer une détresse psychologique que ceux qui ne partagent pas cette perception. À l'inverse, les scientifiques qui trouvent un sens à leur travail et le considèrent comme une « vocation » présentent une probabilité quelque peu plus faible de déclarer une détresse psychologique. En revanche, l'importance accordée aux dimensions extrinsèques du travail, telles que la titularisation, les promotions et l'avancement professionnel, n'est pas associée de manière statistiquement significative à la détresse psychologique. **Conclusion:** Ces résultats suggèrent que les perceptions qu'ont les scientifiques du sens de leur travail et de sa dimension vocationnelle sont associées à la détresse psychologique pendant la pandémie de COVID-19, tandis que les récompenses professionnelles extrinsèques ne semblent pas liées à cette détresse. Nous examinons les implications théoriques et stratégiques de ces résultats, ainsi que les limites de l'étude et les pistes de recherche futures.

Mots-clés: stress chez les enseignants-chercheurs ; détresse psychologique ; motivation au travail ; science comme vocation ; pandémie de COVID-19 ; théorie de l'autodétermination ; enseignement supérieur

1. Introduction

Scholarly concerns over the meaning of work extend as far back as Max Weber's famous arguments on vocation (Weber, 1905/2001). In his view, a "vocation" is a form of work that is not solely dependent on economic rationality but that is, instead, internalized by individuals as a calling or obligation. More recently, social psychologists have examined the intrinsic and extrinsic motivations that individuals attach to their work. While these scholars have highlighted specific dimensions of these two major motivation types, we begin by proposing a concise definition that aligns with the operationalization of our key focal variables. In our view, as specified by Self-Determination Theory (SDT) (Deci & Ryan, 1985), motivation is an essential aspect of *action*, so that individuals engage in the activities of daily living, to a great extent, as a function of some psychological, environmental or—to use sociological parlance—a *structural* motivator. In a widely cited article, the authors provide a concise account of the two major motivation types by noting that "[t]he most basic distinction is between intrinsic motivation, which refers to doing something because it is inherently interesting or enjoyable, and extrinsic motivation, which refers to doing something because it leads to a separable outcome" (Ryan & Deci, 2000, p. 55). When applied specifically to employment settings, intrinsic motivation is associated with aspects of work which are valued in themselves, such as the ability for self-expression, enjoyment from leading others and/or receiving pleasure and fulfillment from the work itself. Extrinsic motivation, on the other hand, is most directly associated with instrumental rewards such as compensation, financial bonuses, job security (e.g., tenure), and other forms of recompense that are separate from the innate pleasure one receives from the work itself (Gerhart and Fang, 2015).

Additionally, ample scholarly work has examined associations between work and psychological distress (Bliese *et al.*, 2017). Scholars have more recently focused on the multiple pathways by which noxious working conditions influence various comorbidities that significantly correlate with poor employee mental health (Bültmann *et al.*, 2002). These may include either organizational (Marchand *et al.*, 2005) or exogenous factors, as exemplified by the expanding research agenda exploring COVID-related workplace pressures and their impact on mental health and well-being (Galbraith *et al.*, 2021; van der Feltz-Cornelis *et al.*, 2020).

We draw from these lines of inquiry and test several hypotheses using a nationally representative data set that includes scientists from STEM fields in the USA (n=535), UK (n=925), India (n=1,345) and Italy (n=637; Total N=3,442). Our study contributes to the literature in three ways. First, we focus on academic researchers in the STEM disciplines, a highly competitive line of work that requires substantial amounts of training and personal investment. Second, we take a comparative approach and explore the relationship between work and psychological distress across four distinct regions of the world. Finally, our models account for the potential stressors produced by the COVID-19 pandemic, an unparalleled exogenous factor that impacted individuals across national

and international borders. In our view, this final point bears additional consideration, a brief discussion to which we now turn.

We begin by highlighting classic and contemporary research in the behavioral sciences that explores social processes during times of far-reaching exogenous stress. As examples, we can consider post-World War II studies like Stouffer's towering four-volume study of American soldiers (for the social psychological dimensions of combat-related stress, see particularly, Stouffer *et al.*, 1949) to more recent scholarship that has explored the short and long-term impact of the events of September 11, 2001 on psychological distress (Adler & Poulin, 2009; Rousseau *et al.*, 2011). Secondly, we can plausibly expect the occurrence of epidemic strain to remain cyclical and its emergence to be a recurring feature of contemporary social life. As a result, the recent debates over strict lockdowns and their negative economic impact may lead to situations where organizations will be asked to continue on-site operations at a high level of productivity, and all during times of epidemiological strain. Finally, understanding the processes of psychosocial resilience may have practical implications for clinicians and community practitioners who are asked to provide psychological support during times of societal disruption and change. These are a few reasons why the aim of the study is to contribute to mental health research in scientific academic settings, particularly considering a growing body of work that explores these issues during the time of the COVID-19 pandemic.

2. Review of the Literature and Hypotheses

We begin by placing our work within the context of more general occupational stress and mental health research—a line of scholarship that identifies aspects of workplace experiences that are related to noxious mental health outcomes (Marchand *et al.*, 2005; Wang *et al.*, 2015). Related work has recently focused on linkages between occupational strain and mental health stress in various occupational settings that include medical, industrial and other high-stress workplaces (Arlinghaus *et al.*, 2012). We hope to add to a burgeoning line of scholarly investigation aimed at understanding possible associations between work and psychological distress in higher education settings (Winefield & Jarrett, 2001).

We next consider workplace intrinsic and extrinsic motivation as possible factors that would influence employee mental health. In our view, this may be a particularly salient question during times of heightened stress, as would be the case during the COVID-19 pandemic. While social psychologists have generated a large body of work related to these two motivation types (for influential reviews of the early and mid-stage research see, for instance, Deci *et al.*, 1999; Ryan & Deci, 2000), our focus here will be on proposing a general framework allowing us to operationalize these concepts in relation to our data.

Our conceptualization of motivation draws from the SDT framework as articulated by Ryan and Deci (2000). Specifically, intrinsic workplace motivation may

provide meaning and purpose as well as a sense of accomplishment that is a result of the work itself. Extrinsic motivation, on the other hand, is tied to rewards that are external to the role, so that workplace personnel continue to engage in the work not out of a sense of purpose or meaning (as in a calling or vocation), but rather for the material rewards that are gained from employment. These may include monetary compensation, health benefits, employment security such as tenure, etc. Such a conceptualization has been shown to load reliably with predicted psychometric scales (Tremblay *et al.*, 2009). Furthermore, when applied to workplace motivation, we can then refine these concepts to specific reward systems based on the characteristics of individual workplaces and to the specific reward systems employees value (Gerhart and Fang, 2015). Here, an influential framework indicates that “*people see their work as either a Job (focus on financial rewards and necessity rather than pleasure or fulfillment; not a major positive part of life), a Career (focus on advancement), or a Calling (focus on the enjoyment of fulfilling, socially useful work)*” (Wrzesniewski *et al.*, 1997, p. 21).

