

# IN-PERSON VOTING

## BEST PRACTICES AND NEW AREAS FOR RESEARCH

LISA A. BRYANT • DAVID KIMBALL • GRETCHEN MACHT •  
ANITA MANION • MINDY ROMERO • ROBERT M. STEIN

### SUMMARY

Despite the popularity of mail voting in the 2020 election, in-person voting at a physical polling location remains the most common mode of voting in U.S. elections; however, for many voters, access to in-person polling locations is a significant obstacle to voting. Lines and waiting times to process voters may hinder voters' access to the ballot. Inadequate staffing, equipping, and layout of polling locations contribute to increased waiting times, which can diminish satisfaction and voter confidence in the electoral process. Finally, the devices on which voters cast their ballots can determine the accuracy and completion of their ballot choices. While scholars and local election officials know many of the actions needed to remedy these obstacles to in-person voting, others require further study.

In this report, we examine the existing literature on in-person voting to determine best practices and identify areas where more research is needed. The report is broken into two sections. The first section examines the operations of in-person polling, including access to in-person polling locations, checking in to vote and voting, securing the layout of polling locations, recording voter choices, and the design of ballots. The second section of the report examines voters' experiences at in-person polling locations and the consequences these experiences have on voter satisfaction and confidence.

In the first section, we find that the layout and design of voting locations can have significant impacts

on the voter experience. Existing research in this area is somewhat limited, but studies show that there is wide variation in polling place quality, usability, and proximity to voters. Low-income and non-white voters tend to have longer travel and lower-quality polling locations. More research on finding quality locations in all neighborhoods is needed and could make use of new location siting tools that have been developed in recent years. We also find that lines can have a significant impact on the voter experience. Information on arrival rates, processing times, and error rates should be utilized to better understand how these factors contribute to waiting times and the voter experience. We propose that there should also be more research on how to collect accurate data across all jurisdictions, including those that do not use electronic poll books. Better data collection efforts could improve our understanding and lead to improvements in the system.

In section two, we find that in-person voting is generally a positive experience; however, negative experiences at the polls can lower both satisfaction and confidence. We also find that the method of voting can impact voter confidence, with paper ballots providing the highest confidence in election outcomes. Finally, we find that there are persistent differences in the in-person voting experience by racial and ethnic groups. Overall, we find that the research in this area is fairly comprehensive, though may be somewhat dated. While some baseline research in this area should be continued, studies focusing on how to increase voter confidence in the electoral process and how to close

satisfaction and confidence gaps among voters should be prioritized for future research.

Below we list best practices identified and suggestions for new research areas related to in-person voting:

***Best practices:***

- » Maximize access to in-person voting by assuring all voters live within one mile of their respective polling locations. This is particularly true for non-white and low-income voters (Cantoni, 2020).
- » Keep wait times under thirty minutes to reduce negative experiences and prevent voters from leaving the line (Presidential Commission on Election Administration, 2014).
- » Adopt electronic poll voting ebooks with magnetic strips on photographic IDs to reduce wait times (Stein et al., 2020; Hostetter, 2022).
- » Configure and layout polling places in an efficient way to increase usability of the complete voting system and create positive perceptions of the voting experience (McCool-Guglielmo et al., 2022).
- » Use recommended ballot features to reduce the number of unrecorded votes and voter errors on ballots (Kimball and Kropf 2005).
- » Collect data needed to implement analytical methods, allowing improvements in design of the internal layout and flow of polling locations (Stewart III, 2015).

***Need for new research in the following areas:***

- » There is a lack of information on how poll workers exercise discretion in requiring the presentation of IDs, independent of what state laws are. This requires greater oversight through poll-worker training.
- » Election Day vote centers pose a unique problem for optimal siting and operation. Several researchers have developed accessible algorithms for identifying the best spatial location of in-person polling locations. Studies should examine to what extent are election officials aware of these tools and are willing to use them, as well as whether or not they reduce workload for LEOs and/or improve voter experiences.
- » Because of potential litigation and expenses, the issue of error detection is increasingly critical and deserving of more rigorous study by researchers with expertise in human factors engineering, computer science, and related fields.
- » More research is needed to determine the most cost-effective ways for local election officials to collect data in the field (e.g., during in-person

voting) that can be used to address issues such as long lines and other factors that may reduce voter satisfaction and confidence or lead to gaps among different demographic groups.

- » There are currently no statewide or national best practices on polling place designs or layouts. More research on the feasibility of plans that could be universally implemented is needed.

## IN-PERSON VOTING: AN INTRODUCTION

Although the share of people voting in person has declined steadily over the past twenty years (see Figure 1), in-person voting remains the most common method of voting in the United States. The prominence of in-person voting has led much of the research in election administration to focus on this mode. Over the past two decades, this research has examined both the location and operation of polling places. Research on the location of polling places has established that proximity to a polling place increases turnout. Studies into the operation of polling places have shown that long-established tools in operations research and newer advances in logistical studies are valuable for improving the experience of voters. Unlike voting by mail, voting technology is a major topic in the subject of in-person voting. This research has established the importance of applying knowledge from human factors research to the design of ballots and the deployment of equipment.

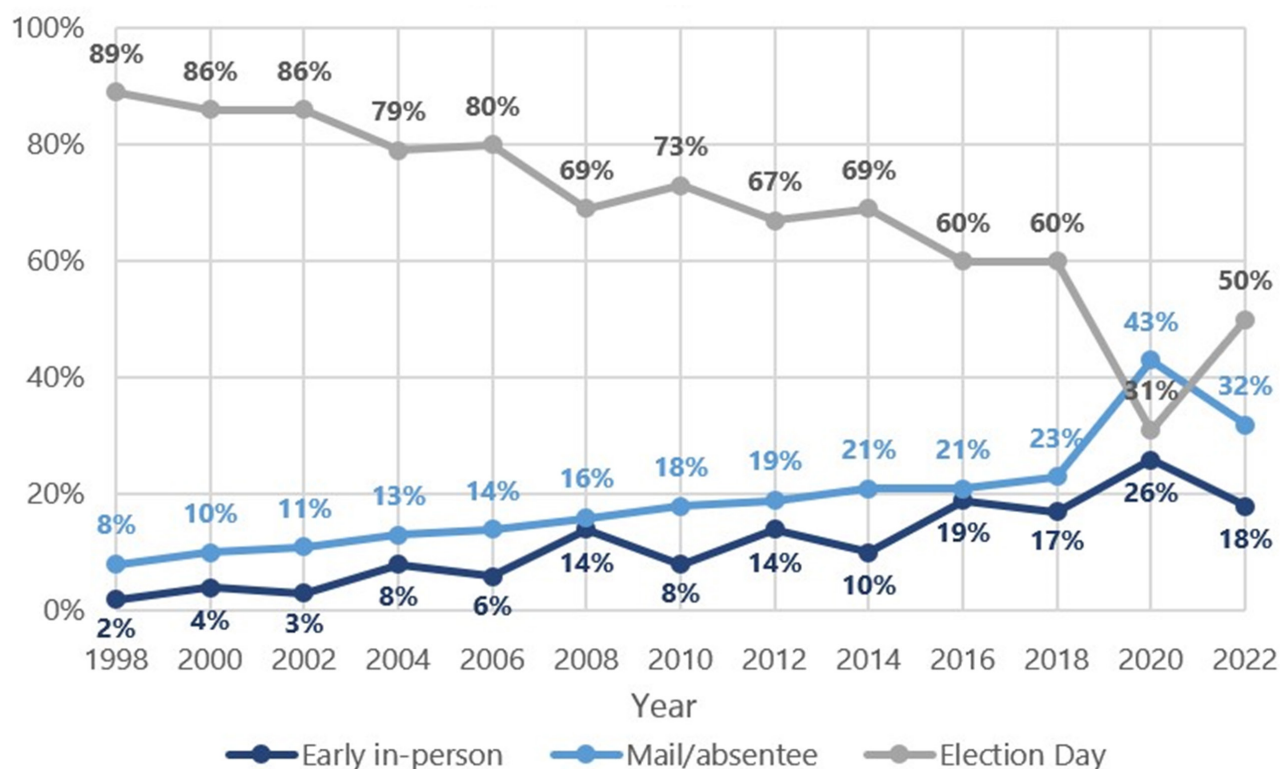
Research into in-person voting has also established many important findings regarding access to the polls by various marginalized populations. In particular, voters of color are disproportionately affected by polling location decisions and wait times to vote.

At the same time, many questions remain in the effort to apply research to increasing access and the voting experience for people who vote in person. Among these questions are:

- » What are the best practices for achieving voter access to in-person polling locations?
- » What are the best practices for minimizing voters' time waiting to vote?
- » What are the best practices for checking in voters at in-person polling locations?
- » What are the best floor plans for in-person polling locations?
- » What are the preferred ballot design features for paper ballots and other ballot-marking devices?

Our review of research on in-person voting distinguishes between what we know about the operation

FIGURE 1. BALLOTS CAST BY DIFFERENT VOTING MODES, 1996-2022



Data Source: MIT Election Data and Science Lab (<https://electionlab.mit.edu/research#reports>)

of in-person voting and the consequences of these operational features for voter participation, satisfaction, and confidence in the outcome of the election. Our goal is to identify the features of in-person voting that are most consequential for achieving positive and equitable voting experiences for U.S. voters and to identify uneven experiences across groups, including by race and ethnicity, age, income, language needs, and for voters with disabilities. At the conclusion of our report, we list best practices that should be followed for various aspects of in-person voting. We also focus on those features of in-person voting for which we do not have sufficient information to make recommendations of best practices. We recommend these topics for further study and future research.

Section One of the report details the operational features of in-person voting.<sup>1</sup> The subsections are as follows:

1. Access to polling locations
2. Checking in to vote
3. Photo identification
4. Improving the layout of polling locations
5. Recording of voter choices: Voting equipment and the design of ballots

Section Two of the report details voters' experiences at the in-person polling locations and the consequences these experiences have on voter satisfaction and confidence. The following subsections are as follows:

1. In-person voting is generally a positive experience
2. Method of voting can affect voter confidence for in-person voters
3. Persistent differences in the in-person voting experience by racial/ethnic groups

Within each section, we consider potential inequitable impacts on communities of color and other electorally underrepresented groups. Equity in election administration refers to the principle of ensuring all eligible individuals and communities have equal access and opportunity to participate in the electoral process, including the ability to register to vote, the ease of accessing polling locations, the ability to cast a ballot that is accurately counted, and fair enforcement of election laws.

---

<sup>1</sup> The appendix to this report provides a brief overview of current voter turnout patterns.

## 1. OPERATIONAL FEATURES OF IN-PERSON VOTING

Policymakers and local election officials have significant discretion in how they operate in-person voting to the benefit of voters. How the voting experience is administered and the options that are made available to voters can be used by elections offices to address disparities in voter turnout rates among groups underrepresented in the U.S. electorate, as well as to the benefit of all voters.

However, the body of research on how the in-person voting process in the U.S. is administered has shown mixed results. In the following subsections of this report, we examine what we know of their impact on the likelihood of voting and the representativeness of the electorate.

### 1.1. ACCESS TO POLLING LOCATIONS

In-person precinct voting requires an individual to travel to an assigned location within their jurisdiction to cast their ballot. The distance from a person's residence to their assigned polling location has been shown to have a significant effect on the likelihood that an eligible voter will cast a ballot (Dyck and Gimpel 2005; Gimpel, Dyck, and Shaw 2004; Haspel and Knotts 2005). The strongest evidence to date is Cantoni's (2020) rigorous test of the distance hypothesis. Cantoni (2020) finds that a quarter-mile increase in distance to the polling place reduces the number of ballots cast by two to five percent, which translates to a one to three percentage point decrease in turnout. The negative impact of distance to the polling place is concentrated disproportionately in areas with a high number of non-white voters, especially in lower-turnout non-federal elections. Corresponding proportional effects in primarily white areas are one-third as large and mostly insignificant.

Voters may also have difficulty getting to polling locations that are challenging to locate, at a new location, hard to travel to, have limited parking, or are not accessible for people with disabilities (Barreto, Cohen-Marks, and Woods 2009; Brady and McNulty 2011; Haspel and Knotts 2005; Tomkins et al. 2023). Black voters are less likely to drive and more likely to use public transportation to vote in person (Romero et al. 2021), and Hispanic voters were more likely to abstain from voting after being reassigned to a different Election Day polling place than voters in other racial groups (Amos, Smith, and Ste. Claire 2017). Polling

places in low-income communities and communities of color tend to be lower quality, which can depress voter turnout (Baretto, Cohen-Marks, and Woods 2009; Pitzer, McClendon, and Sherraden 2021; see Stein et al. 2020 for a contrary finding). These factors can be incorporated into access measurement methodologies for precinct voting locations. Changes in the number and location of Election Day polling locations have a negative effect on voter turnout (Brady and McNulty 2011). Others report that where early voting is available voters respond to changes in the number and location of Election Day polling locations by choosing to vote early (Clinton et al. 2020; Tomkins et al. 2023).

