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A threat in the network: STEM women in less powerful network positions avoid integrating stereotypically feminine peers

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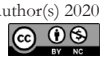

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Abstract

Integrating social identity threat and structural hole theories, this work examines how social network positions affect group-based identity threats. For individuals less well positioned to bridge (or "broker") relations between unconnected friends, stigma-by-association concerns may constrain affiliation with stereotypic targets. Three experiments (*N*s = 280, 232, 553) test whether women (vs. men) in male-dominated STEM (vs. female-dominated) majors avoid befriending a female target with feminine-stereotypic (vs. STEM-stereotypic) interests. Only STEM women with less brokerage (i.e., less ability to manage introductions to unconnected friends) in their existing friendship networks avoided befriending (pilot experiment) and socially integrating (Experiments 1 and 2) feminine- (vs. STEM-) stereotypic targets, despite standardized target similarity and competence. STEM women in particular anticipated steeper reputational penalties for befriending stereotypically feminine peers (Experiment 2). Social identity threat may lead women in STEM—especially those lacking brokerage—to exclude stereotypically feminine women from social networks, reinforcing stereotypes of women and STEM fields.

Keywords

brokerage, gender, intergroup relations, social identity threat, social networks

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Imagine Ada, an aspiring computer scientist working in a male-dominated domain with peers who read sci-fi, play computer games, and watch *Game of Thrones*. Enter Betty, a smart, friendly biology major who enjoys Jane Austen, shopping, and *Mean Girls*. Even if Ada privately shares these interests, she may balk at befriending Betty, lest their connection harm her reputation among her peers. This fear can reflect *social identity threat*, the concern that one could be broadly "devalued, marginalized, or discriminated against" because

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"one's group has low or marginalized status in the setting" (Steele, Spencer, & Aronson, 2002, pp. 416–417).

Seminal work on stigma finds that devaluation can be triggered vicariously (Goffman, 1963): mere copresence with stigmatized individuals can lead to stigma by association (Pryor, Reeder, & Monroe, 2012), with friendship intensifying derogation from others (Shapiro, Baldwin, Williams, & Trawalter, 2011). Similarly, fellow ingroup members can trigger *collective threat*, or concern that *other* ingroup members' behavior (not one's own) will confirm group stereotypes (Cohen & Garcia, 2005). Collective threat carries costs: exposing racial minorities or women to an incompetent ingroup member lowers state self-esteem, while increasing stereotype activation and behavioral distancing (Cohen & Garcia, 2005). Minorities report more anxiety and metastereotyping after ingroup members' stereotypic (vs. nonstereotypic) negative behavior (Taylor, Garcia, Shelton, & Yantis, 2018). Rather than test specific negative stereotypes, this research investigates avoidance and exclusion of ingroup peers based on overall stereotypicality.

Women in STEM: Undervalued, Underrepresented, and Unwelcome

This work probes friendship choices among women in science, technology, engineering, and math (STEM) majors, whose field-specific abilities are devalued (Diekman, Weisgram, & Belanger, 2015). Indeed, children (Cvencek, Meltzoff, & Greenwald, 2011) and adults (Nosek, Banaji, & Greenwald, 2002; Pronin, Steele, & Ross, 2004) explicitly and implicitly associate boys more with math/science and girls with reading.

Consistent with social role theory (Eagly, 1987), these stereotypes reflect the composition of male-dominated STEM fields. The portion of North American bachelor's degrees awarded to women in engineering, computer science, and physics has stalled around 20%, and women remain underrepresented among employed scientists and engineers (Dionne-Simard, Galarneau, & LaRochelle-Côté, 2016; National Science Foundation, 2017). Skewed gender ratios can deter women from STEM (Murphy, Steele, & Gross, 2007), yet other historically male-dominated fields (e.g., law) have narrowed their gender gaps greatly, suggesting broader cultural forces at play in STEM. Even with balanced gender ratios, women avoid settings with physical markers of "masculine" culture (e.g., *Star Trek* posters; Cheryan, Plaut, Davies, & Steele, 2009). Seeing STEM as masculine (Carli, Alawa, Lee, Zhao, & Kim, 2016) correlates with men believing women in STEM should assimilate to men's norms (Danbold & Huo, 2017). Femininity may be risky: incompatibility between gender versus occupational stereotypes is linked to bias against women in hiring (Koch, D'Mello, & Sackett, 2015) and job evaluations (Heilman, 2001), supporting role congruity (Eagly, 1987) and lack-of-fit (Heilman, 1983) accounts of gender bias.

Strategic Responses to Stereotypes

The threat of devaluation may lead individuals to selectively distance themselves from their ingroup by psychologically highlighting their differences from—or behaviorally avoiding—ingroup members (Cohen & Garcia, 2005; Derks, Ellemers, van Laar, & de Groot, 2011; Veldman, van Laar, Meeussen, & Bue, 2019). Such distancing can be selective, not holistic. For example, stereotype-threatened female math majors specifically disavow stereotypically feminine traits (e.g., gossipy) devalued in math, but not valued characteristics (e.g., empathic; Pronin et al., 2004). Similarly, senior women in male-dominated companies report distancing from more junior—not all—women (Faniko, Ellemers, & Derks, 2016).

The present research investigates selective affiliation based on stereotypicality. Just as female math majors prefer to identify *personally* with traits valued in math—not negatively stereotyped feminine traits—female STEM majors may prefer to associate *socially* with STEM-stereotypic women, that is, not stereotypically feminine women. Highly feminine women may imperil their standing by reinforcing stereotypes of women as unfit

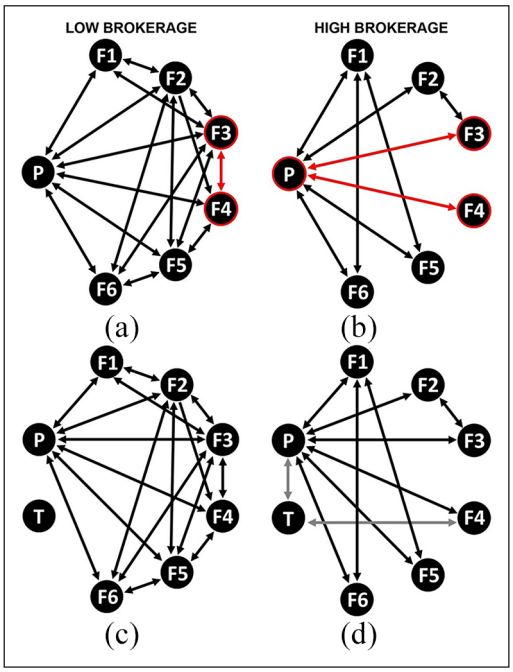
for STEM, threatening personal prototypicality (Maass, Cadinu, Guarnieri, & Grasselli, 2003) and collective reputation (Cohen & Garcia, 2005). This work tests whether STEM women avoid and exclude stereotypically feminine peers, reporting reputational concerns.

Network Position: Brokerage Versus Constraint

Decisions by members of stigmatized groups to include or exclude stereotypic peers involve their friendship network. STEM women's position within their friendship network may influence their willingness to integrate stereotypically feminine women. Structural hole theory (Burt, 1992, 1997) proposes that high-brokerage structural positions afford advantage and social capital. Formally, *network brokerage* quantifies the extent to which someone serves as a bridge, or *broker*, between unconnected others. Individuals occupying high-brokerage positions "have better access to information and enjoy comparative advantages in negotiating relationships" (Gargiulo & Benassi, 2000, p. 184) via their structural power to control information flow between parties who lack direct access to each other, and to maintain or exploit their separation (Fernandez & Gould, 1994; Obstfeld, 2005). Empirically, high-brokerage positions are linked to reputational benefits (Burt, Kilduff, & Tasselli, 2013), plus increased flexibility, autonomy, and receptivity to outsiders (Gargiulo & Benassi, 2000). Brokerage gives individuals more opportunity to control information flow and manage relationships within their networks (see Figure 1). In contrast, highly dense networks—characterized by many ties and few "structural holes" between unconnected individuals—constrain individuals' actions to existing group norms (Gargiulo, 1993). Thus, higher brokerage may attenuate identity threat for STEM women by enabling selective introductions and reputation management in their network.

The psychological experience of threat depends on subjective perceptions of one's social context. Perceived and actual brokerage are correlated yet distinct (Brands & Kilduff, 2014; Brands & Mehra, 2018), and believing one brokers between two unconnected friends can guide behavior, regardless of actual ties. Experts thus recommend "ask[ing] A if he/she perceives B and C to be friends" (Krackhardt, 1987, p. 113). This research focuses on ego-networks—individuals' reports of their ties to others and of these people's ties among themselves (Wellman, 1979)—with a "realist" approach encoding friend status as perceived by participants (Scott, 2013, p. 43).

Figure 1. Panels (a) and (b) depict networks of two individual participants (P) whose normalized brokerage among their six listed friends (F1–F6) is respectively low (0.23) or high (0.80). For example, the F3–F4 connection is brokered by the participant in panel (b) but not in panel (a), where these friends are connected directly. Panels (c) and (d) depict these participants' reported willingness to personally befriend a feminine-stereotypic target (T), establishing a P-to-T tie and/or integrating her into their network by introducing her to specific friends, creating T-to-F ties.



Overview of Experiments

Three experiments examine whether STEM women avoid and exclude a female peer with feminine- (vs. STEM-) stereotypic interests (see Figure 2),

depending on network brokerage (see Figure 3). Each compares women in STEM majors—a stigmatized group affected by social identity threat—with two control groups: STEM men and non-STEM women (to isolate gender and major effects, respectively). Here, "STEM" refers specifically to male-dominated STEM majors (also known as "pSTEM" for physical sciences). At the University of Waterloo, women in male-dominated (⩽ 20% female) STEM majors—versus gender-diverse STEM majors—report greater stigma and benefit more from threat-reducing interventions (Walton, Logel, Peach, Spencer, & Zanna, 2015). The pilot experiment tests whether STEM women (unlike control participants) prefer befriending a STEM- (vs. feminine-) stereotypic target, especially when they have low network brokerage. Experiments 1 and 2 extend the pilot experiment, addressing any similarity confounds. Experiment 2 also tests whether STEM women express concerns about reputational costs of befriending a stereotypically feminine woman. These experiments reveal a pattern of stereotype-based friendship preferences among members of a stigmatized minority whose network positions afford less brokerage.

