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The Distribution of Family-Friendly Benefits Policies across Higher Education Institutions: A Cluster Analysis

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Abstract
Although the underrepresentation of women in science and engineering tenure-track faculty positions is often linked to the conflict between childcare responsibilities and the normative academic tenure-track pathway, previous studies have tended to focus on individual life choices, rather than the effects of institutional-level policies and structure. More recent research on work/life policies in higher education have pushed our understanding of how organizational structure and political climates at the department and institution levels influence the ability of faculty members to integrate career and life responsibilities. Many postsecondary institutions offer more generous work/life benefits than required by the 1993 Family Medical Leave Act (FMLA), which provides employees with 12 weeks of unpaid, job-protected leave for family and medical reasons per year if the employee has worked for the employer at least 12 months. The types of family-related benefits offered, however, vary greatly across postsecondary institutions in the United States. Taking a systems view of higher education institutions, this study uses k-means cluster analysis to identify how institutions cluster and the availability of parental leave and childcare benefits at clusters of similar institutions. By so doing, the paper highlights the rates at which different types of institutions adopted family-friendly policies since the FMLA. Results indicate that the adoption of family-related benefits (paid maternity leave, paid paternity leave, and subsidized childcare) increased during the time period following the enactment of FMLA, suggesting FMLA had some impact on the system. The increase in family-related benefits is associated with an academic institution's expenditures. Research institutions are more likely than master's, bachelors and associates institutions to offer a greater number of benefits. This study provides a historical national perspective of academic institutions' efforts to facilitate work-life integration among faculty with implications for helping administrators, policy makers, and other stakeholders shape educational policy.

Introduction

Family friendly legislation, such as paid maternal, paternal leave and subsidized childcare, exist as national policies in many European and other countries around the world[1-3]. Institutions in these countries, from businesses to universities, are required to implement at minimum the baseline requirements for these national policies. In contrast to many nations around the world the United States stands as an outlier in that it lacks national *paid* or *subsidized* family friendly policies[4-6]. The United States instituted the Family Medical Leave Act (FMLA) in 1993, which grants employees of companies with 50 or more employees 12 weeks of *unpaid* leave for the birth or adoption of a child[7]. Many institutions, however, offer family friendly benefits in excess of the FMLA. The breadth of these benefits varies across institutions at the discretion of the employer.

Previous research shows that family friendly policies are unevenly distributed across American universities[8,9]. The level of family friendly benefits provided to academic faculty has important implications for work-life balance. Family friendly policies have the potential to ease tensions associated with trying to start a family and having an academic career—tensions that are particularly acute for women[10]. These policies are particularly important in Science,

Technology, Engineering and Mathematics fields, where women remain underrepresented as faculty members[11]. While offering these types of policy may not be the only step in addressing barriers to entry and retention in STEM fields, providing inadequate or no policy limits these universities' ability to increase access and success for all faculty. Past research into how policies are distributed across American universities provides an overview of the types of benefits policies offered across institutions stratified by Carnegie Classification[8]. The Carnegie Classification groups institutions into categories, such as Master's, Baccalaureate, Associate, etc. Yet, institutions within a Carnegie Classification type can be quite heterogeneous across factors, including, importantly, policy offerings.

In this study we propose to use a complex systems framework to examine how the system of higher education institutions changed in response to the introduction of FMLA. In order to do so we draw on the technique of cluster analysis, specifically k-means[12,13] cluster analysis to sort institutions into internally similar but externally dissimilar clusters. Analyzing how the system of higher education institutions cluster before and after the introduction of FMLA can lead to many important insights. Our analysis is guided by the following questions: How many clusters do higher education institutions fall into and how many family-friendly policies are available at them? How do the clusters differ from studies that rely on the Carnegie Classification as groupings? What do the profiles of these clusters look like and how do the profiles change after the passage of FMLA? Answers to these questions provide critical details on how the system of higher education institutions have developed over time and may offer insights into their future trajectory. STEM students and faculty thinking about their career trajectories (e.g. whether to pursue a job in a research university vs. bachelor's only institution in light of balancing with family responsibilities) may also benefit from the findings of this study.

Our data come from the National Study of Postsecondary Faculty (NSOPF). NSOPF includes faculty member and institutional data. Our dataset for this study contains data from 1993 and 2004, which is the last year the NSOPF was administered. These two years were selected because FMLA was passed in 1993. NSOPF 1993's data collection started in 1992 and can therefore serve as a baseline of the patterns of policy distribution before FMLA's implementation. Data from 2004 will show changes, if any, in the patterns of family-friendly benefits distribution thereafter. Given that FMLA is a widespread national policy, we hypothesize that there will be positive change between these periods.

Literature Review

Challenges in work-life integration

Parents in the U.S. workforce have been shown to experience conflict associated with the ideal worker norm, which places an expectation on workers that they must prioritize their job over other commitments including family[14,15]. While men have taken relatively more responsibility for household and childcare compared to men from previous generations, there is still an existing norm for women to carry much of this responsibility[16,17]. This places a unique burden on women in the workforce. Indeed, researchers have found that women in academic STEM experience more work-family conflict[18]. Although expectations for childcare are lower for men than women, some men experience considerable pressure to maintain their work schedule after the birth of a child or are stigmatized for taking paternity leave[19].

