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Article

Making STEM "Family Friendly": The Impact of Perceiving Science Careers as Family-Compatible

Erica S. Weisgram [1,*] and Amanda B. Diekman [2]

[1] Department of Psychology, University of Wisconsin-Stevens Point, Stevens Point, WI 54481, USA
[2] Department of Psychology, Miami University, Oxford, OH 45056, USA; diekmaa@miamioh.edu
* Correspondence: Erica.Weisgram@uwsp.edu

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Abstract: Two studies extended the communal goal congruity perspective to examine perceived incongruity between science careers and family caregiving goals. Study 1 examined beliefs about science careers among young adolescents, older adolescents, and young adults. Science careers were perceived as unlikely to afford family goals, and this belief emerged more strongly with age cohort. Study 1 also documented that the perception that science affords family goals predicts interest in pursuing science. Study 2 then employed an experimental methodology to investigate the impact of framing a science career as integrated with family life or not. For family-oriented women, the family-friendly framing of science produced greater personal favorability toward pursuing a science career. In addition, perceived fulfilment of the scientist described predicted personal favorability toward a science career path. We discuss the implications of these findings for research and for policy.

Keywords: gender; STEM; goal congruity; family

1. Introduction

Researchers across the disciplines of psychology, sociology, education, and many others offer an assortment of possible explanations for the underrepresentation of women in STEM (Ceci and Williams 2007; Diekman et al. 2015). Recent reviews have called for greater emphasis on the role of girls' and women's personal choice in the process of selecting a STEM career (Valla and Ceci 2014), along with an understanding of how these choices are influenced by both individual-level and structural-level factors (Diekman and Fuesting). The factors that influence girls' and women's personal choices often reflect gendered cultural beliefs, internalized gender stereotypes, and perceptions of gender bias by individuals and organizations. For example, individuals' assessments about their own skill within domains are influenced by gender stereotypic expectations (Correll 2001), and occupational structures do not readily integrate caregiving responsibilities that continue to be central to the female role (Stone 2007). Understanding how STEM occupations are perceived to afford family goals, and how these perceptions influence choice processes, is the purpose of the current research.

This research utilizes a goal congruity framework that suggests that a key factor influencing entry into social roles is the perceived alignment between those roles and the valued goals of the individual (Diekman et al. 2017). We extend the goal congruity framework that has been applied to communal goals and STEM interests (Diekman et al. 2010) to include family caregiving goals. Thus, we specifically focus on how perceptions of science careers as affording family goals—allowing one to spend time with one's family and care for one's family—impact individuals' interest in pursuing STEM pathways. We explore this research question across two studies. In Study 1, we investigate age and gender differences in children's, adolescents', and adults' perceptions of STEM careers as affording family goals and whether these perceptions predict interest in STEM careers. In Study 2, we use an experimental design to investigate the causal impact of perceptions that science careers afford family goals on young women's attitudes toward STEM careers.

1.1. The Goal Congruity Framework

The goal congruity approach posits that perceived congruity between individuals' goals and their social roles fosters positivity toward entering into and persisting in social roles (Diekman et al. 2017). Social roles function as an opportunity structure that people navigate in order to meet their valued goals (Diekman and Eagly 2008). Critically important is the recognition that in the goal congruity framework, *anticipated* incongruity between goals and roles is central. Even though anticipated incongruity may or may not align with *actual* incongruity, anticipated incongruity can affect decisions (Diekman et al. 2017). As we illustrate in the current research, the mere perception that STEM careers are incompatible with family goals can influence intentions to persist along those pathways, regardless of the accuracy of this perception.

The goal congruity model has documented robust, consensual stereotypes of STEM careers as less likely to afford communal goals than other kinds of careers (Diekman et al. 2010, 2011). Given these stereotypes, more communally-oriented individuals (who tend to be women; (Diekman et al. 2011; Schwartz and Rubel 2005)) are less likely to be interested in STEM careers (Diekman et al. 2010). However, individuals who do see STEM as affording communal goals express greater interest in STEM (Brown et al. 2015). Especially important is evidence demonstrating that beliefs about communal goal affordances in STEM are malleable. Interventions that frame science careers as affording altruistic and collaborative goals succeeded in increasing positivity toward STEM careers, particularly among young girls and women (Diekman et al. 2011; Weisgram and Bigler 2006).

To date, the goal congruity research has focused on communal goals as a broad construct, including a general orientation to help others or work with others. In the current work, we extend the goal congruity approach to consider the endorsement of family goals, and the perception that STEM fields allow one to meet family goals (Weisgram and Diekman 2016). Although the endorsement of family goals could be seen as an extension of communal goals in that family caregiving also is other-oriented (Weisgram et al. 2011), people who endorse communal goals may or may not also endorse family goals—the desire to have a family and spend time caretaking for their family members. Thus, research is needed to investigate specifically how perceived congruity or incongruity of family goals influences women's and men's and STEM interests and attitudes.

1.2. The Importance of Family

In the social, vocational, and developmental psychology literatures, research has demonstrated that caring for one's future family is a high priority for both men and women (Konrad et al. 2000; Weisgram and Hayes 2014). However, gender differences in family goal endorsement also emerge, with women endorsing family goals more than men (Weisgram et al. 2010, 2011). This gender difference is not present in childhood and adolescence, but emerges in young adulthood as men and women begin to consider their future more closely (Weisgram et al. 2010). This increasing gender difference may also be due to increasing influence of gender norms with age. Moreover, men and women encounter different opportunities to pursue and display their family-oriented values: because family orientation is more central to the female gender role, others may elicit more expectancy-confirming behavior and attitudes (Geis 1993), resulting in greater expression of family goals by women than men.

