# Finding Levers for Organizational Change in Postsecondary Education: Development and Validation of the Survey of Climate for Instructional Improvement (SCII)

Emily M. Walter[1], Andrea L. Beach[2, 3], Charles Henderson[2, 4], Cody R. Williams[5], and Ivan Ceballos-Madrigal[1]

[1] Department of Biology, California State University, Fresno

[2] Center on Research in Institutional Change in Postsecondary Education (CRICPE), Western Michigan University

[3] Department of Educational Leadership, Research, and Technology, Western Michigan University

[4] Mallinson Institute of Science Education, Western Michigan University

[5] Science and Mathematics Program Improvement (SAMPI), Western Michigan University

## INTRODUCTION

Reforming undergraduate STEM education is a strategic imperative in the 21$^{st}$ century (e.g. President's Council of Advisors on Science and Technology, 2012; National Science and Technology Council [NSTC], 2018). Postsecondary STEM instructors are often familiar with calls for change; that is, they know they should lecture less and do more active learning (Freeman et al., 2014). They also often have access to the resources needed to do these practices (Henderson, Beach, & Finkelstein, 2012). Despite this, adoption of active learning is not widespread. Around 50-75% of North American STEM professors exclusively lecture (Stains et al., 2018).

Low implementation of active learning in STEM higher education is caused in part by poor design of pedagogical reforms. Many are designed without consideration of the conditions necessary for systemic reform (Henderson, Beach, & Finkelstein, 2011). Although there is a need to encourage individual instructors to change their practice, there is also a need for a systems-based approach. This approach allows for the social and organizational landscape in which faculty operate to be considered, measured, and ultimately changed (Austin, 2011; Kezar, 2011; Trowler, 2008; Beach, Henderson, & Finkelstein, 2012; Henderson et al., 2011).

The purpose of this paper is two-fold. We begin by describing the conceptual foundations and survey development for a novel survey to measure organizational climate for instructional improvement. The Survey of Climate for Instructional Improvement (SCII; pronounced "ski"), is reliable, interdisciplinary (including STEM and non-STEM disciplines), and elicits a range of systemic features related to improving teaching. In this paper, we also explore SCII results from 6 sampled institutions of higher education, nest these results within related research in STEM and higher education research and propose ongoing work to support broader implementation of teaching reform efforts.

## BACKGROUND AND CONCEPTUAL FRAMEWORK

### *Defining the Phenomenon of Interest*

As we began to develop our survey, we sought literature to define our phenomenon of interest. Operationalizing the phenomenon required us to (a) outline the distinctions between culture and climate, (b) separate organizational and psychological climate, and (c) dive into existing conceptual frameworks to outline how we could describe the environment in which faculty operate. Lastly, the reader should note that our phenomenon, *organizational climate for instructional improvement*, is not the same thing as *campus climate* (e.g. Austin, 1993). Campus climate is the current attitudes, behaviors, and standards of faculty, staff, administrators, and students concerning the level of respect for individual needs, abilities and potential (UC Berkeley, 2018). Campus climate is focused how universities treat particular groups of people and is not specifically related to this study. Rather, we study organizational climate for instructional improvement, which we operationalize in the following sub-sections.

*Climate and Culture.* We begin by distinguishing between organizational *climate* and *culture* in pursuit of operationalizing what we mean by 'academic environments.' Many definitions of culture and climate exist, and the subject of their designation has been a topic of debate (see review in Ashkenazy, Wilderom, & Peterson, 2001). The primary conclusion of these debates is that climate and culture are complementary and overlapping ideas that are distinguishable from one another (Ashkenazy et al., 2001). *Culture* of an organization is its deeply instilled values, beliefs, myths, and rituals (Corbo, Reinholz, Dancy, Deetz, & Finkelstein, 2016). Culture is embedded and enduring, taking cataclysmic, long-term, and/or intensive efforts to change (Peterson & Spencer, 1990). In contrast, *climate* of an organization is the “shared, subjective experiences of organizational members that have important consequences for organizational functioning and performance” (Ashkenazy, Wilderom, & Peterson, 2001, p. 1). Climate includes the current patterns or atmosphere of an organization and is considered more malleable to change than culture (Peterson & Spencer, 1990). The concepts of climate and culture overlap in that the perceptions, attitudes, and behaviors of a group (climate) reflect the deeply rooted values and beliefs of that group (culture). Another way of thinking about this is that what people do and how people think about on a daily basis (climate) is influenced by norms and values of the groups in which they belong (culture). As change agents ourselves, we were less interested in slow-to-change values and beliefs and more interested in identifying easy-to-change organizational conditions. We therefore focus our study on *climate*.

*Psychological Climate and Organizational Climate.* Climate can be considered as an individual, psychological construct or as a property of an organization (Kozlowski & Klein, 2000) - given that individual perceptions are aggregated and consensus can be demonstrated (Dansereau & Alluto, 1990; James, Demaree & Wolf, 1993; James & Jones, 1974; Kozlowski & Hults, 1987). Returning to the overarching research problem, we recognize that individual approaches to change are important. However, they are not sufficient for change in STEM higher education (Henderson et al., 2011. Austin, 2011; Kezar, 2011; Trowler, 2008). Given the need to look at the organization, we narrowed the study to look at organizational climate. Organizational climate includes perceptions of current organizational elements (e.g., patterns of relationships, atmosphere, organizational structures) that have the potential to influence attitudes and behaviors

(Peterson & Spencer, 1990; Schneider, 1975, Schneider & Reichers, 1983; Schneider et al., 2013).