Women continue to be underrepresented in STEM faculty positions in the United States[11]. Norms related to the ideal worker and familial responsibilities make it challenging for faculty women, as well as men, to integrate family with academic work[18, 20-22]. For example, Drago et al. report that women engage in a number of bias avoidance behaviors to avoid defying the ideal worker norm, such as remaining single, delaying childbirth or not attending their children's events[23]. Other researchers have reported similar bias avoidance activities, such as distancing oneself from others viewed as too 'feminine' [24,25]. Although these norms develop and fluctuate over time and vary across landscapes, they are, in many respects, deeply entrenched and require policy and other interventions to generate systemic changes and improvements[6,16]. In response to these conditions and calls for increasing the accessibility and equality in workplace institutions, numerous family friendly policies have been proposed. Paid maternal and paternal leave grant mothers and fathers time with their newborn or newly adopted children[1,3]. Childcare policies, particularly subsidized childcare, allow parents to have professionals care for and educate their children during business hours[16,26]. As comparative researchers have noted, however, the family friendly policy environment in the United States is very different than the family friendly policy environment in Europe and many other parts of the world[1,2,4].

U.S. family-related policies in context

The vast majority of countries, excluding the United States, have some form of paid maternal leave[1,2]. Indeed, as of 2007, there were only 3 countries in the world that did not offer some form of paid maternity leave[2]. Although not as widespread as paid maternity leave, many countries also offer paid paternity leave or leave for fathers to spend time with their children after birth. However, the lengths of paternity leave are typically shorter, some as short as two weeks[1]. In contrast, some European countries like France and Sweden have a year or more of maternity leave[16]. It is important to note, however, that not all countries fully subsidize parental leave; in some, it is only partially subsidized[1,27]. Furthermore, many countries have some form of childcare policy[16]. For instance, France and Nordic countries have subsidized and high quality, regulated childcare. Childcare can include both care-taking and educational components[16] and French society typically views exposure to and experience in subsidized childcare as a means for developing well-adjusted children[16].

In contrast, the United States has no national policy for paid paternal or maternal leave[1,2] and its childcare policies primarily comprise providing childcare to families with lower incomes (e.g. Headstart) or providing tax breaks for commercial childcare[26]. The one national family friendly policy it does have is FMLA. Research on the effects of FMLA reveal modestly higher levels of leave taken[7,28,29] with mixed findings on its effect on wages[7,30]. Although they only apply within state boundaries, some states do supplement FMLA with additional provisions including paid leave [28,31].

In the absence of a national policy, some institutions, including universities, have established their own family friendly policies[8,9]. Hollenshead et al. (2005) present the most comprehensive treatment of family friendly policies at American universities and colleges to date[8]. In their analysis they find that research-intensive doctorate-granting universities offer the largest number of policies related to work-life balance. These policies include paid parental leave and dependent care, tenure-clock extension, reduced workload and release from work responsibilities such as teaching. In decreasing order, doctorate-granting (non-research intensive), masters' colleges, 4-

year colleges and 2-year associate colleges follow research-intensive doctorate granting universities in the number of family-friendly policies offered.

Hollenshead et al. (2005) provide a significant overview of the distribution of family-friendly policies across U.S. academic institutions using Carnegie Classifications. The heterogeneity of institutions within Carnegie categories, however, leads to questions regarding whether there are differences within or similarities across Carnegie classifications. We contribute to this literature by providing a more nuanced inspection of the level of benefits policies offered - generating detailed profiles for groups of institutions on key factors using comprehensive data sampled from institutions across the United States. Further, we present a historical account of changes in benefits policies across two meaningful time points (the inception of FMLA and ten years thereafter) to demonstrate patterns in the uptake of more family-friendly policies.

Theoretical Framework

The complex systems framework comes from the interdisciplinary field of Complexity Science, where complex systems are the primary objects of study across the physical sciences, social sciences, biological sciences and other fields[32]. In this framework systems are defined as bounded entities with an interconnected set of elements or objects that interact on some level. For example, here academic institutions and their faculty members are the set of components within a bounded entity and they can potentially interact by forming partnerships. While this is a relatively standard definition of a system, the complexity emerges when we examine the system context and components. The system is situated in some environment (here the policy environment of the U.S.) and components of the system respond to changes in that environment. In a complex system such as the set of U.S. higher education institutions, the institutions (components of the system) have some agency and ability for self-organization in how they respond to changes in their environment. In contrast, for a non-complex system, such as an automobile, the mechanical, chemical, and electrical components have relatively stable interrelationships and require direct input from a driver; it cannot self-organize and respond as an agent. Another important concept for complex systems is that an historical trajectory exists. Given the agency and ability to self-organize in complex system, its historical trajectory may transform considerably over time. Education is one of the major social systems that define modern society[33] and thus, the complex systems framework can provide a foundation to study the whole of U.S. higher education institutions as a coherent system that is interrelated and changing over time.

This framework also unveils two critical attributes of the NSOPF 93 and 04 data that highlights its relevancy. First, as will be discussed in more detail in the data section, the NSOPF data is the most comprehensive and largest dataset currently available. The data includes institution-level and individual-faculty level data for over 900 institutions across the United States across time. NSOPF uniquely provides an opportunity to model changes in institutional benefits policies across time (for example, between 1993 and 2004).

