

Publishing while female

Are women held to higher standards?
Evidence from peer review.

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Background

Women are held to higher standards

- ▶ Men are rated more competent when compared to otherwise equally competent women (Foschi, 1996).
- ▶ Male undergraduate biology students underestimated female classmates' ability (Grunspan et al., 2016).
- ▶ Female graduate students are rated less qualified for laboratory management positions (Moss-Racusin et al., 2012).
- ▶ When collaborating with men, women are given less credit for their mutual work (Heilman and Haynes, 2005; Sarsons, 2017).
- ▶ Manuscripts by female authors are rated lower quality (Goldberg, 1968; Paludi and Bauer, 1983; Krawczyk and Smyk, 2016).

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“Women must do twice as well to be thought half as good.”

–Charlotte Whitton

Gender discrimination in peer review

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- ▶ Are referees, *e.g.*, more likely to double-check technical details, demand robustness checks or require clearer exposition in a female-authored paper?
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“I have no doubt that one of [discrimination's] results has been that those women who do manage to make their mark are much abler than their male colleagues.”

–Milton Friedman

Writing clarity

1. Clear writing is valued by journals.
2. Good writing $\approx f$ (simple vocabulary, short sentences).
 - ▶ Flesch Reading Ease, Flesch-Kincaid, Gunning Fog, SMOG and Dale-Chall.

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 - ▶ Flesch Reading Ease, Flesch-Kincaid, Gunning Fog, SMOG and Dale-Chall.
 - ▶ Every article abstract published in the *AER*, *Econometrica*, *JPE* and *QJE* since 1950.
 - ▶ Readability scores highly correlated across abstract, introduction and discussion sections of a paper (Hartley et al., 2003).

Strategy

Identification

1. Establish that there is a gender difference in readability.
2. Causally link this difference to the peer review process.
3. Establish sufficient conditions to verify discrimination is present in academic publishing.
 - ▶ Show evidence that these conditions are satisfied on average for two different measures of research quality: readability *and* citation counts.
 - ▶ Use a matching estimator to estimate the causal impact of higher readability standards in peer review.

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Consequences

- ▶ Female-authored papers take half a year longer in peer review.
- ▶ As women update beliefs about referees' standards, they increasingly meet those standards before peer review.

Article-level analysis

$$R_j^s = \beta_0 + \beta_1 \text{female ratio}_j + \theta \mathbf{X}_j + \varepsilon_j.$$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Flesch Reading Ease	0.90* (0.48)	0.87* (0.48)	0.83* (0.50)	0.81 (0.48)	0.97* (0.50)	0.52 (0.53)	0.92 (0.71)
Flesch-Kincaid	0.19* (0.11)	0.18 (0.11)	0.18 (0.11)	0.19* (0.11)	0.22* (0.12)	0.23* (0.12)	0.25* (0.14)
Gunning Fog	0.33*** (0.12)	0.33*** (0.12)	0.33*** (0.12)	0.33*** (0.13)	0.37*** (0.14)	0.34** (0.14)	0.36** (0.16)
SMOG	0.21** (0.09)	0.21** (0.09)	0.22** (0.09)	0.21** (0.09)	0.23** (0.10)	0.19* (0.10)	0.23* (0.12)
Dale-Chall	0.10** (0.04)	0.10** (0.04)	0.10** (0.05)	0.09** (0.04)	0.11** (0.05)	0.09* (0.05)	0.13** (0.06)
Editor effects	✓	✓	✓	✓	✓	✓	✓
Journal effects	✓	✓	✓	✓	✓	✓	✓
Year effects		✓	✓	✓	✓	✓	✓
Journal×Year effects			✓	✓	✓	✓	✓
Institution effects				✓	✓	✓	✓
Quality controls					✓ ¹	✓ ¹	✓ ¹
Native speaker					✓	✓	✓
JEL (primary) effects						✓	
JEL (tertiary) effects							✓

Notes. 9,122 articles in (1)–(5); 5,216 articles in (6); 5,777 articles—including 561 from *AER Papers & Proceedings*—in (7). Figures represent the coefficient on female ratio from an OLS regression on the relevant readability score. Quality controls denoted by ✓¹ include citation count and max. T_j fixed effects. Standard errors clustered on editor in parentheses. ***, ** and * statistically significant at 1%, 5% and 10%, respectively.

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Notes. 9,122 articles in (1)–(5); 5,216 articles in (6); 5,777 articles—including 561 from *AER Papers & Proceedings*—in (7). Figures represent the coefficient on female ratio from an OLS regression on the relevant readability score. Quality controls denoted by ✓¹ include citation count and max. T_j fixed effects. Standard errors clustered on editor in parentheses. ***, ** and * statistically significant at 1%, 5% and 10%, respectively.

