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Political information search in "noisy" online environments: Insights from an experiment examining older and younger adults' searches on smartphones and laptops

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ABSTRACT

An important problem voters face is that they frequently encounter unfamiliar candidates and policies during elections. The Internet provides a solution to this problem by allowing voters to access vast amounts of information using communication technologies like laptops and smartphones. However, the online environment is "noisy," containing information both relevant and irrelevant to any given query. Existing research has not examined whether voters are able to discriminate between relevant and irrelevant political information during online search and how this discrimination ability influences voting decisions. We conducted a preregistered experimental study ($N = 128$; 64 younger participants and 64 older participants) in which we created our own search engine and webpages about political candidates to examine people's discrimination ability during search. We found that people's ability to discriminate between relevant and irrelevant facts during search increased the likelihood that their later vote choices were influenced by relevant (instead of irrelevant) information. In addition, older and younger adults' discrimination abilities did not differ between searches on smartphones or laptops. Our findings demonstrate a new way to integrate theories of political behavior and communication technology and highlight information search in "noisy" online environments as an important problem faced by voters in democracies.

KEYWORDS

Voting; information search; search engines; communication technology; smartphones; older adults; political decision-making

In the United States and other countries, one important problem voters face is that they frequently encounter unfamiliar candidates and proposed laws during elections (Banducci, Karp, Thrasher, & Rallings, 2008; Barth, Burnett, & Parry, 2020; Bonneau & Cann, 2015). Although these candidates and ballot measures receive little campaign publicity, they are important as they often involve public offices (e.g., judges) and policies (e.g., financing of public education, infrastructure projects) that can have a substantial impact on people's daily lives. It is therefore critical that voters are able to obtain information about often unknown – but important – candidates and proposed laws to inform their voting decisions.

Fortunately, the Internet can provide a solution to this problem by allowing voters to access vast amounts of information. Specifically, voters can use communication technologies such as laptops and smartphones to conduct online searches to learn about unfamiliar candidates and policies prior to, or even while, making a voting decision.

But, are voters able to effectively identify *relevant* information online to inform their voting decisions? The online information environment in which voters search for information is "noisy," meaning that it contains information both relevant and irrelevant to one's main query. Here, we define "relevant" information as information that is pertinent to a decision task, whereas irrelevant information is *not* pertinent to one's decision. For example, an internet search for a U.S. state representative in Ohio (e.g., Adam Miller) yields webpages pertaining to his official webpage and press releases (relevant information). But, the search also generates results related to webpages and online news stories about an "Adam Miller" that, upon careful inspection, is not the same state representative (irrelevant

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information). Importantly, the irrelevant information can be misleading if voters do not realize that the information is irrelevant and subsequently use it to inform their voting decisions.

Existing research is unable to address the questions of whether voters are able to discriminate between relevant and irrelevant political information during online search and how this discrimination ability influences their voting decisions. For example, previous work has studied information search indirectly by asking survey respondents the types of information they would typically search for about political candidates (Bernhard & Freeder, 2020). Although valuable, this work does not directly concern people's actual information search behaviors. Further, while some studies have directly examined information search behaviors (Huang, 2000; Lau & Redlawsk, 2006; Redlawsk, 2001, 2004), this work has primarily operated in an environment where all the information available to study participants was relevant to the decision task (e.g., all information is about the study's candidates).

The main goal of our study, then, is to examine information search behaviors in a noisy online environment and their influence on voting decisions. Specifically, we examine whether improvements in people's ability to discriminate between relevant and irrelevant facts during information search can increase the likelihood that their later vote choices will be primarily influenced by relevant (instead of irrelevant) information. We present two theoretical accounts that make competing predictions as to whether improved discrimination ability during search will lead to later vote choices that are primarily influenced by relevant information. Our study provides two key contributions to the political communication and communication technology literatures.

First, we devised an experimental lab study in which we created our own search engine, fictitious political candidates, electoral races between the candidates, and webpages about the candidates. In other words, we created our own "micro online environment" and electoral competition. This allowed us to control all features of the information environment, including the contents and distribution of relevant and irrelevant information. In addition, it also gave us the ability to track people's information search behaviors with a high level of precision, such as the specific webpages participants accessed and the amount of time they spent on a webpage. This, in turn, allowed us to directly link people's information search behaviors with their voting decisions. By incorporating naturalistic online search, while at the same time maintaining experimental control over the information environment, our design is an improvement over existing experimental work which does not use a realistic online information search task or environment. In a number of those studies, participants, without entering a search query, are shown a virtual board filled with only relevant information about candidates and are given a fixed amount of time to consume that information before making a voting decision (Huang, 2000; Lau & Redlawsk, 2006; Redlawsk, 2001, 2004).

Second, we used a device-comparison approach to examine whether individuals are better able to discriminate between relevant and irrelevant political information on laptops than on smartphones. This is an important issue because voters may use different devices – laptops, smartphones – when they search for political information online. In fact, political information consumption today occurs more often on smartphones than laptop and desktop computers (Newman et al., 2021). But, research in human-computer interaction suggests that smartphones have certain features (such as smaller text and touchscreens; Ghose, Goldfarb, & Han, 2013; Harper, Yesilada, & Chen, 2011), that may make discriminating relevant from irrelevant information difficult on smartphones. Furthermore, in the actual voting booth, where voters may want to conduct last-minute searches for information about unfamiliar candidates or issues on their ballots, voters are likely to only have access to their smartphones. In addition, we compare political information search on smartphones and laptops between older and younger adults as some have theorized that, due to the unique features of smartphones, older adults may especially struggle to use them effectively (Berenguer et al., 2017; Hwangbo, Yoon, Jin, Han, & Ji, 2013; Pang, Vu, Zhang, & Foo, 2015; Wilkowska & Ziefle, 2009). Moreover, older adults are important to study because they are more likely than other age groups to vote, not just in the U.S. but in democracies around the world (Bunis, 2018; Franklin, 2004). This approach is an advance over prior work on political information search,

most of which has not explored the process and outcomes of search across different devices (e.g., all information search takes place on a computer; Lau & Redlawsk, 2006; Valentino, Banks, Hutchings, & Davis, 2009; Valentino, Hutchings, Banks, & Davis, 2008; Xenos & Becker, 2009).

