Effect size and power

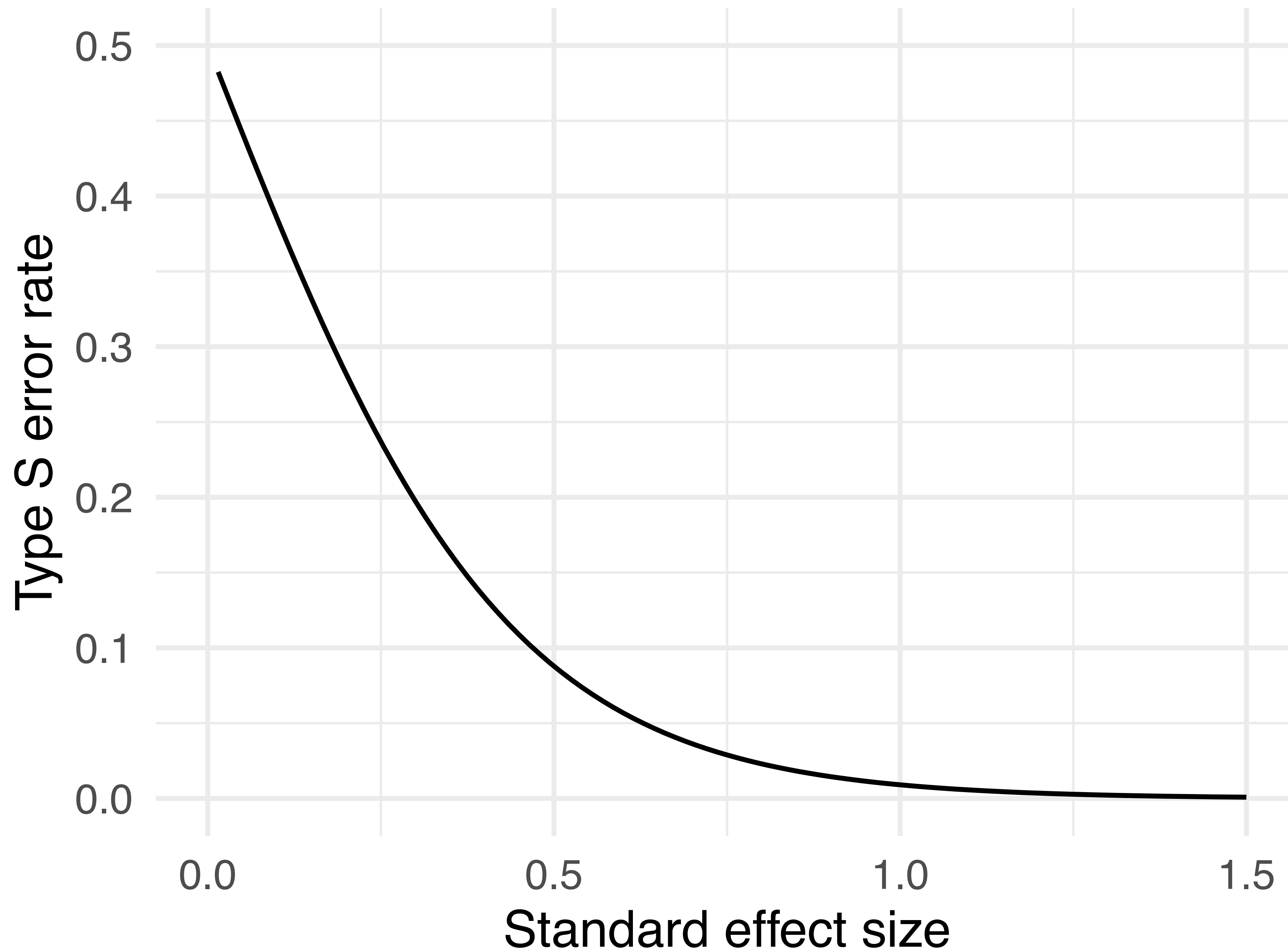
Exercise

Let $X \sim N(\mu, 1)$ and suppose you are testing

$$H_0 : \mu = 0 \text{ vs. } H_A : \mu \neq 0.$$

- Suppose the true $\mu > 0$.
- Conditional on rejecting H_0, what is the probability that $X < 0$?
- (In other words, that your reported estimate does even have the correct sign).

```r
p.type.S <- function(mu) {
  a <- pnorm(-1.96, mean=mu)
  b <- 1 - pnorm(1.96, mean=mu)
  a / (a+b)
}
```



Type S error

- In the preceding plot, μ was the standardized effect size.
- For effect sizes in the $.1\sigma - .2\sigma$ range, there is a 30-40% chance that a statistically significant finding **does not even get the sign correct**.
- This is referred to as *Type S* error.

