Closing the Leadership Gap:
One Step Closer using System Dynamics

Deborah Campbell

Catalyst

165 Gibraltar Court

Sunnyvale, CA 94089

dcampbell@catalyst.org

Abstract

Social science theories are developed to understand problematic behavior and describe the social structure believed to be the cause. Only occasionally used, system dynamics has long been considered an ideal testing ground for such theories.

Most Americans believe in equal opportunity for men and women, yet the difference between the number of men and women in leadership positions, the "leadership gap", continues to be significant. In Justice, Gender, and the Family, *Susan Moller Okin presents a feminist theory of a social structure that perpetuates the U.S. gender gap in leadership. This paper interprets Okin's theory by translating the descriptive theory into a system dynamics model and analyzing whether the structure Okin presents produces the behavior she describes. With an eye to closing the leadership gap, the purpose of this research is to more deeply understand Okin's theory and the ability of system dynamics to advance social science theory in general and feminist theory in particular.*

Key words: gender, leadership, feminist theory

1 Introduction

> *"As long as women are prevented from attaining their highest possibilities, so long will men be unable to achieve the greatness which might be theirs."* [1]
>
> *-- 'Abdu'l-Bahá*

Most Americans believe they live in an egalitarian society, a society where men and women are treated equally. Unfortunately, despite the progress that has been made in the last 40 years -- the number of women that have entered the workforce, the increase in the availability of childcare and part-time employment options, and the changes in attitudes in both the workplace and family that support women pursuing careers -- the facts do not support a belief in an egalitarian society. While the situation has certainly improved from 40 years ago, in reality the U.S. is far from reaching gender

[1] *The Promulgation of Universal Peace*, the Bahá'í International Community.

equity (World Economic Forum 2006, Wilson 2004, Babcock and Laschever 2003, Rhode 2003). This difference, or gap, between men's and women's achievement is known as the "gender gap".

In her 1989 book *Justice, Gender, and the Family*, the late Susan Moller Okin, professor of Political Science at Stanford University, presents a feminist theory of a social structure that perpetuates the U.S. gender gap in education, employment, and leadership.[2] This paper presents an interpretation of Okin's theory. It translates the descriptive dynamic theory into a system dynamics model and analyzes whether the structure Okin presents produces the behavior she describes. System dynamics has been used previously to explore social science theories, yet feminist theory, a specific type of social science theory, is new territory. The purpose of this research is to more deeply understand this theory of gender equity and the applicability of system dynamics to issues of gender.[3]

In preparation for developing a system dynamics model of Okin's theory, the rest of section 1 discusses the role of system dynamics in advancing social science and feminist theory, and characterizes the problem of the U.S. gender gap. The theory is described and translated into a causal loop model in section 2. The system dynamics simulation model, composed of three submodels, is summarized in section 3. In section 4, the model validation is explained and a sample simulation is provided comparing simulation results with empirical data from the literature. Then, in section 5, the simulation results of some likely scenarios are compared with the behavior Okin describes. Finally, section 6 presents the major findings and current limitations of the research, as well as opportunities for further development.

1.1 Social Science Theory and System Dynamics

Social science theories are developed in an attempt to understand a problematic behavior, and describe the social structure believed to be causing it. System dynamics has long been considered an ideal testing ground for social science theories (Forrester 1961), but has not as often been used for that purpose (Lane 2001).

The value that system dynamics adds to an exploration of theory is multidimensional: the translation of a theory into a model clarifies concepts and concisely documents the complex interrelationships, and experimentation with the simulation model deepens the understanding of cause and effect relationships between structure and behavior. All of this allows for more informed discussion and refinement of the theory. In order to translate the verbal description of a theory about social structure into the numerical values and mathematical equations required for a simulation model, the verbal description must first be made clear (Forrester 1961). In the process of translation, assumptions and underlying details required to make the theory mathematically explicit are revealed. Additionally, one determines the completeness and consistency of the theory: lack of completeness leads to missing information in the model and lack of consistency leads to conflicts in the formulations of the relationships that constitute the structure of the model. All of this tests the coherence of the theory in ways that may not have been done before.

[2] While other authors refer to the same theory (see for example Wilson 2004, Strober and Chan 1999), Okin makes it a fundamental point in the argument of her book and describes it in more depth.
[3] This paper is based on the author's master's thesis, which was completed prior to joining Catalyst.

The challenge of using system dynamics to explore social science theory is also multidimensional: several obstacles to translating theory exist. Most social science theories are not written with the intension to be translated into unambiguous mathematical form. Additionally, the assumptions or underlying details required to translate the theory into mathematical form often do not exist in the written words of the theory, so additional research must be conducted and/or assumptions made about what the theory's author intended in order to make the representation complete.

Several system dynamicists have used system dynamics to test and explore specific social science theories. They include John Sterman modeling the work of Kuhn on scientific revolutions (Sterman 1985), Elise A. Weaver modeling the work of Flynn on homeland security (Weaver 2005), Elise A. Weaver and George Richardson modeling the work of Hammond on the cycling of a decision threshold (Weaver and Richardson 2006), and Agata Sawicka modeling the work of various theorists on the psychology of risk to explore how human psychology in decision making is a factor in the security of IT infrastructures (Sawicka 2004). In each case, valuable insights into each theory have been gained and new policies proposed.

1.2 Feminist Theory and System Dynamics

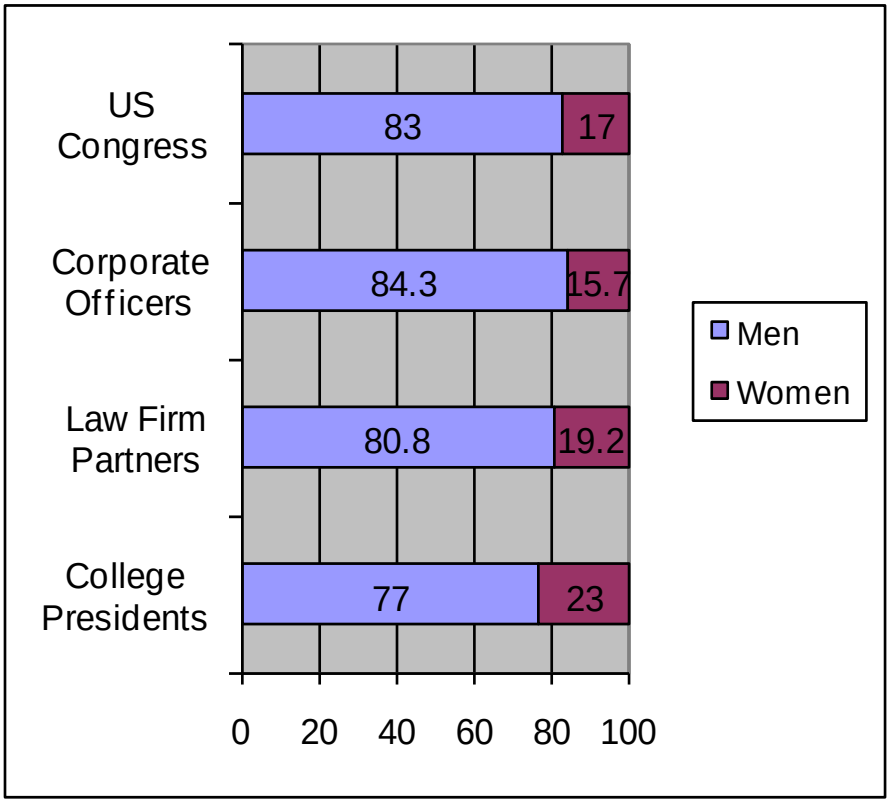
Very little work has been done with system dynamics to facilitate greater understanding of feminist theories and of the social structure(s) they hypothesize perpetuate the problematic behavior of the gender gap. Published papers modeling gender diversity with system dynamics include Bleijenbergh's work using group model building to capture gender equity issues in the workplace (Bleijenbergh 2008, Bleijenbergh 2006), Dudley's work evaluating the pipeline delay explanation for the lack of women in leadership (Dudley 2007), and the author's previous work on improving business performance through workforce diversity (Campbell and Crespo-Marquez 1997). The author's paper on the negative effects of unconscious gender bias in the workplace (Campbell and Hovmand 2004) was the only published work found explicitly modeling feminist theory using system dynamics.

On the other hand, an entire field exists with the purpose to integrate feminist theory and another form of mathematical modeling: feminist economics. While much work in the field of feminist economics is focused on merging a feminist worldview with an economist worldview, many researchers in the field are also using economic modeling techniques and models to explore feminist issues and feminist theories. Feminist economists have found it useful to use mathematical modeling techniques as a "systemic framework for exploring all these questions" of gender equity in feminist theory (Blank and Reimers 2003, 161). While some feminist economists have found this strategy successful, many find that several fundamental assumptions of neoclassical and heterodox economics and economic modeling tools do not fit a feminist perspective (England 2003). Not only does this field's work demonstrate the value of modeling feminist theory, but system dynamics could be a valuable tool to add to the feminist economics toolbox, one that does not come with the problematic assumptions of neoclassic or heterodox economics.

1.3 The Problem: an Ever-present Gender Gap in the U.S.

In her book, Okin presents a feminist theory of structural inequities that perpetuate the ever-present U.S. gender gap in education, employment, and leadership. Research strongly suggests that significantly reducing the leadership gap will have the high leverage effect of reducing the gender gaps in education and employment (Wilson 2004, Carroll 2001, Carroll 2000, and Mansbridge 1998). Hence, this paper summarizes the reinforcing structures described by Okin's theory and their dynamic effect on the gender gap in leadership.

To examine the gender imbalance in a set of leadership positions that represent politics, business, and the professions, following are the current figures for the percentages of men and women who are national politicians (U.S. Congress), corporate officers of Fortune 500 companies[4], law firm partners, and college presidents (see Figure 1).

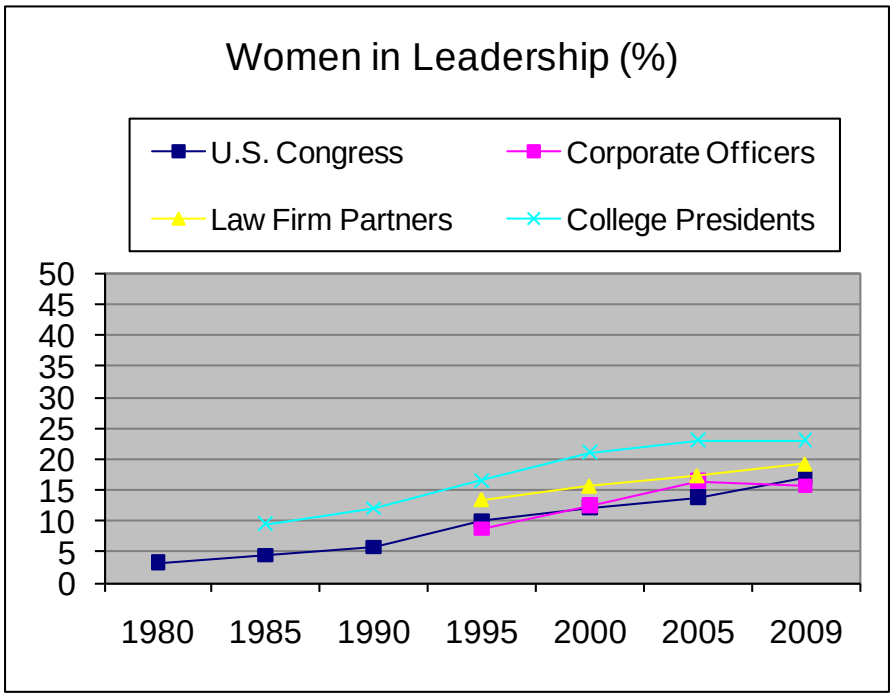


Sources: The White House Project[5], Catalyst[6], Catalyst[7]

Figure 1: Percentage of men and women in leadership roles (2008/9)

[4] CEOs and other board-elected or board–appointed officers.
[5] "The White House Project Report: Benchmarking Women's Leadership". November 2009 http://thewhitehouseproject.org/documents/Report.pdf
[6] "Women in U.S. Management". March 2011 http://www.catalyst.org/publication/206/women-in-us-management.
[7] "Quick Takes: Women in Law in the U.S.", May 2010 http://www.catalyst.org/publication/246/women-in-law-in-the-us.