"Noisy" online environments and political information search

The ability to access a vast amount of political information online is useful in a variety of electoral contexts for voters to inform their voting decisions. This ability may be especially useful in low-information elections, where proposed laws and candidates receive little publicity, and nonpartisan elections (e.g., races for judges, school board members), where candidates' political party is not provided on the ballot. In these instances, voters can use devices such as laptops and smartphones to gain access to political information before making a voting decision.

But searching for political information online presents important challenges. Specifically, information search online involves effectively identifying information that is relevant to one's main query and ignoring the sea of irrelevant information. To put it simply, the information environment is "noisy." Importantly, discriminating between relevant and irrelevant information can be challenging because irrelevant information can also be misleading. By "misleading," we mean that irrelevant information can be mistaken as relevant information and used to erroneously inform voters' decisions.

Consider the following real-world example: In 2015, a 33-year old law student named Ruben Ramirez Hinojosa ran in the Democratic primary for U.S. Congress in the state of Texas (Malewitz, 2015). At that time, there was also a 74-year Texas congressman named Ruben Hinojosa. If voters in the voting booth searched for information about "Ruben Hinojosa," the search would yield webpages about both the 33-year old Ruben Ramirez Hinojosa and the 74-year old Ruben Hinojosa. If a voter was trying to search for information about Ruben Ramirez Hinojosa to inform their decision to vote for them or not, webpages about 33-year old Hinojosa would be relevant to their decision whereas webpages about the 74-year old Hinojosa would be irrelevant and could mislead. Critically, if voters were unable to discriminate between relevant and irrelevant information online, they could misattribute the accomplishments of the 74-year old Hinojosa to the 33-year old Hinojosa, mistakenly believing that they were the same person. As highlighted by this example, this distinction is important in the political domain because the need to discriminate between relevant and irrelevant information online – such as distinguishing between candidates who share very similar names – arises often in the U.S. and other countries (Huriash, 2018; Leeder, 2019; Mainichi Daily News, 2017; Swegles, 2012).

As this example illustrates, irrelevant information can appear in the online environment and may mislead people trying to make political decisions such as choosing which candidate to vote for.[1] Thus, it is important to determine whether an ability to discriminate between relevant and irrelevant facts during information search can increase the likelihood that later vote choices will be primarily influenced by relevant, instead of irrelevant, information.

Discriminating relevant from irrelevant information and voting decisions

Does the ability to discriminate between relevant and irrelevant information during online search affect voting decisions? Ideally, people's voting decisions are informed by relevant information and not by irrelevant information. But, when the online information environment is saturated with both relevant and irrelevant information, will voters be able to distinguish which is which? Furthermore, if voters *are* able to discriminate relevant from irrelevant information during search, will relevant information exert a greater influence on their later voting decisions?

On the one hand, there are reasons to believe that the ability to distinguish relevant from irrelevant information during online search will increase the likelihood that voters' decisions that occur later are primarily influenced by relevant rather than irrelevant information. Online information search can be costly in terms of time and effort (Lorigo et al., 2006). One view suggests that voters are

cognitive misers who try to conserve time and effort when learning about political information (Lau & Redlawsk, 2001). In other words, they will likely not engage in exhaustive information search nor will they dedicate the same amount of effort to learning about each piece of information they encounter. It follows, then, that if voters are able to discriminate relevant from irrelevant information during their online search, they will spend more time reading, or thinking about, relevant political information than irrelevant information. Indeed, evidence from other domains (e.g., education, health) suggests that some users spend more time on online information that is pertinent to their main query than irrelevant information (Feufel & Stahl, 2012; Tsai, Tsai, & Hwang, 2011). Greater attention or elaboration for relevant information, in turn, may increase the likelihood that individuals remember it compared to irrelevant information (Pertzov, Avidan, & Zohary, 2009). Weaker memory for irrelevant information then may decrease the extent to which it influences voting decisions (Lodge & Hamill, 1986). Under this account, people's ability to discriminate between relevant and irrelevant information during their online search can increase the likelihood that their later voting decisions are informed primarily by relevant, rather than irrelevant, information.

On the other hand, there are also reasons to believe that even if people are able to reliably distinguish relevant from irrelevant information during online search, irrelevant and relevant information may exert equal influence on subsequent voting decisions. This may be more likely to occur for information about political candidates that generates an emotional response. According to the *on-line model of candidate evaluation*, voters extract affective information from content they are exposed to about political candidates (Lodge, McGraw, & Stroh, 1989; Lodge, Steenbergen, & Brau, 1995; for neuropsychological evidence, see Coronel at al., 2012). For example, a voter may experience positive emotion when they learn that a candidate volunteers their time to help homeless individuals. This positive affective information is then incorporated into an accumulated affective tally, a running average specific to that candidate. Importantly, the updated tally endures irrespective of whether the information that generated the initial emotional responses (e.g., information that the candidate volunteers their time to help the homeless) is remembered or forgotten. When the voter is later queried about whether they would vote for the candidate, they only have to reactivate the affective tally.

A problem, however, can arise in noisy online environments as irrelevant information can also convey affective information. If the voter remembers that the source of these affective associations is irrelevant information, then they may simply discount the feelings induced by that irrelevant information. However, if the voter does not remember the source of such affective associations, then they may treat the affective information derived from irrelevant information the same way as affective information derived from relevant information (Coronel & Bucy, 2020). In other words, the voter may incorporate this emotional information into their affective tally. In this way, although voters are able to reliably discriminate relevant and irrelevant information during their online search, irrelevant and relevant information exert equal influence on later voting decisions.[2]

Given that there are competing expectations about how information search behaviors will influence voting decisions in noisy online environments, we pose the following research question:

RQ1: Does the ability to discriminate relevant and irrelevant information during online search increase the likelihood that later voting decisions are primarily influenced by relevant (instead of irrelevant) information?