Gelman, Andrew, and John Carlin. 2014. “Beyond Power Calculations: Assessing Type S (sign) and Type M (magnitude) Errors.” *Perspectives on Psychological Science: A Journal of the Association for Psychological Science* 9 (6): 641–51.

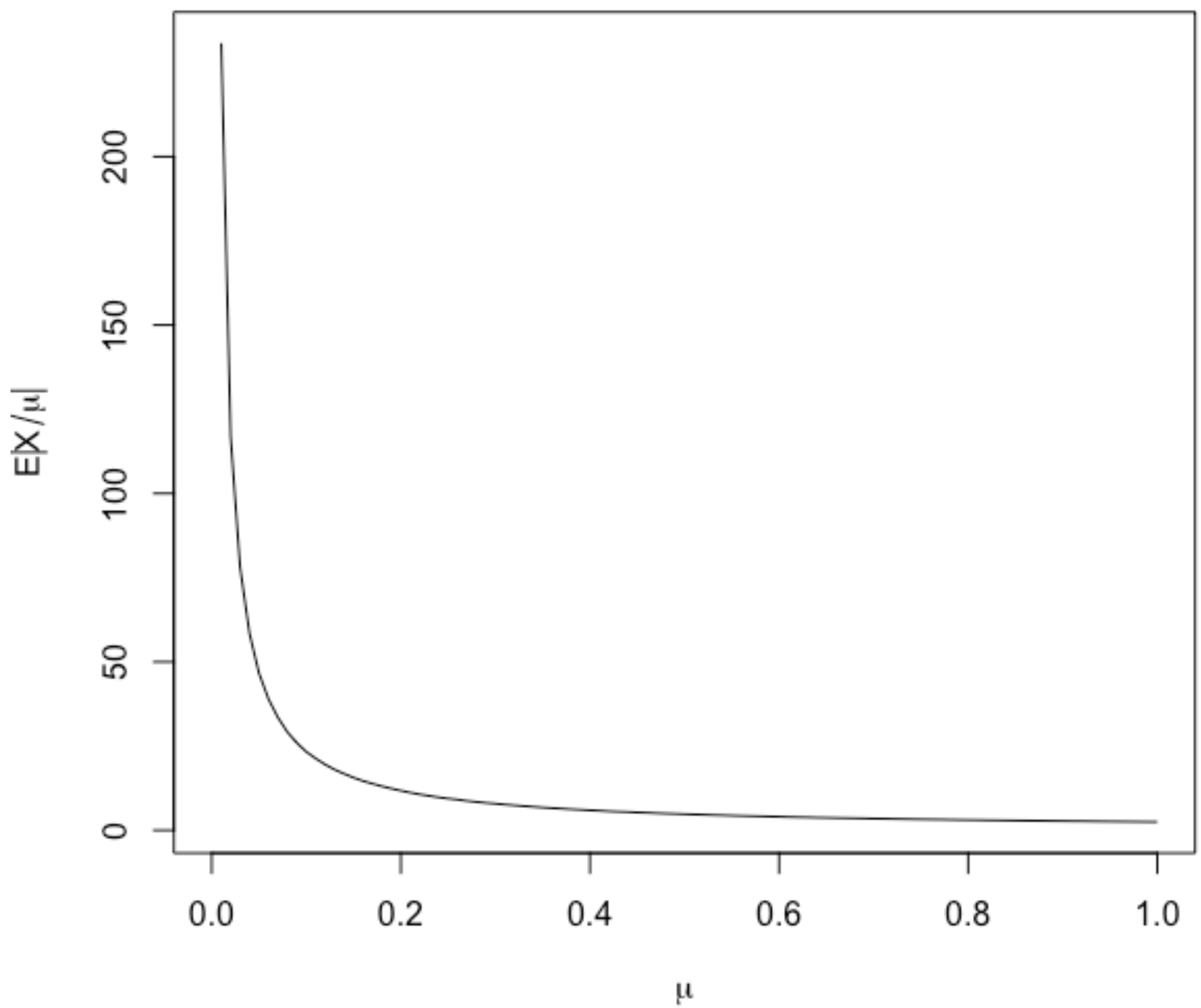
Exercise

Let $X \sim N(\mu, 1)$ and suppose you are testing

$$H_0 : \mu = 0 \text{ vs. } H_A : \mu \neq 0.$$

- Suppose the true $\mu > 0$.
- Conditional on rejecting H_0, what is the expected value of $|X/\mu|$?
- i.e. compute $\mathbb{E}_\mu(|X/\mu| \mid \text{reject } H_0)$

```r
E.type.M <- function(mu) {
  X <- rnorm(n=10000) + mu
  sig <- abs(X) > 1.96
  mean(abs(X[sig]/mu))
}
```



