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The Relation Between the Protestant Work Ethic and Undergraduate Women's Perceived Identity Compatibility in Nontraditional Majors

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We examined whether the Protestant work ethic (PWE), a fundamental, individually held belief associated with both sexist attitudes and personal striving, relates to undergraduate female science, technology, engineering, and math (STEM) majors' perceived identity compatibility (PIC) between being a woman and being in a STEM field and expectations of dropping out of their majors across the beginning of college. Using within-person analyses across six time points, PWE-Equalizer (suggesting hard work is a social equalizer) was positively associated with PIC and inversely associated with expectations of dropping out of one's major; PWE-Justifier (justifying disadvantage by blaming group members for not working hard enough) showed the opposite pattern. PIC mediated the relationship between PWE and expectations of dropping out. Implications for future directions in research, as well as for educational policy aimed at increasing the numbers of women in STEM fields, are discussed.

Gender disparities in science, technology, engineering, and math (STEM) fields are sizeable, pervasive, and occur at all levels of achievement (e.g., AAUW, 2004; NSF, 2009; Valian, 2005). The persistent underrepresentation of women who complete bachelor's degrees in STEM and go on to have careers in STEM fields continues to be a societal problem examined by researchers and policy makers aiming to understand and ultimately increase women's representation in STEM. Psychologists seeking to identify the causes of gender disparities in STEM fields have examined a variety of factors, but the most common explanations are

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focused on the academic environment, such as the gender discrimination that women face as students in STEM disciplines (e.g., Blickenstaff, 2005; Cronin & Roger, 1999). The Protestant work ethic (PWE)—a fundamental, individually held belief in the United States and in many other countries that hard work leads to success—has a long history of being associated with gender discrimination (Campbell, Schellenberg, & Senn, 1997; Swim, Aikin, Hall, & Hunter, 1995), including women's beliefs toward themselves (Quinn & Crocker, 1999), as well as personal striving and persistence in academic domains (McClelland, Atkinson, Clark, & Lowell, 1953). Yet, to our knowledge, previous work has not examined whether women's beliefs in PWE are related to their experiences in STEM fields. Past work suggests that the beginning of college is a particularly important time to study PWE, because women's feelings of self-doubt, anxiety, and discouragement in STEM fields often appear within the first two years of college (e.g., Brainard & Carlin, 1998; Erwin & Maurutto, 1998) and because many of the college women who drop out of STEM majors do so during their first or second years (e.g., Brainard & Carlin, 1998). In this investigation, among female undergraduates pursuing STEM majors, we examined connections among PWE, perceived identity compatibility (PIC) between being a woman and being in a STEM field (an established factor related to women's withdrawal from STEM), and expectations about dropping out of one's STEM major across the first two and a half years of college, which also allowed for tests of stability versus change in these variables.

The Protestant Work Ethic

PWE is a fundamental, individually held belief about hard work and success, which is related to people's judgments and behaviors across different facets of life, including academics and work (e.g., Furnham et al., 1993; Weber, 1958; see Rosenthal, Levy, & Moyer, 2011). Consistent with past work, we focus on two subtypes of PWE: (a) PWE as a social equalizer (PWE-Equalizer), and (b) PWE as a justifier of inequality (PWE-Justifier; e.g., Levy, Freitas, Mendoza-Denton, & Kugelmaas, 2006; Levy, Freitas, Mendoza-Denton, Kugelmass, & Rosenthal, 2010; Levy, West, & Ramírez, 2005; Levy, West, Ramírez, & Karafantis, 2006; Ramírez, Levy, Velilla, & Hughes, 2010).

As a facilitator of egalitarianism, PWE is often referred to as the "American Dream," with the implication that people from all social categories have equal potential to succeed through hard work and effort (e.g., Levy, West, & Ramírez, 2005). PWE-Equalizer is widely endorsed in the United States and is considered a motivator of personal striving (e.g., Levy et al., 2010; Levy, West, Ramírez, & Karafantis, 2006; McClelland, Atkinson, Clark, & Lowell, 1953; Ramírez, Levy, Velilla, & Hughes, 2010). PWE-Equalizer, as captured by widespread "rags to riches" stories, may have special value and significance to members of disadvantaged groups, such as women and African Americans, because it suggests that

they have the ability to overcome inequalities and disadvantages (e.g., Levy et al., 2010; Levy, West, & Ramírez, 2005; Levy, Freitas, Mendoza-Denton, & Kugelmaas, 2006; Ramírez, Levy, Velilla, & Hughes, 2010). For members of groups that have been stigmatized and underrepresented in high-status fields, believing that one can succeed through hard work may help buffer them against other prevalent societal stereotypes that suggest they do not belong or cannot succeed in that field. We predict that when college women in STEM fields more strongly believe that anyone who works hard has equal potential to succeed (PWE-Equalizer), these women will perceive greater compatibility between their gender and their STEM major and have lower expectations of withdrawing from their STEM major before graduating.