The cost of providing polling locations proximate to every voter can be daunting. Establishing a maximum distance based on Cantoni's (2020) recent findings of one mile is one means of mitigating the negative turnout effects of distance from polling locations, especially in non-white areas. Abbasi et al. (2023) have developed an algorithm "that can reduce these disparities by suggesting new polling locations from a given list of identified public locations at a state level." The authors' algorithm can be calibrated for different distances to accommodate costs and available venues for polling locations. "The developed voting access measurement methodology and algorithmic remediation technique demonstrates that better polling location placement is possible (Abbasi et al. 2023)."

Whether distance to early voting affects turnout is mixed in the literature. Early in-person voting typically allows voters to choose when and where to vote from among multiple locations on multiple days and hours of the day. This results in significant voter convenience that should positively affect turnout. Kaplan and Yuan (2020) "find substantial positive impacts of early voting on turnout equal to 0.22 percentage points of additional turnout per additional early voting day... greater impacts on women, Democrats, independents, and those of child-bearing and working age." Other studies of early voting have mixed results regarding the effects on turnout, with some finding no significant effects (Gronke, Galanes-Rosenbaum, and Miller 2007; Walker, Herron, and Smith 2018) or a short-lived increase in turnout (Giammo and Brox 2008) and others reporting that early voting significantly reduces turnout by undermining the mobilizing effects of Election Day voting (Burden et al. 2014; Larocca and Klemanski 2011). Herron and Smith (2012, 2014) find that Black and Latino voters are more likely to engage in early voting, and cutting early voting days has been found to decrease turnout among those groups (Kaplan and Yuan 2020). Orey and Weil (2021) recommend

providing at least seven days of early voting before a federal election.

In recent years, states and local jurisdictions have begun applying the early-voting vote-center model to voting on Election Day.<sup>2</sup> These Election Day vote centers (EDVC) allow voters to vote at any polling location in their jurisdiction on Election Day. Election Day vote centers pose a different challenge to voter access. Like early voting, EDVCs allow Election Day voters to ballot at any location in their voting jurisdiction. Unlike early voting, these choices are typically restricted to just one day of voting (though this varies by state). When early voters experience difficulty accessing an early voting location, they can choose another location or return to the same location and vote on another day and time. These options are usually not readily available to voters in jurisdictions using only Election Day vote centers.<sup>3</sup> Attempting and failing to access an Election Day vote center sometimes does not give the voter sufficient time to search for other locations to vote. A potential danger with Election Day vote centers is that voters can congest at one or more locations, leaving other locations underutilized. Congested polling places lead to long lines and higher voter wait times.

A challenge with EDVCs is matching the proper number and location of EDVCs with the choices of voters. When done well, this results in higher voter turnout (Stein and Vonnahme 2008); however, when done poorly, the result is lower voter turnout, longer lines waiting to vote, and voter dissatisfaction (Montjoy 2008; Chen, Sadeghpour, and Lamb 2021). Properly identifying where voters choose to cast their ballot on Election Day likely requires a careful trade-off between a large number of small polling locations more centrally located to the voter's residences and

2 The National Conference of States legislatures report that eighteen states allow jurisdictions to use vote centers on Election Day: Arizona, Arkansas, California, Colorado, Hawaii, Indiana, Iowa (for some elections), Kansas, Kentucky, Nevada, New Mexico, North Dakota, South Dakota, Tennessee, Texas, Utah, Washington and Wyoming. In 2022, Illinois established a vote center pilot program in Campaign County, which is set to run until January 1, 2025. In 2006 only one state i.e., Colorado allowed its jurisdictions to use vote centers on Election Day. <https://www.ncsl.org/elections-and-campaigns/vote-centers>

3 In some jurisdictions, early voting is available at vote centers. For instance, in California counties that have adopted the Voter's Choice Act (Senate Bill 450), vote centers are open up to ten days before Election Day, as well as Election Day.



a small number of larger polling locations more centrally located to where voters travel on Election Day (e.g., work, shopping, schools). While implementing EDVCs can reduce the number of rejected provisional ballots, recent research shows that successful implementation requires coordination and adjustments in many elements of the election ecosystem (Manion et al. 2023). There is also some evidence that voters and poll workers prefer a vote-center approach to the traditional system of assigned polling places (Burden et al. 2022; Manion et al. 2023). At the same time, we also note that there is some evidence that a large majority of both voters and potential voters are unaware that these new in-person options are available in their local jurisdiction (e.g., Romero and Chami 2022). There is a clear need for further research on the optimal use of vote centers. Knowing where and when persons vote at Election Day vote centers across different elections will enable LEOs to determine the number, location, and resources (e.g., voting equipment, poll workers) required for each election. These are essential pieces of information for assuring voters do not congest at one Election Day vote center causing long lines to vote and depressing voter turnout.

Monitoring where and when voters choose to cast their in-person ballots is a challenge, and this is particularly true in larger urban areas where the ebb and flow of voters varies significantly between elections. The Center for Inclusive Democracy provides a *Voting Location and Outreaching Tool* (“Voting Location Tool”) for EDVCs and polling places that has been widely used in states. The publicly available tool allows users to visualize relevant data on the number, location, and historical use of EDVCs in different elections and to project an equitable location distribution of EDVCs and polling places at the jurisdiction level for upcoming elections. This tool for siting EDVCs can be calibrated for different criteria (e.g., distance from residential neighborhoods, central business districts).

## 1.2. CHECKING IN TO VOTE

How long is too long to wait to check in to vote? In its 2014 report, the bipartisan Presidential Commission on Election Administration (2014) set a benchmark of thirty minutes as the maximum time a voter should wait in line. Engineering polling places to achieve wait times within this benchmark is largely dependent on the availability of resources to staff elections, voter arrival patterns, community voting characteristics, and the data-enabled intelligence to make efficient choices, a topic the academy has only just begun to study (Mohr et al. 2019).

All forms of in-person voting face the challenge of minimizing the time it takes a voter to check in to vote and cast their ballot. Researchers have found that long lines and waiting times to check in deter people from voting when they arrive at a polling place to vote and while they wait in line to vote (i.e., renegeing or balking) (Stein et al. 2020; Pettigrew 2017; Pettigrew 2021). Increased wait times and technical difficulties have also demonstrated an increase in the likelihood of renegeing (i.e., leaving prior to voting) on voting as the wait time increases (Bernardo and Macht 2022; Stein et al. 2020). Pettigrew (2021) demonstrates that “for every additional hour a voter waits in line to vote, their probability of voting in the subsequent election drops by one percentage point.” Black and Latino voters wait longer in line, on average, than white voters (Stewart III and Ansolabehere 2015; Klain et al. 2020; Pettigrew 2017). Voters in densely populated areas wait longer than those in sparsely populated areas (Pettigrew 2017). Moreover, these negative voting experiences carry over to lower turnout in subsequent elections and disproportionately for underrepresented and infrequent voters.

Waiting times to vote have been productively modeled using standard queuing models from operations research and industrial engineering. Research into wait times has relied on approaches that require only two variables per election (i.e. the voter turnout and the length of time the polls are open) and has been successfully used to ascertain election lines (Allen and Bernshteyn 2006; Edelstein 2006; Fortier et al. 2018). Empirical studies of polling place operations have incorporated manual counts to provide a rate interval for arrival pattern generation that builds on these previously built proportional approaches (Herron and Smith 2016; Spencer and Markovits 2010; Olabisi and Chukwunoso 2012; Stewart III 2015; Seligson 2008). Others rely on rate timetables and percent turnout to establish arrival patterns (Edelstein and Edelstein 2010; Yang, Fry, and Kelton 2009; Yang et al. 2014). For example, Herron and Smith (2016, 253-255) use a fixed arrival rate per time interval for a time-divided Election Day. In an attempt to build more computationally accurate models that account for non-stationarity in arrival patterns (i.e., that not all arrivals are the same throughout the day), some research has extended into non-homogeneous Poisson processes (Houghton 2019).

The empirical study of polling places has established that arrival patterns are bimodal, with a big peak in arrivals in the morning and a smaller peak in the afternoon (Edelstein 2006; Yang et al. 2014), although other studies have found subtle differences in these

peaks (Bernardo, King, and Macht 2022; Yang et al. 2014; Olabisi and Chukwunoso 2012). With respect to the last few decades of work attempting to understand voter arrival patterns, there is still much to learn about how these patterns can change based on communities in order to create predictive models for future elections.

Several factors operate to minimize wait times, including the proper number of polling locations, their siting, staffing, and equipping. Like the siting of polling locations discussed above, staffing and equipping polling locations can follow one of several algorithms (Yang et al. 2014). Election officials often use their own criteria, or “Rules-of-Thumb,” when deciding how many machines, poll workers, and other resources to deploy. Still, little is known about the efficacy of these recipes for stanching long lines and wait times. Many states have laws and regulations that set the number of polling locations per voter as well as the number of voting equipment and poll workers at in-person polling locations. In many instances, these requirements fail to consider the variation in the number of voters voting in different elections. The inflexibility in siting, staffing, and equipping in-person polling locations is a barrier to the implementation of evidence-based practices for the organization of polling places. Research that catalogues the states in which resource allocations are set rigidly in law or regulation would be helpful in guiding advocacy for the change of laws.

States and localities have increasingly used electronic poll books (EPBs) to check in voters at the polls (EAC 2020:1). Electronic poll books, or e-poll books, are systems “containing an electronic list of registered voters that may be transported to the polling location” (California Code of Regulations). The rise in the use of EPBs, as opposed to more traditional paper poll books, has raised questions about how they affect the experience of voters in polling places, particularly wait times to vote. The research here is mixed.

For example, Stein et al. (2020) and Hostetter (2022) both report the use of EPBs increases check-in time. Stein et al. (2020) note that many states with strict ID laws use EPBs to check in voters and have installed card readers in their EPB so that driver’s license information can be more quickly entered and processed. Rather than speeding up check-in, Stein and colleagues report, “[I]n majority nonwhite polling places, where we expect a lower percentage of voters to have a valid photographic ID, a photo ID requirement significantly lengthens the time to check in by thirty-two seconds on average in majority-minority polling places” (Stein et al. 2020, 447). However, other

research undertaken by the University of Rhode Island (Election Assistance Commission, forthcoming) finds that check-in times using EPBs are longer when photo ID is not required (mean = 2.5 minutes) than when it is (1.2 minutes). Further research on this question is important because differences in check-in time may affect voter wait times and require adjusted resource allocations regardless of the ID requirement to keep voter wait times short.

### 1.3. PHOTO IDENTIFICATION

The requirement that voters show voter identification (ID) has been one of the most controversial topics in election administration for the past two decades. Not surprisingly, it has also been well-studied in the literature.

As of April 2023, 35 states have laws requiring voters to provide some form of identification at the polls (NCSL 2023). The National Conference of State Legislatures has classified these laws along two dimensions—(1) whether they require voters to show an ID in order to vote and (2) whether this requirement is “strict” or not. The first dimension can be further refined by, for instance, whether the ID must have a photograph, be government-issued, etc. A “strict” law is one that requires someone who does not have an ID to produce one in order to have their ballot counted. A non-strict law allows the voter to validate their identity in the absence of an ID in some other way, such as signing an affidavit of identity under penalty of perjury.

The voter ID issue is relevant to in-person voting because, until very recently, these laws applied only to voters who cast their ballots in person.

Non-white voters are more likely to lack access to acceptable photographic identification (Henninger, Meredith, and Morse 2021), and those voting without ID are disproportionately Latino and Black compared to those with ID (Fraga and Miller 2021). There are mixed findings regarding the impact of voter ID laws on turnout. Some find little to no evidence of negative impacts (Grimmer, et al. 2018; Ansolabehere 2009; Mycoff, Wagner, and Wilson 2009), while others find significant and negative associations between voter ID laws and diminished turnout for voters who are less educated and lower income (Alvarez, Bailey, and Katz 2008) and for voters who are racial or ethnic minorities (Kuk, Hajnal, and Lajevardi 2020; Hajnal, Lajevardi, and Nielson 2017).

Another important aspect of voter ID laws is their implementation at polling places. A few studies have

demonstrated that poll workers exercise discretion in requiring the presentation of IDs, independent of what state laws are. Ansolabehere (2009) and Barreto and colleagues (2009) found that poll workers in low-income precincts were more likely to ask for ID, and poll workers are more likely to ask non-white voters for ID than white voters (also see Atkeson et al. 2010). Cobb, Greiner, and Quinn (2010) studied poll worker training and discovered that even rigorous training programs only mitigated inappropriate poll worker training to a limited degree. As voter ID laws become more common and stringent, understanding how poll workers actually implement these laws—and how to train them to implement them as written—is important.

#### 1.4. IMPROVING THE LAYOUT OF POLLING LOCATIONS

The layout of polling places is an essential environmental component of system operations that can significantly affect performance and assist in achieving a safe, efficient flow of entities throughout a system (Russell and Taylor 2011). Like the rest of election administration in the U.S., polling place layouts are determined locally. In some jurisdictions, election officials create polling location layout diagrams that are used in the setup process. In contrast, other counties leave the poll workers or setup crews responsible for those decisions, either based on experience or simply fitting those materials into the designated space. Other than the Americans with Disabilities Act of 1990 (ADA), there are no federal standards for polling place layouts, nor has the EAC published best practices on layouts, except for the Election Management Guidelines that discuss physical security and location management.<sup>4</sup> (U.S. Department of Justice 2016; U.S. Election Assistance Commission 2007).