Type M error

- Gelman & Carlin refer to this as the “exaggeration ratio”.
- Low-powered experiments will tend to drastically inflate effect sizes.

Typical effect sizes

- What sort of effect sizes do we expect to see in practice?
- Much depends on your field, but generally, the effect size is often smaller than you (the researcher) ~~hope~~ expect.
- The literature can offer a guide:
- "There is a large literature on variation in the sex ratio of human births, and the effects that have been found have been on the order of 1 percentage point (for example, the probability of a girl birth shifting from 48.5 percent to 49.5 percent). Variation attributable to factors such as race, parental age, birth order, maternal weight, partnership status and season of birth is estimated at from less than 0.3 percentage points to about 2 percentage points, with larger changes (as high as 3 percentage points) arising under economic conditions of poverty and famine. That extreme deprivation increases the proportion of girl births is no surprise, given reliable findings that male fetuses (and also male babies and adults) are more likely than females to die under adverse conditions. (Gelman & Weakliem, 2009, p. 312)"

Exercise

- Kanazawa reported an effect size of 8% with $p = 0.015$.
- What is the standard error?
- Suppose the true (standard) effect size is {.1, 1}:
  - What is the power?
  - What is the probability of a type S error?
  - What is the expected exaggeration ratio?

Are most research findings false?

The smaller the studies conducted in a scientific field, the less likely the research findings are to be true.

The smaller the effect sizes in a scientific field, the less likely the research findings are to be true.

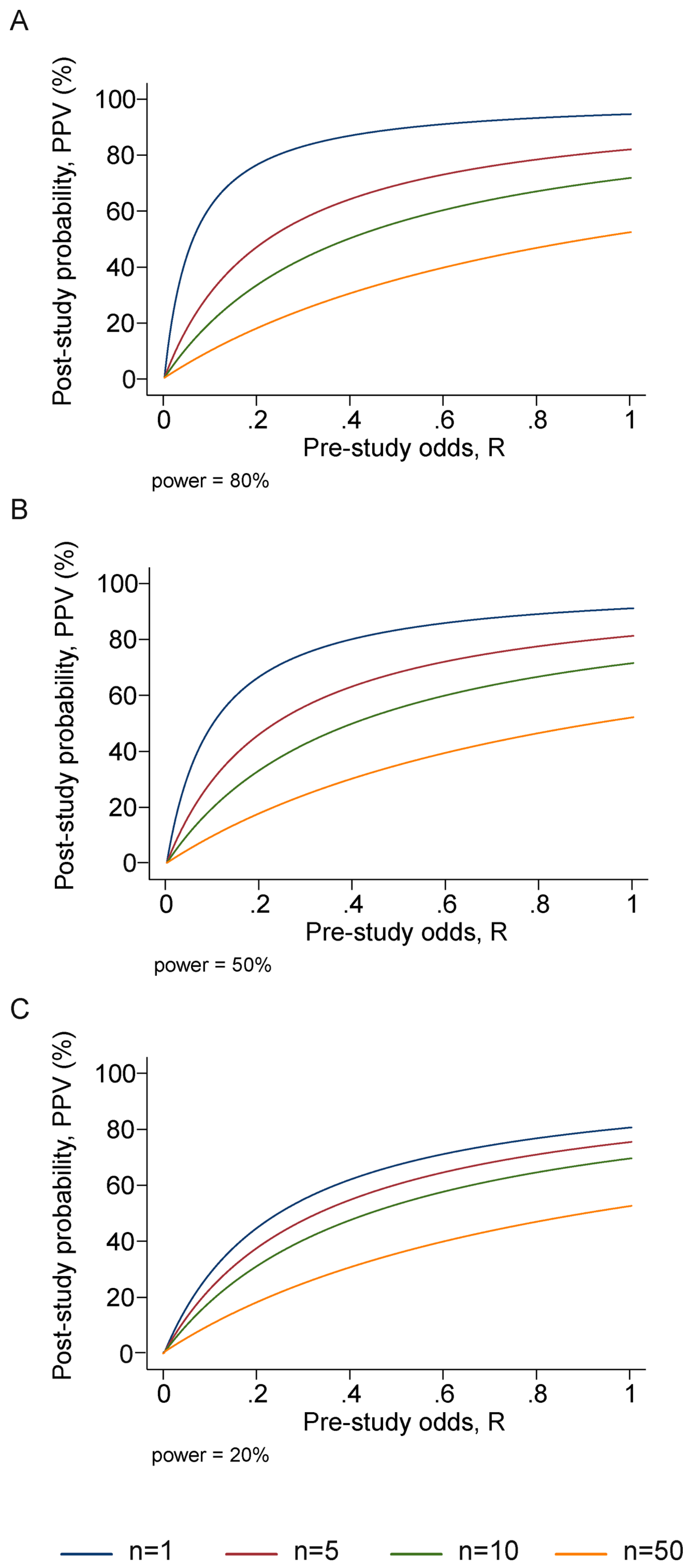
The greater the number and the lesser the selection of tested relationships in a scientific field, the less likely the research findings are to be true.