*Narrowing Organizational Climate to Faculty Teaching.* Since organizational climate can operate on different organizational levels (Kozlowski & Klein, 2000), it is most useful when focused on specific outcomes – "climate for something" (Schneider, 1975). In our case, we were interested in climate for *instructional improvement*, which we define as the action or process of making changes in instruction with the goal of achieving the best possible learning outcomes. This includes the introduction or continued use of reform-based instructional strategies, technologies, and/or curricula. Specifically, within an academic organization, the department is a key leveraging point for change (e.g. Braxton & Bayer, 1999; Colbeck, Cabrera, & Terenzini, 2001; Wieman, Perkins, & Gilbert, 2010). We there set out to design an instrument that elicited organizational climate for instructional improvement in postsecondary settings. The items within our instrument are focused on the facets of organizational climate acting at the department level.

*Conceptual Framework*

We began to seek a conceptual framework under which we could develop survey items after operationalizing our phenomenon of interest. Organizational climate defined as "shared, subjective experiences of organizational members" was too broad for our goals. This definition did not apply enough to the complex system in which faculty teach (e.g. Austin, 2011; Kezar, 2011; Trowler, 2008). Further, there was not an existing theoretical or conceptual framework designed to measure organizational climate for instructional improvement. We therefore chose to pull from several conceptual frameworks about the faculty work experience to build our own conceptual model (Gappa, Austin, & Trice, 2007; Beach, 2002). In the end, this approach also allowed us to build empirical support for SCII items and confirm how our results relate our findings to published models.

Our conceptual framework draws from comprehensive review of postsecondary STEM education research (e.g. levers and barriers work) and higher education research literature. We began with two models from Gappa et al. (2007), including a model of the faculty work experience and a model of institutional and departmental characteristics that influence faculty. We added the construct of ‘shared perceptions about students and teaching’ (Beach, 2002) to our conceptual model, as Beach’s work attributed a large amount of variance in faculty teaching practices to these views. Using the models, we developed an initial conceptual framework for the SCII. Figure 1 describes the facets we included or excluded from our initial conceptual framework. We chose to keep aspects of a prior framework only if they were (a) reportable and observable by survey, (b) specifically related to teaching, and (c) moderated by policy or actions of the organizational members (i.e. the facet of faculty work experience measured climate and not culture).

<<Insert Figure 1 here>>

From the Gappa et al. (2007) model of Faculty Workplace Elements that affect teaching, we retained three areas: (a) academic freedom and autonomy, (b) collegiality, and (c) professional growth (which we later renamed as ‘professional development’). We excluded both *employment equity* and *flexibility*, as Gappa et al. (2007) tie these concepts to like vacation and leave time, not with teaching. We also excluded *respect* from our conceptual framework as we intended to elicit organizational climate, not culture and norms.

In our other conceptual framework of key departmental and institutional characteristics from Gappa et al., we considered six organizational characteristics that could affect faculty, including (a) governance and structure, (b) culture and norms, (c) mission, (d) leadership, (e) reward structure, and (f) resources. In our conceptual model for the SCII, we kept leadership, rewards, and resources, as these ideas were well tied to literature documenting levers and barriers to making pedagogical change (e.g. Shadle et al., 2018; Ramsden et al., 2007; Beach, 2002). Gappa et al. (2007) describe *governance and structure* as features of the school like institutional size, complexity, and history, but also shared governance, resources, and faculty reward systems. Since our leadership and resource factors overlapped with this construct, and we did not consider size or complexity of the university directly tied to instructional improvement, we did not develop items around *governance and structure*. We also removed *mission* as a construct as most institutional missions promote 'student success' and/or 'high impact practices' and we therefore did not expect variance from this construct. Lastly, we did not explicitly include *culture and norms* from the Gappa model, as our ideas were by organizational climate (that is, the actions of organization members that could change on a day-to-day or policy-driven basis).

## METHODS

### *Instrument Development*

We developed our first set items for the SCII to satisfy the seven dimensions on our initial conceptual framework. We operationalize these seven dimensions of climate for instructional improvement, including where we sourced our definitions, in Table 1. Although we anticipate that these seven dimensions can and do influence one another, did not write items to fit intersections of the dimensions. We encourage readers to explore data generated by the SCII to find predictive relationships.

We used the conceptual framework to generate the survey in three ways. First, we began by exploring seven existing instruments from STEM education, higher education, and organizational management research: Bouckenooghe et al., 2009; Beach, 2002; Deci & Ryan, 2011; Hurtado et al., 2011; Knorek, 2012; Massy et al., 1994; Ramsden et al., 2007. These instruments were chosen based given available literature in 2013, and our best attempts at an exhaustive search. We then sorted these existing survey items into our conceptual dimensions. For example, the item “Instructors in my department are regularly nominated for campus teaching awards”, from Knorek (2012), was sorted into *Rewards*. As part of the sorting process, we removed items that did not address organizational climate, had poor or awkward wording, were not applicable to all anticipated participants, and/or had redundancies from other items we had already sorted.

<<Insert Table 1 Here>>

As a secondary step in item development, we revised existing items to fit our referent groups and phenomenon of interest (instructional improvement). We chose *the department* or *department chair* as a referent, as the department is a key leveraging point for change (e.g. Braxton & Bayer, 1999; Colbeck et al., 2001; Wieman, Perkins, & Gilbert, 2010). Many of our revisions focused on changing context of items to meet higher education settings. For example, the Boukenoogh et al. (2009) survey was originally designed to measure organizational climate readiness for change, but was originally made for business settings. One item revised from their survey was item I-19, “the corporate management team consistently implements its policies in all departments.” We revised this item to be: “*the department chair* consistently implements *teaching-related policies.*”

As a final step in initial item generation, the research team wrote and revised items to the conceptual dimensions, seeking to fill potential gaps in the framework based on our knowledge of the literature. We did not seek an equal number of items per construct, but rather, a set of items that we felt measured the phenomenon without being redundant or reaching the potential for survey fatigue among participants. In particular, we had no items that fit Professional Development and few items in the Collegiality categories. These items were vetted through both content, expert, and construct validity measures which we describe as part of our *Pilot Testing.*

*Scale.* We chose a 6-point Likert style scale for items on the SCII. Statements are rated from strongly agree, agree, somewhat agree, somewhat disagree, disagree, and strongly disagree. Six-point scales are considered preferable to 4-point, as they generate better variance (Bass, Cascio, & O'Connor, 1974). We chose to have no neutral point, as forcing agreement or disagreement avoids an artificial increase in 'no opinion' responses (Bishop, 1987; Johns, 2005).