Communication technologies and political information search

Online information search can occur across a variety of different devices, from smartphones and laptops to tablets and smart speakers. There are reasons to believe that successfully discriminating relevant from irrelevant information may be more difficult on smartphones than more traditional computing devices (i.e., laptops, desktops) (Chae & Kim, 2004; Ghose, Goldfarb, & Han, 2013; Kim & Sundar, 2016). This is important because political information consumption increasingly occurs on

smartphones compared to on laptop and desktop computers (Newman et al., 2021).

Why would discriminating relevant from irrelevant information be more difficult on smartphones than other devices such as laptops? According to one set of human-computer interaction models, certain smartphone features can impair people's ability to effectively search for online information compared to other devices. We refer to these as *device-impairment models* (Harper, Yesilada, & Chen, 2011). According to these models, smartphones have smaller screens, text, and visual content which make it harder for individuals to discriminate between different types of information online. Specifically, these features can decrease the ease of on-screen navigation (Chae & Kim, 2004), draw on more cognitive resources to process information (Kim & Sundar, 2016), and render users less likely to conduct thorough searches (Ghose, Goldfarb, & Han, 2013).

Furthermore, most smartphones have touch rather than traditional type input interfaces. Touchscreens are harder to use because they do not provide tactile feedback provided by physical keypads, making it difficult for people to select their targets (Guerreiro, Nicolau, Jorge, & Gonçalves, 2010). Indeed, users are slower on typing on smartphones compared to computers (Bao, Pierce, Whittaker, & Zhai, 2011). Because of these features, search queries on mobile devices typically take longer to enter and produce fewer visible results compared to desktop computers (Kamvar & Baluja, 2006). Thus, online searches and the ability to discriminate between relevant and irrelevant information might be impaired on smartphones compared to on other devices with larger screens and traditional keyboards such as laptops. Consistent with device-impairment models, we specify the following preregistered hypothesis[3]:

H1: Individuals will be more likely to identify relevant and irrelevant political information when using a laptop than a smartphone.

While we predict that laptops will possess a general advantage over smartphones, there may be age-related differences in the relationship between the device used to search for political information and the likelihood of casting a vote consistent with relevant information. Specifically, older adults may experience greater difficulties discriminating between relevant and irrelevant information when using smartphones than laptops compared to younger individuals. Features of smartphones that make them more difficult to use across all individuals – smaller screens and display contents, touchscreens – have been found to present even greater challenges for older adults, who are less likely to have the eyesight and physical dexterity needed to use smartphones compared to younger people (Berenguer et al., 2017; Hwangbo, Yoon, Jin, Han, & Ji, 2013; Pang, Vu, Zhang, & Foo, 2015; Wilkowska & Ziefle, 2009).

That said, there are also reasons to believe that there may not be differences between older and younger adults' ability to identify relevant and irrelevant information on smartphones compared to laptops. First, older adults' smartphone ownership has increased rapidly in recent years, nearly reaching parity with the demographic's rate of laptop ownership (Kakulla, 2020). In addition to greater device ownership, recent evidence suggests that older adults' digital literacy has been increasing over time (Martínez-Alcalá et al., 2021). Indeed, for some information-seeking online tasks (e.g., browsing social media), older adults actually *prefer* using smartphones to laptop and desktop computers (Kakulla, 2020). Finally, the strongest predictor of smartphone proficiency among older adults is computer proficiency (Champagne & Boot, 2017), suggesting that older adults adept at using laptops are likely also adept at using smartphones (and vice-versa).

In sum, it is not clear whether older adults' ability to distinguish relevant from irrelevant political information will differ between laptops and smartphones compared to the difference between devices among younger adults. Examining whether older adults can navigate political information search as effectively on smartphones as on laptops is important in part because older adults increasingly own and use smartphones, but also because older adults are significantly more likely to turnout to vote compared to younger adults (Bunis, 2018; Franklin, 2004), potentially increasing the effects of older adults' online searches for unfamiliar political information on electoral

outcomes compared to searches by younger adults. As such, we pose the following research question:

RQ2: Will older adults' ability to discriminate between relevant and irrelevant political information on smartphones and laptops differ from younger adults' discrimination ability on smartphones and laptops?

Methods

Participants

We recruited a total of 141 participants from a large university in the Midwestern United States and the surrounding community and compensated them with $15 for taking part in the study. The study was approved by The Ohio State University's Institutional Review Board and all participants provided informed consent. The study lasted approximately one hour for each participant. We excluded 13 participants who encountered technical problems during the experiment session (e.g., our search engine stopped working). We analyzed data from the remaining 128 participants (M_{Age} = 41.06, SD = 21.43, range = 18–84, identifying as female = 50%).[4] Our participants consisted of two groups of 64, in which one group consisted of individuals at or under the age of 25 (M_{Age} = 20.36, SD = 1.23, range = 18–25) and the other group consisted of individuals that were 50 years of age or older (M_{Age} = 61.76, SD = 7.47, range = 50–84). We recruited older[5] and younger adult participants for the purposes of exploring RQ2.

Procedure and materials

The general structure of the study is as follows. Upon entering the lab, participants were told they would be learning about political candidates (judges) and choosing to vote for one of two candidates in a series of four elections.[6] Prior to beginning the experiment, participants were asked to fill out a brief device preference questionnaire asking which brand of laptop (Apple, Dell, HP, Lenovo) and smartphone (Apple, Samsung) they were most comfortable using.

