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Family Friendly Policies in STEM Departments: Awareness and Determinants

Xuhong Su[1] · Barry Bozeman[2]

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Abstract Focused on academic departments in science, technology, engineering, and mathematics (STEM) fields in the United States, we attempt to map department chairs' awareness of family friendly policies and investigate possible determinants of their knowledge levels. Based on a sample of STEM department chairs in American research universities, we find that chairs only have limited knowledge of family friendly policies and face different incentives and constraints in pursuing more. Chairs prove more committed to family friendly policies if departments embrace a diversity strategy. Those aspiring to move up in the administrative hierarchy are more likely to champion policies of unpaid family leave, spousal hiring assistance and workload reduction for family reasons, whereas female chairs advocate more of family leave and onsite childcare policies. Departments self-assessed with less desirable status prove more knowledgeable about spousal employment assistance policy. We call for contingent understanding of family friendly policies and conclude the study by discussing research implications and developing policy recommendations.

Keywords STEM fields · Department chairs · Family friendly policies

Family friendly policies have been embraced by American universities to pursue more equity and inclusion (Smart and Fox 2008; Sturm 2006; Sullivan and Mainiero 2007). Serving as a buffer against work and family conflicts (Mayer and Tikka 2008; Raabe 1997), implementation of more family friendly policies is called for to create better

✉ Xuhong Su
xuhong.su@gmail.com

Barry Bozeman
barry.bozeman@gmail.com

[1] Department of Political Science, University of South Carolina, Columbia, SC, USA

[2] School of Public Affairs and Center for Science, Policy and Outcomes, Arizona State University, Tempe, USA

working environment (Sullivan and Mainiero 2007) and to facilitate more career success for people of all sexes and races (Sturm 2006). Nevertheless, extant evidence seems to indicate that family friendly policies have rarely transformed higher education institutions, but at most played out at the margins (for example, see Lewis 1997, 2001). One important missing link in academia occurs on the department level, whose awareness and practices play essential roles in promoting (or hindering) the use of family friendly policies (Monroe et al. 2008). The demand for family friendly policies has been acute (Sturm 2006), particularly within STEM departments wherein the underrepresentation of women and minority academics as well as their career disadvantage has attracted nationwide attention (Fox and Colatrella 2006; Hill et al. 2010). However, to date, there is only limited understanding on departments' awareness and practices of family friendly policies.

We focus on STEM departments to explore their chairs' awareness of family friendly policies. Of course, policy awareness does not necessarily equate to more adoption or uses of family friendly policies. Awareness may fail to bring in positive changes due to constrained resources or resistance from important policy players (Anderson et al. 2002; Mayer and Tikka 2008). Yet, it is inherently useful to assess how well department chairs are knowledgeable of specific family friendly policies as their awareness is certainly an important precursor toward better adoption and more policy uses (Stockard et al. 2008). In academic departments, chairs are key decision makers and arguably the best ones for capturing departmental dynamics in policy arenas. They enjoy varying degrees of influences on setting departments' policy agenda, establishing a culture of equity and inclusion, and designing and adopting policies that directly affect working environment and members' career development (Ann 2000; Fox and Colatrella 2006; Hopkins 2002). Constrained by working contexts and various incentives, chairs develop awareness of specific policies and further put them into practice. For instance, chairs sensing a stronger need for family friendly policies tend to show more support (Stockard et al. 2008), whereas those in resource-tight departments may be reluctant to accommodate family friendly requests.

To date, very few studies have been conducted to map departmental awareness of family friendly policies, even less dedicated to exploring their antecedents. Such effort is challenged by different policy specifications embedded in different institutional settings and universal plight of measuring policy knowledge. In recognition of possible complexities, we confined our study to explore the factors that shape chairs' knowledge of family friendly policies in STEM departments at research extensive universities (Carnegie Foundation for the Advancement of Teaching 2000) in the United States. We propose that STEM chairs' knowledge of family friendly policies is empowered and constrained by their working contexts and incentives and in particular, we pay special attention to the following factors: departmental strategies, female faculty composition, peer pressure, departmental resources, chairs' career aspiration and their gender, among a good many others.

The call for more family friendly policies has been strong in STEM departments as such policies are perceived instrumental toward the level playing fields, reduced working stress and increased recruitment and retention of more female and minority academics (Mayer and Tikka 2008; Mesmer-Magnus and Viswesvaran 2006; Raabe 1997; Rosser and Lane 2002). However, implementation of family friendly policies in departments has been plagued by many concerns and challenges (Monroe et al. 2008), upon which key leaders are often able to exercise substantial impact. Our research represents an early effort to unfold the dynamics of chairs' knowledge on family friendly policies and provide baseline knowledge upon which further interventions can be effectively designed and implemented.

Family Friendly Policies

As an umbrella term, family friendly policies cover a wide array of policies intending to buffer the conflicts between workers' family needs and their work responsibilities (Lewis 1997; Raabe 1997). There is neither a widely accepted definition of the term nor any agreement on just what does or does not constitute family friendly policies (Scheibl and Dex 1998). In general, family friendly policies are concerned with such issues as flexible working arrangements (i.e. flexible time, part-time, workload reduction), leave entitlement (i.e. paid leave, unpaid leave, maternity leave), financial and hiring assistance (i.e. on-site childcare, spousal hiring) and other forms of help on work conditions and responsibilities (say, elder care) (for example, see Mesmer-Magnus and Viswesvaran 2006; Poelmans et al. 2003; Sullivan and Mainiero 2007).