Female-authored abstracts are 1–2 % more clearly written.

Author-level analysis

$$R_{jit}^s = \beta_0 R_{it-1}^s + \beta_1 \text{female ratio}_j + \beta_2 \text{female ratio}_j \times \text{male}_i + \theta \mathbf{X}_j + \alpha_j + \varepsilon_{it}.$$

	Flesch Reading Ease	Flesch- Kincaid	Gunning Fog	SMOG	Dale- Chall
Female ratio (women)	2.37** (1.00)	0.35* (0.20)	0.66*** (0.24)	0.47** (0.19)	0.23** (0.10)
Female ratio (men)	0.57 (1.31)	0.10 (0.25)	0.15 (0.29)	0.09 (0.21)	0.10 (0.11)
N_j	✓	✓	✓	✓	✓
Editor effects	✓	✓	✓	✓	✓
Journal effects	✓	✓	✓	✓	✓
Year effects	✓	✓	✓	✓	✓
Journal × Year effects	✓	✓	✓	✓	✓
Institution effects	✓	✓	✓	✓	✓
Quality controls	✓ ¹	✓ ¹	✓ ¹	✓ ¹	✓ ¹
Native speaker	✓	✓	✓	✓	✓

Notes. Sample 9,186 observations (2,827 authors). Figures from first-differenced, IV estimation of the regression equation (Arellano and Bover, 1995; Blundell and Bond, 1998). Quality controls denoted by ✓¹ include citation count and max. T_j fixed effects. Regressions weighted by $1/N_j$; standard errors adjusted for two-way clustering on editor and author (in parentheses). ***, ** and * statistically significant at 1%, 5% and 10%, respectively.

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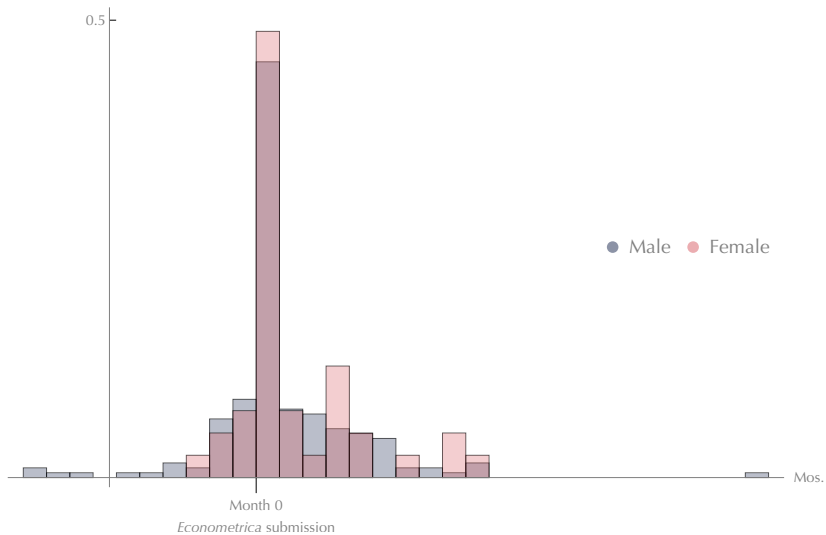
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Everyone writes better when co-authoring with women!

- ▶ Female-authored abstracts are 2–6 % more clearly written.
- ▶ Convex relationship between readability and female ratio.

NBER Working Papers



Causal impact of peer review

	FGLS			OLS
	Working paper	Published article	Difference	Change in score
Flesch Reading Ease	2.26** (1.00)	3.21*** (1.21)	0.95* (0.57)	0.94 (0.60)
Flesch-Kincaid	0.31 (0.23)	0.75*** (0.28)	0.44** (0.18)	0.44** (0.19)
Gunning Fog	0.44* (0.24)	0.86*** (0.29)	0.42** (0.19)	0.42** (0.20)
SMOG	0.33** (0.15)	0.56*** (0.19)	0.24** (0.12)	0.24* (0.12)
Dale-Chall	0.32*** (0.10)	0.45*** (0.11)	0.13** (0.05)	0.13** (0.05)
Editor effects	✓	✓		✓
Journal effects	✓	✓		✓
Year effects	✓	✓		
Journal × Year effects	✓	✓		✓
Quality controls	✓ ²	✓ ²		✓ ³
Native speaker	✓	✓		✓

Notes. Sample 1,709 NBER working papers; 1,707 published articles. Estimates exclude 279 pre-internet double-blind reviewed articles. Column one standard errors clustered by editor in parentheses. Columns two and three standard errors clustered by year and robust to cross-model correlation in parentheses. Column five standard errors clustered by year in parentheses. Quality controls denoted by ✓² include citation count, max. T_j and max. t_j ; ✓³ includes max. t_j , only. ***, ** and * statistically significant at 1%, 5% and 10%, respectively.

