The Creation and Building of Trust in an Online Voting System

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

On January 6, 2021, over 2000 people stormed the capitol building in protest of the 2020 presidential election results (Duignan, 2023). As people watched an act of domestic terrorism be committed on national television, they realized that over 200 years integrity and trust in the United States election system had been corroded in a little over two months. This corrosion was spearheaded by an outcry from the losing candidate, President Donald Trump, and other members of the republican party claiming that the election had been "stolen" and was illegitimate, with some of these representatives still being vocal to this day (Associated Press, 2024). The 2020 presidential election also experienced the largest voter turnout in United States history with 154.6 million Americans going to the polls (United States Census Bureau, 2022). This was a result of a year-long two-front campaign being run that both encouraged people to get registered though services like vote.gov, as well as encouraging individuals to vote early or by mail to ensure that they would end up actually voting. Celebrities, such as Taylor Swift, also began encouraging their fans to register and vote, with some even endorsing candidates in the process. However, despite this enormous push for registration and turnout, only two-thirds of all eligible voters cast a ballot in the election, a shockingly low percentage.

In this paper, I will look into the origins and spreading of conspiracy theories, specifically those surrounding election results, as well as discuss the feasibility of designing a new online voting system promoting ease of use, efficiency, and security. I will analyze this theoretical new system using Actor-Network Theory to ensure that the system is as equitable as possible, especially for the poor and the elderly. Finally, I will analyze a survey conducted to determine how college students voted and whether or not they would support this theoretical system.

Methods and Framework

The push for online voting

In the 1990s, some countries, including the United States, began switching over to electronic voting systems in their polling places. By the mid 2000s, these were commonplace in polls around the world. (Lin et al., 2007). The increase in technology in election systems led some to ask if they could simply vote from home and skip the polling lines altogether. Ireland was one of the first countries to conduct a trial in 2002. This lasted until 2010 when it was ultimately scrapped over security concerns. (Ireland Stationery Office, 2004). In 2003, Switzerland created their online voting system. While many considered it an initial success, the need to register in-person in Geneva was often cited as the biggest issue with the system. In 2014, Switzerland closed down the system domestically and it is currently only usable by expatriates. However, in 2019, the Swiss Federal Council was tasked with creating a new trial run of online voting, with some cantons using the new system through 2026. (Federal Chancellery FCh, 2023). In 2005, Estonia introduced its i-voting system to national elections. The system requires the installation of a mobile or desktop app, and you must use your national identification card or a mobile device with a valid digital certificate to verify your identity. I-voting is open for the entire week of the election, and voters can change their vote at any time. All votes are time stamped by a third party, and are ensured to be cryptographically secure. Online votes can be overridden at any time by an in-person ballot, and individual's votes cannot be traced back to them. It is estimated that one third of all votes are cast via the i-voting system (Estonia State Electoral Office, 2025). Estonia is currently the only country with a voting system that has a permanent online option.

Estonia has neither the budget or the technical experts of the United States and they have created a reliable and secure online voting system. Additionally, Robert Krimmer and coauthors conducted a study and found that the country spends less per electronic vote than per vote in physical polling places (Krimmer et al., 2018). Therefore, it stands to reason that the United States could do the same, even given its significantly larger population. The failures of other countries can provide significant advantages as well. Switzerland and Ireland documented their process extensively, and conducted massive studies to determine what made their systems fail. The United States could utilize these to avoid these pitfalls and make development easier.

What new challenges do we face today ?

Trust and confidence are essential for an election system to function. The 2000 presidential election between George W. Bush and Al Gore was a very close race with significant controversy. The epitome of this was the infamous “hanging chads” in punch card ballots in Florida which triggered multiple recounts and ultimately resulted in Bush winning the presidency by only 537 votes. (National Constitution Center, 2022). The 2004 presidential election still had many states using punch card ballots and several reports of glitches within voting machines. Ohio was the subject of both of these, and was a key state in Bush winning re-election. (The Associated Press, 2004). The 2008 election and Obama’s victory was a major tipping point in electoral trust. Ohio was once again a target of voter fraud allegations, with some lawsuits taking over a year to resolve. (The Columbus Dispatch, 2009). Far right voters were outraged that the United States had a black president, and rumors of assassination plots and “race wars” brewed within the group. (Potok, 2008). Others believed that election interference would become necessary for a Republican candidate to ever win the presidency again. Leading up to the 2016

presidential election, Donald Trump claimed “The election is going to be rigged”, a sentiment he also echoed during the 2024 election. However, the accusations with the most evidence were directed towards GOP officials removing registered voters shortly before the election for supposedly “double registering”, or registering to vote in two states. (Palast, 2016). Pressure and resentment had been building over the last 2 decades, and it boiled over following the 2020 presidential election. Trump claimed outright that the election was stolen, and this culminated in the infamous January 6th storming of the capitol. There has still been no evidence to support fraud, rigging, or illegitimacy. However, some individuals still do not believe the 2020 presidential election was legitimate. At its core, the election denialism surrounding the 2020 election is a conspiracy theory. A new voting system would bring about opportunities for conspiracy theories to take root and spread, causing susceptible individuals to distrust the new system. Therefore, it is paramount to understand how they originate and spread so that we can have preventative measures in place.