Evidence abounds that women and minority academics have not been entitled to equal treatment as their male counterparts (Smart and Fox 2008). Rather than blaming individuals for their career disadvantage, the latest scholarship turns attention to institutional barriers in working contexts, contending that academic structure, rules and culture are not gender or race neural and that policy interventions are imperative to level the playing fields (Hill et al. 2010; Smart and Fox 2008; Sturm 2006). The demand for active interventions has been further extended to young parents and other members who might also be struggling with work-life balance (Frye and Breaugh 2004; Honeycutt and Rosen 1997). Family friendly policies are critical parts of institutional prescriptions to meet the demands.

The acute demand for more family friendly policies notwithstanding, the implementation of these policies is at most incomplete (Lewis 1997, 2001). Evidence points out that reluctance and resistance of using family friendly policies is largely due to cultural and institutional barriers (Mayer and Tikka 2008; Swody and Powell 2007), particularly so within academic departments (for example, see Monroe et al. 2008; Rosser and Lane 2002). Many decisions of policy uses are made on the department levels. Even with formal policies on campus, less progressive department chairs may not facilitate the use of policies, creating undue pressure upon faculty members (Frye and Breaugh 2004; Swody and Powell 2007). The need of change has been highly emphasized (Etzkowitz et al. 2000). Our study, in examining the dynamics of chairs' knowledge on family friendly policies, intends to facilitate such change and promote evidence-based interventions.

Literature and Research Hypotheses

Departmental Strategies

STEM departments pursue multiple sets of strategies, mainly including research, teaching and diversity ones. Diversity strategy seems most pertinent as such strategy emphasizes the importance of gender and racial diversity among faculty bodies and often necessitates active policy interventions such as family friendly policies. While diversity strategy may not necessarily dictate the use of family friendly policies, its presence provides mandates and incentives for departmental chairs to search more knowledge and practices consistent with diversity value. Extant literature has confirmed that family friendly policies are positive addition to fulfill diversity value among different kinds of institutions, including higher education institutions (Honeycutt and Rosen 1997; Poelmans et al. 2003; Smart and

Fox 2008; Sturm 2006). It stands to reason that with a diversity strategy, academic departments are likely to have more knowledge on family friendly policies.

An alternative perspective is that policy knowledge shapes organizational strategies (Farjoun 2002). Pertaining to family friendly policies, studies point out that the use of family friendly policies has been confronted with multiple organizational barriers, including but not limited to lack of supervisory support, limited organizational understanding and the presence of chilly working climate, among others (Frye and Breaugh 2004). While family friendly policies help to reduce stress for individual employees, such policies seem to at most play out at the margins (Lewis 1997, 2001), short of evidence that they create a widespread organizational culture change or a redirection of departmental strategies.

H1 A diversity strategy in STEM departments promotes chairs' knowledge of family friendly policies.

Relative to diversity strategy, little empirical research has been conducted to explore the impact of research and teaching strategies on chairs' awareness of family friendly policies. There is a concern that research and teaching strategies may be at odds with diversity strategy as the chilly climate (Sandler 1986) prevailing in academic departments often results in underrepresentation and career disadvantage among minority faculty (Piercy et al. 2005). However, the concern seems not well justified and no casualty has been established between chilly climate and pursuit of research or teaching strategies. In order to recruit and retain quality faculty (National Research Council 2001), departments committed to heavy research and/or teaching strategies often see family friendly policies as good instruments toward research and teaching excellence (Mayer and Tikka 2008; Su and Gaughan 2014). Moreover, in light of the theory of institutional isomorphism (Dimaggio and Powell 1983), academic departments are subject to heavy institutional pressure to embrace diversity endeavors, independent of their research and teaching strategies. This line of research further shows that research and teaching excellence may not necessarily come in conflict with family friendly policies (Fox and Colatrella 2006; Smart and Fox 2008).

Female Faculty Composition

Academic departments are governing bodies wherein faculty members share authority and responsibility with administrators to make decisions (American Association of University 1966). As such, female faculty composition within departments matters. As the proportion of female faculty rises in the department, it is highly likely that they voice concerns, particularly on policies closely related to their own interests (Marschke et al. 2007). While all members benefit from family friendly policies, female faculty could gain more (i.e. maternity leave, onsite childcare services etc.) since they are often burdened with a disproportionate share of family responsibilities. Their push for friendlier working arrangements and more family assistance urges department leaders to enhance their knowledge on family friendly policies. Moreover, as women are better represented within academic departments, a greater balance between genders may create an environment more conducive to learning and implementing new policies toward equity (Kanter 1977; Yoder 2001).

A refined theory is referred to as the critical mass theory, contending that the percentage or absolute number of female faculty needs to be present to make substantial impact on leaders' knowledge or behaviors (for example, see Meier et al. 1999). With more members sharing similar demands, female groups are more likely to be motivated and use political process to make policy requests. Extant literature provides little insight regarding the specific thresholds or possible ranges. Nevertheless, the theory suggests that a higher (i.e. higher than threshold) proportion of female members may push for more policy learning among leaders (Meier et al. 1999). At least, with more female faculty in departments come with more requests for using family friendly policies, which help department chairs to accumulate more knowledge via learning by doing.

H2 Ahigher proportion of female faculty in STEM departments push departmental chairs to be more knowledgeable about family friendly policies.

