Final report
Designing an accessible RCV ballot

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Center for Civic Design

Center for Civic Design

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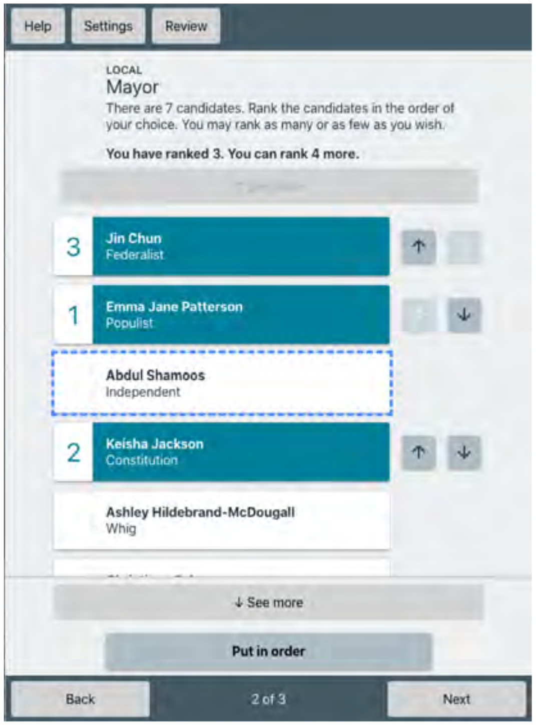


LOCAL

Mayor

There are 7 candidates. Rank the candidates in the order of your choice. You may rank as many or as few as you wish.

You have ranked 3. You can rank 4 more.

3 **Jin Chun** Federalist

1 **Emma Jane Patterson** Populist

Abdul Shamoos Independent

2 **Keisha Jackson** Constitution

Ashley Hildebrand-McDougall Whig

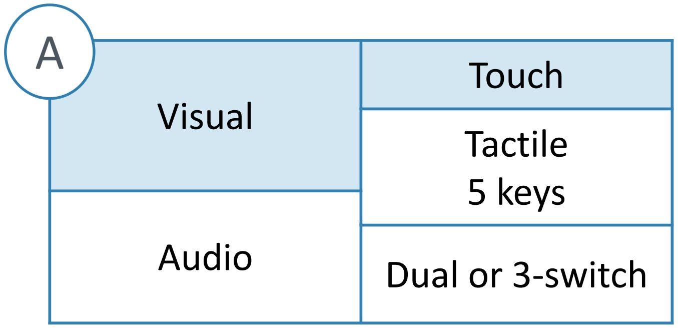
Completed

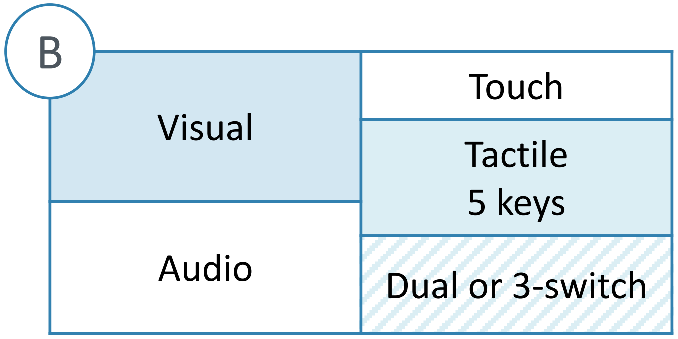
- ✓ Created a prototype to use for testing
- ✓ Initial testing of the prototype, updating the design between small groups of test sessions
- ✓ Audio workshop, testing the audio voicing script with blind voters
- ✓ Final testing with prototype to confirm the interaction design

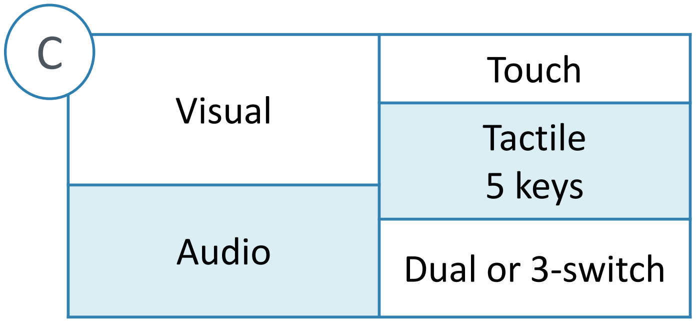
Designing accessible ranking for all interaction modes

The default navigation and ranking interaction was designed for to work with a wide range of voters abilities

We tested using 3 interaction modes







We wanted a default interaction design for ranked choice voting that would work for the most voters without special settings needed. Rather than focusing on disabilities, we designed to the interaction modes identified in the VVSG 2.0 requirements:

A. Visual + Touch
All of the buttons and selections can be used in any order.

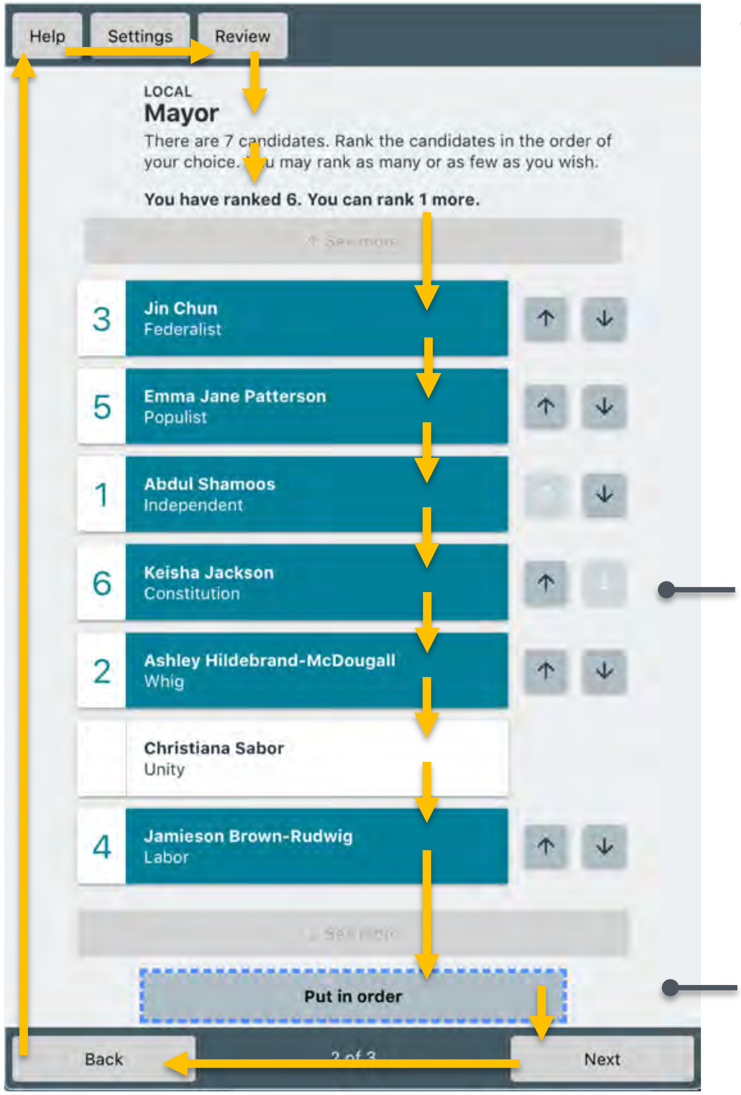
B. Visual + Tactile keys
The screen is viewed visually, but navigation is limited to:

5 keys:	up/down, left/right and select or
dual switch:	(back)/next and select

The dual switch can be emulated with the tab key

C. Audio + Tactile keys
5-button navigation with no visual overview of the screen or current status of the interaction or ranking progress

Navigating with tactile keys: down/up/select



LOCAL

Mayor

There are 7 candidates. Rank the candidates in the order of your choice. You may rank as many or as few as you wish.

You have ranked 6. You can rank 1 more.

3	Jin Chun Federalist
5	Emma Jane Patterson Populist
1	Abdul Shamoos Independent
6	Keisha Jackson Constitution
2	Ashley Hildebrand-McDougall Whig
	Christiana Sabor Unity
4	Jamieson Brown-Rudwig Labor

The standard tactile keypad for voting systems has 5 primary keys: up, down, left, right and select. We emulated these keys with the arrow keys and Enter/Return key on a standard keypad.

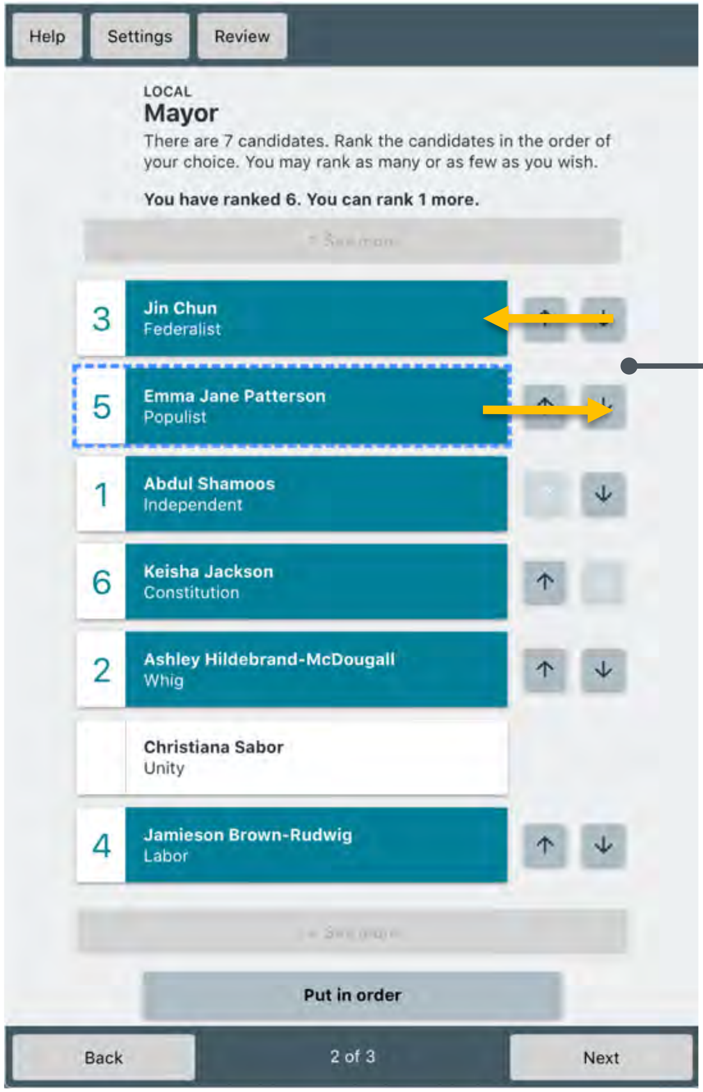
- The Up and Down key moves around the screen to every screen element

  *The up and down keys **skip** the buttons to change the ranking of a candidate.*

- The Select key activates the button currently in focus, completing the action the button represents.

  In this screen shot, with the focus on Put in Order, pressing Select will arrange the candidates in order

Navigating with tactile keys: left/right/select



LOCAL
Mayor
There are 7 candidates. Rank the candidates in the order of your choice. You may rank as many or as few as you wish.

You have ranked 6. You can rank 1 more.