This program of research is reported completely, including all experiments conducted, with all measures, manipulations, and exclusions. Exploratory tests of potential moderators (e.g., target photo, participant race, gender, and major identification) are described in the supplemental material. Full materials, de-identified data, and syntax are available at osf.io/3vkre to promote open science.

Pilot Experiment

In a 3 (participant type) × 2 (target stereotypicality) between-subjects design with network brokerage measured continuously, STEM women, STEM men, and non-STEM women viewed either a STEM- or feminine-stereotypic female student's profile. STEM women were theorized to be less eager to befriend another woman with feminine- (vs. STEM-) stereotypic interests. STEM men and non-STEM women (the control groups), as majority groups in their majors, should not experience group-based threat: no target preference was predicted.

Analyses of friendship network structure tested whether the predicted selective affiliation effect for STEM women varies based on network position. Greater brokerage—affording control over information flow between network members—could reduce reputational risks for STEM women of associating with stereotypically feminine peers.

Method

Participants and Procedure

Undergraduates completed this online experiment (and the following experiments) for $5.00 or course credit. The sample (N = 280) comprised three participant types: 44 women in STEM majors (the focal group), 123 men in STEM majors, and 113 women in designated "non-STEM" majors (see Table 1 for exclusions and demographics across experiments). To ensure women's minority/majority status, eligible majors were identified via female enrolment averaged over 5 years: ⩽ 20% for STEM and ⩾ 65% for non-STEM. Only White and East Asian students (groups overrepresented in STEM) were recruited, to test gender-based (not race-based) effects. Sample size was determined by maximizing recruitment over two terms.[1]

Protocol. After consent and eligibility questions (race, gender, major, age), any ineligible individuals were excluded. To bolster the cover story about forming friendships on Facebook, participants completed an Internet (including Facebook) usage profile. Next came an ego-network assessment. Participants were randomly assigned to view a STEM- or feminine-stereotypic target profile, then completed measures of friendship intentions. Last came identification, attention-check, engagement, and suspicion questions, followed by debriefing (see osf.io/3vkre).

Materials

This experiment used novel Facebook profiles and single-item measures.

Table 1. Exclusions and participant demographics by experiment.

	Pilot		Experiment 1		Experiment 2	
	n	%	*n*	%	*n*	%
Nonparticipants	225		106		269	
Ineligible	222	99	105	99	260	97
Duplicate	3	1	1	1	9	3
All participants	315		272		669	
Incomplete	21	7	30	11	78	12
Listed no friends	10	3	9	3	27	4
Withdrew consent	4	1	1	< 1	11	2
Final sample	280		232		553	
Mean age (years)	20		20		20	
Participant type						
Men in STEM majors	123	44	123	53	240	43
Women in STEM majors	44	16	50	22	117	21
Women in non-STEM majors	113	40	59	25	196	35
Participant race						
White	160	57	140	60	334	60
East Asian	120	43	92	40	219	40
Experimental condition						
STEM-stereotypic profile	141	50	116	50	265	48
Feminine-stereotypic profile	139	50	116	50	288	52

Note. Ineligible individuals were redirected automatically out of the survey. Duplicate submissions (from the same person) within each experiment were omitted. Among the eligible, unique participants, analyses excluded submissions that were incomplete (missing all friendship intentions data), listed no friends (with no friends, some questions had invalid response options), or withdrew consent (after debriefing). Across studies and in descending order, participants came from the following STEM majors (with ⩽ 20% female enrollment): engineering (mechatronics, software, nanotechnology, mechanical, computer), computer science, electrical engineering, physics, and pure math; and non-STEM majors (with ⩾ 65% female enrollment): psychology; social development; health; English; sexuality, marriage, and family; fine arts; environment and resources; recreation and leisure; pharmacy; sociology; peace and conflict; speech communication; recreation and business; French; international development; optometry; and anthropology. In Experiment 1, 25 non-STEM men participated to be a third control group, but were excluded prior to analysis due to low number (22, applying exclusion criteria).

Ego-network assessment. Participants' networks were assessed using an ego-centric name generator (Wellman, 1979) asking participants to "list the first names of your 10 closest friends who attend [this university], with whom you spend the most time," excluding romantic partners. Next, participants reported each friend's gender, race, and academic area/major. A sociomatrix captured sociometric ties between friends with checkmarks (see Appendix A) in an adjacency matrix (e.g., von der Lippe & Gamper, 2017), with friends' names labeling rows and columns. Collecting case-by-case relational data is a "gold standard" (Krackhardt, 1987) method viable for small networks (Scott, 2013).

Facebook profile. Fictive Facebook profiles presented a female undergraduate majoring in biology (a gender-balanced major) and "in a relationship" (to minimize romantic interest). The profile photo (matching participant race) came from a set of White and East Asian women (see Appendix B) pretested as comparably attractive and friendly (see the supplemental material). The stereotypicality manipulation varied whether the target's interests matched typical preferences of STEM male students versus non-STEM female students (from > 2,300 students). In categories (e.g., books, TV, activities) featured on Facebook profiles, the STEM- and feminine-stereotypic profiles respectively featured interests

popular among STEM men (e.g., *Sherlock, Ender's Game*) or non-STEM women (e.g., *Gossip Girl, Pride and Prejudice*; see Appendix B).

Measures. Participants indicated whether—assuming they had met the target—they would accept a Facebook friend request from her (*friendship formation*), or suggest her as a friend to each listed friend (*friendship integration*), from 1 (*definitely not*) to 4 (*definitely yes*).[2] Participants rated her similarity to themselves and each friend from 1 (*very dissimilar*) to 5 (*very similar*), and her fit in their circle of friends from 1 (*not at all well*) to 5 (*extremely well*). For identification, two single-item measures ("In general, my [gender/academic major] is an important part of my self-image"; Luhtanen & Crocker, 1992) were rated from −2 (*strongly disagree*) to 2 (*strongly agree*).

Results

Analytic Approach

Across experiments, participant-level measures were tested using a 3 (participant type) × 2 (target stereotypicality) × brokerage (mean-centered) regression model (implemented in SPSS with custom GLM models including all interaction terms). Friend-level responses were tested using generalized estimation equations (GEE; Liang & Zeger, 1986), a multilevel regression method that controls for nonindependence of scores for friends clustered within networks. The GEE models used an exchangeable covariance matrix assuming identical correlations between friends (Fitzmaurice, Laird, & Rotnitzky, 1993).

To probe participant-type effects, specifically testing STEM women's divergence from control groups, analyses used two unweighted effects-coded contrasts. The focal *STEM female* contrast (STEM women = 1, STEM men = 0, non-STEM women = −1) compared STEM women with the other two groups; the simultaneous *STEM male* contrast (STEM men = 1, STEM women = 0, non-STEM women = −1) compared responses from STEM men versus the other combined groups.[3] Target stereotypicality was coded STEM-stereotypic = −1, feminine-stereotypic = 1. For predicted effects involving STEM women evaluating the two targets differently than control groups, interactions with the focal STEM female contrast are reported. Retaining partial submissions meant *df* vary across measures.

Tests of simple interactions/effects used rescaled predictors (recentered at ± 1 *SD*; Aiken & West, 1991) in the full sample (maximizing power), barring heterogeneous variance. Post hoc comparisons for participant type need no correction for familywise error, given a significant omnibus effect with three groups (Howell, 2013). Standardized effect sizes are reported (except when t or $F < 1$, so $\eta^2_p < .01$), but cannot be reliably estimated for multilevel models (West, Koslov, Page-Gould, Major, & Mendes, 2017), so unstandardized coefficients reflect effect magnitude. Tables 4 and 5 report *b*s and *SE*s, with exact *t*s (for GLM analyses), χ^2s (for GEE models), and *p*s for key effects in the text (exact *p* values are reported when *t, F*, or $\chi^2 > 1$).

Table 2 reports overall means, standard deviations, and correlations for dependent measures (Table S1 reports means and standard deviations for background measures—major and gender identification, number of friends, normalized brokerage—by participant type). Condition means for primary dependent measures (friendship formation, friendship integration) are shown in Table 3, with secondary measures (perceived similarity to self and friends, fit with friends) in Table S2. Tables 4 and 5 present unstandardized coefficients for regression and GEE models involving brokerage.

Initial Analyses

Before analyzing friendship intentions, initial tests—reported in the supplemental material and summarized in what follows—assessed basic variation by participant type or target.

Identification. Participants' identification with their major did not differ by participant type. Non-STEM women identified most strongly with their gender and STEM women least strongly; STEM men did not significantly differ from either group.

Table 2. Descriptives and correlations between dependent measures across experiments.

Measure	Mean (*SD*)	Bivariate correlation with each measure						
		1	2	3	4	5	6	7
Pilot experiment								
1. Similarity to self	2.94 (1.10)							
2. Similarity to friends	2.69 (0.73)	.67***						
3. Perceived fit	2.40 (0.90)	.50***	.57***					
4. Friendship formation	2.81 (0.77)	.29***	.13*	.22***				
5. Friendship integration	2.11 (0.72)	.37***	.45***	.41***	.28***			
6. Gender identification	3.68 (0.85)	.03	.04	.03	.14*	.03		
7. Major identification	3.76 (0.92)	.08	.10†	.14*	.16**	.06	.35***	
Experiment 1								
1. Similarity to self	3.08 (0.87)							
2. Similarity to friends	2.86 (0.65)	.58***						
3. Perceived fit	2.61 (0.84)	.42***	.43***					
4. Friendship formation	2.73 (0.81)	.21**	.13*	.30***				
5. Friendship integration	2.17 (0.79)	.27***	.28***	.36***	.49***			
6. Gender identification	3.56 (0.97)	.01	.03	.05	.06	.10		
7. Major identification	3.74 (0.97)	.01	.04	.03	.01	.00	.27***	
Experiment 2								
1. Similarity to self	2.99 (0.98)							
2. Similarity to friends	2.78 (0.61)	.52***						
3. Perceived fit	2.51 (0.80)	.43***	.41***					
4. Friendship formation	2.85 (0.87)	.14**	.12**	.25***				
5. Friendship integration	2.22 (0.73)	.23***	.24***	.34***	.37***			
6. Gender identification	3.53 (1.01)	.09*	.03	.09*	.02	.04		
7. Major identification	3.80 (0.91)	.00	−.01	.04	.00	.00	.33***	
8. Reputational harm	2.83 (0.56)	−.11*	−.10*	−.15***	−.07	−.04	−.03	−.04

Note. ***$p < .001$. **$p < .01$. *$p < .05$. †$p < .10$.