There is also a growing line of research exploring these conceptual questions in various workplace settings. One study of office computer usage found that intrinsic motivation may impact the acceptance or rejection of organizational practices to a greater degree than extrinsic motivation (Davis *et al.*, 1992). Similar work has examined workplace motivation in various settings, including healthcare organizations (Allen *et al.*, 2017), secondary education institutions (Ryan & Deci, 2020), hazardous work settings like outdoor construction (Hashiguchi *et al.*, 2021), and among military personnel (Wynd & Ryan-Wenger, 2004). Wrzesniewski and colleagues (Rosso *et al.*, 2010; Wrzesniewski *et al.*, 1997) have provided both a theoretical and empirical foundation to the “*meaning in work*” literature across organizational domains. In our view, such categorizations align well with the intrinsic and extrinsic domains that originate from the SDT framework.

Most relevant to our study, several studies have shown how individuals classify their work motivation in higher education settings as either intrinsic (e.g., focused on enjoyment, fulfillment, and meaning) or extrinsic (e.g., focused on necessity, finances, or professional advancement and tenure). One comparative example comes from a study of faculty in the US and Spain (Luna-Arocas & Tang, 2004) where results of survey data, using multiple statistical techniques, found that among both US and Spanish faculty, high levels of intrinsic satisfaction with one’s professional role had the strongest association with measures of overall life satisfaction. Barnett and colleagues (Barnett *et al.*, 1998), in a study of medical faculty members’ publication records, present rather counterintuitive results that for both men and women faculty, intrinsic career motivation was associated with a greater number of publications, while extrinsic motivation was negatively associated. More recent studies report similar associations between intrinsic workplace motivation and faculty publication records (Horodnic & Zait, 2015). A growing body of work, both theoretical and empirical, continues to highlight the positive impact of intrinsic motivation factors in shaping productivity, retention, and enhanced personal well-being in academic settings (Lyness *et al.*, 2013).

We close here by briefly noting the relevance of the COVID-19 pandemic as a contextual factor that impacted the global workplace. In the wake of the COVID-19 pandemic, a growing body of research explores associations between COVID-related workplace stressors and mental health outcomes (Dunning *et al.*, 2022; Lai *et al.*, 2020). We would expect the additional workplace burdens brought on by the COVID-19 pandemic to exacerbate the already existing high prevalence of acute distress, depression and anxiety among medical professionals; a suggestion that is receiving substantial confirmation in recent empirical research (Heath *et al.*, 2020). Consequently, it would be reasonable to expect such deleterious effects to impact faculty and research scientists working in higher education settings (Melnik *et al.*, 2021; Saw *et al.*, 2022). Overall, the growing, accumulating research points to a marked rise in faculty psychological distress because of the COVID-19 pandemic and its impact on workplace dynamics. Our data will allow us to assess the role of intrinsic and extrinsic workplace motivation in shaping psychological distress while controlling for the effects of specific COVID-related stressors among faculty researchers.

We suspect that during the pandemic, views of work would shape the mental health of individuals engaged in university-based research. Theoretically, we suggest that the intrinsic value of work will play a central role in positively shaping staff member mental health so that greater value placed on intrinsic workplace rewards will be associated with lower levels of overall psychological distress. Conversely, we surmise that greater value placed on extrinsic workplace rewards will be associated with higher levels of psychological distress. Drawing from the literature on workplace motivation cited above, we suggested three research hypotheses about scientists' mental health during the COVID-19 pandemic. First, scientists and faculty who see their work as "just a job" with little meaning would report greater levels of psychological distress than those who find greater meaning in their work (H1). Second, scientists and faculty who place greater value on intrinsic workplace rewards (e.g., see their work as a vocation or calling that adds meaning to their life) will report lower levels of psychological distress than those who do not see their jobs as a vocation or calling (H2). Third, scientists and faculty who place greater value on the extrinsic value of their work (e.g., tenure, promotions, awards, and professional advancement opportunities) will report greater levels of psychological distress than those who place lower value on extrinsic rewards (H3).

3. Methods

3.1. Data Sources

The data for this study are based on an original data collection endeavor carried out under the direction of one of the authors, who also served as the principal investigator for the larger project. Data collection was supported by collaboration with researchers at participating institutions. Nationally representative surveys of scientific researchers employed at research centers and universities in India, Italy, the United Kingdom, and the United States of America (N=3,442) were administered between May to October 2021,

with an overall response rate of 15%. We are aware that the low response rate may raise some concerns, and we will revisit this issue in the limitations section below. In terms of areas of specialization, we focused on scientists whose primary areas of interest are in physics or biology. The survey instrument includes a battery of items that will allow us to examine the relationship between extrinsic and intrinsic work motivation and psychological distress in four distinct global regions, while also considering the effects of COVID-related stressors.

We next provide a brief rationale for the selection of the country-level cases used in this study. Moreover, we will suggest that our reasoning for case selection was driven by both conceptual and methodological considerations. Conceptually, we find several compelling reasons why these four countries provide the type of macro, country-level variation that may influence distinct forms of personal motivation. First, the four cases show variation in terms of economic development and the percentage of GDP spent on research and development. In 2020, GDP per capita varied substantially among our cases, with the US having the highest at \$63,530 USD, India the lowest at \$1,910 USD, and the UK and Italy somewhere between the two outlying cases (\$40,318 USD and \$31,911 USD respectively).¹ This type of variation in economic vitality allows us to contrast societies with similar *and* dissimilar economic infrastructures. Similarly, the percentage of GDP spent on research and development also varies substantially across cases, with the US leading at 2.83%, the UK at 1.7%, Italy at 1.39% and India at 0.65% (The World Bank, 2021). We suspect that such macro-level governmental support for research might influence perceptions of work for professional scientists working in disciplines that often depend on government allocation of monetary assets as a source of research funding. Second, each national-level case is characterized by its own religious and cultural history which might impact perspectives on workplace motivation. Our case selection includes predominantly Protestant (US, UK), Catholic (Italy) and Hindu (India) populations, each having a distinct historical trajectory that has impacted the role that each nation plays in contemporary global affairs. Finally, in light of the unprecedented period of data collection during the pandemic, there was also a practical, methodological reason for case selection. Specifically, the four cases have been used in previous research and correspond to the four nations that have attained the highest response rates in those previous studies (Ecklund *et al.*, 2019). Realizing the challenges of data collection during the pandemic, we selected countries that represented some of the highest response rates from the set of available cases.

