**Interdisciplinarity and intellectual virtues in knowledge work: Evidence from a longitudinal survey of IDR-engaged faculty**

Abstract

Though its ideal place within the academy is contested, collaborative interdisciplinary knowledge work—including teaching and interdisciplinary research, or IDR—has only increased in prominence since the early 2000s. Concurrently, a global era of rising misinformation and scholarly distrust has lent credence to the notion that “intellectual virtues,” including but not limited to *curiosity* and *intellectual humility*, may provide a necessary antidote. Aside from their potential to combat misinformation, intellectual virtues of many kinds have been found to benefit scientists themselves and scientific communities more broadly. Particularly in light of the potential benefits of intellectual virtues, this study asks: To what extent might interdisciplinary knowledge work be related to them? Through a longitudinal, quantitative research design, this study explores the relationship between U.S. higher education faculty’s engagement in IDR and their self-reported endorsement of three intellectual virtues: *humility, intellectual curiosity* and *collaboration.* Findings suggest a significant correspondence and point toward other potential benefits—for faculty and the broader campus community—of IDR and IDR-oriented university initiatives. Implications for practice and scholarship are discussed.

Keywords

*interdisciplinarity, faculty, intellectual virtue, humility of inquiry*

**Interdisciplinarity and intellectual virtues in knowledge work: Evidence from a longitudinal survey of IDR-engaged faculty**

Scholarly interest in interdisciplinarity and collaborative “team science” has increased continuously since the turn of the century (e.g., Hall, Feng et al. 2008, Holley 2009, Boix Mansilla, Lamont et al. 2016, Hall, Vogel et al. 2018, Barringer, Leahey et al. 2020). Viewed as a force for innovative scholarship and the creation of both new knowledge and transformative, world-bettering technologies, interdisciplinary research (IDR) and knowledge work has become nothing less than a “cornerstone” of modern scientific inquiry (Barringer, Leahey et al. 2020). Its real-world prominence has thus given rise to a varied literature exploring many facets of IDR.

One key strand of inquiry comprises IDR’s precursors, including fieldwide shifts in knowledge; broadscale national policy; and intentional strategies—strategic planning, academic field institutionalization, infrastructure development, cluster hiring and more—that are undertaken by higher education organizations (HEOs) (Harris and Holley 2008, Olzak and Kangas 2008, Sá 2008, Brint, Turk-Bicakci et al. 2009, Wood 2012, Jacobs 2014, Leahey, Barringer et al. 2019, Barringer, Leahey et al. 2020). Another thread of this literature explores the intended and unintended outcomes of advancing IDR—for knowledge and science, for HEOs and academia writ large, for faculty themselves, etc. (Leahey, Beckman et al. 2017, Bloom, Curran et al. 2020, Leahey and Barringer 2020). And while skeptics (see Jacobs 2014 in particular) counter pat conclusions of IDR as an unalloyed good, significant research supports the notion that increased IDR can benefit students, faculty and HEOs more generally (e.g., Holley 2009).

Concurrent to IDR’s forward march, science generally has faced ballooning mistrust and skepticism. This has manifested internal to the academy through phenomena such as psychology’s “replication crisis” (Wiggins and Christopherson 2019), and externally via broad public distrust of public health discourse, climate science and other increasingly politicized science-backed policy initiatives (e.g., Deane, Parker et al. 2021). As misinformation has gained speed, scholarship in psychology and the neurosciences has arisen to explore its potential causes and cures. A specific strand of this work investigates ways in which the development of “virtues,” generally, “intellectual virtues,” more specifically, and perhaps *intellectual humility*, most specifically, may prove an antidote. Though multiple—and in some cases competing—definitions of *intellectual humility* exist, its most commonsense definition constitutes an individual-level “concern[…] with getting at the truth [rather] than promoting [one’s self] or protecting [one’s] own ideas” (Barrett 2017). As Ballantyne (2023) states,

 [*Intellectual humility*] helps us overcome problematic egoic and egoistic responses to our evidence. This mindset frees us up to seek out and evaluate evidence in such a way that we are less influenced by our own self-oriented motives and more oriented toward reality. p. 200

 In the quest for scholarly truth and a more just world, scholars have alighted on *intellectual humility* and other intellectual virtues as a force for good. In work exploring how the virtues can be cultivated and how they correspond with the development of skills, attitudes and beliefs, findings suggest that these virtues can signal and/or support the development of good moral character, desirable “soft skills” such as self-reflection, and community well-being via the promotion of “prosocial” behaviors (e.g., Keltner, Kogan et al. 2014). Beyond their important role as a “core value of the scientific ethos,” (Hoekstra and Vazire 2021), *intellectual humility* and the other intellectual virtues are thus seen as having the potential to combat misinformation while also increasing truth and justice. In fact, scientists who are perceived to be intellectually humble by the public are trusted more, suggesting that intellectual humility in the academia could be an antidote for rising mistrust towards academics and scientific findings (Koetke, Schumann et al. 2024).