Perceived similarity and fit with friends. STEM women and men—but not non-STEM women—perceived the STEM- (vs. feminine-) stereotypic target as more similar to themselves and their friends, and fitting their friendship circle better.

Network Analysis

For participants listing at least two friends, UCINET software Version 6.6 (Borgatti, Everett, & Freeman, 2002) analyzed sociometric data. Raw brokerage counts how often each participant directly links two otherwise unconnected friends, thus serving as a *broker* between them. Normalized brokerage—henceforth *brokerage*—divides this sum by the number of possible brokerage opportunities (i.e., pairs of friends) to control for network size (number of friends). Thus, brokerage ranges from 0 (friends maximally interconnected) to 1 (all friends connected only via the participant). Brokerage, which correlates positively with ego-betweenness (Everett & Borgatti, 2005) and inversely with density (i.e., existing friend–friend ties divided by all possible friend–friend ties), is a proxy for structural holes (Podolny & Baron, 1997): denser networks afford fewer brokerage opportunities. In ego-centric networks defined by friend-listing, all friends are the participant's friends, automatically centering each participant in a "hub-and-spoke" structure, with structural variation only in the extent to which friends are interconnected (reducing

Table 3. Dependent measures by participant type and target stereotypicality.

	Target stereotypicality	
	STEM-stereotypic Mean (*SD*)	Feminine-stereotypic Mean (*SD*)
Pilot experiment		
Friendship formation		
STEM men	2.65 (0.85)	2.80 (0.83)
STEM women	2.93 (0.83)	3.00 (0.79)
Non-STEM women	2.75 (0.70)	2.94 (0.63)
Friendship integration		
STEM men	2.13 (0.79)	1.86 (0.66)
STEM women	2.23 (0.55)	1.81 (0.60)
Non-STEM women	2.24 (0.75)	2.28 (0.69)
Experiment 1		
Friendship formation		
STEM men	2.70 (0.85)	2.71 (0.83)
STEM women	2.90 (0.79)	2.60 (0.81)
Non-STEM women	2.88 (0.83)	2.70 (0.67)
Friendship integration		
STEM men	2.07 (0.87)	2.17 (0.76)
STEM women	2.33 (0.80)	2.06 (0.89)
Non-STEM women	2.27 (0.77)	2.33 (0.57)
Experiment 2		
Friendship formation		
STEM men	2.84 (0.91)	2.84 (0.90)
STEM women	2.85 (0.84)	2.54 (0.96)
Non-STEM women	2.87 (0.81)	3.01 (0.73)
Friendship integration		
STEM men	2.07 (0.80)	2.07 (0.72)
STEM women	2.23 (0.71)	2.02 (0.72)
Non-STEM women	2.43 (0.70)	2.47 (0.62)
Reputational influence		
STEM men	1.71 (0.86)	1.75 (0.85)
STEM women	1.57 (0.82)	1.51 (0.78)
Non-STEM women	1.64 (0.84)	1.61 (0.88)
Reputational harm		
STEM men	2.84 (0.62)	2.81 (0.55)
STEM women	2.83 (0.50)	2.98 (0.44)
Non-STEM women	2.88 (0.63)	2.74 (0.52)

Note. Reputational "influence" and "harm" reflect degree and direction of reputational concerns.

brokerage). In such networks, brokerage is more relevant than centrality (constant across participants) or constraint (Burt, 1992), which factors in participant–friend ties (also constant). In general, peripheral and low-brokerage network positions both reduce individuals' influence, but here low- (relative to high-) brokerage participants held equally (albeit less distinctively) central positions (see Figure 1).

Friendship network size and structure were analyzed to compare participant groups. Participants listed on average 8.1 friends (*Mdn* =

Table 4. Friendship formation by participant type, target stereotypicality, and normalized brokerage.

Model parameter	Pilot experiment *b* (*SE*)	Experiment 1 *b* (*SE*)	Experiment 2 *b* (*SE*)	Experiments 1 and 2 *b* (*SE*)
Omnibus model				
Intercept	2.88 (0.05)***	2.75 (0.07)***	2.85 (0.04)***	2.82 (0.03)***
STEM male	−0.14 (0.07)*	−0.05 (0.08)	0.01 (0.05)	−0.01 (0.04)
STEM female	0.16 (0.09)†	−0.02 (0.10)	−0.12 (0.06)†	−0.09 (0.05)†
Target	0.10 (0.05)†	−0.07 (0.07)	−0.04 (0.04)	−0.04 (0.03)
Brokerage	0.15 (0.20)	−0.02 (0.23)	0.00 (0.15)	−0.01 (0.12)
STEM Male × Target	0.00 (0.07)	0.09 (0.08)	0.02 (0.05)	0.04 (0.04)
STEM Female × Target	−0.01 (0.09)	−0.06 (0.10)	−0.13 (0.06)*	−0.11 (0.05)*
STEM Male × Brokerage	0.00 (0.25)	0.04 (0.27)	0.35 (0.19)†	0.23 (0.15)
STEM Female × Brokerage	0.22 (0.33)	0.02 (0.32)	−0.45 (0.25)†	−0.25 (0.19)
Target × Brokerage	0.70 (0.20)**	0.19 (0.23)	0.12 (0.15)	0.13 (0.12)
STEM Male × Target × Brokerage	0.04 (0.25)	0.06 (0.27)	−0.26 (0.19)	−0.12 (0.15)
STEM Female × Target × Brokerage	**0.65 (0.33)**[a]	**0.17 (0.32)**	**0.36 (0.25)**	**0.28 (0.19)**
Simple interactions				
Target × Brokerage (for STEM women)	**1.35 (0.46)****	**0.36 (0.40)**	**0.48 (0.34)**	**0.41 (0.26)**
Target × Brokerage (for STEM men)	0.73 (0.26)**	0.25 (0.25)	−0.14 (0.19)	0.00 (0.15)
Target × Brokerage (for non-STEM women)	0.01 (0.27)	−0.04 (0.49)	0.01 (0.24)	−0.04 (0.21)
Simple effects				
Target (for STEM women with low brokerage)	**−0.28 (0.16)†**	**−0.24 (0.16)**	**−0.30 (0.12)***	**−0.26 (0.10)****
Target (for STEM women with high brokerage)	0.46 (0.19)*	−0.02 (0.19)	−0.03 (0.12)	−0.04 (0.10)
Target (for STEM men with low brokerage)	−0.10 (0.09)	−0.06 (0.10)	0.02 (0.07)	−0.01 (0.06)
Target (for STEM men with high brokerage)	0.30 (0.11)**	0.09 (0.12)	−0.06 (0.08)	0.00 (0.07)
Target (for non-STEM women with low brokerage)	0.10 (0.12)	−0.08 (0.25)	0.06 (0.10)	0.05 (0.09)
Target (for non-STEM women with high brokerage)	0.10 (0.09)	−0.10 (0.13)	0.07 (0.08)	0.03 (0.07)

Note. Participant type and target stereotypicality are effects-coded as STEM male (non-STEM female = −1, STEM female = 0, STEM male = 1), STEM female (non-STEM female = −1, STEM male = 0, STEM female = 1), and target (STEM-stereotypic = −1, feminine-stereotypic = 1). Coefficients are unstandardized. Hypothesized effects are bolded.
***$p < .001$. **$p < .01$. *$p < .05$. †$p < .10$. [a]$p = .051$.

Table 5. Friendship integration by participant type, target stereotypicality, and normalized brokerage.

Model parameter	Pilot experiment *b* (*SE*)	Experiment 1 *b* (*SE*)	Experiment 2 *b* (*SE*)	Experiments 1 and 2 *b* (*SE*)
Omnibus model				
Intercept	2.11 (0.04)***	2.20 (0.05)***	2.22 (0.03)***	2.21 (0.03)***
STEM male	−0.09 (0.06)	−0.13 (0.07)†	−0.16 (0.04)***	−0.15 (0.04)***
STEM female	−0.09 (0.07)	−0.05 (0.08)	−0.09 (0.05)†	−0.07 (0.04)†
Target	−0.10 (0.04)*	0.03 (0.05)	−0.01 (0.03)	0.00 (0.03)
Brokerage	−0.12 (0.18)	−0.37 (0.21)†	−0.20 (0.13)	−0.26 (0.11)*
STEM Male × Target	0.00 (0.06)	0.06 (0.07)	0.03 (0.04)	0.04 (0.04)
STEM Female × Target	−0.11 (0.07)†	−0.13 (0.08)	−0.08 (0.05)	−0.10 (0.04)*
STEM Male × Brokerage	0.23 (0.24)	−0.21 (0.24)	−0.03 (0.17)	−0.10 (0.13)
STEM Female × Brokerage	0.06 (0.29)	0.38 (0.31)	0.13 (0.23)	0.20 (0.18)
Target × Brokerage	0.10 (0.18)	0.39 (0.21)†	0.22 (0.13)†	0.31 (0.11)**
STEM Male × Target × Brokerage	0.18 (0.24)	0.23 (0.24)	−0.10 (0.17)	−0.01 (0.13)
STEM Female × Target × Brokerage	**−0.16 (0.29)**	**0.53 (0.31)†**	**0.32 (0.23)[a]**	**0.39 (0.18)***
Simple interactions				
Target × Brokerage (for STEM women)	**−0.06 (0.39)**	**0.92 (0.41)***	**0.55 (0.32)†**	**0.70 (0.25)****
Target × Brokerage (for STEM men)	0.27 (0.27)	0.63 (0.23)**	0.12 (0.17)	0.31 (0.14)*
Target × Brokerage (for non-STEM women)	0.09 (0.28)	−0.37 (0.40)	0.00 (0.18)	−0.07 (0.17)
Simple effects				
Target (for STEM women with low brokerage)	**−0.19 (0.12)†**	**−0.37 (0.16)***	**−0.24 (0.11)***	**−0.29 (0.09)****
Target (for STEM women with high brokerage)	−0.23 (0.16)	0.17 (0.17)	0.06 (0.10)	0.10 (0.09)
Target (for STEM men with low brokerage)	−0.18 (0.09)*	−0.09 (0.08)	−0.02 (0.06)	−0.04 (0.05)
Target (for STEM men with high brokerage)	−0.03 (0.11)	0.28 (0.11)*	0.05 (0.07)	0.13 (0.06)*
Target (for non-STEM women with low brokerage)	−0.01 (0.13)	0.21 (0.19)	0.04 (0.08)	0.07 (0.07)
Target (for non-STEM women with high brokerage)	0.04 (0.08)	0.00 (0.11)	0.04 (0.06)	0.03 (0.05)

Note. Participant type and target stereotypicality are effects-coded as STEM male (non-STEM female = −1, STEM female = 0, STEM male = 1), STEM female (non-STEM female = −1, STEM male = 0, STEM female = 1), and target (STEM-stereotypic = −1, feminine-stereotypic = 1). Coefficients are unstandardized. Hypothesized effects are bolded.
***$p < .001$. **$p < .01$. *$p < .05$. †$p < .10$. [a]$p = .154$.