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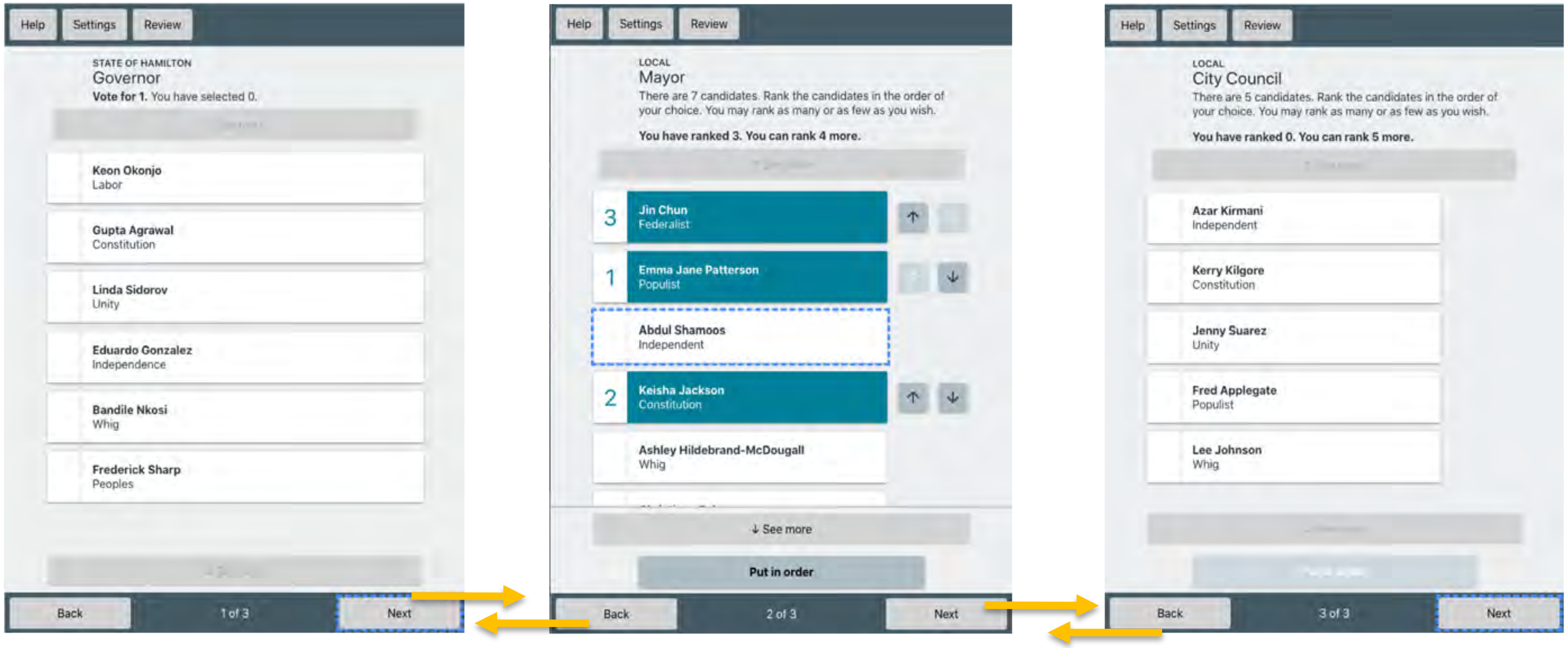
1	**Abdul Shamoos** Independent
6	**Keisha Jackson** Constitution
2	**Ashley Hildebrand-McDougall** Whig
	Christiana Sabor Unity
4	**Jamieson Brown-Rudwig** Labor

The Left and Right keys are only operational in one situation:

- When the focus is on a candidate that has already been ranked
- And only to reach options to move up or down:
  - The *first-ranked* candidate cannot move up, so that button is not active
  - The *last-ranked* candidate cannot move down, so that button is not active.

Selecting a button to move a candidate up or down in the rankings executes that action, but does not move the focus from the button

Navigating with tactile keys: moving between contests



STATE OF HAMILTON
Governor
Vote for 1. You have selected 0.

Keon Okonjo
Labor

Gupta Agrawal
Constitution

Linda Sidorov
Unity

Eduardo Gonzalez
Independence

Bandile Nkosi
Whig

Frederick Sharp
Peoples

LOCAL
Mayor
There are 7 candidates. Rank the candidates in the order of your choice. You may rank as many or as few as you wish.

You have ranked 3. You can rank 4 more.

3 Jin Chun
Federalist

1 Emma Jane Patterson
Populist

Abdul Shamoos
Independent

2 Keisha Jackson
Constitution

Ashley Hildebrand-McDougall
Whig

LOCAL
City Council
There are 5 candidates. Rank the candidates in the order of your choice. You may rank as many or as few as you wish.

You have ranked 0. You can rank 5 more.