The failure to address the organization of polling places more systematically is likely due to a lack of systems understanding and the assumption that physical characteristics do not impact system performance or the perceived necessity based on their jurisdictional needs. This would be similar to the lack of widespread understanding of the principles of queuing theory before the greater attention to wait times after the 2012 election. At the same time, limited resources, funds, and time may prevent election administrators from

effectively incorporating polling location layouts in election planning.

Despite its importance to effective election administration, the literature exploring resource allocation that has arisen in recent years has overlooked the critical factor of physical space and is rarely recognized in the design and evaluation processes (Stewart III and Ansolabehere 2015). Acknowledging that facilities are inherently limited by their size and shape is necessary for designing polling location layouts for successful elections. McCool-Guglielmo et al. (2022) indicate that layout method and path directionality have a significant effect on average voter travel distance. The work of McCool-Guglielmo et al. (2022) exemplifies the critical role that layout plays in the performance of elections and presents valuable insight into ways in which layout can be utilized to design more efficient in-person voting systems.

Additionally, the organization and layout of in-person polling locations can influence voters' perception of the usability of a voting system. The placement and configuration of voting booths within the polling location is crucial to these perceptions. Space between voting machines, dividers, or screens around the voting booths and laying out booths so that voters do not face one another all significantly increase levels of "anticipated voting systems usability" (Acemyan and Kortum 2016). These findings further buttress other research that shows that trust in voting systems is significantly enhanced by their usability (Acemyan and Kortum 2012).

Studies have demonstrated theoretical improvements in the voting process with a focus on accessibility (e.g., Feng et al. 2010; Jafar, Aziz, and Shukur 2021). The Help America Vote Act (HAVA) requires the number of ADA-compliant voting equipment as "at least one... per polling location." Recently, Bernardo and Macht (2022), challenged this minimum as insufficient and suggested that local election officials select the number of these devices based on the proportion of voters with disabilities in their particular jurisdiction. With that stated, local election officials and various reports have observed a lack of utilization of these ADA-compliant machines when set up in polling locations. This most likely reflects that voters with disabilities often opt for voting methods independent from physical polling locations, with a fifty-three percent utilization of mail voting in 2020 (Miller and Powell 2016; U.S. Election Assistance Commission 2021a). And, of those who vote in person, eighteen percent of surveyed voters with disabilities reported difficulties using accessible voting equipment, understanding the

---

<sup>4</sup> Several states do stipulate the minimum number of polling locations per 10,000 voters. Beyond enforcing federal standards for disable voter access, states do not prescribe standards for the layout of polling locations.



ballot, finding polling locations, navigating polling locations, communicating with election workers, and waiting in lines to vote (Alvarez et al. 2021; Schur and Kruse 2021a; Syed et al. 2022). Yet, when surveyed, forty-nine percent of the voters with disabilities stated that they would prefer to vote in person at a polling location in future elections (Schur and Kruse 2021a, p. 12). Additionally, experts have identified several methods for improving the physical accessibility of polling locations and the usability and functionality of accessible voting equipment (Lord, Stein, and Fiala-Butora 2014; Swierenga et al. 2014; Syed et al. 2022). In general, there is limited scholarship on the disabled voter population, and there needs to be a focus placed on in-person voting for those with disabilities and the importance of investigating polling location planning, resource allocation, and accessibility (Bernardo and Macht, 2022).

To enhance the layout of polling locations, planning and executing the resources allocated to these systems is imperative. Resource allocation is a way of planning and distributing assets across multiple demands, such that all the demands are met and support the task goals. Since we know that election laws directly impact operational efficiency and capacities (Wadowksi et al. 2023), it is important to maximize the efficiency and effectiveness of the electoral process by employing data-driven methods and simulations to inform decision-making (Bernardo, King, and Macht 2022; Bernardo and Macht 2022; Burden and Stewart III 2014; Yang et al. 2014; Alvarez, Atkeson, and Hall 2013).

Basic simulation models and queuing theory have been applied in election administration for resource allocation planning (Buell 2013; Stewart III 2015; Stewart III and Ansolabehere 2015; Schürmann and Wang 2016; Famighetti, Melillo, and Pérez 2014). Much resource allocation literature frequently focuses on: (i) election outcomes (Rully and Nakazato 2014), (ii) “one-size-fits-all” models (Stewart III 2015), or (iii) models tailored to specific jurisdictions during a specific election (Edelstein 2006; Edelstein and Edelstein 2010; Yang, Fry, and Kelton 2009; Yang et al. 2014).

Some of these more prominent studies include the work of Allen and BernshTEYN (2006), which implemented basic queuing theory and data from the 2004 presidential election in Franklin County, Ohio, to determine average wait times and the required number of voting machines to reduce wait times. Yang, Fry, and Kelton (2009) employed a more technical approach, applying two heuristics (i.e., Greedy Improvement Algorithm and Utilization Equalization Model) to simulate and optimize polling location resource al-

location in order to overcome a lack of specific voting system data. Following up on Yang, Fry, and Kelton (2009), Yang and colleagues (2014) generate simulation models to portray five different resource allocation methods. These models provided resource allocation recommendations for the 2008 presidential election in Franklin County, Ohio, based on data collected during the 2006 gubernatorial election in the same jurisdiction. Allen et al. (2020) generated voter wait time estimates through a discrete-event simulation model and optimized the allocation of resources (i.e., poll books and voting machines) through an Indifference Zone Generalized Binary Search. King and Leemis (2016) similarly utilized discrete-event simulation to model a voting process and incremented resource quantities to determine required resources (i.e., poll workers and voting booths) to meet a desired time-in-system (King and Leemis 2016, 202-203). Bernardo, King, and Macht (forthcoming) utilized simulation optimization to identify voting equipment allocation requirements for different polling location consolidation strategies. Ultimately, Allen et al. (2020), Yang et al. (2014), King and Leemis (2016), and Bernardo, King, and Macht (2022) demonstrate that some form of optimization can be utilized to estimate voting equipment resource allocation.

A continuing challenge faced by researchers and election officials who wish to organize polling places on a more rigorous basis is the need for more data describing voting processes for any voting method. These more advanced operations research methods are more computationally advanced, which means a heavy reliance on data to implement most of these techniques. While in-person voting has experienced a high degree of investigation and academic research, it is not until recently that this research has begun to see broader interest from an analytical and operational perspective.

IT is also important to encourage election officials to collect the data needed to implement analytical methods. According to Stewart III (2015), “An important first step in addressing long polling place lines is for local jurisdictions to get into the habit of regularly collecting the data necessary to diagnose the presence of congestion and analyzing it in a way that helps them to allocate the resources they have, or to advocate more effectively for new resources.” For most steps in elections, there is equipment that assists with the fundamental operations of the voting process. Information on arrival rates, processing times, and error rates can be extracted from equipment data log files (Bernardo, Pearson-Merkowitz, and Macht 2021; Jaffe, Stewart III, and Coblenz 2018), and this data should be utilized.

Although there is a significant amount of research that tangentially relates, there is a lack of research considering voters' perceptions of physical safety and security during in-person voting. However, some research discusses the perception that the ballots themselves are considered secret and that the design of a polling place can affect perceptions of secrecy (Karpowitz, et al. 2011). Dowling et al. (2019) suggest that there is also a divergence in public perception of the secrecy of voter's ballots based on voting method. Overall, large numbers of voters do not perceive that their ballots are secret and harbor doubts about the institutional ability to keep them private (Dowling et al. 2019; Gerber et al. 2013).

### 1.5. RECORDING VOTE CHOICES: VOTING EQUIPMENT AND THE DESIGN OF BALLOTS

Voters have historically struggled with complicated and often unfamiliar ballots in the U.S. In-person voting is conducted on a wide variety of voting technologies ranging from pencil and paper ballots, to direct recording electronic devices (DREs), and ballot marking devices (BMDs).

Starting with the controversy following the 2000 recount in Florida, scholarship has attended to the advantages and capabilities of different voting technologies in terms of their security, usability, and voter perception. Research has shown that "voting systems that are not designed to support human perceptual and cognitive limitations also pose a serious and immediate threat" (Kortum and Byrne 2016). The mismatch between the design of voting technologies and "human capabilities can cause tremendous difficulty for voters who are trying to cast a ballot and has almost certainly altered the outcome of elections in the United States" (Kortum and Byrne 2016). The infamous butterfly ballot that plagued the Florida 2000 presidential election is an extreme example of how the design of voting technologies can interfere with voters accurately recording their true ballot preferences. Kimball and Kropf (2005) and others (Laskowski et al. 2004; Laskowski and Redish 2006; Frisina et al. 2008; Herrnson et al. 2008) identify human interaction with different technologies and ballot layout and design as integral to the reliable recording of voters' intended ballot choices.

In the two decades since the 2000 presidential election, the nation has seen two waves in the adoption of new voting equipment on which voters cast their ballots. The first wave, fueled by funds made available through HAVA, saw a growth in optical scanners for paper ballots and an explosion in the use of DREs, which relied

on touch screens to record votes, tallying those votes without the use of paper ballots.<sup>5</sup> In part because they provided no permanent artifact of the ballot, DREs became very controversial. As a consequence, they have begun to be phased out, typically in favor of hybrid systems that have a touch screen that allows the voter to make selections, but which prints out a paper ballot with those selections that is then scanned.

Although BMD systems ultimately produce a paper ballot, which can be verified by the voter and used in a recount or audit as an independent check on the results, doubt has been cast by some about the ability of voters to actually verify that the paper ballot reflects the choices they made on the screen. Studies investigating voting processes utilizing BMDs have focused on assessing voters' ability to identify mistakes on the ballot, yielding varying success rates. Some studies suggest a low success rate (Bernhard et al. 2020), while others indicate a higher success rate (Kortum, Byrne, and Whitmore 2020). The main challenge lies not in the voters casting their ballots, but rather in their capacity to detect and address issues with their ballot after it has been printed (Appel, DeMillo, Stark 2020).

The issue of verifying ballots can be approached as a two-part question: will voters check their ballot, and if they do, are voters scrutinizing its contents? The aforementioned studies tested sample sizes of approximately 108 and 241 participants, respectively, and tested if the participants were (i) observed examining their ballot, (ii) if they reported the error on the exit survey, or (iii) if they reported the error to poll workers (Kortum, Byrne, and Whitmore 2020; Bernhard et al. 2020). These studies reveal that some voters uncover errors without or with interventions to prompt voters to check their ballots. One of the studies showed an increase in voters checking their ballots after proper signage, poll workers prompting participants, and additional materials (i.e., scripts similar to sample ballots that could be filled out prior to voting) (Bernhard et al. 2020). The other study employed differing levels of errors, lengths of the ballots, ballot design, and between-subjects design (Kortum, Byrne, and Whitmore 2020) and saw an increase in shorter Voting Solutions for All People (VSAP) style ballots. Kortum, Byrne, and Whitmore (2020) argue that this two-part approach is more appropriate since voters are separating not checking the ballot in the first place from checking the ballot and failing to find an error. This approach allows for a more nuanced evaluation of suc-

---

5 Some DREs had "voter-verifiable paper trails" (VVPTs) that could serve as a backup.

cesses and failures in relation to the two-step process. By separating these components, a more comprehensive assessment can be made regarding voter behavior in verifying the ballots. BMDs and the accompanying design of the ballot should ensure that voters' intent is accurately recorded when they cast their ballot.

Because millions of dollars are currently being spent on the acquisition of BMD systems, accompanied by millions of dollars in litigation costs necessitated by lawsuits brought by anti-BMD activists, the issue of error detection by users of these devices is critical and is deserving of more rigorous study by researchers with expertise in human factors engineering.

Scholarship has investigated the relationship between ballot characteristics and overvotes and undervotes (Acemyan et al. 2015; Acemyan and Kortum 2017; Alvarez, Beckett, and Stewart III 2011; Ansolabehere and Stewart III 2005; Brady 2000; Bullock III and Hood III 2002; Herrnson, Hanmer, and Niemi 2012; Kimball and Kropf 2005; Knack and Kropf 2003; Reilly and Richey 2011; Shocket, Heighberger, and Brown 1992). Specifically, Kimball and Kropf (2005) and Norden et al. (2012) identified several ballot design features that have consequential effects on both voters and the outcome of elections. These features include instructions written in short and simple sentences (i.e., eighth-grade reading level), the use of graphic design principles, and limiting extraneous text near ballot choices. The Center for Civic Design (2013) has constructed a *Usability Testing Kit*<sup>6</sup> that LEOs can easily download for evaluating their ballot designs.