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Peer review causes a large increase in the readability gap

Causal impact of peer review

- ▶ No readability gap under double-blind review *before* the internet.
- ▶ Definitely a readability gap under double-blind review *after* the internet.
 - ▶ The internet was why the *AER* and *QJE* got rid of it in 2004 and 2011, respectively.
 - ▶ Referees were remarkably good at guessing the identity of authors before the internet, too (Blank, 1991).
- ▶ Conclusions:
 - ▶ Fields like economics (*long* review times, culture of presenting, disseminating and publicising working papers) probably can't rely on double-blind review to counteract bias.
 - ▶ Fields not like economics (short review times and culture of not releasing results until publication), may have more luck.

Causal impact of discrimination: theory

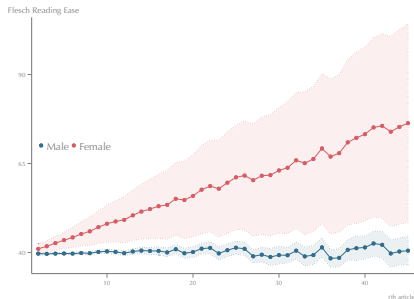
Why does peer review cause women to write more clearly?

Possibility 1 Women voluntarily write better papers—e.g., they're more sensitive to referee criticism.

Possibility 2 Better written papers are women's response to higher standards imposed by referees and/or editors.

- ▶ Model an author's decision making process within a subjective expected utility framework.
- ▶ Establish 3 sufficient conditions that distinguish Possibility 1 from Possibility 2.
 1. Experienced women write better than equivalent men.
 2. Women improve their writing over time.
 3. Female-authored papers are accepted no more often than equivalent male-authored papers.

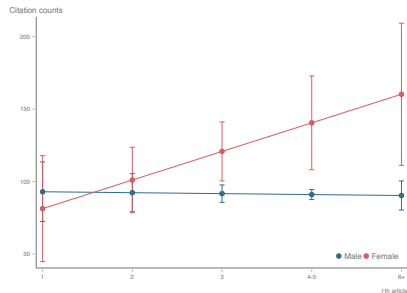
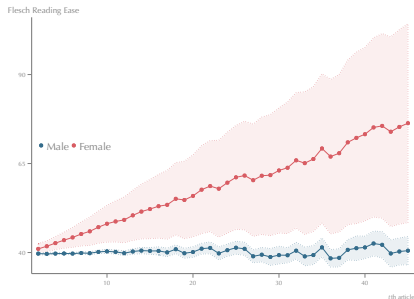
Causal impact of discrimination: evidence (I)



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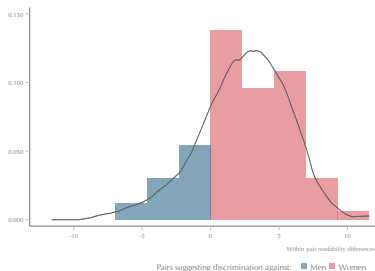
1. Experienced female economists are cited more than equivalent male economists.
2. Women increase citation counts over time.

No female advantage in acceptance rates (Ceci et al., 2014).

Causal impact of discrimination: evidence (II)

- ▶ Use a matching estimator to account for the fact that each condition must hold for the same author in two different situations:
 - ▶ Before and after gaining experience.
 - ▶ When compared to an equivalent, experienced author of the opposite gender.
- ▶ Matches based on ten observable characteristics: primary *JEL* category, citation counts, decade, institution, *etc.*

- ▶ Evidence of discrimination in 60–70 percent of matched pairs.
 - ▶ Subtracted experienced male scores from experienced female scores within each of these matched pairs.



