

Supporting Information

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SI Text

Demographic Differences in VMP. In study 2, we found substantial differences in how vulnerable different demographic groups were to SEME. Although the groups we examined are somewhat arbitrary, overlapping, and by no means definitive, they do establish a range of vulnerability to SEME. Ten groups ($n \geq 50$) that appeared to be highly vulnerable in study 2, as indicated by their VMP scores, were, in order from highest to lowest, as follows:

- i) Moderate Republicans (80.0%; 95% CI, 62.5–97.5%)
- ii) People from North Carolina (66.7%; 95% CI, 42.8–90.5%)
- iii) Moderate Libertarians (73.3%; 95% CI, 51–95.7%)
- iv) Male Republicans (66.1%; 95% CI, 54–78.2%)
- v) Female conservatives age 30 and over (67.7%; 95% CI, 52.5–82.7%)
- vi) People from Virginia (60.0%; 95% CI, 38.5–81.5%)
- vii) People earning between \$15,000 and \$19,999 (60.0%; 95% CI, 42.5–77.5%)
- viii) Hispanics (59.4%; 95% CI, 42.4–76.4%)
- ix) Independents with no political leaning (58.3%; 95% CI, 38.6–78.1%)
- x) Female conservatives (54.7%; 95% CI, 41.3–68.1%)

Ten groups that appeared to show little vulnerability to SEME, as indicated by their VMP scores, were, in order from highest to lowest, as follows:

- i) People from California (24.1%; 95% CI, 15.1–33.1%)
- ii) Moderate independents (24.0%; 95% CI, 15.4–32.5%)
- iii) Liberal independents (23.4%; 95% CI, 13.1–33.8%)
- iv) People from Texas (22.9%; 95% CI, 11–34.8%)
- v) Liberal Libertarians (22.7%; 95% CI, 5.2–40.2%)
- vi) People earning between \$40,000 and \$49,999 (22.5%; 95% CI, 13.8–31.1%)
- vii) Female independents (22.0%; 95% CI, 13.5–30.5%)
- viii) Male moderates age 30 and over (19.3%; 95% CI, 9.1–29.5%)
- ix) Female independent moderates (17.9%; 95% CI, 13.5–30.5%)
- x) People with an uncommon political party (15.0%; 95% CI, –0.6% to 30.6%)

In study 3, as in study 2, we found substantial differences in how vulnerable different demographic groups were to SEME. Although the groups we examined are somewhat arbitrary, overlapping, and by no means definitive, they do establish a range of vulnerability to SEME. Ten groups ($n \geq 50$) that appeared to be highly vulnerable in study 3, as indicated by their VMP scores, were, in order from highest to lowest, as follows:

- i) Unemployed males from Kerala (72.7%; 95% CI, 46.4–99.1%)
- ii) Unemployed Christians (68.8%; 95% CI, 46.0–91.5%)
- iii) Unemployed moderate males (50.0%; 95% CI, 33.2–66.8%)
- iv) Moderate Christian males (47.6%; 95% CI, 26.3–69.0%)
- v) Christian moderates (42.9%; 95% CI, 26.5–59.3%)
- vi) Males from Kerala (40.4%; 95% CI, 26.4–54.5%)
- vii) Unemployed moderates (33.3%; 95% CI, 22.0–44.7%)
- viii) Male Christians (32.7%; 95% CI, 19.9–45.4%)
- ix) People from Kerala (32.4%; 95% CI, 21.8–43.1%)
- x) Unemployed females with no political ideology (31.6%; 95% CI, 10.7–52.5%)

Ten groups that appeared to show little vulnerability to SEME, as indicated by their VMP scores, were, in order from highest to lowest, as follows:

- i) People from Tamil Nadu with no political ideology (0.0%; 95% CI, –0.01%–0.04%)
- ii) Employed females with no political ideology (0.0%; 95% CI, –0.01%–0.06%)
- iii) People earning between Rs 10,000 and Rs 29,999 (–3.2%; 95% CI, –7.6%–1.3%)
- iv) Married people who are separated (–3.3%; 95% CI, –10.0%–3.3%)
- v) People with a pre-university education (–4.3%; 95% CI, –10.5%–1.81%)
- vi) Unemployed liberals (–4.3%; 95% CI, –10.5%–1.81%)
- vii) Unemployed conservatives (–5.0%; 95% CI, –15.0%–5.0%)
- viii) People from Gujarat (–5.9%; 95% CI, –17.8%–6.0%)
- ix) Unemployed male liberals (–8.0%; 95% CI, –19.5%–3.5%)
- x) Female conservatives (–11.8%; 95% CI, –29.0%–5.5%)