*Pilot Testing.* We field tested the instrument with five instructors from non-participating institutions and an expert panel of four education researchers from another institution prior to launching at our first institution. The pilot testing and expert panel process allowed us to evaluate items for clarity, and subsequently revise, add new items, and better define the structure and definition of each climate factor. We chose not to do additional cognitive interviews, as many of our items had been well validated on other surveys. Additionally, our external panel review suggested we were ready to pilot the survey (with their suggested revisions).

We conducted our pilot testing phase with 82 instructors at a non-participating institution. Testing allowed us to explore misfit items and refine our response scale. After this phase, we removed "I choose not to respond" as a response option, as its inclusion often resulted in respondents not answering all questions on the instrument. Instead, we now encourage users to allow participants to skip items if they so choose, and no items on the survey are forced response. There are mechanisms to do this in most online survey interfaces, and this approach allowed us both participant autonomy and a comprehensive data set. During the pilot phase, we also tried adding new items and testing to see if we could improve our factor analyses. During this period, we also determined the reliability of items that did not contribute much to the overall variance of the instrument and removed them from the SCII.

*Sampling.* We used Qualtrics to survey a convenience sample of 917 postsecondary instructors. Our sample included graduate student instructors, full-time, and part-time faculty from six institutions of higher education in the United States. Our overall response rate was 28.3% (917/3244). We include additional details about the sampled institutions in Table 2. Since we had a convenience sample of institutions and individual respondents, and we do not claim we have a representative sample of all postsecondary instructors. In particular, since we had all 4-year institutions from the United States, most of which were large enrollment, our claims are centered on what we can say about that given population. Furthermore, since this paper is seeking to develop and explore potential results from the instrument, our primary goal was to have a sufficient sample size. Since our sample size (N=917) is sufficient for the number of items on the instrument (30 items), and 10 participant cases are considered necessary each item (Garson; 2008; Everitt, 1975; Kunce, Cook, & Miller, 1975), we have triple the necessary sample for survey validation and factor analysis.

<<Insert Table 2 here>>

*Construct Validity.* We conducted both confirmatory and exploratory factor analyses after confirming our sample had an acceptable Kaiser-Meyer-Olkin measures of sample adequacy

(KMO = 0.953) and a significant Bartlett's Test of Sphericity ($\chi^2(435) = 16015.889$; $p = 0.00$). Factor analysis is a statistical technique that determines the dimensionality of an instrument (e.g. how many constructs it measures). The analysis explores relationships among items by exploring individual responses on items, how these responses relate to one another, and how subsets of items can be subsequently confirmed or generated (Knekta, Runyon, and Eddy, 2019).

As we ran factor analyses, we followed Hu and Bentler's (1995) model fit recommendations. We first ran exploratory factor analyses (EFA) to identify factors of climate using maximum-likelihood extraction with Promax rotations. We selected a maximum-likelihood approach as it allows for shared variance from the model each time a factor is created, while allowing unique variance and error variance to remain. We selected a Promax rotation as we expected some of factors to be oblique (correlated), and because oblique rotations often yield identical or superior results to orthogonal rotations (Osborne, 2015). We compared competing models (e.g., five- vs. six-dimensional model) using the likelihood ratio test under the null hypothesis that a more complex model would not improve fit significantly ($p < 0.05$).

We then completed confirmatory factor analyses (CFA) to evaluate our EFA results. We evaluated goodness of fit of hypothesized models by using the root mean square error of approximation (RMSEA; Steiger, 2000), Chi-squared/df below 5.0 (Bollen, 1989), and comparative fit index (CFI) near 0.90 (Hu & Bentler, 1999; Byrne, 2013). Guidelines vary for acceptable model fit statistics. Hu and Bentler (1995) suggest RMSEA of 0.06 for a good-fit model. MacCallum, Browne and Sugawara (1996) suggest 0.01, 0.05, and 0.08 for excellent, good, and mediocre fit models.

*Additional Analyses*. Lastly, we ran ANOVA, independent t-tests, and correlational analyses to examine differences to see in what ways SCII could identify differences in climate, and if those differences were similar to other claims in the literature.

# RESULTS

The final version of the SCII has 30 climate items, 5 supplemental questions, and 10 demographic questions. It has a very reliable with a high overall Cronbach's alpha of 0.952. We could not improve the alpha value with removal of items. Cronbach's alpha is a function of how the instrument correlates to itself (Tavakol & Dennick, 2011), and effectively documents that all items in the SCII scale measure some aspect of the same construct (Knekta et al. 2019). However, the SCII is multidimensional. Our EFA revealed five SCII factors also with good reliability (Table 3). Our results of the EFA were then confirmed using CFA (per Bandalos & Finney, 2010). Our CFA also supported good to very good fit of the 5-factor solution (Chi-squared/df = 1.831; CFI = 0.997; RMSEA = 0.039).

<< Insert Table 3 Here>>

*Climate Factors and Misfit Items*

Given the exploratory and confirmatory factor analyses, we conclude that the SCII is multidimensional and has five factors. The five factors explain 66.748% of overall variance in organizational climate for instructional improvement, including (1) Leadership, 7 items; α = 0.946; (2) Resources, 7 items; α = 0.846; (3) Collegiality, 4 items; α = 0.826; (4) Respect for teaching, 8 items; α = 0.900, (5) and Organizational support, 4 items; α = 0.634. See Table 3 for additional details. We could not improve construct reliabilities with removal of items.