Conspiracy theories originate in motivated reasoning, or the “psychological phenomenon that describes how people rely on biased cognitive processes while assessing, constructing and evaluating beliefs” (Georgacopoulos, 2020). Eric Oliver and Thomas Wood conducted a study at the University of Chicago and concluded that there are three main types of bias that lead to motivated reasoning. The first is confirmation bias, where an individual is more likely to seek out information that agrees with their current beliefs and avoid material that challenges it. This appears frequently online in the form of echo chambers, which shun outside members and ideas while constantly reinforcing their own beliefs. The second type of bias is disconfirmation bias, where an individual is more skeptical of viewpoints that contradict their beliefs. An example would be seeing negative reviews on a product they like and viewing them as illegitimate or

incorrect. The third type of bias is attitude-congruence bias. This is when people see arguments supporting what they believe to be stronger or more valid than arguments against what they believe. An example would be a scientist continuing to frame tests to support their initial hypothesis when others have proved it wrong, and not trying experiments that would go against it. They also found that fifty percent of Americans believe in at least one conspiracy theory. This ranges from what some would consider harmless theories such as Area 51 houses aliens all the way to the United States government being behind the 9/11 attacks. (Oliver and Wood, 2014).

Political leaders have recently begun to embrace conspiracy theories as a way of securing voters, regardless of whether or not they truly believe them (Wang, 2022). Following his loss in the 2020 presidential election, Donald Trump began spreading the conspiracy theory that the election was rigged. Despite no concrete evidence, the sentiment quickly spread throughout his right-wing voting base. With his re-election in 2024, other Republican candidates are encouraged, if not required, to support this theory if they hope to garner his support and the votes of his election base. Don Bolduc, a 2022 republican nominee for senator, repeatedly switched back and forth on his stance of whether or not the election was stolen (Cillizza, 2022). While it is possible that his opinion could have changed every time, it is far more likely that he was attempting to get votes from as many people as possible, and by any means necessary. Even today, Vice President JD Vance has refused to state that Trump legitimately lost the 2020 election (Associated Press, 2024). However, this has not been without consequence. Some left leaning individuals have had concerns about the security of the 2024 election. This is also a conspiracy theory, but four years of the sentiment being normalized has desensitized individuals to the gravity of what they are really saying. Eight years ago, the concept of a presidential election being rigged would have been absurd. Now, it is commonplace to hear individuals arguing about

the legitimacy of our elections. Conspiracy theories have corroded trust in one of the most important systems of our federal government.

Gathering Data on Student's opinions on online voting

In addition to online research, I conducted a survey targeted at college-age students utilizing a Google Form. College students were chosen as the age group is notoriously underrepresented in the polls and would likely benefit the most from this system. The goal of this survey was to help answer a few questions: how did students vote, would they be willing to vote online if given the opportunity, and what would be their biggest concern surrounding online voting. To answer this, individuals were prompted with six questions. First, they were asked whether or not they voted in the 2024 presidential election. Second, they were asked how and given the options in-person early, in-person election day, by mail, absentee ballot, or N/A for those who answered no to the first question. Third, they were asked if they would have to travel a long distance, which I defined as 50 or more miles, to vote in person. Fourth, they were asked if online voting would be something appealing or convenient to them and given the options of yes, no, and maybe. Fifth, they were given a free response prompt and asked what, if any, were their biggest concern(s) about being able to vote online. Lastly, they were asked where they went to college to ensure that individuals outside the University of Virginia were represented. All data collected was anonymous, and questions 5 and 6 did not require an answer in order to give individuals additional anonymity if they desired. The survey was passed into large social circles, including clubs, greek life, both at and outside the University of Virginia. Individuals who filled out the survey were encouraged to pass it along to their friends to both widen the potential net to other colleges as well as distance myself from those who filled it out.