The greater the flexibility in designs, definitions, outcomes, and analytical modes in a scientific field, the less likely the research findings are to be true.

The greater the financial and other interests and prejudices in a scientific field, the less likely the research findings are to be true.

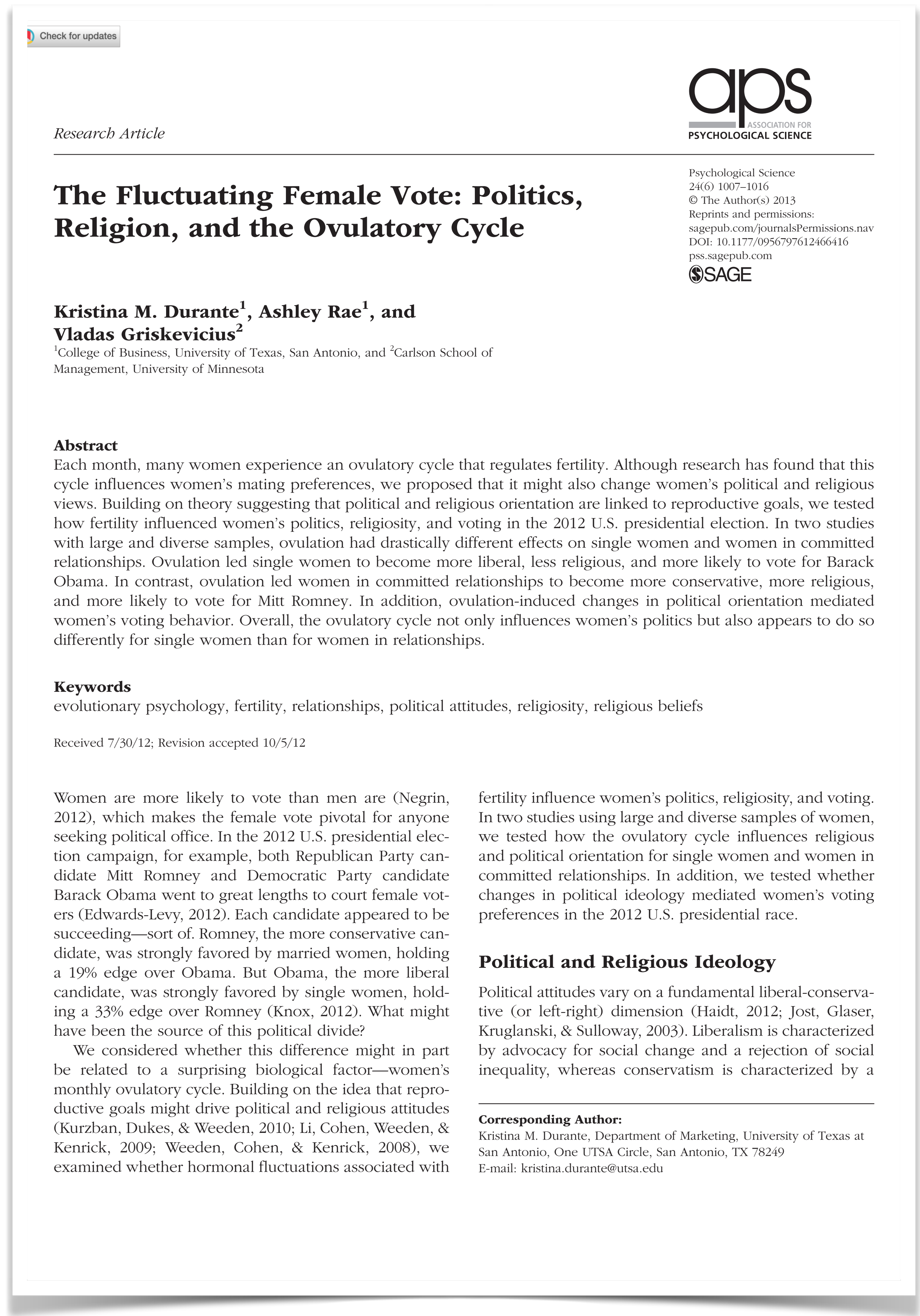
The hotter a scientific field (with more scientific teams involved), the less likely the research findings are to be true.

