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Gender Differences in Career Persistence among Research and Development (R&D) Engineers in Japan

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ABSTRACT
Regardless of the pressing need to increase women in STEM fields education and occupations in Japan, little is known about issues those women would face. Career persistence among female professionals is one of the important issues. Using the recent national sample of Research and Development (R&D) engineers (3,425 men and 714 women), we address the following research questions: (1) Do women in R&D have lower level of intentions to persist in their engineering careers than their male counterparts? (2) Do the gender differences in family status, work interference with family life, professional role confidence, and intrinsic motivation for work explain why women are less likely to persist in an engineering career? Results showed that women had significantly lower levels of intention to persist in their careers as engineers than men. Regression models indicated that women were still less likely than men to state an intention to persist in engineering even after controlling for factors including family status, work-life balance, professional role confidence, and intrinsic motivation for work. Thus, the gender difference in career persistence was not explained by those factors. Directions for future research are discussed.

KEYWORDS
gender; career persistence; STEM; engineers; R&D

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INTRODUCTION

In this study, we investigate gender differences in career persistence among Research and Development (R&D) engineers in Japan. Specifically, we address the following research questions: (1) Are the levels of intentions of career persistence different for men and women in R&D, such that women might have a lower level of intention to persist in the career in engineering than men? (2) Do the gaps between women and men in family status, work interference with family life, professional role confidence, and intrinsic motivation for work explain why women are less likely to persist in an engineering career?

Science, Technology, Engineering, and Mathematics fields, (STEM*)* are losing popularity among Japanese students as academic majors (Kawaguchi, 2009). The decline in the number of college students majoring in STEM fields has caused public concern that the undersupply of scientists and engineers may become a chronic problem in Japan. Thus, the issue of women's underrepresentation in STEM fields has often been discussed in the past few decades (e.g., Mainichi Shimbun Kagaku Kankyo-bu, 2003; Homma et al., 2013). For instance, there are studies on factors related to reduced popularity of science among junior-high and high school students (e.g., Muramatsu, 2004; Japan Science Support Foundation, 2005). The Japanese Ministry of Education, Culture, Sports, Science and Technology has been active in trying to attract more female junior-high and high school students into STEM fields. The Japan Inter-Society Liaison Association Committee for Promoting Equal Participation of Men and Women in Science and Engineering has conducted a number of large-scale surveys of researchers from academic associations in STEM fields (2008, 2013, 2015). Those survey results demonstrate gender differences in various domains, including academic disciplines, institutions, tenure, job ranks, income, marital status, and presence of children.

The proportion of female researchers in Japan has slowly been increasing, but it was still 14.6% in 2014, and this was much lower than other industrialized nations (Statistics Bureau, Ministry of Internal Affairs and Communications, 2015). Notably, this proportion includes female researchers in all disciplines, and the proportion is even lower in STEM fields. For example, among researchers who belong to universities and university-related institutions, proportions of women are 9.8% in engineering, and 13.8% in science (Statistics Bureau, Ministry of Internal Affairs and Communications, 2015). Homma et al. (2013) pointed out three possible reasons for such low proportions of women in STEM fields in Japan; (1) few role models for younger women, (2) unconscious bias among male researchers towards female colleagues, and (3) avoiding competition and underestimation of ability by women themselves. Although policy makers concerned with the underrepresentation of women in STEM fields stress the importance of developing and utilizing women's talents, the fact remains that Japanese women are still underrepresented in most STEM-related fields of study and they are significantly less likely to persist in occupations, such as in Research and Development (R&D).

Studies suggest that biological traits (Berenbaum & Korman Bryk, 2008), parental influence (Chhin, Bleeker & Jacobs, 2008), and social and institutional barriers (Watt, 2008) all contribute to women's underrepresentation in male-dominated occupations. Research examining women's careers in math (Ceci, Williams, & Barnett, 2009) indicates that preference and choices are powerful factors that explain women's likelihood of leaving math-intensive careers. Ceci and Williams (2011) claim that while fertility/lifestyle choices, career preferences, and ability differences are relevant to the underrepresentation of women in math-intensive occupations, career preference and lifestyle choices are the most salient reasons.