PWE also has long been considered a justifier of inequality with people justifying others' disadvantage by blaming negative or less successful outcomes on lack of effort (e.g., Crandall, 2000; Kinder & Sears, 1981; Kluegel & Smith, 1986; Levy, West, & Ramírez, 2005). From this point of view, less advantaged groups (e.g., women, African Americans, individuals with low economic status) are seen as not working hard enough and therefore at fault for their own disadvantage or underrepresentation in particular fields or careers (e.g., Kinder & Sears, 1981). In the United States, PWE-Justifier has been shown to relate to prejudice and negative attitudes toward many disadvantaged groups, including women, as well as opposition to social policies intended to help disadvantaged groups (e.g., Campbell, Schellenberg, & Senn, 1997; Christopher & Mull, 2006; Masser & Abrams, 1999; Swim, Aikin, Hall, & Hunter, 1995; see meta-analysis by Rosenthal, Levy, & Moyer, 2011).

Because both PWE-Justifier and PWE-Equalizer are deeply woven into the social fabric of U.S. society, members of both advantaged and disadvantaged groups are expected to have exposure to and awareness of both meanings (e.g., Katz & Hass, 1988; Kinder & Sears, 1981; Levy et al., 2010; Levy, West, & Ramírez, 2005; Levy, Freitas, Mendoza-Denton, & Kugelmaas, 2006; Levy, West, Ramírez, & Karafantis, 2006; Ramírez, Levy, Velilla, & Hughes, 2010). However, because PWE-Justifier presents an argument that justifies the disadvantage of some groups, it may be less likely to be emphasized to members of disadvantaged groups by their family and friends, for example. As evidence, PWE-Justifier is generally more widely endorsed by advantaged than by disadvantaged groups (e.g., Levy et al., 2010; Levy, West, & Ramírez, 2005). Nonetheless, there is still reason for disadvantaged group members, such as women in STEM majors, not to fully reject PWE-Justifier and thus for PWE-Justifier to be a contributing factor in women's experiences in STEM majors. For one, PWE-Justifier may be particularly salient in environments in which women are underrepresented, because it provides an explanation for why there are persistent gender disparities in these fields: that women have not worked hard enough to succeed on par with male peers. Second, although PWE-Justifier may undermine women's motivation and confidence, it may still serve other epistemic, social, and psychological needs over time and

across situations, such as fostering a sense of control over women's outcomes and offering validity to their observations of who is getting ahead and why (e.g., see Levy, Chiu, & Hong, 2006). We predict that when STEM women have a stronger belief in PWE-Justifier, they will report less perceived compatibility between being a woman and their STEM major and greater expectations of withdrawing from their STEM major before graduating.

The longitudinal study of PWE among college women in STEM majors allows for unique tests of PWE's stability and malleability. PWE is expected to be a stable belief because it is a deeply ingrained cultural belief in the United States and serves people's needs such that perceivers are assumed to be motivated to maintain their beliefs (e.g., Abelson, 1986; Heider, 1958; Hong, Levy, & Chiu, 2001; Levy, Chiu, & Hong, 2006). However, PWE and other prevalent beliefs are conceptualized as knowledge structures (e.g., Hong, Levy, & Chiu, 2001; Levy, Chiu, & Hong, 2006), which can be deactivated (or activated) in relevant situations (e.g., Higgins, 1996). Prior laboratory research has shown that PWE (and other prevalent beliefs) can be made more or less accessible, affecting participants' subsequent social judgments (e.g., Chiu, Hong, & Dweck, 1997; Levy, West, Ramírez, & Karafantis, 2006). While PWE is presumed to be malleable outside tightly controlled experiments, few investigations have tested this assumption. An exception is Levy, Freitas, Mendoza-Denton, & Kugelmaas's (2006) and Levy et al.'s (2010) demonstration of a temporary shift in PWE beliefs among African Americans following the U.S. government's slow response to Hurricane Katrina's mostly African American victims. For African Americans, who have faced a long history of discrimination in the United States, the events surrounding Hurricane Katrina seemed to provide a dramatic reminder of social injustices and inequities, highlighting that society's institutions (U.S. government) cannot always be trusted to reward individuals for their hard work and efforts or to be equitable in the opportunities awarded to individuals to succeed.

Specifically, in the immediate aftermath of Hurricane Katrina, African Americans', but not European Americans', endorsement of PWE-Equalizer was reduced. Months later when Katrina began to fade from the headlines, African Americans' endorsement of PWE-Equalizer returned to levels seen before Katrina. However, African Americans primed to think about Hurricane Katrina, even 7 months after, reported reduced endorsement of PWE-Equalizer. African Americans' endorsement of PWE-Justifier did not fluctuate with triggers of Katrina, presumably because PWE-Justifier is generally more relevant to privileged groups and might not be affected by such an event. Similarly, European Americans' levels of PWE-Equalizer and PWE-Justifier did not fluctuate following Katrina, presumably because the cues of disadvantage that Katrina activated did not relate to their group's experience, both historically in the United States and in the then-current context of Katrina. These findings suggest that contextual triggers can undermine or lead to at least temporary reductions in endorsement of PWE-Equalizer, but

potential shifts in PWE have not yet been examined in more everyday contexts. Women have faced a history of discrimination, including in STEM fields, and as described below, the continued sexism within STEM environments may undermine undergraduate women's belief in PWE-Equalizer. While PWE-Justifier is likely prevalent in the STEM environment because it provides an explanation for gender disparities (women have not worked hard enough to succeed), we did not anticipate shifts in PWE-Justifier for women in STEM as a disadvantaged group, similar to how African Americans' belief in PWE-Justifier was not affected by Katrina.