However, men and women may have different perspectives on what caring for one's family entails, perhaps stemming from the traditional breadwinner-caregiver model (Fulcher and Coyle 2011; Fulcher et al. 2015). Women may see themselves as caring for their family by taking time off from their careers, being home with their children, and providing physical and emotional care; and men may see themselves as caring for their family by providing income for housing, food, and other expenses (Brown and Diekman 2010; Curry et al. 1994). These gendered perspectives may have educational and occupational consequences as adolescents and adults make achievement-related choices. Indeed, for women, two competing cultural schemas—devotion to work and devotion to family—can be seen as wholly impossible to pursue simultaneously (Blair-Loy 2009). These presumed tradeoffs emerge in educational and career expectations: among adolescents, endorsing traditional attitudes about work-family gender roles predicted lower educational expectations (i.e., only graduating high school), while endorsing egalitarian attitudes predicted higher educational expectations (i.e., attending college or graduate school; (Davis and Pearce 2007)). Among undergraduate college students, valuing family goals predicted higher anticipated pay for men and lower work commitment and anticipated pay for women (Lips and Lawson 2009).

In general, gendered ideas about caring for one's family may lead women to negotiate flexible work roles or take time off from work altogether (Fulcher et al. 2015). If flexible options are not available, women may opt out of a particular career: for example, women who leave a male-dominated field for a female-dominated field often cite family reasons (Frome et al. 2006). Given the current workplace structure and traditional gender role expectations, women may be more likely than men to project explicit trade-offs between work and family. For example, traditionally college-aged men and women project gender-differentiated possible selves ten years into the future (Curry et al. 1994). In particular, women who rated their family selves as highly relevant were less likely to rate their career selves as relevant. Other research has shown a negative correlation between the importance of and commitment to work and importance of and commitment to family among women, but not among men (Owen Blakemore et al. 2005; Friedman and Weissbrod 2005). Although both men and women appear to value family involvement, this involvement is projected to be in opposition to paid work for women, but not for men. In general, the ability to balance work and life is related to a sense of life fulfilment and satisfaction for men and women (Greenhaus et al. 2003; Gröpel and Kuhl 2009), but how men and women combine work and life may differ.

As men and women explore their career options and then enter the world of work and parenthood, their endorsement of family goals may change. Across the 10 years following graduate school entry, women in STEM fields, particularly those with children, significantly increased their preference for a job that was flexible, had weekends free, and had reasonable hours (less than 50 hours per week); in contrast, these preferences stayed the same for men across the same time period (Ferriman et al. 2009). Indeed, 40% of women with children felt that working part-time was very important, whereas fewer than 15% of men agreed. These family orientations have been shown to negatively predict young women's (and young men's) interest in Computer Science (Beyer 2014)—a finding that may generalize to other STEM fields as well.

A key point is that presumed incongruity between career and family goals can influence decisions, even if individuals are unaware of this influence. For example, in interviews with 100 students at multiple campuses, Cech found that neither male nor female students considered their family plans as important in their career decisions (Cech 2016). Some comments also reflected a sense that their career paths would accommodate their family goals, reflecting the value they accorded to work-family alignment. The questions we pose in the current research are: (1) are STEM fields in particular perceived as posing challenges to integrating family; and (2) do models of scientists who integrate or do not integrate family influence women's positivity toward pursuing science? We thus first turn to the literature that suggests that STEM careers are often perceived to impede engaging in family caregiving (Weisgram and Diekman 2016).

1.3. Perceptions of STEM Careers as "Family-Unfriendly"

According to the goal congruity approach, the perception of STEM careers as affording the opportunity to attain family goals is key to the recruitment of family-oriented men and women into the field. However, research by Weisgram et al. suggests that individuals (children, adolescents, and young adults) perceive masculine jobs, in general, as affording family goals to a lesser extent than feminine jobs (Weisgram et al. 2010). Importantly, the study also reported adults' ratings of family goal affordances for individual occupations. Indeed, the job of "scientist" (M = 2.16, SD = 0.74) was rated lower in affording family goals than masculine jobs (M = 2.51, SD = 0.32) and feminine jobs (M = 3.07, SD = 0.40).

There are several reasons that STEM jobs may be perceived as being family "un-friendly." One reason may be the overall stereotype of scientists: young adults perceive successful scientists to be less communal and more agentic than men and women in general (Carli et al. 2016). Indeed, parents are perceived as less agentic, and less committed to potential jobs, than nonparents (Fuegen et al. 2004). Thus, it may be that perceptions of successful scientists are at odds with perceptions of successful parents.

Beliefs about perceived affordances of roles can be rooted in a range of prior experience with the role (Diekman et al. 2017). The cues to perceptions of whether science affords family goals can thus come from either primary or secondary experience. Primary experience might include science activities or classes, or interactions with scientists. As students approach college, they are increasingly likely to have more first-hand contact with scientists (rather than science educators); however, these members of the science faculty may actually reinforce perceptions that science careers do not align with family caregiving goals. First, there are fewer women than men in academic science and engineering positions (National Science Board 2016); second, those female scientists who are in academia may not disclose information about their family caregiving responsibilities, given that these are not normative within the profession. Thus, as students move from childhood to emerging adulthood, they may be exposed to more information that confirms, rather than disconfirms, perceptions that science does not afford family goals.

Perceptions of scientists and their work may also develop based on media depictions of scientists. Because children, adolescents, and adults may not interact personally with scientists in their everyday life, presentations of scientists in books, television, and movies influence individuals' perceptions of both scientists and STEM careers (Steinke et al. 2007). Representation of science as integrated with family caregiving is rare: For example, a content analysis of popular films found that of the 23 female scientists depicted, only four were depicted as mothers and of those, only two were depicted as full-time employed mothers (Steinke 2005). The lack of media models of scientists, especially female scientists, who combine family caregiving and career may contribute to children's, adolescents', and adults' perceptions of STEM careers being incompatible with spending time with and caring for family members.