Peer Pressure

Departments have been under strong pressure to increase the diversity of their faculty bodies (Smart and Fox 2008; Sturm 2006; Su et al. 2014). Studies demonstrate that departments are often involved in intense competition for minority and female academics (Tolbert et al. 1995), and that family friendly policies play active roles in recruitment and retention (Hopkins 2002). On the flip side, potential faculty candidates may pay special attention to family friendly policies and seek employment where life and family can be more balanced. For different reasons, those self-assessed with a lower status on family friendliness may find high instrumental values from family friendly policies, which promote more learning of specific policies.

Beyond direct competition for faculty members, departments learn from their peers to seek organizational legitimacy and to increase competitive advantage (Brewer et al. 2002; Keith 1999; Meara 2007). Self-assessment is often the first step to discover inadequacies and deficiencies and may lead to positive measures to rectify their less desirable status by adopting policies that prove successful among peers (Su et al. 2014). Pertaining to family friendly policies, learning and emulation prove particularly important as there is no specific national standard or benchmark to define family friendly working environments (Scheibl and Dex 1998). When departments assess their programs and find themselves in less desirable status, they are motived to search more knowledge and to explore more possibilities.

H3 departments self-assessed with less desirable status than their peers on family friendliness are more knowledgeable about family friendly policies.

Departmental Resources

Resources are critical to departmental functions (Ingram and Simons 1995; Pfeffer and Salancik 2003). Department chairs are generally endowed with substantial amount of resources to implement policies and promote organizational strategies (Ann 2000; Carroll 1991). While the amount of financial resources is critical, autonomy to exercise leeway merits more attention. Family friendly policies are newly emerged arenas wherein hierarchical mandates are still developing and much success depends on autonomous effort. As

almost all efforts balancing work and family conflicts may be brought under the umbrella of family friendly policies, the field offers enormous opportunities to exercise autonomy. Chairs in resourceful departments may see this arena as a fertile ground to substantiate and expand their autonomy and positions in institutions (Roberts and King 1991). At the minimum, departments with more resources and autonomy are able to accommodate more family-related requests and to create friendlier working environments should the demands are voiced and heard. On the flip side, evidence is presented that family friendly policies are costly to organizations (Heywood et al. 2007), which may explain a large part of reluctance and resistance to accommodate these requests.

H4 Chairs with more departmental resources are likely to be more knowledgeable about family friendly policies.

Career Aspiration

While we are challenged to disentangle different determinants of policy awareness, we contend that career aspiration shapes individual momentum. Family friendly policies are often framed as policy instruments toward diversity and equity. Given the importance of both value sets, individual knowledge of family friendly policies may signal their commitment to organizational missions, help them to identify potential career opportunities and move on to better positions wherein their knowledge and skills can be effectively utilized. Evidence confirms that the returns of policy knowledge are not only reflected in good job performance, but also take a form of increasing individual probability of promotion (March 1991). As such, department chairs aspiring to move up in the administrative hierarchy may have special incentives to learn family friendly policies.

H5 department chairs aspiring to move up in the administrative hierarchy are likely to be more knowledgeable about family friendly policies

Gender and Representative Bureaucracy

Female leaders are more likely to engage in learning family friendly policies either out of self-interest or shared understanding of women's problems within the departments. The theory of substantive representation provides good insights, contending that female leaders tend to advance policies favorable to female members within their organizations (Keiser et al. 2002; Wilkins 2007). Two conditions are presumed necessary for the presence of substantive representation (Bradbury and Kellough 2008; Wilkins 2007; Wilkins and Keiser 2006). First, female leaders need to have an adequate amount of leeway to exercise impact on policy areas. Second, the policy areas must be gendered so that policy outcomes are essential to women. In the case of family friendly policies, both conditions are well satisfied. Since policy knowledge is the prerequisite for advancing family friendly policies, we hypothesize:

H6 Female chairs are likely to be more knowledgeable about family friendly policies.

Research Design

We focus on academic departments in STEM fields at American research extensive universities (Carnegie Foundation for the Advancement of Teaching 2000). Two data were combined to map STEM chairs' knowledge of family friendly policies: *The 2010 Survey of Academic Chairs/Heads* (hereafter the Survey or Survey data) and *A data-based assessment of research- doctorate programs in the United States* (National Research Council 2011) (hereafter the NRC report or NRC data). Intending to map departmental strategies and behaviors in STEM fields, the survey was administered to all STEM department chairs and heads (n = 1832) in 149 STEM doctoral degree-granting universities. After two waves of solicitation, the response rate reached 43 %. Further statistical analyses showed little response bias with regard to subjects' demographic characteristics.

Supplementary information was extracted from the NRC report (National Research Council 2011), which provided the most comprehensive information on research-doctorate programs in the United States (National Research Council 2011). One concern with the NRC data was the limited size of rated academic departments. As a result, a portion of surveyed departments was not included in our analysis due to the lack of evaluation information from the NRC report. The merged data ended up with full information from 408 department chairs working at 135 universities. Further analyses (regressions not shown) show that included chairs are not significantly different from those excluded in term of their demographic characteristics; however, departments more committed to diversity strategy and with less female faculty seem more included, possibly reflecting the overrepresentation of highly prestigious programs where institutional pressure for diversity is higher and female faculty are less.