Bias Awareness. Subjects were counted as showing awareness of the manipulation if (i) they had clicked on a box indicating that something “bothered” them about the rankings and (ii) we found specific terms or phrases in their open-ended comments suggesting that they were aware of bias in the rankings, such as “biased,” “bias,” “leaning towards,” “leaning toward,” “leaning against,” “slanted,” “skewed,” “favorable towards,” “favorable toward,” “favorable for,” “favorable against,” “favorable results,” “favored towards,” “favored toward,” “favored for,” “favored against,” “favored results,” “favor toward,” “results favor,” “favor Modi,” “favor Kejriwal,” “favor Gandhi,” “negative toward,” “negative for,” “negative against,” “all negative,” “all positive,” “mainly negative,” “mainly positive,” “nothing positive,” “nothing negative,” “more results for,” “less results for,” “most of the articles were negative,” “most of the articles were positive,” “pro Modi,” “pro Kejriwal,” “pro Gandhi,” “Modi leaning,” “Kejriwal leaning,” “Gandhi leaning,” “pro Gillard,” “pro Abbott,” “favor Gillard,” “favor Abbott,” “Gillard leaning,” and “Abbott leaning.”

Derivation of the Formulas for Computing W , the Maximum Win Margin Controllable Through SEME, in Two- and Three- Person Races.

Two-person race. Where T = total number of eligible voters in a population, i = proportion of T who are internet users, u = proportion of i who are undecided, p = proportion of u who are prone to vote for the target candidate, and VMP = proportion of p who can be shifted by SEME.

The number of votes that can be shifted by SEME is given by

$$n = T * i * u * p * \text{VMP}.$$

In a two-person race, the number of votes for the candidate favored by SEME when the vote is initially evenly split is

$$\frac{T}{2} + n,$$

and the number of votes for the losing candidate is

$$\frac{T}{2} - n.$$

The vote margin in favor of the winning candidate is therefore the larger vote minus the smaller vote, or, simply: $2n$.

Therefore, the margin of voters, expressed as a proportion, that can be shifted by SEME is

$$\frac{2n}{T} = \frac{2 * T * i * u * p * VMP}{T} = 2 * i * u * p * VMP.$$

Because the undecided voters in a two-person race have only two voting options, the value of p before outside influence is exercised can reasonably be assumed to be 0.5.

Therefore, W can be calculated as follows:

$$W = 2 * i * u * 0.5 * VMP,$$

and the calculation can be simplified as follows:

$$W = i * u * VMP.$$

In other words, the maximum win margin controllable by SEME in a two-person race is equal to the proportion of people who can be influenced by SEME (the VMP) times the proportion of undecided Internet voters in the population. ($i * u$).

Three-person race. Where T = total number of voters in a population, i = proportion of T who are internet users, u = proportion of i who are undecided, p = proportion of u who are prone to vote for the target candidate, and VMP = proportion of p who can be shifted by SEME.

The number of votes that can be shifted by SEME is given by

$$n = T * i * u * p * VMP.$$

In a three-person race, because the winning candidate can draw votes from either of the two losing candidates, W can vary between two extremes:

- i) At one extreme, one of the two losing candidates draws zero votes, in which case the formula for the two-person case (above) is applicable.

- ii) At the other extreme, voting preferences are initially split three ways evenly, and the winning candidate draws votes equally from the other two. This distribution will give us the lowest possible value of W in the three-person race, as follows.

The number of votes for the candidate favored by SEME will still be

$$\frac{T}{2} + n.$$

However, because of the split, the number of votes for each of the losing candidates will now be

$$\frac{T}{2} - \frac{n}{2}.$$

The vote margin in favor of the winning candidate will therefore be the larger vote minus either of the smaller votes or, simply, $1.5n$.