Perceived challenges in combining STEM careers and family goals can result from a number of factors, including the type of training needed to attain STEM careers, the timing of advanced education or training opportunities, and discrimination based on parental status. Many professional fields include long hours and extensive training, such as law and medicine—fields that have a greater proportion of female workers than most STEM fields (48% of medical degrees and 47% of law degrees are awarded to women (National Center for Education Statistics 2011). Although many individuals move to STEM careers with a Bachelor's degree (i.e., jobs in industry), many jobs, including those within academia, require advanced degrees and have a particularly long period of apprenticeship before an individual secures a permanent position. Most academic scientists attend graduate school, followed by a post-doctoral apprenticeship (or two), and then enter a tenure-track position achieving tenure after six to seven years—a combined probationary period that often overlaps with the developmental time period in which many women wish to have children. In addition, the work of scientists often includes labor- and time-intensive work in the lab (e.g., chemistry, neuroscience) or in the field of study (e.g., biology, paleontology), and thus they may not be able to have a flexible schedule to accommodate children's needs, may need to travel to conduct fieldwork (perhaps to locations that are unsafe for children), travel to conferences to present and learn about current research, or may have to make decisions between attending to a time-sensitive research project (e.g., work with rats who reach puberty on a given day) and children's care (e.g., sick child care, special occasions at children's schools). Because of the perceived and real difficulties of combining an academic STEM job with family duties, many women elect to leave academic positions for STEM positions for positions in industry that have more reliable hours and often higher salaries (Newsome 2008).

Advocates for gender equality in STEM fields have recently argued that decreasing barriers to family commitments is key in recruiting and retaining women (Weisgram and Diekman 2016; Villablanca et al. 2011; Williams and Ceci 2012). Policies are present in many academic and non-academic workplaces that may decrease these barriers such as parental leave (paid or unpaid) or stopping a tenure clock. Women are more likely than men to want to use these policies but chose not to make a request to do so (Villablanca et al. 2011). Women were more concerned than men with the reaction of their colleagues for using family benefits. In addition, within a School of Medicine, women were more likely than men to report remaining childless or having fewer children than desired (Villablanca et al. 2011).

In surveys of both postdoctoral fellows and tenure-track faculty, the perception that an institution supports family responsibilities strongly predicts job satisfaction and workplace belonging (Heilbronner 2013). Among STEM postdocs and faculty (including medical sciences), this relationship was stronger for women than for men. In addition, surveys of men and women who left STEM careers often note that the incompatibility with family responsibilities strongly influenced their decision to leave (Heilbronner 2013).

The importance of gender balance and work-life interaction to individuals considering STEM careers was demonstrated in an experimental study (DeFraine et al. 2014). Undergraduate and graduate students who were highly identified with math watched one of two lab recruitment videos, which either depicted a male-dominated, work-focused environment that emphasized competition, or a gender-equal work/life-interaction-focused environment that emphasized flexibility and collaboration. Although commitment to science did not differ between the groups, those students, both men and women, who watched the work-life-interaction video projected that they would feel a greater sense of belonging in the lab and reported a greater desire to participate. Thus, depicting a research lab as allowing flexibility across work and home domains led to benefits. However, whether these benefits are specifically due to perceived family-friendliness, or are also due to the increased presence of women and increased collaboration, is a question that remains.

1.4. The Present Studies

The present studies examine the relationships between individuals' perceptions of science as affording family goals and their interest in science. In Study 1, we examine gender and developmental differences in interest in science and perceptions that science jobs afford family goals among three different age groups: young adolescents, older adolescents, and young adults. We also examine whether perceptions that science affords family goals predicts interest in science. In Study 2, we present an experiment that directly manipulates perception of science jobs as affording family goals and examines effects on women's interest in pursuing these roles. We focus on women in particular because of the underrepresentation of women in STEM fields and because of the perceived family-impacting-work conflict that young women anticipate relative to young men (Fulcher and Coyle 2011). Given the importance that men and women ascribe to family goals and the relatively little literature on the perception of STEM careers as affording these goals in relation to interest in STEM, these studies fill an important void in the literature.

2. Study 1

In Study 1, we examined gender and age differences in individuals' perceptions of science as affording family values and their relation to interest in science tasks and careers. This developmental timepoint is critical, as boys and girls begin to lose interest in STEM careers in adolescence, with boys retaining higher interest than girls across development (Frenzel et al. 2010). Research by Weisgram et al. has demonstrated that age differences, but not gender differences, emerge for the perception that masculine jobs afford family goals less than feminine jobs (Weisgram et al. 2010). Moreover, research with young adults has found consensus across male and female participants in beliefs that STEM fields lack communal opportunities (Diekman et al. 2010, 2011). We predict that family affordances of STEM jobs will also follow this pattern.

We expected to replicate robust gender differences in science interest with boys and young men reporting greater interest than girls and young women, and with gender differences increasing across age groups. We then sought to examine whether family goal affordances would predict interest in STEM. Specifically, we expected that the belief that science affords family goals will positively predict interest in science careers and science tasks.

2.1. Methods

2.1.1. Participants

Participants included 103 middle school adolescents (37 boys, 66 girls; M_{age} = 12.47, SD = 0.52), 80 high school adolescents (32 boys, 48 girls; M_{age} = 15.64, SD = 0.73), and 217 undergraduate students (92 men, 125 women; M_{age} = 19.49, SD = 1.34). Middle school (7th grade) and high school (10th grade) students were recruited from public schools in a mid-sized city in the Midwest. Science teachers recruited students from their classrooms with surveys administrated to each student who received parent permission. Undergraduate students were recruited from introductory psychology classes at a mid-sized regional university in the Midwest in the same city where the adolescent data were collected. Students completed the study as part of course participation. The sample was 88% European American, 4.5% Asian American, 2% African American, 2% Hispanic American, 1% Native American/Alaskan, 2.5% Other/Unreported, and is reflective of the region in which the data was collected. Parent permission was received for all adolescents in the sample.

2.1.2. Procedures

Participants completed three surveys: (a) perceptions of science; (b) interest in science careers, and (c) interest in science tasks. Adolescents completed paper and pencil versions of the survey during their mandatory science classes. Undergraduate students completed online versions of the same survey.

2.1.3. Measures

Perceptions of Science Jobs

To assess whether participants perceive science jobs as affording family values, participants answered four items derived from Weisgram and Bigler's Occupational Values Scale (Weisgram and Bigler 2006). Participants were given the prompt of "Being a scientist is a job that . . . " with sentence completions including "allows scientists to take time off when they become a parent," "allows scientists to easily manage both a career and a family," "gives scientists plenty of time to spend with their family," and "allows scientists to work part-time when their children are young." Response options ranged from (1) "Not at all" to (4) "Very Much." Reliability was high for each age group, with Cronbach alphas ranging from 0.78 to 0.88.