Participants were asked to vote in four electoral races. In each race, participants were presented with the names of two political candidates (judges; e.g., Scott Taylor vs. David Walker) and were asked to vote for one of them. Although the candidates were fictitious, we told participants that they would be voting on real candidates to increase the likelihood that they treated these candidates as they would candidates outside the lab context. We used fictitious candidates to ensure that participants had no prior knowledge about the candidates (similar to many low-information elections in the real world).

Before making their voting decision in each race, we instructed participants to search for political information about candidates using our customized search engine, called "Sagamore" (Figure 1a; see Supplemental Information for further details). Sagamore closely resembled mainstream search engines (e.g., Google) in terms of design and functionality. Our custom search engine and results pages afforded us complete control over the information contained in the search environment and allowed us to track participants' information search behaviors (e.g., webpages they accessed, amount of time spent on each webpage).

Participants searched for information about the two candidates running against each other in each race using either a smartphone or laptop computer. Specifically, participants were randomly assigned to one of two conditions: 1) they searched for information on a smartphone for the first two races and then on a laptop for the last two races, or 2) they searched for information on a laptop for the first two races and a smartphone for the last two. Individuals used a device (smartphone or laptop) to search for candidate information while standing in one voting booth and, after they had finished searching, cast their vote on a laptop in a separate voting booth next to them (Figure 2).

When participants searched for information about a given candidate (e.g., Scott Taylor), they could access webpages about the candidate in the search page results (Figure 1b,c). However, they could also access webpages about someone who was *not* the candidate on the ballot but whose name bore a close resemblance to the candidate's

Figure 1. a. Search page for the custom search engine, Sagamore. b. Example of the search page results. c. Example of a webpage about one of the candidates. d. Example of search page results highlighting webpage links to target and misleading candidates and whether the information is positive (+), negative (-), or neutral.

name (e.g., Jerry Taylor). These webpages contained news articles which conveyed information about candidates via text (see Supplementary Information for more details about the contents of the webpages). Webpages that referred to the candidates' actual names (Scott Taylor) were therefore relevant information while webpages that referred to the other person whose name only resembled the actual candidate (Jerry Taylor) were irrelevant information.[7] Hereafter, we refer to the two actual candidates on the ballot as the *target* candidates and the individuals whose names resembled the target candidates' as the *misleading* candidates. In every race, each of the two target candidates (e.g., Scott Taylor, David Walker) had a corresponding misleading candidate (Jerry Taylor, James Walker). Participants were able to spend as much time as they wished searching for candidate information before casting a vote. We were able to track the amount of time participants spent on the target and misleading candidates' webpages.

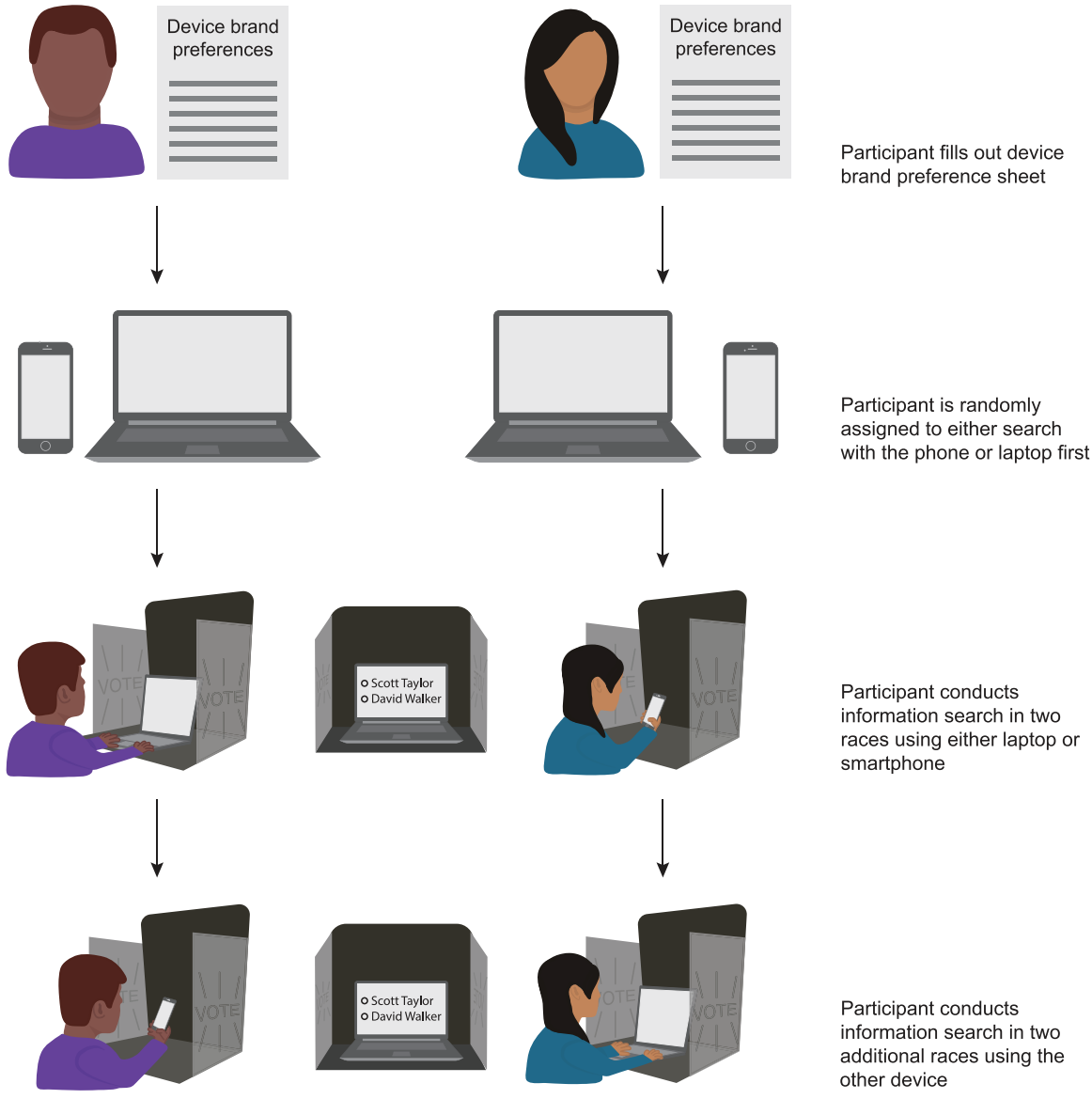

Figure 2. Schematic of experimental design. Example shows two participants assigned to one of two within-subjects conditions: 1) participant conducts information search on a laptop first before a smartphone and 2) participant conducts information search on a smartphone first before a laptop.