Studies that investigate ballot characteristics consider the complexity of *ballot questions* (Milita 2017; Niemi and Herrnson 2003; Reilly and Richey 2011), *graphic design principles* (e.g., the use of bolding, shading, positioning of questions, and candidates; Kimball and Kropf 2005), and *ballot format* (e.g., bubble ballots, connect the arrow ballots, punch-card ballots, digital ballots; Herrnson, Hanmer, and Niemi 2012; Bullock III and Hood III 2002; Alvarez, Beckett, and Stewart III 2011; Ansolabehere and Stewart III 2005; Shocket, Heighberger, and Brown 1992; Hamilton and Ladd 1996). Voters in the United States are asked to vote on more offices and on more topics than most other countries, which increases the cost of voting and particularly the cost of gathering information on different offices and ballot questions—a characteristic of US elections that has been attributed to low voter turnout

(Lijphart 1997). Research by Kimball and Kropf (2005) found that recommended ballot features can substantially reduce the number of overvotes and undervotes, particularly for racialized minority groups.

In the face of a lengthy and complicated ballot, voters may speed through and decrease the amount of time they spend reading carefully and making sure they select their choices correctly, particularly on races or questions they know little about or have little personal interest (Selb 2007). Selb (2016, 116) found that “as the length of the ballot increases, voters become frantic, struggling to manage time and using different search and acquisition strategies” and that voters also spent significantly less time researching each candidate as the number of candidates increased. This indicates that the complexities of a ballot, both in length and question type, may also increase voting errors as voters attempt to hurry to get to the end of the ballot. Additionally, the longer the ballot, the more likely voters will be asked to vote on issues and candidates of which they have never heard (Palfrey and Rosenthal 1983). Bernardo, Pearson-Merkowitz, and Macht (2021) found that measures of ballot length affect specific types of voting errors (i.e., human-machine interaction, the inner workings of the mechanics of the machine processing itself, and the voter's ballot marking). These findings generally align with the limited literature on ballot length and errors (e.g., Selb 2007). While an in-person voter has the opportunity to correct errors on their ballot, assuming they cast their ballot into a scanner themselves, a centrally counted ballot with marking errors has little to no opportunity to be corrected (Alvarez, Katz, and Pomares 2011; Kropf and Kimball 2012). While more complex ballots increase the voter's ability to participate in democratic governance, one of the consequences is an increase in voting errors, which can lead to long wait times, voter disenfranchisement, and low voter confidence (Ansolabehere and Shaw 2016; Everett, Byrne, and Greene 2006).

6 <https://www.electiontools.org/tool/usability-testing-kit/#getting-started>

## 2. VOTER EXPERIENCE - VOTER CONFIDENCE AND SATISFACTION

Many of the research findings regarding efficient polling place operations are buttressed by public opinion surveys that measure voter confidence and voter satisfaction. While these two concepts are closely related, there are some slight differences. Voter confidence frequently refers to public confidence that votes are counted correctly, and election outcomes are correct (Atkeson and Saunders 2007; Atkeson, Alvarez, and Hall 2015), but voter confidence can also refer to more general trust in the integrity of the entire electoral process (Alvarez, Hall, and Llewellyn 2008). Voter satisfaction refers to evaluations, positive or negative, of the voting experience. In some cases, voter satisfaction is measured by survey questions that ask voters to report their general voting experience (Stein et al. 2008). In other cases, voter satisfaction is measured by more specific questions about problems with voting equipment, wait times, and evaluations of poll workers and polling place conditions (Alvarez, Atkeson, and Hall 2013; Stewart III 2023). Measures of both concepts reveal similar findings about polling place operations.

We identify four major themes in the research on voter satisfaction and voter confidence associated with in-person voting, either on or before Election Day. These themes are:

1. Voters are generally satisfied with their own voting experience and confident their votes are counted correctly.
2. Those who have negative experiences while voting in person are less satisfied and have lower confidence.
3. Method of voting can affect voter confidence and satisfaction levels.
4. There are persistent differences in the in-person voting experience by racial/ethnic groups.

Below we discuss the findings in each of these areas in more detail.

### 2.1. IN-PERSON VOTING IS GENERALLY A POSITIVE EXPERIENCE.

First, most Americans report high levels of voter confidence and satisfaction when describing their own in-person voting experiences (Alvarez, Hall, and Llewellyn 2008; Alvarez, Atkeson, and Hall 2013; Stewart III 2023; Stein and Vonnahme 2014; Adona and Gronke 2018). Research by Stewart III (2023) pro-

vides much of the evidence for these broad findings. Working with colleagues from the Caltech/MIT Voting Technology Project, he developed the Survey for the Performance of American Elections (SPAЕ), which includes representative samples of registered voters from each state, allowing for comparisons of voting experiences across the fifty states and D.C. The SPAЕ surveys cover many dimensions of the voting experience, including questions about voter registration problems, difficulties with voting equipment, wait times, disruptions at polling places, evaluations of poll workers and polling places, and voter confidence. Finally, the SPAЕ surveys have asked these same questions after many general elections, starting in 2008, supporting an examination of trends over many years. Surveys repeatedly show that large majorities (roughly ninety percent) report positive in-person voting experiences, and very few report voting problems in American general elections (Stewart III 2023; Stein and Vonnahme 2014). Similarly, large majorities of Americans (roughly ninety percent) believe that their own ballots were counted correctly (Stewart III 2023). Administrative data measuring incidents at polling places also suggest a low rate of in-person voting problems and indicate that problems tend to occur at the same polling places in multiple elections (Burden et al. 2017). Negative experiences at the polls can lower satisfaction and confidence.

Second, voters who experience difficulties with polling place voting report lower levels of confidence and satisfaction. Experiencing a technological issue with voting equipment or needing assistance during the voting process is associated with lower levels of voter confidence (Claassen et al. 2013; Bryant 2020; King 2020). Positive interactions with poll workers are associated with higher levels of voter confidence (Atkeson and Saunders 2007; Claassen et al. 2008, 2013; Hall, Monson, and Patterson 2008; Burden and Milyo 2015). Poor voting experiences, especially long wait times and confusing voting equipment or instructions, are also associated with lower levels of voter satisfaction and lower trust in election fairness (Claassen et al. 2008; Stein et al. 2008; Hall, Monson, and Patterson 2008; Stein and Vonnahme 2012, 2014; King 2020; Alvarez, Cao, and Li 2021) and can decrease the likelihood that voters vote in subsequent elections (Pettigrew 2021). Finally, voters with a high sense of privacy while voting report higher confidence (Claassen et al. 2013; Bryant 2020). Long voting lines and wait times are a significant source of problems for in-person voting. Long lines discourage voting, reduce voter confidence, and reduce voter satisfaction (Spencer and Markovits 2010; Claassen et al. 2013; Sances and Stewart III 2015; Stewart III, and Ansolabehere 2015;

Stein et al. 2020). Finally, research shows that when individuals have high levels of confidence in the integrity of elections, they are more likely to turn out in subsequent elections (Alvarez, Hall, and Llewellyn 2008; Birch 2010; Levin and Alvarez 2009).

## 2.2. METHOD OF VOTING CAN AFFECT VOTER CONFIDENCE FOR IN-PERSON VOTERS.

Third, differences in how and where people cast their ballots seem to produce different levels of voter confidence and satisfaction. In-person voters tend to have higher voter confidence than absentee/vote-by-mail voters—those who cast a ballot that was sent to them through the mail (Atkeson, Alvarez, and Hall 2009; Stewart III, Alvarez, and Hall 2010; Bryant 2020; Alvarez, Cao, and Li 2021). Those who cast a paper ballot with an optical scan tabulator tend to have higher levels of voter confidence than those voting on DRE/electronic voting equipment (Stein et al. 2008; Alvarez, Bailey, and Katz 2008; Alvarez, Katz, and Pomares 2011; Claassen et al. 2013). An experiment conducted by de Jong and colleagues (2007) found that paper ballots were rated more highly than DREs in terms of maintaining voting secrecy, but DREs were rated more highly than paper ballots in terms of usability and confidence that ballots were counted correctly. Herrnson and colleagues (2008) also find higher levels of voter satisfaction and confidence with touch-screen machines than with paper ballots. Voters tend to give high ratings to paper ballots and electronic voting machines, but it is not clear which system voters prefer.

With DREs being phased out in favor of BMDs, an important area for future research is whether the newer BMDs are regarded more like the DREs, because of the touchscreen interface, or scanners, because of the method of tabulation.

The transition from precinct-based polling places to early voting and vote centers has produced a more positive voting experience in many cases (Stein and Vonnahme 2012, 2014; Folz 2014; Scheele, Losco, and Vasicko 2009; Manion et al. 2023). However, in a few jurisdictions, implementation problems have produced longer wait times and less pleasant voting experiences after shifting to vote centers (Montjoy 2008; Chen, Sadeghpour, and Lamb 2021). Adopting vote centers requires careful planning and implementation.

It is worth noting that most of the evidence on voter satisfaction and voter confidence is observational. Research by Bryant (2020) provides a rare experiment comparing in-person versus absentee voting. In this experiment, subjects voted using ballots and voting

equipment provided by the local county election office. Subjects were randomly assigned to cast a ballot in person versus via an absentee ballot. Voters in the in-person condition reported significantly higher levels of voter confidence, on average, than voters in the absentee condition. The Bryant (2020) study, conducted before the COVID-19 pandemic, reinforces other research indicating that in-person voting produces higher levels of voter confidence than absentee voting. Another experiment by Acemyan and Kortum (2012) finds that easier-to-understand ballots produce higher levels of trust in the voting system.

## 2.3. PERSISTENT DIFFERENCES IN THE IN-PERSON VOTING EXPERIENCE BY RACIAL/ETHNIC GROUPS

Fourth, there are persistent racial differences between in-person voting experiences. As previously stated (see page four), polling places in minority-white precincts tend to be lower in quality and have fewer resources, poll workers, and voting machines than polling places in majority-white precincts (Barreto, Cohen-Marks, and Woods 2009; Pettigrew 2017). Black, Latino, and Asian American voters tend to report longer wait times, on average, than white voters, and wait times tend to be longer in minority-white neighborhoods than in majority-white neighborhoods (Pettigrew 2017; Stein and Vonnahme 2014; Stewart III 2023). Black voters consistently report lower levels of confidence than white voters, even while voting in person (Alvarez, Hall, and Llewellyn 2008; Claassen et al. 2013), making them less likely to turn out in future elections. However, the presence of co-ethnic poll workers can increase voter confidence (King and Barnes 2019).



## IN-PERSON POLLING PLACE BEST PRACTICES RECOMMENDATIONS

Based on the extant research, there are a number of best practices that are recommended for in-person voting.

### OPERATIONS

#### LOCATING POLLING PLACES

Decisions about the number and location of in-person polling locations should be based on:

- » Prior voting behavior
- » Changes in polling locations
- » Public transportation
- » Available parking
- » Voters' social and demographic traits
- » Distance of polling locations from voters' residences, places of work, etc. (Dyck and Gimpel 2005; Gimpel, Dyck, and Shaw 2004; Haspel and Knotts 2005; Catoni 2020; Tomkins et al. 2023).

#### CONTROLLING LINE LENGTHS

Recommended interventions to mitigate long lines include:

- » Increasing access to vote-by-mail and early in-person voting (Clinton et al. 2021).
- » Decreasing the length of ballots (Stein et al. 2019).
- » Increasing the functionality of electronic vote books to check in voters, and applying queuing theory (Stewart III and Ansolabehere 2015; Pettigrew 2017; Stein et al. 2019).
- » It is also recommended that jurisdictions increase resources as needed to precincts with majority non-white populations (Pettigrew 2017).
- » Identify precincts with a history of long wait times and allocate additional resources (Klain et al. 2020).

#### POLLING PLACE DESIGN

- » Optimize resources (including poll workers) and layout of polling places to minimize long lines and wait times.

#### POLLING PLACES

- » Recruit and train capable poll workers to minimize problems at polling places. Put differently,

invest in quality, hands-on training for poll workers (Atkeson et al. 2010).

- » When installing specific ADA-compliant voting equipment in the polling place (that is separate from other ballot marking options), consider allocating this equipment based on the proportion of voters with disabilities in that jurisdiction.

### VOTER IDENTIFICATION

- » It is critical that poll workers are trained on ID requirements to be sure that they are equally enforced (Ansolabehere 2009; Atkeson et al. 2010; Barreto, Cohen-Marks, and Woods 2009).

### BALLOT DESIGN

- » Adoption of ballot design features should include instructions written in short and simple sentences (i.e., eighth-grade reading level), the use of shading and boldfacing, and limiting extraneous text near ballot choices (Norden et al. 2012; Center for Civic Design 2013; Kimball and Kropf 2005; Herrnson, Hanmer, and Niemi 2012; Bullock III and Hood III 2002; Alvarez, Beckett, and Stewart III 2011).

## FUTURE RESEARCH

### UNIVERSITY-LEO PARTNERSHIPS

- » We recommend collaborations between local universities and colleges and local election officials to conduct research on many of the topics listed below. These collaborations can be a permanent component of local election officials' preparation for elections or post-mortems on elections that exhibit the pathologies.