As can be readily seen, women are far from holding equal numbers of these leadership positions. In examining the historical percentages of women in these positions, it becomes clear that not only are current percentages low, but the growth rate since 1995 has stagnated (see Figure 2).



Sources: Center for American Women in Politics[8], Catalyst[9], Catalyst[10], American Council on Education[11]

Figure 2: Women in leadership – Historical trends

"[P]rogress has almost come to a standstill", writes Ilene Lang, President of Catalyst (Catalyst 2006). This, when women still hold less than 25 percent and in most cases less than 20 percent of these leadership positions. "At current rates of change, it will be almost three centuries before women are as likely as men to become top managers in major corporations or achieve equal representation in Congress" (Rhode 2003, 7).

This is especially disturbing when there are plenty of women with the skills and experience to be successful in these leadership positions (Catalyst 2005, Rhode 2003). There are, and have been for some time, significant numbers of women holding the "pipeline" positions that feed into these top leadership positions. Many researchers conclude, after accounting for other important factors, that some form of discrimination plays a significant role in the discrepancies between how many women are in leadership positions and how many are in the ranks just below (see for example Catalyst 2005, Wilson 2004, Rhode 2003). This effect has been labeled the "glass ceiling".

[8] "Women in the U.S. Congress 2006", fact sheet, National Information Bank on Women in Public Office, Eagleton Institute of Politics, Rutgers University, 2006, http://www.cawp.rutgers.edu/Facts/Officeholders/cong.pdf.
[9] "Women in U.S. Management"
[10] "Quick Takes: Women in Law in the U.S."
[11] "American College President: 2007 Edition", presentation, http://www.acenet.edu/Content/NavigationMenu/WhatsHot/King_Jaci_07Presentation.pdf.

Yet employers have declared the glass ceiling shattered as a result of various policies and programs they have put in place over the years. So why are women not moving up into leadership positions? The slowdown in women's advancement suggests that previous changes in policy and culture to remove the glass ceiling have only been partially successful, and that other fundamental changes are necessary to continue the country's progress towards gender equity in leadership. Thus the rationale for exploring Okin's theory, as it presents a potential explanation of this stalled progress.

2 The Theory -- A Dynamic Hypothesis

Okin explains that the traditionally unequal sharing of unpaid domestic work in a marriage, with the wife taking on more of the domestic work than the husband, sets up a reinforcing cycle of inequities linking the workplace and the family. After revealing the cultural assumptions underlying why husbands and wives typically choose not to share the unpaid domestic work of the home and family equitably, she explains that the resulting gender inequities at home reinforce inequities in the workplace: less investment in career assets, lower wages, and less opportunity to take on significant work -- including leadership positions in the professions, business, or politics -- for the wife than the husband. These inequities in assets, earning potential, and career opportunity then reinforce the unequal sharing of work at home. This dynamic crosses the perceived boundaries of workplace and family, creating a structural interaction between the two that mutually reinforces gender inequities in both (see Figure 3).

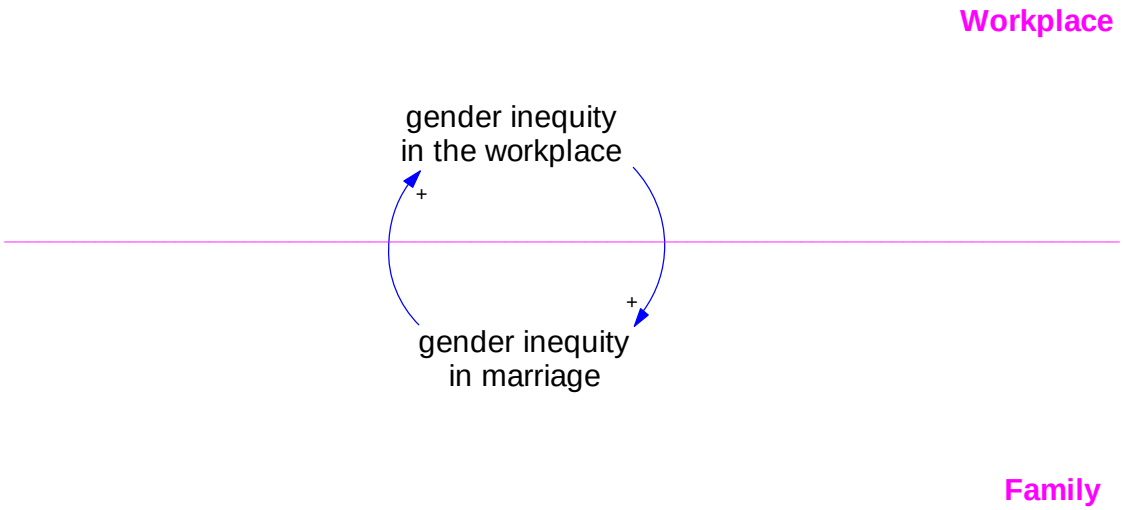


Figure 3: A reinforcing dynamic perpetuating inequities

Okin explains, in the context of this dynamic, why the U.S. gender gaps in *education*, *employment*, and *leadership* still exist. In anticipation of future family responsibilities, young women make culturally-driven educational "choices", choosing, for example, fields of study that will allow them job flexibility or greatly reduced travel time so they can be available for their husbands and children. These choices create the education gap, which in turn sets the stage for the employment gap: the issues of occupational segregation, lower pay, and career paths with

reduced leadership opportunities that women face. Even as recently as 2009, women in equivalent full-time jobs earn on average 80% of the wage men earn.[12]

Additional "choices" women make once they marry, which satisfy the cultural expectations to be a good mother and supportive wife but reinforce the employment gap, include working low paid but flexible jobs, working part time, or taking time out from the workforce all together. Finally, the leadership gap is an outcome of these educational and employment "choices" as well as unintentional bias in favor of men in the workplace that results from the inability of the majority of people (men *and* women) to cognitively resolve the stereotypes of female domesticity with those of leadership.

This reinforcing dynamic between workplace and family has not been addressed by previous workplace-focused "glass ceiling" policies. Okin and many other feminist researchers believe that equalizing the division of domestic work is crucial to equalizing leadership opportunities for women in business, the professions, and politics. This section describes the theory in more detail, using a causal loop model to illustrate it. Before delving into the causal loop model, assumptions that impact the fundamental design of the model are discussed.

2.1 Fundamental Model Assumptions and Model Scope

The use of system dynamics to examine the theory described in Okin results in an immediate observation: there is a mismatch between the aggregation level of the problematic behavior and that of the social structure believed to be causing it. The problematic behavior is defined at the level of the U.S. workforce whereas the structure is described at the level of an individual couple. The assumption is made, both in Okin's work and in the paper, that if the problematic behavior can be demonstrated for a couple (or a variety of couples with different characteristics) then the behavior produced by a multitude of couples would collectively produce the aggregate workforce behavior described by Okin and shown in the figures of section 1. The simulation model allows for a variety of couple types, and the dynamic behavior of each of these couple types is assumed to represent some portion of the behavior witnessed in the aggregate.

Another fundamental choice was made regarding which unit of measure would represent domestic work and wage work in the model: time (in hours per week) or number of tasks per week. It is rare in system dynamics to model time directly (and, in fact, is cautioned against [13]). Yet Okin refers much more frequently to issues of time than tasks. Also, when researching beyond Okin to determine the availability of empirical data with which to validate the model, time-use theory was identified as a large discipline within feminist research. Therefore, in the interest of representing the theory most closely, as well as integrating the work with ongoing feminist research, time (in hours per week) was chosen as the unit of measure.

Finally, the scope of the project is able-bodied, heterosexual couples who do not have, or do not choose, the option of hiring outside domestic services.

---

[12] "The Gender Pay Gap by Industry", C Rampell, New York Times, February 17, 2011, http://economix.blogs.nytimes.com/2011/02/17/the-gender-pay-gap-by-industry/

[13] "Resource Allocation Models" thread, System Dynamics mailing list archive, December 13, 1999, http://www.ventanasystems.co.uk/forum/viewthread.php?tid=1415.

2.2 Domestic Work Decision Dynamics

The traditionally unequal division of domestic work between husband and wife is fundamental to the theory described in Okin. An important decision criterion for deciding which of them does more domestic work is whose job is more important to the family. The traditional method for determining this is economic – which spouse earns more.

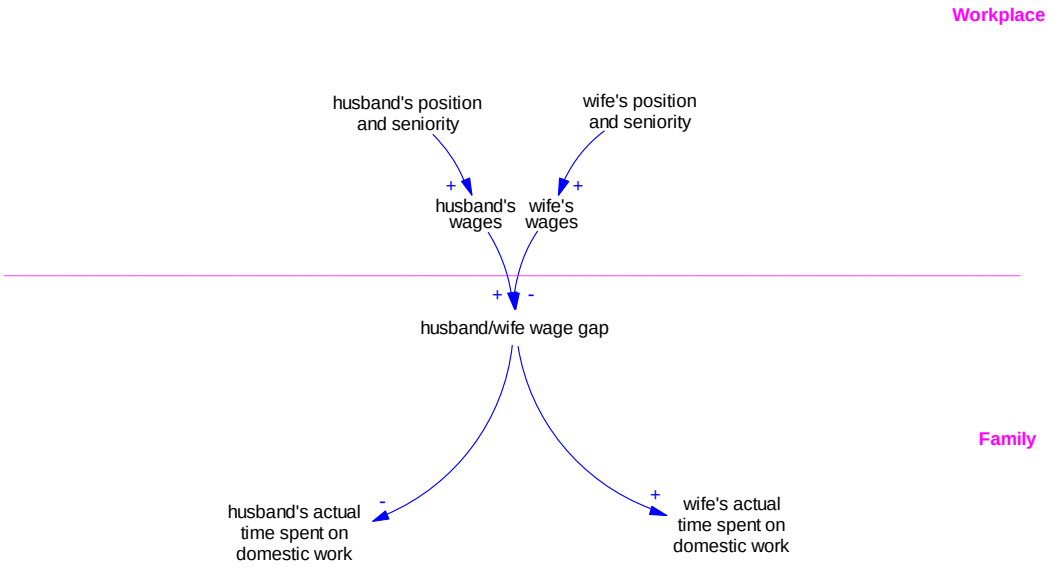


Figure 4: Couple's wage gap drives domestic work decision

In Figure 4, the division of domestic work is driven by the difference between the husband's and wife's current annual wages. If the husband's wages are greater than the wife's, she performs more domestic work. If their wages are similar, they share the domestic work equitably. If her wages are greater than his, he performs more domestic work.