3.2. Measures

3.2.1. Psychological Distress

The dependent variable in our models—psychological distress—is measured via the well-known, Kessler-6 (K6) index that was developed by Kessler and colleagues (Kessler *et al.*, 2002) and that has been used in previous studies measuring several dimensions of psychological distress. The K6 is a 6-item scale of nonspecific psychological distress that is included in many clinical and nationally representative health surveys using US and

international samples. (Acevedo *et al.*, 2014; Kessler *et al.*, 2010). Respondents were asked: "During the past 30 days, about how often did you feel: (1) nervous, (2) hopeless, (3) restless or fidgety, (4) so depressed that nothing could cheer you up, (5) that everything was an effort, and (6) worthless?" Items are coded as, 1 = none of the time, 2 = a little of the time, 3 = some of the time, 4 = most of the time, and 5 = all of the time, such that higher scores indicate higher levels of psychological distress (Cronbach's $\alpha = .87$). As applied in previous large-scale, international population studies (Kessler *et al.*, 2010; Prochaska *et al.*, 2012), we calculate a dichotomized indicator for self-reported serious psychological distress which was coded as 1 if respondents had a score of 13 or higher on the K6 scale and 0 if below, allowing us to estimate binary logistic regression models predicting the presence of self-reported psychological distress symptomology.ⁱⁱ

3.2.2. Workplace Motivation

In terms of our focal predictor variables, we include three single-item indicators of intrinsic and extrinsic motivation, which, for ease of interpretation, we label in statistical tables as (a) job orientation, (b) calling orientation and (c) career orientation. The items are based on the "work-life questionnaire" meant to distinguish between 3 orientations (job, career, and calling), that have been shown to have high levels of validity and reliability in previous published studies (Wrzesniewski *et al.*, 1997, see also Seligman, 2002, p. 169). All three items are prompted with the statement, "to what extent do the following statements reflect how you view your work as a scientist?" The first statement reads, "My work as a scientist is just a job; I may enjoy it, but it is not among the most meaningful aspects of my life" (extrinsic "job orientation"). The second reads, "My work as a scientist feels like a calling or vocation; it is one of the most meaningful aspects of my life" (intrinsic "calling orientation") while the third statement, "for me, tenure, promotions, awards, and professional advancement opportunities are the most important aspects of a scientific career", captures extrinsic workplace motivation, which we label as "career orientation". We retain the Likert response categories and use dummy coding to account for any possible curvilinear effects where, 1 = Not at all like me (serving as the reference category), 2 = A little like me 3 = Somewhat like me, 4. = Mostly like me and 5 = Very much like me.

3.2.3. Statistical Controls

Our models include a series of control variables to account for possible confounding factors that might also impact levels of psychological distress. First, in our models, we felt it important to include additional stressors that individuals might have experienced as a result of the COVID-19 pandemic. Fortunately, the survey includes several items that allow us to account for both physical and workplace related factors. The questions are prompted with the statement, "In the following questions, we would like to learn how the COVID-19 pandemic has affected you. In what ways has the COVID-19 pandemic changed the following?" Our first indicator asks specifically, "Your physical health." We also gauge work related stress during COVID with a 5-item index that includes (1) Your

job prospects or chances of tenure/promotion, (2) Your productivity, (3) Funding opportunities in your areas of interest, (4) The prestige or value of your scientific field, (5) The prestige or value of scientists in your country (Cronbach's $\alpha = .68$). Possible response categories for both items are coded as, 1 = Decreased considerably, 2 = Decreased somewhat, 3 = No change, 4 = Increased somewhat, 5 = Increased considerably. We retain the original Likert-scale and enter these indicators in our models as ordinal and continuous, respectively. Models include an additional measure of personal stress related to financial insecurity during the COVID pandemic. Respondents were asked, "How often do you worry about being able to meet normal monthly living expenses"? Responses are based on an 11-point ordinal scale which we recode so that higher scores are associated with higher levels of financial insecurity (financial stress scores ranged from 0 = "Do not ever worry" to 10 = "Worry all the time").

Our models also include a series of demographic and occupational controls. We estimate parameters with pooled models that control for the researcher's geographic workplace region.ⁱⁱⁱ The four countries are dummy coded, with the US serving as the reference category. Other controls include gender, which is dummy coded with male as the reference, age (in years), academic discipline (dummy coded with "Physics" as the reference), and academic position (dummy coded with "Postgraduate student" serving as reference).

3.3. Analytic Strategies

Our analytical strategy involved estimating binary logistic regression models and reporting log odds of experiencing psychological distress as measured by the K6 index. We estimated five nested regression models for the stressor variable. Model 1 estimated the main effects of COVID stressors without the presence of additional statistical controls. Models 2 through 4 tested the independent effects of each workplace motivation and are specified as follows: Model 2 introduces job orientation while also adding statistical controls for financial stress and age as ordinal variables, accompanied by a series of dummy-coded categorical controls for workplace country-level region, gender identification, academic discipline in physics or biology, and level of academic position from postgraduate student to senior faculty. Models 3 and 4 retain all statistical controls and test the independent effects of calling orientation (Model 3) and career orientation (Model 4). Model 5 is a full regression model that includes all the variables used in the previous models, including the combined influence of workplace motivation types. To facilitate interpretations, odds ratios with linearized standard errors are reported.

4. Results

4.1. Descriptive Statistics

Descriptive statistics for the variables used in this study are displayed for each country in Table 1. While our focus will be on the results of regression estimates below, several key distributions are worth noting here. First, percentages reporting symptoms of

psychological distress are overall consistent across the four countries, with the US showing the lowest percent (16%) and the highest in India at 20%. Second, we find generally consistent mean scores in COVID-related stressors but note the low levels of COVID-related physical stress in India and the generally high levels of COVID-related workplace stress in the US. Mean scores on the financial stress indicator are also generally consistent across countries, except the US, with the lowest mean scores in financial distress. Finally, gender distributions are generally consistent across countries and indicate higher representation among men in these fields, with marginally the lowest percentage of women faculty/researchers found in India. We limit our discussion of descriptive statistics to these key points and move to our analytical strategies and presentation of results from multivariate models.

Table 1: Sample descriptive statistics (unweighted)