### POLLING PLACE OPERATIONS

- » The factors that cause EPBs to slow down check-ins at non-white polling places and how to remedy them.
- » What are the needs and demands for staffing in-person polling locations? When is the difficulty LEOs report recruiting poll workers really about recruiting experienced and qualified persons to work the polls, and when is the issue merely finding "enough" people to fill the slots available?

### POLLING PLACE LOCATIONS

- » Operation Research, Lean, Six Sigma, and other engineering techniques could improve operational efficacy, efficiency, and performance of in-person election operations. Future research can include more interdisciplinary research into the elections space, such as human systems engineers and industrial engineers.

### BALLOT DESIGN

- » Overall, there is a notable gap in the literature regarding the human factors application of verifying ballots. However, it presents an opportunity to employ research to investigate how BMDs and alternative voting systems impact human interaction, usability, and decision-making processes. By addressing this gap, more human-centered design can be implemented across voting technologies and methods.

### POLL WORKERS

- » Does seeing bi-partisan teams of poll workers (e.g., party on name tags) at the polls impact confidence that votes will be counted correctly or voter satisfaction and enhance checking in of voters?
- » Does having bi-lingual poll workers increase confidence among non-English speaking voters, similar to the co-ethnic poll worker finding? Conversely, does it decrease confidence among native English speakers?
- » Would seeing a live stream of local polling places increase voter confidence?
- » Would live updates (on a county website) of the number of in-person voters checked in throughout the day at each polling location increase confidence in the final results?

### LIMITATIONS TO INNOVATION

- » State and Federal laws and regulations in the siting, staffing, and equipping in-person polling locations should be revisited and studied to identify the most efficient number, siting, staffing, and equipping polling locations for each type of election.

## APPENDIX

### OVERVIEW OF TURNOUT RESEARCH

#### OVERVIEW OF U.S. VOTER TURNOUT PATTERNS

Historically and still today, disparities in voter turnout rates by group occur within almost any given election. Communities of color, youth, lower-income communities, and other historically underrepresented groups consistently experience lower turnout than white, older, and higher-income populations resulting in a voting electorate (those casting ballots) that is not represented by the overall eligible voter population at the national, state and local level (Barber and Holbein 2022; Fraga 2018). We note here that there are two common ways to calculate turnout rates: registered voter turnout (percent of registered who voted), and eligible voter turnout (percent of adult citizens who voted and are not felons, have been legally declared mentally incompetent, or are otherwise ineligible).

The key predictors of whether an eligible voter casts a ballot are the competitiveness of the election (e.g., safe or competitive district) and demographic group membership (Leighley and Nagler 2014). The dominant theory in the political science literature for why people vote has been that an individual voter engages in a cost-benefits analysis determining whether costs incurred in the act of voting (e.g., time, travel) are outweighed by the perceived benefits of voting (Aldrich 1993). Today, there are a number of additional theories, supported by empirical findings, which suggest individual reasons that can influence the likelihood of voting, perhaps most notably the intrinsic reward from the act of voting and the competitiveness of the election (along with additional campaign funding) (Riker and Ordeshook 1968).

Individuals *do not* vote for a variety of reasons. A lack of interest, dislike of candidates, illness, and a lack of time to vote are among the most cited reasons, with the frequency of these reasons varying by demographic group (U.S. Census Current Population Survey Voting and Registration Supplements, 1964-2022). However, mobilization efforts can positively impact turnout for voters of color, such as get-out-the-vote efforts (García Bedolla and Michelson 2012) and outreach through non-English language media (Ramírez 2013).

The composition of the voting electorate matters. U.S. Voters and nonvoters have different preferences on so-

cial and economic policies, (Wolfinger and Rosenstone 1980; Leighley and Nagler 2014). Due to disparities in turnout, underrepresented groups have less influence on the candidates and policies that are chosen in any given election.

To this mix of turnout predictors, we add in-person voting and its many different types and practices. A deeper understanding of the mechanics of in-person voting tells us much about why we vote, our experiences at the polls, and possibly whether we return to vote in future elections. In this paper, we focus on in-person voting and its myriad of applications as the dominant form of casting a ballot in most U.S. states (only eight states—California, Colorado, Hawaii, Nevada, Oregon, Utah, Vermont, and Washington—are universal vote-by-mail states where all registered voters are automatically sent a ballot in the mail).

Policymakers and local election officials have significant discretion in how they operate in-person voting to the benefit of voters. How the voting experience is administered and the options that are made available to voters can be used by elections offices to address disparities in voter turnout rates among groups underrepresented in the U.S. electorate, as well as to the benefit of all voters.

However, the body of research on how the in-person voting process in the U.S. is administered, including reforms to increase access, as potential mechanisms to increase turnout has shown mixed results. In the following subsections of this report, we examine what we know of their impact on the likelihood of voting and the representativeness of the electorate.

## CONTRIBUTORS

*Lisa A. Bryant* ([lbryant@csufresno.edu](mailto:lbryant@csufresno.edu)) is an Associate Professor of Political Science and chair of the Department of Political Science at California State University, Fresno.

*David Kimball* ([dkimball@umsl.edu](mailto:dkimball@umsl.edu)) is Professor of Political Science and chair of the Department of Political Science at the University of Missouri-St. Louis.

*Gretchen A. Macht* ([macht@uri.edu](mailto:macht@uri.edu)) is an Associate Professor of Industrial & Systems Engineering at The University of Rhode Island.

*Anita Manion* ([maniona@umsl.edu](mailto:maniona@umsl.edu)) is an Assistant Professor of Political Science at the University of Missouri-St. Louis.

*Mindy Romero* ([msromero@usc.edu](mailto:msromero@usc.edu)) is an Assistant Research Professor of Public Policy at the University of Southern California, Price School of Public Policy and the Director of the USC Center for Inclusive Democracy.

*Robert M. Stein* ([stein@rice.edu](mailto:stein@rice.edu)) is Lena Gohlman Fox Professor of Political Science and Fellow, James A. Baker III Institute for Public Policy at Rice University, Houston, TX.

## REFERENCES

- Abbasi, Mohsen, Calvin Barrett, Kristian Lum, Sorelle A. Friedler, and Suresh Venkatasubramanian. 2023. "Measuring and Mitigating Voting Access Disparities: A Study of Race and Polling Locations in Florida and North Carolina," June. <https://doi.org/10.1145/3593013.3594061>.
- Acemyan, Claudia Ziegler, and Philip Kortum. 2012. The Relationship Between Trust and Usability in Systems. Proceedings of the Human Factors and Ergonomics Society Annual Meeting 56 (1): 1842-46. <https://doi.org/10.1177/1071181312561371>.
- Acemyan, Claudia Ziegler, and Philip Kortum. 2016. "Does the Polling Station Environment Matter? The Relation between Voting Machine Layouts within Polling Stations and Anticipated System Usability." Proceedings of the Human Factors and Ergonomics Society Annual Meeting 59 (1): 1066-70. <https://doi.org/10.1177/1541931215591299>.
- Acemyan, Claudia Ziegler, and Philip Kortum. 2017. "Assessing the Usability of the Hart InterCivic ESlate during the 2016 Presidential Election." Proceedings of the Human Factors and Ergonomics Society Annual Meeting 61 (1): 1404-8. <https://doi.org/10.1177/1541931213601835>.
- Acemyan, Claudia Ziegler, Philip Kortum, Michael D. Byrne, and Dan S. Wallach. 2015. From Error to Error: Why Voters Could Not Cast a Ballot and Verify Their Vote with Helios, Prêt à Voter, and Scantegrity II. USENIX Journal of Election Technology and Systems (JETS) 3 (2): 1-25.
- Adona, Natalie, and Paul Gronke. 2018. "Understanding the Voter Experience: The Public's View of Election Administration and Reform." Democracy Fund.
- Ahearn, Caitlin E., Jennie E. Brand, and Xiang Zhou. 2022. How, and for Whom, Does Higher Education Increase Voting? Research in Higher Education 64 (September): 574-97. <https://doi.org/10.1007/s11162-022-09717-4>.
- Aldrich, John H. 1993. Rational Choice and Turnout. American Journal of Political Science 37 (1): 246-78. <https://doi.org/10.2307/2111531>.
- Allen, Theodore T., Muer Yang, Shijie Huang, and Olivia K. Hernandez. 2020. Determining Resource Requirements for Elections Using Indifference-Zone Generalized Binary Search. Computers & Industrial Engineering 140 (February). <https://doi.org/10.1016/j.cie.2019.106243>.
- Allen, Theodore T., and Mikhail Bernshiteyn. 2006. Mitigating Voter Waiting Times. CHANCE 19 (4): 25-34. <https://doi.org/10.1080/09332480.2006.10722812>.
- Alvarez, R. Michael, Lonna Rae Atkeson, and Thad E. Hall. 2013. Evaluating Elections: A Handbook of Methods and Standards. Cambridge England; New York: Cambridge University Press.
- Alvarez, R. Michael, Delia Bailey, and Jonathan N. Katz. 2008. The Effect of Voter Identification Laws on Turnout. SSRN Electronic Journal. <https://doi.org/10.2139/ssrn.1084598>.
- Alvarez, R. Michael, Dustin Beckett, and Charles Stewart III. 2011. Voting Technology, Vote-By-Mail, and Residual Votes in California, 1990-2010. Political Research Quarterly 66 (3): 658-70. <https://doi.org/10.1177/1065912912467085>.
- Alvarez, R. Michael, Jian Cao, and Yimeng Li. 2021. Voting Experiences, Perceptions of Fraud, and Voter Confidence. Social Science Quarterly 102 (4): 1225-38. <https://doi.org/10.1111/ssqu.12940>.
- Alvarez, R. Michael, Thad E. Hall, and Morgan H. Llewellyn. 2008. Are Americans Confident Their Ballots Are Counted? The Journal of Politics 70 (3): 754-66. <https://doi.org/10.1017/s0022381608080730>.
- Alvarez, R. Michael, Gabriel Katz, and Julia Pomares. 2011. The Impact of New Technologies on Voter Confidence in Latin America: Evidence from E-Voting Experiments in Argentina and Colombia. Journal of Information Technology & Politics 8 (2): 199-217. <https://doi.org/10.1080/19331681.2011.559739>.
- Amos, Brian, Daniel A. Smith, and Casey Ste. Claire. 2017. Reprecincting and Voting Behavior. Political Behavior 39 (1): 133-56. <https://doi.org/10.1007/s11109-016-9350-z>.
- Ansolabehere, Stephen. 2009. Effects of Identification Requirements on Voting: Evidence from the Experiences of Voters on Election Day. PS: Political Science & Politics 42 (1): 127-30. <https://doi.org/10.1017/s1049096509090313>.