The retention and progression of women in non-traditional occupations are impaired by a range of structural and institutional barriers. Metaphors such as glass ceiling (Rosser, 2004) and glass cliff (Ryan & Haslam, 2005) emphasize the presence of structural drivers of women's attrition in competitive careers, suggesting that differential role expectations for men and women at work are related to women's voluntary resignation from academia. Factors such as workplace cooperation and collaboration are also important to understand the work outcome for women scientists. For example, limited opportunities for egalitarian collaborations tend to create obstacles to women's career progression (Sonnert & Holton, 1996). Hewlett et al. (2008) indicate four factors that drive women away from science and engineering careers: isolation and minority status at work, a lack of clarity in career paths, extreme work pressure, and work cultures placing high values on risk-taking behaviors. Research has found that long working hours and expectation for total availability are the dominant culture in STEM fields, and the decision to spend more time with family rather than work has detrimental effects on career progression for women who are still perceived to be primary family care takers (Davis, 2001; Grant, Kennedy, & Ward, 2000).

The tendency that women in STEM fields leave the labor force as their career progresses is often described as the "leaky pipeline" (e.g., Blickenstaff, 2005). Proportions of women become smaller for higher positions/ranks both in private sectors (Statistics Bureau, Ministry of Internal Affairs and Communications, 2015) and academia (Japan Inter-Society Liaison Association Committee for Promoting Equal Participation of Men and Women in Science and Engineering, 2008; Ogawa, 2006) in Japan. Japanese women in STEM fields are especially underrepresented in the private sector, and that is why we focus on engineers in this paper. Indeed, female and male researchers tend to belong to different institutions in Japan. Over 60% of female researchers work at universities and university-related institutions, and around 30% work in the private sector. The opposite patterns are observed for male researchers (Statistics Bureau, Ministry of Internal Affairs and Communications, 2010). Ogawa (2012) discusses the importance of expanding and diversifying career paths for female researchers into the private sector for scientific and technological innovation and discovery. Nevertheless, only limited attention has been paid to the problems in career development experienced by women in the STEM labor force. In Japan, some studies in the past focused on issues of human resource management of scientists and R&D engineers (Fukutani, 2007; Hirakimoto, 2006; Misaki, 2004; Yoshimura, 2007), yet they failed to include the gender perspective in their analyses and examine why women were less likely to persist in their engineering careers. Therefore, this study aims to examine the sources of gender differences in career persistence for Japanese engineers, and attempts to illuminate why Japanese women are less likely to persist in engineering occupations. First, we expect that family responsibilities and work-life balance have impacts on women's career persistence in STEM fields. Next, we also expect that the sense of confidence as professional and intrinsic motivation for work are associated with their career persistence.

BACKGROUND

(1) Family Status, Work-Life Balance, and Women's Career Persistence

Research suggests that women with stronger commitments to family responsibilities are less likely to choose science as their specialization (Ware & Lee, 1988) and less likely to express an intention to remain in male-dominant occupations (Frone et al., 2008). Although approximately half of Japanese women today agree with the idea that "women should keep their employment after childbirth," traditional gender ideology on the division of household labor continues to influence Japanese women's employment choices (Takeishi, 2009). Furthermore, life events such as marriage and childbearing set a limit on women's continuous employment and career development (Higuchi, 2009). The *Longitudinal Survey of Babies in 21st Century* conducted by the Japanese Ministry of Health, Labor and Welfare revealed that while 54.4% of respondents with children were employed one year prior to the survey, the proportion was reduced to 25.1% at six months after childbirth. While more women today choose to take parental leave and return to work, a significant number of Japanese women still leave their jobs during pregnancy.

Family responsibilities including housework and childcare constrain the work-related decisions for women in the STEM workforce. About 40% of Japanese female researchers with children spend three to five hours a day on housework, childcare, or elderly care, on average, while almost 60% of male researchers with children spend less than one hour a day on such domestic labor (Ogawa, 2006). According to a survey conducted by Japan Inter-Society Liaison Association Committee for Promoting Equal Participation of Men and Women in Science and Engineering (2008), 66% of female scientists and engineers in the survey considered "the difficulty in maintaining family and career" as a main reason why women were underrepresented in research and engineering, and 46% attributed the underrepresentation to "the difficulty of returning to work after child-rearing". Another survey shows that thesa majority of female unemployed former scientists and engineers had left their jobs within ten years of starting them, and major reasons for leaving their jobs were childcare and marriage (Kuwahara, 2001). Ogawa (2012) argues that the interruption of research by childbearing is a serious problem for Japanese female researchers, and many of them give up their careers. Thus, family responsibilities and difficulty in balancing work and family life are likely to impact career persistence for women in STEM fields in Japan.