Variables and Model Specifications

Given the ambiguous nature of family friendly policies, we focus our attention on the following specific policies:

- Tenure clock stop
- Paid family leave,
- Unpaid family leave,
- Onsite childcare,
- Spousal employment assistance,
- Workload reduction for family reasons

For each of these policies, department chairs were asked to select all that exist at their university and indicate the extent to which they were familiar with. The task was two-fold. First, dummy variables "Formal university policies" were constructed to reflect whether universities have formal written policies on six items. Second, for each item, an ordinal variable was created to indicate chairs' degrees of familiarity, ranging from "very familiar", "somewhat familiar" to "somewhat unfamiliar" and "not familiar at all". To capture the general status of family friendliness in STEM departments, we constructed the variable "Family friendliness" by adding all valid responses on six policies and dividing it by the number of valid responses.

STEM chairs were also asked to assess the extent to which they considered the following to be departmental priorities, with a four-point scale ranging from "top priority",

"very important but not a top priority", to "somewhat important" and "not that important".

- Improving the research ranking of your department
- Increasing the amount of sponsored research
- Increasing the racial diversity of faculty
- Increasing the gender diversity of faculty
- Increasing the number of classes offered
- Increasing the number of students taught
- Increasing the quality of graduate students

We factor analyzed all seven items and sorted out three departmental strategies: diversity strategy, research strategy, and teaching strategy. The factor scores of each strategy were incorporated into the regression models (see Table 1).

Centered on distributing resources for new hires, chairs indicated whether they had full autonomy or needed approval from others on the thirteen items,[1] including salary and funding resources, workload and working conditions and family-related benefits. More autonomy on distributing resources is perceived as having more departmental resources at the disposal of chairs. An index for "Departmental resources" was constructed via multiplying the dummies with their inverse weights, summing all items up and dividing further by the effective number of responses (mroe details, see Bozeman et al. 2013).

The variable "Female faculty composition" captured female faculty as a percentage of total core faculty in 2006. The gender of department chairs was coded from the Survey. Department chairs were asked to reveal their future career plans, with three options from "move up in administration", "go back to faculty position" to "retire". The variable "Career aspiration" was created, with one indicating that chairs aspire to move up in the administrative hierarchy, and zero otherwise. The "Peer pressure" variable was created by soliciting chairs' opinion on their family friendliness relative to their disciplinary peers.

Other control variables were also incorporated. The variable "Tenure" captured the length of time for being department chairs. The variable "Outsider" indicated whether department chairs were recruited from outside of the departments. "Department prestige" was extracted from the NRC report (2011), indicating the numerical rankings of the departments in their fields. "Department size" was classified with a quartile system based on the number of doctoral students enrolled in 2005. In our analysis, we used life science as the reference group, controlling for engineering and physical departments.

Understanding STEM chairs' policy knowledge can hardly be complete without taking into account university level factors. For this purpose, multilevel mixed effect models were used. In our study, the level-1 focused on departmental factors that presumably affected chairs' knowledge of family friendly policies and the level 2 addressed university-level parameters. One might wonder whether disciplinary fields exercise independent clustering impact on chairs' policy awareness as chairs are also subject to professional norms and rules. To test this possibility, three-level mixed effect models were conducted and compared with two-level models, suggesting that the two-level models are a better fit and that

[1] The thirteen items include: additional salary, summer money, research money, start-up money, research assistants, course reductions, teaching assistants, computing/software, laboratory space, laboratory supplies, spousal hiring assistance, moving expenses, and travel funds. Their inverse weights are operationalized as one minus the mean of each independent variable on the ground that those less adopted merit more weights due to their scarcity and those more adopted merit less weights.

Table 1 Factor analysis of departmental strategies in STEM fields

Variable	Mean	Std. dev.	I	II	III
Diversity strategy					
Increasing the racial diversity of faculty	2.74	.81	.99		
Increasing the gender diversity of faculty	2.75	.81	.74		
Teaching strategy					
Increasing the number of classes offered	1.79	.81		.31	
Improving the quality of graduate students	3.44	.69		.58	
Improving the quality of classroom teaching	2.86	.81		.63	
Research strategy					
Increasing the research ranking of your department	3.56	.67			.56
Increasing the amount of sponsored research	3.63	.56			.63

Method: maximum likelihood

Rotation: orthogonal varimax (Kaiser off)

I = Diversity strategy

II = Teaching strategy

III = Research strategy

Table 2 Descriptive statistics of family friendly policies

Family friendly policies	Formal university policies		Familiarity with family friendly policies						
	Mean	Std. dev.	4 (%)	3 (%)	2 (%)	1 (%)	Missing variables	Mean	Std. dev.
Stop the tenure clock	.60	.25	47	37	10	2	8	3.38	.74
Paid family leave	.55	.27	28	44	23	5	12	2.94	.85
Unpaid family leave	.55	.26	22	41	31	7	12	2.78	.86
Onsite childcare	.34	.25	20	35	30	25	32	2.61	.97
Spousal employment assistance	.33	.26	25	38	26	11	34	2.78	.94
Workload reduction for family reasons	.42	.27	19	36	29	11	25	2.67	.93

The percentages were calculated via dividing the number of valid responses in each category by the total number of respondents. Four categories were reported, with 4 signaling "very familiar", 3 "somewhat familiar", 2 "not very familiar" and 1 "not at all familiar"

disciplines exercise little significant impact on chairs' awareness relative to university factors (regressions not reported).