Therefore, the margin of voters, expressed as a proportion, that can be shifted by SEME is

$$\frac{2n}{T} = \frac{1.5 * T * i * u * p * VMP}{T} = 1.5 * i * u * p * VMP.$$

Therefore, W can be calculated as follows:

$$W = 1.5 * i * u * 0.5 * VMP,$$

and the calculation can be simplified as follows:

$$W = 0.75 * i * u * VMP.$$

Therefore, in a three-person race, W will vary between 75% and 100% of the W found in the two-person case, depending on how votes are distributed between the two losing candidates; the more even the split, the smaller the controllable win margin.

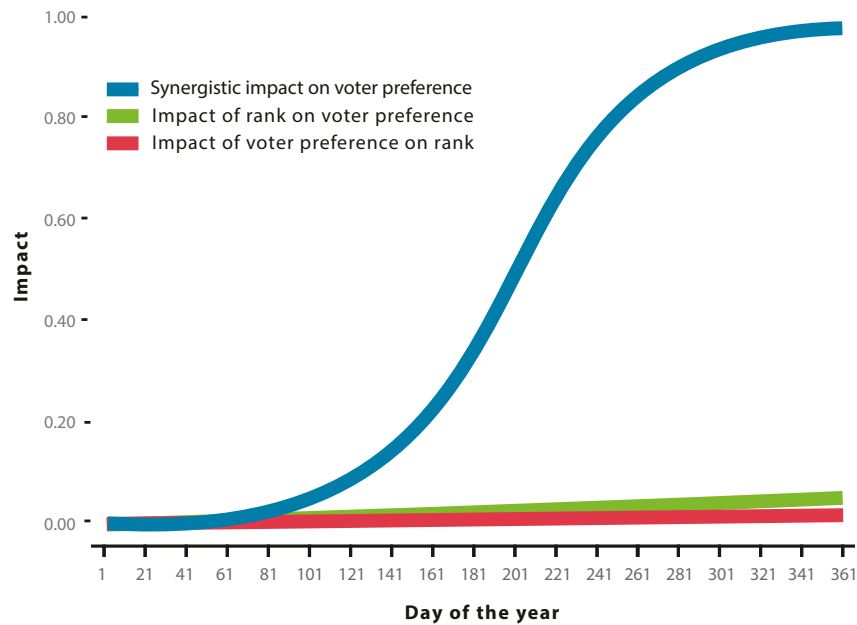


Fig. S1. A possible synergistic relationship between the impact that search rankings have on voter preferences and the impact that voter preferences have on search rankings. The lower curves (red and green) show slow increases that might occur if each of the processes acted alone over the course of a year (365 iterations of the model). The upper curve (blue) shows the result of a possible synergy between these two processes using the same parameters that generated the two lower curves. The curves are generated by an iterative model using equations of the general form $V_{n+1} = V_n + r[R_n \times (1 - V_n)] + r[O_n \times (1 - V_n)]$, where V is voter preference for one candidate, R is the impact of voter preferences on search rankings, O is the impact (randomized with each iteration) of other influences on voter preferences, and r is a rate-of-change factor. Because a change in voter preference alters the proportion of votes available, its value in the model cannot exceed 1.0.