Our search results page, then, represents a noisy information environment because it contains both relevant information (webpages about target candidates) and irrelevant information (webpages about misleading candidates). This environment also mirrors real-world contexts in which candidates share similar names with other candidates or non-candidates, all of whom can surface during online searches (Huriash, 2018; Leeder, 2019; Mainichi Daily News, 2017; Swegles, 2012).

To obtain an objective measure of task performance, we further structured the information environment such that one of the two target candidates in each race (e.g., Scott Taylor) was always associated with webpages containing news stories with positive information (e.g., "Judge receives award – Outstanding judicial service and support for youth recognized") while the other candidate (e.g., David Walker) was always associated with webpages containing news stories with negative information (e.g., "Judge suspended for 2012 intoxication"). Given that no other information about these candidates beyond what was contained in our search engine was available, following the

relevant information contained in the search results would lead people to cast a vote for the target candidate associated with positive information (in this example, Scott Taylor). Because information about candidates in our study was not related to issues or policy positions but rather was limited to only positive or negative personal characteristics related to being a capable office-holder, the "correct" candidate to vote for in each race did not depend upon individual participants' political beliefs or policy preferences.

Critically, each misleading candidate was associated with webpages that disseminated news information that was the *opposite* valence as the corresponding real candidate. For example, if Scott Taylor was the target candidate and Jerry Taylor was the misleading candidate, then Scott Taylor was associated with positive news stories while Jerry Taylor was associated with negative news stories. Similarly, if David Walker was the target candidate and James Walker was the misleading candidate, then David Walker was associated with negative news stories and James Walker was associated with positive news stories. If participants are unable to distinguish between relevant and irrelevant information (i.e., they did not realize that the target and misleading candidates had different first names), we expect participants to have spent an equal amount of time on the target candidates' webpages and the misleading candidates' webpages.

Thus, in a given trial, a vote primarily influenced by relevant information is one for the target candidate associated with positive information (e.g., Scott Taylor). A vote primarily influenced by irrelevant information is one for the target candidate associated with negative information (e.g., David Walker). Finally, if relevant information and irrelevant information had an equal influence on later vote choices, then we expect participants to be equally likely to vote for each of the target candidates (e.g., 50% probability of voting for Scott Taylor or David Walker). This is because, from their perspective, both target candidates were associated with equal amounts of positive and negative information.

Analytic strategy

If the ability to distinguish between relevant and irrelevant information during search increases the likelihood that later voting decisions are primarily influenced by relevant (rather than irrelevant) information (RQ1), then we expect the following: As the time spent on the target candidates' webpages over the misleading candidates' webpages increases, the probability for voting for the target candidate associated with the positive news stories will increase. Spending a greater amount of time in the target candidates' webpages than the misleading candidates' webpages is evidence that the participants are able to discriminate between relevant and irrelevant information. This is because, as cognitive misers, individuals will dedicate more of their time and effort at learning information that is pertinent to their decision task.

Next, if people are better able to distinguish relevant from irrelevant information during information search on laptops compared to smartphones (H1), then we expect two patterns in the data. First, the amount of time that participants spend in the target candidates' webpages compared to the misleading candidates' webpages should be greater in laptops than smartphones. This is because if participants are less able to distinguish relevant from irrelevant information on smartphones than on laptops, they would be more likely to view all the webpages as relevant and therefore spend closer to an equal amount of time on them. Second, the probability that participants vote for target candidates associated with positive news stories will be greater when they conduct information search on laptops than on smartphones.

Finally, if older adults' ability to discriminate between relevant and irrelevant political information on smartphones and laptops differs from younger adults' ability to discriminate between relevant and irrelevant information on smartphones and laptops (RQ2), then we expect the following: The difference in the amount of time spent on the target candidates' webpages compared to the misleading candidates' webpages between devices will be greater among older adults than younger adults. Additionally, the difference in the

probability that participants vote for the target candidate associated with positive information between devices should also be larger among older adults than among younger adults.

Results

We first answered RQ1: Does the ability to discriminate relevant and irrelevant information *during online search* increase the likelihood that *later* voting decisions are primarily influenced by relevant (instead of irrelevant) information?[8] To do so, we estimated a logistic regression model in which the independent variable is discrimination ability. We calculated discrimination ability as the difference between the average amount of time participants spent on the target candidates' webpages during search and the average amount of time participants spent on the misleading candidates' webpages.[9] A positive value indicates that participants spent more time on the target candidates' webpages than the misleading candidates' webpages. A value of zero indicates that participants spent an equal amount of time on the target and misleading candidates' webpages. A negative value indicates that participants spent more time on the misleading candidates' webpages than the target candidates' webpages.

The dependent variable was the participant's voting decision: coded as "1" if the participant voted for the target candidate associated with positive information (i.e., a vote primarily influenced by relevant information) and "0" if they voted for the target candidate associated with negative information. Standard errors were clustered on participants to account for repeated observations within individuals. As is shown in Table S1 (Model 1), we found a positive and statistically significant effect of discrimination ability on the probability of voting for the target candidate associated with positive information ($B = 0.06$, $SE = 0.02$, $p = .002$).[10] As can be seen in Figure 3a, as discrimination ability moves from its lowest value of −48 seconds to its highest value of +86 seconds, the probability of voting for the target candidate associated with positive information increases from 33% to 99%.