Azar Kirmani
Independent

Kerry Kilgore
Constitution

Jenny Suarez
Unity

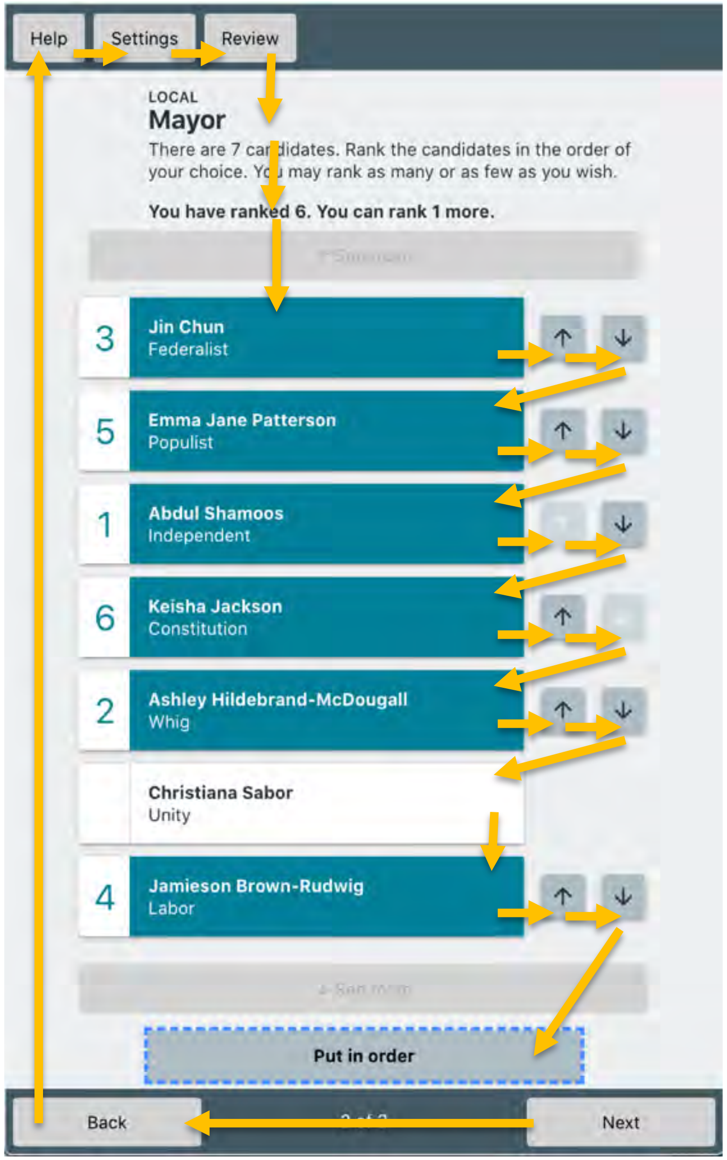
Fred Applegate
Populist

Lee Johnson
Whig

Moving between screens requires navigating to the Next or Previous buttons.

In some voting systems, the Right and Left keys on the 5-key keypad are a shortcut to move between contest but we have used those buttons to enable changing rankings.

Navigating with a 2-switch or 3-switch keypad



LOCAL

Mayor

There are 7 candidates. Rank the candidates in the order of your choice. You may rank as many or as few as you wish.

You have ranked 6. You can rank 1 more.

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Constitution

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Whig

Christiana Sabor
Unity

4 Jamieson Brown-Rudwig
Labor

2-switch keyboard (Next, Select)

This is the most limited interaction mode, and used for sip-and-puff or for voters with extremely limited dexterity.

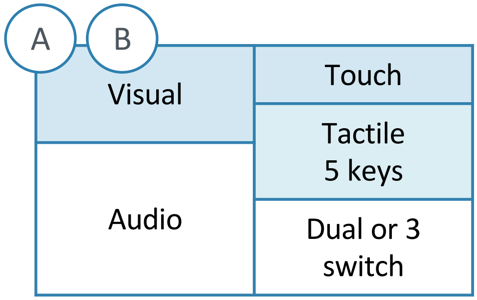
- The Next key moves around the screen to every screen element, *including the change-rank controls*
- The Select key activates the currently highlighted control.

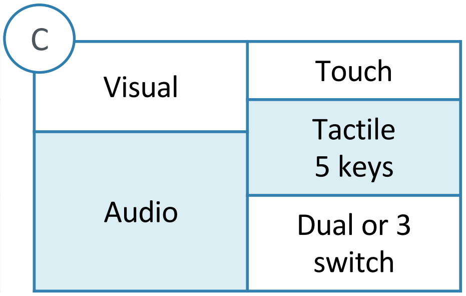
3-switch keyboard (Next, Back, Select)

For voters who can use three switches, adding the ability to move backwards and forwards in the control order makes the interaction more forgiving if the voter accidentally moves past the desired action.

This interaction can be emulated on a standard keyboard with Tab, Shift+Tab and Enter

Adjusting the ranking requires additional controls that make the design challenge difficult





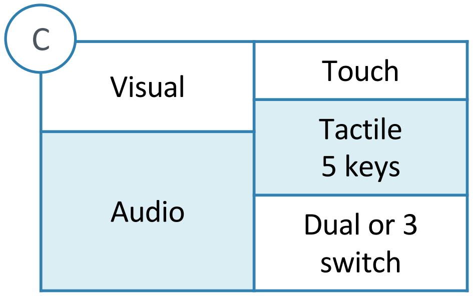
A design that works well for

visual + touch

visual + tactile with 5-keys

and reasonably for

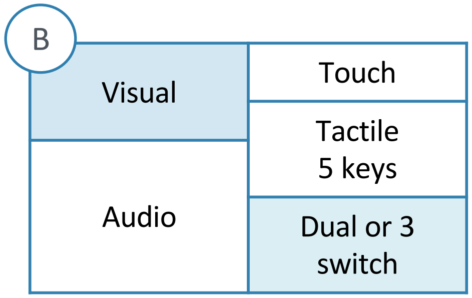
visual + tactile with 3-keys



.. Is not optimized for efficiency for

audio + tactile with 5-keys

because it does not include shortcut keys to change ranks directly, instead requiring moving to the change-rank controls in order to execute a up-rank or down-rank action.



...Is slow and tedious navigation

visual + dual switch or 3-switch

because the change-rank buttons cannot be skipped, requiring more navigation.
but is easier with a third switch which allows more direct navigation to a candidate.

The design challenge is to create an interaction that is both possible and reasonable in all interaction modes.

It may not be possible to optimize

For voters with extreme dexterity limitations

and

For voters with no vision but high digital literacy

and

For voters using visual and touch

without specialized settings (or a way to detect the mode in use.)

How we ran the test sessions

The testing procedure including planning the rankings for 1 contest, then marking the ballot, reviewing, and changing rankings.