Though a potential for close ties may seem obvious, little research has directly explored how intellectual virtues may correspond with interdisciplinary activity. Without explicitly naming IDR, recent scholarship suggests *collaboration*—a tenet of IDR—as fundamental to *intellectual humility*, framing *intellectual humility* as an “interactive virtue” that is “scaffolded” by what Bland (2024) terms a “humbling environment”:

Forecasting tournaments and ***open institutional science are paradigmatic examples of intellectually humbling environments***; the former promotes epistemic competences and intellectual humility in individuals through focused practice; ***the latter promotes fruitful divergent thinking checked by self-correction in collectives***. Targeting humbling environments, rather than humble individuals, is a more effective approach to cultivating intellectual humility, given our cognitive limitations, though the one does not preclude the other. p. 3 (***emphasis authors***)

By encouraging collaborative IDR, might higher education be helping to create humbling environments?

To address the empirical gap on potential ties between intellectual virtues and interdisciplinarity, the studies presented in this report probe the longitudinal relations between faculty’s receipt of a collaborative IDR grant, their IDR engagement and their endorsement of three particular intellectual virtues: *collaboration*, *curiosity* and *intellectual humility*. In exploring these relationships, this work considers the extent to which IDR may prove a fruitful “humbling environment” in and of itself—or help in creating one as part of the broader campus community—in which truly virtuous truths can be uncovered.

**Literature Review**

This study is grounded in the scholarly literatures on IDR from the fields of higher education, organizational theory, the science of science, and more, as well as the study of virtues from moral psychology and human behavior.

Why IDR?

 While interdisciplinary research activity is encouraged in higher education for myriad reasons, the catch-all justification is its ability to solve the pressing, real-world problems of an increasingly complex and global society (Leahey, Barringer et al. 2019). As knowledge work that brings new configurations of scholars and scholarship together, IDR is also thought to bring novelty to the scientific process and “innovation, creativity, and reform” to the creation, dissemination and application of knowledge (Holley 2009). As such, science produced by multidisciplinary teams has been an increasing priority of national-level funders (Council 2014, Boix Mansilla, Lamont et al. 2016, Hall, Vogel et al. 2018). To foster interdisciplinarity, universities must strive to overcome preexisting challenges—most overtly, the formal structure of disciplines that grounds many key dimensions of academic socialization, university organization, faculty hiring, tenure and promotion and more (Austin 1990, Tierney and Bensimon 1996, Abbott 2002, Rhoten and Parker 2004, Barringer and Pryor 2021, Pryor and Steinberg 2023).

As the fluid in which knowledge work swims, the powerful force of disciplinary socialization and training can also complicate effective trans-disciplinary collaboration. A fast-growing body of scholarship has thus begun to interrogate how HEOs, as well as teams of and individual faculty, navigate these complications (Siemens, Liu et al. 2014, Kaplan, Milde et al. 2017, Klein and Falk-Krzesinski 2017, Roper 2021). On the part of HEOs seeking to spur IDR, this literature describes an also/and approach with myriad institution-level initiatives including but not limited to the adaptation of tenure and promotion guidelines (e.g., Benson, Lippitt et al. 2016); the pursuit of IDR-oriented “cluster” hiring (Foley 2008, Sá 2008, Sá 2008, Bloom, Curran et al. 2020, Curran, Bloom et al. 2020); the construction of interdisciplinary infrastructure and academic units (Geiger 1990, Harris and Holley 2008, Sá 2008, Sá and Oleksiyenko 2011, Trani 2014, Pryor and Steinberg 2022) and the offering of competitive funding opportunities (Sá 2008, Davies and Devlin 2010).

Faculty who conduct research in collaborative scientific teams face significant challenges. The “science of team science” explores the “complex social, organizational, political, and technological milieu” that constitutes this process (e.g., Hall, Vogel et al. 2018). This rich body of research identifies factors of team effectiveness “ranging from science policy to psychological” and has robustly investigated the structural components of scientific teams, such as team size and diversity; as well as team member cognitive and affective orientations (Stokols, Hall et al. 2008, Falk-Krzesinski, Contractor et al. 2011, Hall, Vogel et al. 2018). When discussing the motivational and affective dispositions that best facilitate effective team science, Hall, Vogel et al. (2018) summarize the findings of this work thusly:

Researchers with a CD [cross-disciplinary] orientation (i.e., those who see the value in working with others and integrating ideas across disciplines) are found to be more closely linked to others in their research networks, and more often serve as brokers (Okamoto, Centers for Population, & Health Disparities Evaluation Working, 2015). Furthermore, they participate in more CD collaborative activities, have more collaborators, report better collaborative productivity, and often garner more institutional resources (Hall et al., 2008; Vogel et al, 2014). In turn, scientists possessing a CD orientation are found to produce more creative and CD publications with greater anticipated translational impact (Misra et al., 2015).

The notion that faculty’s “cross-disciplinary orientation” and “values” contribute to their engagement in effective team science and IDR thus suggests that these affective and interpersonal aspects of individuals have a role to play in nurturing—and in turn being nurtured by—IDR engagement. As may seem obvious, they are also related to intellectual virtue.

Why Virtue?

In recent decades, the study of “virtues” has burgeoned primarily in the fields of human behavior and psychology (e.g., Fowers, Carroll et al. 2021). In exploring how to foster individuals’ moral decision-making, trustworthiness and propensity for cooperation (among other desirable behaviors), scholarly work on virtue—related to but distinct from “good character”—posits it as a key mechanism (Peterson 2004).