Research Findings

The factor analysis (Table 1) produced three departmental strategies: diversity, teaching and research strategy. Most departments acknowledged some priority with regard to diversity issues. Diversity strategy was manifested on two items: increasing the racial

diversity of faculty and increasing the gender diversity of faculty, which accounted for roughly half of total variance. Teaching strategy was reflected on three items: increasing the number of classes offered, improving the quality of graduate students and improving the quality of classroom teaching, which amounted to 27 % of total variance. Comparatively, research strategy was more prioritized than both teaching and diversity strategies, signaled by higher means and smaller standard deviations across the board. Given that our population is research-doctorate programs in prestigious universities, their emphasis on research excellence has been well justified (Brewer et al. 2002). Research strategy was reflected on two items: increasing the research ranking of your department and increasing the amount of sponsored research, which corresponded to 24 % of total variance.

Table 2 presents the descriptive statistics of family friendly policies. Sixty percent of department chairs indicated the formal presence of tenure clock stop policy on campus, the percentage going down to 55 % for the policies of paid family leave and unpaid family leave. Forty-two percent of chairs suggested that their universities had formal policies on workload reduction for family reasons and around one third of respondents confirmed the presence of onsite childcare and spousal employment assistance policies. Further analysis showed wide variation among chairs, even those within the same universities, suggesting that chairs' knowledge about formal university policies was uneven and to some extent worrisome.

Among valid responses, forty-seven percent of department chairs claimed to be very familiar, 37 % somewhat familiar, 10 % not very familiar and 2 % not familiar at all with the tenure clock stop policy. The variation appeared to be more striking in other types of policies. 28 % of chairs were very familiar, 44 % somewhat familiar, 23 % not very familiar and 5 % not familiar at all with the paid family leave policy. When it comes to the policy of onsite childcare, only 20 % were very familiar and 25 % were not familiar with it at all. The rest of respondents were roughly split between somewhat familiar and not very familiar. Nineteen percent of respondents claimed to be very familiar with the policy of workload reduction for family reasons and 11 % had no knowledge at all with this policy.

Aside from the tenure clock stop policy, the majority of department chairs had their levels of policy knowledge between somewhat familiar and not very familiar. A good portion of chairs showed little familiarity with multiple policies. Given that academic departments are responsible for implementing these policies (Ann 2000), their limited knowledge raises concerns whether these policies are effectively implemented and if so, to what degree of effectiveness. Extant literature has pointed out that lack of supervisory support is one of main barriers for members to use family friendly policies (Frye and Breaugh 2004). In academia, lack of supervisory support among chairs may at least be partially attributable to their limited knowledge on family friendly policies.

One concern is raised with regard to the missing variables. Aside from tenure clock stop policy, more than 10 % of respondents failed to indicate their levels of knowledge with specific family friendly policies, the percentage going even higher up to 34 % on the policy of spousal employment assistance. One may argue that no responses may signal chairs' lack of knowledge on specific family friendly policies, particularly when such policies were present on campus. To test this possibility, a series of dummy variables were created and multilevel mixed effect models were run (regressions not shown). The missing patterns varied widely across different types of policies. Departments with a diversity strategy proved more likely to have valid responses on policies of tenure clock stop, unpaid family leave and spousal employment assistance, suggesting that diversity strategy seems to improve chairs' awareness on these policies. Departments with more resources were more likely to respond on the policies of onsite childcare and workload reduction for family

reasons, possibly indicating that more resources facilitate more accommodation of these family-related concerns. On the contrary, prestigious departments were less likely to respond on the policy of workload reduction for family reasons. The implications of these findings need to be interpreted in combination with the general models presented below.

The descriptive statistics of independent variables are presented in Table 3. The means of three categories of departmental strategies were the factor scores extracted from the factor analysis (Table 1). Female members accounted for 17 % of faculty bodies within departments, confirming their underrepresentation status. STEM departments generally showed positive views on their family friendliness relative to their peers. The average index of departmental resources was 0.19, with a wide variation across departments. Roughly eleven percent of chairs aspired to move up in the administrative hierarchy. Only ten percent of department chairs were female, suggesting that chair position remained to be male-dominated. The average tenure of department chairs was 6.6 years. Twenty percent of department chairs were recruited from the outside. Seventy seven percent of departments were public. In terms of academic disciplines, 48 % were in engineering fields, 34 % in physical science and 18 % in life science.

The regression outcomes are reported in Table 4. One common finding is that departments with a diversity strategy demonstrate higher levels of knowledge on all family friendly policies except onsite childcare. The odds ratios for departments with a diversity strategy proved 41 % higher on their knowledge of tenure clock stop policy, 21 % higher on paid family leave, 31 % higher on unpaid leave, 49 % higher on spousal employment assistance, and 35 % higher on workload reduction for family reasons relative to those without a diversity strategy. Noticeable is that a diversity strategy seems particularly helpful to gain knowledge on those less adopted policies such as spousal employment assistance and workload reduction for family reasons, among others. Cumulatively, departments with a diversity strategy proved family friendlier than those without. The

Table 3 Descriptive statistics of independent variables

Independent variables	Mean	Standard deviation	Min	Max
Diversity strategy	.07	.99	−2.24	1.75
Teaching strategy	.00	.76	−2.14	1.53
Research strategy	.03	.73	−2.54	1.02
Female faculty composition	.17	.13	0	.71
Peer pressure	2.52	.59	1	3
Departmental resources	.19	.11	0	.58
Career aspiration	.11	.32	0	1
Female chairs	.10	.30	0	1
Tenure	6.57	5.76	0	33
Outsider	.22	.41	0	1
Department prestige	41.17	33.21	1	169
Public	.76	.43	0	1
Department size	2.60	1.10	1	4
Engineering departments	.48	.50	0	1
Physical departments	.34	.47	0	1
Life science	.18	.38	0	1