Interest in Science Careers

Interest in five science careers was assessed: scientist (general), astronomer, physicist, chemist, and biologist. A brief description of each career was given (e.g., "a physicist is someone who studies what things are made of (matter), energy, atoms, light, sound, x-rays, gravity, and many other aspects of the physical world"). Participants were asked how much they would want to do each job on a scale of (1) "Not at all" to (4) "Very Much." Reliability was high for each age group, with Cronbach alphas ranging from 0.68 to 0.80.

Interest in Science Tasks

Because many individuals are unaware of what science jobs entail or feel they are unable to commit to a science career, interest in scientific tasks was also assessed (Weisgram and Bigler 2006, 2007). This list of 25 scientific tasks was developed by Weisgram and Bigler in consultation with female scientists (Weisgram and Bigler 2006). Participants were asked to indicate how interested they were in performing each task with response options ranging from (1) "Not at all" to (4) "Very Much." Cronbach alphas ranged from 0.89 to 0.92 for the three age groups.

2.2. Results

Data analysis was a two-step process. First, we investigated age and gender differences on family affordances, interest in science careers, and interest in science tasks. Second, we examined whether beliefs that science afforded family goals predicted interest in science careers and science tasks.

2.2.1. Gender and Age Differences

For each construct, a 2 (gender: male, female) × 3 (age group: younger adolescents, older adolescents, college students) analysis of variance (ANOVA) was performed. As shown in Figure 1, the belief that science afforded family goals decreased with each age group, as reflected in the significant effect of age group, $F(1, 386) = 24.40$, $p < 0.001$, partial $\eta^2 = 0.11$. Post hoc comparisons (LSD) indicated that beliefs that science affords communal goals were held most by middle school students and least by college students, with each age group significantly differing from the others. No gender differences emerged for perceptions of science as affording family goals.

Consistent with past research, boys and young men reported greater interest in science careers and tasks than did girls and young women across all age groups. These differences were significantly different for science tasks, $F(1, 387) = 31.12$, $p < 0.001$, partial $\eta^2 = 0.11$, and marginally significant for science careers, $F(1, 386) = 3.34$, $p = 0.06$, partial $\eta^2 = 0.01$. See Table 1 for means and standard deviations.

Table 1. Study 1: Means and Standard Deviations for Dependent Variables by Gender and Age Group.

	Males							
	Middle School (*n* = 37)		**High School (*n* = 32)**		**College (*n* = 92)**		**Overall (*n* = 161)**	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Perception of Science as Affording Family Goals	3.03 [a]	0.71	2.81 [b]	0.77	2.40 [c]	0.49	2.63	0.67
Interest in Science Careers	2.13	0.52	2.07	0.85	2.11	0.68	2.11	0.69
Interest in Science Tasks	2.22	0.52	2.17	0.63	2.09	0.48	2.14	0.52
	Females							
	Middle School (*n* = 66)		**High School (*n* = 48)**		**College (*n* = 125)**		**Overall (*n* = 239)**	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*Mean*	*SD*
Perception of Science as Affording Family Goals	2.95 [a]	0.77	2.65 [b]	0.63	2.51 [c]	0.55	2.66	0.66
Interest in Science Careers	2.11	0.60	1.95	0.56	1.85	0.67	1.94	0.64
Interest in Science Tasks	1.90	0.43	1.86	0.49	1.80	0.48	1.84	0.47

Note: All values range from 1 (low) to 4 (high). Superscripts indicate significant differences across groups.

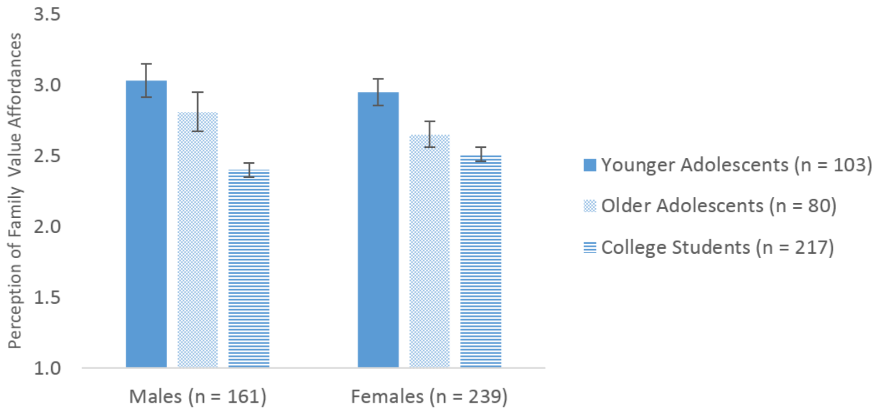

Figure 1. Perception that science affords family goals by gender and age group.

2.2.2. Predicting Science Interests

To examine whether interest in science careers and tasks was predicted by participants' perceptions of science as affording family goals, regression analyses were performed. Because there were significant age differences (but not gender differences) in perceptions that science affords family goals, age group was included as dummy variables with the middle school group representing the reference group. Perceptions that science affords family goals, and the interactions between this construct and the dummy variables, were included as predictor variables in the linear regressions. For interest in science tasks, perceptions that science careers afford family goals was a significant predictor (see Table 2). Results for interest in science careers followed a similar pattern (see Table 2).

Table 2. Study 1: Predictors of Interest in STEM Careers and Tasks

	Standardized Beta Values
Interest in Science Tasks	$F(3, 388) = 13.89$, $p < 0.001$, $R^2 = 0.10$
Perceptions of STEM as affording family goals	0.30 *
Age group (high school = 1) × Perceptions	0.06
Age group (college = 1) × Perceptions	0.05
Interest in Science Careers	$F(3, 387) = 4.60$, $p = 0.004$, $R^2 = 0.03$
Perceptions of STEM as affording family goals	0.19 *
Age group (high school = 1) × Perceptions	−0.02
Age group (college = 1) × Perceptions	−0.02

Note: * $p < 0.05$.