Table S2. Voting preferences by group for study 1

Experiment	Voting preferences	Mean (SE)			Kruskal–Wallis (χ^2)	Mann–Whitney u
		Group 1 (Gillard bias)	Group 2 (Abbott bias)	Group 3 (control)		
1	PreImpressionAbbott	8.09 (0.34)	7.74 (0.40)	7.41 (0.26)	3.979	525.0
	PreImpressionGillard	7.06 (0.42)	7.47 (0.35)	6.88 (0.32)	1.395	529.5
	PreTrustAbbott	7.82 (0.31)	7.85 (0.39)	7.35 (0.28)	3.275	538.5
	PreTrustGillard	6.38 (0.40)	7.56 (0.30)	6.88 (0.32)	5.213	407.0
	PreLikeAbbott	6.06 (0.52)	5.68 (0.47)	5.79 (0.38)	0.296	538.5
	PreLikeGillard	5.29 (0.48)	5.76 (0.41)	5.29 (0.37)	1.335	500.0
	PostImpressionAbbott	4.24 (0.49)	7.29 (0.51)	5.85 (0.38)	19.029***	252.0***
	PostImpressionGillard	7.26 (0.45)	4.71 (0.47)	5.65 (0.46)	14.667**	286.0**
	PostTrustAbbott	4.59 (0.43)	7.32 (0.51)	6.15 (0.38)	18.385***	260.5***
	PostTrustGillard	6.91 (0.42)	4.97 (0.43)	6.15 (0.40)	10.809**	326.5**
2	PostLikeAbbott	3.88 (0.43)	6.24 (0.58)	5.18 (0.42)	11.026**	341.5**
	PostLikeGillard	5.68 (0.49)	4.15 (0.45)	5.41 (0.42)	5.836	403.0*
	PreImpressionAbbott	6.76 (0.43)	7.50 (0.34)	6.76 (0.44)	1.761	477.0
	PreImpressionGillard	6.50 (0.36)	7.29 (0.43)	6.12 (0.45)	4.369	449.5
	PreTrustAbbott	6.41 (0.44)	7.12 (0.30)	7.32 (0.44)	2.700	499.0
	PreTrustGillard	6.56 (0.41)	7.32 (0.36)	6.35 (0.43)	3.094	465.0
	PreLikeAbbott	5.56 (0.46)	5.65 (0.43)	5.76 (0.49)	0.170	575.0
	PreLikeGillard	5.79 (0.44)	5.79 (0.48)	5.47 (0.45)	0.306	568.0
	PostImpressionAbbott	3.79 (0.41)	7.15 (0.49)	5.24 (0.48)	20.878***	226.5***
	PostImpressionGillard	7.35 (0.39)	4.79 (0.47)	6.00 (0.38)	15.270***	279.5***
3	PostTrustAbbott	3.82 (0.40)	7.18 (0.47)	5.53 (0.51)	21.917***	207.5***
	PostTrustGillard	7.32 (0.41)	4.97 (0.46)	6.18 (0.36)	13.410**	302.0**
	PostLikeAbbott	3.91 (0.42)	6.09 (0.53)	5.56 (0.48)	9.822**	353.0**
	PostLikeGillard	6.68 (0.45)	4.29 (0.48)	5.79 (0.40)	12.905**	311.5**
	PreImpressionAbbott	7.24 (0.39)	7.18 (0.39)	7.88 (0.27)	1.346	568.5
	PreImpressionGillard	6.12 (0.43)	7.09 (0.39)	7.26 (0.34)	4.134	452.0
	PreTrustAbbott	7.18 (0.35)	6.41 (0.41)	7.53 (0.32)	3.837	478.0
	PreTrustGillard	6.65 (0.38)	6.68 (0.40)	6.97 (0.33)	0.259	568.5
	PreLikeAbbott	6.59 (0.42)	5.94 (0.39)	6.59 (0.43)	2.301	491.0
	PreLikeGillard	5.85 (0.46)	5.85 (0.43)	6.26 (0.41)	1.065	576.5
	PostImpressionAbbott	5.29 (0.48)	6.82 (0.41)	6.26 (0.48)	5.512	384.0*
	PostImpressionGillard	6.50 (0.45)	5.47 (0.43)	6.21 (0.48)	3.027	445.5
	PostTrustAbbott	5.38 (0.49)	6.85 (0.45)	6.47 (0.47)	5.091	399.0*
	PostTrustGillard	6.44 (0.45)	5.76 (0.47)	6.29 (0.44)	1.365	493.0
	PostLikeAbbott	5.29 (0.48)	6.03 (0.48)	5.79 (0.53)	1.129	487.0
	PostLikeGillard	6.12 (0.47)	5.26 (0.54)	6.09 (0.51)	1.475	491.5

* $P < 0.05$; ** $P < 0.01$; and *** $P < 0.001$: Kruskal–Wallis tests were conducted between all three groups, and Mann–Whitney u tests were conducted between groups 1 and 2. Preferences were measured for each candidate separately on 10-point Likert scales.