The Beginning of College for Women in STEM Majors

Women's self-doubt and departure from STEM fields often appear within the first two years of college (e.g., Brainard & Carlin, 1998; Erwin & Maurutto, 1998) and seem to derive in part from negative expectations and stereotypes within STEM environments that communicate incompatibility between their gender and career or major (e.g., Davies, Spencer, & Steele, 2005; Settles, 2004; Shih, Pittinsky, & Ambady, 1999; Steele, James, & Barnett, 2002). As examples, they may notice in class that compared to male students, female students receive less positive feedback and overall encouragement to succeed and persist in STEM (e.g., Erwin & Maurutto, 1998; Ferreira, 2003), or that their classes are taught by more male than female instructors, they have more male than female classmates, and they are learning about more male than female exemplars in their STEM courses (e.g., Valian, 2005; NSF, 2009). Alienation, marginalization, and subtle and overt sexism in STEM fields may be reflected in undergraduate women's perceptions of an incompatibility between their gender identity and their commitment to STEM during the beginning of college (e.g., Bonnot & Croizet, 2007; Schmader, Johns, & Barquissau, 2004; Settles, 2004). And, past work has demonstrated the importance of perceived compatibility between one's gender and STEM field for women at various levels in STEM careers (Settles, 2004; Settles, Jellison, & Pratt-Hyatt, 2009). The more women perceive incompatibility between their gender and STEM identities, the more stress they experience, the more they doubt their abilities, the lower sense of belonging they feel in their field of study, the lower their self-reported performance is, and the more they consider leaving their STEM field, despite previous success in their area of study (e.g., Ancis & Phillips, 1996; London, Rosenthal, Levy, & Lobel, 2011; Rosenthal, London, Levy, & Lobel, 2011; Settles, 2004).

Developmental research suggests the beginning of college is an influential, stressful time in all students' lives in which important changes occur (e.g., Kerr, Johnson, Gans & Krumrine, 2004; Ruble & Seidman, 1996; London, Downey, Bolger, & Velilla, 2005). Classic work has identified the beginning of college as an important time for ego development (e.g., Loevinger et al., 1985), and a

time during which there may be conflict or disequilibrium as students navigate the new environment (e.g., Turiel, 1974), and therefore students' belief systems may be challenged and changed during this period. Gall, Evans, and Bellerose (2000) demonstrate that the transition to college is an acute stressor for most college students, but that women may be particularly vulnerable to the stress of this period. Sidanius, Levin, Van Laar, and Sears (2008) found that the college experience results in shifts in attitudes and beliefs of college students, particularly those from historically marginalized groups. For members of marginalized or underrepresented groups, this new environment may be particularly threatening and may be even more disruptive to belief systems and ideas about the self (e.g., Crocker, Karpinski, Quinn, & Chase, 2003; Ethier & Deaux, 1994; Sidanius, Levin, Van Laar, & Sears, 2008), potentially affecting later development and decision making, such as for careers.

This Study

In this investigation, we examined for the first time connections among PWE, PIC, and expectations about dropping out of one's STEM major across the first two and a half years of college for female undergraduates pursuing STEM majors. Collecting data at multiple time points on these key variables enabled us to better understand the consequences of changes over time in endorsement of PWE-Justifier and PWE-Equalizer for changes in PIC and expectations of dropping out of the STEM major.

Based on past research and theorizing reviewed earlier, we hypothesized that the transition to college in a STEM major would lead to a decrease in women's endorsement of PWE-Equalizer. However, we did not expect women's endorsement of PWE-Justifier to change. Given existing research on the challenges faced by women in STEM fields across the first year of college and the importance of this time in development, we also hypothesized that first-year college women pursuing STEM majors would experience a decline in their perceived compatibility between their gender and STEM major and an increase in their expectations for dropping out of their STEM major before graduating. Yet, consistent with research showing that people generally recover after a transition to a new environment (e.g., Bronfenbrenner, 1979; Ruble, 1994) and beliefs recover in the aftermath of an environmental trigger (Levy, West, Ramírez, & Karafantis, 2006; Levy et al., 2010), we predicted that women's PIC, expectations about dropping out of their major, and endorsement of PWE-Equalizer would stabilize and/or return to precollege levels over time.

While we expected PWE-Equalizer and PWE-Justifier to be correlated with each other because they are both forms of the PWE belief, consistent with past work, we expected associations of these two meanings of PWE with the other study variables to be in opposite directions. We predicted that at times when women's

endorsement of PWE-Equalizer was greater, their perceived compatibility between their gender and STEM major would be greater and their expectations about dropping out of their major would be lower, but that at times when women's endorsement of PWE-Justifier was greater, their PIC would be lower and their expectations about dropping out of their major would be greater.

Also, we predicted that at times when women's PIC was greater, their expectations of dropping out of their major would be lower. Further, we predicted that PIC would mediate the relationships that PWE-Justifier and PWE-Equalizer have with expectations about dropping out of one's major.

Method

Participants

Participants included in all analyses were 150 women pursuing undergraduate STEM majors during their first two and a half years at a public, mid-sized university in the Northeast United States. Participants' majors were varied within STEM fields, including Applied Mathematics and Statistics, Astronomy, Biology, Biochemistry, Biomedical Engineering, Chemistry, Computer Science, Electrical Engineering, Marine Biology, Mathematics, Pharmacology, and Physics. The mean age of participants was 18.51 years ($SD = 1.95$). Mean high school grade point average on a 100-point scale was 91.95 (approximately an A- average; $SD = 5.73$). Participants were from diverse racial and ethnic backgrounds, with 57 identifying as European American or White, 31 as East Asian, 26 as South Asian, 15 as African American or Black, 11 as Latino or Hispanic, and 10 as Other or Mixed. This distribution is representative of the student body at the university.