Table 4 Multilevel mixed effect models on family friendly policies

Family friendly policies	Stop the tenure clock	Paid family leave	Unpaid family leave	Onsite childcare	Spousal employment assistance	Workload reduction for family reasons	Family friendliness
Level 1 factors							
Diversity strategy	1.41 (.17)**	1.21 (.13)*	1.31 (.15)**	1.12 (.14)	1.49 (.21)**	1.35 (.17)**	.16 (.04)***
Teaching strategy	.96 (.16)	1.07 (.16)	.99 (.15)	.95 (.16)	1.13 (.20)	1.34 (.22) *	.01 (.05)
Research strategy	1.25 (.23)	1.14 (.17)	1.07 (.16)	1.03 (.17)	.87 (.17)	.90 (.15)	.06 (.06)
Female faculty	.29 (.28)	.81 (69)	1.53 (1.27)	.26 (.25)	.61 (.69)	1.03 (.97)	.06 (.32)
Peer pressure	.89 (.20)	.91 (.17)	.89 (.17)	.95 (.22)	1.87 (.48)**	1.20 (.26)	.01 (.07)
Department resources	1.04 (.01)**	1.01 (.01)	1.01 (.01)	1.02 (.01)**	1.01 (.01)	1.02 (.01)	.01 (.00)**
Career aspiration	1.61 (.65)	1.93 (.68)*	3.47 (1.23)***	1.62 (.60)	3.53 (1.59)**	2.58 (.99)**	.35 (.12) **
Female chairs	1.63 (.67)	3.49 (1.31)**	2.26 (.79)**	2.45 (1.08)**	2.50 (1.20)*	1.59 (.62)	.28 (.13)**
Tenure	1.04 (.02)*	1.03 (.02)*	1.06 (.02)**	.97 (.02)	1.00 (.02)	1.01 (.02)	.01 (.01)
Outsider	.95 (.30)	.69 (.18)	.62 (.16)*	.71 (.22)	.97 (.32)	1.11 (.32)	−.09 (.10)
Department Prestige	1.00 (.00)	1.00 (.00)	1.00 (.00)	1.00 (.00)	1.00 (.01)	1.00 (.00)	−.5.96e−06 (.00)
Department size	.91 (.12)	1.25 (.15)*	1.09 (.12)	1.23 (.18)	1.02 (.15)	1.06 (.13)	.05 (.04)
Public	.81 (.24)	1.24 (.31)	1.50 (.37)	.64 (.18)	.76 (.25)	.68 (.19)	−.03 (.09)
Engineering departments	.96 (.34)	.73 (.22)	.76 (.23)	1.48 (.50)	1.14 (.41)	1.36 (.46)	−.03 (.11)
Physical departments	1.12 (.41)	.94 (.30)	.97 (.31)	1.58 (.57)	1.79 (.71)	1.65 (.59)	.11 (.12)
Level 2 factors							
University	.61*** (.35)	5.464e−16*** (3.211e−08)	1.138e−22*** (5.076e−12)	.16*** (.26)	.76*** (.56)	.19*** (.23)	.19*** (.07)

Table 4 continued

Family friendly policies	Stop the tenure clock	Paid family leave	Unpaid family leave	Onsite childcare	Spousal employment assistance	Workload reduction for family reasons	Family friendliness
Log likelihood	−306.42	−370.35	−375.99	−316.35	−293.61	−341.55	−394.90

1. * $p < .10$, ** $p < .05$, *** $p < .001$

2. The last model "family friendly policies" differed from all others in that the dependent variable is continuous, which necessitates the use of mixed linear model

magnitudes of these effects are substantial, highlighting the great importance of a diversity strategy within departments. No evidence is found that teaching or research strategies are at odds with family friendly policies.

Departments with more female faculty fail to push for more knowledge on family friendly policies, contradicting our hypothesis. Departments self-assessed with a less desirable status on family friendliness tend to possess more knowledge on spousal employment assistance policy, with their odds ratios being 87 % higher than their peers. Chairs in resourceful departments gained more knowledge on tenure clock stop, onsite childcare and general family friendliness, though the magnitudes seem trivial.

Female chairs demonstrated a higher level of knowledge on the policies of paid leave, unpaid leave, onsite childcare and spousal employment assistance ($p = .06$), supporting the hypothesis that female chairs are more knowledgeable about family friendly policies. Their odds ratios proved more than 2.5 times higher on paid leave, and roughly 1.5 times higher on unpaid leave, onsite childcare, and spousal employment assistance than those of male chairs. Positive evidence was also found in the general family friendliness model. To further explore whether female chairs in resourceful departments are more knowledgeable of family friendly policies, we added an interaction term between departmental resources and female chairs into regression models. However, no significance was found (regressions not reported), indicating that female chairs act as women advocates regardless of possible limitations on department resources.

Chairs aspiring to move up in the administrative hierarchy showed more awareness on the policies of unpaid leave, spousal employment assistance, and workload reduction for family reasons, with the odds ratios being 2.5 times higher on the first two policies and 1.5 times higher for the latter. Individual career aspiration also proved significant in the general family friendliness model. One might wonder whether aspiring chairs, when endowed with more departmental resources, would be more knowledgeable about family friendly policies. Adding the interaction effects between career aspiration and departmental resources (regressions not reported), we failed to find empirical support, indicating that career aspiration and departmental resources seemingly play out independently.