2.3 Effect on Husband's Wage Work

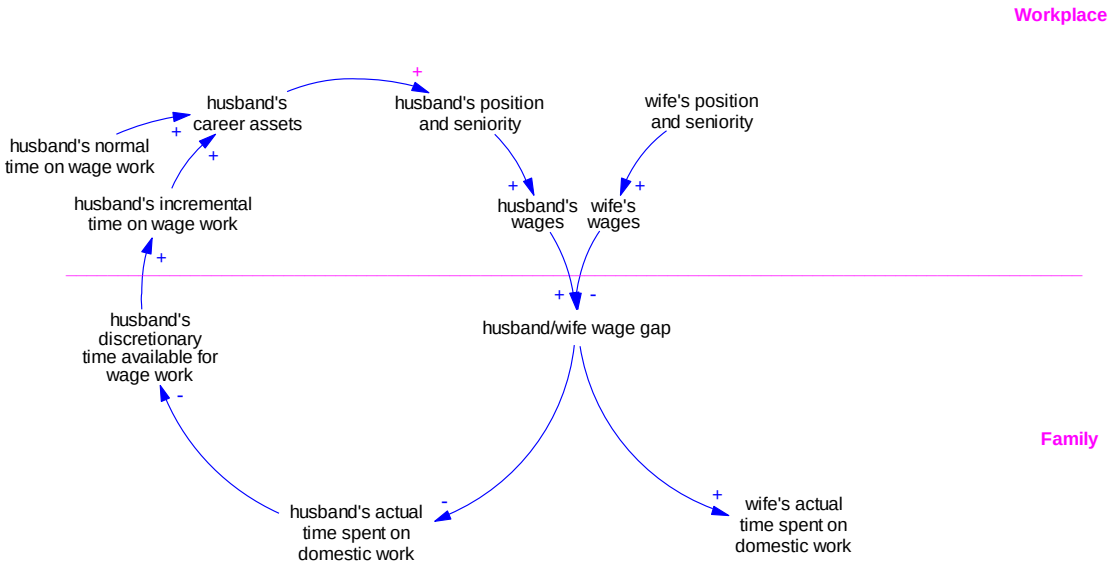


Figure 5: Effect on husband's wage work

Assuming the wife's wages are lower, as the wife takes on more domestic work, the husband is granted more discretionary time to spend on wage work. [14] This gives him the flexibility to go into the office on the weekend or take a special client to dinner or work an extra shift or accept a promotion to a (more senior) leadership position, knowing his wife is at home taking responsibility for the children and housework. This extra time on the job is the couple's investment in his career assets, which in turn has an eventual positive impact on his position and seniority (a proxy for his leadership position), and his wages. As his wages increase, the difference in their wages increases, and she takes on still more domestic work, granting him yet more discretionary time for wage work and continuing the cycle (see Figure 5).

[14] As described in Section 1, it is common for a wife to earn less than her husband due to her chosen field of study or career. The causal model is therefore described from this starting assumption, though the tradeoff between domestic work responsibility and discretionary time could function either way in the model at this stage.

2.4 Effect on Wife's Wage Work

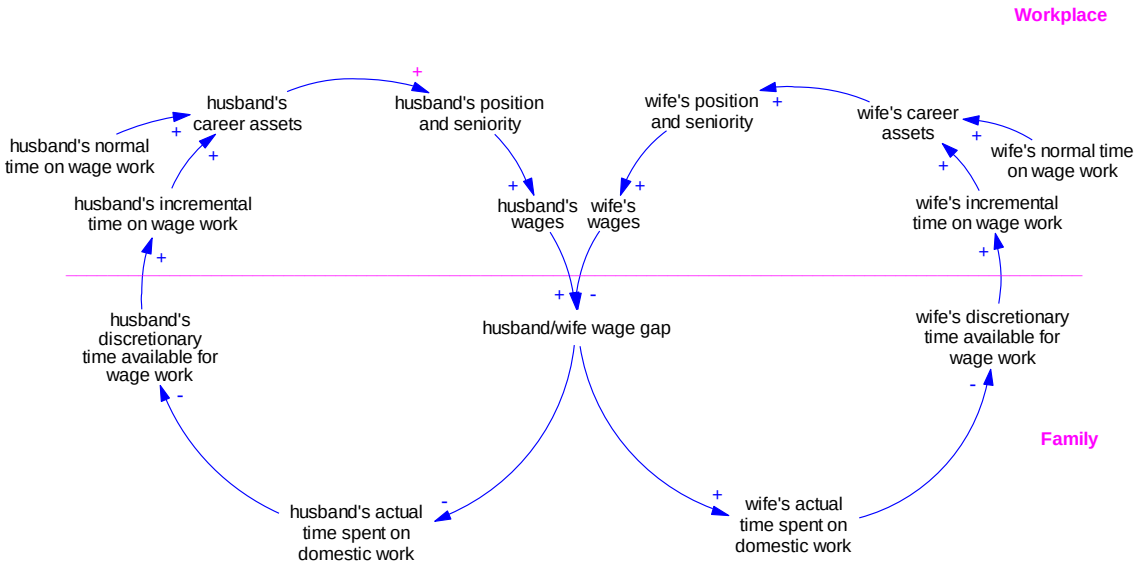


Figure 6: Effect on wife's wage work

As the wife takes on more domestic work, her discretionary time available to spend on wage work decreases. This reduces her flexibility to go into the office on the weekend or take a special client to dinner or work an extra shift or accept a promotion to a (more senior) leadership position because of her responsibility to be at home taking care of the children and housework. This loss of discretionary time for wage work reduces the couple's investment in her career assets, which in turn has a slowing impact on her promotions and her wage increases (see Figure 6).

Okin argues that even husbands and wives who begin their marriage in equal positions with equal salaries tend to experience this dynamic of shifting domestic workload. Well-documented unintentional bias in favor of men occurring in the workplace, resulting from traditional gender stereotypes (see for example Catalyst 2007, Catalyst 2005), causes the woman to advance and receive raises more slowly than her husband. As his status and earning power increase beyond hers, in the context of family decision-making his job is considered more important to the family. While she may already be doing more than her share of the domestic work at home (research shows this to be typical, even in two-career families (Sayer 2005, Strober and Chan 1999)), it is even more likely that she performs more of this work to support the demands of his job.

2.5 Impact of Time Demands of the Family

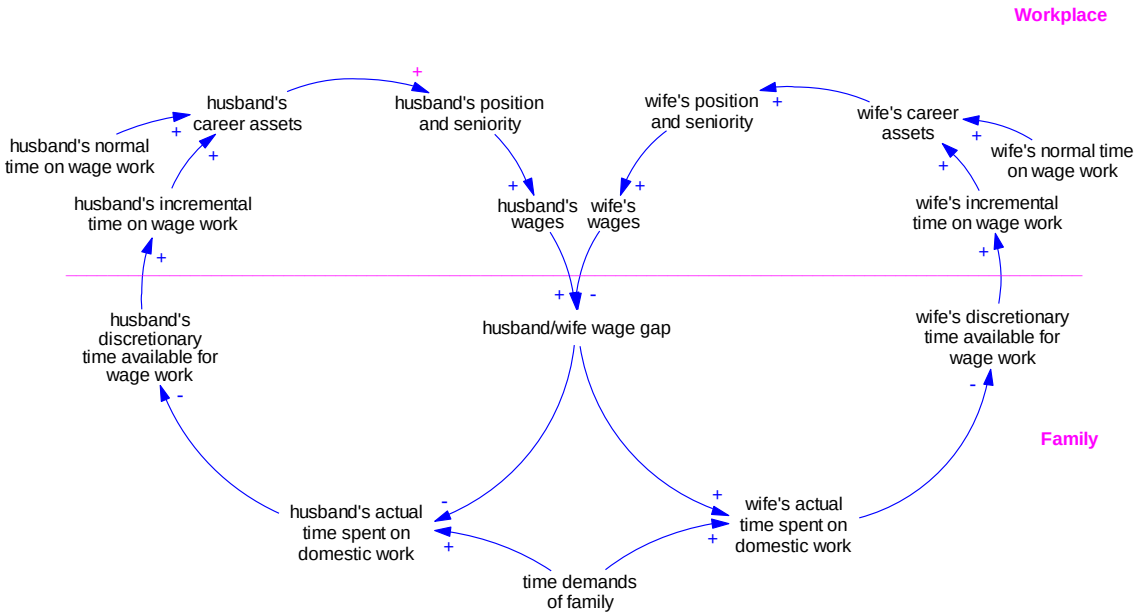


Figure 7: Impact of time demands of the family

The time needed for domestic work is not static. For example, with the purchase of a home or the birth of a child, the time demands of the family increase dramatically (see Figure 7). Because the husband's job is considered more important to the family, when it comes time to take time off from work for child-rearing, the wife is the "logical choice" to do this, resulting in her becoming even less economically equal in the marriage as she dramatically loses seniority, leadership opportunities, and economic value to the family by working part time or stepping out of the job market.

2.6 Impact of Cultural Expectations

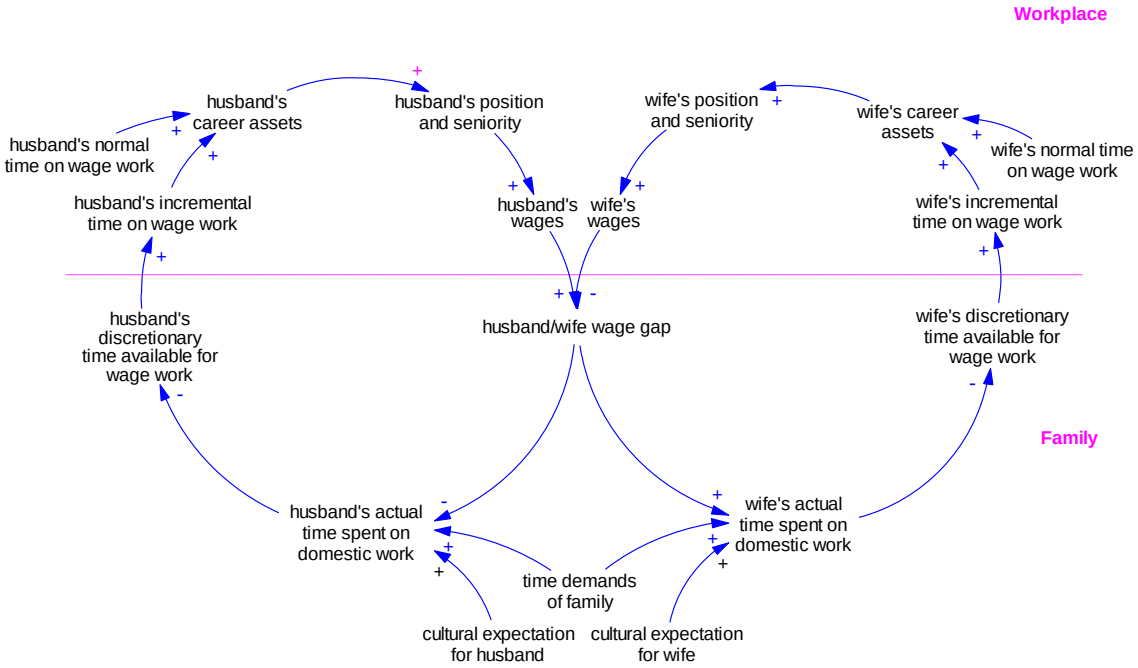


Figure 8: Impact of cultural expectations

Until this point in the theory description, the dynamic can function either way: if the husband earns more, the wife performs more domestic work; if the wife earns more, the husband performs more domestic work. But there are very few real life examples of men performing more domestic work than their wives when their wives earn more than they do, so Okin describes an additional factor at play.