As part of a longitudinal study, participants completed a questionnaire at each of six different time points: several days before beginning classes at the university (Fall background survey–Time 1; and were paid $15), during the first week of the Spring semester (Time 2; $10), during the first week of the Fall semester of the second year (Time 3; $20), during the first week of the second semester of the second year (Time 4; $10), during the first week of the Fall semester of the third year (Time 5; $20), and during the first week of the second semester of the third year (Time 6; $10).

Given our interest in acquiring baseline data from first-year undergraduate STEM women before their first day of college, we relied on obtaining new-student contact information from the university Registrar. Anticipating errors in student contact information, eligibility criteria, and nonresponses to recruitment invitations, we distributed email invitations widely to 500 incoming students identified by the Registrar as STEM women. From the 500 email invitations, 150 women completed the background questionnaire before the beginning of classes in the Fall semester of their first year of college at the university (a 30% response

rate, similar to other studies with similar samples and recruitment methods; e.g., Blackwell, Snyder, & Mavriplis, 2009; Settles, 2004). Out of the 150 participants from the first time point, 88 completed the second questionnaire, 87 the third, 81 the fourth, 68 the fifth, and 58 the sixth, but all 150 participants were included in all analyses. These rates of attrition from longitudinal studies are roughly consistent with those found in other longitudinal studies with college students (e.g., Erwin & Maurutto, 1998; Settles, Jellison, & Pratt-Hyatt, 2009). Several analyses, including *t*-test comparisons and survival analyses (using Cox regression), did not find differences between participants who dropped out of the study and those who remained in the study on any study variable, and did not identify any variables that predicted dropout.

Measures

Demographics. For the background survey (Time 1), participants provided sociodemographic information. This information included participants' age, gender, race/ethnicity, their high school grade point average, and intended major in college.

Protestant work ethic. Our measure of PWE was developed from Levy, West, Ramírez, & Karafantis's (2006; see also Levy, Freitas, Mendoza-Denton, & Kugelmaas, 2006; Levy, West, & Ramírez, 2005; Ramírez, Levy, Velilla, & Hughes, 2010) research distinguishing different forms of PWE. Levy, et al.'s (2006) measure evolved from Katz and Hass's (1988) Protestant Ethic Scale, which has its roots in Mirels and Garrett's (1971) PWE Scale. Due to space constraints of the longitudinal study, the PWE subscales were restricted to two items each (see Levy et al., 2010, for use of single-item measures of these subscales). At all six time points, participants rated their agreement from 1 (*Do not agree at all*) to 7 (*Agree completely*), with the four items: "Anyone can work hard and succeed because people in different groups have similar abilities and the potential to do well" and "Anyone can succeed and make a good life for themselves, if they work hard" for PWE-Equalizer; "Different groups do not face extra obstacles, such as discrimination, which would interfere with their ability to succeed" and "Hard work is all that is necessary for success so it is not fair to give preferences to minority or disadvantaged groups" for PWE-Justifier. Factor analyses with a varimax rotation at each time point revealed two distinct factors, and items loaded at least 0.77 onto their appropriate factor (equalizer or justifier of inequality) and at most 0.34 on the other factor. A mean was computed for each of the two subscales to create two composite scales. At all time points, both subscales demonstrated good internal reliability (*r*'s between the two items of each subscale from .58 to .80, corresponding to reliabilities of 0.73 and 0.89, respectively).

Compatibility between gender and major. At all six time points, participants completed a six-item measure of perceived compatibility between their gender and major that was adapted from work with first-year female law school students (London & Downey, 2006) and has been used with women in STEM fields (London, Rosenthal, Levy, & Lobel, 2011). Participants responded on a 6-point scale, ranging from 1 (*Strongly Disagree*) to 6 (*Strongly Agree*). An example item is: "I think my gender and major are very compatible." A mean was computed to create a composite scale, for which higher scores denote greater perceived compatibility. At all time points, the measure demonstrated acceptable internal consistency (Cronbach's alphas from .67 to .78).

Expectations for dropping out of major. At all six time points, participants completed a single item reflecting their expectations about dropping out of their major. They rated on a scale from 1 (*Strongly Disagree*) to 7 (*Strongly Agree*) the statement "I may consider dropping out of my major before graduating" (cf. Institutional Belonging Scale; Tyler & Degoey, 1995).

Procedure

At all six time points, participants were sent links to the online surveys by electronic mail. All surveys could be completed from any computer with Internet access, but had to be completed in one session, and participants' data were linked by using a unique identification number or username, which they created. Measures were completed in the order in which they are described earlier. Procedures were approved by the university's Institutional Review Board.

Results

Means, standard deviations, and between-subjects bivariate correlations for the average scores on all study variables across the six time points can been found in Table 1. We first conducted multilevel or hierarchical linear modeling (HLM) analyses (Kenny, Kashy, & Bolger, 1998) to test the patterns of change in study variables over time. Multilevel modeling allows for the correction of correlations among repeated measures, and therefore is ideal for exploring stability and change in variables at multiple time points. Then, we used HLM analyses to test the within-subjects relationships that endorsement of the two meanings of PWE had with PIC and expectations for dropping out of one's STEM major over time, as well as whether PIC mediated the within-subjects relationships between the two meanings of PWE and expectations of dropping out of one's STEM major.