We attribute the majority of variance to Leadership (44.066%), Resources (8.268%) and Collegiality (6.123%) factors. Although Organizational Support had an alpha of 0.634, below a desired level of 0.7, the factor had unique variations from other factors (see *Discussion*). For example, when Organizational Support was high, other factors tended to be lower (and visa versa). Furthermore, Organizational Support as a factor had several key items of interest to us, including items about professional development and faculty mentoring (Kezar, Gehrke, & Bernstein-Sierra, 2017). For these reasons, we chose to retain the Organizational Support factor for its utility as a discriminatory variable, in spite of slightly lower reliability.

*Alternate Loadings.* There are a few items that had secondary factor loadings, including S4, S5, S6, S7, S8, and S14. These items small correlation values between -0.4 and 0.4 with factors other than their original factor. We recognize that additional sampling may result in these items loading onto other climate factors and encourage others to use their best judgment for how to interpret their data. We are reporting the alternate item loadings to aid others in doing this. In our data set, items S4, S6 and S8 have alternate loadings (0.391, 0.319, 0.363; respectfully) on Collegiality. Item S7 has an alternate loading on Resources (0.326). Item S5 has an alternate loading on Respect for Teaching (0.366). Item S14 was negatively loaded onto the Leadership factor (-0.321).

### *How to Interpret SCII Scores*

We chose to normalize scores on a scale of 0 to 100. Scores of 0 to 49 are disagreeable climate for instructional improvement, 50 is neutral, and scores 51 to 100 are agreeable climate scores. We chose to use a normalized scale from 0 to 100 to make easier comparisons among climate factors. Without normalization, sums would vary factor to factor, leading to confusion when comparing means. For example, without normalizing the scores, *Leadership* would have a maximum sum of 42 (from 7 items), but *Collegiality* would have a maximum score of 30 (from 5 items). Instead, to calculate a factor score, users should begin by adding scores for the items in that factor, divide by the maximum possible sum for that factor, and then multiply by 100.

When we describe a score as "negative," the term is a synonym for *disagreement*; i.e. instructors with such scores predominantly disagreed with items in a given factor. These are scores that were generally below 50 on the 100-point SCII scale. When we describe a score as "positive," the term is a synonym for *agreement*; i.e. instructors with such scores predominantly agreed with items in a given factor. Such are scores above 50 on the 100-point SCII scale.

*Demographic Differences among SCII Factors*

This section describes significant differences in SCII factor scores by demographic groups of interest. Sub-sample sizes vary, as some participants did not disclose all applicable demographic information. SCII scores range from 0 (strongly disagree) to 100 (strongly agree) on any given factor.

*Differences by Demographic Group*

All findings we present in this paper (unless otherwise noted) are based on samples that exclude graduate students. We present our findings in order from largest to smallest comparison group, beginning with institutional differences and ending with climate comparisons by leadership role.

*Institutional Differences.* Mean climate factor scores significantly differed among our 6 sampled institutions for all climate factors (Figure 2, $p < 1E\text{-}25$). Notably, post-hoc Scheffe tests indicated homogenous subsets among some institutions. These subsets place Institutions A and C as statistically equivalent to each other in Leadership, Collegiality, Respect for Teaching ($p>.05$); these scores are significantly lower than Institutions B, D, E, and F (which likewise did not significantly differ from one another in these factors). If comparing views of resources among institutions, Institutions A and C were again in a homogenous subset. Institutions E and F were in a homogenous subset that was significantly different from other institutions with resource scores around 50 (neutral). Institutions B and D had the highest resource scores, with equivalent scores to one another, but significantly higher from other institutions.

<<Insert Figure 2 here>>

Institutional populations also varied in their views of Organizational Support. We found several institutional patterns in this factor that did not appear in the other climate factors. For example, Institutions A, D, and E paired together as a homogenous subset, with significantly higher mean organizational support scores than other institutions. Another way to examine the organizational support homogenous subsets is to place Institutions D and E in a subset with Institutions B and C. In doing so, this group had statistically equivalent scores to each other but significantly lower mean scores than Institution A ($p<.05$). Unique among the institutional populations was Institution F; this institution not group in a subset with other institutions, as it had significantly lower organizational support scores ($35\pm17$).

*Departmental Differences.* Several mean climate factor scores significantly differed by department within parent institution. We ran ANOVA within each institution to explore differences in SCII climate factor scores by department. We excluded departments with a sample size of less than 5, resulting in fewer department-to-department comparisons than the overall number of departments noted in Table 2.

Four of six institutions (Institutions A, C, E, and F) had similar views of climate across the institution, regardless of department. At Institution A, 9 departments had significant differences in only in resources ($p$=0.014). At Institution C, the departments only had significant differences in leadership ($p$=.002). At Institutions E and F; we only found significant differences in organizational support ($p$=0.018; $p$=0.023).

In contrast, 2 of our six institutions had significant departmental differences among nearly all climate factors. The 8 departments at Institution B had significant differences in views of leadership ($p$=.031), collegiality ($p$=.033), resources ($p$=6.8E-8), and organizational support ($p$=3.64E-4). Similarly, the 18 departments at Institution D had significant differences in leadership ($p$=2.64E-4); collegiality ($p$=.001), resources ($p$=.009); and respect ($p$=.009)

*Disciplinary Differences between STEM and non-STEM.*

In our comparisons of STEM ($n$=594) and non-STEM instructors ($n$=108), we found significant differences only in Organizational Support ($p$=4.5E-4). Non-STEM instructors (56.1±20.0) had significantly more positive views of Organizational Support than STEM instructors (48.5±19.5). There were no significant differences in STEM and non-STEM instructors by leadership, collegiality, resources, or respect for teaching ($p$>.05).

We compared scores among 8 STEM disciplines, including biology (n=120), chemistry ($n$=79), physics ($n$=73), geoscience ($n$=36), engineering ($n$=140), mathematics ($n$=89), statistics ($n$=13), and computer science ($n$=30). We found no significant differences for leadership, collegiality, respect for teaching, and organizational support ($p$>.05). In contrast, we found significant disciplinary differences in perceptions of resources ($p$=.032), and these scores remained significant in post-hoc tests. Computer science instructors had significantly higher views of resources than biology ($p$=.023), geoscience ($p$=.011), and mathematics instructors (*p*=.028). We also wished to compare among non-STEM disciplines, but did not have large enough sub-sample sizes for non-STEM disciplinary groups.