In addition to the economic decision the husband and wife make, more or less consciously, Okin argues there is a subtle yet equally powerful driver of the division of domestic work: the cultural expectations society has for the amount of domestic work both husband and wife "should" perform (see Figure 8). As U.S. cultural expectations are for the wife to perform most of the domestic work regardless of her wage work seniority or annual wages, there is significant pressure for the wife to comply to avoid peer disapproval. Women receive disapproval from family members, friends, colleagues, even complete strangers, for performing what society perceives as "too little" domestic work relative to cultural expectations. This makes it easier for the husband to perform less domestic work because he does not experience the same disapproval when performing a smaller share of the domestic work. Douglas and Michaels (2004) and Johnson (1997) confirm the strength of these cultural expectations on individual and group behavior.

2.7 Conclusion

Okin hypothesizes that this reinforcing dynamic between workplace and family, with the traditionally unequal division of domestic work at its core, is the constraint holding women back from achieving an equal number of leadership positions to men. This causal loop model concisely summarizes her dynamic hypothesis. The dynamics it describes are similar to the *Success to the Successful* archetype (Senge 1990), but with a twist – the two sides are not exact reflections of each other. The woman, due to the imbalance of cultural expectations, never achieves the same level of success as the man when their archetype roles are reversed. The simulation model developed in the next section allows this hypothesis to be tested, both against empirical data and Okin's description of the problematic behavior.

3 Model Development

The simulation model is an integration of three submodels: the Domestic Work submodel, the Wage Work submodel, and the Time Allocation submodel (see Figure 9). This section summarizes the purpose and dynamics of each submodel and concludes with the complete integrated model. A detailed description and build-up of these submodels is provided in Campbell (2007).

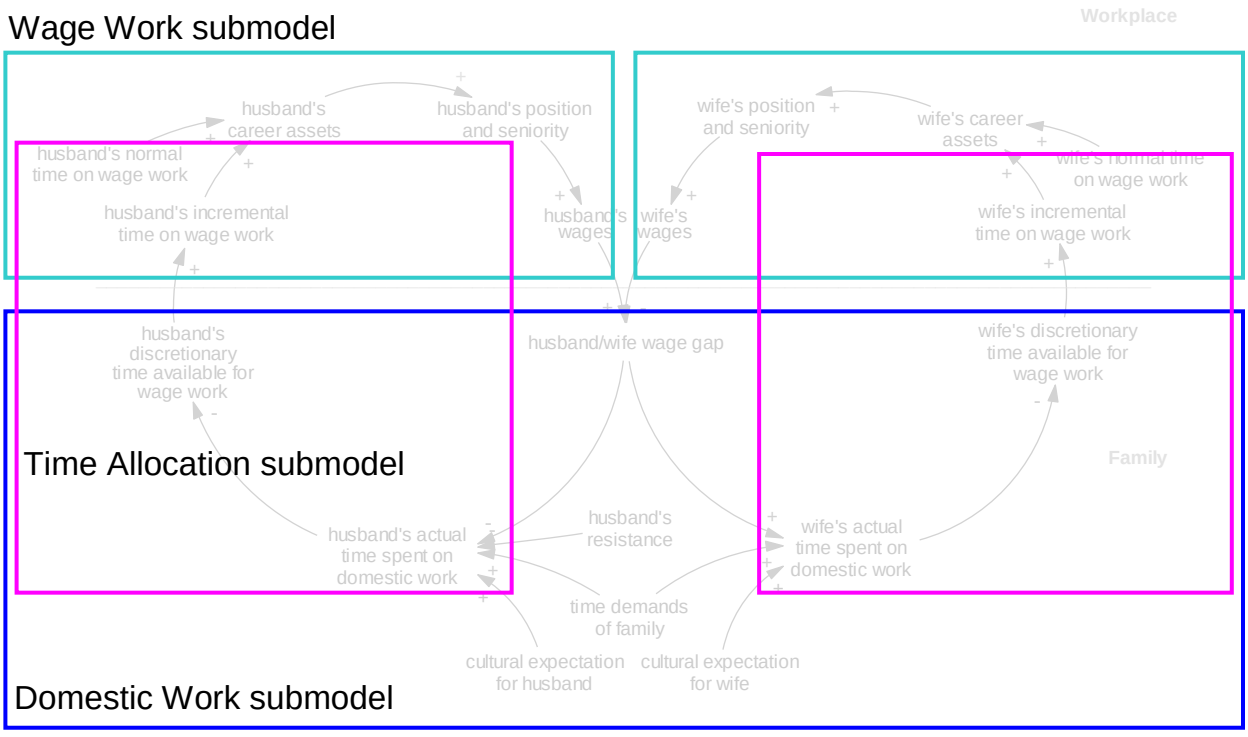


Figure 9: Three submodels in simulation model

3.1 Domestic Work Submodel: The Impact of Wages, Personal Attitudes, and Cultural Expectations on the Division of Domestic Work Time

Domestic work includes child care, housework, shopping, cooking, laundry and planning (Bianchi, Raley, and Milkie 2005; Okin 1989). The Domestic Work submodel (see Figure 10) represents the fundamental mechanics of a husband (left side) and wife (right side) dividing domestic work time between them and the important decision criteria they use for dividing the work: the difference between their wages, their individual attitudes, and the prevailing cultural expectations (top half of the structure). They feel pressure to adjust the amount of time they spend on domestic work based on how adequately they are meeting the time demands of the family and/or their agreed to distribution of time (bottom half of the structure).

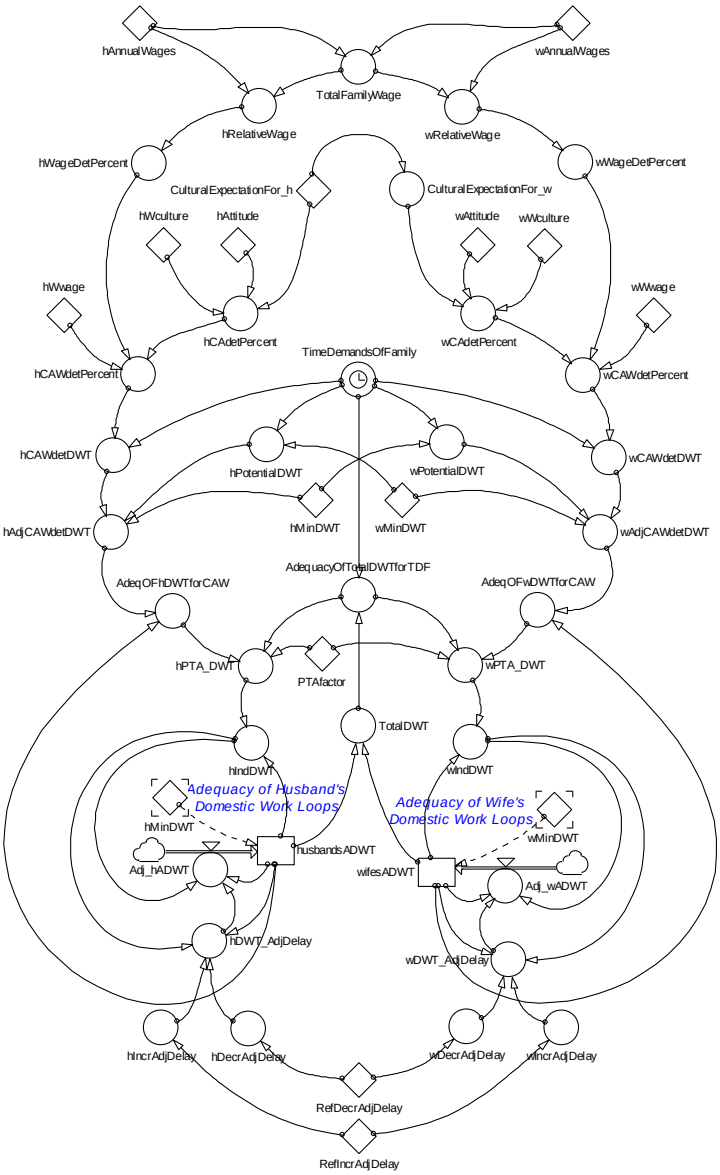


Figure 10: Domestic Work submodel

3.2 Wage Work Submodel: The Impact of Wage Work Time on Career Assets, Leadership Position, and Wages

The Wage Work submodel (see Figure 11) represents the fundamentals of the workplace: the way time spent in wage work increases career assets and leadership position (represented by current seniority), which in turn drives wages. It includes any pressure the husband or wife feel to adjust actual wage work time based on how adequately they are meeting the time demands of their job or their desired wage work time, as well as promotion, demotion, unemployment, and new job dynamics.