Sociotechnical Framework and Relevant Groups

I chose Actor-Network theory to analyze this system due to its scale, complexity and fragility. Actor-Network theory is also useful as it emphasizes how human and non-human actors interact. (Latour, 1996). Analysis of non-human actors is important because we cannot build trust and rapport with non-human actors, and yet we must trust them regardless for the system as a whole to function. Key human actors include voters, candidates, political parties, incumbents, poll workers, election officials, and interest groups. The majority of these actors are essential to the functioning of elections, and the outright removal of them would result in the system as a whole failing. Removing voters or candidates defeats the purpose of an election, and poll workers and election officials ensure legitimacy at all levels. The system also contains non-human actors including the vote counting machines and even the ballots themselves. The average voter does not, and will never, understand exactly how these machines work. Therefore, it is easy for them to be a target of doubt within the system. Human actors who create and understand these non-human actors must be representatives for them and act as a trust liaison. An online voting system would result in the replacement of a large percentage of poll workers with additional non-human actors. The other actors would have to place trust in the voting website, the servers that store the votes, and the cryptographic security of both. There would also be additional human actors in the form of programmers who create and IT employees who maintain the system.

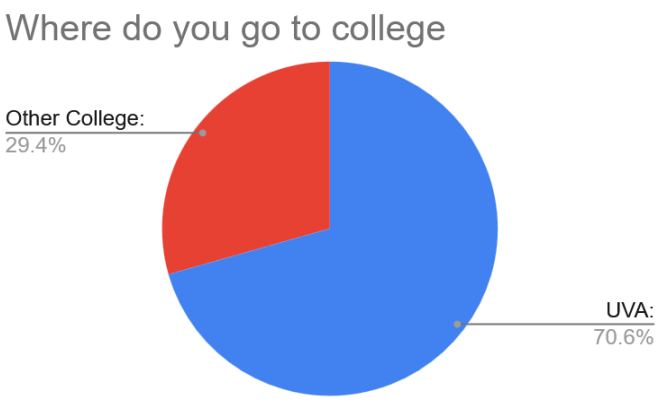
The largest relevant group, and the one I will be looking into is the voters, and ultimately the entire United States population. This group is too large to analyze in one piece, so I will divide them in two ways: age and class. Age is relevant because of the direct correlation with technological literacy, and class is relevant because of the direct correlation with access to

technology. Other divisions, such as race or gender, could be considered in the analysis, however they were intentionally not chosen. If we envision a world where there is no racial or gender bias, class would still play a role in access to technology.

Results and Analysis

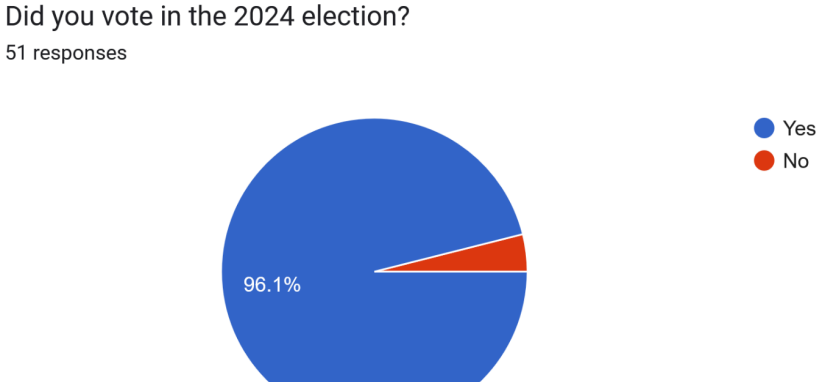
In total, I received 51 responses to the survey. 36 of the responses were students at the University of Virginia, but the remaining responses were from students who attend other universities, such as Penn State, Virginia Tech, Savannah College of Art and Design, George Mason, and Rochester.

Figure 1



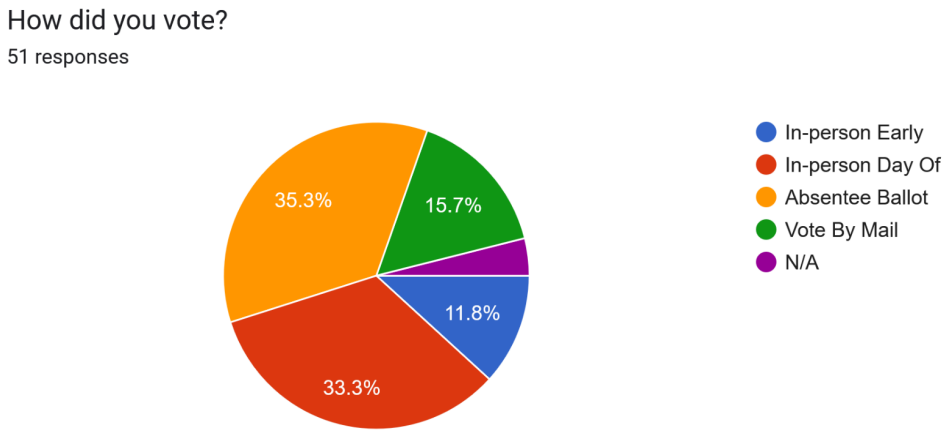
49 responses said they voted in the 2024 presidential election, with 2 saying they did not vote