The second attribute highlights a unique aspect of the data. During the time between these two periods, FMLA went into effect in the United States. FMLA happened in the larger policy environment in which the educational system is positioned and as we discuss impacted the system. No other national-level family-friendly policy has been passed in the U.S.; therefore,

this event represents a unique instance in the systems trajectory that would be lost by looking at later data only (e.g. 2004-2013, if it were available). By studying these periods we can understand the impact of this unique event on the system. While changes have likely continued since 2004, the NSOPF constitutes a historical account of the benefits policies environment of the pre-FMLA and the period thereafter. Documenting the past trajectory of this system is critical for understanding our current and potential trajectory in designing policies to integrate work and life.

Methods

Cluster analysis is a family of techniques that group units of study (e.g. people, animals, and institutions) based on similarity, dissimilarity or correlations between a set of measures[34]. Most cluster analysis techniques take as input a set of variables associated with each case to be grouped or clustered. The techniques then use one of the methods above, as reflected in different sorting algorithms, to generate one or more clusters of related cases. It is used across many fields including education, engineering, and life, social, and physical sciences[12,13,35,36] for many purposes including verifying underlying group structures or as exploratory and data-mining methods. This study applies a k-means cluster analysis, a well-established technique previously used in engineering education research, to identify clusters of institutions with different profiles that have a greater or fewer number of family-related benefits. Past studies in engineering education research have used k-means to develop skill and ability profiles for students in community learning programs[37], profiles of engineering students' study habits[38], profiles of students' key engineering skills and abilities as identified by *The Engineering of 2020*[39,40], as well as to categorize institutions offering technical entrepreneurial courses[41].

As a cluster technique, k-means requires the researcher to select the number of clusters, *k*, as well as a list of relevant variables for use in sorting the cases. Here, each institution constitutes a case. K-means then operates by using a method (e.g. randomized or criteria defined[42]) to select initial seeds that operate as the clusters "centroids," that is the centroids values are used as the means for the cluster. K-means then attempts to minimize the distance between cases and these centroids by moving cases to their closes matching clusters[13]. After this, centroids are updated to be the mean of all of the cases now in the cluster. This continues until changes in case location will only have a miniscule effect on distance minimization.

While some researchers recommend the use of algorithms for selecting the number of *k* or clusters to run on k-means before analysis (e.g.[43,44]), others use an exploratory data-driven (mining) approach where multiple cluster solutions are analyzed[12,42]. Like Castellani and Rajaram[12], we apply an exploratory, data-driven approach in identifying the number of clusters, selecting a 5 cluster solution for the 1993 and 2004 data. To avoid potential limitations associated with an exploratory analysis, we explored multiple cluster solutions for the 1993 and 2004 data, starting with 2 clusters and ending at 10 clusters. Results were analyzed for consistency with past research findings and against an external variable to check for non-arbitrary clusters[34]. External variables are variables not used in the cluster analysis that have been found to (through related research) differ systematically with the unit of analysis or other variables used to generate clusters. We use the Carnegie Classification for academic institutions as our external variable. The 1987 Carnegie Classification system[45] is used for the 1993 data and the 2000 system[46] was used for the 2004 data. Furthermore, we conducted a replication analysis

after the exploratory study. Here the data is split into two random samples and clustered. Then the centroids in sample A are matched with the cases in sample B. Finally Cohen's Kappa is used to calculate agreement between the cluster assignments in sample B and their matched centroid in sample A[43,47]. Clusters in 2004 and 1993 both had high levels of agreement at 87.3 and 86.5, respectively. Based on these analyses, we selected the 5-cluster solution.

Although the following variables were collinear: full time faculty, graduate students, and expenditures, they were included in the models because analyses with and without these variables remained identical. Further analyses and variable swapping revealed that expenditure had a dominant influence over the clusters. The converse did not hold. Using other institutional factors or policy factor alone resulted in mostly homogenous (across factors) and similarly-sized clusters. Thus while profiles are presented in our analysis to give a deeper understanding of each cluster, the primary predictor of the clusters is expenditure. The categorization system used in Hollenshead et al, Carnegie Classification, also relies implicitly on expenditure, as institutions generally have higher funding as one moves across categories. As reported below, our system is less constrained than Carnegie and allows for a more nuanced understanding of institutions interrelationships.

Castellani and Rajaram (2012), in their work on modeling complex social systems, have argued for the use of clustering techniques like k-means at different time points to produce comparable

Table 1: Description and Summary Statistics of Profile Variables

Variable Name	Description	1993 Mean	1993 SD	2004 Mean	2004 SD
Institutional Faculty Demographics					
Full time faculty	Average number of full-time faculty members	401	559	434	602
Part time faculty	Average number of part-time faculty	241	316	289	377
Institutional Student Demographics					
Undergraduate students	Average number of undergraduate students	7,717	7,248	7,635	7,671
Professional Students	Average number of professional students	179	470	224	544
Graduate students	Average number of graduate students	1,295	2,243	1,448	2,400
Native American students	Average percent of NA students	.73%	3.5%	.63%	1.6%
African American students	Average percent of AA students	10%	16%	12%	18%
Hispanic students	Average percent of Hispanic students	5.5%	10%	7%	12%
Asian students	Average percent of Asian students	4.3%	7%	4.8%	7.2%
Academic Workplace Conditions					
Tenure Rate	Average proportion of faculty who receive tenure over who applied for tenure	64%	40%	68%	41%
Institutional Expenditure	Average total expenditure of an institution (in millions)	$86	$150	$161	$282
Family-friendly policies	Average number of policies offered	2.02	1.78	2.16	1.83

"maps" of social systems[12]. By comparing two or more maps of a social system or subsystem, continuity and change within that system can be identified. Consistent with Castellani and Rajaram (2012), we use clustering techniques to analyze changes in social system across time[12]. We hypothesize that there will be changes in the institutional profiles between 1993, when FMLA was introduced, and ten years thereafter in 2004.