2.3. Discussion

Study 1 provided a novel examination of whether students from middle school through college perceive science as affording opportunities to have a family life. We assessed gender and age differences and in perception that STEM careers afford goals and also examined the predictive relationship between beliefs that science affords family goals and interest in science tasks and careers. Results showed a clear developmental trend in the perception that a career in science affords family goals; although middle schoolers endorse these beliefs to a moderate extent, high school students are less likely to hold these beliefs, and college students are even less likely than their younger counterparts.

To our knowledge, this study is the first to document age trends in perceptions of whether science affords family goals. The finding that these perceptions decrease with age is important: as students move to life stages where their beliefs about family and career matter most for their own decisions, they are increasingly likely to see science as incompatible with family goals. Specifically, as students choose STEM electives in high school, courses in college, and career paths in college, achievement-related choices that are crucial to choosing a career in STEM (Wang and Degol 2013), they are simultaneously and increasingly perceiving incongruity between these career paths and their family goals.

Study 1 clearly demonstrated that those who perceive that science affords family goals are especially positive toward science. This finding suggests that perceptions about family goals might play a critical role in shaping decisions about entry into and persistence in science careers. However, Study 1 rests upon a correlational design, and thus it is always possible that third variables that were not measured could explain this relationship. In order to establish that perceptions that science affords family goals play a causal role in attraction to science careers, we turned to an experimental method in Study 2. In this study, we focus, in particular, on women's responses to framing STEM occupations as "family friendly," given that women may experience more work-family interference than men (Borelli et al. 2017; Duxbury et al. 1994).

3. Study 2

In Study 2, we examined whether experimentally manipulating the family-friendliness of an entry-level science career would elevate women's positivity toward science. In addition, in this study we expanded our positivity variables to include both general positivity toward science, as well as personal positivity toward pursuing science as a career. Although both attitudes are important in determining who persists in the STEM pipeline, personal favorability may be more challenging to influence with short-term exposure to information. However, understanding the beliefs that predict both general positivity and personal favorability are critical to forming interventions and policy to broaden participation in STEM.

In Study 2, we investigated two hypotheses. First, we hypothesized that framing a scientist's career as family-friendly will elicit greater general positivity toward science and personal positivity toward a career in science, particularly for women who are family-oriented. Second, we posited that this effect of family-friendly science will be mediated by beliefs that the scientist is fulfilled in life and in work. Thus, we expected that framing a scientist's career as family-friendly will lead to greater beliefs that the scientist is fulfilled, which will in turn predict positivity toward science and personal positivity toward pursuing science.

3.1. Methods

3.1.1. Participants

Participants included 87 women (M_{age} = 19.08), recruited from undergraduate psychology classes at a regional University in the Midwest. Students were predominantly European American (87%), with African American (7%), Hispanic American (2%), Asian American (2%), and Biracial (2%) students also represented in the sample. Students were predominantly first year students (74%), with smaller groups of second year students (17%), third year students (3%) and fourth year students (2%). Three non-traditional students were eliminated from analyses.

3.1.2. Procedures

Students were randomly assigned to one of two conditions, described below: (a) a family-friendly condition, and (b) a control condition in which family was not mentioned. After reading the description, students completed a brief measure of their positivity toward science, perceptions of people in science careers, and perceptions of career and life fulfilment.

3.1.3. Materials

A description of a day in the life of an entry-level female chemist was based on similar descriptions used by Diekman et al. (2011). The work-related tasks were the same across both conditions (e.g., "I go to the lab after about an hour to check on samples left overnight (for example, to see if a drug crystallized), characterize samples from the previous afternoon to integrate the data collected the previous day, and characterize new samples that have come in that day"). In the family-friendly condition, some events described interactions with spouse and children (e.g., "I wake up and wake the children. I watch morning cartoons with them for a bit."); in the control condition, these events described the same content but without spouse or children (e.g., "I wake up. I watch a bit of television in the morning.").

Both descriptions note that the scientist enjoys "working by myself and solving problems," and the work tasks are identical across the two conditions. Thus, unlike previous research (Diekman et al. 2011), the nature of the work is consistent across both conditions; instead, only the presence and support for family caregiving differs between the two conditions. See Appendix A for the complete descriptions.

Control Condition

In the control description, the chemist (Joyce) wakes up, watches television, gets dressed and makes lunch, walks to work, checks her email, and checks a research database to get up-to-date about some of her experiments. She then goes to her lab to check on samples left over night and prepare new samples and catches up on her research. She walks across campus for exercise.

Family-Friendly Condition

The description of the scientist was modified to include family responsibilities and caregiving. In this description, Joyce wakes up and wakes up her children, watches television with her children, gets herself dressed and the children dressed and makes them all lunch. She walks to work dropping the children off at day care along the way. While at work, the duties are identical to the duties in the control condition. Late morning, she walks across campus and visits her children as they have lunch.

3.1.4. Measures

Family Orientation

To capture individual differences in family orientation, participants responded yes or no to the question, "Have your future family plans factored into your career decisions?" Individuals responding "Yes" were categorized as high in family orientation and those responding "No" were categorized as low in family orientation.

Positivity toward Science

Two indices of positivity were assessed. First, an index of general positivity toward science was created by averaging two items (alpha = 0.73): "What is your general impression of an entry-level career in STEM?" and "What is your general impression of science careers?" with response options ranging from (1) Very Negative to (7) Very Positive. Second, an index of personal favorability toward pursuing a science career was created by averaging three items (alpha = 0.91): "How successful do you think you would be as an entry-level scientist?"; "How enjoyable do you believe you would find a career as an entry-level scientist?"; "How interested are you in a career as an entry-level scientist?" with response options ranging from (1) Not at all to (7) Extremely.

Fulfilment

Two items assessed fulfilment. The first item asked "How fulfilling do you believe the scientist you read about finds her career?" and the second item asked "How fulfilling do you believe the scientist you read about finds her life?" Response options for both questions ranged from (1) Not at All to (7) Extremely. These items were highly correlated (alpha = 0.76) and were averaged to create an index of perceived fulfilment.

Demographics

Participants reported demographic information, including gender, age, race, year in college, and current major.