*Intra-Departmental Groups.* We designed four questions to identify departmental sub-groups. These are supplementary items S32, S33, S34, and S35. Upon examination of data from these items, we found 70.5% of our sample reported belonging to a 'subgroup' within their department. When asked how differently these individuals would answer their SCII questions in regard to the subgroup, 35.7% would not answer differently, 16.7% would answer a little differently, 28.6% would answer somewhat differently, 14.2% would answer quite a bit differently, and 4.7% would answer completely differently.

To explore statistically significant department sub-groups, we ran tests for non-normal distributions in each of 71 departments with $n > 5$. This included Kolmogorov-Smirnov (K-S) tests, tests for skewness and kurtosis, and Q-Q plots. Our hypothesis was that if we explored the nature of non-normal distributions within each department, we could then identify sub-groups in organizational climate for instructional improvement. For the departments with significant K-S tests (30 cases), we generated histograms with normal curve overlays. However, we did not find many bi- or multi-model distributions. This means that the non-normal distributions identified were caused by either skewed or peaked distributions. As such, the non-normal patterns in climate within the 30 identified departments are likely not indicative of intra-departmental groups. Furthermore, we note that the few departments we found with bimodal climate distributions had a smaller sample size (5 to 7 faculty). This led us to conclude that we either had a biased sample or that smaller departments are less varied by group than by individual.

*Gender Identity.* The SCII gathers gender data by asking faculty to self-report their gender identity as cis-gender female, cis-gender male, transgender, non-cisgender, or prefer not to respond. We did not have any participants report as transgender or non-cisgender in our sample. Mean climate factor scores significantly differed by gender for all climate factors except for Collegiality ($p$=.087). Mean climate scores significantly differed between women ($n$=290) and men ($n$=306); for Leadership ($p$=.017), Resources ($p$=.001), Respect for Teaching ($p$=3.07E-4) and Organizational Support ($p$=3.40E-4). We illustrate these gender identity differences in Figure 3.

<<Insert Figure 3 Here>>

*Ethnicity*. We found no significant difference in mean climate scores among Asian ($n$=62), Hispanic/Latino ($n$=16), and White ($n$=486) faculty ($p$>.05). We did not compare climate mean scores for Black ($n$=4); Native American ($n$=3), Multi-racial ($n$=3) faculty due to small sample sizes of these groups. When we grouped faculty of color ($n$=95) and compared the group to white faculty ($n$=486), we likewise found no significant differences in mean climate scores.

*Faculty Rank and Tenure Status.* We found no significant differences in mean climate factor scores by rank among full ($n$=252), associate ($n$=166), assistant ($n$=127), adjunct ($n$=72), or visiting professors ($n$=13), and full-time lecturers ($n$=72). We also found no significant differences ($p$>.05) among tenured ($n$=384), tenure-track ($n$=105), and non-tenure track instructors ($n$=170). We also did not find significant differences ($p$>.05) between non-tenure track faculty ($n$=170) and tenured/tenure-track faculty ($n$ =489). Lastly, when comparing full-time faculty ($n$=542) to part-time faculty ($n$=61), we only found significant differences in mean organizational climate scores. Full-time instructors (49.0±19.3) perceived significantly less Organizational Support than part-time instructors (54.8±22.6).

*Graduate Students.* Our comparisons between graduate student ($n$=129) and faculty instructors ($n$=316) are only representative of instructors at Institutions A, C, and D, as other institutions did not sample graduate students. Within these institutions, we found significantly lower mean scores among all 5 climate factors for graduate students ($p$<.01). In particular, Collegiality scores for graduate students (37.7±23.3) were significantly lower ($p$=1.345E-7) than faculty (50.6±24.7).

*Leadership Role.* We ran independent t-tests to compare views of individuals who were the formal leader in department ($n$=19) and individuals without a leadership role in their department ($n$=299). This sample did not include institutional deans or other administration roles, so these findings are most likely descriptive of department chairs. Department leaders had significantly more agreeable views of Leadership ($p$=.002) and significantly more agreeable views of Respect for Teaching ($p$=.027). Department leaders did not have significantly different views than their colleagues in Collegiality, Resources, or Organizational Support.

*Years Teaching, Teaching Load, and Class Size.* There was no significant correlation (p>.05) between years teaching and class size and any of the SCII factors. In contrast, teaching load was significantly negatively correlated with Resources (r=-0.120; $p$=.002), and class size was significantly negatively correlated with Organizational Support (r=-0.115; $p$=.022). If we had included graduate students in the sample, we also find that years teaching is significantly correlated with Collegiality (r=0.096; $p$=.015) and Respect for Teaching (r=0.097; $p$=.014).

# DISCUSSION

We organize our discussion into four sections. We begin with a summary what we have learned about the overall design of the SCII, its conceptual framework, and nature of organizational climate for instructional improvement. We follow with how the literature helps to explain the five factors of the SCII (leadership, resources, collegiality, respect for teaching, and organizational support). Third, we discuss women and graduate students as marginalized groups identified by the SCII. We conclude with recommendations for future work.

*Overall SCII Design and Conceptual Framework*

Our research supports an instrument that can differentiate among elements of organizational climate for instructional improvement. The SCII is reliable; easy-to-use, and can quickly collect data from a large number of participants. Reliability indicates consistency when testing procedure is repeated (Knekta, Runyon, and Eddy, 2019). The SCII has excellent overall reliability at 0.952 (0.700 or higher is preferable), and excellent construct reliabilities among its factors.