Next, we tested H1: Individuals will be more likely to identify relevant and irrelevant political information when using a laptop than a smartphone. First, we estimated a mixed-effects linear regression in which device (smartphone = 1, laptop = 0) was the independent variable. The dependent variable was the participant's discrimination ability. Participants were modeled as random effects. We found no statistically significant effect of device ($B = -1.61$, $SE = 1.10$, $p = .14$). As is shown in Figure 3b, regardless of the device used for information search, participants were more likely to spend greater time on the target than the misleading candidates' webpages. On average, individuals spent 20.20 seconds ($SD = 11.30$ seconds) on the target candidates' webpages and 11.40 seconds ($SD = 8.70$ seconds) on the misleading candidates' webpages.

Second, we estimated a mixed-effects logistic regression in which device (smartphone = 1, laptop = 0) was the primary independent variable. The dependent variable was the participant's voting decision: coded as "1" if the participant voted for the target candidate associated with positive information and "0" if they voted for the target candidate associated with negative information. We modeled participants as random effects. We found no statistically significant effect of device on the probability of voting for the target candidate associated with positive information ($B = 0.13$, $SE = 0.35$, $p = .72$; see Table S2 for additional model specifications). In addition, participants overall and across devices were above chance (over 50%) in the rate at which they voted for the target candidate associated with positive information. Across trials, participants voted for the target candidate associated with positive information 90% (SD = 19%) of the time. This rate for smartphones was 91% (SD = 21%) and for laptops was 90% (SD = 25%). Taken together, we did not find support for H1.

Finally, we answered RQ2: Does older adults' ability to discriminate between relevant and irrelevant political information on smartphones and laptops differ from younger adults' ability to discriminate between relevant and irrelevant information on smartphones and laptops? First, we estimated a mixed-effects linear regression in which device (smartphone = 1, laptop = 0), age group (older adults = 1, younger adults = 0), and the interaction between device and age group were independent variables. The dependent variable

was the participant's discrimination ability. Participants were modeled as random effects. As can be seen in Table S3 (Model 1), we did not obtain a significant interaction between device and age group ($B = 0.69$, $SE = 2.21$, $p = .75$), indicating that the difference in discrimination ability between devices among older adults did not significantly differ from the difference in discrimination ability between devices among younger adults.

Second, we estimated a mixed-effects logistic regression in which device, age group, and their interaction were independent variables. The dependent variable was whether a participant voted for the target candidate associated with positive information (1) or instead the target candidate associated with negative information (0). Participants were modeled as random effects. As can be seen in Table S3 (Model 2), we did not obtain a significant interaction between device and age group ($B = -0.72$, $SE = 0.72$, $p = .32$), indicating that the difference in the likelihood of voting for the target candidate associated with positive

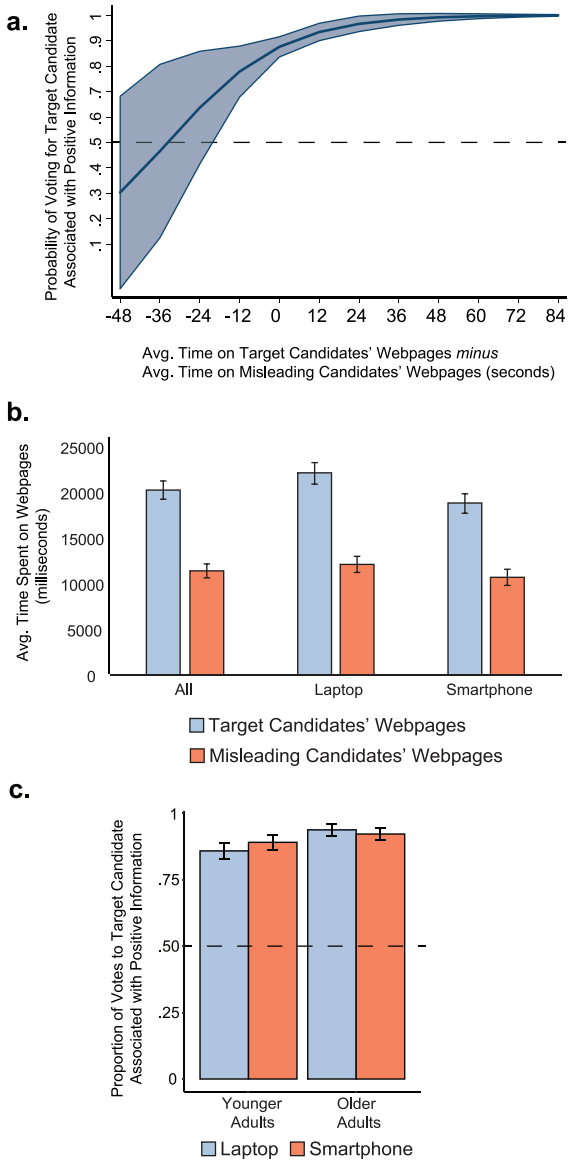

Figure 3. a. As participants spend more time on target candidates' webpages than misleading candidates' webpages, their predicted probability of voting for the target candidate associated with positive information increases (error bars = 95% CIs). b. Participants overall spend more time on target candidates' webpages than misleading candidates' webpages, regardless of device (error bars = SEMs). c. Both older and younger adult participants are above chance (50% as dashed line) and show similar rates of voting for the target candidate associated with positive information across devices (error bars = SEMs).

information between smartphones and laptops among older adults did not significantly differ from the difference in that likelihood between devices among younger adults. Figure 3c displays the proportion of votes cast for the target candidate associated with positive information across trials by device and age group. Younger adults voted for the target candidate associated with positive information 86% (SD = 29%) of the time when conducting searches on a laptop and 89% (SD = 23%) of the time when conducting searches on a smartphone. Older adults voted for the target candidate associated with positive information 94% (SD = 19%) of the time when searching on a laptop and 92% (SD = 18%) of the time when searching on a smartphone.