	US (N=535)			UK (N=925)			India (N=1,345)			Italy (N=637)		
	Mean ¹	n	%	Mean ¹	n	%	Mean ¹	n	%	Mean ¹	n	%
Psychological distress	-----	534		-----	924		-----	1,338		-----	634	
No	-----		84%	-----		81%	-----		80%	-----		83%
Yes	-----		16%	-----		19%	-----		20%	-----		17%
COVID-Physical Stress	3.35	535	----	3.34	925	----	3.27	1,345	----	3.36	637	----
	(.897)			(.902)			(.863)			(.753)		
COVID-Job Stress	3.34	534	----	3.30	925	----	3.21	1,345	----	3.19	637	----
	(.540)			(.562)			(.691)			(.497)		
Job orientation												
Not at all like me	-----	241	45%	-----	381	41%	-----	545	41%	-----	308	48%
A little like me	-----	128	24%	-----	219	24%	-----	226	17%	-----	186	29%
Somewhat like me	-----	81	15%	-----	148	16%	-----	301	22%	-----	66	10%
Mostly like me	-----	64	12%	-----	126	14%	-----	213	16%	-----	61	10%
Very Much like me	-----	19	4%	-----	50	5%	-----	57	4%	-----	16	3%
Calling orientation												
Not at all like me	-----	26	5%	-----	53	6%	-----	52	4%	-----	29	5%
A little like me	-----	63	12%	-----	135	15%	-----	142	11%	-----	77	12%
Somewhat like me	-----	98	18%	-----	198	21%	-----	379	28%	-----	159	25%
Mostly like me	-----	185	35%	-----	307	33%	-----	400	30%	-----	258	41%
Very Much like me	-----	161	30%	-----	232	25%	-----	371	28%	-----	114	18%
Career orientation												
Not at all like me	-----	156	29%	-----	290	31%	-----	239	18%	-----	139	22%
A little like me	-----	178	33%	-----	288	31%	-----	331	25%	-----	220	35%
Somewhat like me	-----	127	24%	-----	211	23%	-----	415	31%	-----	164	26%
Mostly like me	-----	57	11%	-----	105	11%	-----	252	19%	-----	90	14%
Very much like me	-----	15	3%	-----	31	3%	-----	104	8%	-----	24	4%
Financial stress	2.42	534	----	3.0	925	----	3.30	1,343	----	3.22	637	----
	(3.07)			(3.10)			(2.59)			(3.02)		
Male	-----	322	60%	-----	538	58%	-----	828	62%	-----	374	59%
Female	-----	212	40%	-----	383	41%	-----	500	37%	-----	262	41%
Other gender ²	-----	1	0%	-----	4	0%	-----	17	1%	-----	1	0%
Age	40.9	516	----	37.8	909	----	33.9	1,323	----	42.1	627	----
	(16.8)			(13.5)			(11.0)			(13.7)		
Discipline												
Physics	-----	278	52%	-----	533	58%	-----	704	52%	-----	322	51%
Biology	-----	217	41%	-----	348	38%	-----	564	42%	-----	252	40%
Other discipline	-----	40	7%	-----	44	5%	-----	77	6%	-----	63	10%
Position/status												
Postgraduate student	-----	210	39%	-----	326	35%	-----	637	47%	-----	197	31%
Postdoc	-----	90	17%	-----	201	22%	-----	82	6%	-----	92	14%
Research scientist	-----	9	2%	-----	80	9%	-----	193	14%	-----	NA	NA

<i>Junior faculty</i>	-----	43	8%	-----	59	6%	-----	135	10%	-----	72	11%
<i>Mid-level faculty</i>	-----	33	6%	-----	85	9%	-----	114	8%	-----	127	20%
<i>Senior faculty</i>	-----	122	23%	-----	116	13%	-----	126	9%	-----	60	9%
<i>Other</i>	-----	28	5%	-----	58	6%	-----	58	4%	-----	89	14%
¹ Standard errors in parentheses												
² Due to small-size sample models exclude "other" gender												

4.2. COVID-19 Effects and Hypotheses Testing

Table 2 shows the results of logistic regression models using the pooled data while including dummies for the researcher's home country. Baseline model 1 shows the significant deleterious effects of both COVID-related stressors on psychological distress. Here we see that each unit increase in COVID-related physical stress and COVID-related work stress is associated with 74% and two and a half times increased odds of reporting psychological distress, respectively (physical stress OR=1.74, $p<.001$; work stress OR=2.59, $p<.001$).

We next examine the effects of workplace motivation types with a focus on intrinsic and extrinsic forms of motivation, net of COVID-related stressors. We assess H1 by turning to Table 2, Models 2 and 5. Recall, in both models, we are assessing responses to the statement, "My work as a scientist is just a job; I may enjoy it, but it is not among the most meaningful aspects of my life." As shown by both models, compared to individuals who felt that this sentiment is "not at all like me," researchers who felt this sentiment is "very much like me" reported significantly higher odds of experiencing symptoms of psychological distress. While the effect is partly attenuated in model 5—the full model that includes extensive statistical controls—researchers who felt their work was "just a job" were over two times more likely to report psychological distress compared to those who did not agree with this sentiment (OR=2.36, $p<.01$), lending substantial support for H1.

Table 2: Binary logistic regression parameter estimates to predict
psychological distress: COVID-related stress, workplace motivation, with controls ^{a b}

	Model 1	Model 2	Model 3	Model 4	Model 5
	OR	OR	OR	OR	OR
COVID-Physical Stress	1.74***	1.49***	1.50***	1.48***	1.50***
	(.167)	(.122)	(.112)	(.117)	(.119)
COVID-Job Stress	2.59***	2.33***	2.32***	2.38***	2.33***
	(.368)	(.290)	(.285)	(.273)	(.290)
Job orientation	-----		-----	-----	
<i>Not at all like me</i> (omitted)		1			1
		(base)			(base)
<i>A little like me</i>		1.44†			1.35
		(.285)			(.331)
<i>Somewhat like me</i>		1.35			1.38
		(.438)			(.460)
<i>Mostly like me</i>		1.33			1.40
		(.238)			(.311)
<i>Very Much like me</i>		2.56***			2.36**
		(.624)			(.657)
Calling orientation	-----	-----		-----	
<i>Not at all like me</i> (omitted)			1		1
			(base)		(base)
<i>A little like me</i>			0.49		0.54
			(.217)		(.233)
<i>Somewhat like me</i>			0.39**		0.44*
			(.136)		(.165)
<i>Mostly like me</i>			0.56†		0.70
			(.168)		(.253)
<i>Very Much like me</i>			0.35**		0.50†
			(.114)		(.205)
Career orientation	-----	-----	-----		
<i>Not at all like me</i>				1	1
				(base)	(base)
<i>A little like me</i>				1.36	1.40
				(.326)	(.354)
<i>Somewhat like me</i>				1.08	1.09
				(.271)	(.296)
<i>Mostly like me</i>				0.91	0.95
				(.262)	(.311)
<i>Very Much like me</i>				1.23	1.14
				(.512)	(.567)
Financial stress	-----	1.09***	1.10***	1.10***	1.09***
		(.017)	(.016)	(.018)	(.017)
Country dummies	-----				
<i>USA</i> (omitted)		1	1	1	1
		(base)	(base)	(base)	(base)
UK		1.74***	1.68**	1.78***	1.73***
		(.242)	(.254)	(.259)	(.249)
India		1.99***	1.96***	1.93***	2.08***
		(.199)	(.210)	(.179)	(.180)
Italy		2.09***	1.97***	2.02***	2.04***
		(.194)	(.220)	(.201)	(.201)
Male (reference)	-----	1	1	1	1
		(base)	(base)	(base)	(base)
Female		1.27	1.25†	1.27†	1.28†
		(.195)	(.165)	(.180)	(.173)
Age	-----	0.97**	0.97**	0.97**	0.97*
		(.008)	(.008)	(.008)	(.008)
Discipline	-----				
<i>Physics</i> (omitted)		1	1	1	1

Gabriel A. Acevedo, Brandon Vaidyanathan, Xi Chen
HIGHER EDUCATION RESEARCHERS' VIEWS OF SCIENCE AS A VOCATION AND ITS
RELATIONSHIP TO PSYCHOLOGICAL DISTRESS DURING THE COVID-19 PANDEMIC