- Ansolabehere, Stephen, and Daron Shaw. 2016. Assessing (and Fixing?) Election Day Lines: Evidence from a Survey of Local Election Officials. *Electoral Studies* 41 (March): 1–11. <https://doi.org/10.1016/j.electstud.2015.10.010>.
- Ansolabehere, Stephen, and Charles Stewart III. 2005. Residual Votes Attributable to Technology. *The Journal of Politics* 67 (2): 365–89. <https://doi.org/10.1111/j.1468-2508.2005.00321.x>.
- Appel, Andrew W., Richard A. DeMillo, and Philip B. Stark. 2020. Ballot-Marking Devices Cannot Ensure the Will of the Voters. *Election Law Journal: Rules, Politics, and Policy* 19 (3): 432–50. <https://doi.org/10.1089/elj.2019.0619>.
- Atkeson, Lonna Rae. 2014. Voter Confidence in 2010: Local, State, and National Factors. Edited by R. Michael Alvarez and Bernard Grofman. *Election Administration in the United States*. Cambridge University Press. <https://doi.org/10.1017/cbo9781107264199.009>.
- Atkeson, Lonna Rae, R. Michael Alvarez, and Thad E. Hall. 2015. Voter Confidence: How to Measure It and How It Differs from Government Support. *Election Law Journal* 14 (3): 207–19. <https://doi.org/10.1089/elj.2014.0293>.
- Atkeson, Lonna Rae, Lisa Ann Bryant, Thad E. Hall, Kyle Saunders, and Michael Alvarez. 2010. A New Barrier to Participation: Heterogeneous Application of Voter Identification Policies. *Electoral Studies* 29 (1): 66–73. <https://doi.org/10.1016/j.electstud.2009.08.001>.
- Atkeson, Lonna Rae, and Kyle L. Saunders. 2007. The Effect of Election Administration on Voter Confidence: A Local Matter? *PS: Political Science & Politics* 40 (4): 655–60. <https://doi.org/10.1017/s1049096507071041>.
- Atkeson, Lonna, R. Alvarez, and Thad Hall. 2009. “Assessing Electoral Performance in New Mexico Using an Ecosystem Approach.” [http://www.unm.edu/~atkeson/center/papers/Final\\_New\\_Mexico\\_Full\\_Report\\_08\\_Post\\_PEW\\_3.pdf](http://www.unm.edu/~atkeson/center/papers/Final_New_Mexico_Full_Report_08_Post_PEW_3.pdf).
- Barber, Michael, and John B. Holbein. 2022. 400 Million Voting Records Show Profound Racial and Geographic Disparities in Voter Turnout in the United States. Edited by Noam Lupu. *PLOS ONE* 17 (6). <https://doi.org/10.1371/journal.pone.0268134>.
- Barreto, Matt A., Mara Cohen-Marks, and Nathan D. Woods. 2009. Are All Precincts Created Equal?: The Prevalence of Low-Quality Precincts in Low-Income and Minority Communities. *Political Research Quarterly* 62 (3): 445–58. <https://doi.org/10.1177/1065912908319572>.
- Berger, Jonah, Marc Meredith, and S. Christian Wheeler. 2008. “Contextual Priming: Where People Vote Affects How They Vote.” *Proceedings of the National Academy of Sciences* 105 (26): 8846–49. <https://doi.org/10.1073/pnas.0711988105>.
- Bernardo, Nicholas D., Bridgett A. King, and Gretchen A. Macht. “Assessing Precinct Consolidation Strategies through Simulation Optimization.” *Election Law Journal* (forthcoming).
- Bernardo, Nicholas D., Bridgett A. King, and Gretchen A. Macht. 2022. COVID-19 and United States Election Systems: A Simulation Study of In-Person Voting in Rhode Island. *Journal of Simulation* DOI: 10.1080/17477778.2022.2155258.
- Bernardo, Nicholas D., and Gretchen A. Macht. 2022. Assessing Minimum Accessible Voting Equipment Requirements through Simulation. *Election Law Journal: Rules, Politics, and Policy* 21 (4): 259–79. <https://doi.org/10.1089/elj.2022.0019>.
- Bernardo, Nicholas D., Shanna Pearson-Merkowitz, and Gretchen A. Macht. 2021. The Effect of Ballot Characteristics on the Likelihood of Voting Errors. *State Politics & Policy Quarterly*, October, 1–19. <https://doi.org/10.1017/spq.2021.24>.
- Bernhard, Matthew, Allison McDonald, Henry Meng, Jensen Hwa, Nakul Bajaj, Kevin Chang, and J. Alex Halderman. 2020. “Can Voters Detect Malicious Manipulation of Ballot Marking Devices?” *IEEE Symposium on Security and Privacy (SP)*, May, 679–94. <https://doi.org/10.1109/SP40000.2020.00118>.
- Birch, Sarah. 2010. Perceptions of Electoral Fairness and Voter Turnout. *Comparative Political Studies* 43 (12): 1601–22. <https://doi.org/10.1177/0010414010374021>.
- Brady, Henry E, Sidney Verba, and Kay Lehman Schlozman. 1995. Beyond SES: A Resource Model of Political Participation. *The American Political Science Review* 89 (2): 271–94. <https://doi.org/10.2307/2082425>.

- Brady, Henry E. 2000. "Report on Voting and Ballot Form in Palm Beach County." Berkeley: University of California. <http://www.skirsch.com/politics/election2000/brady.pdf>.
- Brady, Henry E., and John E. McNulty. 2011. Turning out to Vote: The Costs of Finding and Getting to the Polling Place. *The American Political Science Review* 105 (1): 115–34. <http://www.jstor.org/stable/41480830>.
- Bryant, Lisa A. 2020. Seeing Is Believing: An Experiment on Absentee Ballots and Voter Confidence. *American Politics Research* 48 (6): 700–704. <https://doi.org/10.1177/1532673x20922529>.
- Buell, Duncan A. 2013. An Analysis of Long Lines in Richland County, South Carolina. *USENIX Journal of Election Technology and Systems (JETS)* 1 (1). <https://www.usenix.org/system/files/conference/evtvote13/jets-0101-buell.pdf>.
- Bullock III, Charles S., and M. V. Hood III. 2002. One Person-No Vote; One Vote; Two Votes: Voting Methods, Ballot Types, and Undervote Frequency in the 2000 Presidential Election. *Social Science Quarterly* 83 (4): 981–93. <https://doi.org/10.1111/1540-6237.00127>.
- Burden, Barry C. 2018. Disagreement over ID Requirements and Minority Voter Turnout. *The Journal of Politics* 80 (3): 1060–63. <https://doi.org/10.1086/696616>.
- Burden, Barry C., David T. Canon, Kenneth R. Mayer, and Donald P. Moynihan. 2014. Election Laws, Mobilization, and Turnout: The Unanticipated Consequences of Election Reform. *American Journal of Political Science* 58 (1): 95–109. <http://www.jstor.org/stable/24363471>.
- Burden, Barry C., David T. Canon, Kenneth R. Mayer, Donald P. Moynihan, and Jacob R. Neihsel. 2017. What Happens at the Polling Place: Using Administrative Data to Look inside Elections. *Public Administration Review* 77 (3): 354–64. <https://doi.org/10.1111/puar.12592>.
- Burden, Barry C., and Jeffrey Milyo. 2015. The Quantities and Qualities of Poll Workers. *Election Law Journal* 14 (1): 38–46. <https://doi.org/10.1089/elj.2014.0277>.
- Burden, Barry C., Robert M. Stein, and et al. 2022. "The Front Lines of Elections: Poll Workers in the New Election Administration Environment." <https://electionlab.mit.edu/sites/default/files/2023-01/The-Front-Lines-of-Elections.pdf>.
- Burden, Barry C., and Charles Stewart III. 2014. *The Measure of American Elections*. <https://doi.org/10.1017/cbo9781107589117>.
- Cantoni, Enrico. 2020. A Precinct Too Far: Turnout and Voting Costs. *American Economic Journal: Applied Economics* 12 (1): 61–85. <https://doi.org/10.1257/app.20180306>.
- Chen, Cynthia, Arisa Sadeghpour, and Matt Lamb. 2021. Vote Centers and the Voter Experience. *American Politics Research* 49 (6): 591–603. <https://doi.org/10.1177/1532673x211029581>.
- Claassen, Ryan L., David B. Magleby, J. Quin Monson, and Kelly D. Patterson. 2008. "At Your Service": Voter Evaluations of Poll Worker Performance. *American Politics Research* 36 (4): 612–34. <https://doi.org/10.1177/1532673x08319006>.
- Claassen, Ryan L., David B. Magleby, J. Quin Monson, and Kelly D. Patterson. 2013. Voter Confidence and the Election-Day Voting Experience. *Political Behavior* 35 (2): 215–35. <http://www.jstor.org/stable/43653066>.
- Center for Civic Design. 2013. *Field Guides to Ensuring Voter Intent*. <https://civicdesign.org/fieldguides/>.
- Clinton, Joshua, Nick Eubank, Adriane Fresh, and Michael E. Sheperd. 2021. Polling place changes and political participation: evidence from North Carolina presidential elections, 2006–2016. *Political Science Research and Methods*. 9:800–817.
- Cobb, Rachael V., D. James Greiner, and Kevin M. Quinn. 2010. Can voter ID laws be administered in a race-neutral manner? Evidence from the city of Boston in 2008. *Quarterly Journal of Political Science* 7 (1): 1–33.
- Cortina, Jeronimo, and Brandon Rottinghaus. 2019. Vote Centers and Turnout by Election Type in Texas. *Research & Politics* 6 (3). <https://doi.org/10.1177/2053168019864224>.
- de Jong, Menno, Joris van Hoof, and Jordy Gosselt. 2007. Voters' Perceptions of Voting Technology: Paper Ballots versus Voting Machine with and without Paper Audit Trail. *Social Science Computer Review* 26 (4): 399–410. <https://doi.org/10.1177/0894439307312482>.

- Dowling, Conor M., David Doherty, Seth J. Hill, Alan S. Gerber, and Gregory A. Huber. 2019. The Voting Experience and Beliefs about Ballot Secrecy. Edited by Gregg R. Murray. PLOS ONE 14 (1). <https://doi.org/10.1371/journal.pone.0209765>.
- Dyck, Joshua J., and James G. Gimpel. 2005. Distance, Turnout, and the Convenience of Voting\*. Social Science Quarterly 86 (3): 531-48. <https://doi.org/10.1111/j.0038-4941.2005.00316.x>.
- Edelstein, William. 2006. "New Voting Systems for NY- Long Lines and High Cost." New Yorkers for Verified Voting. <http://www.wheresthepaper.org/DREs-CauseLongLines061114.pdf>.
- Edelstein, William A., and Arthur D. Edelstein. 2010. "Queuing and Elections: Long Lines, DREs and Paper Ballots." Washington, DC: 2010 Electronic Voting Technology Workshop/Workshop on Trustworthy Elections. [https://www.usenix.org/legacy/events/evtvote10/tech/full\\_papers/Edelstein.pdf](https://www.usenix.org/legacy/events/evtvote10/tech/full_papers/Edelstein.pdf).
- Election Assistance Commission. 2020. Election Administration and Voting Survey 2020: Comprehensive Report.
- Election Assistance Commission (EAC), and URI VOTES. "SMILE - Voting Process Changes." Election Assistance Commission (EAC) (forthcoming).
- "Electronic Poll Books: California Code of Regulations." n.d. California Secretary of State. Accessed July 28, 2023. <https://www.sos.ca.gov/administration/regulations/current-regulations/poll-books#:~:text=Definitions>.
- Everett, Sarah P., Michael D. Byrne, and Kristen K. Greene. 2006. Measuring the Usability of Paper Ballots: Efficiency, Effectiveness, and Satisfaction. Proceedings of the Human Factors and Ergonomics Society Annual Meeting 50 (24): 2547-51. <https://doi.org/10.1177/154193120605002407>.
- Famighetti, Christopher, Amanda Melillo and Myrna Pérez. 2014. Election Day Long Lines: Resource Allocation. Brennan Center for Justice. [https://www.brennancenter.org/sites/default/files/2019-08/Report\\_ElectionDayLongLines-ResourceAllocation.pdf](https://www.brennancenter.org/sites/default/files/2019-08/Report_ElectionDayLongLines-ResourceAllocation.pdf).
- Feng, Quiyuan, Yan Lindsay Sun, Ling Liu, Yafei Yang, and Yafei Dai. 2010. "Voting Systems with Trust Mechanisms in Cyberspace: Vulnerabilities and Defenses." IEEE Transactions on Knowledge And Data Engineering 22: 1766 - 1780.
- Folz, David H. 2014. Vote Centers as a Strategy to Control Election Administration Costs: Findings from a Pilot Project. SAGE Open 4 (1): 1-10. <https://doi.org/10.1177/2158244014525414>.
- Fortier, John C., Charles Stewart III, Stephen Pettigrew, Matthew Weil, and Tim Harper. 2018. "Improving the Voter Experience: Reducing Polling Place Wait Times by Measuring Lines and Managing Polling Place Resources." Bipartisan Policy Center. <https://bipartisanpolicy.org/download/?file=/wp-content/uploads/2019/03/Improving-The-Voter-Experience-Reducing-Polling-Place-Wait-Times-by-Measuring-Lines-and-Managing-Polling-Place-Resources.pdf>.
- Fraga, Bernard L, and Michael G Miller. 2021. Who Does Voter ID Keep from Voting? The Journal of Politics 84 (2): 1091-1105. <https://doi.org/10.1086/716282>.
- Fraga, Bernard L. 2018. The Turnout Gap: Race, Ethnicity, and Political Inequality in a Diversifying America. Cambridge University Press.
- Frisina, Laurin, Michael C. Herron, James Honaker, and Jeffrey B. Lewis. 2008. Ballot Formats, Touchscreens, and Undervotes: A Study of the 2006 Midterm Elections in Florida. Election Law Journal 7 (1): 25-47. <https://doi.org/10.1089/elj.2008.7103>.
- Fullmer, Elliott B. 2015. Early Voting: Do More Sites Lead to Higher Turnout? Election Law Journal 14 (2): 81-96. <https://doi.org/10.1089/elj.2014.0259>.
- García Bedolla, Lisa, and Melissa R. Michelson. 2012. Mobilizing Inclusion: Transforming the Electorate through Get-Out-The-Vote Campaigns. New Haven, Conn.: Yale University Press.
- Gerber, Alan S., Gregory A. Huber, David Doherty, Conor M. Dowling, and Seth J. Hill. 2013. Do Perceptions of Ballot Secrecy Influence Turnout? Results from a Field Experiment. American Journal of Political Science 57 (3): 537-51. <https://doi.org/10.1111/ajps.12019>.
- Giammo, Joseph D., and Brian J. Brox. 2008. Reducing the Costs of Participation: Are States Getting a Return on Early Voting? Political Research Quarterly 63 (2): 295-303. <https://doi.org/10.1177/1065912908327605>.
- Gimpel, James G., Joshua J. Dyck, and Daron R. Shaw. 2004. Registrants, Voters, and Turnout Variability across Neighborhoods. Political Behavior 26 (4): 343-75. <https://doi.org/10.1007/s11109-004-0900-4>.