10; $SD = 2.64$), with non-STEM women reporting slightly fewer ($Mdn = 9$) than STEM men and women (Mdns $= 10$). Brokerage differed by participant type, $F(2, 271) = 7.91$, $p < .001$, $\eta^2_p = .055$. Non-STEM women had the most brokerage; STEM men, the least (see Table S1 for post hoc tests). Although larger networks are often less dense (individuals can sustain only so many friendships; Scott, 2013), in these small ego-networks, brokerage was orthogonal to number of friends, $r(272) = -.01$, $p = .917$.

To assess whether brokerage moderated specifically STEM women's willingness to befriend a STEM- (vs. feminine-) stereotypic target, models tested the three-way interaction of the participant type effects codes (i.e., STEM male, STEM female), target stereotypicality, and participants' normalized brokerage. STEM women with less brokerage were hypothesized to be more hesitant to associate with a feminine- (vs. STEM-) stereotypic female target.

Perceived similarity and fit. Brokerage did not moderate the interaction of participant type (specifically the key STEM female contrast) and target stereotypicality to predict perceived similarity to self or friends, or perceived fit with friends, all ps $> .35$.

Friendship formation. Willingness to accept the target's friend request was analyzed using a Participant Type × Target Stereotypicality × Brokerage model (see Table 4). Unexpectedly, participants marginally preferred befriending the feminine- (vs. STEM-) stereotypic target, $t(262) = 1.83$, $p = .068$, $\eta^2_p = .013$. STEM men were less willing than others to befriend targets, $t(262) = -2.09$, $p = .038$, $\eta^2_p = .016$. A significant Target Stereotypicality × Brokerage interaction, $t(262) = 3.52$, $p = .001$, $\eta^2_p = .045$, was qualified by a significant omnibus Participant Type × Target Stereotypicality × Brokerage interaction, $F(2, 262) = 3.75$, $p = .025$, $\eta^2_p = .028$, or when tested with the focal STEM female contrast, $t(262) = 1.96$, $p = .051$, $\eta^2_p = .015$ (see Figure 3a).

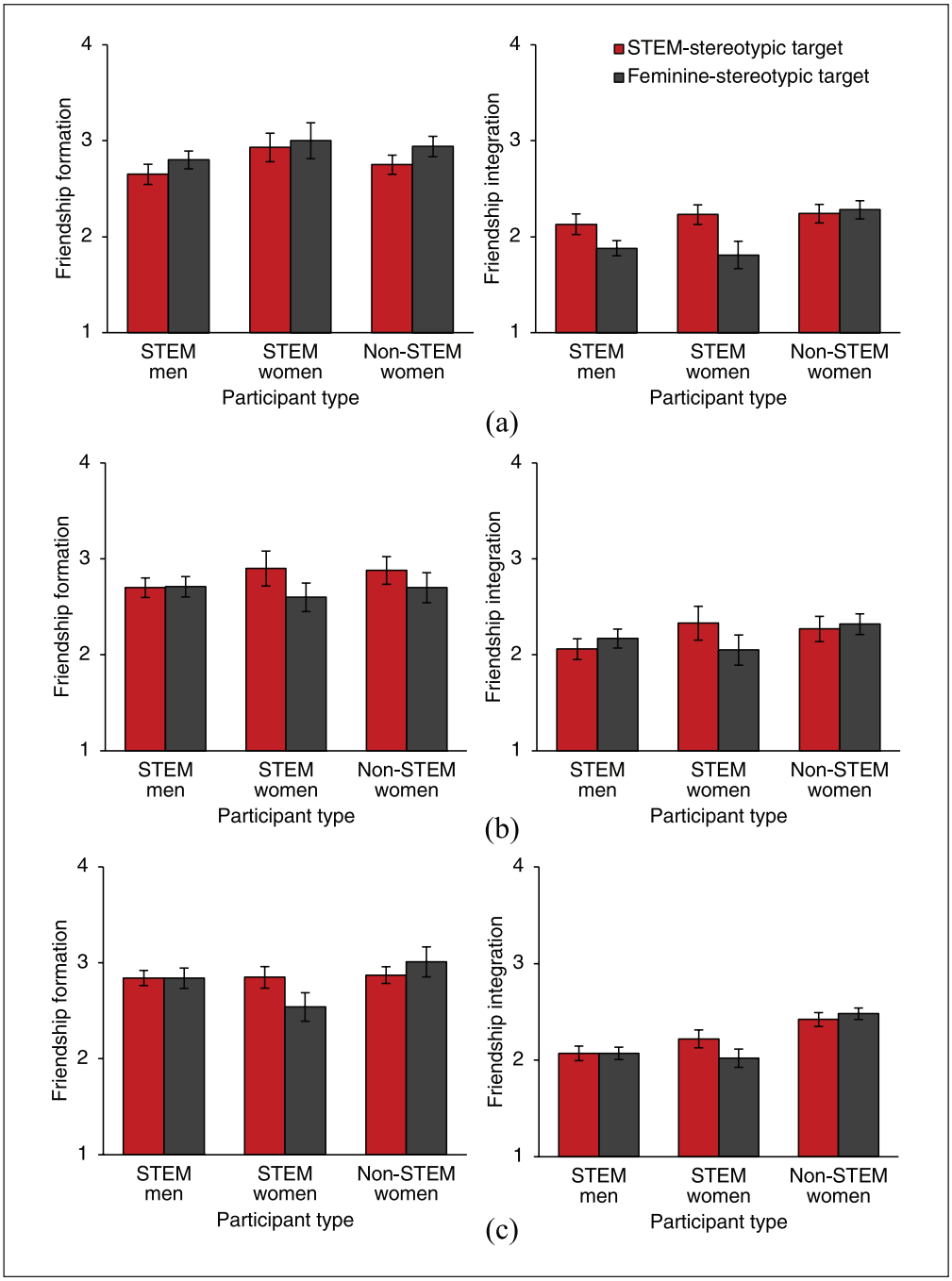
Probing the key interaction for each group, the simple two-way Target Stereotypicality × Brokerage interaction was significant for STEM women, $t(262) = 2.93$, $p = .004$, $\eta^2_p = .032$, and STEM men, $t(262) = 2.79$, $p = .006$, $\eta^2_p = .029$, but not non-STEM women, $t(262) = 0.04$. For STEM women and men, simple effects of target stereotypicality (comparing the STEM- vs. feminine-stereotypic target) were tested at lower and higher brokerage (± 1 SD from mean; in each sample the mean neared 0.5, the midpoint of the theoretical range, so values ± 1 SD are low and high in absolute terms). For low-brokerage participants, the preference to befriend STEM- over feminine-stereotypic targets was marginally significant for STEM women, $t(262) = -1.74$, $p = .083$, $\eta^2_p = .011$, as predicted, but not STEM men, $t(262) = -1.12$, $p = .262$, $\eta^2_p = .005$. At high brokerage, unexpectedly, a significant preference for the feminine- (vs. STEM-) stereotypic target emerged for both STEM women, $t(262) = 2.47$, $p = .014$, $\eta^2_p = .023$, and STEM men, $t(262) = 2.69$, $p = .008$, $\eta^2_p = .027$.

Friendship integration. Overall, participants preferred introducing the STEM- (vs. feminine-) stereotypic target to their friends, $\chi^2(1) = 5.15$, $p = .023$. The two-way STEM Female Contrast × Target Stereotypicality interaction attained marginal significance, $\chi^2(1) = 2.72$, $p = .099$, indicating a marginally stronger STEM-stereotypic target preference among STEM women than among the other groups, as hypothesized (see Figure 2a). Only STEM women significantly preferred socially integrating the STEM- over the feminine-stereotypic target, $b = -0.21$, $SE = 0.09$, $\chi^2(1) = 6.00$, $p = .014$; no significant preference emerged for STEM men or non-STEM women, respective bs $= -0.10$ and 0.01, SEs $= 0.07$, χ^2s$(1) = 2.31$ and 0.03, ps = .128 and .856. The STEM Female Contrast × Target Stereotypicality × Brokerage interaction and Target Stereotypicality × Brokerage simple interaction for STEM women were not significant, χ^2s $(1) = 0.31$ and 0.03, respectively. For STEM women, the predicted target preference was marginal at low brokerage, $\chi^2(1) = 2.72$, $p = .099$, and nonsignificant at high brokerage, $\chi^2(1) = 2.13$, $p = .145$ (see Table 5).