		(base)	(base)	(base)	(base)
<i>Biology</i>		1.00	0.99	0.98	1.00
		(.151)	(.142)	(.140)	(.144)
<i>Other discipline</i>		0.99	0.94	0.98	0.95
		(.222)	(.202)	(.212)	(.205)
Position/status	-----				
<i>Postgraduate student (omitted)</i>		1	1	1	1
		(base)	(base)	(base)	(base)
<i>Postdoc</i>		0.59**	0.57**	0.56**	0.56**
		(.112)	(.102)	(.116)	(.111)
<i>Research scientist</i>		0.76	0.79	0.75	0.76
		(.263)	(.250)	(.236)	(.218)
<i>Junior faculty</i>		0.57**	0.62*	0.57*	0.61*
		(.116)	(.118)	(.130)	(.150)
<i>Mid-level faculty</i>		0.36***	0.36***	0.35***	0.34***
		(.076)	(.080)	(.073)	(.067)
<i>Senior faculty</i>		0.24***	0.26***	0.23***	0.23***
		(.088)	(.091)	(.084)	(.084)
<i>Other</i>		0.62	0.67	0.60	0.62
		(.275)	(.311)	(.273)	(.295)
N	3,407	3,337	3,340	3,337	3,335
Constant	.001***	.003**	.008***	.003***	.004***
	(.000)	(.001)	(.003)	(.001)	(.001)
Likelihood ratio chi-sq	120.98***	326.08***	298.01***	291.08***	340.30***
^a Data are weighted to match the population characteristics.					
^b Standard errors in parentheses					
† < .10; *p < .05; **p < .01; ***p < .001					

Our second hypothesis (H2) tests the proposition that researchers and faculty who strongly associate with the statement, “My work as a scientist feels like a calling or vocation; it is one of the most meaningful aspects of my life,” will report lower levels of psychological distress than those who felt the statement does not express their sentiments on work as a calling. As shown by Table 2 Model 3, compared to individuals who felt that this sentiment is “not at all like me” researchers who felt this sentiment is either “somewhat like me” or “very much like me” reported approximately 60 to 65 percent lower odds of experiencing symptoms of psychological distress (OR=0.39, $p<.01$; OR=0.35, $p<.01$, respectively). However, when we turn to full Model 5, these effects are less pronounced than in Model 3, but still statistically significant at the .05 level. Here, we see researchers who felt that this sentiment is “somewhat like me” are approximately 56% less likely to report psychological distress (OR=0.44, $p<.05$) when compared to those who felt it is “not at all like me.” Additionally, in Model 5, the effects for those who felt the idea that work is a vocation is “very much like me,” while still lowering the odds of experiencing symptoms of psychological distress by 50%, exceed the .05 cut-off but is below .10 (OR=0.50, $p<.10$). Taken in their totality, we suggest that these results lend persuasive support for H2.

Our final hypothesis (H3) explores possible associations between valuing extrinsic workplace rewards and the likelihood of experiencing symptoms of psychological distress. We expect scientists and faculty who place greater value on “tenure, promotions, awards, and professional advancement opportunities” to report greater levels of psychological distress than those who place a lower value on such extrinsic rewards. We

evaluate this final hypothesis by turning to Table 2, Models 4 and 5. Across models, the value researchers place on extrinsic workplace rewards was not statistically significantly associated with the likelihood of psychological distress. We therefore find no support for H3. However, the absence of a statistically significant association between career orientation and psychological distress should not be interpreted as evidence that extrinsic rewards or institutional working conditions are wholly unimportant to researchers' well-being. Instead, our results suggest that, within the context of the present study, perceptions of intrinsic meaning were more consistently associated with psychological distress than researchers' reported emphasis on tenure, promotion, awards, and professional advancement. Furthermore, this nonsignificant finding may reflect the characteristics of the present sample, the pandemic period during which the data were collected, the measurement of extrinsic motivation, or the specification of the statistical models. We discuss this null finding in greater detail below.

4.3. Hypothesis Testing and Results of Country-specific Models

To test the robustness of our findings, we also ran country-specific models that allowed us to assess within-country variation in psychological distress (results available upon request). We find that most country-level results largely confirm our general hypotheses, with one notable exception. Results of country-specific models suggest that, when compared to the other regions we examine, in the US, neither extrinsic nor intrinsic motivation plays as significant a role in lowering psychological distress. However, country-specific models also show that the effects of both physical and COVID-related work stressors are strongest in the US, possibly moderating the effects of motivation types. Additionally, controlling for US-specific race/ethnicity categories also seems to suppress the effects of intrinsic and extrinsic motivation. In supplementary analysis, when these variables are removed from the US regression equations, one key motivation variable becomes statistically significant and operates in the hypothesized direction, where the effect of seeing one's job as a "vocation or calling" lowers the odds of psychological distress. In short, it is quite likely that the effects of COVID-19 related stressors and controls for race/ethnicity suppress the effects of intrinsic and extrinsic motivation among US researchers. However, results of country-specific models show that in the UK, India and Italy, researchers who see their roles as "just a job" with little meaning, report higher levels of psychological distress, offering confirmatory evidence for H1.

Next, recall that H2 set out to assess the expectation that researchers and faculty who view their work as a meaningful "vocation or calling," will have lower odds of experiencing psychological distress. Apart from the US, odds ratios for Italy, India, and, to a lesser extent, the UK, tend to generally reinforce the findings of pooled models in support of H3. While in the UK, statistical significance is just slightly above .05 ($p=.057$) the general pattern of negative odds ratios predicting psychological stress among those who see their work as a vocation or calling in the UK, India, and Italy, provides additional confirmatory evidence for H2.

Finally, pooled models shown above, as Table 2 presented little evidence for H3, leading us to reject the expectation that greater emphasis on extrinsic workplace motivation (e.g., “tenure, promotions, awards, and professional advancement”) would be associated with a higher likelihood of reporting psychological distress. Results of supplementary country-specific models tend to confirm these findings. First, country-specific models show that extrinsic motivation effects are not statistically significant in the US or India. Effects are significant in Italy but in the opposite direction of the hypothesized relationship so that increased value placed on extrinsic workplace rewards is actually associated with generally *lower* psychological distress. Support for H3 is only found among researchers in the UK. These mixed results would lead to non-significant findings in the pooled model and lend considerable clarity to our failure to find support for H3. We close with this brief overview of results from country-specific models and move to a more detailed discussion which places our results in a broader theoretical and organizational context.

5. Discussion

Our study tests several hypotheses that explore possible associations between workplace motivation and psychological distress. We do so by analyzing nationally representative survey data that includes scientists from STEM fields in the USA, UK, India, and Italy. To recap, our study results indicate that (a) scientists who view their professions as providing little meaning in their lives (e.g. “my work is just a job”) have higher odds of self-reported psychological distress than their counterparts who disagree with this view; (b) those who find meaning and see their work as a “calling or vocation” have somewhat lower odds of reporting psychological distress and (c) the value scientists place on the extrinsic aspects of their work (e.g. tenure, promotions, professional advancement) was not significantly associated with self-reported psychological distress. These effects are robust net of extensive controls and accounting for COVID-related physical and workplace stressors. While above we also outline the results of country-specific models showing weaker effects of work motivation among US researchers, we also report the heightened noxious effects from the COVID-19 pandemic among US researchers, which may have moderated motivation effects among the US-based scientists in our sample. Below, we discuss both the theoretical and practical implications from our findings and close with study limitations and recommendations for areas of future inquiry.