Those with longer tenure had more knowledge on tenure clock stop and family leave policies, whereas those recruited from outside had less knowledge on unpaid family leave policy. University-level factors proved highly significant across all models, suggesting that chairs' knowledge on family friendly policies is constrained by university contexts. This provides a good testament for the presence of the clustering effect. Further analyses showed that multiple assumptions hold across the models and that model specifications are robust (regressions not reported).

Discussion

Our inquiry is to map STEM departments' awareness and knowledge of family friendly policies and further investigate their potential determinants in the context of United States. The call for more family friendly policies has been loud among STEM departments; yet implementation is not up to expectations (Quinn et al. 2004). Our study contributes to extant literature by exploring the knowledge gap on family friendly policies among chairs of STEM departments. We find that chairs' knowledge of family friendly policies is at least worrisome and that their knowledge is simultaneously empowered and constrained by their working contexts and incentives.

Using a representative sample of STEM departments in American research universities, we find that departments possess more knowledge of family friendly policies if with a diversity strategy. Coupled with more active responses to survey questionnaires, a diversity strategy proves effective in promoting more awareness on family friendliness among departments. This finding corroborates existing studies (Gilbert et al. 1999; Su et al. 2014). After all, a diversity strategy requires systematic thinking and massive efforts within organizations, often soliciting policies and practices to institutionalize equity and diversity as a part of core value and to create conditions enabling all members, regardless of their races or genders, to fulfill their capacities and potentials (Dobbin and Kalev 2007; Sturm 2006). The presence of a diversity strategy directs departmental commitment toward all types of family friendly policies, and particularly toward those innovative and less adopted policies such as spousal employment assistance, unpaid family leave and others.

We find no evidence that research or teaching strategies work against family friendly policies. Our findings do not deny that research-doctorate departments may suffer chilly climate (Sandler 1986), or that broad institutional changes are deemed critical toward more inclusion (Etzkowitz et al. 2000; Rosser and Lane 2002), but indicate that departments may be able to pursue research and teaching excellence without necessarily scarifying family friendly working environment. Indeed, the finding may present one assuring signal that family friendly policies can and should survive in research doctorate programs.

No evidence is found that more female faculty in STEM departments push for more departmental awareness of family friendly policies. This is surprising. Plausibly, due to low representation of female faculty in STEM departments, their voices have not been heard or transformed into collective preferences. Women only account for 17 % of faculty bodies, which is lower than the critical mass thresholds that have been found in existing literature (Meier et al. 1999). Alternatively, female faculty may be reluctant to push their demands for family friendly policies. Some may be concerned with career cost or other penalties associated with using family friendly policies (Baughman et al. 2003; Heywood et al. 2007; Mayer and Tikka 2008), whereas others may be highly sensitive and vulnerable to chilly climate and institutional barriers (Ingram and Simons 1995; Lewis 2001). A third possibility is that department chairs' awareness and knowledge of family friendly policies may not be aligned with faculty members' demands. To what extent these interpretations reflect reality remains unclear, and future studies are warranted in this regard.

Departments self-assessed with a less desirable status on family friendliness are motivated to have more knowledge on spousal employment assistance, the policy that mainly targets at recruiting and retaining more diverse members. Our finding suggests that self-assessment allows departments to identify inadequacies and adopt pertaining policies to rectify their less desirable status. Given that the major concerns among less friendly STEM departments seem to address the inadequate representation of female and minority faculty members, self-assessment is at least an important early step toward more comprehensive changes in departments.

Resourceful departments proved more knowledgeable about the policies of tenure clock stop, onsite childcare and general family friendliness. Tenure clock stop policy has been somehow institutionalized and its knowledge is well integrated into job duties. Endowed with more resources, chairs are more likely to exercise their job duties in full capacity. In our sample, 84 % of valid respondents indicated they were either very familiar or somewhat familiar with this specific policy. More knowledge of onsite childcare policy may be attributable to chairs' wider networks and stronger social capital, both of which can be facilitated by strong departmental resources. Resources fail to help department chairs to gain more knowledge on the policies of paid leave, unpaid leave or workload reduction for

family reasons. Not yet institutionalized on campus, these policies may require departments to adjust their workloads and/or bear potential costs. Seemingly, department chairs are not highly incentivized in these policy arenas. This presents a thorny issue for diversity management since department chairs may divert costly options even with resources at their disposal.

Chairs aspiring to move up in the administrative hierarchy tend to demonstrate more knowledge on the policies of unpaid leave, spousal employment assistance and workload reduction for family reasons. Given that these policies are less adopted on campus, aspiring chairs may use these arenas as grounds for better career pursuits. After all, learning is likely to be rewarded with a career promotion (March 1991). Aside from tenure clock stop, the policy of paid family leave is somehow institutionalized by the Family and Medical Leave Act of 1996. Knowledge about institutionalized policies is expected, failing to distinguish aspiring chairs from their less ambitious peers. Academic departments have very limited influence on the policy of onsite childcare and aspiring chairs may see only limited returns from learning this policy. We contend that aspiring chairs develop their policy knowledge in light of their career prospects. Chairs' attention to the policies of unpaid leave, spousal employment assistance and workload reduction for family reasons seems to fit well with our argument.

Female chairs prove more knowledgeable on family friendly policies, including the policies of paid family leave, unpaid family leave, onsite childcare and spousal employment assistance ($p = .06$), supporting the hypotheses of substantive representation theory. Nevertheless, concerns remain with regard to two other types of family friendly policies: tenure clock stop and workload reduction for family reasons. The institutionalized nature of tenure clock stop policy suppresses gender difference as its knowledge is generally expected. We argue that the substantive representation is most likely to occur among nascent and gendered policies wherein more leeway is afforded and more salience is perceived. Speculatively, the policy of workload reduction for family reasons may apply to broad situations that make it less gendered. However, to what extent this argument holds remains nebulous, subject to further investigation.