Discussion

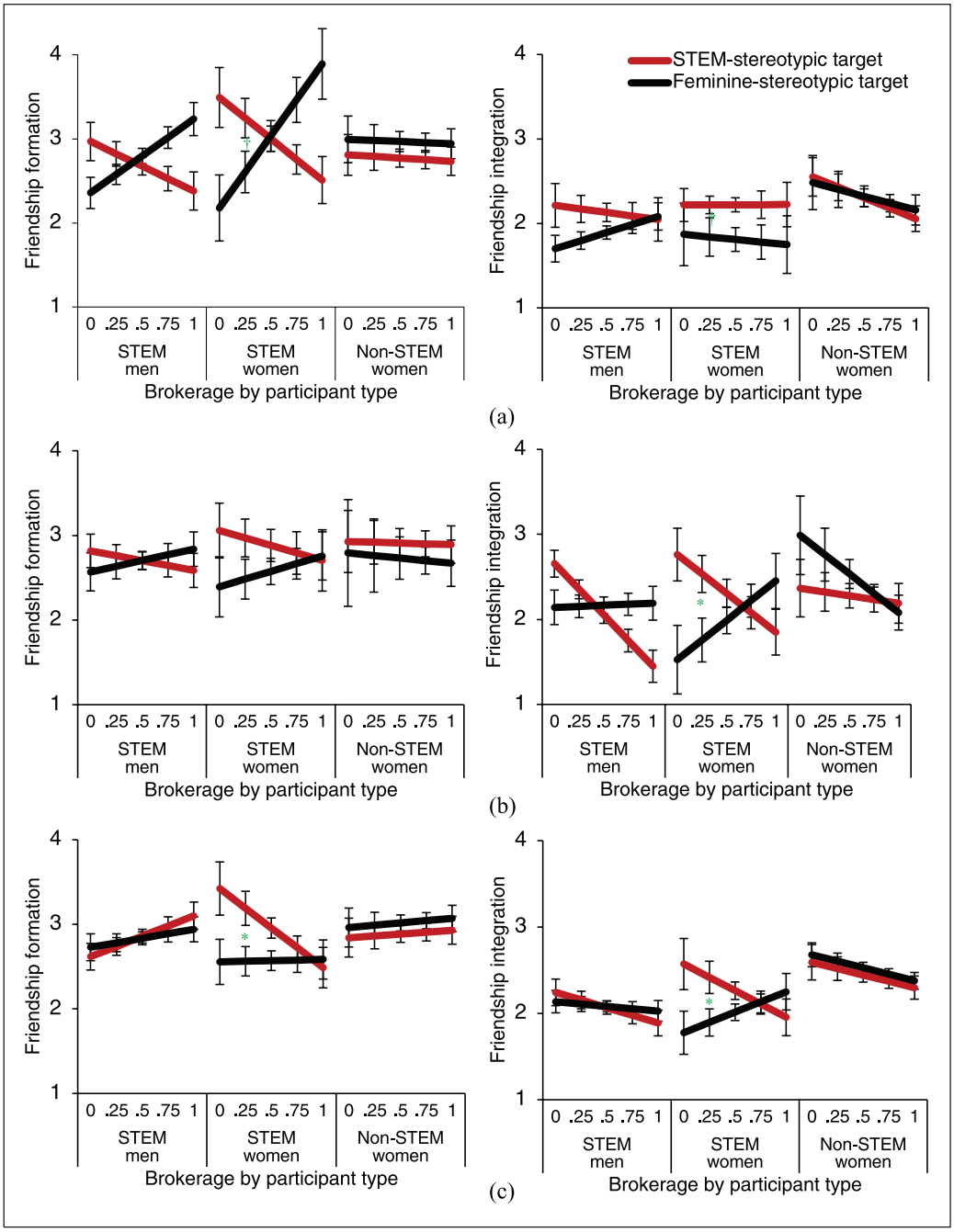
As hypothesized, STEM women—unlike the control groups—preferred introducing the STEM- (vs. feminine-) stereotypic female target to their

Figure 2. Friendship intentions by participant type and target stereotypicality in (a) pilot experiment, (b) Experiment 1, and (c) Experiment 2.



Note. Error bars: ± 1 *SE*.

Figure 3. Friendship intentions by participant type, target stereotypicality, and normalized brokerage in (a) pilot experiment, (b) Experiment 1, and (c) Experiment 2.



Note. Green markers flag the predicted target simple effect for low-brokerage STEM women. Error bars: ± 1 *SE*.
†$p < .10$. *$p < .05$.

friends. Exploratory network analyses revealed that for STEM women, selective avoidance of stereotypically feminine women varied by brokerage. Specifically, STEM women with low-brokerage network positions were marginally less likely to personally befriend (and socially integrate) a woman with feminine- (vs. STEM-) stereotypic interests. In contrast, high-brokerage STEM women (and men) were significantly more likely to personally befriend the feminine-stereotypic target. That target effects attained significance only at higher brokerage (favoring the feminine-stereotypic target) likely reflects participants' overall preference for this target, which hindered detecting the reverse pattern for low-brokerage STEM women (a marginal effect). The friendship intentions of low-brokerage STEM women align with theorizing that dense networks, which constrain control over information flow, may lead members of stigmatized groups to avoid stereotypical peers.

Experiment 1

Experiment 1 tests whether this preference to avoid befriending feminine- (vs. STEM-) stereotypic peers—observed only among STEM women, especially those low in brokerage—replicates, and addresses a similarity-based account of these results. In the pilot experiment, the STEM- versus feminine-stereotypic profile interests differed in actual popularity among STEM majors. The STEM-stereotypic profile featured interests stereotypically and objectively popular among STEM majors, whereas the feminine-stereotypic profile featured interests both counterstereotypic and objectively unpopular among STEM majors. Thus, STEM participants' preference for socially integrating a STEM-stereotypic target (see Figure 2a) could reflect greater objective convergence of her interests with theirs or their friends', rather than group-stereotypicality considerations. Indeed, the STEM- (vs. feminine-) stereotypic target was rated as more similar to and a better fit with STEM participants' friends (independent of brokerage). Experiment 1 rules out this similarity-based explanation by refining both Facebook profiles to feature interests with divergent stereotypicality but convergent objective popularity in STEM. This experiment added a target LinkedIn profile to convey (and standardize) her competence.

Method

Participants and Procedure

The sample (N = 232) comprised 50 STEM women, 123 STEM men, and 59 non-STEM women (see Table 1). Sample size was based on maximizing recruitment in one term.

Protocol. The protocol mirrored the pilot experiment, adding a question about LinkedIn usage and a standardized LinkedIn profile shown after the STEM- or feminine-stereotypic Facebook profile.

Materials

Except as noted in what follows, all materials were identical to those of the pilot experiment.

Ego-network assessment. Participants indicated which listed individuals were Facebook friends or LinkedIn contacts, and saw the participant as a friend (not assuming reciprocal ties).

Facebook profile. Revised profiles (see Appendix C) contained interests pretested for objective popularity among STEM majors (see the supplemental material). The STEM-stereotypic profile combined exclusively STEM and universally unpopular interests—and the feminine-stereotypic profile combined exclusively non-STEM and universally popular interests—to hold overall STEM popularity consistently moderate across profiles, minimizing similarity confounds.

LinkedIn profile. A standardized LinkedIn profile featured the same photo and academic major as the Facebook profile, plus strong volunteer and work experience (see Appendix S1).

Measures. Participants completed the pilot measures and questions about accepting a LinkedIn request from the target and suggesting her as a LinkedIn contact to each friend, from 1 (*definitely not*) to 4 (*definitely yes*). Exploratory academic

inclusion measures produced null effects in Experiments 1 and 2 (see the supplemental material).

Results

Initial Analyses

Tests of basic differences are summarized in what follows (see the supplemental material).

Identification. Participants' identification with their major did not differ by participant type. Non-STEM women identified most strongly with their gender; STEM men, least strongly.

Perceived similarity and fit. With revised target profiles, the previously significant Participant Type × Target Stereotypicality interactions for perceived similarity to oneself or to friends, or perceived fit with friends, disappeared (all ps $> .26$), as intended. These results suggest that perceived similarity/fit cannot explain STEM women's friendship intentions.

LinkedIn connections. LinkedIn usage rates were low (see the supplemental material) in Experiments 1 and 2, so target LinkedIn introductions were not analyzed.

Network Analysis

The three participant groups did not differ on number of friends listed ($M = 8.3$, $Mdn = 10$), but did differ on brokerage, $F(2, 227) = 8.80$, $p < .001$, $\eta^2_p = .072$ (see Table S1 for post hoc tests). Non-STEM women had the most brokerage and STEM men the least. Brokerage was again unrelated to number of friends, $r(228) = .06$, $p = .399$.

Perceived similarity and fit with friends. Brokerage again did not moderate the STEM Female Contrast × Target Stereotypicality interaction to predict perceived similarity to self or friends, or fit with friends, all ps $> .19$.

Friendship formation. Willingness to accept the target as a Facebook friend was tested in regression. With revised profiles, the overall preference in the pilot experiment for befriending the feminine-stereotypic target disappeared: participants showed a slight (nonsignificant) reverse preference. The STEM Female Contrast × Target Stereotypicality × Brokerage interaction did not predict friendship formation, $t(218) = 0.52$, nor were any lower order effects significant (see Table 4). As per the predicted pattern, high-brokerage STEM women showed no target preference, $t(218) = 0.13$, whereas low-brokerage STEM women descriptively (but nonsignificantly) preferred to befriend the STEM-stereotypic target, $t(218) = -1.50$, $p = .135$, $\eta^2_p = .010$ (see Figure 3b).

Friendship integration. The GEE model of willingness to introduce the target revealed nonsignificant lower order effects (see Table 5), including a trending two-way STEM Female Contrast × Target Stereotypicality interaction, $\chi^2(1) = 2.53$, $p = .112$ (see Figure 2b). (Only STEM women descriptively preferred integrating the STEM-stereotypic target, $b = -0.10$, whereas STEM men and non-STEM women had the opposite preference, respective bs $= 0.10$ and 0.11, but these simple effects were nonsignificant, ps $> .18$.) Replicating the interaction pattern for friendship formation in the pilot experiment, the hypothesized STEM Female Contrast × Target Stereotypicality × Brokerage interaction was marginally significant, $\chi^2(1) = 2.83$, $p = .093$ (see Table 5). The Target Stereotypicality × Brokerage simple interaction was significant (as predicted) for STEM women, $\chi^2(1) = 5.09$, $p = .024$ (see Figure 3b), and (unexpectedly) for STEM men, $\chi^2(1) = 7.66$, $p = .006$, but not for non-STEM women, $\chi^2(1) = 0.82$. At low brokerage, STEM women significantly preferred integrating the STEM- (vs. feminine-) stereotypic target, as predicted, $\chi^2(1) = 5.19$, $p = .023$; STEM men had no preference, $\chi^2(1) = 1.14$, $p = .285$. At high brokerage, STEM men preferred the feminine-stereotypic target, $\chi^2(1) = 6.48$, $p = .011$, but STEM women did not, $\chi^2(1) = 1.09$, $p = .296$.