HLM analyses were conducted using SAS 9.2 PROC MIXED software (Singer, 1998). We tested whether controlling for participants' high school grade point average and the number of time points they completed had any effect on

Table 1. Bivariate Correlations, Means, and Standard Deviations for All Study Variables

Variable	1	2	3	4	5	6
1. Age	—					
2. High school grade point average	−.18*	—				
3. Average PWE equalizer across 6 time points	.02	−.12	—			
4. Average PWE justifier of inequality across 6 time points	.04	−.10	.37**	—		
5. Average perceived identity compatibility across 6 time points	−.04	.02	.26**	.03	—	
6. Average expectations for dropping out of major across 6 time points	−.06	.03	−.11	−.07	−.19*	—
Means Time 1	18.51	91.95	5.19	3.45	4.86	2.26
Standard deviations Time 1	1.95	5.73	1.36	1.78	0.82	1.54
Means Time 2	—	—	4.75	3.18	4.63	2.58
Standard deviations Time 2	—	—	1.47	1.57	0.82	1.86
Means Time 3	—	—	5.00	3.45	4.51	2.37
Standard deviations Time 3	—	—	1.34	1.65	0.86	1.71
Means Time 4	—	—	4.35	2.82	4.49	2.54
Standard deviations Time 4	—	—	1.14	1.37	0.97	1.70
Means Time 5	—	—	4.36	3.29	4.37	1.72
Standard deviations Time 5	—	—	1.28	1.69	1.02	1.41
Means Time 6	—	—	4.47	2.97	4.48	1.71
Standard deviations Time 6	—	—	1.29	1.51	0.90	1.20

Note. Means and standard deviations for each time point are based on 150 participants at Time 1, 88 at Time 2, 87 at Time 3, 81 at Time 4, 68 at Time 5, and 58 at Time 6.
High school grade point average is reported on a 100-point scale; the mean of 91.95 is approximately an A- average.
*$p < .05$; **$p < .01$.

the outcomes. These controls did not change any results; thus, results are reported without these control variables included in the models.

Analyses of Change Over Time

Four separate HLM analyses were conducted to test for changes within individuals overtime in (a) endorsement of PWE-Equalizer, (b) endorsement of PWE-Justifier, (c) perceived compatibility between gender and major, and (d) intentions of dropping out of one's major. In each analysis, time and time squared (in order to test a curvilinear effect of time) were entered as within-subjects predictors in the models. Thus, these analyses tested whether there was a within-subjects linear and/or curvilinear pattern of change over time in any of these study variables.

PWE-Equalizer. Time was a significant predictor, but time squared was not a significant predictor of women's endorsement of PWE-Equalizer ($B = -.26$,

$SE = .10$, $p = .011$ for time, and $B = .02$, $SE = .02$, $p = .318$ for time squared), indicating a general decline in endorsement over time. Women tended to agree "a lot" with PWE-Equalizer at the start of college, and agreement declined to "a medium amount" by the beginning of their third year of college.

PWE-Justifier. Neither time nor time squared significantly predicted endorsement of PWE-Justifier ($B = -.15$, $SE = .12$, $p = .217$ for time and $B = .02$, $SE = .03$, $p = .498$ for time squared). Throughout the study, women tended to only agree "somewhat" with PWE-Justifier.

Compatibility between gender and major. Both time and time squared significantly predicted perceived compatibility between one's gender and STEM major ($B = -.23$, $SE = .06$, $p < .001$ for time, and $B = .03$, $SE = .01$, $p = .022$ for time squared), indicating a general linear decline over time, but also with a significant curvilinear pattern over time. The results suggest that women's perceived compatibility between their gender and major first decreased at the beginning of college and later stabilized, yet never returned to the level of compatibility before the start of college. Throughout the study, women's PIC tended to be on the "agree" side of the scale, but declined by about half a point (on a 6-point scale) by their second year in college, and remained at that level until the middle of their third year.

Expectations for dropping out of major. Both time and time squared significantly predicted expectations for dropping out of one's major ($B = .31$, $SE = .14$, $p = .022$ for time, and $B = -.09$, $SE = .03$, $p = .003$ for time squared), indicating some linear increase over time (specifically from first to second year), but qualified by a significant curvilinear pattern, suggesting that women's expectations of dropping out of their STEM major increased during the beginning of college, and later decreased. Throughout the study, women's expectations of dropping out were on the "disagree" side of the scale, but they increased by about half–a point (on a 7-point scale) by the second year of college, and then declined to lower than at background by the middle of their third year.

PWE, Identity Compatibility, and Expectations of Dropping Out

Two HLM analyses were conducted to examine whether changes within individuals in the endorsement of the two meanings of PWE across the six time points predicted changes in perceived compatibility between gender and STEM major and intentions of dropping out of one's STEM major. Both the equalizer and justifier meanings of PWE were entered as within-subjects predictors in the models with perceived compatibility between gender and STEM major and intentions of dropping out of one's major as the outcome variables.