Policy knowledge is also shaped by other organizational and individual characteristics. Longer tenure results in more knowledge on tenure clock stop and family leave, the opposite being true that outside-recruited chairs have less knowledge on the unpaid family leave policy. The effects of university-level factors prove highly salient across all models. Further studies are in great need to unfold how university institutions and rules shape departments' awareness and practices on family friendly policies.

Conclusion

The pursuit of more equity and inclusion has been constant among STEM departments, for which family friendly policies are perceived as effective instruments. The limited success on embracing and implementing family friendly policies calls for more sophisticated understanding of how policy awareness and knowledge is nurtured and facilitated by departmental factors. We find that department chairs are key policy entrepreneurs, whose policy knowledge is subject to their working contexts and incentives. A diversity strategy within STEM departments proves critical as it not only improves policy awareness on different family friendly efforts, but offers special incentives for those innovative and less adopted ones. Departmental assessment of less desirable status on family friendliness helps

to promote policy knowledge on spousal employment assistance. Those aspiring to move up in the administrative hierarchy show stronger momentum to explore less adopted policies such as unpaid family leave, spousal employment assistance and workload reduction for family reasons. Female chairs prove more likely to be policy advocates and possess greater knowledge on policies of family leave, onsite childcare and spousal employment assistance.

One disappointing message is that family friendliness among STEM departments would not be naturally improved simply because more female faculty are recruited and retained. The low representation of female faculty has not pushed for more awareness on family friendly demands. Our finding contradicts with the general expectation that with more female faculty come more family friendly endeavors. Given female faculties' limited influence on policy awareness, our study provides support that effective interventions are needed to produce departmental changes on family friendliness and that the waiting strategy can hardly lead departments to where they need to be.

Chairs are key players in departments and their limited knowledge on family friendly policies presents a serious challenge. However, our study finds a few factors that empower chairs to pursue more family friendly efforts. Chairs prove more knowledgeable about family friendly policies if departments embrace a diversity strategy. This highlights the importance of a diversity strategy in STEM departments. Furthermore, we find evidence that departments committed to research and teaching strategies do not necessarily have to sacrifice family friendly efforts as they are not necessarily at odds with each other. We recommend that STEM departments adopt a diversity strategy and be prepared for leading changes toward more inclusive and friendlier working environment, regardless where they are in the field hierarchy (Bailyn 2003; Smart and Fox 2008).

For those less friendly departments, self-assessment may be an important early step to find out their deficiencies and sort out potential solutions. While much effort among less friendly departments tends to address the representation concerns among faculty bodies, self-assessment may lead departments to pursue more active endeavors over time. For instance, studies show that department chairs, after participating in intensive intervention workshops, show more commitment to policies on gender equity and inclusion (Stockard et al. 2008). Self-assessment on gender equity and family friendliness has been widely practiced among universities, evidenced by the production of women status reports among more than two thirds of research universities (Allan 2003; Smart and Fox 2008; Su and Gaughan 2014). For university administrators, self-assessment could be a good instrument to be practiced among STEM departments and to usher in positive changes on family friendlier environments.

Our study confirms that leadership matters and that choosing the right leader makes substantial difference (Newton 2002). Chairs aspiring to move up in the administrative hierarchy prove more knowledgeable about family friendly policies, particularly on innovative and less adopted ones. These policies likely present aspiring chairs with new opportunities for their careers (Vera and Crossan 2004). Female chairs seem to be motivated differently than male peers. They possess more knowledge about different family friendly policies and serve as policy advocates for female groups. Their advocacy roles are more likely to be detected among nascent and gendered policies, but not among institutionalized ones. Female chairs' advocacy roles present a good window for policy interventions. Seasoned chairs possess more knowledge on policies of family leave and tenure clock stop, whereas chairs in resourceful departments show more awareness on the policies of tenure clock stop and onsite childcare, both suggesting that policy knowledge takes autonomous efforts and time to develop.

Family friendliness among STEM departments hardly takes place by and in itself, but requires active intervention, for which adequate knowledge is deemed critical. Our study finds that chairs possess limited knowledge on family friendly policies and that chairs are presented with different incentives and constraints in pursing more family friendly endeavors. A diversity strategy proves to be an effective instrument, so are localized interventions such as conducting self-assessment of family friendliness among departments, granting more departmental resources, choosing seasoned and aspiring leaders, and unleashing female chairs' advocacy roles. One cautionary note is that incentives and constraints vary across different specific policies. Analysis of specific policies is always necessary for better design and implementation of policy interventions.

Our study is also presented with different limitations. First, our study is largely based on survey data, which often solicits socially desirable responses and other concerns. For instance, to what extent departments are truly committed to diversity strategy remains to be unanswered. Our study sample has more representation of departments committed to diversity strategy and future studies are needed to unfold the potential dynamics. Second, the study focuses on department awareness and its antecedents, without paying attention to real implementation and use of family friendly policies. Future studies are warranted to explore how departments facilitate the use of specific policies and what are the possible outcomes of using family friendly policies among faculty members. Building awareness of family friendly policies is an early effort and only provides baseline knowledge, upon which future studies should be empowered to further test different dynamics and if possible, empirical intervention should be well designed.

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