Discussion

Experiment 1 provided some more support for the hypothesis that STEM women lacking network brokerage avoid associating with stereotypically feminine women. This preference for introducing the STEM- (vs. feminine-) stereotypic target to one's friends emerged only for STEM women with less

influential network positions, not high-brokerage STEM women. This pattern of results parallels the pilot experiment, in which low-brokerage STEM women were (marginally) more likely to personally befriend a STEM- (vs. feminine-) stereotypic target, whereas high-brokerage STEM women showed a reverse preference. Collectively, these results provide initial evidence that network position can modulate individuals' experience of group-based threat. Low-brokerage network positions afford less influence over reputations within friendship networks, potentially increasing susceptibility to stigma via association with stereotypic ingroup others.

Experiment 2

Though the pilot experiment and Experiment 1 data patterns aligned with social identity threat-based predictions, the key simple effect of target stereotypicality for low-brokerage STEM women was variable (marginal for friendship formation and integration in the pilot experiment; significant for friendship integration in Experiment 1). Both experiments are somewhat underpowered to detect a two-way simple interaction within STEM women (*n*s = 42 and 44) involving a measured predictor (McClelland & Judd, 1993). Experiment 2 was designed to replicate low-brokerage STEM women's hesitation to befriend or socially include another woman with feminine- (vs. STEM-) stereotypic interests by doubling the number of STEM women (the scarcest group).

Finally, to probe for stigma-by-association phenomenology, Experiment 2 added a face-valid measure of reputational concerns or "own-reputation" threat (Shapiro & Neuberg, 2007). This measure assessed the anticipated reputational harm of affiliating with the target. The most acute concerns were expected for STEM women encountering stereotypically feminine peers.

Method

Participants and Procedure

The sample (N = 553) comprised 117 STEM women, 240 STEM men, and 196 non-STEM women (see Table 1). Sample size was determined by maximizing recruitment across three terms, seeking at least 100 STEM women.

Protocol. The procedure was unchanged except for an unsuccessful target competence manipulation (see the supplemental material) that did not moderate any reported results.

Materials

Materials matched those used in Experiment 1 except where otherwise indicated.

Reputational concerns. Asking "How might your association with [the target] affect your friend's impressions of you?" assessed expected reputational costs of befriending the target, with participants rating how it would "influence their impressions" from 1 (*better*) to 5 (*worse*).[4]

Results

Initial Analyses

Tests of basic differences are summarized in the following lines (see the supplemental material).

Identification. Major identification did not differ by participant type, whereas non-STEM women identified more strongly with their gender than STEM men and STEM women.

Perceived similarity and fit. As in Experiment 1, no significant Participant Type × Target Stereotypicality interaction emerged for perceived similarity to oneself or friends, or fit with friends (all *p*s > .16), minimizing concerns about a target-similarity confound.

Reputational Concerns

The participant type contrasts analyzed perceptions of whether associating with the target would harm participants' reputation with their friends. As predicted, the STEM Female Contrast × Target Stereotypicality interaction was significant, b = 0.08, $t(533)$ = 2.04, p = .042, η^2_p = .008.

Probing this significant interaction, no participant group showed a significant simple effect of target stereotypicality, though descriptively STEM women reported that befriending the feminine- (vs. STEM-) stereotypic target would harm their reputation more, $b = 0.08$, $t(533) = 1.49$, $p = .137$, $\eta^2_p = .004$. Simple effects of participant type revealed that for the STEM-stereotypic target, STEM women did not differ from others, $b = -0.02$, $t(533) = 0.10$, but STEM women were significantly more worried than others about befriending the feminine-stereotypic target, $b = 0.14$, $t(533) = 2.50$, $p = .013$, $\eta^2_p = .012$, as predicted. STEM women anticipated greater harm than STEM men (marginally), $b = -0.17$, $t(533) = 1.90$, $p = .059$, $\eta^2_p = .007$, and non-STEM women (significantly), $b = -0.24$, $t(533) = 2.66$, $p = .008$, $\eta^2_p = .013$, whereas the latter groups did not differ, $b = 0.08$, $t(533) = 1.01$, $p = .314$, $\eta^2_p = .002$. For STEM women, befriending a stereotypically feminine woman may pose risks of stigma by association.

Brokerage did not significantly moderate the STEM Female Contrast × Target Stereotypicality interaction, $b = 0.26$, $t(514) = 1.62$, $p = .106$, $\eta^2_p = .005$,[5] nor did reputational concerns correlate with friendship formation or integration, $|r|$s $< .07$. Many STEM women selected the midpoint on this 5-point scale, suggesting that a more nuanced, multi-item measure might be needed to fully capture participants' reputational concerns, enabling mediation tests.

Network Analysis

The three participant groups listed comparable numbers of friends ($M = 8.1$, $Mdn = 10$; see Table S1), but differed on brokerage, $F(2, 535) = 8.04$, $p < .001$, $\eta^2_p = .029$. Non-STEM women had the most brokerage and STEM men the least (see Table S1 for post hoc tests). Brokerage was again unrelated to number of friends listed, $r(536) = -.003$, $p = .953$.

Perceived similarity and fit with friends. As in prior experiments, brokerage did not moderate the STEM Female Contrast × Target Stereotypicality interaction to predict perceived similarity to self or friends, or perceived fit with friends (all ps $> .26$).

Friendship formation. The predicted STEM Female Contrast × Target Stereotypicality interaction was significant, $t(526) = 2.06$, $p = .040$, $\eta^2_p = .008$ (see Table 4), meaning that STEM women's relative willingness to befriend the two targets differed from control participants' (see Figure 2c). STEM women significantly preferred befriending the STEM- (vs. feminine-) stereotypic target, $b = -0.16$, $t(526) = 2.05$, $p = .040$, $\eta^2_p = .008$; STEM men and non-STEM women had no preference, bs $= -0.02$ and 0.07, ts$(526) = 0.36$ and 1.02, ps $> .30$, η^2_p s $< .002$.

Supplemental analyses confirmed that STEM women were significantly less likely than others to befriend the feminine-stereotypic target, $b = -0.24$, $t(526) = 2.83$, $p = .005$, $\eta^2_p = .015$, with no differences emerging for the STEM-stereotypic target, $b = 0.01$, $t(526) = 0.10$. Specifically, STEM women were less willing than STEM men ($p = .046$) and non-STEM women ($p = .002$)—who did not differ ($p = .133$)—to befriend a stereotypically feminine peer.

The three-way STEM Female Contrast × Target Stereotypicality × Brokerage interaction for friendship formation seen in the pilot experiment was not significant, but trended in the predicted direction, $b = 0.36$, $t(526) = 1.47$, $p = .142$, $\eta^2_p = .004$ (see Figure 3c). Similarly, the Target Stereotypicality × Brokerage simple interaction was trending for STEM women, $t(526) = 1.43$, $p = .152$, $\eta^2_p = .004$, and clearly absent for STEM men and non-STEM women, both ts$(526) < 1$ (0.71 and 0.04). As predicted, high-brokerage STEM women had no target preference, $t(526) = 0.28$, and low-brokerage STEM women significantly preferred befriending the STEM- (vs. feminine-) stereotypic target, $t(526) = -2.39$, $p = .017$, $\eta^2_p = .011$. Notably, no target stereotypicality effects emerged at either low or high brokerage for STEM men or non-STEM women (all ps $> .40$).

Friendship integration. One significant lower order effect emerged for integration (see Table 5): STEM men were less likely to introduce targets to their friends, $\chi^2(1) = 13.90$, $p < .001$. A trending

STEM Female Contrast × Target Stereotypicality interaction emerged, $\chi^2(1) = 2.65$, $p = .104$, as in Experiment 1. Friendship integration results nonsignificantly paralleled friendship formation: descriptively, only STEM women preferred introducing the STEM- (vs. feminine-) stereotypic target, $b = -0.09$, $\chi^2(1) = 2.00$, $p = .157$; STEM men and non-STEM women had a slight reverse preference, bs = 0.02 and 0.04, χ^2s(1) = 0.09 and 0.71 (see Figure 2c).

Unexpectedly, the STEM Female Contrast × Target Stereotypicality × Brokerage interaction for friendship integration was only trending, $\chi^2(1) = 2.03$, $p = .154$ (see Table 5). Despite this nonsignificant moderation, the predicted Target Stereotypicality × Brokerage simple interaction was marginally significant among STEM women, $\chi^2(1) = 2.96$, $p = .085$, but not STEM men or non-STEM women, both χ^2s(1) < 1 (0.53 and 0.001). Paralleling prior experiments, low-brokerage STEM women were significantly less likely to introduce the feminine-stereotypic (vs. STEM-stereotypic) target to their friends, $\chi^2(1) = 4.59$, $p = .032$. As predicted, no target stereotypicality effects emerged for high-brokerage STEM women, $\chi^2(1) = 0.29$, or STEM men or non-STEM women (low or high in brokerage; all ps > .50).

Moderation by Major Identification

Unexpectedly, major identification moderated friendship intentions (see the supplemental material). Participants highly identified (+1 *SD*) with their major showed no STEM Female Contrast × Target Stereotypicality effects, whereas those less major-identified (−1 *SD*, near the midpoint) showed the predicted effects. The key STEM Female × Target Stereotypicality × Brokerage interaction—trending in the full sample—was significant for less (i.e., moderately) major-identified participants. Among this group, only STEM women reported significantly higher friendship intentions toward STEM- (vs. feminine-) stereotypic targets when low in brokerage. Major identification did not moderate effects in prior (less well powered) experiments and was assessed at the end, meriting cautious interpretation. Nonetheless, these results parallel larger stereotype threat effects for moderately low math-identified women (meta-analytic $d = .52$) than highly math-identified women ($d = .29$; Nguyen & Ryan, 2008). Highly STEM-identified women may feel sufficient fit to allay stigma-by-association concerns.