$$
\begin{aligned}
\text{PPV} &= \frac{R(1-\beta^n)}{R+1-(1-\alpha)^n - R\beta^n} \\
&= \frac{\frac{R}{1+R}(1-\beta^n)}{1-\frac{(1-\alpha)^n}{R+1} - \frac{R}{R+1}\beta^n} \\
&= \frac{P(\text{at least one true finding})}{P(\text{at least one finding})}
\end{aligned}
$$



Durante et al. (2013)

- During the fertile phase of their menstrual cycle:
  - Single women were more likely to be politically liberal and less likely to be religious.
  - Women in relationships were more likely to be conservative.
  - Hypothesis: fertility might be influencing behavior to increase reproductive success.
- Thoughts?



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The Fluctuating Female Vote: Politics, Religion, and the Ovulatory Cycle

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Abstract
Each month, many women experience an ovulatory cycle that regulates fertility. Although research has found that this cycle influences women's mating preferences, we proposed that it might also change women's political and religious views. Building on theory suggesting that political and religious orientation are linked to reproductive goals, we tested how fertility influenced women's politics, religiosity, and voting in the 2012 U.S. presidential election. In two studies with large and diverse samples, ovulation had drastically different effects on single women and women in committed relationships. Ovulation led single women to become more liberal, less religious, and more likely to vote for Barack Obama. In contrast, ovulation led women in committed relationships to become more conservative, more religious, and more likely to vote for Mitt Romney. In addition, ovulation-induced changes in political orientation mediated women's voting behavior. Overall, the ovulatory cycle not only influences women's politics but also appears to do so differently for single women than for women in relationships.

Keywords
evolutionary psychology, fertility, relationships, political attitudes, religiosity, religious beliefs

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Women are more likely to vote than men are (Negrin, 2012), which makes the female vote pivotal for anyone seeking political office. In the 2012 U.S. presidential election campaign, for example, both Republican Party candidate Mitt Romney and Democratic Party candidate Barack Obama went to great lengths to court female voters (Edwards-Levy, 2012). Each candidate appeared to be succeeding—sort of. Romney, the more conservative candidate, was strongly favored by married women, holding a 19% edge over Obama. But Obama, the more liberal candidate, was strongly favored by single women, holding a 33% edge over Romney (Knox, 2012). What might have been the source of this political divide?

We considered whether this difference might in part be related to a surprising biological factor—women's monthly ovulatory cycle. Building on the idea that reproductive goals might drive political and religious attitudes (Kurzban, Dukes, & Weeden, 2010; Li, Cohen, Weeden, & Kenrick, 2009; Weeden, Cohen, & Kenrick, 2008), we examined whether hormonal fluctuations associated with fertility influence women's politics, religiosity, and voting. In two studies using large and diverse samples of women, we tested how the ovulatory cycle influences religious and political orientation for single women and women in committed relationships. In addition, we tested whether changes in political ideology mediated women's voting preferences in the 2012 U.S. presidential race.