Data

The data come from the National Study of Postsecondary Faculty (NSOPF) Institution survey conducted by the National Center for Education Statistics with response rates exceeding 86%. The 1993 and 2004 samples include 872 and 920 public and private not-for-profit institutions that confer associates, bachelors, or advanced degrees, respectively. The institutional questionnaire covered topics including number of faculty and staff, trends in tenure, employment benefits (including family friendly policies), size of student enrollment by race/ethnicity, institutional funding, and other relevant institutional demographics. For all years NSOPF also administered individual faculty surveys, which have been used fruitfully for much research[48-53]; however, there appear to be few studies that use the institution survey.

The variables we selected to use in the k-means analysis can be grouped into three different categories, displayed in table 1. Table 1 displays the variable names, a description of the variable and its mean and standard deviation for 1993 and 2004. Institutional Faculty Demographics include the number of full time and part time faculty at institutions, whereas Institutional Student Demographics describe the number of undergraduate, professional and graduate students, as well as the percentage of racial/ethnic representation in the student body for Native Americans, African Americans, Asians and Hispanics. The final variables under Academic Workplace Conditions include each institution's total expenditure, rate of tenure for the previous year at the institution, and the types of family friendly benefits offered. Taken together these 3 categories provide an in-depth profile of institutions with greater or fewer number of family friendly policies.

The family friendly policies variable requires additional explanation. Four policies, paid maternal leave, paid paternal leave, childcare services and subsidized childcare, are included in this composite variable. If a university or college had this policy it was coded as 1 and if it did not, it was coded as a 0. These policies are not equally available for part time and full time faculty; therefore, presence or absence was counted for both faculty types, for maximum total of 8. These policies were measured with some slight differences in 1993 and 2004. We merged the variables from 1993 and 2004, which resulted in a measure of the presence or absence of a policy for at least some faculty with at least partial subsidy. It is important to note that institutions with no tenure system as well institutions who had a tenure system but had no faculty members receive tenure will both have tenure rates of 0, for this analysis.

Due to missing key variables, several cases were dropped: 43 cases were dropped from the 1993 dataset and 48 cases were dropped from the 2004 dataset. Analysis of the distributions of different institution types before and after the cases were dropped revealed minimal (<1%) shifts suggesting that their removal should have minimal impact on results. The resulting dataset contains 829 observations in 1993 and 872 of observations in 2004.
A limitation of the research data is that NSOPF was last collected in 2004, and the National

Center for Education Statistics does not plan to administer this survey again. Although the data is not current, it constitutes the most comprehensive data available on academic institutions and benefits policies. Although the NSOPF is a nationally representative dataset, we did not use the weights in our analysis. Our results are therefore not representative of all institutions in the United States; however, given the sample size, NSOPF provides a relatively broad look at the landscape of family friendly policies across academic institutions. Furthermore, the two samples from 1993 and 2004 are well suited to address one of the main objectives of identifying changes in the level of benefits policies offered across institutions in the time following the introduction of the FMLA. The large sample of institutions and numerous variables contained in NSOPF enable us to generate an array of profiles to describe in depth groups of institutions by policy offerings. It is worth noting that NSOPF data continues to be used in recent research despite being somewhat older[48,49,53]. Finally, the NSOPF institution survey appears to have received less attention from researchers than the faculty survey, providing an opportunity to address issues of work-life balance from a different perspective.

Preliminary findings from exploratory cluster analysis

Aggregated summary statistics

Table 2 presents the percentage of institutions offering each of the policies for part time and full time faculty in 1993 and 2004. As the table shows, the proportion of institutions offering paid paternity and paid maternity leave to part-time and full-time faculty increased between 1993 and 2004. Interestingly, the number of institutions offering childcare benefits shows the opposite trend. For example, the proportion of institutions offering childcare in 1993 was 40% compared to 29% in 2004.

Table 2: Policy coverage across institutions

Part Time		**1993**	**2004**	
Paid Maternity Leave		17.6%	25.5%	
Paid Paternity Leave		10.4%	16.6%	
Childcare Available		20.7%	20.9%	
Childcare Subsidized		6%	4.8%	
Full Time		**1993**	**2004**	
Paid Maternity Leave		53.7%	66.6%	
Paid Paternity Leave		40%	45.1%	
Childcare Available		40.2%	29%	
Childcare Subsidized		13.0%	7.1%	
1993 Policy Composite				
Count	Min	Mean	Max	Standard Dev.
830	0	2.02	8	1.78
2004 Policy Composite				
Count	Min	Mean	Max	Standard Dev.
872	0	2.16	8	1.83