Defined broadly as “a stable, well-motivated disposition to act in self- and other-benefitting ways on the basis of knowledge about those actions” (Fowers, Carroll et al. 2021), “virtue” is thus proffered as uniquely moralistic and capable of intentional development (Peterson 2004, McAdams 2015). Though most commonly described as individualistic traits, virtues may be cultivated within individuals through “well-designed, structured interventions in the family, in schools, in workplaces, and in other settings” (Fowers, Carroll et al. 2021) To this end, and in light of the polarization of society and knowledge, the aim to instill virtues in students via “virtues education” has recently gained popularity, particularly in higher education (Orona, Pritchard et al. 2024).

Work on virtue traits (e.g., *justice, curiosity*) frames them as desirable both within individuals, fostering their soft skills, reflective thinking, personal flourishing and “prosocial” behaviors (Keltner, Kogan et al. 2014). Prosociality, in turn, is found to positively shape communities and other groups as well as improving the lives of individuals who endorse it (Crocker, Canevello et al. 2017). For these and other reasons, efforts to assess the prevalence, precursors and outcomes of virtues across communities of knowledge and practice has gained increasing empirical attention.

In education—comprising teaching, learning and knowledge creation in both K-12 and postsecondary contexts—the presence of and development of various virtues has proved a scholarly focal point. This includes an emphasis on the so-called “intellectual virtues”—*curiosity*, *humility*, *integrity* and more (Orona, Pritchard et al. 2024). For teaching and learning, “good teachers,” who may be expected to “exemplify a set of virtues which they demonstrate through personal example” and instill in their young charges (Arthur, Kristjánsson et al. 2015). For knowledge creation, the emerging study of *intellectual humility*, also related to *humility in inquiry*, spans “psychology and philosophy with overlaps in the science of science due to the role of humility in scientific inquiry.”

[Humility of inquiry] grew out of the study of intellectual humility, a branch of research focusing on the nature, function, and impacts of humble thought and action. [Humility in inquiry] is of practical interest because reducing intellectual arrogance counters misinformation and polarization. (Bratt, Leahey et al. 2024)

In particular relation to faculty and the traditional collegiate work of teaching, research and service, empirical research suggests that faculty with desirable intellectual virtues such as *intellectual humility* may:

* Serve as strong exemplars for postsecondary students at a critical life stage of character development (e.g., Arthur, Kristjánsson et al. 2015, Orona, Pritchard et al. 2024);
* Produce “Servant Research,” which aims to “serve others by understanding individuals and communities and designing, implementing, and disseminating research that will create meaningful change that will ultimately improve the lives of the people being researched” (Granello 2024);
* Contribute to the “positive university” climate through their approach to research and knowledge (Oades, Robinson et al. 2014); and
* Be less intellectually arrogant, more openminded, and more oriented toward cross-disciplinary engagement, leading to numerous benefits observed within the science of team science (Hall, Vogel et al. 2018, Ballantyne 2023, Bland 2024).

Conclusion

The preceding literature review suggests suggest a likely connection between IDR and intellectual virtues, centrally *intellectual humility*, that has heretofore been unexplored. Because HEOs have demonstrated the ability (or at least fervent desire) to facilitate IDR, they may also consider how doing so can aid or be aided by the framework of intellectual virtue development. Together, significant IDR engagement and the potentially correspondent “virtuous professors” who undertake it may thus achieve multiple strategic goals for HEOs while also bettering individuals, communities and an increasing skeptical world.

**Instrumentation: Measuring Intellectual Virtues and IDR Support and Engagement**

We report on two studies in this paper, both utilizing measures of intellectual virtues and IDR support and engagement. Virtues more broadly, and intellectual virtues in particular, are most commonly measured via self-report (Fowers, Carroll et al. 2021). As part of a Virtue Identification Scale developed within a larger grant-funded project on the impact of social norms on virtue, the two studies presented here utilized an abbreviated scale assessing faculty’s self-reported endorsement of three intellectual virtues most germane to IDR engagement: *collaboration*, *curiosity* and *intellectual humility*. We refer to this instrument as the Abbreviated Intellectual Virtue Identification Scale (A-IVIS).

Measuring Intellectual Virtues

We modified the A-IVIS slightly between Study 1 and Study 2. Both formats of the scale provided a dictionary definition of each virtue prior to its related response items:

* *Collaboration:* Working with others in a purposeful relationship to accomplish a shared outcome
* *Curiosity:* Demonstrating the desire to obtain information
* *Intellectual humility:* Accepting the limits of one’s experience or knowledge

*A-IVIS: Study 1 Format*

For Study 1, the A-IVIS comprised three items through which respondents endorsed each intellectual virtue:

* *I see myself as a person who demonstrates [virtue].*
* *I want to demonstrate [virtue].*
* *I want others to see me as having [virtue].*

Responses were recorded on a 7-point Likert scale (1 = strongly disagree, 7 = strongly agree). We estimated the average of the three items for each virtue, and each composite was reliable (*a*curiosity = 0.83, *a*int.humility = 0.86, *a*collaboration = 0.92).

*A-IVIS: Study 2 Modifications*

For Study 2, the modified A-IVIS comprised only one item through which respondents endorsed each intellectual virtue on the same Likert scale: *I see myself as a person who demonstrates [virtue].* This item was answered for *collaboration* (M = 6.40, SD = 0.85), *curiosity* (M = 6.54, SD = 0.64), *intellectual humility* (M = 6.20, SD = 0.84), *patience* (M = 5.62, SD = 1.20) and *loyalty* (M = 5.82, SD = 1.20). We additionally included four items capturing specific dimensions of intellectual humility. Two captured *intellectual overconfidence* (Krumrei-Mancuso and Rouse 2016): *My ideas are usually better than other people’s ideas* and *For the most part, others have more to learn from me than I have to learn from them* (*a* = 0.71).