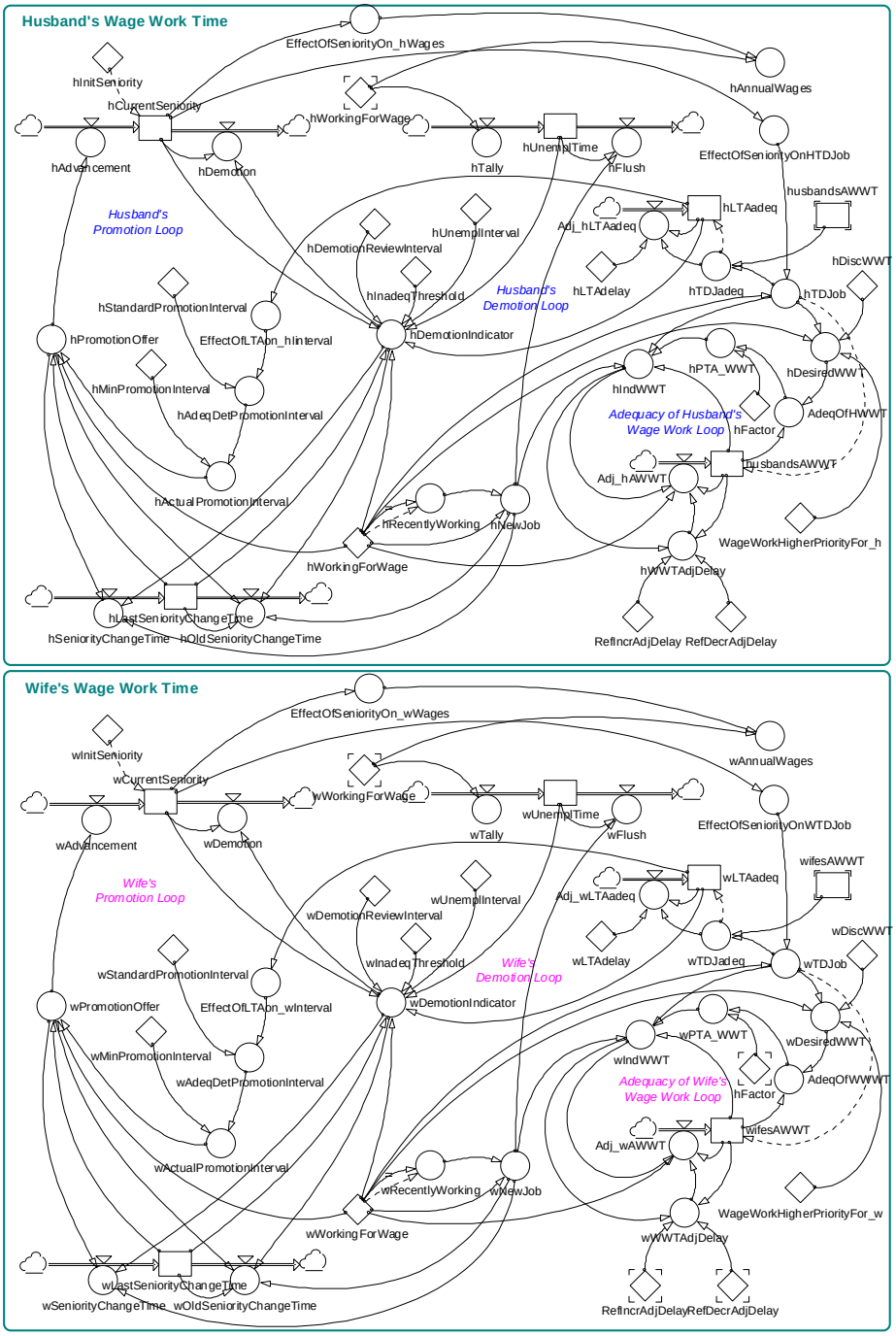


Figure 11: Wage Work submodel

3.3 Sleep and Leisure Time Structures

Individuals spend their time each week in four major activities: domestic work, wage work, sleep, and leisure (Bianchi, Raley, and Milkie 2005; Sayer 2005). In preparation for the Time Allocation submodel, two additional structures are necessary, the sleep and leisure time structures.

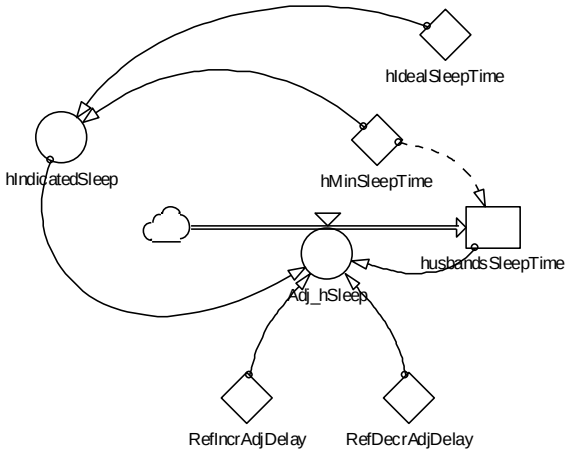


Figure 12: Husband's sleep time structure

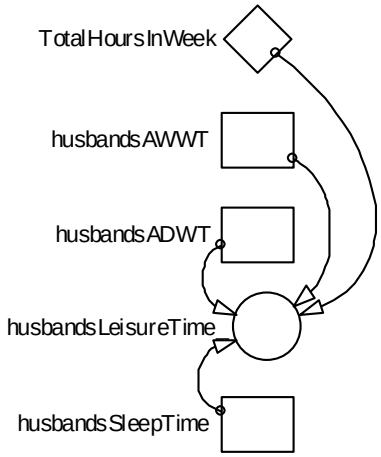


Figure 13: Husband's leisure time structure

The structure for sleep time is based on the concepts of a minimum sleep time required for functioning and an ideal or preferred sleep time (see Figure 12). Leisure time is the time left over each week after wage work, domestic work, and sleep times have been allocated (see Figure 13).

3.4 Time Allocation Submodel: The Mechanics of Allocating Time between Domestic Work and Wage Work

The Time Allocation submodel represents the method an individual might use for allocating his or her time each week between domestic work, wage work, sleep, and leisure. This submodel implements a resource allocation scheme conceptually described by Will Glass-Husain.[15]

The resource allocation scheme begins with a list of resource requests, prioritizes them, and then allocates resources to each of the requests in order of priority, based on the available supply of the resource. If there is enough resource for all the requests, then all receive their requested supply. If there is not enough of the resource, then the highest priority requests are fulfilled first. One request may only receive a partial supply if there is not enough resource left to fulfill its full request (see Figure 14).

[15] Will Glass-Husain, email to the system dynamics mailing list, December 22, 1999, "Resource Allocation Models" thread, system dynamics mailing list archive, December 13, 1999, http://www.ventanasystems.co.uk/forum/viewthread.php?tid=1415.

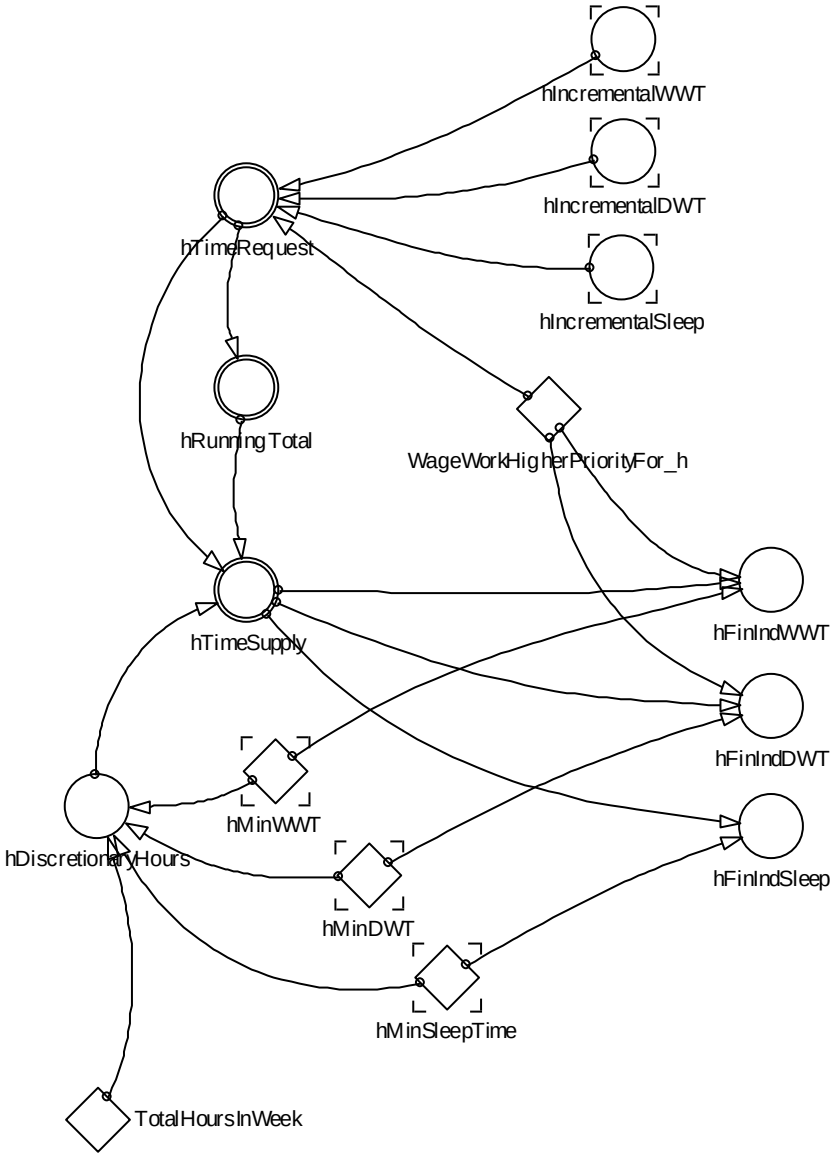


Figure 14: Husband's Time Allocation submodel

3.5 Complete Model: Integration of the Domestic Work, Wage Work, and Time Allocation Submodels

Integrating the three submodels and the additional structures requires connection at two junction points. All of the structures are interconnected through the Time Allocation submodels for husband and wife. Additionally, the husband's and wife's Wage Work submodels are connected to the Domestic Work submodel through the *Husband's* and *Wife's Annual Wages* variables.

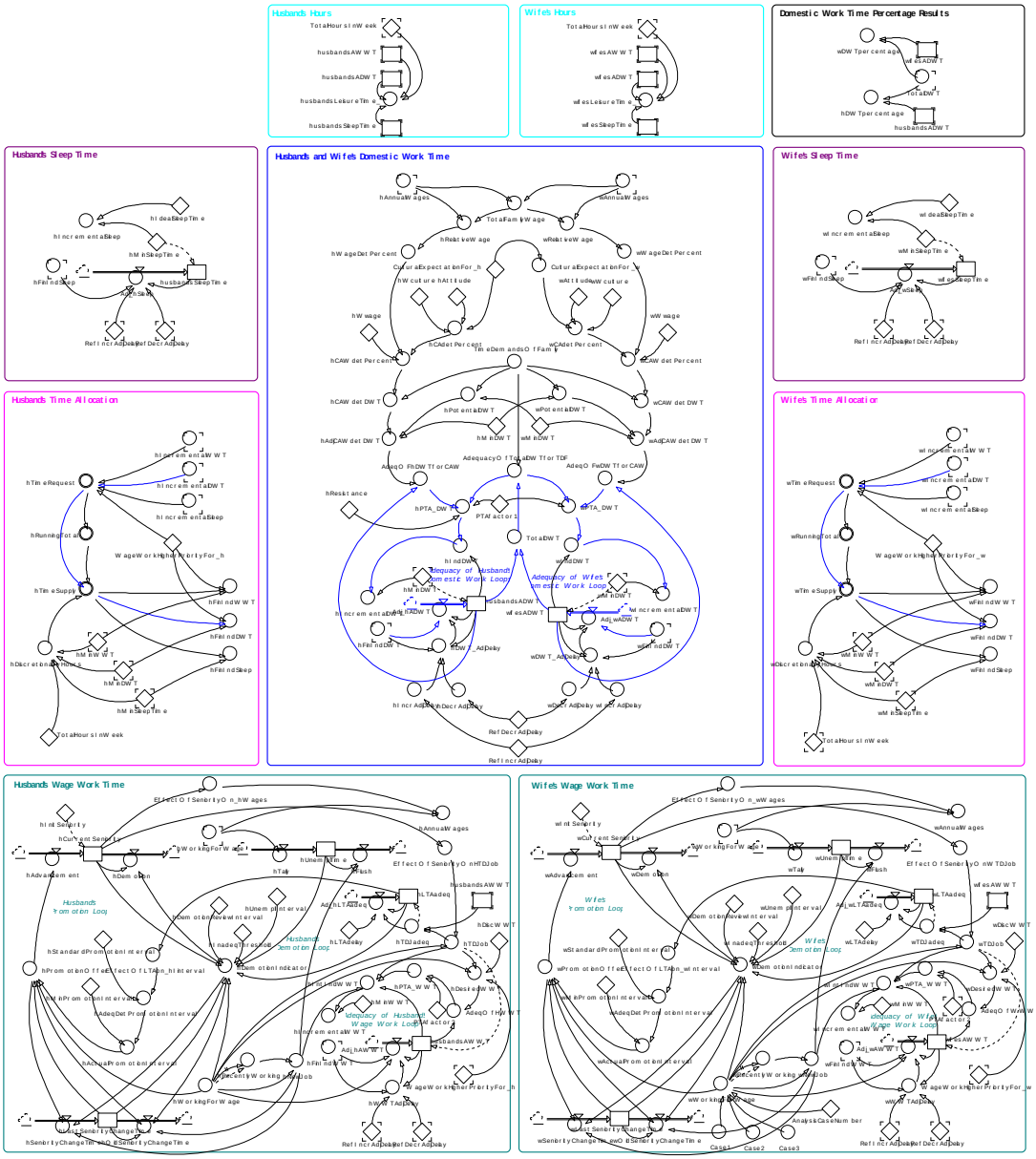


Figure 15: Complete model

4 Model Validation

Barlas (1996) proposes three types of validation tests: direct structure tests, structure-oriented behavior tests, and behavior pattern tests. All three types of tests were used to validate the model. The submodels were validated first, with direct structure tests and structure-oriented behavior tests. Then the complete model was validated using behavior pattern tests. A summary of the complete model validation is presented here, while the details are available in Campbell (2007).