5.1. Workplace Motivation

Workplace motivation continues to draw the attention of industrial/organizational psychologists and is a growing area of interest among human resource specialists (Heyns & Kerr, 2018; Mahmoud *et al.*, 2021). In many organizations, financial rewards take precedence over non-financial ones, so factors such as workplace culture, meaning in work, and the use of creativity in daily tasks often play a secondary role in shaping the overall workplace experience. Our results speak to an accumulated body of research

showing considerable evidence to the contrary. In our study, seeing scientific work as “just a job” increased the chances of experiencing psychological distress. Such a result highlights the growing importance, in the modern workplace, that is placed on systems of value above and beyond what might have been the predominantly financial standard held in previous times.

As articulated in his influential book *Why We Work*, social psychologist Barry Schwartz (2015) has amassed substantial empirical evidence showing the importance of intrinsic rewards in motivating workers in contemporary organizational settings. Particularly among highly educated and skilled employees, Schwartz shows that it is often the experience of being challenged intellectually, self-empowerment, and autonomy, along with meaningful interactions with supervisors and peers, that enhance the workplace experience. Additionally, these factors were more strongly correlated with workplace satisfaction than financial incentives. The support we find for our first hypothesis resonates with this expectation and speaks to the importance of non-financial reward systems in higher education research settings, particularly during a time of heightened public health stress.

We find similar results among those who strongly agree that their work is a “calling or vocation” that is also “one of the most meaningful aspects of life.” Recall that in our study, researchers who strongly agreed with this statement experienced lower levels of mental health distress compared to those who disagreed with this sentiment. On the other hand, we found little evidence in our data that extrinsic motivation (e.g., “tenure, promotions, awards, and professional advancement opportunities are the most important aspects of a scientific career”) had any significant influence on shaping the likelihood of reporting symptoms of psychological distress. It is to these interrelated findings that we now turn.

5.2. Theorizing Work as “a Calling”

We opened this manuscript by alluding to the work of the German economist and sociologist Max Weber, whose influential yet contested “Protestant Ethic Thesis” emphasized traditional, 17th-century views of work as central to the development of advanced capitalism (Weber, 1905/2001). In Weber’s mind, the early Puritans’ quest for otherworldly salvation led to the adherence to a strict ascetic lifestyle in which dedication to one’s work was seen as a calling in and of itself. While contemporary scholars have repeatedly commented on the limitations and oversimplification of many of Weber’s arguments, the idea that work can be motivated by non-material and financial rewards continues to be of interest to contemporary researchers in the social behavioral sciences (Hackett, 1990).

Dik and Duffy (2009) have highlighted much of the academic and popular scholarship that has both been inspired by and critiqued aspects of Weber’s classic conceptualization of work. In their view, a growing line of contemporary interdisciplinary research has called “*for the importance of reestablishing the constructs of calling and vocation as pathways for infusing meaningfulness into work and other life roles*” (Dik

& Duffy, 2009, p. 426). They go on to note how prevailing, market-oriented conceptions of productivity have often overshadowed previously held notions of workplace satisfaction, *"so that economic and societal shifts have engendered values antithetical to meaningfulness and purpose instead, viewing work as a segmental, self-interested activity"* (Dik & Duffy, 2009, p. 426). In our study, we find support for the former perspective, where the driving factors shaping well-being in the academic workplace seem more associated with intrinsic value and meaning, and less with financial and professional rewards such as tenure and academic awards.

5.3. Self-Determination Theory

Theoretically, we find that our results also add an additional measure of empirical validation for the SDT framework. Specifically, we suggest that one of the major contributions of SDT was to move the locus of motivation away from purely external towards internal sources. This implies that beyond the external, often instrumental factors that might influence motivation, internal factors stemming from affective dispositions and human emotion can also influence psychological processes. Our findings particularly align with theoretical expectations that predict intrinsic reward systems in the workplace to produce greater productivity returns than simply pay-for-performance (PFP) strategies (Gerhart & Fang, 2013). In fact, as has been noted, *"PFP has been described as a high-risk, high return strategy"* that is susceptible to a series of potential drawbacks including *"excessive risk-taking, excessive competition within the firm, focusing too little on performance measures (e.g., quality, customer service, long-term performance) not explicitly included in the PFP plan, and focusing too much on (including gaming or manipulating) performance measures (e.g., sales, stock returns) that are included in the plan"* (Gerhart and Fang 2015, pp. 490-491). In a large-scale account of workplace motivation, Pink (2009) has suggested that PFP may, in fact, overshadow or possibly suppress the positive effects of intrinsic motivation. Our general view is in line with accumulating research suggesting the value added to managers and team leaders when organizations strike an appropriate balance between intrinsic and extrinsic rewards (Cerasoli *et al.*, 2014). A theory that can synthesize two often competing sources of motivation (e.g., intrinsic versus extrinsic) may, in our view, provide greater explanatory utility than a perspective that takes an "either or" approach to the issue of workplace motivation.

From an institutional perspective, SDT can be seen as suggesting organizational strategies that may work to enhance workplace experiences, above and beyond instrumental reward systems. Sansone and Tang succinctly express this sentiment when they note that SDT theory *"also sheds light on the influence of need-supportive social environment and education on people's motivation as well as self-regulation of behavior. These contributions helped to create the foundations for numerous studies and wide-ranging applications, providing a valuable heuristic framework to guide studies in experimental settings as well as in education, health and work settings, among many others"* (Sansone & Tang, 2021, p. 113). Furthermore, while most of the empirical work that applies the SDT framework in the workplace has been interested in overall employee satisfaction and measures of

happiness, we feel we add to the literature that applies concepts from SDT to the evaluation of mental health outcomes in higher education settings.

5.4. Implications for Practice and Future Research

Our results also evoke several plausible policy implications. The first has to do with the noxious effects of work-related COVID stressors on the mental health of faculty and researchers in our study sample. Such negative outcomes may speak to the need for higher educational institutions to institute policies that are designed to mitigate the deleterious effects of workplace stressors, particularly in times of heightened collective trauma. For instance, we surmise that higher educational institutions that were better able to support remote faculty teaching and research during the pandemic may have, in turn, enhanced the sense of security and well-being among their staff. The fact that, in our data, workplace stress was a stronger factor shaping increased symptoms of psychological stress than even physical stressors, underscores this point.