- Greene, Kristen K., Michael D. Byrne, and Sarah P. Everett. 2006. A Comparison of Usability between Voting Methods. 2006 USENIX/ACCURATE Electronic Voting Technology Workshop (EVT 06).
- Grimmer, Justin, Eitan Hersh, Marc Meredith, Jonathan Mummolo and Clayton Nall. 2018. Obstacles to Estimating Voter ID Laws' Effect on Turnout. *Journal of Politics* 80:1045-1051.
- Gronke, Paul, Eva Galanes-Rosenbaum, and Peter A. Miller. 2007. Early Voting and Turnout. *PS: Political Science & Politics* 40 (4): 639-45. <https://doi.org/10.1017/s1049096507071028>.
- Hajnal, Zoltan, Nazita Lajevardi, and Lindsay Nielson. 2017. Voter Identification Laws and the Suppression of Minority Votes. *The Journal of Politics* 79 (2): 363-79. <https://doi.org/10.1086/688343>.
- Hall, Thad E., J. Quin Monson, and Kelly D. Patterson. 2008. The Human Dimension of Elections: How Poll Workers Shape Public Confidence in Elections. *Political Research Quarterly* 62 (3): 507-22. <https://doi.org/10.1177/1065912908324870>.
- Hamilton, James T., and Helen F. Ladd. 1996. Biased Ballots? The Impact of Ballot Structure on North Carolina Elections in 1992. *Public Choice* 87 (June): 259-80. <https://doi.org/10.1007/bf00118648>.
- Haspel, Moshe, and H. Gibbs Knotts. 2005. Location, Location, Location: Precinct Placement and the Costs of Voting. *The Journal of Politics* 67 (2): 560-73. <https://doi.org/10.1111/j.1468-2508.2005.00329.x>.
- Henninger, Phoebe, Marc Meredith, and Michael Morse. 2021. Who Votes without Identification? Using Individual-Level Administrative Data to Measure the Burden of Strict Voter Identification Laws. *Journal of Empirical Legal Studies* 18 (2): 256-86. <https://doi.org/10.1111/jels.12283>.
- Herrnson, Paul S., Richard G. Niemi, Michael J. Hanmer, Benjamin B. Bederson, Frederick C. Conrad, and Michael W. Traugott. 2008. *Voting Technology: The Not-So-Simple Act of Casting a Ballot*. Brookings Institution Press.
- Herrnson, Paul S., Michael J. Hanmer, and Richard G. Niemi. 2012. The Impact of Ballot Type on Voter Errors. *American Journal of Political Science* 56 (3): 716-30. <https://www.jstor.org/stable/23316016>.
- Herron, Michael C., and Daniel A. Smith. 2012. Souls to the Polls: Early Voting in Florida in the Shadow of House Bill 1355. *Election Law Journal* 11 (3): 331-47. <https://doi.org/10.1089/elj.2012.0157>.
- Herron, Michael C., and Daniel A. Smith. 2014. Race, Party, and the Consequences of Restricting Early Voting in Florida in the 2012 General Election. *Political Research Quarterly* 67 (3): 646-65. <https://doi.org/10.1177/1065912914524831>.
- Herron, Michael C., and Daniel A. Smith. 2016. Precinct Resources and Voter Wait Times. *Electoral Studies* 42: 249-63. <https://doi.org/10.1016/j.electstud.2016.02.014>.
- Hood, M.V., and Charles S. Bullock. 2011. An Examination of Efforts to Encourage the Incidence of Early In-Person Voting in Georgia, 2008. *Election Law Journal* 10 (2): 103-13. <https://doi.org/10.1089/elj.2010.0084>.
- Hostetter, Joshua D. 2022. Do Electronic Poll Books Increase Voter Wait Times? *Election Law Journal* 21 (4). <https://doi.org/10.1089/elj.2022.0017>.
- Houghton, James P. 2019. "Estimation of Voter Arrival Rates Using Electronic Poll Book Transaction Logs." <https://doi.org/10.23860/thesis-houghton-james-2019>.
- Hur, Aram, and Christopher H. Achen. 2013. Coding Voter Turnout Responses in the Current Population Survey. *Public Opinion Quarterly* 77 (4): 985-93. <https://doi.org/10.1093/poq/nft042>.
- Jafar, Uzma, Mohd Juzaidin Ab Aziz, and Zarina Shukur. 2021. Blockchain for Electronic Voting System—Review and Open Research Challenges. *Sensors* 21 (17). <https://doi.org/10.3390/s21175874>.
- Jaffe, Jacob, Charles Stewart III, and Jacob Coblenz. 2018. Modeling Voting Service Times with Machine Logs. *SSRN Electronic Journal*, July. <https://doi.org/10.2139/ssrn.3216178>.
- Kaplan, Ethan, and Haishan Yuan. 2020. Early Voting Laws, Voter Turnout, and Partisan Vote Composition: Evidence from Ohio. *American Economic Journal: Applied Economics* 12 (1): 32-60. <https://doi.org/10.1257/app.20180192>.
- Karpowitz Christopher F., J. Quin Monson, Lindsay Nielson, Kelly D. Patterson, and Steven A. Snell. 2011. Political Norms and the Private Act of Voting. *Public Opinion Quarterly* 75: 659-685.

- Kimball, David C., and Martha Kropf. 2005. Ballot Design and Unrecorded Votes on Paper-Based Ballots. *Public Opinion Quarterly* 69 (4): 508–29. <https://doi.org/10.1093/poq/nfi054>.
- King, Bridgett A. 2020. Waiting to Vote: The Effect of Administrative Irregularities at Polling Locations and Voter Confidence. *Policy Studies* 41 (2-3):230-248.
- King, Bridgett A., and Alicia Barnes. 2019. Descriptive Representation in Election Administration: Poll Workers and Voter Confidence. *Election Law Journal* 18 (1): 16–30. <https://doi.org/10.1089/elj.2018.0485>.
- King, Catherine K., and Lawrence M. Leemis. 2016. “Data Analysis and Simulation: Optimizing Voter Wait Times.” 2016 IEEE Systems and Information Engineering Design Symposium, April. <https://doi.org/10.1109/sieds.2016.7489298>.
- Klain, Hannah, Kevin Morris, Max Feldman, and Rebecca Ayala. 2020. “Waiting to Vote: Racial Disparities in Election Day Experiences.” New York University School of Law: Brennan Center for Justice. [https://www.brennancenter.org/sites/default/files/2020-06/6\\_02\\_WaitingtoVote\\_FINAL.pdf](https://www.brennancenter.org/sites/default/files/2020-06/6_02_WaitingtoVote_FINAL.pdf).
- Knack, Stephen, and Martha Kropf. 2003. Roll-off at the Top of the Ballot: International Undervoting in American Presidential Elections. *Politics & Policy* 31 (4): 575–94. <https://doi.org/10.1111/j.1747-1346.2003.tb00163.x>.
- Kortum, Philip, and Michael D. Byrne. 2016. The Importance of Psychological Science in a Voter’s Ability to Cast a Vote. *Current Directions in Psychological Science* 25 (6): 467–73. <https://doi.org/10.1177/0963721416665104>.
- Kortum, Philip, Michael D. Byrne, and Julie Whitmore. 2020. “Voter Verification of BMD Ballots Is a Two-Part Question: Can They? Mostly, They Can. Do They? Mostly, They Don’t,” March. <https://doi.org/10.48550/arxiv.2003.04997>.
- Kropf, Martha, and David C. Kimball. 2012. *Helping America Vote: The Limits of Election Reform*. New York: Routledge.
- Kuk, John, Zoltan Hajnal, and Nazita Lajevardi. 2020. A Disproportionate Burden: Strict Voter Identification Laws and Minority Turnout. *Politics, Groups, and Identities* 10 (1): 1–9. <https://doi.org/10.1080/21565503.2020.1773280>.
- Larocca, Roger, and John S. Klemanski. 2011. U.S. State Election Reform and Turnout in Presidential Elections. *State Politics & Policy Quarterly* 11 (1): 76–101. <https://doi.org/10.1177/1532440010387401>.
- Laskowski, Sharon J., and Janice (Ginny) Redish. 2006. “Making Ballot Language Understandable to Voters.” 2006 USENIX/ACCURATE Electronic Voting Technology Workshop (EVT 06). <https://www.usenix.org/conference/evt-06/making-ballot-language-understandable-voters>.
- Laskowski, Sharon J., James H. Yen, Marguerite W. Autry, John Cugini, and William H. Killam. 2004. “Improving the Usability and Accessibility of Voting Systems and Products.” NIST Special Publication, January. <https://doi.org/10.6028/nist.sp.500-256>.
- Laurison, Daniel, and Ankit Rastogi. 2023. “Income Inequality in U.S. Voting: A Visualization.” *Socius: Sociological Research for a Dynamic World* 9 (January). <https://doi.org/10.1177/23780231231154358>.
- Leighley, Jan E., and Jonathan Nagler. 2014. *Who Votes Now?: Demographics, Issues, Inequality, and Turnout in the United States*. JSTOR. Princeton University Press. <http://www.jstor.org/stable/j.ctt4cgcqb>.
- Levin, Ines, and R. Michael Alvarez. 2009. “Measuring the Effects of Voter Confidence on Political Participation: An Application to the 2006 Mexican Election.” Caltech/MIT Voting Technology Project. <https://dspace.mit.edu/handle/1721.1/96610>.
- Lijphart, Arend. 1997. *Unequal Participation: Democracy’s Unresolved Dilemma*. Presidential Address, American Political Science Association, 1996. *American Political Science Review* 91 (01): 1–14. <https://doi.org/10.2307/2952255>.
- Lord, Janet E., Michael A. Stein, and János Fiala-Bu-tora. 2014. Facilitating an Equal Right to Vote for Persons with Disabilities. *Journal of Human Rights Practice* 6 (1): 115–39. <https://doi.org/10.1093/jhuman/hut034>.
- Manion, Anita, David Kimball, Joseph Anthony, Adriano Udani, and Ryan Pritchard. 2023. Vote at Any Polling Place: A Case Study of St. Louis County, Missouri. *Election Law Journal*, July. <https://doi.org/10.1089/elj.2022.0056>.



- McCool-Guglielmo, Emma C, Nicholas D Bernardo, Jennifer I Lather, and Gretchen A Macht. 2022. Impact of Facilities Layout Methods on In-Person Elections: A Theoretical Exploration. *Journal of Simulation*, September: 1–19. <https://doi.org/10.1080/17477778.2022.2125847>.
- McGhee, Eric, Jennifer Paluch, and Mindy Romero. 2022. “Equity in Voter Turnout after Pandemic Election Policy Changes.” Public Policy Institute of California. <https://www.ppic.org/?show-pdf=true&docraptor=true&url=https%3A%2F%2Fwww.ppic.org%2Fpublication%2Fequity-in-voter-turnout-after-pandemic-election-policy-changes%2F>.
- McGhee, Eric, and Mindy Romero. 2020. “Effects of Automatic Voter Registration in the United States.” University of Southern California: Center for Inclusive Democracy. <https://static1.squarespace.com/static/57b8c7ce15d5dbf599fb46ab/t/5eb9847fb7a1f3362ced2d99/1589216438166/USC+CCEP+Effects+of+AVR+in+the+U.S.+Final.pdf>.
- McNulty, John E., Conor M. Dowling, and Margaret H. Ariotti. 2009. Driving Saints to Sin: How Increasing the Difficulty of Voting Dissuades Even the Most Motivated Voters. *Political Analysis* 17 (4): 435–55. <https://doi.org/10.1093/pan/mpp014>.
- Milita, Kerri. 2017. Beyond Roll-Off: Individual-Level Abstention on Ballot Measure Voting. *Journal of Elections, Public Opinion and Parties* 27 (4): 448–65. <https://doi.org/10.1080/17457289.2017.1300157>.
- Miller, Michael G. 2013. Do Audible Alerts Reduce Undervotes? Evidence from Illinois. *Election Law Journal* 12 (2): 162–78. <https://doi.org/10.1089/elj.2012.0147>.
- Miller, Michael G., Michelle D. Tuma, and Logan Woods. 2015. Revisiting Roll-off in Alerted Optical Scan Precincts: Evidence from Illinois General Elections. *Election Law Journal* 14 (4): 382–91. <https://doi.org/10.1089/elj.2015.0299>.
- Mohr, Zachary, JoEllen V. Pope, Martha E. Kropf, and Mary Jo Shepherd. 2019. Strategic Spending: Does Politics Influence Election Administration Expenditure? *American Journal of Political Science* 63 (2): 427–38. <https://doi.org/10.1111/ajps.12422>.
- Montjoy, R. S. (2008). The Public Administration of Elections. *Public Administration Review*, 68(5), 788–799. <https://www.jstor.org/stable/25145665>.
- Mycoff, Jason D., Michael W. Wagner, and David C. Wilson. 2009. The Empirical Effects of Voter-ID Laws: Present or Absent? *PS: Political Science & Politics* 42 (1): 121–26. <https://doi.org/10.1017/s1049096509090301>.
- Niemi, Richard G., and Paul S. Herrnson. 2003. Beyond the Butterfly: The Complexity of U.S. Ballots. *Perspective on Politics* 1 (02): 317–26. <https://doi.org/10.1017/s1537592703000239>.
- Norden, Lawrence, David C. Kimball, and Whitney Quesenbery. 2012. “Better Design, Better Elections.” Brennan Center for Justice. New York University School of Law. <https://www.brennancenter.org/our-work/research-reports/better-ballots>.
- Olabisi, Ugbebor O., and Nwonye Chukwunoso. 2012. Modeling and Analysis of the Queue Dynamics in the Nigerian Voting System. *The Open Operational Research Journal* 6 (1): 9–22. <https://doi.org/10.2174/1874243201206010009>.
- Orey, Rachel, and Matthew Weil. 2021. “Improving the Voting Experience after 2020 | Bipartisan Policy Center.” [Bipartisanpolicy.org](https://bipartisanpolicy.org/report/voting-experience-2020/). April 7, 2021. <https://bipartisanpolicy.org/report/voting-experience-2020/>.
- Palfrey, Thomas R., and Howard Rosenthal. 1983. A Strategic Calculus of Voting. *Public Choice* 41 (1): 7–53. <https://www.jstor.org/stable/30024031>.
- Pettigrew, Stephen. 2017. The Racial Gap in Wait Times: Why Minority Precincts Are Underserved by Local Election Officials. *Political Science Quarterly* 132 (3): 527–47. <https://doi.org/10.1002/polq.12657>.
- Pettigrew, Stephen. 2021. “The Downstream Consequences of Long Waits: How Lines at the Precinct Depress Future Turnout.” *Electoral Studies* 71 (August). <https://doi.org/10.1016/j.electstud.2020.102188>.
- Pitzer, Kyle, Gena Gunn McClendon, and Michael Sherraden. 2021. Voting Infrastructure and Process: Another Form of Voter Suppression? *Social Service Review* 95 (2): 175–209. <https://doi.org/10.1086/714491>.
- Ramírez, Ricardo. 2013. “Mobilizing Opportunities: The Evolving Latino Electorate and the Future of American Politics,” January, 1–177.
- Reilly, Shauna, and Sean Richey. 2011. Ballot Question Readability and Roll-Off: The Impact of Language Complexity. *Political Research Quarterly* 64 (1): 59–67. <https://www.jstor.org/stable/41058322>.