Results of the first HLM analysis indicated that changes in endorsement of PWE-Equalizer were significantly positively associated with changes in perceived compatibility between gender and STEM major ($B = .09$, $SE = .03$, $p = .001$), and changes in endorsement of PWE-Justifier were significantly negatively associated with changes in perceived compatibility between gender and STEM major ($B = -.07$, $SE = .03$, $p = .005$). Results of the second analysis indicated that changes in endorsement of PWE-Equalizer were significantly negatively associated with changes in expectations for dropping out of one's STEM major ($B = -.25$, $SE = .06$, $p < .001$), but changes in endorsement of PWE-Justifier were not significantly associated with changes in expectations for dropping out of one's STEM major, although the trend was in the predicted direction ($B = .06$, $SE = .05$, $p = .237$).

Next, another HLM analysis was conducted to examine whether changes within individuals in PIC were associated with changes in expectations about dropping out of one's STEM major. Results of this analysis indicated that at times when women's PIC was greater, their expectations of dropping out of their STEM major were significantly lower ($B = -.38$, $SE = .09$, $p < .001$).

Next, we tested whether PIC mediated the within-subjects relationships between PWE's two meanings and expectations of dropping out of one's STEM major over time. The analyses already reported indicated that the first step of mediation testing (Baron & Kenny, 1986) was only satisfied for PWE-Equalizer's relationship with expectations of dropping out, but many contend that the first step of mediation testing is not necessary (e.g., see Shrout & Bolger, 2002), at least to provide evidence of an indirect effect. Therefore, we continued to test for the predicted mediated relationship for PWE-Equalizer, and for an indirect effect for PWE-Justifier. With the analyses already reported, the second step for each of these relationships was satisfied. We then entered the two meanings of PWE and PIC as within-subjects predictors in an HLM analysis, with expectations of dropping out as the outcome variable. PIC (hypothesized mediator) remained a significant predictor of reduced expectations of dropping out of one's STEM major ($B = -.32$, $SE = .09$, $p < .001$), supporting the third step of mediation testing. PWE-Equalizer also remained a significant predictor ($B = -.21$, $SE = .06$, $p < .001$), whereas PWE-Justifier remained a nonsignificant predictor ($B = .04$, $SE = .05$, $p = .473$). For the final step, we ran two Sobel's tests, the first of which supported that PIC significantly mediated the relationship of PWE-Equalizer with expectations of dropping out (Sobel's statistic $= -2.29$, $p = .022$), and the second of which supported an indirect relationship through PIC of PWE-Justifier with expectations of dropping out (Sobel's statistic $= 1.95$, $p < .05$ using the z-prime method for the Sobel test with a revised critical value; MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). Results of these analyses are depicted in Figure 1.

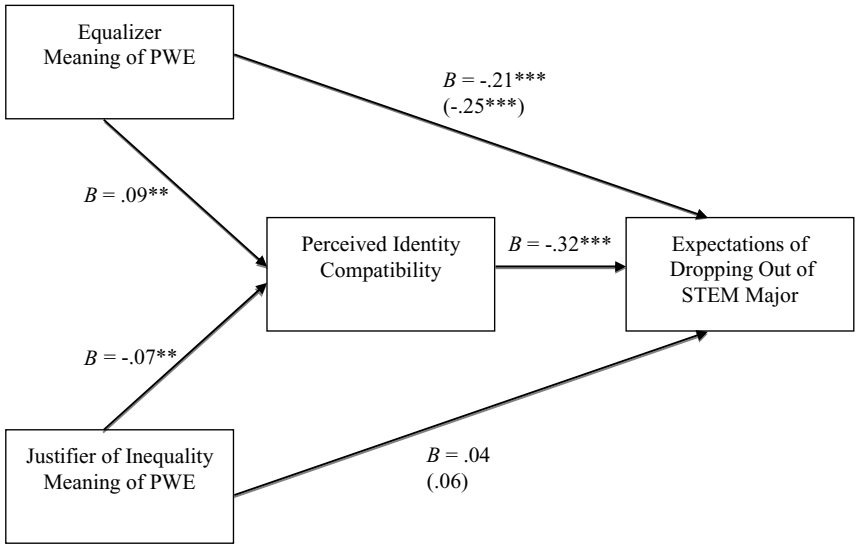

Fig. 1. Results of within-subjects hierarchical linear modeling (HLM) mediation analysis testing whether changes in perceived identity compatibility (PIC) mediate the relationship between changes in endorsement of the two meanings of PWE and changes in expectations of dropping out of one's STEM major over time ($N = 150$). Paths in parentheses represent the relationships before the mediator was included in the model. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$.

Discussion

In this investigation, we examined a pervasive individually held belief in the United States considered both a motivator and a justifier of behavior—PWE—and its relationship with women's perceived compatibility between their gender and STEM majors, as well as their expectations of dropping out of their STEM majors during the first two and a half years of their undergraduate education.

Results from the present investigation show for the first time, to our knowledge, that changes in PWE endorsement are associated with shifts over time in individual women's PIC and expectations about dropping out of their STEM major, and that therefore this belief system may be an important one to study in relation to the experiences of women in STEM. Consistent with hypotheses, we found that at time points when women's endorsement of PWE-Equalizer was greater, their perceived compatibility between their gender and STEM major was greater and their expectations about dropping out of their major were lower; but at times when women's endorsement of PWE-Justifier was greater, their PIC was lower.