Political and Religious Ideology

Political attitudes vary on a fundamental liberal-conservative (or left-right) dimension (Haidt, 2012; Jost, Glaser, Kruglanski, & Sulloway, 2003). Liberalism is characterized by advocacy for social change and a rejection of social inequality, whereas conservatism is characterized by a

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Criticisms

Causality

Abstract

Each month, many women experience an ovulatory cycle that regulates fertility. Although research has found that this cycle influences women's mating preferences, we proposed that it might also change women's political and religious views. Building on theory suggesting that political and religious orientation are linked to reproductive goals, we tested how fertility influenced women's politics, religiosity, and voting in the 2012 U.S. presidential election. In two studies with large and diverse samples, ovulation had drastically different effects on single women and women in committed relationships. Ovulation led single women to become more liberal, less religious, and more likely to vote for Barack Obama. In contrast, ovulation led women in committed relationships to become more conservative, more religious, and more likely to vote for Mitt Romney. In addition, ovulation-induced changes in political orientation mediated women's voting behavior. Overall, the ovulatory cycle not only influences women's politics but also appears to do so differently for single women than for women in relationships.

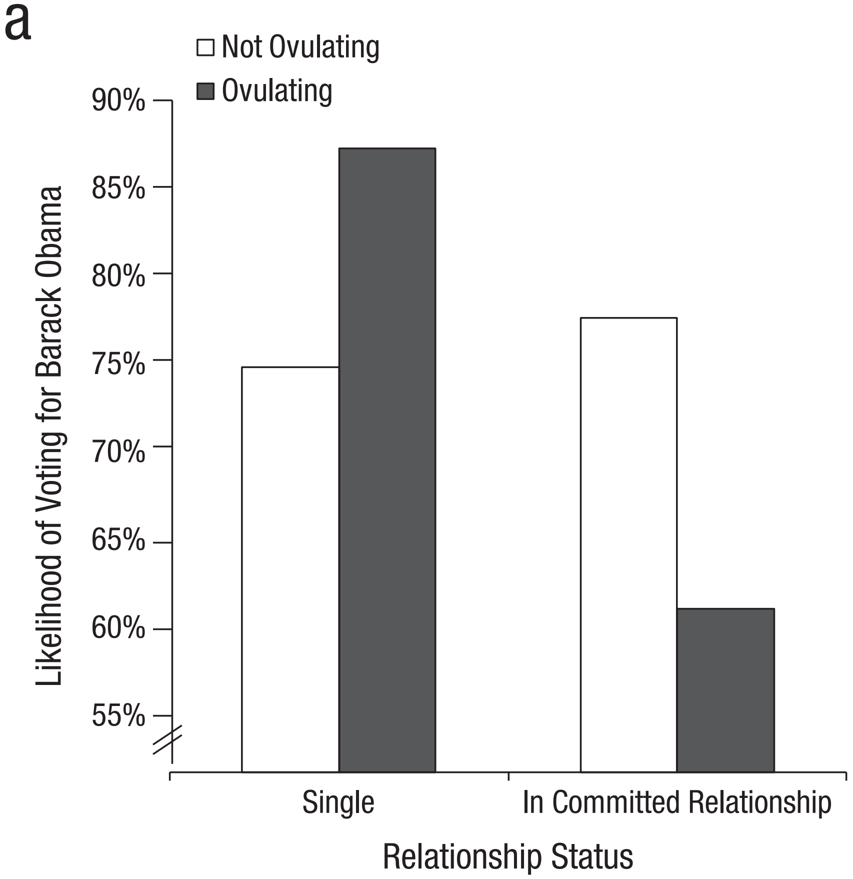
- Language strongly suggests of causality.
- Does the paper establish that?
- Does the paper compare the same women at different stages of their cycle?

Criticisms

Effect sizes

- Raw effect sizes of ~17% were reported.
- (Can you think of an intervention that would make a person 17% more likely to vote for the other side?)
- The std. effect size here is qt$(1 - .035/2, 134) = 2.1.$
- $s = 17\,\%/2.1 = 8.1\,\%$.

a



Voting preferences. Single women were more likely to vote for Barack Obama (79.3%) than were women in relationships (69.4%), $\chi^2(1, N = 502) = 3.88$, $p = .049$. However, a logistic regression revealed that this main effect was qualified by a Fertility × Relationship Status interaction, $b = -1.62$, Wald(1) = 8.35, $p = .004$. Single women were more likely to vote for Obama if they were in the high-fertility group (86.5%) than if they were in the low-fertility group (73.7%), $\chi^2(1, N = 169) = 4.15$, $p = .042$, $d = 0.32$. Women in relationships, however, were more likely to vote for Romney at if they were in the high-fertility group ($M = 40.4\%$) than if they were in the low-fertility group (23.4%), $\chi^2(1, N = 134) = 4.44$, $p = .035$, $d = 0.37$ (see Fig. 4a).