After developing confidence in the structure of the model (in this case, through submodel validation), behavior pattern tests were performed, comparing the model's behavior with empirical data. Barlas (1996) notes that emphasis should be placed on matching data *patterns* of behavior rather than data *points*. Unfortunately, the only empirical data found in this research was in the form of data points. This paper identifies a research opportunity for long-term pattern data to be identified or collected.

4.1 Empirical Data

Examining the results of a research study undertaken by the Survey Research Center of the University of Michigan, Arlie Hochschild, in her book *The Second Shift*, identifies a percentage correlation between a husband's relative wage and the amount of domestic work his wife performs. The data in Table 1 is based on a sample of couples with children under age 15 in which both husband and wife work full time.

Table 1: Husband's relative wage and wife's domestic work time

Wage Gap	Husband's Relative Wage (percentage of family income)	Wife's Domestic Work Time (percentage of total)
A)	75% or more	72%
B)	55 - 75%	66%
C)	45 - 55%	55%
D)	0 - 45%	49% or more

Source: Hochschild 1989, 291

As a result of her own research described in the same book, Hochschild develops a categorization scheme for couples, based on their gender ideology for the division of domestic work. In her scheme there are three couple types: Traditional, Egalitarian, and Transitional. Traditional couples both believe that the wife should --ideally -- stay home and be responsible for most of the domestic work, while the husband takes the breadwinner role. The traditional man bases his identity on his wage work, while the traditional woman bases her identity on her roles as wife and mother. Egalitarian couples both believe that domestic work should – ideally – be shared 50/50. (None in her study actually achieved this division.) Egalitarian couples base their identities on the same sphere, either both on career or both on family life. Transitional couples have a mixed ideology. Both base their identity on their careers, though the transitional woman wants to additionally identify with her roles at home. The husband accepts that the wife chooses to work, but believes she should perform most of the domestic work and not allow her wage work to interfere with her home responsibilities. The wife believes her husband should share the domestic work with her because she is working. In Hochschild's research she

determined that transitional couples were the most prevalent, followed by traditional couples, then egalitarian couples (Hochschild 1989).

Using these couple types as a basis for defining several of the model parameters, then tuning one or more of the additional parameters, the model successfully replicated each of the wage gap pairings described in Table 1. In fact, through a variety of plausible scenarios, the model was able to replicate each wage gap pair for each couple type. One sample of these model validation runs is described in the next section.

4.2 Family Lifecycle

To develop a plausible family lifecycle, a context needed to evaluate the simulation against the empirical data points, three dimensions need to be defined: the time demands of a "typical" family over the span of a career, and the husband's and wife's years of wage work. One hypothetical case for time demands of the family was created:

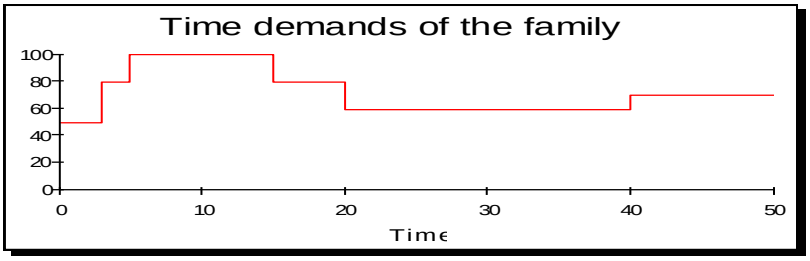
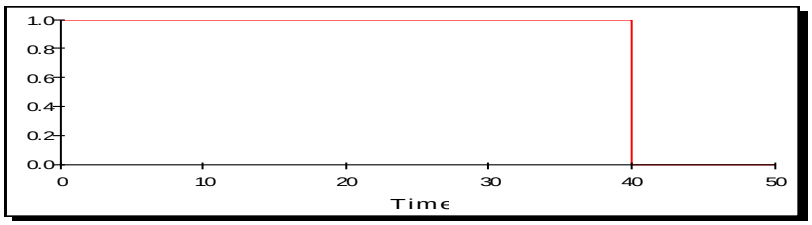


Figure 16: Time demands of the family

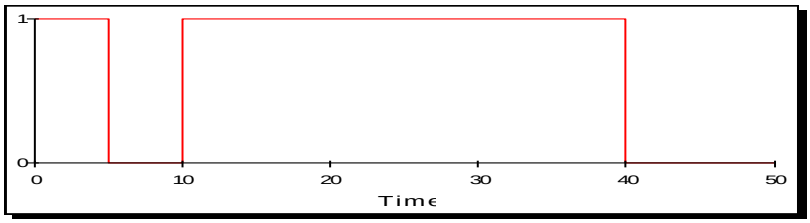
The man and woman marry at age 25, and this is time 0 of the simulation. They have their first child after 3 years and their second child after 5 years. After the children turn 12, the demands decrease, and once the children are 18, the demands decrease again. They do not decrease to as little as they were at the beginning of their marriage because the couple has a house now, and other acquisitions that take time to maintain. At age 65, they both retire. Due to illness, one of them requires more care than before.

Three different hypothetical cases for the wife's wage-earning years were developed:

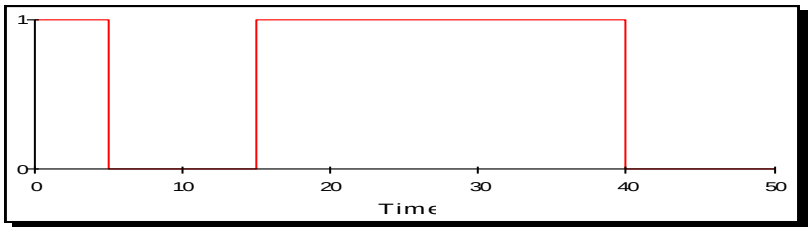
Case 1 – The wife works for the entire marriage until she retires after 40 years elapse.



Case 2 – The wife stays home for 5 years after the second child arrives, then returns to work and retires after 40 years elapse.



Case 3 – The wife stays home for 10 years after the second child arrives, then returns to work and retires after 40 years elapse.



The husband is assumed to work for the entire marriage, retiring after 40 years.

When these three dimensions are integrated to create a family lifecycle, then the portion of the lifecycle used for comparison with the empirical data is narrowed – to the portion(s) in which both the husband and wife work and their children are under age 15. Yet the simulations are run over the entire lifecycle to understand the impact of the interrelated family and work dynamics on the results.

4.3 Complete Model Validation

To set up the model simulations, several parameters need to be initialized. While the details of categorizing and initializing the parameters are provided in Campbell (2007), in summary, 1) assumptions were made based on descriptions in the literature to define cultural expectations, and basic delays and thresholds; 2) several parameters were prescribed based on the definition of couple types; and 3) other parameters were tuned to achieve the empirical data and then evaluated as possible or plausible. As transitional couples are most prevalent, a sample result for this couple type matching wage gap B is shown next.

Wage Gap	Husband's Relative Wage (percentage of family income)	Wife's Domestic Work Time (percentage of total)
A)	75% or more	72%
B)	55 - 75%	66%
C)	45 - 55%	55%
D)	0 - 45%	49% or more

To replicate Wage Gap B requires the use of Case 2 for the wife's wage work – 5 years out of the workforce. The resulting table demonstrates that, once the wife has gone back to work after staying home for 5 years (in pink), for the years 11 through 15 the husband's relative wage and the wife's domestic work time percentage match Wage Gap B (in blue).

Time	hRelativeWage	wDWTpercentage	hDWTpercentage
1	50	55	45
2	50	55	45
3	50	55	45
4	47	55	45
5	100	55	45
6	100	80	20
7	100	80	20
8	100	80	20
9	100	80	20
10	71	80	20
11	71	66	34
12	71	66	34
13	71	66	34
14	71	66	34
15	71	66	34
16	71	65	35
17	71	65	35
18	70	67	33
19	70	67	33
20	70	67	33

5 Scenario Analysis

Hochschild found that 87% of transitional couples and 33% of traditional couples divided their domestic work as in Wage Gap A, 44% of traditional couples divided their domestic work as in Wage Gap B, and 70% of egalitarian couples divided their domestic work as in Wage Gaps C and D (Hochschild 1989, 290). Therefore, two of these most-likely scenarios are examined to determine whether the behavior of the model (at an individual family level) matches the outcomes described in Okin's work (at the workforce level). (All six most-likely scenarios are described in detail in Campbell (2007).)

5.1 Transitional Couple – Wage Gap A

As 87% of transitional couples divide their domestic work as in Wage Gap A, the following scenario replicates Wage Gap A. In this scenario, consistent with the definition of a transitional couple, the husband identifies himself with wage work, but the wife wants to identify herself with *both* wage work and the home. The husband believes he should follow the cultural expectations for domestic work and the wife wants to share equally. The husband's belief that his wife should continue to take responsibility for the home even if she works is reflected in his decision criteria for dividing domestic work -- he puts less emphasis on their wages and more on his culturally influenced attitudes. The wife puts more emphasis on wage work as an important criterion for decision making. Yet her identification with responsibilities at home is reflected in

her willingness to take 5 years off from work to stay home (but not 10). It is also reasonable to assume, due to their ideology and the "choices" they each made as a result, that the husband begins their marriage with a higher seniority level than the wife.

The resulting graphs of relative wage and domestic work time, as well as those of current seniority, annual wages, domestic work time, wage work time, leisure time, and sleep time, are shown. The behavior exhibited in the graphs is discussed below.