Second, we suggest that higher educational institutions could consider correlates of motivation as part of employee counseling services and mental health outreach. As clinical psychologists have pointed out, an increasing number of professionals undergoing therapy point to a lack of meaning in work as a source of personal strain (Colozzi & Colozzi, 2000), many utilizing the language of “calling” or “vocation” to describe the aspects of work they are missing and seeking (see also, Dik & Duffy, 2009, pp. 440-441). A balanced emphasis on traditional markers of academic success such as tenure, promotion, and salary, with more intrinsic reward systems such as the use of creativity, the value of science for the sake of discovery, and others, might enhance the experiences of researchers seeking greater validation and sense of purpose in their work. Next, we suggest two additional avenues that institutions and departments could consider as they look to promote well-being and improved mental health among their faculty and research personnel. One, it is possible that a greater emphasis on *teaching science* in the classroom could be aligned with research expectations. For many academic researchers, the charge of serving as an educator and mentor to students often provides a great level of personal fulfillment and meaning in work. Aligning institutional and departmental expectations with faculty who value their teaching roles could enhance the overall sense of purpose that these faculty feel. Additionally, we suggest that considering the institutional dynamics of institutions and education systems should also inform the mental health and well-being of faculty researchers. Here we draw from scholarship showing the additional mental health burden that the competitive work environment at high-impact (R1) research universities can have on faculty, particularly faculty from underrepresented groups, international faculty, and women (Carson *et al.*, 2013; Limas *et al.*, 2022); as well as a growing body of work showing the mental health challenges experienced by sexual minority researchers working at demanding research centers (Yoder & Mattheis, 2016). Taking into consideration the particular demands of research-intensive educational systems (as opposed to teaching-oriented “liberal arts” colleges)

may be an important step in addressing the specific mental health needs of their faculty and research staff.

Second, we suggest that the role of research funding and the greater expectations for STEM researchers and faculty to acquire external funding should be considered as a correlate of psychological well-being. Studies have indicated the noxious effects that grant-related activity can have on researchers, particularly among early and mid-career researchers who understand that employment stability and tenure are often largely based on securing external grants (Hammoudi *et al.*, 2023; Herbert *et al.*, 2014; Piano *et al.*, 2023). We suggest that one plausible avenue in the STEM fields—where grantsmanship is a highly rewarded professional activity—is to not only reward researchers for the monetary *size* of grants but also for the *outcomes* of grant-funded scholarship. Specifically, institutions and departments could highlight how certain grants, regardless of size, could have a positive social impact and may serve as vehicles for positive social and/or community change. Rewarding such grant-funded work might have the multiple effects of supporting organizational goals in external funding while also providing researchers a greater sense of personal satisfaction in their work.

Taken together, our findings suggest that higher education institutions have an important role to play in fostering meaningful workplace experiences, autonomy, and a sense of purpose, all of which may support researchers' well-being and mental health. However, these goals are often viewed as "personal aspirations," with insufficient attention given to the institutional conditions that can promote and sustain a culture of meaningful work. Excessive workloads, temporary employment contracts, and unclear evaluation policies may undermine researchers' sense of purpose and meaning in their work while also contributing to psychological distress. Our findings therefore suggest that intrinsic meaning may serve as an important psychological resource, but not as a substitute for supportive organizational policies and appropriate working conditions.

5.5. Limitations and Directions for Future Research

We acknowledge several study limitations. First, the data used for this study are cross-sectional, limiting our ability to make precise causal claims about the relationship between workplace motivation and mental health outcomes. Because the data are cross-sectional, the observed associations should not be interpreted as demonstrating that perceptions of meaningful work causally reduce psychological distress. Rather, our findings identify a theoretically plausible association between perceptions of meaningful work and psychological distress that remains evident after adjustment for multiple demographic, occupational, and COVID-related factors. While the use of random sampling techniques does allow us to generalize our results to the larger national population of each country, cross-sectional data raises concerns over causality. In our study, for instance, it is possible that mental health stressors may, in themselves, lead individuals to emphasize certain types of cognitive motivation as a coping style, and not the other way around. In other words, the relationship we identify may also operate in the opposite direction, such that researchers experiencing lower levels of psychological

distress may be more likely to perceive their work as meaningful or as a calling. Cross-sectional “snapshots” lack the ability to account for possible temporal factors that shape outcomes at the individual level. Future studies could apply longitudinal research designs to assess the timing of employee and staff motivation in relation to mental health outcomes. Such approaches include a temporal dimension in the data structure that allows researchers to account for the specific trajectory of the focal predictors being tested and how these factors impact later life outcomes. Additionally, future qualitative studies may have the potential to frame our findings within specific cognitive mechanisms that are best captured via in-depth interviews or focus group designs.

As with many survey-based studies, we are also aware of limitations in measurement and operationalization. Our career-orientation measure captures the importance researchers place on tenure, promotion, awards, and professional advancement, but it does not directly measure their exposure to precarious employment, excessive workloads, funding uncertainty, or inadequate institutional support. Moreover, the mixed results from the country-specific models suggest that associations between career orientation and psychological distress may vary across national and institutional contexts, reinforcing the need for caution when interpreting the nonsignificant pooled association. Similarly, our dependent variable captures self-reported psychological distress during the 30 days preceding the survey rather than a clinical diagnosis or longer-term trajectory of mental health. The measure therefore cannot determine whether reported distress was temporary or persistent over time.

A third limitation has to do with the relatively small number of country-level cases and our inability to provide a broader comparative framework. While our selection of countries offers wide-ranging diversity in terms of geography, national religious cultures, and organizational structure, this variation may, in fact, pose problems in terms of comparative analysis. Including counterpart cases, such as Canada, France, Pakistan, and Spain, may have offered an opportunity for an even more refined analysis of comparative cases. Future work mirroring global-scale projects such as the *World Values Surveys* could focus on mental health issues in higher education from an even more expansive comparative context. Additionally, research combining longitudinal and comparative approaches could further examine how perceptions of vocation, workplace culture, institutional support and psychological well-being influence one another over time and across national contexts.

Next, and as noted above, while we are aware the 15% response rate is a study limitation, we suggest that there are several offsetting challenges and accompanying contributions from the data that may help provide some context for the low response rates. First, the data were collected at a turbulent time during the pandemic, where respondents may have had less access to offices and online work time, a possibility that would likely impact response rates. Second, the sample is nationally representative but also inclusive of only individuals concentrated in specialized fields in higher education research settings. Third, we feel that the richness of the data, accompanied by low levels of missing data for our key items of interest, adds to the overall value of data measuring

the views and behaviors of a highly specialized segment of the workforce from various regions of the world.

Finally, we did not explicitly test any mechanisms that may explain the causal pathways between workplace motivation and psychological distress that we uncovered here. Additionally, it may be difficult to untangle the distinct effects that shaped individuals' psychological profiles during such a tumultuous, historical period. Could these effects be amplified or possibly mitigated during the time of the pandemic, and if so, what could be the motivating factors explaining such fluctuation during a time of heightened stress? As noted above, we suggest that longitudinal studies might answer the first question as to whether the COVID-19 pandemic played a central role in altering the impact of intrinsic and extrinsic motivation on shaping mental health, while qualitative studies could help shed light on underlying mechanisms that may (or may not have) impacted statistical associations and outcomes during the pandemic.