Discussion

Our primary goal was to examine whether people's ability to discriminate between relevant and irrelevant political information in online information search can influence their voting decisions. The results from our experimental lab study suggest that the ability to discriminate relevant from irrelevant political information during information search increases the likelihood of casting a vote primarily influenced by relevant, rather than irrelevant, information (RQ1). Despite reasons to believe that the ability to discriminate relevant from irrelevant information should be more difficult on smartphones than on laptops, we did not find a difference in discrimination ability or the probability of casting a vote primarily influenced by relevant information when participants conducted their information searches on smartphones compared to laptops (H1). Furthermore, differences in discrimination ability and the likelihood of casting a vote influenced by relevant information between smartphones and laptops did not differ between younger and older adults (RQ2). Our findings have implications for both the political communication and communication technology literatures.

First, our study extends the literature on political information search by incorporating "noise" into the process of information search. Individuals frequently encounter information during online political information search in their everyday lives that is irrelevant to their main query. Existing work on political information search has not incorporated this notion of noise into information search tasks, where all information presented to participants is relevant to the decision task (Huang, 2000; Lau & Redlawsk, 2006; Redlawsk, 2001, 2004). We found that the ability to discriminate between relevant and irrelevant information significantly increases the likelihood that individuals cast votes primarily influenced by relevant information.

Our study also makes a contribution to research on political knowledge more generally. A large body of work has examined what information people know about politics when asked using survey batteries (Amsalem & Nir, 2019; Delli Carpini & Keeter, 1996). While information about who is more or less likely to possess political knowledge when queried out of the blue is useful, researchers have called for greater attention to who has the ability and skills to effectively acquire political information to increase their political knowledge (Prior & Lupia, 2008). Given the portability and accessibility of devices like smartphones, it is reasonable that people can simply query the internet when they need to learn new political information, rather than rely solely on the knowledge stored in their memories (Smith, Clifford, & Jerit, 2020; Style & Jerit, 2020). Our study contributes to this direction for political knowledge research by carefully tracing the process by which people use internet searches to become informed about politics in a noisy online information environment. Our findings demonstrate that the ability to discriminate relevant from irrelevant information in a noisy environment matters, as it influences whether political decisions are more likely to be informed by relevant information. This discrimination ability, then, may be an important skill for future work on political knowledge acquisition to consider.

Second, we examine if the ability to discriminate relevant from irrelevant information and its impact on voting decisions differs across laptops and smartphones. This comparison is important as information about politics and news is increasingly consumed via mobile devices. Nearly twice as many Americans report often getting their news on mobile than those who report often getting news via desktop/laptop (Walker, 2019). Furthermore,

mobile devices can be used in situations where information search can be particularly consequential for political decision making (i.e., while physically in the voting booth). We discussed a model of human-computer interaction, *device-impairment*, which predicts that because of certain features of smartphones (e.g., small text, touchscreens), it is more difficult for individuals to discriminate between relevant and irrelevant political information on smartphones than on laptops (Chae & Kim, 2004; Ghose, Goldfarb, & Han, 2013; Guerreiro, Nicolau, Jorge, & Gonçalves, 2010; Harper, Yesilada, & Chen, 2011; Kamvar & Baluja, 2006; Kim & Sundar, 2016).

However, our results indicate that individuals were equally good at discriminating relevant from irrelevant political information on smartphones and laptops. These results can be interpreted as consistent with a different model of human-computer interaction, *device-adaptation*. This perspective suggests that individuals may improve their ability to use new technologies, such as smartphones, with frequent use and as the devices become ubiquitous in society (Hargittai, 2002; Pearce & Rice, 2013; Rahmati & Zhong, 2013). In addition, improvements in UX and design may also make smartphones easier to use over time (Kujala, Roto, Väänänen-Vainio-Mattila, Karapanos, & Sinnelä, 2011). For certain use cases, people may feel that smartphones are as or even more useful than more conventional desktop environments for seeking and consuming political information (Kakulla, 2020; Newman et al., 2021).

Furthermore, despite reasons to believe that older adults may have had an especially difficult time distinguishing relevant from irrelevant political information on smartphones compared to on laptops, there were no differences in discrimination ability or the likelihood of casting a vote influenced by relevant information between smartphones and laptops between younger and older adults. These findings suggest that older adults are able to search for political information online as effectively as younger adults, on both laptops and smartphones. While this is a promising result, recent research has also demonstrated that older adults are more susceptible to misinformation online than younger adults (Guess, Nyhan, & Reifler, 2020; Moore, Dahlke, & Hancock, 2022), and that this could be due to differences in digital skills between the age groups (Moore & Hancock, 2022). Future work on political information search, then, should continue recruiting older and younger adult participants when possible to compare how different information search behaviors and skills, across different communication technologies, compare between the two age groups.

Our work has potential policy implications because countries like India and the USA have local laws that ban the use smartphones in the voting booth, arguing that their features such as the ability to take photos of the ballot and post them online violate the secrecy of the ballot (Indo-Asian News Service, 2019; Willingham, 2018). For example, in the US state of Illinois, taking a "ballot selfie" is a felony that can send a person to prison (O'brien, 2016). These statewide bans on smartphone use in the voting booth have been challenged in US federal courts (Malone, 2016). Our work contributes to this policy debate by providing some of the first evidence on the positive consequences of smartphone use in the voting booth (although our study should be interpreted in light of its limitations, discussed below).