Our study also provides empirical support for conceptual models of faculty work proposed by Gappa et al. (2007) and Beach (2002). However, we note that three constructs from those models and some of our individual items did not sort onto consistent factors. This included items about (a) shared attitudes about students and teaching, (b) academic freedom and autonomy, and (c) rewards. Items from these apriori categories sorted into more conglomerate factors with better Eigenvalues, or were removed from the survey during its early development. Specifically, items related to academic freedom and autonomy (Gappa et al., 2007) loaded with items about time, financial, and space resources (Beach, 2002; Knorek, 2012; Walczyk, Ramsey,

& Zha, 2007; Chasteen et al., 2015; Parker et al., 2015). Other items also did not load onto any of the climate dimensions and were removed during our pilot phase. We removed items on (a) institutional incentives for teaching (Walczyk et al., 2007; Chasteen et al., 2015; Parker et al. 2015), (b) shared views of teaching and learning, including instructor concerns that students are underprepared (Felder & Brent, 1996; Parker et al., 2015) or are resistant to change (Henderson & Dancy, 2007; Hastings & Breslow, 2015; Parker et al., 2015), and (c) coordination of teaching across similar courses. We agree that these barriers are important to shifting instructional improvement climate. However, we cannot claim these ideas are elements of *organizational climate for instructional improvement* - at least as measured by the SCII.

*The Nature of Organizational Climate for Instructional Improvement*

As we considered the nature of our findings, we reconsidered at what organizational level we could best measure organizational climate. The SCII asks participants about climate at the department level, perhaps with the exception of some items in Organizational Support, which may be managed at a higher organizational level (e.g. university-level professional development). We agree that faculty are strongly influenced by their departments, but they are also influenced by their institutions, disciplines, and academia as a whole. Academic cultures are "inseparably intertwined with the subject matter" and disciplines are important groups that can help explain the differences among faculty across the academy; some faculty may identify more strongly with their discipline than with their institution (Clark, 1983, Ruscio, 1987; Brownell & Tanner, 2012). Faculty therefore may be more likely to adopt the values, beliefs, and practices that constitute their discipline (Becher, 1981; 1985). In our study, two of six institutions had significant differences among climate factors by department (and therefore discipline). As expected, most responses in a department were also normative to one another (e.g. no distinct sub-groups).

We also hypothesize that climate is normative to institution, but not exclusively. Four of the six institutions (Institutions A, C, E, and F) had similar views of climate across the institution, regardless of department. This leads us to expect that organizational climate, even when measured at the department level (as with the SCII), is sometimes normative at the institution-level. That is, other higher order variables may be tied to organizational climate. This is also supported by statistically distinct homogenous subsets among institutional climate means: Institutions A and C and Institutions B, D, E, and F had nearly identical views in leadership, respect for teaching, and collegiality. These findings lead us to wonder: (a) what cross-institutional variables could explain these data and (b) what aspects of organizational climate are normative to the academia as a whole?

*Exploring the Five Climate Dimensions of Organizational Climate*

*Factor 1. Leadership for Instructional Improvement*

Leaders have important influence in creating a sense of belonging and job satisfaction of faculty (Campbell & O'Meara, 2014) and an environment for resource exchange (Van Waes et al., 2015). They also can provide flexibility when instructors are testing new ideas and place value on teaching quality in tenure, promotion, and retention decisions (Shadle et al., 2017). Faculty who experience transformational leadership and work in collaboratively managed environments are more likely to adopt student-centered teaching practices (Ramsden et al., 2007; Trigwell, Prosser, & Ginns, 2005). We likewise saw the importance of leaders in our SCII data, as leadership accounted for over 44% of the variance, indicating that formal department leader(s) and their policy decisions have a central role in organizational climate.

Given these findings and the large contribution of leadership to the variance, we highlight leadership as a key variable in catalyzing change, in particular, *department level* leadership. SCII items focus on formal department leaders, not college and university-level leadership (e.g. Dean, Provost, President). Although higher-level leadership is important, Henderson, Beach, and Finkelstein (2011) note that change initiatives need to empower and support stakeholders and be prescribed by individuals in power. Our data identifies department chairs as key for instructional improvement given the large amount of overall variance from the factor. We hypothesize that perhaps the department chair is at a unique intersection of resources, policy, and collegiality; they are both in power and a peer, empowering them to be important loci of organizational change.

However, since department leadership SCII scores were still mostly normative by institution, our data may also support the idea that institutional support and guidance is important. Work like *Increase the Impact* would describe this balance as "the sweet spot" between emergent and prescribed change. Institutions need to give individual users freedom and support, but still provide a set of prescribed principles in which to customize an innovation (Henderson, Cole, Froyd, Friedrichsen, Khatri, & Stanford, 2015).

*Factor 2. Resources for Instructional Improvement*

The resources factor was the next most influential factor in our data, contributing 8% to overall variance. This is fitting with research documenting resource availability as one of the most common drivers/barriers for adoption of teaching innovations (e.g. Andrews & Lemons, 2015; Shadle et al., 2017). The 7 items on the Resources factor align well with related literature in this area, including perceptions of the resources of (a) time (e.g. Miller, Martineau, & Clark, 2000; Hanson & Moser, 2003; Pundak & Rozner, 2008; Henderson & Dancy, 2007; Brownell & Tanner, 2012), (b) money incentives (Knorek, 2012; Andrews & Lemons, 2015), (c) teaching space (Bland et al., 2006), and (d) autonomy in content and pedagogy (Shadle et al., 2017).

One notable finding in the Resource factor is that our data suggest autonomy to be a *resource,* and not a separate *autonomy* construct as Gappa et al. (2007) suggest. Self-determination theory also describes autonomy through the lens of resources (Deci & Ryan, 2011). The only oddity in the resources factor was an item regarding pedagogy resources for new instructors (S23), which loaded onto the "respect for teaching" dimension. We consider the S23 loading in our *Respect for Teaching* subsection of the Discussion. We are uncertain why both instructors with a higher teaching load and computer science faculty viewed resources so positively, but note that this finding supports the idea that some ranks and disciplines may have (a) differences in how teaching-related resources are perceived and/or (b) have different allotment of resources (Cavanaugh, 2017).