6. Conclusion

Our study investigates the association of COVID-related stress with psychological well-being in the workplace and is based on nationally representative surveys of STEM researchers from four diverse regions of the world (Italy, India, UK, USA). Our focus on intrinsic and extrinsic workplace motivation led to several key study results which suggest that (a) scientists who view their professions as simply meaningless work have higher odds of self-reported psychological distress, (b) those who find meaning and see their work as a "calling or vocation" report lower levels of psychological distress, and (c) the value scientists placed on tenure, promotion, awards, and professional advancement was not significantly associated with psychological distress. On the whole, these findings suggest that, among the researchers in our study sample, a sense of purpose and meaning was associated with psychological distress, although this association should not be separated from the broader context of the COVID-19 pandemic. Although our results do not establish a direct causal pathway, the statistical models suggest that meaningful work may have functioned as a psychosocial resource during this period of exceptional uncertainty. Also, in reference to this third finding, we want to reiterate a point made above. Although workplace rewards related to extrinsic motivation (e.g. tenure, promotion, awards) were not significantly associated with psychological distress in the pooled models, this result does not establish that extrinsic rewards or institutional working conditions are generally unimportant to academics' mental health. We can reasonably expect compensation, employment security, and opportunities for professional advancement to remain important dimensions of employee well-being. However, our results add to a growing line of research showing that nonmaterial aspects of work, including meaning, purpose, autonomy, and work-life balance, may also be independently associated with psychological well-being and may serve as important resources for mitigating psychological distress among employees.

We hope our study informs current and future work that explores the role of motivating factors in shaping workplace psychological well-being. Additionally, we do so from an international context, which we feel contributes to both the higher education and psychological literature focused on faculty and university researchers. Writing in what some have termed a “post-COVID world,” we are able to retrospectively look back at the immediate effects of this major public health emergency whose effects continue to reverberate around the world. Understanding psychological workplace outcomes during this pivotal time will be a critical undertaking as we look to better manage and cope with the next public health emergency that impacts cross-national populations. It is at this level that we hope our study has made a modest contribution that may inform practices in higher education settings.

Along these lines, at the most current stage of our study, we are indeed in a “post-COVID” period that is characterized by both gradual economic recovery and a concomitant rise in COVID infection rates in the US and elsewhere. The politicization of the pandemic, occurring at the most fatal stage of its epidemiologic cycle, will likely prohibit the implementation of even the most modest public health measures designed to mitigate the spread of such viral pathogens in the future. The temporal lens for our study allows us to consider the previous global COVID-mitigation efforts and to suggest that such all-encompassing approaches, including large-scale workplace shutdowns, may not be feasible or politically realistic if cases continue to rise. If this is indeed the case, the timing of our study offers two interrelated implications. First, data collection that occurred during the pandemic allows us to assess the ways that individuals in high-stress work environments drew from socio-psychological resources as a way of coping with a historic, exogenous public health emergency. Second, as noted above, the current stage of our study allows us to assess the implications of our findings with the benefit of hindsight. Specifically, we are now better able to consider workplace dynamics at the peak of the crisis while also considering the swift transition to “normalcy” that we are now experiencing. Such a lens may not have been possible had the data collection occurred during the earliest parts of the outbreak when longer-term impacts were not readily apparent and where workplace lockdowns were intermittent, particularly at the international level.

We close by revisiting our earlier statement which noted that the aims of our study are both theoretical and applied in nature. Specifically, we attempt these interrelated objectives first by contributing to previous scholarship that has drawn from self-determination theory and second by maintaining a level of applicability to workplace dynamics in higher educational settings. In terms of the theoretical contribution, as noted above, our results provide substantial validation for theories of intrinsic motivation while leaving open future questions regarding the effects of workplace extrinsic motivation. Overall, we find the theoretical underpinnings of SDT to align with our empirical findings, with one important contextual caveat: our results are situated within a time of global duress when the COVID-19 pandemic impacted multiple spheres of personal and public life. Additionally, we suggest that the use of cross-sectional survey data in higher

educational settings is an added contribution of our study, allowing us to generalize to larger populations of researchers from the diverse regions of the world captured by our study samples. Finally, our study is also institutionally situated in higher educational institutions and, as such, provides a contribution to work on the mental health of researchers and faculty in these settings. Additionally, while we can undoubtedly expect a growing body of scholarship exploring the costs and long-term impacts in the aftermath of the COVID-19 pandemic, we hope that our work serves as a springboard for additional research focusing on these issues in the higher education workplace.

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Declarations

Ethical Approval

This study received human subjects research approval from the authorized university institutional review board at one of the author's higher education institution (IRB approval no. 21-0005). The research was carried out following the guidelines of the ethics committee listed in this ethics statement. Consequently, the protocol was approved by that institution's relevant guidelines and regulations.

Consent to Participate

All participants provided informed consent to take part in the study.

Data Availability Statement

The datasets generated during and/or analyzed during the current study are not publicly available due to issues of confidentiality. There is potential identifiability of respondents because we have a narrowly defined population. For example, the variables for ethnicity, family life (marital; number of children), gender, country, and academic position (among others) may unmask respondent identity. However, data are available from the corresponding author on reasonable request and upon execution of a signed data sharing agreement to ensure data security.

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Clinical trial number

Not applicable

Generative AI Use Statement

Generative artificial intelligence (AI) tools were not used at any stage of survey development, literature searching, manuscript drafting, or substantive manuscript preparation. Generative AI was also not used to generate, revise, or troubleshoot any of the STATA statistical code used for the analyses reported in this study.

The use of generative AI was limited to two editorial and formatting purposes. First, generative AI was used to assist with translations from English into European French only for the manuscript title, abstract, and keywords, as required by the journal. Second, generative AI was used to assist with the standardization of DOI presentation as direct links in the reference section, in accordance with journal formatting requirements.

All other elements of the research process, including survey construction, literature review, manuscript preparation, statistical analysis, interpretation of findings, and final scholarly judgments, were carried out by the authors without the use of generative AI tools. The authors reviewed and verified all AI-assisted editorial outputs and take full responsibility for the content of the manuscript.

Competing Interests Statement

The authors have no conflicts of interest to declare.

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ⁱ Data on 2020 GDP per capita was accessed via the World Bank "DataBank" which is available for public use at <https://databank.worldbank.org/home.aspx>

ⁱⁱ The non-normal distribution of the measure for psychological distress may violate statistical assumptions when using OLS regression. For this reason, we opted for binary regression as used with the same measure in previous large-scale studies (see, for instance, Kessler et al., 2010; Prochaska et al., 2012). However, based on reviewer recommendations, we ran all models using OLS regression (results available upon request) and found little difference in substantive findings, giving us confidence that the results we report are robust.

ⁱⁱⁱ For pooled models, when using dummies for country, we apply the -svy:- prefix in STATA 16, which calculates standard errors appropriate to the sample design.