Prolonged peer review

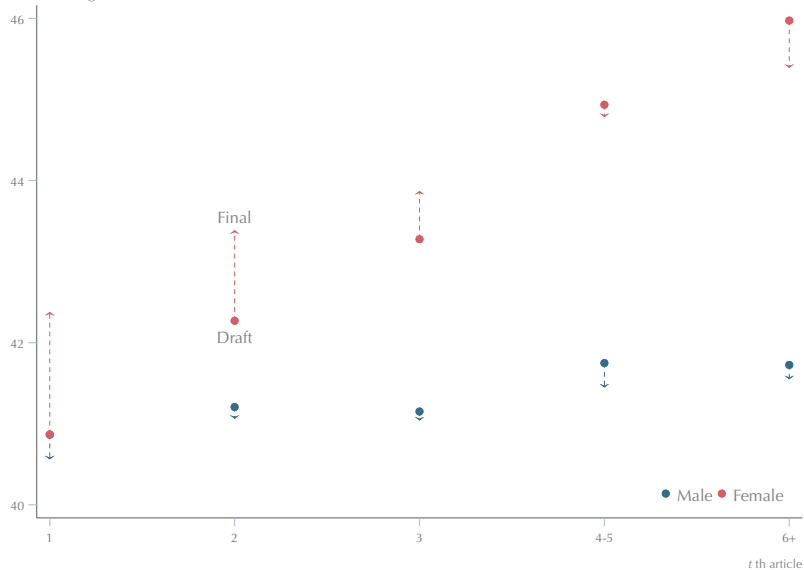
	(1)	(2) ^a	(3)	(4)	(5)	(6)
Female ratio	5.29** (2.01)	6.63*** (2.16)	6.64*** (2.14)	5.54*** (2.05)	6.65*** (2.15)	8.80*** (2.72)
Max. t_j	-0.16** (0.07)	-0.17** (0.07)	-0.17** (0.07)	-0.16** (0.07)	-0.16** (0.07)	-0.17* (0.09)
No. pages	0.18*** (0.03)	0.18*** (0.03)	0.18*** (0.03)	0.18*** (0.03)	0.18*** (0.03)	0.21*** (0.04)
N	1.02** (0.44)	0.97** (0.44)	0.96** (0.44)	1.01** (0.44)	0.97** (0.44)	1.149 (0.70)
Order	0.22** (0.09)	0.22** (0.09)	0.22** (0.09)	0.22** (0.09)	0.22** (0.09)	0.50** (0.22)
No. citations	0.00 (0.000)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	-0.00*** (0.00)
Mother			-6.66** (2.68)		-10.93*** (3.21)	-17.67*** (3.29)
Birth				-2.25 (3.36)	7.58* (4.17)	12.34** (5.59)
Constant	37.71*** (2.04)	37.60*** (2.08)	37.79*** (2.05)	37.69*** (2.05)	37.89*** (2.06)	14.85*** (2.79)
Editor effects	✓	✓	✓	✓	✓	✓
Year effects	✓	✓	✓	✓	✓	✓
Institution effects	✓	✓	✓	✓	✓	✓
<i>JEL</i> (primary) effects						✓
No. observations	2,626	2,610	2,626	2,626	2,626	1,281

Notes. Sample 2,626 articles. Standard errors clustered by year in parentheses. ***, ** and * statistically significant at 1%, 5% and 10%.

^a Excludes papers authored only by women who gave birth (9 articles) and/or had a child younger than five (16 articles) during peer review.

Responses to higher standards

Flesch Reading Ease



Conclusions for academia

Implications for measuring productivity

- ▶ Women may produce better quality output. . .
- ▶ But quality costs time, so women produce less.
- ▶ Women appear less productive than they actually are.

“Publishing Paradox” may not be so paradoxical. . .

Quantity vs. quality tradeoff elsewhere...

1. Lower quantity

- ▶ Female academics publish fewer academic articles (Ceci et al., 2014).
- ▶ Female physicians see fewer patients (Bloor et al., 2008) and submit fewer grant proposals (Waisbren et al., 2008; Gordon et al., 2009).
- ▶ Female novelists produce less non-fiction output (Crozier, 1999).
- ▶ Female reporters write fewer front-page bylines (Klos, 2014).
- ▶ Female real estate agents list fewer homes (Trulia.com, 2011).

2. (Unrewarded) Higher quality

Quantity vs. quality tradeoff elsewhere. . .

1. Lower quantity
2. (Unrewarded) Higher quality
 - ▶ Female students earn better grades (Voyer and Voyer, 2014).
 - ▶ Female auditors are more accurate and efficient (Chung and Monroe, 2001; O'Donnell and Johnson, 2001; Niskanen et al., 2011; Ittonen et al., 2013).
 - ▶ Congresswomen secure more federal funding for their districts, sponsor more legislation and score higher on a composite measure of legislative effectiveness (Anzia and Berry, 2011; Volden et al., 2013);
 - ▶ Houses listed by female real estate agents sell for higher prices (Salter et al., 2012; Seagraves and Gallimore, 2013);
 - ▶ Patients treated by female physicians are less likely to die or be readmitted to hospital (Tsugawa et al., 2017).
 - ▶ Female pilots are involved in fewer fatal accidents (Vail and Ekman, 1986; Bazargan and Guzhva, 2011).

Conclusions beyond academia

- ▶ May explain lower female productivity in a variety of high-skilled professions, e.g., female lawyers (Azmat and Ferrer, 2017).
- ▶ Suggests wage equations that control for unadjusted performance indicators may underestimate labour market discrimination.
- ▶ Efforts to increase female productivity (flexible hours, sharing household responsibilities) will have a limited effect on breaking the “glass ceiling”.

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