Round 1: Who we tested with

Remote test sessions with Zoom

The original plan was to test in-person but we adapted to using Zoom given social distancing requirements

Advantages:

- Able to recruit people from anywhere
- Able to do sessions in small groups and make changes in between

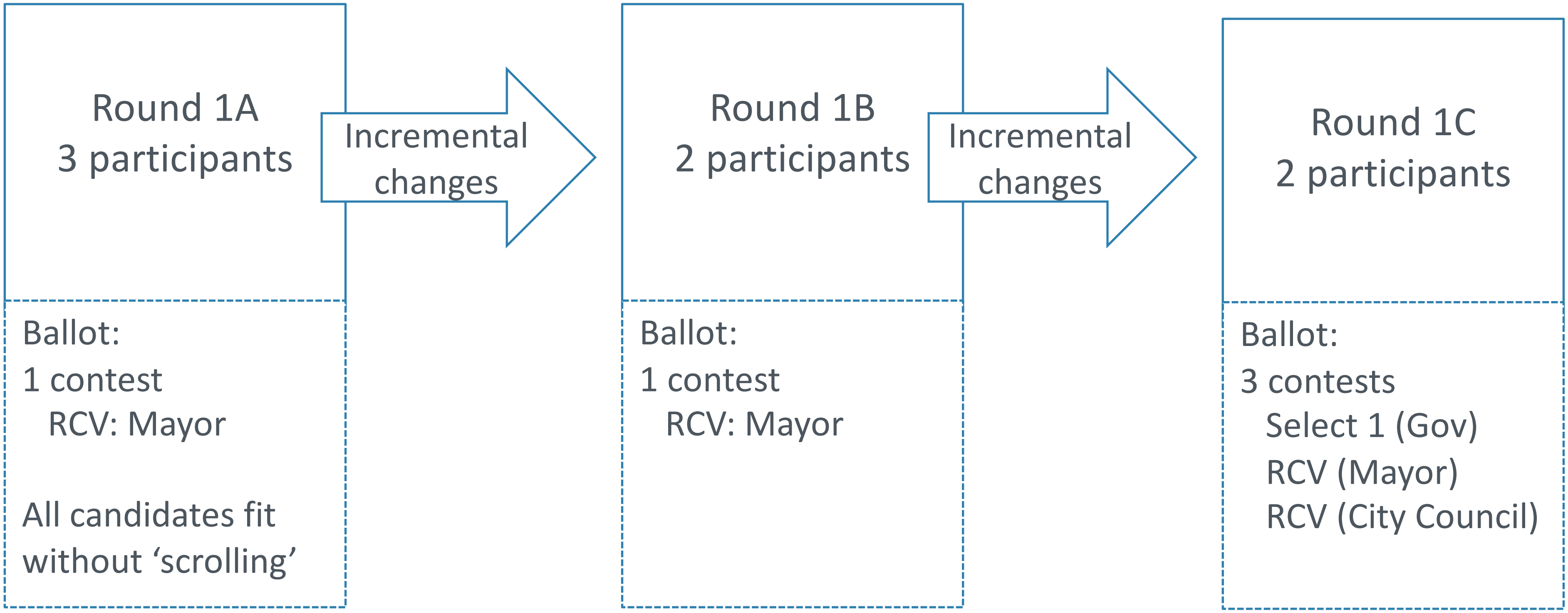
Disadvantages:

- Limited to people with digital skills to use Zoom

10 participants

- 1 person with no disabilities (Rachel)
- 2 clinicians who work with people with disabilities
- 1 person with autism and cognitive challenges
- 3 people with autism or attention disabilities
- 3 blind voters (in the audio workshops)

Round 1: Iterative testing of accessible RCV ballot prototype



Round 1A
3 participants

Incremental changes

Round 1B
2 participants

Incremental changes

Round 1C
2 participants

Ballot:
1 contest
RCV: Mayor

All candidates fit without ‘scrolling’

Ballot:
1 contest
RCV: Mayor

Ballot:
3 contests
Select 1 (Gov)
RCV (Mayor)
RCV (City Council)

Round 1A => Round 1B

What we learned in Round 1

- Proof of concept (ranking in order worked!)
- People confused about where they were when the visual focus cue (dashed outline) disappeared.
- People inadvertently went to the previous/next screens because the Left / Right keys were inconsistent. The Left/Right keys went to the UP/Down rank controls when focus was on a ranked candidate, but went to the previous/next screens when focus was on an unranked candidate.
- People confused when the Up/Down rank controls were inconsistent - moved the boxes after Put In Order had been executed but just changed the numbers the rest of the time.
- People confused when the Put In Order button was sometimes disabled and sometimes enabled.

Changes before Round 1B

- Disappearing focus bug fixed.
- Left/Right keys only moved to the Up/Down controls (didn't sometimes move to the previous/next screens.
- The Up/Down rank controls always swapped numbers (didn't sometimes move the blocks)
- Put In Order button always available (wasn't sometimes disabled)
- See More controls added (providing more options in the height of the browser window)

Round 1B => Round 1C

What we learned in Round 1B

- Further validation that ranking in order worked
- People understood what the Put in Order button would do
- People sometimes unsure whether their Up/Down rank action had happened (the swap of numbers was subtle)

Changes before Round 1C

- Added 2 more contests
  - One more RCV
  - One select-1 contest to give us a mixed ballot
- Removed the un-rank control to reduce clutter (and un-selecting performed the same function)