(2) Professional Role Confidence, Intrinsic Motivation, and Women's Career Persistence

While family responsibilities may affect Japanese women's career persistence, the persistence of women in male-dominated occupations, such as corporate research and development, may be influenced by other profession-specific factors. Being a successful professional requires more than mastery of core intellectual skills and expert knowledge (Schleef, 2006). Individuals must go through professional socialization to "become" a professional, attaining tacit skills and knowledge required for making discretionary expert judgments in ambiguous circumstances (Hughes, 1971). To become a successful professional, individuals must develop confidence in their ability and self-esteem as an expert. Professional role confidence can be defined as "individuals' confidence in their ability to fulfill the expected roles, competencies, and identity features of a successful member of their profession" (Cech et al, 2011). Professional confidence is closely related to the concept of self-esteem, or an individual's belief in her/his ability to succeed in a given situation (Battle, 1990). Individuals with high confidence and self-esteem are more likely to set challenging goals and be persistent in achieving the goal. Confident professionals may have clearer career goals and stronger commitment to their career.

According to Cech et al. (2011), women and men develop different levels of professional role confidence for two reasons. First, professional confidence for women in male-dominant occupations are likely to be low because they must overcome cultural biases that men are naturally better at such professions. Indeed, Kuwahara (2001) introduces the survey result that Japanese women believe that women are not very good at science. Second, professional socialization in male-dominant occupations tends to take place in men's group processes, rather than through individual task performance. Because of low proportions of female researchers in the private sector (Statistics Bureau, Ministry of Internal Affairs and Communications, 2010), Japanese female scientists and engineers are less likely to have same-gender role models than their male counterparts (Ogawa, 2006).

Deci and Ryan's (1985) argument underscores the importance of intrinsic motivation for workers' career persistence. They argue that intrinsic task motivation results when a person's needs for self-determination and competence are satisfied by the task he/she performs. Competence refers to the extent to which a person feels capable of producing desired outcomes and preventing undesired events, whereas self-determination is the extent to which one feels free to show the behaviors of his/her choice. Based on Deci and Ryan's views, one's sense of self-determination will enhance intrinsic motivation, resulting in a higher level of propensity to stay in the occupation. The sense of competence, maximized for instance by mastery and engagement in challenging work, should also increase the level of intrinsic motivation. Thus, R&D engineers with a sense of competence are likely to have strong intrinsic motivation, and that would increase the likelihood of staying in their career.

HYPOTHESES

As explained in the background section above, family status, work-life balance, professional role confidence, and intrinsic motivation for work are likely to have impacts on career persistence among professional workers. Therefore, this study examines whether the gender difference in intentions of career persistence among Japanese R&D engineers disappears, when the impacts of those factors are controlled. Using these sets of broad explanatory variables, we explore the following hypotheses.

H1: Women are more likely than men to exhibit a lower level of intention to persist in an engineering career.

H2: Women’s career persistence would no longer be lower than that of men, when we statistically controlled for the impacts of family status, work-life balance, professional role confidence, and intrinsic motivation for work across genders.

DATA AND METHODS

Data

The data used in this study come from an online survey, “Survey on Work and Life among Research and Development Workers” conducted by one of the authors in March, 2012. Samples were taken from over 22,500 Japanese engineers registered at one online survey company. Our analytic sample for this study was 4,139 engineers, which consisted of 3,425 men and 714 women. Job types for those engineers were as follows. Around 36% of them were in information processing and software development, about 31% of them were in development and planning, 12% of them were in basic and applied research, and 21% of them were in other areas. We understand issues of utilizing data from online surveys. However, to our knowledge, there is no publically available national data on women and men in STEM fields in Japan today. Our sample is geographically diverse, and we believe that the data we used for this study were best-suited to investigate our research questions.