*Factor 3. Collegiality for Instructional Improvement*

Gappa et al. (2007) describe collegiality to be in place when individuals feel they belong to a mutually respectful community of colleagues who value their contributions and feel concern for each others' well-being. Collegiality in academia is enigmatic. Instructors may be socialized to 'not care' what others think, do work that is isolated from one another (like teaching), and fight for limited resources (e.g. Massy et al., 1994). Despite competition, colleagues are also key to instructional improvement. We need one another for the exchange of teaching resources

(Andrews & Lemons, 2015) and for engaging in professional development around teaching (Bouwma-Gearhart, 2012).

In the SCII data, collegiality was institutionally normative among (a) all departments at Institutions A and C, each reporting disagreeable views of collegiality and (b) all departments at Institutions B, D, E, and F, each reporting agreeable views of collegiality. This documents that collegiality, although measured at the department level by the SCII, displays overarching institutional norms. Initially, our hypothesis was that institutional collegiality norms could be tied to Carnegie classification. However, patterns in collegiality were not a function of how research-intensive an institution was. Institutions A and C were large, research-intensive and very research-intensive institution, respectively; both reported disagreeable collegiality. In contrast, Institutions B and F were likewise large and research-intensive, yet reported more agreeable collegiality.

Lastly, we discuss the significant positive correlations between Collegiality and number of years teaching. Peers are a valued source of information when an individual is forming an opinion about an innovation (Rogers, 2003). Van Waes, Van den Bossche, Moolenaar, De Maeyer, & Van Petegem (2015) noted that faculty with teaching experience had larger, stronger, and more diverse networks of colleagues than less experienced faculty. Although faculty inexperienced in teaching (e.g. researchers) also had large networks, they had weaker ties and less diversity in the types of peers with whom they communicated. We postulate that experienced faculty build collegiality with years teaching, but not necessarily other forms of academic work, and our data provide evidence for the improved role of collegial interactions throughout a teaching career.

In particular, we note that the significant correlation between collegiality and years teaching disappeared when we removed graduate students from the sample (these individuals reported around 0-2 years teaching experience). As such, we highlight graduate students as an important focus for future collegiality research. Graduate students are an underserved population in need of not only pedagogical development (Schussler, Read, Marbach-Ad, Miller, & Ferzli, 2015), but also colleagues to talk to about teaching (Andrews & Lemons, 2015).

*Factor 4. Organizational Support for Instructional Improvement*

Lack of pedagogical training and support is a noted barrier to instructional innovation (Walczyk et al., 2007). Faculty engaging in professional development, through structured groups or peer mentorship, would have increased interest interacting with others (Bouwma-Gearhart, 2012) and therefore better ability to exchange teaching-related resources (Andrews & Lemons, 2015).

Mean institution-level *Organizational Support* scores were either significantly higher or significantly lower than other 4 SCII factors (Figure 2). For example, instructors at Institution F reported mean organizational support scores around 35±17, but had significantly higher mean scores for the other 4 SCII factors (at or around 60). We see the reverse pattern at Institutions A and C, where instructors reported high mean organizational support scores, but significantly lower mean scores for the other factors. These patterns led us to wonder if organizational support was more influenced by climate beyond the department (e.g. at the university, college) and therefore causing the Organizational Support factor to behave differently. This may also explain the slightly lower reliability of this factor ($\alpha = 0.634$). Lastly, this may help us to answer how items about professional development (S6), mentorship (S9), structured pedagogy groups (S29), and financial incentive (S30) could be grouped together into this factor -- all of them are supported by infrastructure beyond the department.

At minimum, we can attest that under some circumstances, views of organizational support counter to other elements climate (leadership, resources, collegiality, and respect for teaching). Perhaps when resources, leadership, respect, or collegiality are agreeable, instructors are less inclined to make use of organizational support, and therefore have less agreeable views regarding it. Alternatively, if these elements are less agreeable (e.g. leadership, resources, collegiality and respect are not in place), instructors may be more inclined to seek out, and therefore have agreeable views regarding, broader organizational support.

However, mean organizational support scores are not always different than other climate factors. We saw consistently positive views of climate at Institution B. Perhaps high-quality teaching development can build conversation around teaching, foster community, and come from the support of campus leaders (e.g. Connolly, 2010; Coffey & Gibbs, 2004), thus linking organizational support and the other SCII factors.

We conclude the unique differences in the organizational support factor highlight its importance as a lever for change, and solidify its place within a framework of factors tied to climate for instructional improvement. We also note that items in the Organizational Support factor may be tied attitudes toward instructional improvement. For example, Coffey and Gibbs (2004) and Postareff, Lindblom-Ylänne, & Nevgi (2007) found a range of positive changes in instructors' attitudes about teaching, including shifts toward being more student-focused teaching and improvements in self-efficacy, after pedagogical training.

*Factor 5. 'Respect for Teaching'*

Respect for Teaching as a factor on the SCII includes a potpourri of 7 items, most of which relate to teaching effectiveness as valued in retention, tenure, and hiring policy (S24, S25, S26), perceptions of teaching effectiveness in others (S4 and S28), or the value of teaching as an aspect of academic work (S27). The odd item in this factor is S23, "new instructors are provided with teaching development opportunities and resources." However, this item could also be interpreted as teaching-related policy, in a similar vein such as S24-S26.

At the onset, we did not anticipate 'respect for teaching' would come out as a factor in our analyses. In fact, we toiled over the name of this factor for quite some time. It was our goal to elicit organizational climate (not culture), and we had purposefully avoided developing items around teaching culture and norms. How could it be that 'values regarding teaching effectiveness' was part of organizational climate?