Round 1C

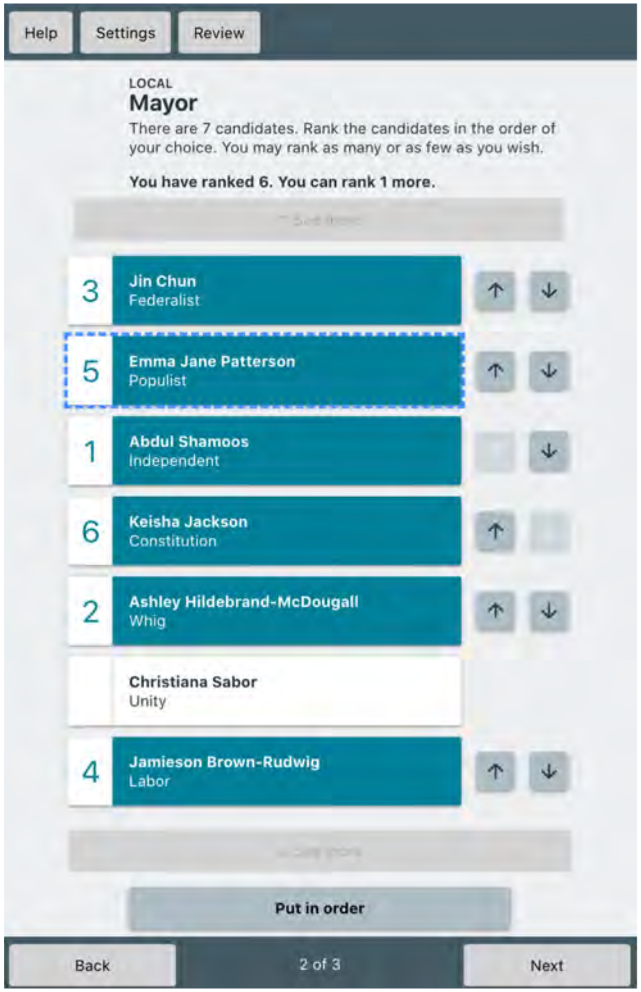
What we learned in Round 1C

- People able to shift between voting a select-1 contest and RCV contests.
- People naturally unselected to un-rank a ranked candidate
- People sometimes unsure whether their Up/Down rank action had happened (the swap of numbers was subtle)

Next Steps

- Since we had something that worked, we put further changes on-hold while we worked out the audio

Round 2



LOCAL

Mayor

There are 7 candidates. Rank the candidates in the order of your choice. You may rank as many or as few as you wish.

You have ranked 6. You can rank 1 more.

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1 Abdul Shamoos, Independent

6 Keisha Jackson, Constitution

2 Ashley Hildebrand-McDougall, Whig

Christiana Sabor, Unity

4 Jamieson Brown-Rudwig, Labor

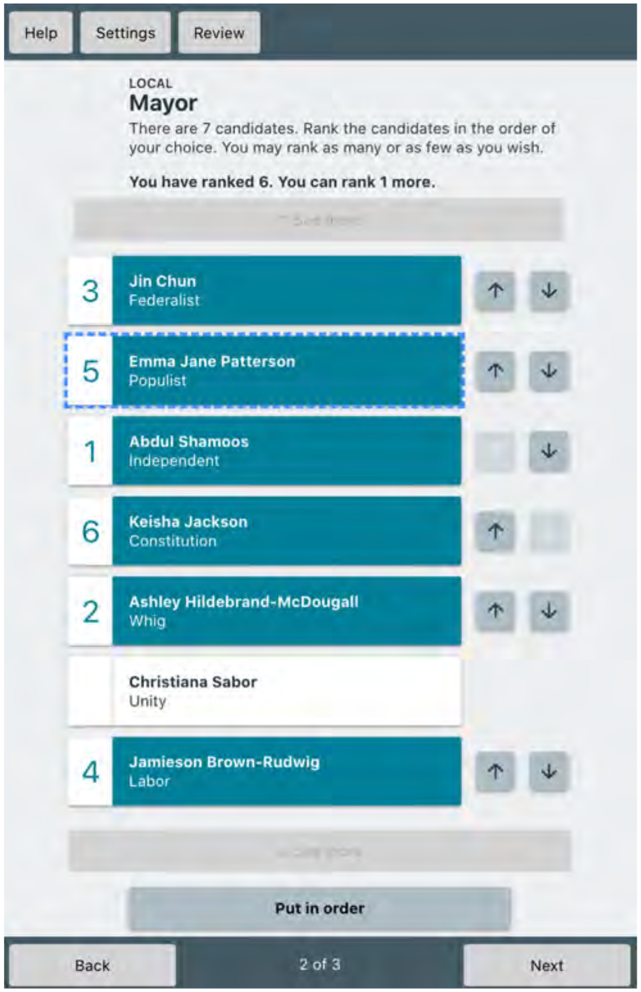
5 additional participants

- 2 people with autism
- 1 person with no use of hands
- 3 blind voters (in the audio workshops)

Goals

- Confirmed the visual design and navigation
- Confirmed audio interface that meshed with the visual layout .

How we tested the design prototypes



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Christiana Sabor Unity

4 **Jamieson Brown-Rudwig** Labor

We asked people to mark a ballot with a vote-for-1 contest and 1 or 2 RCV contests

Rank candidates

- Choose a ranking order in advance.
- Rank/un-rank candidates
- Adjust the rank of ranked candidates
- Sort into order to confirm

Use the review screen

- Read the screen and confirm what it said
- Navigate back a contest from the Review screen, make changes, and return to Review

Verify the ballot

- Interpret a printed ballot and explain how the person who marked that ballot voted in the RCV contests