Dependent Variable: Career Persistence

Career persistence was measured by a questionnaire item phrased "I would like to work as an engineer for the rest of my life." Responses ranged from 1= *strongly disagree* to 4= *strongly agree*, such that higher scores indicated stronger intentions of career persistence in engineering.

Focal Independent Variable: Gender

The focal independent variable in this study was gender, coded as 1=*women* or 0=*men*. Around 20% of the sample was women.

Independent Variable (1): Family Status

Family status was measured by marital status and the presence of children. Marital status was coded as 1=*spouse present* or 0= *spouse not present*. Presence of children was dummy-coded as no children present (reference category), preschool child(ren) present, or non-preschool child(ren) present (i.e., child(ren) age 6 or over present).

Independent Variable (2): Work-Life Imbalance

Work-life imbalance was measured in several domains. First, we used respondents' overall perceptions of work-life imbalance, which was measured by a questionnaire item phrased "I think my work and life are NOT well-balanced." Responses were coded from 1= *strongly disagree* to 4=*strongly agree*, such that a higher score indicated greater work-life imbalance.

Next, average availability of time for self on a weekday was included. Responses were coded from 1=*2 hours or over a day,* 2=*1.5 hours or more and less than 2 hours*, 3=*1 hour or more and less than 1.5 hours*, 4=*30 minutes or more and less than 1 hour*, 5=*less than 30 minutes*, or 6=*no time for self at all*, such that a higher score indicated unavailability of free time.

We also used daily hours spent on housework, such as preparing meals, laundry, or cleaning. Responses ranged from 1=*none* to 6=*more than 2 hours a day*, such that a higher score suggested a greater daily engagement in housework.

Independent Variable (3): Professional Role Confidence

Professional role confidence was measured by a scale, which consisted of 10 items. Items captured several domains of confidence, and sample items are shown below. For instance, respondents were asked about how much confidence they had in knowledge gained through higher education. They were also asked about levels of confidence in knowledge to perform well as engineers for a long time. Responses for these items ranged from 1=*not at all* to 4=*a great deal*. Next, the levels of capacity as engineers were self-evaluated in three domains; capacity to work in current department/position, capacity to work within current company, or capacity to work outside the company. Items used were as follows. "How do you evaluate your level of capacity as an engineer for your current department/position?," "How do you evaluate your level of capacity as an engineer to work in your current company, beyond your department/position?," and "How do you evaluate your capacity as an engineer to work outside the company (i.e., if your capacity holds true outside the company)?" Responses ranged from 1=*not sufficient enough* to 4=*very sufficient*. Finally, statements on confidence gained through work included, for example, "I often experience a sense of accomplishment at work," and "I gain new ability through my work (1=*strongly disagree* to *strongly agree*)." Cronbach's alpha of the scale was .886

Independent Variable (4): Intrinsic Motivation for Work

Intrinsic motivation for work was measured by a scale, which consisted of an unweighted average of 3 items. Questionnaire items included, for example, "My work is very interesting (1= *strongly disagree* to 4= *strongly agree*)," and "I enjoy my work." Cronbach's alpha of the scale was .841.

Control Variables

We also controlled for the following factors. First, length of time working for current employer was measured in years. We utilized years working for current employer, instead of respondents' age, because these two variables are significantly and highly correlated each other (r=.662). Educational attainment was measured from 1=*junior-high school or high school degree*, 2=*junior college or vocational school degree*, 3=*four-year college degree*, 4=*master's degree*, to 5=*doctoral degree*. Managerial status was coded 1=*manager* or 0=*non-manager*. Income in the past year (in Japanese yen) was coded from 1=*less than 3 million yen* (equivalent to approximately US $35,000 or less), 2=*3.00-3.49 million yen* (approximately US $35,000-40,000), 3=*3.50-3.99* million yen, …15=*9.50-9.99 million yen*, to 16=*10 million yen* (approximately US $120,000) or over. Monthly hours of overtime work were measured in hours. Number of projects currently involved was also controlled. Type of industry was dummy-coded, such as communication/IT (reference category), manufacturing, or other types of industry. Finally, area of work was dummy-coded as development/planning (reference category), research, information processing/software development, or other areas.

