

Double-Bubble Ballots

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Abstract

We propose and discuss a format for optical-scan ballots where each selection has *two* bubbles. This format may be used for both machine-marked (e.g. by a BMD) and hand-marked ballots. The first column of bubbles is called the VOTE column; this may be marked by the machine. The second column is the LOCK column; this may be used by the voter to confirm (or override) the vote in the VOTE column.

Normally a voter would fill in the LOCK column with the same selections as shown in the VOTE column, confirming that these selections are indeed what the voter intends.

However, the double-bubble format has the advantage of allowing a voter to change their mind (spoil a ballot) without necessitating a new ballot; as the LOCK column may act as a fresh ballot.

Voters are motivated to complete the LOCK column by hand, as it prevents a third party from changing their vote later (as would be possible if the LOCK column were left blank).

This explicit indication of verification by the voter of their choices may mitigate some of the problems seen with BMD (ballot-marking devices), where voters are observed to frequently not verify their ballots.

The double-bubble proposals is designed to motivate voters to verify their BMD-printed ballots. It does not address the problem that voters may have limited recall of the choices and may thus have cognitive limitations on their ability to verify the ballot. See [3] for more discussion of this point.

1 Introduction

Best practice for elections is based on voter-verified paper ballots [4, 5].

It has often been assumed (by me, among others) that it didn't matter much whether the ballots were hand-marked or machine-marked (e.g. by a BMD). As long as the voter had the opportunity to verify the marked paper ballot before it was cast, then it was reasonable to consider the ballots as "voter-verified."

However, recent research [3] (see also [1, 2]) has found that a large number of voters do *not* verify machine-marked ballots.

It thus appears necessary, when machine-marked paper ballots are used, to incentivize an *explicit* mechanism for voter verification.

The proposal here provides a *second* bubble in each row that the voter may mark, the "LOCK" bubble, that allows the voter to confirm that the candidate named in this row is indeed the voter's intended choice. See Figure 1.

The first bubble in each row is the one that may be marked by the BMD. See Figure 2.

A lazy voter may nonetheless ignore verification, and cast their ballot anyway, with no LOCK bubble marked. Their ballot would count as an ordinary BMD ballot would count today. But it would be clear that the voter did not explicitly verify the ballot.

A conscientious voter can fill in the LOCK bubble next to each selected candidate, thereby "locking-in" the selection. See Figure 3.

The tabulation method favors the LOCK column, if it is marked at all. (A blank LOCK column is ignored.)

Thus, a voter may **override** the BMD-marked choice, by providing a *different* choice in the LOCK column. See Figure 4.

Once the correct column is determined (VOTE or LOCK), tabulation and auditing proceed as usual.

Voters are incentivized to verify their selections and mark them as verified in the LOCK column, as otherwise a malicious third party with access to the cast ballot could override their choice by marking a different candidate in the LOCK column. This rationale explains why the second bubble is called the LOCK bubble.

Voters who are hand-marking double-bubble ballots would typically fill out both the VOTE and LOCK bubbles simultaneously for the selected candidates.

Note that it is also possible to have ballots pre-printed (say, by a political party) and made available to voters. These ballots would have pre-printed “suggestions” in the form of already-filled bubbles in the VOTE column. Voters could take these ballots into a private polling booth and “edit” the ballot to their taste by overriding any desired party-suggested candidates with the LOCK bubbles.

Once again: the double-bubble proposal is designed only to motivate voters to verify their BMD-printed ballots. It does not address the problem that voters may have limited recall of the choices they made and may thus have cognitive limitations on their ability to verify the ballot. See [3] for more discussion of this point. Nor does it address the many other criticisms of BMDs found in the excellent paper [1]. In particular, it does not make BMDs *contestable* or *defensible* (see their paper for definitions).

The bottom line is that double-bubble ballots are likely to lie somewhere between hand-marked paper ballots (which are necessarily “verified” as they are marked) and single-bubble BMD ballots (which may be rarely verified), in terms of the frequency of verification by voters.