Discussion

In Experiment 2, the basic interaction of participant type and target stereotypicality attained significance for friendship formation: STEM women hesitated significantly more than control groups to personally befriend a stereotypically feminine (vs. STEM-stereotypic) woman. (For friendship integration, it was trending.) For network brokerage, the higher order interactions trended in the predicted direction but failed to attain significance, except among participants only moderately identified with their academic majors. Notably, however, the key lower order effects proved significant—overall and among moderately major-identified participants—for both friendship formation and integration. Low-brokerage STEM women were significantly less likely either to befriend or integrate a feminine-stereotypic (vs. STEM-stereotypic) target. High-brokerage STEM women showed no preference, and brokerage did not moderate or predict friendship preferences of STEM men or non-STEM women.

Finally, Experiment 2 assessed the anticipated reputational impact of friendship choices. Relative to control groups, STEM women thought befriending a stereotypically feminine woman would affect their friends' view of them more negatively, a direct marker of threat (specifically, concerns that connections with stereotypic ingroup others may endanger one's own standing).

General Discussion

Three experiments revealed a pattern of selective affiliation, consistent with social identity threat, as members of a stigmatized minority decided whether to associate with a highly ingroup-stereotypic peer. Women in STEM fields were less willing to befriend and socially integrate a female

peer if she expressed feminine- versus STEM-stereotypic interests. This effect was modest: friendship formation scores trended in this direction within two smaller samples of STEM women (average $n = 43$), attaining significance in the best powered experiment ($n = 117$). Friendship integration showed the predicted basic pattern for STEM women in the pilot experiment, but later only trended in that direction, underscoring the need to model brokerage as a moderator.

Across experiments, selective affiliation effects varied based on network brokerage, an index of individuals' structural power to link disconnected others, exerting relational control as per structural hole theory (Burt, 1997; Fernandez & Gould, 1994). Brokerage moderated target stereotypicality effects on friendship intentions for STEM women in each experiment, but failed to do so consistently for control groups.[6] (Notably, STEM women's brokerage levels were moderate and comparable to STEM men's.) STEM women tended to selectively avoid feminine- (vs. STEM-) stereotypic peers most when they lacked brokerage. (High-brokerage STEM women showed a significant opposite preference for friendship formation only in the pilot experiment, but no other significant or marginal effects.) Particularly for members of stigmatized groups, lacking brokerage may constrain affiliation. Finally, in Experiment 2, STEM women—more than control groups—reported that befriending a stereotypically feminine woman would worsen friends' impressions of them, consistent with stigma-by-association concerns.

Limitations

Locus of brokerage effects. Parallel patterns emerged across studies for STEM women's friendship intentions toward feminine- versus STEM-stereotypic targets in general (see Figure 2) and especially as a function of network brokerage (see Figure 3), but brokerage effects emerged more for friendship *formation* in the pilot experiment versus friendship *integration* in Experiments 1 and 2. This inconsistency may reflect postpilot profile revisions balancing objective STEM similarity. Only in the pilot experiment did most participants prefer personally befriending the feminine- (vs. STEM-) stereotypic target, suggesting miscalibration (possibly the STEM-stereotypic profile rivaled participants' own STEM standing), although low-brokerage STEM women nonetheless preferred (marginally) to personally befriend the STEM- rather than the feminine-stereotypic target.

With revised profiles, the predicted brokerage moderation was most evident for STEM women's willingness to integrate the STEM- (vs. feminine-) stereotypic target with their friends, an inherently social outcome related to stigma by association. The supplemental material reports analyses pooling data for Experiments 1 and 2 (using identical profiles), with coefficients also reported in Tables 4 and 5 (main article) for ease of reference. Notably, when raw data are available, pooled "mega-analysis" is preferable to meta-analyzing sample-level effect sizes (Costafreda, 2009; Sung et al., 2014). The predicted Participant Type × Target Stereotypicality interaction was significant for both friendship formation and integration, and significantly moderated by brokerage for integration. Only STEM women significantly preferred to befriend and integrate the STEM-stereotypic (vs. feminine-stereotypic) target in general. This preference was significant for low-brokerage STEM women, not other groups. Predicting null (not reversed) brokerage effects for high-brokerage and control participants yields two- and three-way "knock-out" interactions with smaller effect sizes, whose reliable detection requires samples 4 to 16 times larger than the key simple effect (Giner-Sorolla, 2018; Giner-Sorolla et al., 2019). Accordingly, higher order interactions for friendship integration attained significance in pooled analyses ($N = 785$), while the target stereotypicality effect for low-brokerage STEM women was significant in smaller samples (see Table 5). The predicted brokerage moderation pattern appears among STEM women in five of six instances (see Figure 3).

Homophily. If greater similarity to the preferred target explained STEM women's tendency to befriend and integrate a STEM- (vs. feminine-) stereotypic target, knowledge gains would be

limited: homophily (clustering with similar others) is known to shape friendship networks (McPherson, Smith-Lovin, & Cook, 2001). In the pilot experiment, STEM women saw the STEM- (vs. feminine-) stereotypic target as more similar to themselves and their friends, and these ratings predicted friendship formation and integration, $r(278) = .29$ and $r(277) = .45$ ($ps < .001$). In Experiments 1 and 2, however, revised target profiles (with standardized STEM popularity) erased condition-based differences in similarity ratings and attenuated these correlations, so homophily cannot account for observed effects of target, participant type, and brokerage.

Friend type. High levels of friend type homophily and uncategorized friends (see the supplemental material) precluded clear conclusions about whether identity threat primarily shaped STEM women's decisions about introducing female targets to STEM male (vs. other) friends. Across samples, two thirds of STEM women's friends were also in male-dominated STEM majors. Future work could query only same-major friendships for a more localized brokerage measure.

Controls. These experiments included two control groups (STEM men, non-STEM women) to isolate effects specific to STEM women. Male targets were not used, because men with "feminine" interests are often seen as gay (Oakes, Eibach, & Bergsieker, 2019), triggering derogation in STEM (Cech & Waidzunas, 2011) and potential stigma by association.

Effect sizes. The reported effects are modest in magnitude, mostly accounting for 1% to 4% of observed variance, likely due to methodological factors. Ten-person ego-networks provide a coarser index of individuals' relative brokerage than whole networks. Similarly, offering limited response options—*definitely/probably yes, definitely/probably not*—mirrors binary real-life choices to approach or avoid others, but provides less nuanced detection of friendship intentions. Some participants noted "always" or "never" accepting Facebook friend requests, an individual difference that inflates measurement error, attenuating true effect sizes. Finally, these modest effects emerged for hypothetical friendship intentions without real costs, implying that in live interactions with real-world reputational stakes, selective affiliation effects would increase.

Mechanisms. Additional factors besides stigma-by-association concerns could contribute to low-brokerage STEM women's selective avoidance of stereotypically feminine women. Instrumental concerns about upward mobility lead some high-status women in male-dominated settings to highlight their gender atypicality, derogate other women, and downplay gender bias (see Derks, van Laar, & Ellemers, 2016). Such "queen-bee" behaviors, however, are largely confined to women with weaker gender identification (Derks et al., 2011; Kaiser & Spalding, 2015), a variable that did not moderate the present results (except one instance in which only highly gender-identified women showed a basic avoidance effect; see the supplemental material). The present work finds that for STEM women (only), the prospect of befriending a stereotypic peer leads to reputational concerns and reduced friendship intentions, but not academic exclusion, suggesting mechanisms more related to belonging/fit concerns than instrumental/achievement motives (see Veldman et al., 2019). Notably, brokerage did not significantly moderate the heightened reputational concerns expressed by STEM women about the feminine-stereotypic target—possibly due to low power for this three-way interaction—so more evidence is needed to clarify whether higher brokerage indeed reduces women's experience of this reputational threat.

Brokerage. Because brokerage was measured, not manipulated, its moderating effects across experiments could reflect personality (or situational) factors. For instance, people might attain high-brokerage positions via extraversion (approaching people from distinct walks of life) or introversion (preferring one-on-one friendships over larger groups). Brokerage determinants merit study (e.g., Sasovova, Mehra, Borgatti, & Schippers, 2010), but exceed the scope of this

work, which claims that brokerage positions, however attained, afford behavioral constraint or freedom. Manipulating perceived brokerage (e.g., Brands & Mehra, 2018) is a future direction.

In these ego-centric networks, brokerage is the inverse of network density. That STEM women low in brokerage—hence, in densely interconnected networks—avoid integrating a stereotypically feminine woman parallels findings comparing dense networks to those rich in structural holes (affording brokerage). Dense networks may display "relational inertia," whereby strong interpersonal ties "serve as a filter for information and perspectives reaching the actors, generating a cognitive lock-in" and "the uncertainty associated with the formation of new ties, raises the cost of [forming] new relationships" (Gargiulo & Benassi, 2000, p. 186). Inertia in dense networks may deter friendship with stereotypic peers, whereas less dense networks give high-brokerage individuals control over relationship information and negotiation (Burt, 1997).

Implications

These findings extend social identity threat theorizing to interpersonal network outcomes. Much as concerns about oneself confirming negative stereotypes can cause underperformance (Steele, 1997) and selective distancing from devalued ingroup traits (Pronin et al., 2004), concerns about stereotypic peers can spur underperformance (Cohen & Garcia, 2005), shame (Schmader & Lickel, 2006), metastereotype activation (Taylor et al., 2018), and—as found here—selective distancing from stereotypic ingroup peers. Selective affiliation may facilitate managing identities stereotyped as mutually exclusive (e.g., woman, STEM major; Nosek et al., 2002), but carries broader costs. For example, ingroup contact can help individuals cope with bias, but stigma-by-association concerns may complicate relations with prospective ingroup friends, undermining well-being and cohesion (Branscombe, Schmitt, & Harvey, 1999).

Social networks. Using theories and methods of network science to examine intergroup dynamics goes beyond isolated perceivers, targets, or dyads to the broader social context of networked, interacting actors (see Clifton & Webster, 2017). This work imports a marker of social power underexamined in social psychology: network brokerage. Structural hole theory posits that a broker position—bridging otherwise unconnected individuals—provides a control advantage over information that network members share, facilitating impression management and relationship negotiation (Burt, 1997). Here, only STEM women low (not high) in brokerage selectively avoided a feminine- (vs. STEM-) stereotypic target. Low-brokerage STEM women may worry that if a stereotypically feminine friend seems "unsuited" for STEM, they cannot control who learns of their friendship.