3.2. Results

3.2.1. Positivity

We conducted a 2 (condition: family-friendly or control) × 2 (family orientation: high or low) multivariate analysis of variance (MANOVA) including both general positivity and personal favorability as dependent measures. This analysis yielded a significant interaction between condition and family orientation, $F(1, 85) = 3.23$, $p = 0.04$, *Wilk's* $\Lambda = 0.93$, *partial* $\eta 2 = 0.07$. Univariate analyses revealed that this interaction only emerged as significant for general positivity, $F(1, 85) = 6.53$, $p = 0.01$, *partial* $\eta 2 = 0.07$, and was not significant for personal favorability, $p = 0.17$. See Table 3 for means and standard deviations. To investigate this interaction, comparisons between conditions were examined for family-oriented and non-family-oriented women separately. Family-oriented women who read about a female scientist with a family were more positive toward STEM careers than family-oriented women who read about a female scientist without a family, $t(30) = 2.37$, $p < 0.02$, $d = 0.88$. There were no significant differences between conditions for non-family-oriented women. See Figure 2.

Table 3. Study 2: Means and Standard Deviations by Condition and Family Orientation.

	Family Friendly				**Control**			
	Family-Oriented (N = 13)		**Non-Family-Oriented (N = 29)**		**Family-Oriented (N = 19)**		**Non-Family-Oriented (N = 28)**	
	Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
General Positivity	5.85 [a]	0.94	5.13	0.82	4.82 [b]	1.36	5.29	1.01
Personal Favorability	4.08	1.16	3.41	1.42	3.21	1.84	3.51	1.59
Perceived Fulfilment	6.27	0.78	5.82	0.84	5.65	1.08	5.89	0.94

Note: Superscripts indicate significant differences across groups.

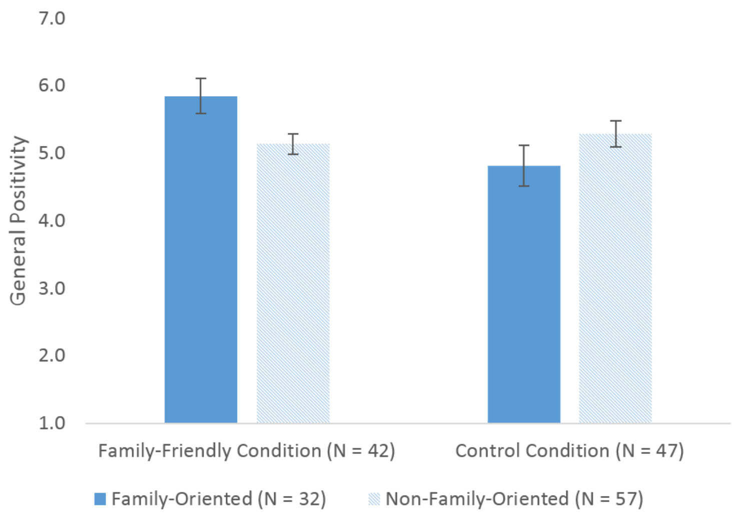

Figure 2. Positivity toward STEM careers by family orientation and condition.

3.2.2. Fulfilment

We examined effects on the perception that the scientist was fulfilled in a 2 (condition) × 2 (family orientation) ANOVA. There were no significant main effects of condition ($p = 0.19$) or family orientation

(p = 0.62), and there was no significant interaction between the constructs (p = 0.11). See Table 3 for means and standard deviations.

3.2.3. Does Perceived Fulfilment Predict Positive Attitudes?

We had predicted that the family-friendly framing would foster positivity through perceptions that the scientist was fulfilled. Because we did not detect condition effects on perceived fulfillment, that mediational model was not supported. However, we were able to examine whether perceived fulfillment would be associated with positive attitudes toward pursuing science. We conducted a linear regression analysis to determine whether this projected sense of fulfilment predicted positivity toward science. For general positivity toward science, perceived fulfilment was a significant positive predictor, $B = 0.53$, $\beta = 0.47$, $p < 0.001$, and for personal favorability, perceived fulfilment was a marginal positive predictor, $B = 0.32$, $\beta = 0.19$, $p = 0.07$. On both measures, women who perceived that the scientist was more fulfilled tended to express more positivity toward science.

3.3. Discussion

In Study 2, we presented participants with a description of an academic science job that was framed as either typical (control) or family friendly. The female scientist in each of the scenarios performed typical duties of scientists, but the family friendly description contained information about spending time with her family members and caring for them, while the control description contained information about her hobbies and activities outside of work.

Our data indicate that family-oriented women who learn about a scientist whose work allows for the integration of caregiving responsibilities were more positive toward STEM than their peers. Thus, this research supports the goal congruity perspective as applied to the affordance and endorsement of family goals (Diekman et al. 2017; Weisgram and Diekman 2016). Specifically, the higher the congruity that was present between women's goals and their perception of STEM careers, the more positive they felt toward these careers in general. Based on this brief study, we may infer that intervention programs aimed at increasing girls' and women's positive evaluation of, STEM may benefit, at least for many individuals, from including information about work-life balance in STEM fields.

In addition to examining general positivity and personal favorability, we also examined the effect of framing STEM careers as family-friendly on the perceptions of personal fulfilment of the female scientist that was described. Although our framing of the STEM career did not affect perceptions of fulfilment, there were individual differences in the degree to which perceptions of fulfilment predicted STEM attitudes. We found that the sense that the scientist was perceived to be fulfilled, across both conditions, influenced attitudes toward STEM careers. For general impression of the field, this relationship was significantly positive: the more a participant perceived the scientist as fulfilled with her life, the more positive attitudes she had toward STEM careers in general. For personal favorability, perceptions that the scientist was fulfilled were positively (but marginally) related to positive STEM attitudes These patterns indicate that a sense that others are fulfilled in STEM careers is important in the development of positive STEM attitudes among women.

Across two studies, we demonstrate the potential impact of beliefs that science careers can be combined with family goals. Study 1 found that across developmental stages from middle school to college, both boys and girls are increasingly likely to perceive science as failing to afford family caregiving. Moreover, in early and late adolescence, these family affordances predict positivity toward STEM career paths. Thus, it is possible that perceiving STEM careers as not "family friendly" deters girls from exploring and pursuing STEM careers. Study 2 employed an experimental design to demonstrate that family-oriented individuals who read about a scientist who incorporates family roles expressed more general positivity toward a scientist career.