Figure 2



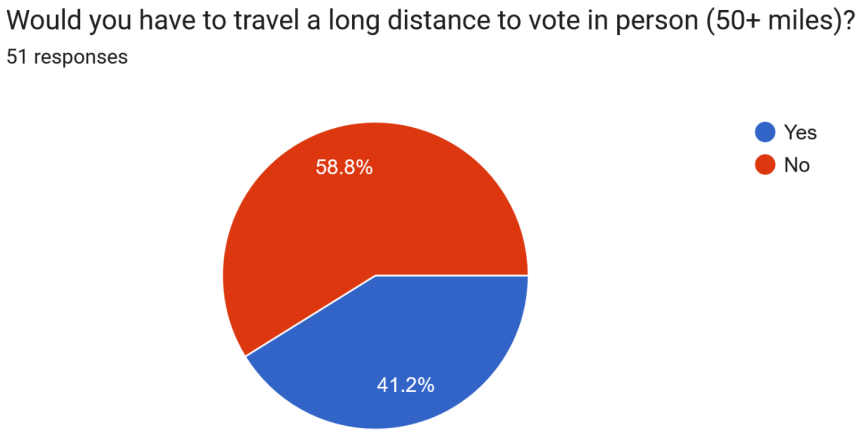
The most popular method of voting was absentee ballot with 18 individuals, followed by in-person day of voting with 17. Vote by mail had 8 responses, and voting in person early had 6 responses.

Figure 3



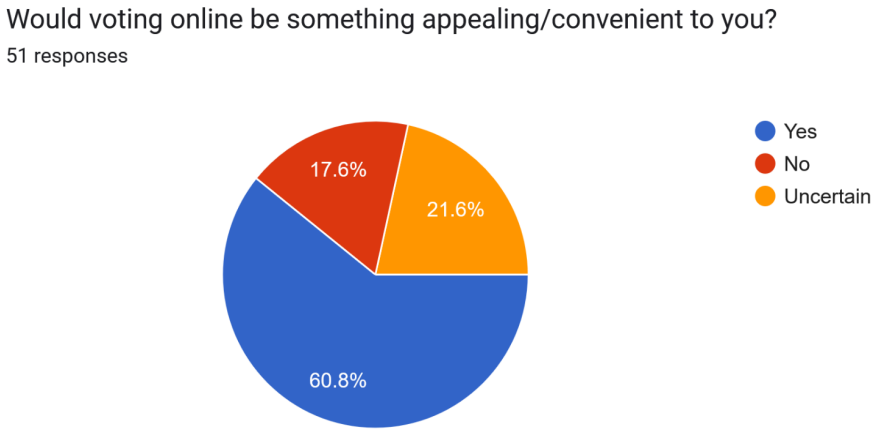
If they were to vote in person, 21 Individuals claimed they would have to travel 50 miles or more. 30 said they would not have to travel that far.

Figure 4



31 individuals said online voting would be appealing to them, while 11 were uncertain. 9 individuals were opposed to it.

Figure 5



The three most popular responses to their largest concerns were security, with 22 responses mentioning it in some way, fraud, with 11 responses, and trust that their vote was actually counted, with 6 responses. Other concerns included site reliability, privacy, trust issues, and preferences to do things in person rather than online.

Data integrity is important when it comes to conducting a survey, and this survey did have its limitations. My goal was to get a good sample of students at the University of Virginia and other colleges. The most glaring issue with the poll is that 96% of respondents said they voted this year. In 2020, approximately half of all individuals 18-29 voted. My guess as to why this happened is that individuals who vote are more likely to fill out surveys than those who do not. The absentee voting and mail in ballot responses were high, composing 51 percent of the responses, but this is to be expected out of college students, many of who travel out of state to attend college. This also contributes to 41 percent of responses saying they would have to travel 50 or more miles to vote in person. However, college students also stand to gain a lot from online

voting. 82% were not opposed to voting online if it was an option. Overall, I believe that data concludes that college students view voting online as something beneficial to them and they would be willing to support it.