Table S3. Voting preferences by group for study 2

Voting preferences	Mean (SE)			Kruskal–Wallis (χ^2)	Mann–Whitney u
	Group 1 (Gillard bias)	Group 2 (Abbott bias)	Group 3 (control)		
PreImpressionAbbott	7.40 (0.07)	7.36 (0.08)	7.37 (0.07)	0.458	241,861.5
PreImpressionGillard	7.13 (0.07)	7.12 (0.08)	7.13 (0.07)	0.081	243,115.0
PreTrustAbbott	7.26 (0.07)	7.22 (0.08)	7.18 (0.07)	0.954	241,924.5
PreTrustGillard	6.95 (0.07)	6.89 (0.08)	6.92 (0.07)	0.222	241,779.0
PreLikeAbbott	6.42 (0.08)	6.39 (0.08)	6.23 (0.08)	2.987	243,677.5
PreLikeGillard	6.24 (0.08)	6.30 (0.08)	6.11 (0.08)	3.178	239,556.0
PostImpressionAbbott	4.61 (0.09)	6.88 (0.09)	5.53 (0.09)	289.065***	120,660.0***
PostImpressionGillard	6.87 (0.08)	4.95 (0.09)	6.21 (0.09)	237.034***	133,106.5***
PostTrustAbbott	4.56(0.10)	6.94 (0.09)	5.57 (0.10)	281.560***	121,786.5***
PostTrustGillard	6.84 (0.09)	4.95 (0.09)	6.19 (0.09)	221.709***	136,689.0***
PostLikeAbbott	4.55 (0.09)	6.31 (0.09)	5.21 (0.09)	177.225***	146,957.0***
PostLikeGillard	6.34(0.09)	4.64 (0.09)	5.71 (0.09)	176.066***	147,372.5***

*** $P < 0.001$: Kruskal–Wallis tests were conducted between all three groups, and Mann–Whitney u tests were conducted between groups 1 and 2. Preferences were measured for each candidate separately on 10-point Likert scales.

Table S4. Treatment effect estimates for study 2 voting preferences

Predictor variable	Presearch vote		Postsearch vote	
	Coefficient	SE	Coefficient	SE
Intercept	−0.073	0.540	0.062	0.543
Sex				
Female	0	Referent	0	Referent
Male	0.039	0.110	−0.135	0.119
Other	−0.430	0.922	−0.568	0.924
Race/ethnicity				
White	0	Referent	0	Referent
Black	0.115	0.224	0.090	0.245
Hispanic	−0.435	0.235	−0.280	0.237
Asian	0.366	0.238	0.668	0.291*
Other	0.133	0.274	−0.072	0.291
Age group				
18–24	0	Referent	0	Referent
25–44	−0.024	0.144	−0.083	0.157
45–64	0.241	0.184	0.029	0.200
65+	0.258	0.411	0.685	0.519
Education level				
Less than ninth grade	0	Referent	0	Referent
Ninth to 12th grade	0.024	0.548	0.732	0.550
High school graduate	0.074	0.528	0.927	0.528
Bachelors	0.094	0.529	0.842	0.530
Advanced	−0.050	0.543	0.549	0.544

The presearch and postsearch columns report the estimate and variance for both treatment groups using classical regression poststratification. Data for sex, race/ethnicity, age group, and education level came from the 2010 US Census. Data on the number of people who identify their sex as “other” came from a 2011 Gallup study.

* $P < 0.05$.

Table S6. Voting Preferences by Group for Study 3

Voting preferences	Mean (SE)			Kruskal–Wallis (χ^2)
	Group 1 (Gandhi bias)	Group 2 (Kejriwal bias)	Group 3 (Modi bias)	
PreImpressionGandhi	5.94 (0.10)	5.73 (0.10)	5.65 (0.10)	4.782
PreImpressionKejriwal	6.80 (0.09)	7.07 (0.09)	7.09 (0.08)	6.230*
PreImpressionModi	7.49 (0.10)	7.46 (0.10)	7.48 (0.09)	0.188
PreLikableGandhi	5.71 (0.10)	5.64 (0.10)	5.61 (0.10)	0.722
PreLikableKejriwal	6.68 (0.09)	6.78 (0.09)	6.87 (0.09)	2.030
PreLikableModi	7.40 (0.10)	7.29 (0.10)	7.29 (0.10)	1.483
PreTrustGandhi	5.57 (0.11)	5.52 (0.11)	5.42 (0.10)	0.955
PreTrustKejriwal	6.54 (0.10)	6.74 (0.10)	6.85 (0.09)	4.546
PreTrustModi	7.22 (0.11)	7.31 (0.11)	7.27 (0.10)	0.159
PreLikelyToVoteGandhi	0.10 (0.12)	0.08 (0.12)	0.08 (0.12)	1.587
PreLikelyToVoteKejriwal	1.19 (0.11)	1.38 (0.11)	1.55 (0.10)	5.178
PreLikelyToVoteModi	2.15 (0.12)	2.12 (0.12)	2.06 (0.12)	0.202
PostImpressionGandhi	5.78 (0.10)	5.52 (0.10)	5.35 (0.10)	9.552**
PostImpressionKejriwal	6.50 (0.09)	6.96 (0.09)	6.70 (0.08)	14.288**
PostImpressionModi	7.27 (0.10)	7.26 (0.10)	7.60 (0.09)	7.860*
PostLikableGandhi	5.62 (0.10)	5.46 (0.10)	5.26 (0.10)	6.322*
PostLikableKejriwal	6.37 (0.09)	6.84 (0.09)	6.64 (0.08)	13.456**
PostLikableModi	7.24 (0.11)	7.20 (0.11)	7.47 (0.10)	3.874
PostTrustGandhi	5.71 (0.11)	5.48 (0.10)	5.22 (0.10)	11.386*
PostTrustKejriwal	6.38 (0.10)	6.89 (0.10)	6.68 (0.08)	15.840***
PostTrustModi	7.18 (0.11)	7.20 (0.11)	7.49 (0.10)	4.758