4. General Conclusions

Overall, these data suggest that highlighting the possibility of STEM careers as family-friendly might be a significant mechanism of intervention for broadening participation of family-oriented individuals—and perhaps more interventions should incorporate information about how STEM careers afford these goals. Interventions that incorporate other communal goals have been successful with adolescent girls and young women (Weisgram and Bigler 2006). Thus, interventions that include portrayals of scientists as multidimensional individuals who are both scientists and parents may increase girls' and women's positive attitudes and break down stereotypes about scientists. A strong caveat to this conclusion, however, is that such family-friendliness cannot only occur in marketing about careers; the real-life cultures of institutions and workplaces must encompass work-life resources (Weisgram and Diekman 2016).

To truly shift workplace cultures to encompass family goals, specific steps need to be taken to remove barriers that particularly influence women's entry and persistence in STEM. Indeed, Mason has widely implemented and discussed some of the ways in which STEM careers, and academic careers more broadly, can be made to help accommodate parents, such as stopping the tenure clock (Mason et al. 2013). In recent years, the National Science Foundation has begun to incorporate more family-friendly policies to help grant holders, including delaying the start of research due to pregnancy or parental leave (particularly for those for whom traveling with young children is dangerous or difficult) and providing additional funding for research assistants to carry out parts of the research that might be difficult or dangerous for a pregnant woman or parents with young children (e.g., paleontology digs in extreme heat, Arctic fieldwork, etc.). Some universities are even providing back-up child care services and sick child care in one's home at a partially subsidized rate to limit the impact child care disruptions have on faculty members' productivity—disruptions that disproportionally affect women (University of Michigan 2016).

Thus, although some steps are being taken to make STEM careers more family friendly, institutions and individuals still have a long way to go. A key message across intervention efforts should be to demonstrate that family goals and STEM careers are not in competition with one another, but can be integrated. In addition, qualitative and quantitative research should be conducted with female and male scientists that aims to investigate the complex challenges these individuals have in combining work with family, and to identify mechanisms that would enable them to be successful and fulfilled in both roles.

Despite the promising findings of these studies, there are a number of limitations to this research. Although the elegant design of Study 2 is useful in determining the causal role of family-friendly framing on individuals' STEM attitudes, it portrays scientists as either being isolated or having a family. Certainly, other forms of connection to people (besides child caregiving) can offer opportunities to meet communal goals. Future research using this vignette paradigm should also depict male and female scientists having a rich social network both in and outside of the workplace, having hobbies and outside interests, and having STEM jobs that afford a variety of values and goals. Given that family-orientation is ranked highly in women's occupational value structures (Weisgram and Hayes 2014) and that the construct moderates the effects of family-friendliness on positivity, we see value in emphasizing the ability to successfully integrate family and career roles in attracting women and girls to STEM fields.

An essential step for future research is to investigate how men navigate family and employment roles. Study 1 found that men and women held similar beliefs about whether science afforded family goals; as men become increasingly involved with caregiving and less able to assume a stay-at-home partner, they too may be faced with perceptions that work and family are incongruent. We anticipate that flexible work structures that allow both men and women to pursue their valued goals will be increasingly favored. However, an initial step is to understand whether both male and female scientists can model family-friendly STEM workplaces, and whether both male and female respondents weigh this information equivalently in their choices. In previous experimental studies, both male and female scientists conveyed opportunities to work with or help others within STEM roles (Fuesting and

Diekman 2017). However, because of the gendered nature of family caregiving, it is possible that female scientists can more effectively convey cues that STEM roles can integrate family.

In addition, future research should further examine the direction of the relationships assessed here through experimental and longitudinal research. The experimental method in Study 2 demonstrated that perceived family-friendliness can have a *causal* impact on positivity toward pursuing a science career. However, other naturalistic relationships are possible. For example, individuals who are highly immersed in science and positive toward the field may also have more opportunity to observe scientists who are involved in family caregiving or who are fulfilled in various ways. We also note that explorations of these constructs among individuals who vary in age, ethnicity, socioeconomic status, and a variety of other background variables would provide opportunity to understand the strengths and limitations of the framework explored here. In particular, it is important to understand whether groups vary in their perceptions that science affords family goals, and whether groups have differential access to resources to help them navigate perceived work-family conflict (e.g., affordable high-quality child care; extended family networks).

The experimental stimuli used here were designed to manipulate the presence or absence of family integration in academic science, and a question for extending this research is the ecological validity of this description. In short, does this vignette realistically depict a day in the life of a female scientist who is a primary caregiver or a co-parent? Many real-life situations are more challenging than depicted here: in the vignette, the scientist's children are healthy, they attend the same day care on her campus, have no afterschool activities, and she has a partner who participates in the daily division of labor. Although parents may experience many days such as the one described, daily life with young children can be decidedly more stressful (e.g., illnesses that prevent them from attending day care, the lack of availability of affordable high-quality child care for parents, the stresses that exist between co-parents of young children, and the difficulty of transitions as children develop; (Augustine et al. 2013; Hardway and McCartney 2015; Nelson et al. 2014)). However, these are issues that many families face regardless of discipline, and thus cannot explain gender gaps in STEM pursuits. Finally, we note that career decisions may often be based on ideals rather than reality; thus, the development of perceptions of scientists and science careers across age merits future research. What is important to note here is that when an idealized science career integrates family, it might be more appealing than when it does not.

The current research demonstrates that beliefs that family caregiving is incongruent with a science career become more extreme from adolescence through young adulthood, and this perceived incongruity can have strong implications for career decisions. For those who wish to create greater opportunity for women (and family-oriented men) in science, two paths are clear: First, scientists who do successfully integrate family can make these successes more public, and second, scientists who meet with challenges in integrating family can make these obstacles more public. When parents have to choose family or a scientific career, the losses accrue not only to those individuals, but to institutions, to science, and to society at large.