Cluster analysis preliminary results

Table 3 shows the results of the 5 cluster analysis of the 1993 and 2004 data. Note that expenditures are displayed in the millions. Table 4 displays the clusters by Carnegie categories. The 5-cluster analyses of the 1993 and 2004 data generated groupings we identify as Research A, Research B, Research C, doctoral/masters tier, and associate/bachelors tier. Both 1993 and 2004 data generated a cluster that includes an overwhelming majority of associates and bachelors

colleges (1993: cluster 2 and 2004: cluster 4). Collectively this cluster, referred to as associate/bachelors tier, has the lowest expenditure and the least number of policies, on average. In regard to the number of family friendly benefits policies offered, the cluster identified as the doctorate/masters tier (2004: 5, 1993:5) has a greater average number of benefits and greater average institutional expenditures than the associate/bachelors tier. These two tiers are followed by Research C, Research B, and Research A in generally ascending order in the prevalence of benefits policies and expenditure. An interesting exception to this appears in the 2004 for the Research B cluster. In 2004 this cluster has a higher policy average than the Research A, but lower expenditures.

Consistent with Hollenshead et al. (2005), we also find that doctorate institutions offer the most family friendly policies, followed by master's institutions and then bachelors and associates. Our clusters, however, provide interesting distinctions. Although bachelors' colleges may have had more policies than associates in Hollenshead et al.'s (2005) findings[8], the profiles of associates and bachelors

Table 3: Cluster Profiles for 1993 and 2004

	5 Cluster Solution 1993					5 Cluster Solution 2004				
Variable	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Academic Workplace Conditions										
Policies	3.70	1.78	2.96	3.06	2.70	3.67	3.13	4.00	1.90	2.97
Tenure Rate	81%	60%	81%	75%	80%	79%	84%	76%	64%	86%
Expenditure	$919	$29	$344	$618	$153	$1,914	$708	$1,297	$54	$321
Institutional Faculty Demographics										
Full Time Faculty	2,070	194	1,527	2,116	735	2,805	1,861	2,365	187	944
Part Time Faculty	1,164	197	430	369	324	1,079	522	819	231	422
Institutional Student Demographics										
Undergrad. students	20,220	5,876	15,873	18,195	12,595	20,131	16,628	19,070	5,798	13,005
Professional students	1,922	41	970	1,237	374	1,994	1,141	1,749	54	564
Graduate students	10,551	464	5,269	6,550	2,937	10,578	5,782	7,981	596	3,474
Native American students	1%	1%	0%	0%	1%	1%	0%	1%	1%	1%
African American students	5%	11%	6%	5%	6%	5%	7%	5%	13%	8%
Hispanic students	4%	6%	4%	5%	6%	4%	5%	7%	8%	6%
Asian students	9%	4%	6%	11%	5%	11%	9%	10%	4%	7%
Cluster Title	Resrch. A	Assc/ Bach. Tier	Resrch. C	Resrch. B	Doct/ Mast Tier	Resrch. A	Resrch. C	Resrch. B	Assc/ Bach Tier	Doct/ Mast Tier

institutions are similar enough in our sample that they are grouped together in the same cluster (this remains true even when the number of clusters is changed up to $k = 10+$). Thus when these

institutions are not constrained to be separate, a cluster analysis finds they are more similar than different. Cluster similarities are robust and remained regardless of k level or variables included. It is important to note, however, that Hollenshead et al did not measure the presence of childcare policies, but they had more parental leave related policies (which are covered in the literature review). So while the ordering remains the same the policies identified are not identical. It is also important to note that the actual differences in Hollenshead et al between associates and bachelors colleges was .2 of a policy, lending further evidence to the categories being largely indistinguishable in terms of family-friendly policy. On the other hand, our clusters highlight the heterogeneity in the number of benefits policies offered across doctoral institutions. Thus when institutions are not constrained to be in the same category, a cluster analysis finds they separate into multiple (three to four) clusters. In contrast, associates, bachelors, and master's institutions pool into one to two clusters.

Turning to the profiles we see that, not surprisingly, moving from clusters with less expenditure to more expenditure, the number of undergraduate, professional and graduate students increase. Likewise the overall number of full time faculty increase following a similar trend as do part time faculty in 2004. In 1993 the levels of part time faculty are flatter between clusters. While raw numbers between these periods generally rose for both full time and part time faculty, the ratio of part time to full time increased for the research B (.17 → .35) and associates/bachelors cluster (1 →1.2) and dropped for research A (.56 → .39). In terms of student demographics, Hispanics and Native Americans are distributed similarly across clusters whereas Asians have higher representation in the research clusters and African-Americans have higher representation in the doctorate/masters and associates/bachelors cluster.