Also consistent with hypotheses, changes in PIC were inversely related to changes in expectations of dropping out of one's STEM major. This finding is

consistent with prior research showing that lower PIC relates to women's disengagement from STEM fields (e.g., Settles, 2004), yet extends past work by demonstrating this association longitudinally. Furthermore, PIC partially mediated the within-person relationships of PWE-Equalizer and PWE-Justifier with expectations of dropping out (or demonstrated an indirect pathway for PWE-Justifier).

Results also indicated that women's levels of endorsement of PWE-Equalizer showed a pattern of decrease within individuals across the first two and a half years of college. As already discussed, prior work has shown that endorsement of PWE-Equalizer declines for disadvantaged groups when social injustices concerning their group are made salient in their environment, but recover when those triggers are no longer salient (Levy, Freitas, Mendoza-Denton, & Kugelmaas, 2006; Levy et al., 2010). However, when those social injustices are primed again, PWE-Equalizer can still be threatened. Perhaps for these STEM women, reminders of sexism are fairly consistently salient in their STEM environments (e.g., few female peers, few female professors) such that their beliefs that anyone, and particularly a woman in STEM, can succeed remain threatened and challenged throughout college. These findings, then, suggest that certain environmental contexts or particularly important developmental periods may have longer lasting effects on PWE. Continued study of the STEM environment during the beginning of college, as well as in other contexts and during other transition periods that may have longer lasting effects on PWE and other prevalent belief systems, are needed to understand stability and change in cherished beliefs.

These findings highlight that even for women who persist in STEM fields and plan to finish their undergraduate education in those fields, sexism and societal stereotypes continue to be a challenge. Additionally, it may be that the changes happening specifically during the beginning of college represent a significant moment that has more long-lasting effects on belief systems and views of the self (e.g., Loevinger et al., 1985; Turiel, 1974). As predicted and consistent with past work (Levy, Freitas, Mendoza-Denton, & Kugelmaas, 2006; Levy et al., 2010), there was not a significant pattern of change over time in PWE-Justifier among our sample.

As predicted, we also found that women's perceived compatibility between their gender and their STEM major declined during their first year and into their second year of college, and then it stabilized in the third year. Thus, identity compatibility seems to be especially vulnerable at the beginning of college, but also remains a challenge for women STEM majors throughout college, as perceived compatibility never returned to precollege levels. This finding highlights the importance of studying identity compatibility not just at a single moment in time when identity compatibility may be particularly challenged, but also longitudinally as motivations, expectations, and experiences change and shift over time.

Women's expectations that they would drop out of their STEM major also increased during the first year of college, but decreased into their second and third years, bolstering the idea that the beginning of college is a particularly rocky time for women pursuing careers in STEM fields (e.g., Blickenstaff, 2005; Brainard & Carlin, 1998; Erwin & Maurutto, 1998). These findings are consistent with theories suggesting that as people enter new environments, their goals, expectations, identities, and self-doubts are paramount and influence how they perceive, experience, and negotiate the environment (e.g., Bronfenbrenner, 1979; Deaux & Major, 1987; London, Downey, Bolger, & Velilla, 2005). Uncertainty about how success is achieved and maintained in the new environment may create a sense of ambiguity and stress that, along with cues of marginalization and bias, can interfere with self-confidence and success. It may also be the case that women who persist through particular key transitions or rough periods in their academic careers are likely to expect to persist through future transitions and challenges, possibly because they have gained confidence in being able to overcome those challenges.

Limitations and Strengths

First, whether the findings are generalizable to female STEM students at other universities, in other regions of the United States, or in other parts of the world, is not clear. Second, the nonexperimental nature of this study did not allow us to draw causal conclusions about the relation between PWE and women's PIC or expectations about dropping out of their majors. Third, because of the longitudinal nature of the study, we used rather brief measures to reduce burden on participants and limit attrition from the study. Both the PIC measure and PWE measures demonstrated good internal reliability, and moreover, factor analyses showed that PWE-Justifier and PWE-Equalizer are distinct. Yet, future work should further investigate the reliability and validity of these measures. For example, we report the associations of PWE and PIC with self-reported expectations of (not actual reports of) dropping out of one's major. This self-report method may be confounded with other psychological factors, such as defensive pessimism. At the same time, much past work has noted the importance of women's self-reported perceptions and expectations about their STEM fields (e.g., Settles, 2004). Fourth, although the attrition rate is consistent with prior work and we included all 150 women in all analyses, study findings likely better represent patterns of change for the women who were willing to continue to participate in the study over the course of two and a half years. Last, the lack of a comparison group to STEM women undergraduates is an important limitation. That is, the study design did not allow us to test whether our findings on PWE and PIC are unique to women in STEM or are relevant to all women, to both men and women in STEM fields, or to all undergraduates. Future work that would include several comparisons groups would also allow

us to determine whether current findings reflect, for example, general trends in undergraduates solidifying their majors at particular time points (e.g., third year of college).

This investigation also had several notable strengths. We studied PWE for, as far as we know, the first time in the context of women in STEM fields, examining within-subjects changes and the relationships among variables. We also examined women's PIC, a key variable related to sustained engagement of women in STEM, longitudinally across the first two and a half years of college. Measures of study variables—PWE endorsement, PIC, and expectations about dropping out of one's major—were administered at six time points, allowing for tests of individual variation using HLM. Repeated-measures data enable more in-depth analyses of the process of change over time, enhances the internal reliability of relationships among variables, and provides an opportunity to explore nonlinear trends (Bolger, Davis, & Rafaeli, 2003; London, Rosenthal, & Gonzalez, 2011).