A crude analysis suggests that raising the probability that a voter verifies their ballot from say 10% to 90% could reduce the number of errors in ballots (perhaps intentional errors made by the BMDs) by a factor of 9. Real-world ex-

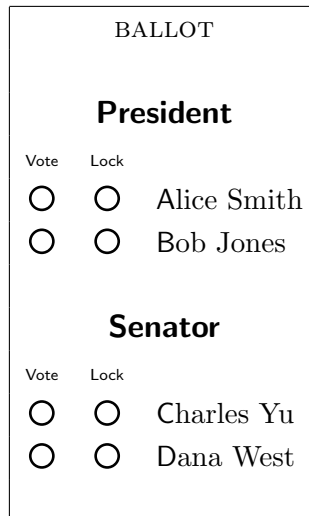


Figure 1: A blank double-bubble ballot. Each candidate has *two* bubbles to the left of their name: one in a VOTE column and one in a LOCK column.

perimentation is necessary to see to what extent double-bubble ballots actually increase the rate at which voters verify their ballots.

Note that it now becomes possible to gather statistics on the number of voters who have explicitly verified and confirmed (locked-in) their choices.

We also do not address here the question as to whether election officials can detect attempted cheating by a BMD by analyzing the frequency with which the LOCK column disagrees with the VOTE column. One might consider extensions of the double-bubble protocol to include such detection attempts, but they would necessarily be based on various kinds of empirical assumptions (e.g. about the rate at which voters change their minds when they verify a ballot).

The idea suggested here may not be entirely novel (please send me links to any relevant prior work), but I suggest that it deserves some further consideration.

One could even imagine a policy that says that if BMDs are to be widely used, they should only be used with double-bubble ballots, and filling in the LOCK column should be mandatory.

BALLOT		
President		
Vote	Lock	
<input checked="" type="radio"/>	<input type="radio"/>	Alice Smith
<input type="radio"/>	<input type="radio"/>	Bob Jones
Senator		
Vote	Lock	
<input type="radio"/>	<input type="radio"/>	Charles Yu
<input checked="" type="radio"/>	<input type="radio"/>	Dana West

Figure 2: A machine-marked double-bubble ballot, showing a vote for Alice Smith for President and a vote for Dana West for Senator in the VOTE column.

BALLOT		
President		
Vote	Lock	
<input checked="" type="radio"/>	<input checked="" type="radio"/>	Alice Smith
<input type="radio"/>	<input type="radio"/>	Bob Jones
Senator		
Vote	Lock	
<input type="radio"/>	<input checked="" type="radio"/>	Charles Yu
<input checked="" type="radio"/>	<input type="radio"/>	Dana West

Figure 4: Here the voter has hand-marked their confirmation of a vote for Alice Smith for President by filling in the second bubble next to Alice Smith’s name. For Senator, however, the voter does not confirm the vote for Dana West, but instead casts a vote for Charles Yu, by filling in the second bubble next to Charles Yu’s name. (When the LOCK column and the VOTE column disagree, the LOCK column takes priority, unless the LOCK column is blank, in which case the VOTE column takes priority.)

BALLOT		
President		
Vote	Lock	
<input checked="" type="radio"/>	<input checked="" type="radio"/>	Alice Smith
<input type="radio"/>	<input type="radio"/>	Bob Jones
Senator		
Vote	Lock	
<input type="radio"/>	<input type="radio"/>	Charles Yu
<input checked="" type="radio"/>	<input checked="" type="radio"/>	Dana West

Figure 3: The ballot of Figure 2 after the voter has “locked-in” (verified) their votes for Alice Smith for President and for Dana West for Senator by filling in by hand the second bubble in the two corresponding rows. Locking prevents the choices from being changed later by someone else.

2 Conclusion

Double-bubble ballots attempt to address an outstanding open problem in the design of BMD-printed paper ballots—how to motivate voters to actually verify them. Double-bubble ballots don’t, however, solve many of the other problems present in BMD-based voting systems.

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