Two others captured *actively open-minded thinking* (Haran, Ritov et al. 2013): *It is important to be loyal to your beliefs even when evidence is brought to bear against them* and *Whether something feels true is more important than evidence* (*a* = 0.73).

Measuring IDR Engagement and Support

We assessed interdisciplinary engagement in a similar way for each study, via one multiple-select item about respondent behavior in the past 12 months (Study 1) and in the past 24 months (Study 2). Respondents were asked whether they had:

1. *Published a paper in an interdisciplinary journal* (Study 1 & 2)
2. *Submitted an abstract to an interdisciplinary conference* (Study 1 & 2)
3. *Attended interdisciplinary (virtual or in-person) events or talks at your university* (Study 1 & 2)
4. *Applied to an interdisciplinary grant opportunity from an external organization* (Study 1 only)
5. *Read interdisciplinary scholarly literature* (Study 1 & 2)
6. *Attended interdisciplinary (virtual or in-person) events or talks outside of your university* **(Study 1 only)**
7. *Gave a talk to an interdisciplinary audience/department (*Study 1 & 2)

A sum score of these items (7 in Study 1, 5 in Study 2) resulted in an index of interdisciplinary engagement ranging from 0 (engagement in *no* activities) to 7/5 (engagement in *all* activities). We further measured support for interdisciplinarity by averaging responses for 4 items detailing different types of support (e.g., *I would support an interdisciplinary hire in my department*; *a* = 0.84), again using a 7-point Likert scale.

Other Measures

Finally, for exploratory analyses in both studies we also assessed how much faculty reported enjoying their research (i.e., *I am enjoying the research I have been conducting recently*). As with our other endorsement measures, responses for research enjoyment were recorded on a 7-point Likert scale (1 = strongly disagree, 7 = strongly agree). We also included two control virtues, *patience* and *loyalty*, to validate our focus on intellectual virtues, as well as included an additional alternative measure of *intellectual humility*.

**Study 1: Research Questions, Methods and Findings**

We undertook Study 1 with the overall goal of probing relations between faculty’s endorsement of three intellectual virtues—*collaboration*, *curiosity* and *intellectual humility—*and their engagement in and/or support for collaborative IDR at one HEO. Below, we describe the research questions, methods and analytic methods and findings of Study 1.

Research Questions

Study 1 addressed four interrelated research questions. First, to what extent do faculty endorse the intellectual virtues of *collaboration*, *curiosity* and *intellectual humility*? Second, to what extent do faculty engage in and/or support collaborative IDR? Third, what relation, if any, exists between faculty’s endorsement of intellectual virtues and engagement in and/or support of collaborative IDR? And fourth, does receipt of an internal collaborative IDR grant (see more details on grant program characteristics below) increase endorsement of the focal virtues as well as support for such collaboration?

Methods

Using the A-IVIS as described above, we surveyed all full-time faculty (FTF) at IDR-U (a pseudonym). IDR-U is a large, PhD-granting HEO in the Northeast U.S with an institution-level collaborative IDR grant program through which recipients are required to collaborate with at least one faculty member from another department or with an external organization (e.g., non-profit) to produce IDR.[[1]](#footnote-1) To ensure an adequate sample, particularly regarding faculty who had applied for and/or received a grant, we solicited survey responses longitudinally over three years. Across this period, 566 total FTF responded to an email to complete the survey. We limited demographic data collection to ensure participant anonymity. Our final Study 1 sample comprised 149 FTF (27%) with fewer than 10 years of experience, 159 (29%) with 11-20 years, 107 (19%) with 21-30 years and 139 (25%) with 31 years of experience in the academy. 178 respondents (32%) were employed as faculty within a “professions” field, 239 (43%) in the humanities and social sciences, 125 (23%) in the applied and basic sciences, and 12 (2%) in another academic field. 56 (10%) had received an internal collaborative IDR grant at IDR-U.

We then used *Prolific,* an online crowdsourcing website, to recruit a sample of employed adults for comparative analyses. We screened 801 respondents into two groups, one of respondents holding a graduate and/or professional degree (N = 390, 50% female, 49% male, 74% White American, Mage = 46.99, SDage = 13.38) and the other of respondents holding less than a graduate degree (N = 411, 49% female, 49% male, 75% White, Mage = 45.52, SDage = 12.06).

Analysis and Findings

Sensitivity analyses run with G\*power 3.1.9.7 (Faul, Erdfelder et al. 2007) for two-tailed tests, with power of .80, suggested that we could meaningfully detect effect sizes as small as r = 0.12 for correlations, Cohen’s dz of 0.14 for paired sample t-tests, and Cohen’s dz of 0.43 for independent sample t-tests, for our comparisons with the smallest sample size. We present our findings below.

*RQ1: Faculty Endorsement of Focal Virtues*

In addressing RQ1, on faculty’s endorsement of intellectual virtues, we conducted six independent sample t-tests and compared endorsement of these virtues on the A-IVIS among three groups: IDR-U faculty, other *highly educated* individuals (i.e., those holding a graduate or professional degree) and other *moderately educated* individuals (i.e., those holding *less than* a graduate/professional degree).