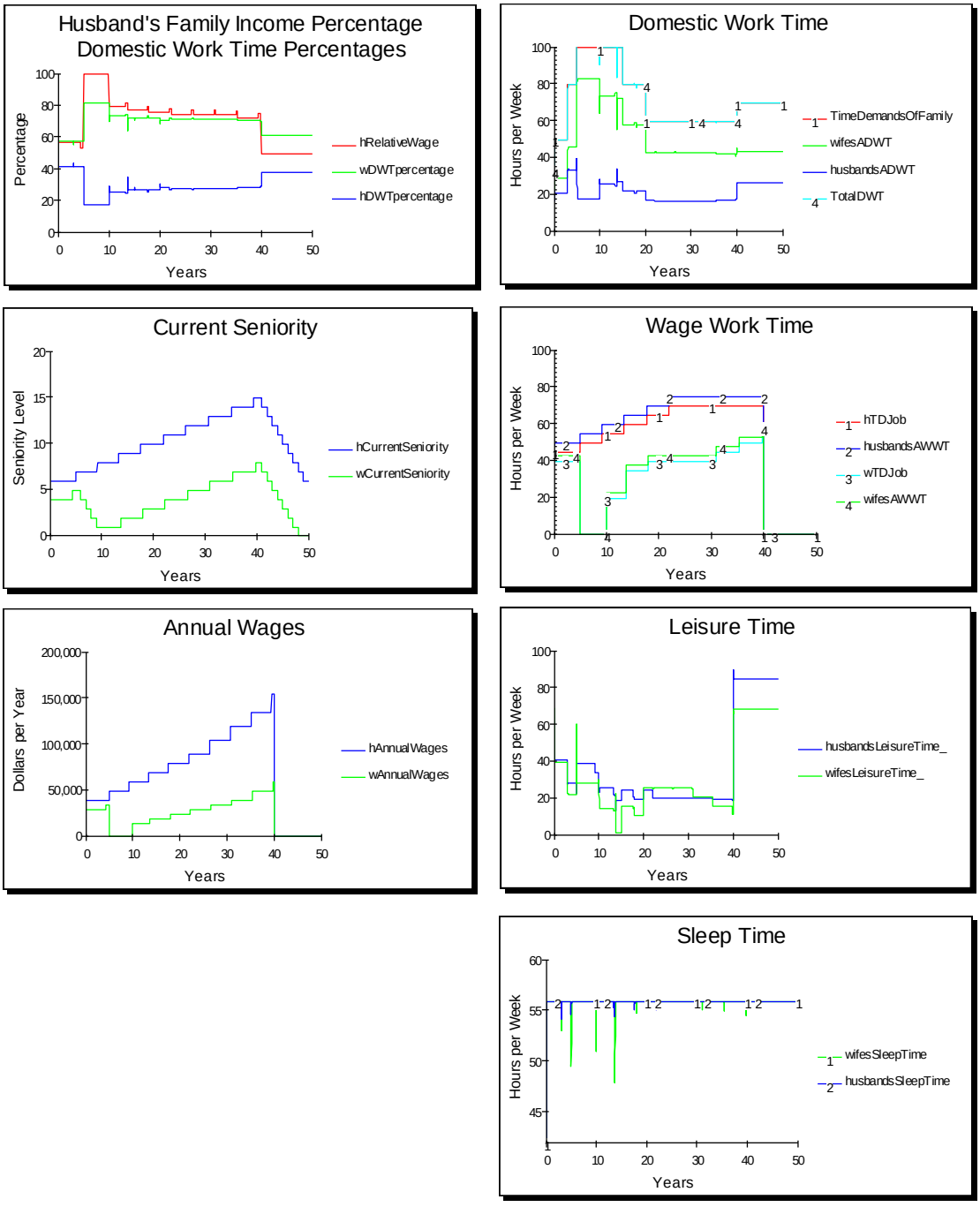


Figure 17: Transitional couple -- Wage gap A

The focus of this research is the leadership gap – why women are not moving up into leadership positions in the same numbers as men. Consider the graphs in Figure 17. Beginning with the Domestic Work Time Percentages graph, one observes that when the woman stops wage work at year 5, her domestic work time responsibility increases dramatically and stays high during the five years she is off work (year 5-10). One can also readily observe from the Current Seniority graph that the woman loses much of her seniority during those years. When she returns to work, due primarily to her low wages and the importance she places on wages as a criterion for dividing domestic work, she continues to perform most of the domestic work. As a result of her time off and the couple's ideology, by the end of her career the woman has only achieved a seniority level slightly higher than where she began the marriage. Thus this couple's domestic choices keep the wife from moving up into leadership positions at work at the same rate as the husband.

One might argue that while she is not moving up in the workplace, she could be taking on leadership roles in other venues. Okin's work is focused on professional leadership positions as an important means of influence. Volunteer positions rarely have the same breadth of influence as professional ones. But for the sake of argument, any possibility of the woman leading an organization outside of wage work is quickly discounted, for in observing her leisure time and sleep time during the child-rearing years (year 3 – 23) it becomes clear she does not have the discretionary time to take on any additional roles. It is concluded that the model under this scenario does replicate, at the individual family level, the leadership gap Okin describes in aggregate at the societal level.

5.2 Egalitarian Couple – Wage Gap C

As 70% of egalitarian couples divide their domestic work as in Wage Gap C and Wage Gap D, the second scenario replicates Wage Gap C.

This egalitarian couple is career-oriented. Both husband and wife base their identity on wage work, and they choose for the wife to continue working through the child-rearing years. They begin the marriage at the same seniority level. Consistent with the definition of an egalitarian couple, both the husband and wife believe in sharing the domestic work equally.

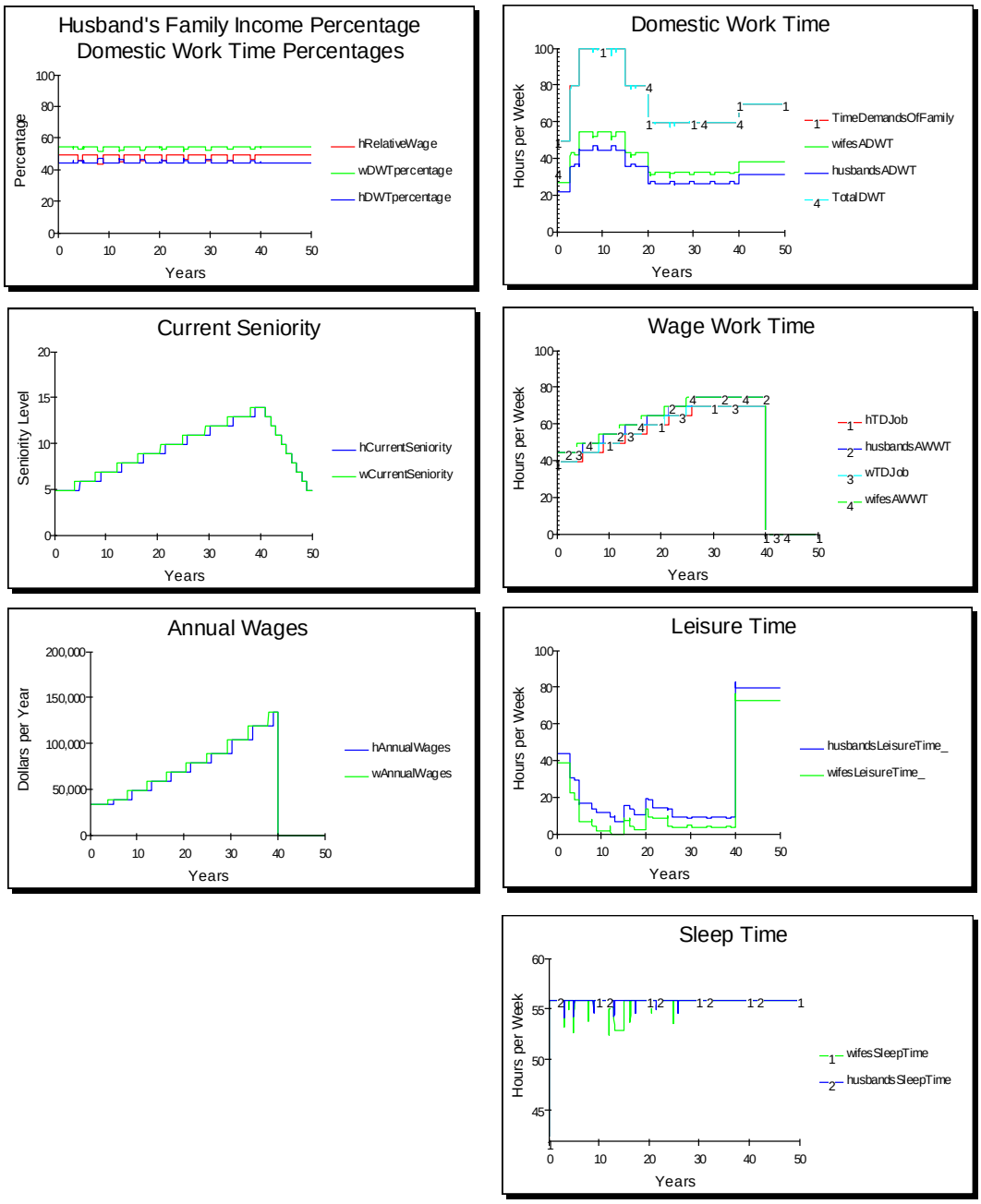


Figure 18: Egalitarian couple -- Wage gap C

In this scenario, the couple chooses for the wife to continue working through the child-rearing years. Due to their initially equal seniority and their commitment to wage work as the primary basis of their identity, both husband and wife reach leadership positions during the course of their careers. Even though this scenario represents a couple with complete parity in mind, cultural expectations impact their division of domestic work. Unfortunately for the woman, because of this greater amount of domestic work time, achieving this wage work parity with the man negatively impacts her leisure and sleep time.

The results of this scenario demonstrate that not taking time off from work can improve a woman's leadership opportunities appreciably, yet at a significant cost to leisure time (and at key junctures to sleep time). While the behavior of this scenario does not match the leadership gap Okin describes, it raises the question whether a woman could, or would choose to, maintain this lifestyle. While this scenario demonstrates how women can make it into leadership positions, it also supports the premise of recent literature indicating that many professional women are "opting out" of this stressful lifestyle and choosing to stay home or work in less demanding positions (see for example Hewlett 2007, Stone 2007, Wallis 2004, and Belkin 2003[16]).

5.3 Conclusion

Several of the scenarios in Campbell (2007) demonstrate that the behavior of the model replicates the leadership gap Okin describes and that is observed in the aggregate U.S. data. Women who take time off from work are significantly susceptible to losing their leadership opportunities. Those who put a high weight on wages, because of their career orientation or standard of living orientation, fair the worst when they take time off because of how their emphasis, coupled with the disparity in wages when they return to work, causes them to take on much more domestic work even when working full time.

Other scenarios demonstrate the difficult lives many women who choose to pursue leadership live. Women with children who work full time and consider wage work their primary identity have little if any leisure time, creating a stressful life. This points to at least one reason women who begin their married lives with leadership ambitions might choose later on to "opt out" – to take time off from work or find less demanding positions.

In total, the results of these two scenarios viewed out of context might appear to paint a balanced picture between the number of women who advance into leadership positions and the number who do not. Yet, each of these scenarios does not represent an equal number of couples in the U.S. population. Based on Hochschild, couples with transitional and traditional ideologies make up the vast majority of couples in the U.S. These couples are the ones most likely to divide their domestic work as in Wage Gaps A and B. Of the full array of simulations that replicate these two wage gap pairings (Campbell 2007), in only one does the wife continue working through the child-rearing years. In all the rest, she takes time off from work for five or ten years. As a result of this time off, her leadership opportunities are severely limited if not lost altogether. Therefore, examining the simulation results that represent the vast majority of couples, in most instances the woman is not able to advance to the same level as the man. Considering these results in the collective as the equivalent of the aggregate, it can be concluded that the scenario results replicate the leadership gap Okin describes.