Table 4: Carnegie Classifications for 1993 and 2004

5 Clusters by Carnegie Classification 1993					
Institution Type	**Cluster 1**	**Cluster 2**	**Cluster 3**	**Cluster 4**	**Cluster 5**
Doctoral Extensive	10	1	43	18	15
Doctoral Intensive	0	41	2	0	49
Masters	0	193	1	0	22
Bachelors	0	69	0	0	0
Associates	0	317	0	0	6
Other	0	24	1	0	12
Cluster Size	10	650	47	18	104
5 Clusters by Carnegie Classification 2004					
Institution Type	**Cluster 1**	**Cluster 2**	**Cluster 3**	**Cluster 4**	**Cluster 5**
Research Doctoral	6	38	18	21	79
Doctoral Granting	0	2	1	52	30
Masters	0	0	0	158	9
Bachelors	0	0	0	126	0
Associates	0	0	0	280	2
Other	0	0	0	50	0
Cluster Size	6	40	19	687	120

Comparison of 1993 and 2004 clusters reveals some important patterns. As our earlier descriptive statistics in table 2 highlighted, there were increases in paid parental leave policies between 1993 and 2004 and decreases in childcare policies during this same period. Comparison of clusters in 1993 and 2004 show increases in the number of policies for most clusters,

suggesting that the gains in paid parental leave outweighed the losses in childcare policies. Thus, as we hypothesized, FMLA, an unpaid parental leave policy passage was followed by increases in the number of paid parental leave policies across the system of higher education institutions.

For three clusters (associates/bachelors, doctorate/masters, research C) saw increases in the level of policies offered from 1993 and 2004. The research B cluster policy average skyrocketed an entire policy (~3 to 4 policies on average) and research A remained about the same. Generally across 1993 and 2004 the number of policies averaged in each cluster increases across clusters.

Discussion

The passage of FMLA seems to have an interesting effect on the system of higher education institutions. FMLA provides a baseline requirement that institutions with 50 or more employees (to which most academic institutions fall) must guarantee 12 weeks of unpaid leave for employees of one year or greater for a number of conditions including the birth or adoption of a child. Earlier inspection of the proportion of institutions with paid parental leave suggests some academic institutions had already gone further than FMLA. During the span of 10 years the proportional coverage of childcare available and childcare subsidies decreased in all but one category (childcare available for full-time faculty) whereas paid parental leave increased in all categories. As reported above, the increases in paid parental leave outweighed decreases in the number of childcare benefits offered across clusters, resulting in increases in the overall level of policies in clusters. This suggests the change in the policy environment did more than set a baseline for institutions and may have encouraged or opened the door for institutions to build and expand upon FMLA's requirements. FMLA seems to have a marked effect on the system and its trajectory, which also has important implications for future family-friendly policy: it may also allow for or encourage further expansion of institutional family-friendly policy across the system. This is particularly salient in light of calls from the National Academies (2007)[54], AAUW (2010)[55] and other organizations to increase family-friendly policies at academic institutions to address barriers to success for women in academic STEM.

The results from the generated cluster profiles, the interrelations and changes in the clusters over time have key implications for aspiring STEM faculty, current faculty and STEM students. First, looking at the number and relationships between clusters reveal important patterns for aspiring or transitional STEM faculty. A new STEM PhD or masters graduate looking out to the academic jobs are left with two very different paths in terms of family-friendly policy availability. If they head toward associates, bachelors or many masters programs, there will not be much difference in terms of policy availability regardless of the type of institution where they find employment. In contrast, if they are headed to a doctorate institution which institute they go to will have a stronger effect on the policy availability they encounter. However, not all doctorate institutions have the same expectations for faculty, as these institutions run the gamut from small doctorate granting universities to large research intensive universities. Furthermore, the two clusters with the fewest policies also have high levels of part-time faculty. This is another important consideration for STEM faculty looking for academic employment as our breakdown of policy types in table 2 indicated that there is generally less policy coverage for part-time faculty. Research B, unlike other Research clusters contains the highest level of policies in 2004 despite having the second highest level of expenditure. This may be because the institutions in Research B take a more progressive view on family friendly policies, although it is not possible to tell with

this data. It also adds nuance to Hollenshead et al.'s (2005) findings[8] and suggests the number of policies institutions have is not always fully linear with their expenditures.

Turning more generally to the cluster profiles, the higher levels of policies at the doctorate only clusters imply higher levels of support and thus likely increased satisfaction, longevity and success of at least some STEM faculty—particularly those who face more barriers to success. Additionally, institutions in these clusters have more students at the undergraduate and graduate level on average (but not in total as noted above). While these institutions also have the most professors on average, higher levels of students means there is the potential for more contact between support faculty and students. This is important as research has found having mentors of a similar background to students can help them along their STEM academic careers. On the other hand, the cluster profiles reveal certain student populations are more likely to encounter more supported professors than others—Asian students are more represented in the doctorate only clusters, whereas African-American students are more represented in the doctorate/master and associate/bachelors clusters. Native Americans and Hispanics are largely evenly distributed across clusters. These profiles show differences in how some mentoring opportunities—particularly those faculty members with more or less institutional support—are distributed for STEM students.

Conclusion

In this paper we generated a set of clusters of institutions with varying levels of family friendly policies based on key institutional factors. Since the United States has limited national level legislation for these types of policies and past research has found the distribution of these policies to vary across institutional type[8-9], a cluster analysis has much to offer. Clusters can give more in depth profiles of institutions with varying levels of family friendly policies and help us make further distinctions within and across institutional types. We conducted an exploratory k-means analysis on the NSOPF Institutional data from 1993 and 2004. Analyzing these two data points allow us to observe changes in the trajectory in the system of higher education institutions from prior to FMLA implementation to ten years afterward. Our results suggest FMLA did have some impact on the systems trajectory, with the number of paid parental leave policies increasing and the number of policies within clusters also increasing over this period. This gives us insight into how the system has developed and how it may develop in response to other outside influences, such as new family-friendly policies called for by the National Academies and AAUW. Expenditure emerged as the most influential variable for distinguishing between institutions; however, other distinctions appeared when not constrained by Carnegie Classifications categories. Doctorate institutions were more differentiated and clustered into multiple groups whereas associate/bachelors colleges and some masters collapsed into one cluster. As new PhD or masters graduates in STEM fields look toward academic careers, these clusters reveal important patterns for the level of benefits potentially offered by future employment.