IDR-U faculty endorsed all virtues to a relatively high degree, with average scores close to 6 out of 7 on the 7-point Likert scale (see Table 1). Of our three focal intellectual virtues, *curiosity* was most highly endorsed, with significantly higher endorsement than *collaboration* (t(560) = 2.37, *p* = .018, *d* = 0.10) and *intellectual humility* (t(560) = 5.89, *p* < .001, *d* = 0.25). *Intellectual humility* was endorsed least, with *collaboration* being endorsed significantly more (t(560) = 2.94, *p* = .003, *d* = 0.12). Our *Prolific* sample responded only to the 3-item virtue measures (*a*curiosity = 0.84, *a*int.humility = 0.89, *a*collaboration = 0.91) identical to the main study. For each of the three virtues, IDR-U faculty scored significantly higher than both groups.

INSERT TABLE 1

*RQ2: Faculty Support for IDR*

In addressing RQ2, on faculty’s engagement in and support for collaborative IDR, we descriptively analyzed survey responses about faculty’s IDR activities within the last 12 months. As Figure 1 shows, IDR-U faculty exhibited high engagement in and support for collaborative IDR activities. Over half of respondents reported *attendance at IDR-U internal and external IDR-related events*, *giving talks at departments/academic events outside of their primary discipline,* and *reading interdisciplinary research*. A lesser but still somewhat large proportion of respondents reported *publishing a paper in an interdisciplinary journal* (40%), *submitting an abstract to an interdisciplinary conference* (33%), and *applying for an external interdisciplinary grant* (25%).

INSERT FIGURE 1

*RQ3: Relation Between Virtue Endorsement and Support for IDR*

In addressing RQ3, on what relation, if any, exists between faculty’s endorsement of the specified intellectual virtues and engagement in and/or support for collaborative IDR, we estimated bivariate correlations between the measures of interest. We found that each of the three virtues correlated positively (albeit weakly for some) with both the extent of faculty’s support for IDR and the extent to which faculty enjoyed their research. However, only *collaboration* correlated with engagement in collaborative IDR (see Table 2).

INSERT TABLE 2

*RQ4: IDR Grant Receipt and Virtue Endorsement*

In addressing RQ4, on whether receipt of a collaborative IDR grant increased endorsement of the focal virtues as well as interdisciplinary support, we conducted independent sample t-tests comparing the two groups. As summarized in Table 3, IDR-U faculty who received an internal grant for collaborative IDR endorsed the three focal virtues, evinced interdisciplinary academic behaviors and reported enjoying their research at significantly higher rates than comparison groups. Further, these faculty reported more support for interdisciplinarity and were more likely to report that *their department and university would benefit from it*, support *interdisciplinary hires in their department*, and consider *IDR essential for “transformative” science*. We found a non-significant effect for the belief that collaborative IDR is useful for addressing complex societal problems. Notably however, a trend was noted, as this effect was small in magnitude and in the expected direction. Overall, across all outcomes, scores by faculty illustrate that they deeply value IDR, and see its value for society.

INSERT TABLE 3

Study 1: Conclusion

Our findings in Study 1 illustrate that FTF at IDR-U endorse the intellectual virtues of *collaboration*, *curiosity* and *intellectual humility* to a high degree and significantly more so than two comparison groups with varying educational attainment. These virtues correspond significantly with IDR engagement, research enjoyment and, to some degree, support for collaborative IDR. Notably, faculty who have received an internal grant for collaborative IDR evince higher levels of all virtues. This suggests the provision of internal funding for collaborative IDR as a potential mechanism for fostering intellectual virtues, increasing faculty enjoyment of research and, relatedly, cultivating an IDR-friendly and intellectually virtuous campus climate. Finally, a key and consistent result was the high levels of support for IDR engagement, and that faculty appear to agree on the potential merits of IDR for the betterment of society.

**Study 2: Research Questions, Methods and Findings**

We undertook Study 2 with the overall goal of increasing the generalizability of our Study 1 results through conceptual replication among institutions other than IDR-U. With the exception of revisions to the A-IVIS instrument as noted in *Measuring Virtue*, above, our research questions and methods mirrored those of Study 1. Thus, below we briefly describe our methods (with a focus on sampling) before discussing our findings, framed by the same research questions outlined in Study 1.

Methods

During Fall 2023, we recruited 239 FTF from other HEOs within the same athletic conference as IDR-U via various methods (e.g., emails, listservs, etc.). Again, we limited demographic data collection to ensure participant anonymity. Our final Study 2 sample comprised 30 FTF (12%) who did not report their years of experience, 72 (30%) with fewer than 10, 61 (25%) with 11-20, 47 (20%) with 21-30, and 29 (12%) with over 31 years of experience in the academy. 30 (12%) did not report the field of their academic employment, 24 (10%) were employed in the professions, 25 (10%) in humanities and social sciences, 64 (27%) in applied and basic sciences, 64 (7%) in social sciences and 32 (13%) in another discipline.

Analysis and Results

Sensitivity analyses run with G\*power 3.1.9.7. (Faul et al., 2007) for two-tailed tests, with power of .80, suggested that we could meaningfully detect effect sizes as small as r = 0.19 for correlations, Cohen’s dz of 0.19 for paired sample t-tests, and Cohen’s dz of 0.38 for independent sample t-tests, for our comparisons with the smallest sample size.