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Author Contributions: Erica S. Weisgram and Amanda B. Diekman both participated in designing the studies, analyzing data, and writing the manuscript. Erica S. Weisgram collected data for both studies.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Appendix A.1 Family Friendly STEM Condition

Joyce is a chemist at a university in the Midwest. She lives with her husband and two children (ages 1 and 3) in a home near the university. A sample day in her life is as follows:

6:30 a.m. I wake up and wake up the children. I watch morning cartoons with them for a bit. Then, I make breakfast and get dressed-helping the children get dressed as well. I pack lunches for them and for myself.

7:45 a.m. I walk to work, dropping off children at the University Child Care Center on the way.

8:15 a.m. I come in and check my e-mail then plan the day. I usually have to check a database maintained by the Operations Group (they run the high-throughput screens) to learn the status of ongoing experiments so I can go from primary to secondary characterizations.

9:15 a.m. I go to the lab after about an hour to check on samples left overnight (for example, to see if a drug crystallized), characterize samples from the previous afternoon to integrate the data collected the previous day, and characterize new samples that have come in that day. I look up relevant past research to consult about the procedures.

11:30 a.m. I often walk to the University Child Care Center to visit the children as they have lunch.

12:00 p.m. The company runs presentations during lunch, where we learn what else is going on both within the company and with the Big Pharma companies who supply us with compounds. I watch video feed of these presentations at my desk while I eat. Speakers might be a researcher from a different lab giving an update, a patent lawyer briefing us on legal issues in patent protection, and a member of the Products Group describing ongoing product development work.

1:00 p.m. Do data analysis (e.g., powder X-ray diffraction, differential scanning calorimetry, thermal gravimetric analysis) and troubleshoot any problems that come up by myself.

2:45 p.m. I call my spouse to check in and say hello and discuss what we should have for dinner that evening.

3:00 p.m. Go to meeting to update my supervisor on the status of my projects, which are typically independent. My supervisor will tell me what further experiments to run or additional data points to collect. My supervisor also gives me a heads-up on what compounds are coming in during the next few weeks. This gives me an idea of what my own workload will be like.

4:00 p.m. Update lab notebook with either data collected that day or experiments started. Get started on experiments that can be set up and run overnight.

4:30 p.m. Commute home.

5:30 p.m. I play with the children before starting dinner for my family. We have dinner, talk about our day, and my spouse cleans up afterwards.

6:30 p.m. We spend "family-time" together—often watching television, spending time in our yard, or going for a walk.

7:30 p.m. We put the children to bed.

8:30 p.m. I catch up on household chores such as laundry, dishes, and picking up items around the house.

9:15 p.m. I check my email from work and respond to any pressing issues and often complete a little bit of grading if needed.

10:00 p.m. I read a leisure book in bed for a bit to relax.

10:45 p.m. I get ready for bed and go to sleep.

Summary I like that so much of my work involves working by myself and solving problems. The solitary nature of my work really lets me advance at a quick pace, and I get the sense that I am achieving a great deal through my projects. I like having a variety of tasks, gathering data through multiple methods, and trying to interpret data from both high-throughput experiments and bench-top experiments. I like the sense of contributing to understanding drug candidates that are likely to get into clinical trials. I like being exposed to industry and to the various issues in the pharmaceutical industry, both within my field and outside—largely from presentations—from the senior scientists and other experts. I also like that I have a flexible schedule that allows me to spend time with my family.

Appendix A.2 Control Condition

Joyce is a chemist at a university in the Midwest. She lives in a home near the university. A sample day in her life is as follows:

6:30 a.m. I wake up. I watch a bit of television in the morning. Then, I make breakfast and get dressed. I pack a lunch for myself.

7:45 a.m. I walk to work.

8:15 a.m. I come in and check my e-mail then plan the day. I usually have to check a database maintained by the Operations Group (they run the high-throughput screens) to learn the status of ongoing experiments so I can go from primary to secondary characterizations.

9:15 a.m. I go to the lab after about an hour to check on samples left overnight (for example, to see if a drug crystallized), characterize samples from the previous afternoon to integrate the data collected the previous day, and characterize new samples that have come in that day. I look up relevant past research to consult about the procedures.

11:30 a.m. I often walk across campus for exercise.

12:00 p.m. The company runs presentations during lunch, where we learn what else is going on both within the company and with the Big Pharma companies who supply us with compounds. I watch video feed of these presentations at my desk while I eat. Speakers might be a researcher from a different lab giving an update, a patent lawyer briefing us on legal issues in patent protection, and a member of the Products Group describing ongoing product development work.

1:00 p.m. Do data analysis (e.g., powder X-ray diffraction, differential scanning calorimetry, thermal gravimetric analysis) and troubleshoot any problems that come up by myself.

2:45 p.m. I decide what to have for dinner that evening and make a shopping list.

3:00 p.m. Go to meeting to update my supervisor on the status of my projects, which are typically independent. My supervisor will tell me what further experiments to run or additional data points to collect. My supervisor also gives me a heads-up on what compounds are coming in during the next few weeks. This gives me an idea of what my own workload will be like.

4:00 p.m. Update lab notebook with either data collected that day or experiments started. Get started on experiments that can be set up and run overnight.

4:30 p.m. Commute home.

5:30 p.m. I make dinner and clean up afterwards.

6:30 p.m. I often watch television, spend time in my yard, or go for a walk.

7:30 p.m. I spend time working on my hobbies

8:30 p.m. I catch up on household chores such as laundry, dishes, and picking up items around the house.

9:15 p.m. I check my email from work and respond to any pressing issues and often complete a little bit of grading if needed.

10:00 p.m. I read a leisure book in bed for a bit to relax.

10:45 p.m. I get ready for bed and go to sleep.

Summary I like that so much of my work involves working by myself and solving problems. The solitary nature of my work really lets me advance at a quick pace, and I get the sense that I am achieving a great deal through my projects. I like having a variety of tasks, gathering data through multiple methods, and trying to interpret data from both high-throughput experiments and bench-top experiments. I like the sense of contributing to understanding drug candidates that are likely to get into clinical trials. I like being exposed to industry and to the various issues in the pharmaceutical industry, both within my field and outside—largely from presentations—from the senior scientists and other experts.

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