Discussion

Voting online would benefit Americans in many ways. Working class individuals would no longer need to take time off of work. Instead they could vote on their phones during lunchtime and not have to take potentially unpaid time off. College students who are away from their voting district would no longer have to request absentee ballots or make the lengthy trek home. Instead they could vote from their laptops during a break between classes. Americans abroad would no longer need to request ballots either. They could simply vote from their home country and not have to worry about international postage getting there and back in time. Individuals who struggle with mobility, both physically and due to a lack of public transit, would be able to vote without unnecessary physical strain. Online voting would also destroy voter intimidation, which is still a very real issue (Wilson, 2024). Minorities who may experience it would not have to physically go to the polls. Instead they could vote from their own homes and not worry about individuals harassing them or making voting as difficult as legally possible.

However, there are two groups that entirely online voting would discriminate against: the poor and the elderly. Poorer Americans can already struggle with getting time off to vote , and taking unpaid time off can lead to further financial insecurity (Ingraham, 2014). As previously stated, voting online would make taking time off of work unnecessary, however, the poorest individuals struggle with access to technology such as laptops, smartphones, and wifi. If voting online was the only option, it would be likely that many of these people would be unable to vote at all, and utilizing publicly available technology such as library computers could result in them

being flagged for fraud. The elderly would also struggle if online voting was the only option. Everyone has struggled with helping their parents or grandparents with technology before, and millions of Americans doing it on election day would be horrendous. This would mean the website would need to be as easy to use and accessible as possible. The elderly are also the most targeted for scams, and a perfectly secure website cannot make up for user error. Because of this, it would be required for in-person voting to still be an option to ensure groups aren't unable to vote due to factors outside of their control.

An online voting system would also have many legal limitations that must be considered. The United States does not have a secure national identification number, instead relying on social security numbers to identify their citizens. Social security numbers are not secure in any way, and some other form of identification, such as a national identification card would likely be required. It is also required that voting remains anonymous. There must be no way to look at the system and determine who an individual voted for, but must also be able to ensure that votes are legitimate and counted properly. These are issues that modern vote counting machines face, so it is very likely that these hurdles would not be impossible to overcome.

Creating trust in the system would be difficult too, especially with security being the most cited concern in the survey. Even if the system is 100% fair and secure, it is likely that conspiracy theorists will attempt to convince others that it is not in some way. Actions such as fact checking on social media can show that these theories have no basis in facts. However, conspiracy theories are founded in biases, and biases are not founded in truth. It can be hard to argue about a conspiracy theory because there is nothing rational about them or the individual's thought processes to believe them. Combating them involves building trust and rapport, which is often an individual process (O'Mahoney et al., 2023). Actions like open sourcing the code would

allow individuals with programming knowledge to see that the system is legitimate, and help convince those around them that it is too. Key actors in the system, including polling officials and others who work within the system would also be good advocates for the system. Elected officials on both sides of the political spectrum, another key actor, would benefit from telling their voting base that the system is good. If side A were to say the system is illegitimate after side B wins an election, then the next time side A wins they would also look illegitimate and we would end up in the scenario we are in today. Each actor would be incentivised to support this system because it gives them their livelihoods. Additional legal protections would also likely be necessary. The federal government would have to take election denialism very seriously, and candidates would have to understand that if they sow doubt in the system they take the entire network as well as themselves with it.

Conclusion

Overall, online voting stands to benefit many groups of voters and make it more accessible to all. Students, a group who would stand to benefit a lot from the system, are in favor of it, even though they have some concerns about security. Estonia has had secure online elections for over two decades now and there is no reason the United States cannot do the same. Elected officials would be encouraged to back the system instead of tearing it down because they are a key actor and besmirching it destroys their livelihoods. Developing personalized relationships with those around you who are likely to be victims of conspiracy theories would be important in preventing their spread. Budget-conscious officials could rest easy knowing that the system could potentially save money in the long term. Individuals with limited mobility would no longer have difficulty accessing in person polling places, convenience would likely increase voter turnout, and voter intimidation would be all but impossible. Online voting would not be

able to replace in-person voting, but could alleviate the need to physically go to the polls or rely on the postal service.

Future research would likely be into the technological choices that would be made in order to make this system a reality, such as utilizing blockchain technology or public encryption algorithms. Larger scale surveys, including those of the groups the system could marginalize would help gather more information on public perceptions. Investigation into the cost of developing the system and whether or not individuals are willing to pay the price is another avenue. Lastly, research can be done into finding the proper channels to raise this proposal to your representatives.

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