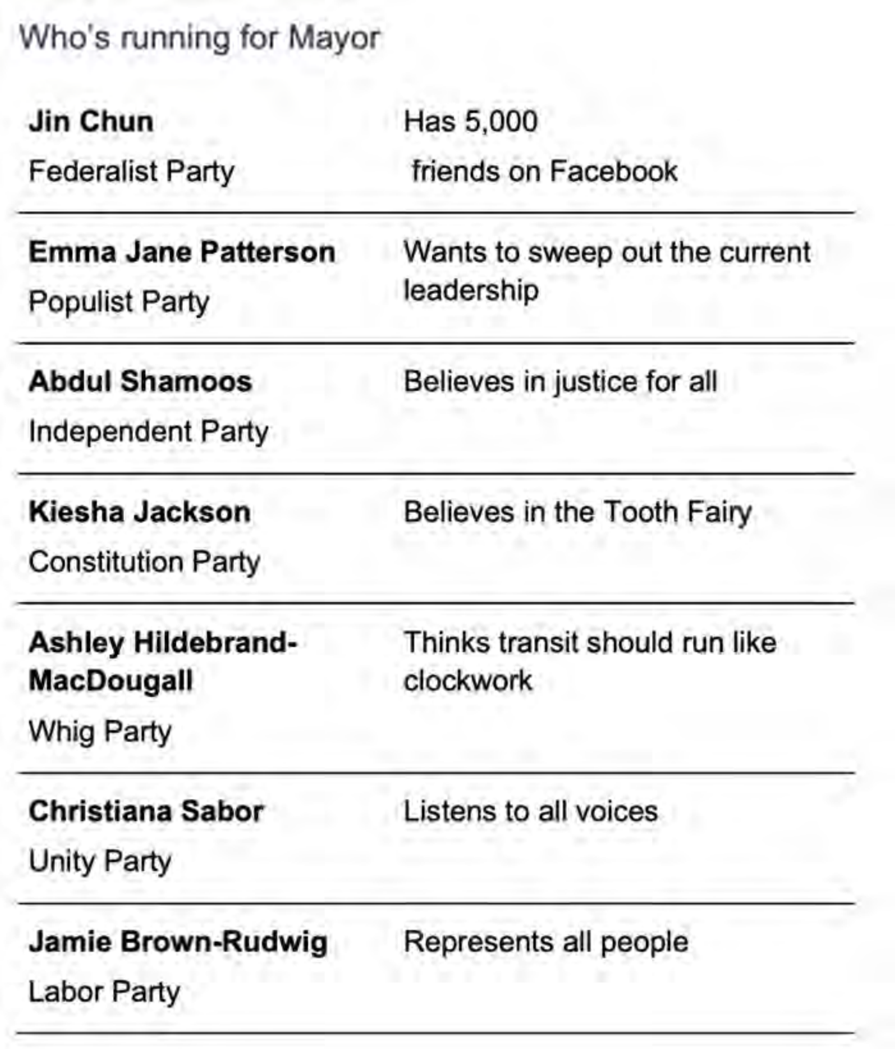
Before starting the ballot - establish intent

Mayoral contest

Participants were shown list of the 7 candidates for Mayor, along with party names and slogans for each and asked to decide how to rank at least 4 of them so that they would be ranking with intent

The other 2 contests

When we moved to 3 contests in Round 2, the participants just made choices in the moment for those contests



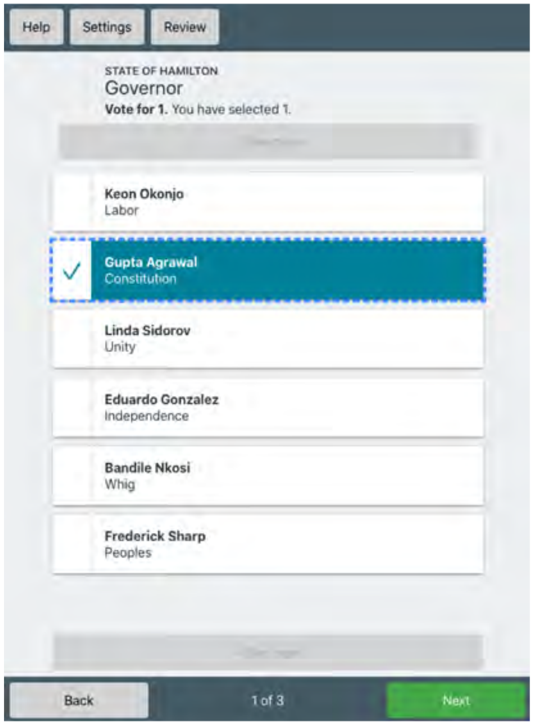
Who's running for Mayor

Jin Chun Federalist Party	Has 5,000 friends on Facebook
Emma Jane Patterson Populist Party	Wants to sweep out the current leadership
Abdul Shamoos Independent Party	Believes in justice for all
Kiesha Jackson Constitution Party	Believes in the Tooth Fairy
Ashley Hildebrand-MacDougall Whig Party	Thinks transit should run like clockwork
Christiana Sabor Unity Party	Listens to all voices
Jamie Brown-Rudwig Labor Party	Represents all people

Step 1: Vote the contest(s)

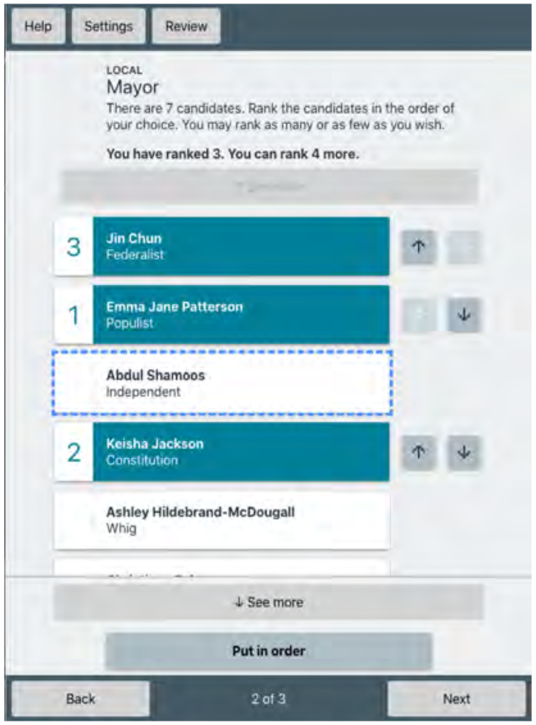
Using the tactile keyboard equivalents (left, right, up, down, select/enter)

Instructions: Vote



STATE OF HAMILTON
Governor
Vote for 1. You have selected 1.