In future work we will be extending these clusters to examine the STEM populations within clusters. In particular we will explore the gender composition of clusters, as well as the rates of marriage and dependent children by gender across clusters. Additionally, we will take a closer look at specific policies within each cluster to better understand issues of accessibility.

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Citations

1. O'Brien, M. Fathers, Parental Leave Policies, and Infant Quality of Life: International Perspectives and Policy Impact. *The ANNALS of the American Academy of Political and Social Science* **624,** 190–213 (2009).
2. Heymann, J., Earle, A. & Hayes, J. The ork, Family, and Equity Index. (2008). at <http://www.inclusionist.org/files/index.pdf>
3. Haas, L. Parental leave and gender equality: Lessons from the European Union. *Review of Policy Research* **20,** 89–114 (2003).
4. Schimpf, C., Santiago, M. M., Hoegh, J., Banerjee, D. & Pawley, A. STEM Faculty and Parental Leave: Understanding an Institution's Policy within a National Policy Context through Structuration Theory. *International Journal of Gender, Science & Technology* **5,** (2013).
5. Palley, E. Expected struggles: U.S. child care policy. *Children and Youth Services Review* **34,** 628–638 (2012).
6. Karch, A. Policy feedback and preschool funding in the American states. *Policy Studies Journal* **38,** 217–234 (2010).
7. Waldfogel, J. The Impact of the Family and Medical Leave Act. *Journal of Policy Analysis and Management* **18,** 281–302 (1999).
8. Hollenshead, C. S., Sullivan, B., Smith, G. C., August, L. & Hamilton, S. Work/family policies in higher education: Survey data and case studies of policy implementation. *New Directions for Higher Education* **2005,** 41–65 (2005).
9. P.H. Raabe, Work–family policies for faculty: How 'career-and family friendly' is academe? In *Academic couples: Problems and promises*, eds M.A. Ferber and J.W. Loeb, 208–25. Urbana: (University of Illinois Press, 1997).
10. The National Academies, *Beyond bias and barriers: fulfilling the potential of women in academic science and engineering*. (The National Academies Press, 2007)
11. National Science Foundation. *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2011. Special Report NSF 11-309*. (National Science Foundation, Division of Science Resources Statistics, 2011)
12. Castellani, B. & Rajaram, R. Case-based modeling and the SACS Toolkit: a mathematical outline. *Computational and Mathematical Organization Theory* **18,** 153–174 (2012).
13. Wu, J. *Advances in K-means Clustering: A Data Mining Thinking*. (Springer, 2010).

14. Blair-Loy, M. *Competing devotions: Career and family among women executives*. (Harvard University Press, 2005).
15. Bailyn, L. *Breaking the mold: Women, men, and time in the new corporate world*. (Free Press, 1993).
16. Lokteff, M. & Piercy, K. W. 'Who Cares for the Children?' Lessons from a Global Perspective of Child Care Policy. *Journal of Child and Family Studies* **21,** 120–130 (2011).
17. Bianchi, S. M. & Milkie, M. A. Work and Family Research in the First Decade of the 21st Century. *Journal of Marriage and Family* **72,** 705–725 (2010).
18. Fox, M. F., Fonseca, C. & Bao, J. Work and family conflict in academic science: Patterns and predictors among women and men in research universities. *Social Studies of Science* **41,** 715–735 (2011).
19. Bygren, M. & Duvander, A.-Z. Parents' workplace situation and fathers' parental leave use. *Journal of Marriage and Family* **68,** 363–372 (2006).
20. Mason, M. A., & Goulden, M. Do Babies Matter? The Effect of Family Formation on the Lifelong Careers of Academic Men and Women. *Academe Online* (2002).
21. Mason, M. A., & Goulden, M. Do babies matter (Part II). *Academe Online*, *90*(6), 11–15 (2004).
22. Mason, M. A., Wolfinger, N., H. & Goulden, M. *Do Babies Matter?: Gender and Family in the Ivory Tower (Families in Focus)*. (Rutgers University Press, 2013).
23. Drago, R., Colbeck, C. L., Stauffer, K. D., Pirretti, A., Burkum, K., Fazioli, J., Lazzaro, J., & Habasevich, T. The Avoidance of Bias against Caregiving: The Case of Academic Faculty. *American Behavioral Scientist*, *49*(9), 1222–1247 (2006).
24. K. D. Beddoes, C. Schimpf & A.L. Pawley, "Engaging Foucault to Better Understand Underrepresentation of Female STEM Faculty," presented at the American Society for Engineering Education Annual Conference, Atlanta, Georgia, 2013.
25. Rhoton, L. A. Distancing as a Gendered Barrier: Understanding Women Scientists' Gender Practices. *Gender & Society* **25,** 696–716 (2011).
26. Palley, E. & Shdaimah, C. Child care policy: A need for greater advocacy. *Children and Youth Services Review* **33,** 1159–1165 (2011).
27. Sümer, S., Smithson, J., das Dores Guerreiro, M. & Granlund, L. Becoming working mothers: Reconciling work and family at three particular workplaces in Norway, the UK, and Portugal. *Community, Work & Family* **11,** 365–384 (2008).
28. Han, W.-J., Ruhm, C. & Waldfogel, J. Parental leave policies and parents' employment and leave-taking. *Journal of Policy Analysis and Management* **28,** 29–54 (2009).
29. Han, W.-J. & Waldfogel, J. Parental leave: The impact of recent legislation on parents' leave taking. *Demography* **40,** 191–200 (2003).
30. Hofferth, S. L. Parental Leave Statutes and Maternal Return to Work After Childbirth in the United States. *Work and Occupations* **33,** 73–105 (2006).