Finally, we use a "micro online environment" in this study to examine information search behaviors in the context of elections. We created our own search engine, fictitious political candidates, electoral races between the candidates, and webpages about the candidates. By doing so, we not only controlled all features of the information environment, such as the distribution of relevant and irrelevant information in search results, but we also were able to track people's information search behaviors to assess time spent on certain pieces of information, etc. Scholars have advocated for using such an approach when studying online information search (Epstein & Robertson, 2015; Unkel, 2019) as it affords researchers the ability to study granular details of the process of searching for, selecting, and consuming information online. Future work should consider making use of this approach when possible.

Of course, our findings should be interpreted in light of our study's limitations. We prioritized the ability to draw stronger causal inferences (or internal validity) rather than external validity in our research design. In particular, our search

environment controlled for many factors that may have changed how individuals engage in information search compared to naturalistic contexts. For example, while our use of fictitious candidates mirrored low-information races, it is plausible that voters in the real-world have some preexisting information about candidates or issues (such as name recognition) before voting. As a result, the information search performed while voting could be more of a tool for recalling rather than gathering new information about candidates. Relatedly, the candidates in our study did not systematically vary in other characteristics which voters may use to decide who to vote for, particularly in low-information races (e.g., race, gender, age, appearance). Given that prior research has demonstrated that these characteristics can serve as cues which voters use to make political decisions absent an abundance of other information about candidates (Bailenson, Iyengar, Yee, & Collins, 2008; Campbell & Cowley, 2014; Jäckle, Metz, Wenzelburger, & König, 2020; Lau & Redlawsk, 2001), future experimental work should systematically vary these candidate characteristics to see how they influence information search in noisy environments and affect voters' post-information search voting decisions. In addition to candidate characteristics, there may be other voter-level characteristics which we did not examine directly in this study but that may relate to people's political information search behaviors and outcomes, such as digital literacy, experience voting in past elections, or news consumption during the election cycle at hand. We investigate age differences in online search between different devices, but future work should investigate other individual differences that may bear an important role on people's ability to discriminate relevant from irrelevant information online and the consequences of that ability.

In addition, while our information environment was noisy in that it contained relevant and irrelevant search results, it stripped away important additional features of laptops and smartphones (e.g., push notifications and phone calls on smartphones) which may interrupt or otherwise influence individuals' information search processes (Rozgonjuk, Elhai, Ryan, & Scott, 2019). Future research should examine online information search in an environment which contains these important and ubiquitous features of communication technologies to understand their role in the information search process.

Despite these limitations, this study offers several directions for future work. Specifically, future studies should use other methods to provide converging evidence for the present findings. For example, while individuals cannot be observed while voting either in the voting booth or in their homes (e.g., while using mail-in ballots) because of the ballot secrecy laws, exit polls or other surveys could be deployed to determine the extent and nature of online information search prior to voting in elections. Furthermore, because we did not identify any effects of the type of device used to search for information, future experimental studies could focus on specific devices such as smartphones and manipulate certain features of the information environment (e.g., the presence of sponsored results or advertisements in search results pages) to determine what features may hinder or enhance voters' ability to search for political information online. Studies that identify ways to enhance voters' ability to search for information online are important as access to online information search continues to increase. Finally, while our results did not uncover significant effects of the device used to search for information, they did reveal that the total time an individual spent searching was significantly related to their likelihood of casting a vote primarily influenced by relevant information (see Table S2). In our study, participants were free to take as much time as possible to search for information before casting a vote, similar to the real-world voting environment in which there are no specified time limits. However, future work could experimentally manipulate the time individuals have to search for information before voting to further examine the relationship between time, the ability to distinguish between relevant and irrelevant information, and the likelihood of casting votes primarily influenced by relevant information.

In summary, voters frequently encounter unfamiliar candidates and policies during elections. Voters can use the Internet to search for political information but the online information

environment is noisy, containing both relevant and irrelevant information. Our results suggest that people's ability to discriminate relevant from irrelevant political information online increases the likelihood of individuals casting votes primarily influenced by relevant rather than irrelevant information. Importantly, this effect occurs regardless of if smartphones or laptops are used for information search. Our study provides the theoretical and methodological foundations that future work can build upon and takes important steps toward better understanding democratic decision making in the information age.

Notes

1. Some elections will of course feature more information about candidates (both relevant and irrelevant) than others. Low-information elections will likely contain less total information available about candidates, but among the information people will encounter when conducting online searches for candidates in those races, some will be relevant (information about the candidate searched for) while other information will be irrelevant, even if little overall information is available compared to higher-profile elections.
2. Beyond a particular voting decision, this account also suggests that irrelevant information can influence people's broader opinions about candidates that can persist beyond the period of a campaign.
3. Prior to data collection, we preregistered the hypothesis, design, and analytic strategy of the study (https://osf.io/uwmm8/).
4. In our preregistration document, we meant to put 128 participants instead of 120 participants in order to have an equal number of participants across our counterbalancing conditions.
5. Participants recruited as part of the group "50 years of age or older" are considered older adults for the purposes of these analyses while those not in this group are considered younger adults. See the Supplementary Information for more information about the sampling frame.
6. More detailed information on the procedure is contained in the Supplementary Information.
7. In addition to the positive and negative articles about candidates, participants also encountered pages which were associated with neither positive nor negative information on the search engine's search results. These "neutral" results resembled popular online directory sites (e.g., WhitePages, Spokeo) that are likely to appear in search results when conducting searches for first and last names and contained no information which could help aid voters in their vote choices (Figure 1d).
8. Data and materials available on request.
9. To calculate discrimination ability, we extracted the amount of time participants spent on each webpage while searching for information in a given voting trial directly from the backend of the Sagamore search engine we created. A participant was considered to have spent time on a webpage if they clicked on the result representing the page in the search results and were taken to the corresponding webpage. Times spent on visited pages were captured in milliseconds.
10. The results are substantively similar if we use the median amount time participants spent on the target and misleading candidates' websites (see Table S1, Model 2).

Disclosure statement

No potential conflict of interest was reported by the authors.

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