- Riker, William H., and Peter C. Ordeshook. 1968. A Theory of the Calculus of Voting. *American Political Science Review* 62 (1): 25–42. <https://doi.org/10.2307/1953324>.
- Romero, Mindy, Anna Meier, Barbara Chami, and Emily Pavia. 2021. “The Experience of Black Voters in California: 2020 General Election and Beyond.” Center for Inclusive Democracy. <https://static1.squarespace.com/static/57b8c7ce15d5dbf599fb46ab/t/621fae5d9e646142640e7a4a/1646243427169/US-C+CID+Black+Voting+Experience+in+California+Report+FINAL.pdf>.
- Romero, Mindy, and Barbara Chami. 2022. “California Voter’s Choice Act: 2020 Primary Election Voter Outreach and Education.” Center for Inclusive Democracy. <https://static1.squarespace.com/static/57b8c7ce15d5dbf599fb46ab/t/6281c24af826eb-6d4ebb0459/1652671058933/CID+SOS+VCA+Primary+Election+Voter+Outreach+and+Education+Report.pdf>.
- Rully, Achmad, and Hidenori Nakazato. 2014. Study on Election Result Risk Model Using Multiagent Simulation. *Journal of Information Processing* 22 (4): 626–33. <https://doi.org/10.2197/ipsjip.22.626>.
- Russell, Roberta S, and Bernard W Taylor. 2011. *Operations Management: Creating Value along the Supply Chain*. 7th ed. John Wiley & Sons, INC.
- Sances, Michael W., and Charles Stewart III. 2015. Partisanship and Confidence in the Vote Count: Evidence from U.S. National Elections since 2000. *Electoral Studies* 40 (December): 176–88. <https://doi.org/10.1016/j.electstud.2015.08.004>.
- Scheele, Raymond H., Joseph Losco, and Sally Jo Vassicko. 2009. “Assessing and Evaluating Indiana Vote Centers: The Development of a National Model.” Final Report to the Pew Center on the States. <https://cardinalscholar.bsu.edu/server/api/core/bitstreams/c549efcb-2b82-4e01-8f8d-47fdc351ef43/content>.
- Schur, Lisa, Mason Ameri, and Meera Adya. 2017. Disability, Voter Turnout, and Polling Place Accessibility. *Social Science Quarterly* 98 (5): 1374–90. <https://doi.org/10.1111/ssqu.12373>.
- Schürmann, Carsten, and Jian Wang. 2016. “Measuring Voter Lines.” 2016 Conference for E-Democracy and Open Government (CeDEM), May. <https://doi.org/10.1109/cedem.2016.16>.
- Seib, J. Drew. 2016. Coping with Lengthy Ballots. *Electoral Studies* 43 (September): 115–23. <https://doi.org/10.1016/j.electstud.2016.05.011>.
- Selb, Peter. 2007. Supersized Votes: Ballot Length, Uncertainty, and Choice in Direct Legislation Elections. *Public Choice* 135 (3-4): 319–36. <https://doi.org/10.1007/s11127-007-9265-7>.
- Seligson, Dan. 2008. “Data for Democracy: Improving Elections through Metrics and Measurement.” The Pew Center of the States. [https://www.pewtrusts.org/-/media/legacy/uploadedfiles/wwwpewtrustsorg/reports/election\\_reform/final20dfdpdf.pdf](https://www.pewtrusts.org/-/media/legacy/uploadedfiles/wwwpewtrustsorg/reports/election_reform/final20dfdpdf.pdf).
- Shocket, Peter A., Neil R. Heighberger, and Clyde Brown. 1992. The Effect of Voting Technology on Voting Behavior in a Simulated Multi-Candidate City Council Election: A Political Experiment of Ballot Transparency. *The Western Political Quarterly* 45 (2): 521–37. <https://doi.org/10.2307/448724>.
- Sinclair, Betsy, Steven S. Smith, and Patrick D. Tucker. 2018. “It’s Largely a Rigged System”: Voter Confidence and the Winner Effect in 2016. *Political Research Quarterly* 71 (4): 854–68. <https://doi.org/10.1177/1065912918768006>.
- Spencer, Douglas M., and Zachary S. Markovits. 2010. Long Lines at Polling Stations? Observations from an Election Day Field Study. *Election Law Journal* 9 (1): 3–17. <https://doi.org/10.1089/elj.2009.0046>.
- Stein, Robert M. 1998. Early Voting. *The Public Opinion Quarterly* 62 (1): 57–69. <http://www.jstor.org/stable/2749718>.
- Stein, Robert M., and Patricia A. García-Monet. 1997. Voting Early but Not Often. *Social Science Quarterly* 78 (3): 657–71. <https://www.jstor.org/stable/pdf/42863559.pdf>.
- Stein, Robert M., Christopher Mann, Charles Stewart III, Zachary Birenbaum, Anson Fung, Jed Greenberg, Farhan Kawsar, et al. 2020. Waiting to Vote in the 2016 Presidential Election: Evidence from a Multi-County Study. *Political Research Quarterly* 73 (2): 439–53. <https://doi.org/10.1177/1065912919832374>.
- Stein, Robert M., and Greg Vonnahme. 2008. Engaging the Unengaged Voter: Vote Centers and Voter Turnout. *The Journal of Politics* 70 (2): 487–97. <https://doi.org/10.1017/s0022381608080456>.

- Stein, Robert M., and Greg Vonnahme. 2011. Voting at Non-Precinct Polling Places: A Review and Research Agenda. *Election Law Journal* 10 (3): 307–11. <https://doi.org/10.1089/elj.2011.1036>.
- Stein, Robert M., and Greg Vonnahme. 2012. When, Where, and How We Vote: Does It Matter? *Social Science Quarterly* 93 (3): 692–712. <https://doi.org/10.1111/j.1540-6237.2012.00863.x>.
- Stein, Robert M., and Greg Vonnahme. 2014. “Polling Place Practices and the Voting Experience.” In *The Measure of American Elections*, edited by Barry C. Burden and Charles Stewart III. Cambridge University Press.
- Stein, Robert M., Greg Vonnahme, Michael Byrne, and Daniel Wallach. 2008. Voting Technology, Election Administration, and Voter Performance. *Election Law Journal* 7 (2): 1123–35. <https://doi.org/10.1089/elj.2008.7203>.
- Stewart III, Charles. 2015. “Managing Polling Place Resources.” Massachusetts Institute of Technology. Caltech/MIT Voting Technology Project. November 2015. <http://web.mit.edu/vtp>.
- Stewart III, Charles. 2023. “How We Voted in 2022: A Topical Look at the Survey of the Performance of American Elections.” <https://electionlab.mit.edu/sites/default/files/2023-05/How-We-Voted-In-2022.pdf>.
- Stewart III, Charles H., R. Michael Alvarez, and Thad E. Hall. 2010. “Voting Technology and the Election Experience: The 2009 Gubernatorial Races in New Jersey and Virginia.” MIT Libraries. Caltech/MIT Voting Technology Project. July 14, 2010. <http://hdl.handle.net/1721.1/96629>.
- Stewart III, Charles, and Stephen Ansolabehere. 2015. Waiting to Vote. *Election Law Journal* 14 (1): 47–53. <https://doi.org/10.1089/elj.2014.0292>.
- “Survey of the Performance of American Elections (SPAEL).” 2022. MIT Election Data + Science Lab. 2022. <https://electionlab.mit.edu/research/projects/survey-performance-american-elections>.
- Swierenga, Sarah J., Graham L. Pierce, Stephen R. Blosser, Adi Mathew, and James E. Jackson. 2014. Smart Voting Joystick for Accessible Voting Machines. *The Journal on Technology and Persons with Disabilities* 2 (December): 144–54.
- Syed, Ihaab, Michelle Bishop, Sarah Brannon, Erika Hudson, and Kristen Lee. 2022. Designing Accessible Elections: Recommendations from Disability Voting Rights Advocates. *Election Law Journal* 21 (1). <https://doi.org/10.1089/elj.2020.0677>.
- “The American Voting Experience: Report and Recommendations of the Presidential Commission on Election Administration.” 2014. <https://web.mit.edu/supportthevoter/www/files/2014/01/Amer-Voting-Exper-final-draft-01-09-14-508.pdf>.
- Tomkins, Sabina, Keniel Yao, Johann Gaebler, Tobias Konitzer, David Rothschild, Marc Meredith, and Sharad Goel. 2023. Blocks as Geographic Discontinuities: The Effect of Polling-Place Assignment on Voting. *Political Analysis* 31:165–180.
- U.S. Census Bureau. 2023. “Current Population Survey: Voting and Registration Supplements, 1964–2022.” United States Census Bureau. 2023. <https://www.census.gov/topics/public-sector/voting.html>.
- U.S. Department of Justice. 2016. “ADA Checklist for Polling Places.” Americans with Disabilities Act. June 2016. <https://www.ada.gov/votingchecklist.pdf>.
- U.S. Election Assistance Commission. 2007. “Polling Places and Vote Centers.” October 2007. [https://www.eac.gov/sites/default/files/document\\_library/files/Quick\\_Start\\_Guide\\_-\\_Polling\\_Places\\_and\\_Vote\\_Centers\\_1.pdf](https://www.eac.gov/sites/default/files/document_library/files/Quick_Start_Guide_-_Polling_Places_and_Vote_Centers_1.pdf).
- U.S. Election Assistance Commission. 2023. Election Administration and Voting Survey 2022 Comprehensive Report, June 2023. [https://www.eac.gov/sites/default/files/2023-06/2022\\_EAVS\\_Report\\_508c.pdf](https://www.eac.gov/sites/default/files/2023-06/2022_EAVS_Report_508c.pdf).
- “Voter ID Laws.” 2023. National Conference of State Legislatures (NCSL). January 25, 2023. <https://www.ncsl.org/elections-and-campaigns/voter-id>.
- “Voting Location Tool.” n.d. Center for Inclusive Democracy. Accessed July 28, 2023. <https://cid.usc.edu/vlot>.
- Wadowski, Gianna M., Leonie S. Otte, Nicholas D. Bernardo, and Gretchen A. Macht. 2023. “A Comparative Study of Electronic and Paper Ballot Voting Systems in Modern Elections.” Proceedings of the 2023 Election Sciences, Reform, & Administration Conference (ESRA) Annual Conference, Athens, GA, May 31–June 2.

Walker, Hannah L., Michael C. Herron, and Daniel A. Smith. 2018. Early Voting Changes and Voter Turnout: North Carolina in the 2016 General Election. *Political Behavior* 41 (4): 841–69. <https://doi.org/10.1007/s11109-018-9473-5>.

Wolfinger, Raymond E, and Steven J Rosenstone. 1980. *Who Votes?* New Haven: Yale University Press.

Yang, Muer, Michael J. Fry, and W. David Kelton. 2009. “Are All Voting Queues Created Equal?” *IEEE Xplore*. December 1, 2009. <https://doi.org/10.1109/WSC.2009.5429279>.

Yang, Muer, Michael J. Fry, W. David Kelton, and Theodore T. Allen. 2014. Improving Voting Systems through Service-Operations Management. *Production and Operations Management* 23 (7): 1083–97. <https://doi.org/10.1111/poms.12088>.