Returning to our aforementioned definitions, *culture* is the deeply instilled values, beliefs, myths, and rituals of an organization (Corbo et al., 2016). Culture takes a long time to change (Peterson & Spencer, 1990). In contrast, *climate* is the "shared, subjective experiences of organizational members that have important consequences for organizational functioning and performance" (Peterson & Spencer, 1990). We posit that since culture and climate are related constructs (Ashkenazy et al., 2001), it is illogical to expect norms and values to be separate from organizational climate factors on the SCII. In our case, formal and informal policy (S23-S26) could be considered as aspects of organizational climate. Policies can be changed and would not inherently take long-term or cataclysmic initiatives to change (like culture). We see the perceptions of others discussed by items 4 and 28 as more tied to values and norms, but not exclusively. S4 asks participants whether instructors "aspire to become better teachers," and S28 asks participants whether "all instructors are sufficiently competent to teach effectively." These views could change easily, depending on other organizational climate factors or personal attitude shifts. If these values can easily change, they are unlikely to be organizational culture. However, item S27 "Teaching is respected as an important aspect of academic work" is almost explicitly culture. To manage this issue, we have concluded that the *Respect for Teaching* construct is neither culture nor climate, but rather a product of the entanglement of culture and climate -- and we see value in keeping these items as a direct measure of participant values.

As researchers begin to use the SCII, we encourage others to monitor *Respect for Teaching* as a factor. If this factor changes over short periods of time, we expect that it will help capture major shifts in climate (which can happen over said durations). However, if this factor does not change or changes only with 'cataclysmic' efforts (Peterson & Spencer, 1990), the SCII may measure both some aspects of organizational culture.

*Marginalized Groups as Identified by the SCII*

We highlight significant differences in organizational climate for instructional improvement for cis-gender women. Across Leadership, Resources, and Respect for Teaching factors, cis-gender women reported significantly lower mean climate scores than cis-gender men. We expect that, at least in part, a negative climate for cis-gender women in STEM may be in play. Cis-gender women have been underrepresented in STEM throughout history, as cis-gender men outnumber them in science both in image and number (Riegle-Crumb, & King, 2010). Differential treatment and micro aggressions to women and other minorities can accrue over time to create wide gaps between groups, leading to negative outcomes such as lower job satisfaction and higher turnover (Preston, 2006; Valian, 1999). In the context of instructional improvement, women in STEM disciplines often participate more in teaching and service than their male counterparts (Rosser, 2004). This downgrading of teaching and service may lead to women being passed over for promotion and tenure because their contributions may be perceived as less valuable than research. These responsibilities also can be viewed as facilitating when institutions implement policies that ensure extra teaching and service duties do not fall exclusively on women faculty and, in addition, the responsibilities should be equally valued as research in consideration for promotion and tenure (Rosser, 2004). It's possible that these facets of the academic workplace manifested in some of our gender identity results.

Exceptions for women were statistically equivalent collegiality scores to men and significantly higher views of organizational support for teaching. We hypothesize that perhaps because negative views other climate aspects led women to value or seek out more organizational supports more than men (e.g. finding a mentor, engaging in professional development available on campus). Women are reported to use more active learning practices than men (Henderson et al., 2012). If there is a direct correlation between instructional improvement and climate, systemic change may be leveraged for women may be through the right organizational supports for teaching (including mentor relationships and professional development groups and structures on campus).

We also identify graduate students as an underserved population and key demographic for additional exploration (e.g. Nicklow et al., 2007; Gardner & Jones, 2011). Graduate students reported significantly less positive views of climate for instructional improvement, documenting a potential need for better supporting the population. Another way this manifested was in a significant positive correlation between mean Collegiality and number of years teaching. This correlation was no longer significant when we removed graduate students from the sample. Graduate students were significantly less likely to have a network of colleagues with whom to discuss teaching. This network may be key to developing a professional identity and troubleshooting early-career teaching problems (e.g. Rogers, 2003; Andrews & Lemons, 2015). We encourage research that focuses on the pedagogical needs of graduate students through the lens of organizational climate, as this work can identify key barriers and affordances tied to their institutions.

*Future Work*

Our study provides insight into common organizational levers and barriers to instructional innovation. Although the goal of this paper was to present our instrument, we expect to continue unpacking relationships between climate and teaching practice. One step in the future will be to examine other indicators of reliability for the SCII, including split-halves and test–retest reliability.

We will also be continuing our work to examine how climate intersects with teaching practice (Authors, 2018). We have a forthcoming paper in which we are exploring how self-reported teaching practices relate to SCII data. Upon initial examination, all of climate factors significant correlate with teaching practice variables, and as such, we have conducted a k-means cluster analysis to sort individuals into unique groups based on patterns in SCII and teaching practice variables. We encourage others to do similar work and be open in sharing data.

We note that postsecondary education researchers are yet to rally behind a cohesive model for explaining adoption of active learning pedagogies. As we move forward, we wonder if it is possible to look at teaching practices and organizational climate using one framework. We value examining these variables together as opposed to separately, but recognize that it will take a carefully crafted study to do so. Our work to develop the SCII incorporated frameworks from different fields of study, including those from organizational climate and higher education fields. Since. Our work exploring teaching practices through the Theory of Planned Behavior (Ajzen, 1991) could serve in this capacity, as could other models (e.g. Gess-Newsome et al., 2003; Deci & Ryan 2011; Rogers, 2003). We welcome collaborators as we pursue understanding of this complex phenomenon.

Lastly, we reiterate that our sample for this study should not be generalized to all postsecondary faculty. Our data gathered in 2013-2015 from 4-year institutions that were large, non-minority serving, and in the United States. We encourage others to implement the SCII in other settings to learn more about how data might differ in non-American settings (especially non-Western countries), different institutions (especially community colleges), and with more diverse postsecondary instructors.

*Access to the Instrument*

The SCII is available in its paper form as *Supplementary Materials* for this paper. Users are also welcome to contact the authors for use of our SCII Qualtrics template. If you use SCII, we request that you use it in its entirety and consider sharing the data with our research team. We also suggest using the SCII with its companion teaching practices instrument (Authors, 2016).

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