Methods

First, gender differences in mean scores for career persistence were investigated. Then, Ordinary Least Squares (OLS) regression models were estimated to examine whether family status, work interference with family life, professional role confidence, and intrinsic motivation for work would explain gender differences in career persistence, holding the impact of other variables constant. In the analyses, gender and demographic characteristics were entered into the initial model. Then, family status and work-life imbalance were added to the model. Finally, professional role confidence and intrinsic motivation were added to the model.

RESULTS

Descriptive Results

Table 1 shows descriptive statistics for all the variables used in this study. The table also reports results of a series of t-tests demonstrating gender differences in mean scores for all variables. First, the mean score of women's intentions to persist in engineering was significantly lower (2.46) than that of men (2.81). Therefore, as hypothesized (H1), female engineers are less likely than men to intend to persist as engineers.

Mean scores for indicators of demographic characteristics also showed gender differences. For instance, men's tenure with the current employer was significantly longer (14.04 years) than women's (7.6 years). This shows that women in this sample have much shorter experience modelmodel 2 as R&D engineers than their male counterparts. Women had slightly higher educational attainment (2.98) than men (2.89). Significantly more men were in managerial position (56%) than women (22%), and men also had higher income level (7.80) than women (3.90). Men had significantly longer monthly overtime hours (70.51 hours) than women (52.00 hours), and men were also involved in more projects (2.35) than women (2.06). Thus, men were working more intensively than women in our sample. Type of industry also indicated gender differences, such that men were more likely (42%) than women (31%) to be working in manufacturing. Furthermore, men and women held different job types.

Table 1 Descriptive Statistics and Results of T-tests for Mean Differences between Men and Women

Variable	Men (n=3,425)				Women (n=714)				
	Min	Max	Mean	S.D.	Min	Max	Mean	S.D.	Mean Difference
Dependent variable									
Career Persistence	1	4	2.81	0.89	1	4	2.46	0.92	***
Demographic characteristics									
Length of time working for current employer	0	40	14.04	9.22	0	35	7.60	6.57	***
Educational attainment	1	5	2.89	0.98	1	5	2.98	1.02	**
Managerial status (1=manager)	0	1	0.56	0.50	0	1	0.22	0.41	***
Income in the past year (mil. Japanese Yen)	1	16	7.80	4.43	1	16	3.90	3.29	***
Monthly hours of overtime work	0	200	70.51	66.46	0	200	52.00	61.40	***
Number of projects currently involved	0	18	2.35	2.12	0	15	2.06	2.12	***
Type of industry:									
Manufacturing	0	1	0.42	0.49	0	1	0.31	0.46	***
Communication/IT	0	1	0.35	0.48	0	1	0.38	0.49	
Others	0	1	0.23	0.42	0	1	0.31	0.46	***
Area of work:									
Research	0	1	0.11	0.31	0	1	0.18	0.39	***
Information processing/software development	0	1	0.36	0.48	0	1	0.33	0.47	**
Development/planning	0	1	0.32	0.47	0	1	0.26	0.44	***
Others	0	1	0.21	0.41	0	1	0.23	0.42	*
Family status									
Marital status (1=spouse present)	0	1	0.68	0.47	0	1	0.45	0.50	***
Presence of children									
Preschool child(ren) present	0	1	0.17	0.38	0	1	0.18	0.38	
Non-preschool children present	0	1	0.36	0.48	0	1	0.10	0.30	***
No children present	0	1	0.43	0.50	0	1	0.72	0.45	***
Work-life imbalance									
Perception of work-life imbalance	1	4	2.46	0.78	1	4	2.44	0.83	*
Unavailability of time for self	1	6	3.06	1.43	1	6	3.01	1.53	*
Daily hours spent on housework	1	6	2.73	1.21	1	6	3.80	1.38	***
Professional role confidence	1	4	2.67	0.55	1	4	2.38	0.55	***
Intrinsic motivation	1	4	2.62	0.69	1	4	2.64	0.71	