* $P < 0.05$; ** $P < 0.01$; and *** $P < 0.001$: Kruskal–Wallis tests were conducted between all three groups. Preferences were measured for each candidate separately on 10-point Likert scales.

Table S7. Treatment effect estimates for study 3 voting preferences

Predictor variable	Presearch vote		Postsearch vote	
	Coefficient	SE	Coefficient	SE
Intercept	−0.716	0.090***	−0.552	0.088***
Sex				
Male	0	Referent	0	Referent
Female	0.168	0.100	0.030	0.099
Age group, y				
18–24	0	Referent	0	Referent
25–44	0.031	0.103	0.067	0.101
45–64	−0.222	0.217	−0.057	0.208
65+	−0.213	0.598	−0.366	0.598
Location				
State	0	Referent	0	Referent
Union Territory	−0.401	0.294	−0.321	0.279

The presearch and postsearch columns report the estimate and variance for both of the treatment groups using classical regression poststratification. Data for sex, age group, and location came from the 2011 India Census.

*** $P < 0.001$.

Table S8. Minimum VMP levels needed to impact two-person races with various projected win margins and proportions of undecided Internet voters

Proportion of undecided Internet voters in the population (i^*u)	Projected win margin									
	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10
0.01	1.000	—	—	—	—	—	—	—	—	—
0.02	0.500	1.000	—	—	—	—	—	—	—	—
0.03	0.333	0.667	1.000	—	—	—	—	—	—	—
0.04	0.250	0.500	0.750	1.000	—	—	—	—	—	—
0.05	0.200	0.400	0.600	0.800	1.000	—	—	—	—	—
0.06	0.167	0.333	0.500	0.667	0.833	1.000	—	—	—	—
0.07	0.143	0.286	0.429	0.571	0.714	0.857	1.000	—	—	—
0.08	0.125	0.250	0.375	0.500	0.625	0.750	0.875	1.000	—	—
0.09	0.111	0.222	0.333	0.444	0.556	0.667	0.778	0.889	1.000	—
0.10	0.100	0.200	0.300	0.400	0.500	0.600	0.700	0.800	0.900	1.000
0.11	0.091	0.182	0.273	0.364	0.455	0.545	0.636	0.727	0.818	0.909
0.12	0.083	0.167	0.250	0.333	0.417	0.500	0.583	0.667	0.750	0.833
0.13	0.077	0.154	0.231	0.308	0.385	0.462	0.538	0.615	0.692	0.769
0.14	0.071	0.143	0.214	0.286	0.357	0.429	0.500	0.571	0.643	0.714
0.15	0.067	0.133	0.200	0.267	0.333	0.400	0.467	0.533	0.600	0.667
0.16	0.063	0.125	0.188	0.250	0.313	0.375	0.438	0.500	0.563	0.625
0.17	0.059	0.118	0.176	0.235	0.294	0.353	0.412	0.471	0.529	0.588
0.18	0.056	0.111	0.167	0.222	0.278	0.333	0.389	0.444	0.500	0.556
0.19	0.053	0.105	0.158	0.211	0.263	0.316	0.368	0.421	0.474	0.526
0.20	0.050	0.100	0.150	0.200	0.250	0.300	0.350	0.400	0.450	0.500

Other Supporting Information Files

[Dataset S1 \(XLS\)](#)