31. Grant, J., Hatcher, T. and Patel, N.. Expecting better: A state-by-state analysis of parental leave programs. (National Partnership for Women and Families, 2005).

32. Castellani, B. & Hafferty, F. *Sociology and Complexity Science: A New Field of Inquiry.* Berlin: Springer, 2009.

33. Luhmann, N. Differentiation of society. *Canadian Journal of Sociology/Cahiers canadiens de sociologie* 29–53 (1977).

34. Aldenderfer, M., S. & Blashfhield, R., K. *Cluster Analysis*. (Sage Publications Inc, 1984).

35. Huberty, C. J., Jordan, E. M. & Brandt, W. C. in *Higher education: Handbook of theory and research* 437–457 (Springer, 2005).

36. Sneath, P., H. & Sokal, R., R. *Numerical Taxonomy: The Principles and Practice of Numerical Classification*. (W.H. Freeman and Company, 1973).

37. S. Maller T. Hong W. Oakes C. Zoltowski and P. Mcdermott, "Normative Typologies of EPICS students on ABET EC Criterion 3: A Multistage Cluster Analysis," presented at the American Society for Engineering Education Annual Conference, Hawaii, 2007.

38. M. Orr L. Benson M. Ohland and S. Biggers, "Student Study Habits and their Effectiveness in an Integrated Statics and Dynamics class," presented at the American Society for Engineering Education Annual Conference, Pittsburgh, Pennsylvania, 2008.

39. National Academies of Engineering. *The Engineer of 2020.* (National Academies Press, 2004).

40. D. Knight, "In search of the Engineers of 2020: An Outcome Based Typology of Engineering Undergraduates," presented at the American Society for Engineering Education Annual Conference, San Antonio, Texas 2012.

41. M. Besterfield-Sacre, N.O. Ozaltin A. Shartrand L.J. Shuman and P. Weilerstein, "Understanding the Technical Entrepreneurship Landscape in Engineering Education," presented at the American Society for Engineering Education Annual Conference, Vancouver, Canada, 2011.

42. Bahr, P. R. Classifying Community Colleges Based on Students' Patterns of Use. *Research in Higher Education* **54,** 433–460 (2012).

43. Steinley, D. & Brusco, M. J. Choosing the number of clusters in K-means clustering. *Psychological Methods* **16,** 285–297 (2011).

44. Overall, J. E. & Magee, K. N. Replication as a Rule for Determining the Number of Clusters in Hierarchial Cluster Analysis. *Applied Psychological Measurement* **16,** 119–128 (1992).

45. A Classification of Institutions of Higher Education 1994 Edition. (Carnegie Foundation for the Advancement of Teaching, 1994).

46. *The Carnegie Classification of Higher Education 2000 Edition*. (Carnegie Foundation for the Advancement of Teaching, 2005).

47. McIntyre, R. M. & Blashfield, R. K. A Nearest-Centroid Technique For Evaluating The Minimum-Variance Clustering Procedure. *Multivariate Behavioral Research* **15,** 225–238 (1980).

48. Xu, Y. J. The Similarities and Differences in the Work Experience of Women Faculty in Traditional and Nontraditional Disciplines. *New Directions for Institutional Research* **2012,** 67–83 (2012).

49. Webber, K. L. Research productivity of foreign- and US-born faculty: differences by time on task. *Higher Education* **64,** 709–729 (2012).

50. Schuster, J., H. & Finkelstein, M., J. *The Restructuring of Academic Work and Careers: The American Faculty*. (John Hopkins Press, 2006).

51. Toutkoushian, R. K. & Conley, V. M. Progress for women in academe, yet inequities persist: Evidence from NSOPF: 99. *Research in Higher Education* **46,** 1–28 (2005).

52. Toutkoushian, R. K. & Bellas, M. L. The effects of part-time employment and gender on faculty earnings and satisfaction: Evidence from the NSOPF: 93. *The Journal of Higher Education* **74,** 172–195 (2003).

53. Kelly, K. & Grant, L. Penalties and premiums: The impact of gender, marriage, and parenthood on faculty salaries in science, engineering and mathematics (SEM) and non-SEM fields. *Social Studies of Science* **42,** 869–896 (2012).

54. National Academies. *Beyond Bias and Barriers: Fulfilling the Potential of Women in Academic Science and Engineering*. Washington, DC: (The National Academies Press, 2007).

55. AAUW. *Why so Few? Women in Science, Technology, Engineering and Mathematics.* (AAUW, 2010).