Note 1: *** p <0.001, ** p <0.01, * p <0.05

Table 2: Regression Models Predicting Career Persistence

	Model 1		Model 2		Model 3	
Variables	B	SE	B	SE	B	SE
Intercept	2.616 ***	.067	3.084 ***	.092	0.887 ***	.108
Gender (1=women, 0=men)	-.262 ***	.039	-.299 ***	.040	-.252 ***	.036
Demographic characteristics						
Length of time working for current employer	.001	.002	-.001	.002	.002	.002
Educational attainment	.002	.016	.007	.015	.011	.014
Managerial status (1=manager)	.064 *	.032	.064 *	.032	-.056	.029
Income in the past year	.014 ***	.004	.009 *	.004	-.007	.004
Monthly hours of overtime work	.000	.000	.000	.000	.000	.000
Number of projects currently involved	1.300E-02 *	.007	.011	.007	-1.500E-02 *	.006
Type of industry:						
Manufacturing	.160 ***	.037	.144 ***	.037	.077 *	.033
Others	.018	.039	.005	.039	-.075 *	.035
Area of work:						
Research	.091	.050	.069	.049	-.006	.044
Information processing/software development	-.108 **	.039	-.113 **	.039	-.090 **	.035
Others	-.178 ***	.040	-.202 ***	.040	-.152 ***	.036
Family status						
Marital status (1=spouse present)			.063	.040	.034	.036
Presence of children						
Preschool child(ren) present			-.075	.046	-.013	.042
Non-preschool children present			.020	.042	.023	.037
Work-life imbalance						
Perception of work-life imbalance			-.197 ***	.018	-.028	.017
Unavailability of time for self			-.005	.010	-.014	.009
Daily hours spent on housework			.022 *	.011	.000	.010
Professional role confidence					.418 ***	.028
Intrinsic motivation					.382 ***	.021
Adjusted R^2	.055		.086		.265	

Note 1: *** *p* <0.001, ** *p* <0.01, * *p* <0.05

Note 2: Reference categories are "communication/IT" for Type of industry, "Development/planning" for Area of work, "No child" for presence of children, respectively.

Women were significantly more likely (18%) than men (11%) to be working in research, while more men were working in information processing/software development (36%) or development/planning (32%) than women (33% and 26%, respectively).

In terms of family status, men were much more likely (68%) than women to have a spouse (45%). Men were significantly more likely (36%) than women (10%) to have non-preschool children in the household, and women were more likely (72%) than men (43%) not to have children at all. The proportions of men and women who had preschool children were around 17%.

Mean scores for perceptions of work-family imbalance was 2.46 for men and 2.44 for women, and the difference was statistically significant. Men also exhibited slightly higher score (3.06) in unavailability of time for self than women (3.01). Thus, men indeed perceived greater work-life interference than women. However, women spent much longer time on housework (3.80) every day, compared to men (2.73).

Professional role confidence also indicated significant gender difference, such that men had significantly higher (2.67) levels of confidence in their profession as engineers than women (2.38). Finally, we found no significant gender difference in mean scores for intrinsic motivation for work.

Multivariate Results

Table 2 shows results of OLS regression models predicting career persistence. Model 1 indicates that women were significantly less likely than men to intend to persist in their engineering career, controlling for various demographic characteristics. Several demographic characteristics were significantly associated with career persistence. For example, those who were in managerial status were more likely to persist in engineering, compared to those who were in non-managerial status. Higher income levels and numbers of projects currently being undertaken were positively related to career persistence. Those who were in manufacturing industries were more likely to express an intention to persist in engineering careers than those who were in a communication/IT industry. Individuals who were engaged in information processing/software development were less likely to express an intention to persist in engineering, compare to those who were engaged in the area of development/planning.

Family status and indicators of work-life balance were added to Model 2. Demographic characteristics exhibited similar effects as in the previous model. This model shows that marital status and presence of children were not significantly related to career persistence. Perceptions of work-life imbalance were negatively associated with career persistence. Nevertheless, Model 2 shows that women were still significantly less likely than men to persist in a career in engineering, controlling for demographic characteristics, family status, and indicators of work-life balance.