*RQ1: Faculty Endorsement of Focal Virtues*

As indicated in Table 4, faculty in this broader sample endorsed our three focal virtues at significantly higher rates than the control virtues of *patience* and *loyalty*. *Curiosity* was endorsed the most, followed by *collaboration* and *intellectual humility*. These findings directly replicate our results from Study 1.

INSERT TABLE 4

*RQ2: Faculty Support for IDR*

Our broader Study 2 sample evinced largely similar patterns of IDR engagement across all respondents, bolstering the generalizability for our initial findings from Study 1 (see Figure 2). In fact, looking across fields and career stage we see similar patterns (see Figures S1-S8 in the Supplemental Online Materials[[2]](#footnote-2)).

INSERT FIGURE 2

*RQ3: Relation Between Virtue Endorsement and Support for IDR*

These faculty’s endorsement of *curiosity* related to greater engagement in IDR-related activities as well as greater research enjoyment, a finding also observed for *intellectual humility* (see Table 5). Further, endorsement of *collaboration* corresponded with increased support for interdisciplinary hires as well as for the belief that collaborative IDR is essential for transformative science. Correlations between *intellectual overconfidence* and *actively open-minded thinking* were mostly nonsignificant, except for *actively open-minded thinking* and increased engagement in IDR-related activities.

INSERT TABLE 5

*RQ4: IDR Grant Receipt and Virtue Endorsement*

Participants self-reported their involvement in IDR funding programs as a Principal Investigator or co-PI/co-I in the last 24 months; we coded them as “1” if they had received an IDR grant (N = 110) and “0” if they had not (N = 103). We compared these two groups on all focal outcomes while expecting potentially weaker results than observed in Study 1 due to (a) greater variety regarding the nature/scope and size of the grant(s) received, (b) the ability to be coded as 1 whether serving as a PI *or* co-PI, and (c) a longer period of time (i.e., 2 years) during which they could have received a grant.

Study 2: Conclusion

Our findings in Study 2 largely replicated those from Study 1. Although significant differences for the effect of IDR grants on virtues were either approaching (*p* = .050 for *collaboration*) or not statistically significant (*curiosity* and *intellectual humility*), observed trends were in the expected direction. Effects on IDR engagement, research enjoyment, support for interdisciplinary hires and the belief that collaborative IDR is essential for transformative science directly replicated findings from Study 1, as those respondents who’d received a grant scored significantly higher. Among the two facets of *intellectual humility*, significant differences in the expected direction were observed for *actively open-minded thinking* but not for *intellectual overconfidence*.

INSERT TABLE 6

**Studies 1 & 2: Meta-Analytic Findings**

In line with recommendations to conduct internal meta-analyses of findings across studies and employing the methodology suggested for such approaches (Goh et al., 2016), we conducted an internal meta-analysis to compare faculty who had and had not received a collaborative IDR grant for similar outcomes across studies (see Table 7). For all outcomes, a significant overall effect was observed, suggesting robustness in our findings. Effect sizes ranged from as small as *d* = 0.31 to as large as *d* = 0.87.

INSERT TABLE 7

**Discussion and Conclusion**

This work highlights the positive association between interdisciplinary engagement and a host of intellectual virtues for faculty—*curiosity*, *intellectual humility*, and *collaboration*. A central finding of our studies is that receiving an internal grant for collaborative IDR work corresponds with a significant increase in faculty’s endorsement of these values. This and our additional findings provide XXX contributions to the study and practice of IDR on U.S. university campuses. First, our conclusions may hearten supporters of IDR and help to advance their efforts to both gain institutional support for IDR work and “win hearts and minds” of faculty who are either skeptical or face significant barriers to participation. Framing IDR’s benefits through the lens of intellectual virtue and humility—themselves foundationally philosophical concepts—may particularly improve IDR-related outreach to scholars in the humanities, arts and social sciences, who may historically have found themselves sidelined in STEM-heavy discussions of team science and interdisciplinarity. In light of efforts to combat misinformation and scientific distrust as well as nourish a connected, collegial and collaborative scholarly community (Hall, Vogel et al. 2018), our conclusion that IDR and intellectual humility can cultivate each other can add to the already-rich list of reasons (e.g., innovation, creativity, transformation) to support IDR (Holley 2009).

Second, this work expands on the quickly burgeoning scholarship of intellectual virtue and humility of inquiry by considering specific activities in which it is found and/or created: specifically, IDR. Because the central administrations of HEOs necessarily play outsized roles (relative to other academic inititiatives) in encouraging IDR across traditional academic disciplinary and departmental structures (e.g., Jacobs 2014), this suggests that they, too, can and should play a large role in realizing their campuses as “humbling environments” (Bland 2024). Simply put, our work supports the notion of IDR as an institutional lever that may promote open-mindedness and humble inquiry in addition to the other benefits—increased prominence, grant funding, etc.—that prior research has already found flows from IDR.

For practice and policy, then, our work suggests tangible benefits to increased funding for collaborative IDR in addition to and, in fact, beyond what has been previously observed (e.g., Leahey, Beckman et al. 2017, Leahey and Barringer 2020). This finding complements that of recent work exploring more holistic benefits of interdisciplinarity for faculty and campus communities, including the notion that faculty’s participation in interdisciplinary service can increase their joy, collegiality and sense of belonging at their home HEO (Pryor & Steinberg, 2023). The findings of the studies presented here thus suggest that more IDR, nourished by HEOs’ strategic initiatives including grant funding programs, can correspond with the broad presence of desirable intellectual virtues and a campus culture of intellectual openness.