Conversely, experiencing chronic social identity threats to one's prototypicality within STEM could affect one's brokerage. When individuals see their ingroup identities (e.g., woman and STEM major) as incompatible (Nosek et al., 2002), distant/conflicting (Benet-Martínez & Haritatos, 2005), or just distinct (displaying social identity complexity; Roccas & Brewer, 2002), they may pursue brokerage for its power to link—or keep separate—friends whose traits or interests match only one ingroup. Over time, such iterative choices could solidify high-brokerage positions and foster bifurcated networks with segregated subgroups (e.g., those with feminine- vs. STEM-stereotypic interests), much as stereotype threat can lead STEM women to bifurcate their personal identity (Pronin et al., 2004). In contrast, if STEM identity (or prototypicality) threat is attenuated by representing multiple identities as compatible or even interconnected, individuals belonging to both groups are anticipated to flourish (see Brannon, Markus, & Taylor, 2015) and express greater willingness to welcome peers stereotypic of either group.

Social capital. Selective affiliation emerged for social—not academic—inclusion (see the supplemental material; notably, the academic scenario was a low-stakes, elective course). In business settings, brokers are stereotyped as assertive and masculine, and women seen as brokers experience more backlash and anxiety (Brands & Kilduff, 2014; Brands & Mehra, 2018). Such factors may

negate any brokerage-as-control advantages, attenuating effects for academic inclusion. For social networks of friends, however, connecting people fits stereotypes of women as social coordinators and "kin keepers" (Rakow, 1992), enabling STEM women to reap brokerage benefits.

Informal social networks can critically facilitate postsecondary success (Bourdieu, 1977) and job attainment (Granovetter, 1995). When pursuing historically denied career opportunities, seeking social capital may motivate strategic avoidance of potentially ingroup-stereotypic peers. Indeed, minority job holders cite reputational concerns when withholding job tips from minority contacts with negative ingroup-stereotypic traits (Smith, 2005). Denying stereotypically feminine women access to friendship networks can perpetuate women's underrepresentation in STEM.

Prototypicality. Excluding feminine women also limits intergroup contact, a robust bias-reduction method (Pettigrew & Tropp, 2006) most effective when interacting parties appear representative of their groups (Ensari & Miller, 2002; Hewstone & Brown, 1986; Wilder, 1984). In contrast, contact with an atypical, homogeneous subgroup (e.g., STEM women with interests uncommon among women generally) leaves intact negative views of other women and a narrow prototype—or masculine default (Cheryan & Markus, 2019)—characterizing people in STEM. Selective affiliation can thus reinforce STEM stereotypes about women and women's stereotypes about STEM culture, deterring women from entering STEM (Cheryan, Master, & Meltzoff, 2015). Conversely, self-affirmation training helps STEM women boost their gender identification and befriend marginally more non-STEM women (Walton et al., 2015), suggesting that affirmation may counteract social identity threat and foster more inclusive STEM networks.

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Supplemental material

Supplemental material for this article is available online.

Notes

1. G*Power (Faul, Erdfelder, Buchner, & Lang, 2009) showed 80% power to detect a Participant Type × Target Stereotypicality × Brokerage interaction of magnitude $\eta^2_p = .034$ (pilot experiment), .040 (Experiment 1), and .017 (Experiment 2), but see Giner-Sorolla (2018) for caveats.
2. Notably, on Facebook, one's friendships are visible to existing friends.
3. Each contrast's *b* is the deviation of the group coded 1 from the unweighted sample mean (see Aiken & West, 1991, pp. 127–128), testing whether that group differs from the other two combined.
4. Participants also rated the degree of change from 1 (*not at all*) to 5 (*completely*).
5. Brokerage was thus omitted from the aforementioned model.
6. Unexpectedly, significant moderation by brokerage emerged for STEM men in the pilot experiment

for friendship formation and in Experiment 1 for friendship integration, but this effect (due to high-brokerage men preferring feminine-stereotypic targets) had half the size of the STEM women's effect and disappeared ($ps > .10$) in higher powered Experiment 2.

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Appendix A. Ego-network assessment (sociomatrix measure).

FRIENDSHIP NETWORK

Which of these people see each other as friends? Person A might consider Person B a friend, but Person B might not see Person A as a friend.

For each person on the left, indicate whether you think he/she considers the person listed at the top to be his/her friend. For example:

- **If [Friend 1] considers [Friend 2] a friend, please check the box that connects [Friend 1] at the left with [Friend 2] at the top; otherwise, leave this box blank.**
- **If [Friend 2] also considers [Friend 1] a friend, please check the box that connects [Friend 2] at the left with [Friend 1] at the top; if not, leave this box blank.**

(You can ignore the boxes on the diagonal; they have already been checked for you.)

	[Friend 1]	[Friend 2]	[Friend 3]	[Friend 4]	[Friend 5]	[Friend 6]	[Friend 7]	[Friend 8]
[Friend 1]	☑	☐	☐	☐	☐	☐	☐	☐
[Friend 2]	☐	☑	☐	☐	☐	☐	☐	☐
[Friend 3]	☐	☐	☑	☐	☐	☐	☐	☐
[Friend 4]	☐	☐	☐	☑	☐	☐	☐	☐
[Friend 5]	☐	☐	☐	☐	☑	☐	☐	☐
[Friend 6]	☐	☐	☐	☐	☐	☑	☐	☐
[Friend 7]	☐	☐	☐	☐	☐	☐	☑	☐
[Friend 8]	☐	☐	☐	☐	☐	☐	☐	☑

How many of the friends named above see you as a friend?

○ All ○ Some ○ None

Note. The first names of participants' listed friends (up to 10) were displayed in the rows and columns of the sociomatrix. In Experiments 1 and 2, participants indicated whether their own friendship nominations were reciprocal by answering "How many of the friends named above see you as a friend?" (*all, some*, or *none*). Those answering "some" were prompted to indicate which of their friends saw them as friends.

Appendix B. Facebook profiles (pilot experiment).

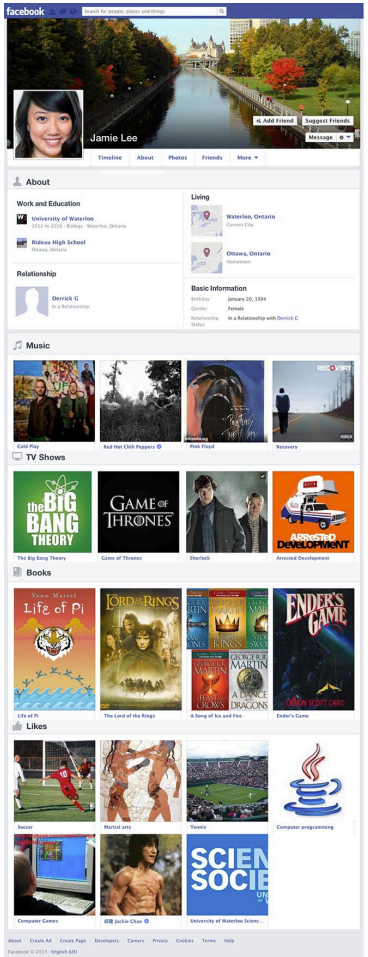
Face stimulus set:

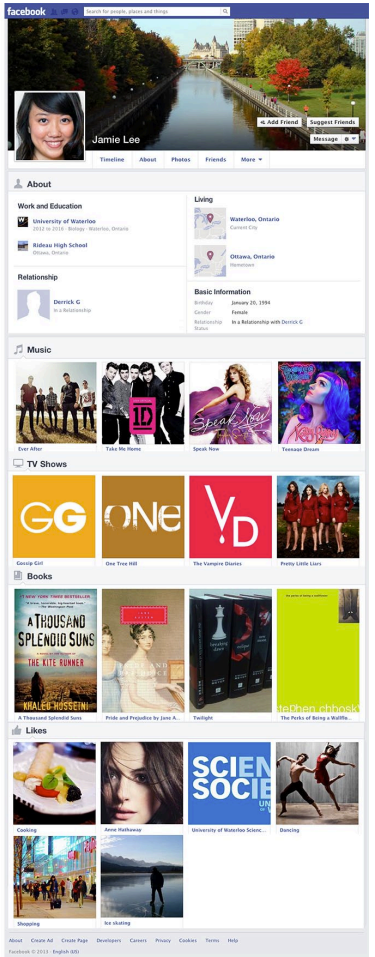
STEM-stereotypic profile (on left):

- Cold Play, Red Hot Chili Peppers, Pink Floyd, Eminem
- The Big Bang Theory, Game of Thrones, Sherlock, Arrested Development
- Life of Pi, The Lord of the Rings, A Song of Ice and Fire, Ender's Game
- Soccer, martial arts, tennis, computer programming, computer games, Jackie Chan, UW Science

Feminine-stereotypic profile (on right):

- Ever After, One Direction, Taylor Swift, Katy Perry
- Gossip Girl, One Tree Hill, The Vampire Diaries, Pretty Little Liars
- A Thousand Splendid Suns, Pride and Prejudice, Twilight, The Perks of Being a Wallflower
- Cooking, Anne Hathaway, dancing, shopping, ice skating, UW Science





Appendix C. Revised interests in Facebook profiles (Experiments 1 and 2).

STEM-stereotypic (on left):

- Bourne Identity, Wreck-It Ralph, Pacific Rim, Ratatouille
- Radiohead, Frank Sinatra, Yellowcard, Red Hot Chili Peppers
- Psych, Beverly Hills 90210, Futurama, House
- Battle Royale, Room, Crime and Punishment, Angels and Demons
- George R. R. Martin, crosswords, cricket, Ewan McGregor, Hugh Laurie, programming, UW Science

Feminine-stereotypic (on right):

- Pride and Prejudice, Mean Girls, Fight Club, The Lion King
- One Direction, Drake, Mumford and Sons, Coldplay
- Grey's Anatomy, The Vampire Diaries, Criminal Minds, The Walking Dead
- Catcher in the Rye, The Fault in Our Stars, A Thousand Splendid Suns, Pride and Prejudice
- J. K. Rowling, art, dancing, Leonardo DiCaprio, Channing Tatum, working out, UW Science