Finally, professional role confidence and intrinsic motivation for work were added in Model 3. Managerial status and income level were no longer significantly associated with career persistence in this model. Marital status and presence of children were still unrelated to career persistence. The negative effect of the perception of work-life balance on career persistence became non-significant in this model. As previous research suggested, both professional role confidence and intrinsic motivation for work were significantly and positively associated with career persistence. That is, those who have higher levels of professional role confidence were more likely to persist in engineering than those who were less confident. Similarly, those with high levels of intrinsic motivation for work were more likely to persist as engineers, compared to those with lower levels of motivation. However, the negative effect of being female on career persistence remained statistically significant even after controlling for the impacts of professional role confidence and intrinsic motivation for work. Thus, contrary to our hypothesis (H2), female engineers' lower levels of intentions of persistence was not explained much by gender differences in family status, work-family imbalance, professional role confidence, and intrinsic motivation for work, along with various demographic characteristics.

CONCLUSION AND DISCUSSION

The Japanese economy has a pressing need to increase women in STEM education and occupations to avoid a chronic undersupply of scientists and engineers. Increasing the number of women entering STEM-related fields and occupations is important, but it is even more important for those women to remain in the profession throughout their career. However, little has been published about the issues women in STEM-related fields in Japan are likely to face. For instance, as Japanese women in many other professions experience, responsibilities related to family, such as housework and childcare, constrain female engineers' career persistence. Another possibility is that gendered processes in the development of professional role confidence might have an impact on women's career persistence. As discussed, professional confidence for women in male-dominant occupations is likely to be low because they must overcome cultural biases that "men are naturally fit" in such professions. Additionally, professional socialization in male-dominant occupations tends to take place in men's group processes, rather than through individual task performance.

Therefore, this study aimed to examine the gender difference in career persistence among Japanese engineers. As we expected, we first found that women had significantly lower levels of career persistence in engineering than men. We expected that the gender difference in career persistence would be diminished by controlling for the impacts of family status, work-life balance, professional role confidence, and intrinsic motivation for work. However, women were still less likely than men to persist in an engineering career, even after holding these factors constant. This suggests that gender differences in intentions of career persistence as engineers were not explained much by differences in family status (i.e., marital status and presence of children), work-life balance, professional role confidence, or intrinsic motivation for work. Those results might be related to sample characteristics in this study. For example, nearly half of the women in our sample were not married, and the majority of them did not have children at the time of survey. Women in our sample were working for their current employer for 7.6 years on average, while men were working for 14 years, suggesting that there are substantial differences in professional experience as engineers. Thus, it is possible that controlling for family and work-related characteristics did not diminish the gender difference in career persistence.

This study has some potential limitations. First, we need to acknowledge that intentions to persist in their career asked at the time of survey may not indicate their actual career persistence. It is likely that intentions of persistence would be affected by various factors. Longitudinal data are required to fully capture the relationship between family status, work-life balance, professional role confidence, intrinsic motivation for work, and patterns of career persistence. Second, indicators of family status could be expanded. For example, a spouse's demographic characteristics, such as hours of overtime work, might be related to women's career persistence. Co-residence with parents or parents-in-law possibly decreases the responsibility of household labor, which could be associated with female engineers' career persistence. Finally, although we found that marital status and presence of children were not significantly associated with career persistence, individuals' gender role attitudes might also be associated with intentions to persist as engineers. For instance, women who strongly support ideas of traditional roles as wives and mothers might be less likely to intend to persist in the profession. Unfortunately, no items measuring gender role attitudes were available in our data set.

Nevertheless, this study demonstrated that Japanese women in R&D engineering had significantly lower levels of intentions to persist as engineers than men, and the gender effect did not disappear when several key factors were controlled. Our results showed that Japanese female engineers who were in relatively early stages of their career did not have very strong intention to stay in the field. This is a serious issue, given the tendency for women to leave the STEM fields as their career stages progress. We need to understand reasons why young female engineers do not or cannot imagine themselves to persist their career. As reviewed earlier in this paper, a combination of multitude of factors affect career decisions for women in science and technology. Present results call for a further investigation of gender differences in career persistence for Japanese R&D engineers to capture more accurately the determinants of women's and men's intention to persist in engineering. Because only a small proportion of women graduating in the STEM-related fields go on to work in STEM occupations, especially in private sectors, in Japan, female young engineers may not have many role models in the workplace. This makes it difficult for them to envision their long-term career paths. In order to better understand female engineers' career persistence, we intend to incorporate qualitative elements in future research. We believe that interviewing female engineers is beneficial to uncover various issues that makes their career persistence difficult, and different strategies to overcome those issues.

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