For scholarship, the correlational analyses in our studies merely scratch the surface of potential positive associations between IDR, campus initiatives aimed toward it and faculty and campus values. While significant prior literature explores the impact of interdisciplinary and collaborative engagement on metrics such as grant attainment, publication count, citation frequency and others (e.g., Curran et al., 2020; Leahey et al., 2017), this work sets the stage to extend holistic exploration of the individual, interpersonal and community-wide impacts of interdisciplinarity. Future research in this area should continue to push these bounds—as some already has for the impact of interdisciplinary learning on students’ critical thinking, sense of curiosity, and “twenty-first century” knowledge attainment. How else might IDR help cultivate a higher education culture that is more humble, more open and more curious?

**Tables and Figures**

Table 1.T-tests, means and standard deviations for the three virtues for the faculty members and the comparison groups.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | Group 1 | Group 2 |
| Group 1 | Group 2 | Virtue | t-test | Cohen's *d* | M | SD | M | SD |
| Faculty members | Graduate/Professional Degree Holders | Collaboration | t(954) = 4.89\*\*\* | 0.32 | 6.06 | 1.11 | 5.71 | 1.05 |
| Faculty members | Graduate/Professional Degrees Holders | Curiosity | t(954) = 6.61\*\*\* | 0.44 | 6.16 | 0.96 | 5.75 | 0.97 |
| Faculty members | Graduate/Professional Degrees Holders | Intellectual Humility | t(951) = 5.31\*\*\* | 0.35 | 5.93 | 1.04 | 5.55 | 1.13 |
| Faculty members | Individuals with less than a graduate education | Collaboration | t(975) = 7.56\*\*\* | 0.49 | 6.06 | 1.11 | 5.51 | 1.13 |
| Faculty members | Individuals with less than a graduate education | Curiosity | t(830.46) = 8.19\*\*\* | 0.53 | 6.16 | 0.96 | 5.63 | 1.06 |
| Faculty members | Individuals with less than a graduate education | Intellectual Humility | t(972) = 6.43\*\*\* | 0.41 | 5.93 | 1.04 | 5.48 | 1.11 |

**Note.** \* *p* < .05, \*\*\* *p* < .01, \*\*\* *p* < .001.

Table 2.Bivariate correlations between all measures for faculty members in Study 1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Measure | 1 | 2 | 3 | 4 | 5 | 6 |
| 1. Collaboration | -- |  |  |  |  |  |
| 2. Curiosity | 0.44\*\*\* | -- |  |  |  |  |
| 3. Intellectual Humility | 0.47\*\*\* | 0.51\*\*\* | -- |  |  |  |
| 4. Interdisciplinary Engagement | 0.16\*\* | 0.08 | -0.02 | -- |  |  |
| 5. Enjoyment of Research | 0.19\*\*\* | 0.10\* | 0.12\*\* | 0.24\*\*\* | -- |  |
| 6. Support for Interdisciplinarity | 0.38\*\*\* | 0.14\*\* | 0.20\*\*\* | 0.15\*\* | 0.31\*\*\* | -- |

**Note.** \* *p* < .05, \*\*\* *p* < .01, \*\*\* *p* < .001.

Table 3. Differences for faculty who received or did not receive an internal interdisciplinary collaborative research grant

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  | Faculty who received grant | Faculty who did not receive grant |
| Outcome | t-test | Cohen's d | M | SD | N | M | SD | N |
| Collaboration | t(112.79) = 5.38\*\*\* | 0.55 | 6.51 | 0.56 | 56 | 6.02 | 1.13 | 504 |
| Curiosity | t(103.62) = 5.06\*\*\* | 0.53 | 6.55 | 0.53 | 56 | 6.13 | 0.99 | 503 |
| Intellectual Humility | t(88.72) = 4.35\*\*\* | 0.50 | 6.33 | 0.67 | 56 | 5.89 | 1.06 | 503 |
| Number of interdisciplinary academic behaviors | t(429) = 3.45\*\*\* | 0.55 | 4.29 | 1.40 | 49 | 3.48 | 1.56 | 382 |
| Enjoying one's research | t(74.46) = 2.79\*\* | 0.37 | 6.49 | 0.77 | 49 | 6.15 | 1.05 | 366 |
| I think that interdisciplinary collaboration is essential for science to be transformative | t(417) = 2.17\*\*\* | 0.36 | 6.33 | 1.11 | 49 | 5.89 | 1.35 | 370 |
| Departments and universities really benefit from interdisciplinary collaboration | t(85.23) = 2.67\*\* | 0.33 | 6.49 | 0.68 | 49 | 6.19 | 1.10 | 371 |
| Support an interdisciplinary hire in one's department | t(418) = 1.97\* | 0.31 | 6.33 | 1.18 | 49 | 5.94 | 1.31 | 371 |
| Interdisciplinary collaboration is a good way to address complex societal problems | t(74.15) = 1.24 | 0.17 | 6.49 | 0.71 | 49 | 6.35 | 0.97 | 372 |

**Note**. \**p* < .05, \*\**p* < .01, \*\*\**p* < .001. Support for interdisciplinarity was examined separately for each item.