Implications for Educational Policy

Study findings suggest that it would be fruitful to examine PWE and PIC among women at other critical points in their careers, such as earlier in their education, in an attempt to prevent gender disparities before they develop. For example, research suggests that previously highly engaged and skillful girls begin to disengage from male-stereotyped classes such as science and math during high school (e.g., AAUW, 2004; Eccles, 2005; Eccles et al., 1993). In addition to studying adolescents, PWE and PIC are important variables to study among women in graduate school and/or a workplace in a STEM field (e.g., Settles, Jellison, & Pratt-Hyatt, 2009). It is also critical that future work attempt to explore PWE and identity compatibility among racially and ethnically diverse samples to examine variability among women's experiences and thus more fully address the challenges of disadvantaged and underrepresented groups in STEM (see Settles, 2004; 2006; Settles, Jellison, & Pratt-Hyatt, 2009).

Findings from this investigation provide several additional suggestions for educational policies and programs. For example, educational curricula, programs, interventions, and broader policies might target PWE as a means of improving women's PIC and intentions of staying in STEM fields. Policies and programs aimed at increasing women's endorsement of the PWE-Equalizer and/or reduce endorsement of PWE-Justifier might improve women's perception that their gender and STEM major or career can in fact be compatible, thereby increasing women's retention in high status, nontraditional fields of study.

As noted earlier, PWE may be a relatively stable belief for individuals in the long term because of its prevalence in U.S. society and ability to serve important social and psychological needs for individuals (e.g., Hong, Levy, & Chiu, 2001; Levy, Chiu, & Hong, 2006). However, findings from this study, as well as from

other work (e.g., Levy, Freitas, Mendoza-Denton, & Kugelmaas, 2006; Levy, West, Ramírez, & Karafantis, 2006; Levy et al., 2010), suggest that PWE beliefs can fluctuate and therefore could potentially be utilized in intervention efforts. It seems possible that increasing activation of the equalizer meaning of PWE (and decreasing activation of the justifier of inequality meaning) could be simulated in academic environments such as classrooms with at least temporary effects, and perhaps potentially lasting effects if the triggers can be made salient frequently within that academic setting. Our findings suggest that it may be particularly pressing to address the equalizer meaning of PWE in educational policy because this belief seemed to buffer women as they entered the STEM major and also because this belief seemed to be threatened during the beginning of college. One way that people are assumed to naturally learn the equalizer meaning of PWE (e.g., Levy, West, & Ramírez, 2005; Levy, West, Ramírez, & Karafantis, 2006) is through "rags to riches" stories about people from disadvantaged or marginalized backgrounds who succeed through hard work, ability, and talent (e.g., Erin Brockovich, Whoopi Goldberg, Jennifer Lopez, Alice Walker, and Oprah Winfrey). The presentation of numerous examples of such people could be communicated in educational settings to reinforce the equalizer meaning of PWE in that setting, and could be tailored to students' particular areas of study and backgrounds (e.g., successful women scientists such as Marie Skłodowska Curie, Mae Jemison, and Barbara McClintock).

There is evidence of some successful educational programs that have aimed to highlight examples of successful members of underrepresented groups in STEM fields who might not be famous, but instead are available in one's direct or distal environment. These include mentoring programs, which have taken a variety of forms and can include both direct, in-person contact with the mentor or role model (e.g., Phinney, Torres Campos, Padilla Kallemeyn, & Kim, 2011), as well as more distal interpersonal connections through for example an online mentoring network (see MentorNet; Blake-Beard, Bayne, Crosby, & Muller, 2011). It may be that these sorts of programs or interventions could help to increase endorsement of PWE-Equalizer, and also could increase PIC, the mechanism through which we found PWE to be related to women's expectations of dropping out of STEM fields.

Regardless of the specifics of the policy that is implemented, findings from this study, along with past work on the developmental importance of transitions, specifically the beginning of college for all undergraduates (e.g., Eccles, 2005; Loevinger et al., 1985; London, Downey, Bolger, & Velilla, 2005; Turiel, 1974), including women in STEM fields (e.g., Blickenstaff, 2005; Brainard & Carlin, 1998; Erwin & Maurutto, 1998; London, Rosenthal, Levy, & Lobel, 2011), suggest that the beginning of college is potentially a crucial time for intervention and policy implementation. Some of the mentoring programs mentioned earlier that have been successful for underrepresented groups in STEM fields were in fact launched at

the beginning of college (Phinney, Torres Campos, Padilla Kallemeyn, & Kim, 2011).

Conclusion

Findings from this study suggest that changes in fundamental PWE beliefs relate to undergraduate women's perceived compatibility between their gender and STEM identities and their intentions of leaving their STEM majors. Further study is needed to confirm the extent to which women's beliefs about hard work as a social equalizer, and beliefs about marginalized groups as being culpable for their own disadvantage, influence perceived compatibility between being a woman and being in a STEM field, as well as persistence and retention in STEM fields. Such efforts ideally will help us identify ways to incorporate our understanding of the roles of psychosocial factors such as PWE and PIC into institutional efforts and policies aimed at increasing women's representation in STEM fields.

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