[16] "The Opt-Out Revolution", L Belkin, New York Times, October 26, 2002, http://www.nytimes.com/2003/10/26/magazine/26WOMEN.html?ex=1382500800&en=02f8d75eb63908e0&ei=5007&partner=USERLAND.

6 Conclusion

In this section, the research findings, contributions, and limitations are summarized, and opportunities for further research outlined.

6.1 Summary of Research Findings

One objective of this research was to translate the theory Okin describes in her book *Justice, Gender, and the Family* into a system dynamics model and determine whether it produces the problematic behavior described: an ongoing gender gap in leadership. This paper presents Okin's descriptive theory in a system dynamics model and demonstrates analytically that a social structure like that described in the theory could be producing the leadership gap. Several decisions and cultural beliefs are identified as having more significant impact on women's leadership outcomes than others, including: whether a woman takes time off from her career, how many years she takes off, whether a woman identifies herself with wage work or with roles at home, a couple's initial seniority at work, and a woman's emphasis on wages as a decision criterion for dividing domestic work time with her husband.

The other objective of this research was to evaluate the applicability of system dynamics to exploring and advancing feminist theory. Applying system dynamics to this theory of gender equity reaped the same benefits that applying system dynamics has brought to social science theories previously: it revealed assumptions, clarified concepts, integrated disparate dimensions of the theory, and created a complete representation of the theory (even when it was necessary to supplement the theory with modeler assumptions and/or additional research) as well as a deeper understanding of the cause and effect relationships within the theory's structure and between the structure and the problematic behavior.

These results confirm that system dynamics can be a valuable tool for advancing feminist theory. As has occurred with the exploration of other social science theories, it is assumed that system dynamics can also be a valuable tool in the development of well-targeted policies aimed at closing the leadership gap.

6.2 Research Contributions

This research has made contributions to feminist theory (which crosses fields), and to the fields of feminist economics and system dynamics.

6.2.1 Contributions to Feminist Theory

The contributions to feminist theory are twofold: to this specific theory of gender equity and as a proof of concept in the applicability of system dynamics to feminist theory in general.

For this specific theory, the research:

- Identifies gaps in the theory and the data (information either unidentified or unavailable) that filled would further the robustness of the theory.
- Integrates the disparate dimensions of the theory scattered throughout Okin's book into one concise, complete representation.
- Provides an analytical tool for evaluating different policy options in the future.

For feminist theory in general, this research provides a proof of concept. By supporting systemic thinking, system dynamics:

- Adds clarity to concepts and terms.
- Drives data collection to support a fuller understanding of the social structure and the problematic *patterns* of behavior.
- Provides tools for scenario and policy analysis, which result in a deeper understanding of a theory, all of which
- Ensures the robustness of the theory's description of social structure and its ability to explain the problematic behavior, resulting in an improved likelihood of success in eliminating the problematic behavior through well-targeted policies.

6.2.2 Contributions to the Field of Feminist Economics

In addition to the contributions made to feminist theory, this research provides the field of feminist economics a proof of concept that system dynamics is a valuable analytical method that provides a systemic framework for exploring questions of gender, yet without the problematic assumptions that analysis methods based in neoclassical or heterodox economics bring, limiting their effectiveness when examining feminist theory.

6.2.3 Contributions to the Field of System Dynamics

Leaders in the field of system dynamics have a goal to increase the number of disciplines that use system dynamics as an analysis method to support systemic thinking. This research demonstrates the applicability of system dynamics to issues of gender and to feminist theory, thereby opening up opportunities for members of multiple fields whose work intersects with feminist theory to consider using system dynamics. The research also provides one more example of the applicability of system dynamics to social science issues in general.

6.3 Research Limitations

The current research has limitations in two primary areas: 1) a somewhat limited usage of feminist research and 2) missing structure. Feminist theory cuts across disciplines, and as such is scholarly, broad, and rich; this project was necessarily limited in the research that could be included. Several gaps in the theory and data details, filled by assumptions of the author, might be more accurately filled by feminist theory or research data in yet unidentified works. The current model structure does not implement a husband's resistance to additional domestic work (Okin 1989) or unintentional bias in favor of men in the workplace, nor does it include structure to create the aggregate behavior described in Okin. These are all opportunities for future expansion.

6.4 Future Directions

Opportunities to further this research exist in the areas of model extension, validation, scenario analysis, and policy analysis (details can be found in Campbell (2007)). All opportunities could be supported by additional research of the existing feminist literature.

One significant purpose of a simulation model is to provide a systematic method for evaluating policy options intended to close the leadership gap. Okin suggests a few in her book, and others are suggested by the thesis analysis. While additional steps are necessary to ensure the robustness of the simulation model for this purpose, the next major objective of the work is to systematically evaluate these and other policy options to identify the highest leverage actions that women, men, and organizations can take to sustainably close the leadership gap.

References

Babcock L, and S Laschever. 2003. *Women don't ask: Negotiation and the gender divide*. Princeton, NJ: Princeton University Press.

Bahá'í International Community. The promulgation of universal peace. http://info.bahai.org/article-1-7-6-1.html.

Barlas Y. 1996. Formal aspects of model validity and validation in system dynamics. *System Dynamics Review* 12(3):183-210.

Bianchi S, S Raley, and M Milkie. 2005. "What gives" when mothers are employed? Time allocation of employed and nonemployed mothers: 1975 and 2000. Original article no longer available, but an updated version can be accessed at http://socialsciences.cornell.edu/0407/Bianchi%20What%20Gives%20April%202006.pdf

Becker GS. 1976. *The economic approach to human behavior*. Chicago, IL: University of Chicago Press.

Blank RM and CW Reimers. 2003. Economics, policy analysis, and feminism. In *Feminist economics today: Beyond economic man*, eds. MA Ferber and JA Nelson. London, UK: University of Chicago Press.

Bleijenbergh I, Y Benschop and J Vennix. 2006. Group model building as a gender mainstreaming instrument. Paper presented at the conference 'Equal is not enough', Antwerp University, Belgium, September 13-15.

Bleijenbergh, I, E Blonk, L Schulte and M van Engen. 2008. Explaining Women's Careers at a Dutch university: Model building as a method for knowledge elicitation in gender analysis. Paper presented at the 26th International System Dynamics Conference, Athens, Greece, the System Dynamics Society.

Campbell D. 2007. *Dynamics that Maintain the Leadership Gap: An Interpretation of Justice, Gender, and the Family by Susan Moller Okin.* M Phil thesis, University of Bergen, Bergen, Norway.

Campbell D and A Crespo-Marquez. 1997. Improving business performance by releasing human potential. Paper presented at the 15th International System Dynamics Conference, Istanbul, Turkey, the System Dynamics Society.

Campbell D and PS Hovmand. 2004. Is your organization collegiality-challenged? A case study demonstrating the effect of unconscious gender bias. Paper presented at the 22nd International System Dynamics Conference, Oxford, England, the System Dynamics Society.

Carroll SJ. 2000. Representing women: Congresswomen's perceptions of their representational roles. Paper presented at 'Women Transforming Congress: Gender Analyses of Institutional Life', Carl Albert Congressional Research and Studies Center, University of Oklahoma, April 13-15. http://www.cawp.rutgers.edu/Facts/Officeholders/congroles.pdf.

Carroll SJ. 2001. Introduction. In *The impact of women in public office*, ed. S Carroll. Bloomington, IN: Indiana University Press.

Catalyst. 2005. Women "take care," men "take charge:" Stereotyping of U.S. business leaders exposed. http://catalyst.org/publication/94/women-take-care-men-take-charge-stereotyping-of-us-business-leaders-exposed.

Catalyst. 2006. 2005 Catalyst census of women corporate officers and top earners of the Fortune 500. http://www.catalyst.org/files/full/2005%20COTE.pdf.

Catalyst. 2007. The Double-Bind Dilemma for Women in Leadership: Damned if You Do, Doomed if You Don't. http://catalyst.org/publication/83/the-double-bind-dilemma-for-women-in-leadership-damned-if-you-do-doomed-if-you-dont.

Douglas SJ, and MW Michaels. 2004. *The mommy myth: The idealization of motherhood and how it has undermined all women*. New York, NY: Free Press.

Dudley, R. 2007. The Equity Supply Chain: Is it the Cause of So Few Women in Management and Leadership Positions? Paper presented at the 25th International System Dynamics Conference, Boston, MA, the System Dynamics Society.

England P. 2003. Separative and soluble selves: Dichotomous thinking in economics. In *Feminist economics today: Beyond economic man*, eds. MA Ferber and JA Nelson. London, UK: University of Chicago Press.

Forrester JW. 1961. *Industrial dynamics*. Portland, OR: Productivity Press. Originally published by MIT Press, Cambridge, MA. Currently available from Pegasus Communications, Watham, MA.

Hewlett SA. 2007. *Off-ramps and on-ramps: Keeping talented women on the road to success*. Boston, MA: Harvard Business School Press.

Hochschild AR. 1989. *The second shift: Working parents and the revolution at home*. Reprint with a new introduction. New York, NY: Penguin Books, 2003.

Johnson AG. 1997. *The gender knot: Unraveling our patriarchal legacy*. Philadelphia, PA: Temple University Press.

Lane DC. 2001. Rerum cognoscere causas: Part II -- Opportunities generated by the agency/structure debate and suggestions for clarifying the social theoretic position of system dynamics. *System Dynamics Review* 17(4):293-309.

Mansbridge J. 1998. The many faces of representation. Working paper, John F. Kennedy School of Government, Harvard University. Quoted in Carroll 2000.

Okin SM. 1989. *Justice, gender, and the family*. New York, NY: Basic Books.

Rhode DL. 2003. Introduction. In *The difference "difference" makes: Women and leadership*, ed. DL Rhode. Stanford, CA: The Stanford University Press.

Sawicka A. 2004. Dynamics of security compliance: Case of IT-based work environment. PhD thesis, University of Bergen, Norway.

Sayer LC. 2005. Gender, time and inequality: Trends in women's and men's paid work, unpaid work and free time. *Social Forces* 84(1):285-303.

Senge PM. 1990. *The fifth discipline: The art and practice of the learning organization*. New York, NY: Currency Doubleday.

Sterman JD. 1985. The growth of knowledge: Testing a theory of scientific revolutions with a formal model. *Technological Forecasting and Social Change* 28(2):93-122.

Stone P. 2007. *Opting out? Why women really quit careers and head home*. Berkeley, CA: University of California Press.

Strober MH, and AM Kaneko Chan. 1999. *The road winds uphill all the way: Gender, work, and family in the United States and Japan*. Cambridge, MA: The MIT Press.

Wallis C. 2004. The case for staying home: Why more young moms are opting out of the rat race. *Time*. March 22, 2004.

Weaver EA. 2005. Flynn's case for a different approach to homeland security. Paper presented at the 23rd International System Dynamics Conference, Boston, Massachusetts, the System Dynamics Society.

Weaver EA and G Richardson. 2006. Threshold setting and the cycling of a decision threshold. *System Dynamics Review* 22(1):1-26.

Wilson MC. 2004. *Closing the leadership gap: Why women can and must help run the world*. New York, NY: Viking.