Table 4. Within subject comparison of endorsement of the five virtues

|  |  |  |  |
| --- | --- | --- | --- |
| Virtue #1(Reference Group) | Virtue #2(Comparison Group) | Paired samples t-test | Cohen's *d* |
| Collaboration | Loyalty | t(217) = 6.54\*\*\* | 0.44 |
| Intellectual humility | Loyalty | t(217) = 4.26\*\*\* | 0.29 |
| Curiosity | Loyalty | t(217) =7.97\*\*\* | 0.54 |
| Collaboration | Patience | t(218) =8.44\*\*\* | 0.57 |
| Intellectual humility | Patience | t(217) =6.46\*\*\* | 0.44 |
| Curiosity | Patience | t(217) =10.12\*\*\* | 0.69 |
| Curiosity | Intellectual humility | t(217) =5.18\*\*\* | 0.35 |
| Collaboration | Intellectual humility | t(217) =3.02\*\* | 0.20 |
| Curiosity | Collaboration | t(217) =2.08\* | 0.14 |

**Note**. \**p* < .05, \*\**p* < .01, \*\*\**p* < .001.

Table 5. Correlations between the three focal virtues, the two facets of intellectual humility and all outcomes

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Measure | Collaboration | Curiosity | Intellectual Humility | Intellectual overconfidence | Actively open-minded thinking |
| Number of interdisciplinary academic behaviors | 0.04 | **0.15\*** | 0.00 | 0.06 | **0.17\*** |
| Enjoying one's research | 0.13 | **0.27\*\*\*** | **0.19\*\*** | -0.03 | 0.06 |
| Support an interdisciplinary hire in one's department | **0.20\*\*** | 0.06 | 0.12 | -0.12 | 0.01 |
| I think that interdisciplinary collaboration is essential for science to be transformative | **0.28\*\*\*** | -0.01 | 0.11 | -0.08 | 0.11 |

**Note**. \**p* < .05, \*\**p* < .01, \*\*\**p* < .001.

Table 6. Comparison of faculty who received and did not

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  |  | Faculty who received grant(N = 110) | Faculty who did not receive grant(N = 103) |
| Outcome | t-test | Cohen's *d* | M | SD | M | SD |
| Collaboration | t(196.75) = 1.93† | 0.26 | 6.51 | 0.71 | 6.29 | 0.97 |
| Curiosity | t(216) = 1.27 | 0.17 | 6.59 | 0.61 | 6.48 | 0.66 |
| Intellectual Humility | t(216) = 1.17 | 0.15 | 6.26 | 0.76 | 6.13 | 0.92 |
| Intellectual Overconfidence | t(206.62) = -1.18 | 0.16 | 3.40 | 1.18 | 3.57 | 0.95 |
| Actively Open-Minded Thinking | t(196.89) = 2.43\* | 0.32 | 6.15 | 0.99 | 5.78 | 1.24 |
| Number of interdisciplinary academic behaviors | t(228) = 9.52\*\*\* | 1.22 | 3.79 | 1.09 | 2.14 | 1.57 |
| Enjoying one's research | t(211) = 2.99\*\* | 0.41 | 6.32 | 0.99 | 5.88 | 1.13 |
| I think that interdisciplinary collaboration is essential for science to be transformative | t(211) = 1.97\* | 0.27 | 6.31 | 1.18 | 5.98 | 1.25 |
| Support an interdisciplinary hire in one's department | t(211) = 2.73\*\* | 0.37 | 6.28 | 1.15 | 5.81 | 1.39 |

**Note.** † *p* = .05, \* *p* < .05, \*\* *p* < .01, \*\*\* *p* < .001.

Table 7. Internal meta analyses, Studies 1 and 2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Outcome | *Mean d* | *Z* | *p* | 95% C.I. |
| Collaboration | 0.40 | 4.06 | <.001 | 0.21 | 0.59 |
| Curiosity | 0.34 | 3.49 | <.001 | 0.15 | 0.54 |
| Intellectual Humility | 0.32 | 3.24 | .001 | 0.13 | 0.51 |
| Number of interdisciplinary academic behaviors | 0.87 | 8.44 | <.001 | 0.67 | 1.07 |
| Enjoying one's research | 0.39 | 3.95 | <.001 | 0.20 | 0.58 |
| I think that interdisciplinary collaboration is essential for science to be transformative | 0.31 | 3.18 | .001 | 0.12 | 0.51 |
| Support an interdisciplinary hire in one's department | 0.34 | 3.45 | <.001 | 0.15 | 0.53 |

******Figure 1. Patterns of interdisciplinary research engagement by academic faculty

****Figure 2.Patterns of interdisciplinary research engagement by academic faculty across all participating institutions

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1. In addition to requiring that grant proposals were authored by at least two faculty from different departments and/or involved the collaboration of an external organization, IDR-U’s grant program also requires a focus in particular topical areas (e.g., health). Grants are awarded in both smaller ($15K) and larger ($50K) amounts. [↑](#footnote-ref-1)
2. Supplementary Online Materials can be found online at Supplementary materials can be found online at <https://www.bc.edu/content/bc-web/centers/schiller-institute/research/schiller-reports.html#tab-interdisciplinarity_in_the_academy>. [↑](#footnote-ref-2)