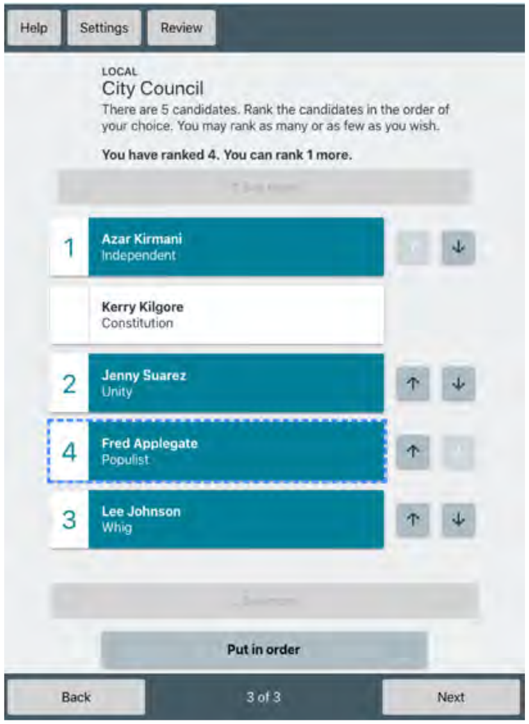
- Keon Okonjo, Labor
- ✓ Gupta Agrawal, Constitution
- Linda Sidorov, Unity
- Eduardo Gonzalez, Independence
- Bandile Nkosi, Whig
- Frederick Sharp, Peoples



LOCAL
Mayor
There are 7 candidates. Rank the candidates in the order of your choice. You may rank as many or as few as you wish.

You have ranked 3. You can rank 4 more.

- 3 Jin Chun, Federalist
- 1 Emma Jane Patterson, Populist
- Abdul Shamoos, Independent
- 2 Keisha Jackson, Constitution
- Ashley Hildebrand-McDougall, Whig



LOCAL
City Council
There are 5 candidates. Rank the candidates in the order of your choice. You may rank as many or as few as you wish.

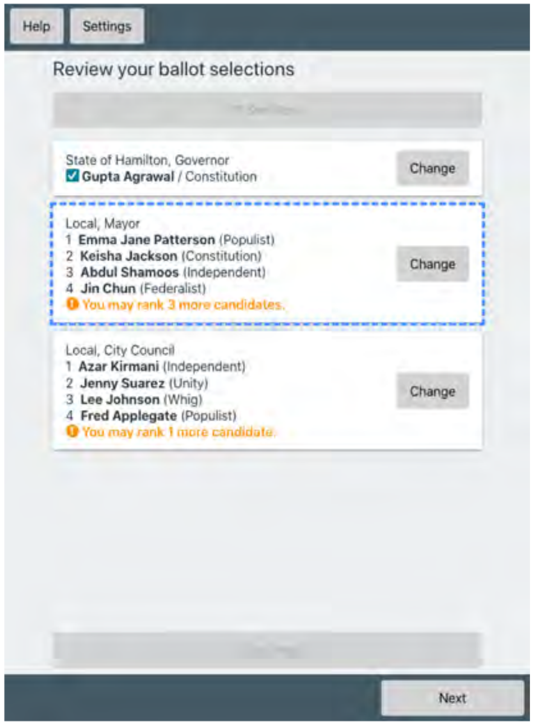
You have ranked 4. You can rank 1 more.

- 1 Azar Kirmani, Independent
- Kerry Kilgore, Constitution
- 2 Jenny Suarez, Unity
- 4 Fred Applegate, Populist
- 3 Lee Johnson, Whig

Step 2: Review, get back to the Mayor contest

Using the tactile keyboard equivalents (left, right, up, down, select/enter)

Review ballot selections



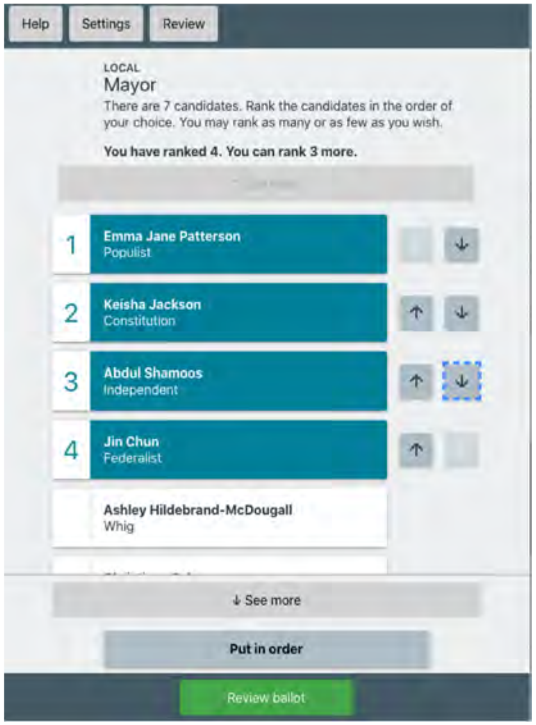
Review your ballot selections

State of Hamilton, Governor
☑ **Gupta Agrawal** / Constitution

Local, Mayor
1 **Emma Jane Patterson** (Populist)
2 **Keisha Jackson** (Constitution)
3 **Abdul Shamoos** (Independent)
4 **Jin Chun** (Federalist)
! You may rank 3 more candidates.

Local, City Council
1 **Azar Kirmani** (Independent)
2 **Jenny Suarez** (Unity)
3 **Lee Johnson** (Whig)
4 **Fred Applegate** (Populist)
! You may rank 1 more candidate.

Return to Mayor contest to make a change in ranking



LOCAL
Mayor
There are 7 candidates. Rank the candidates in the order of your choice. You may rank as many or as few as you wish.

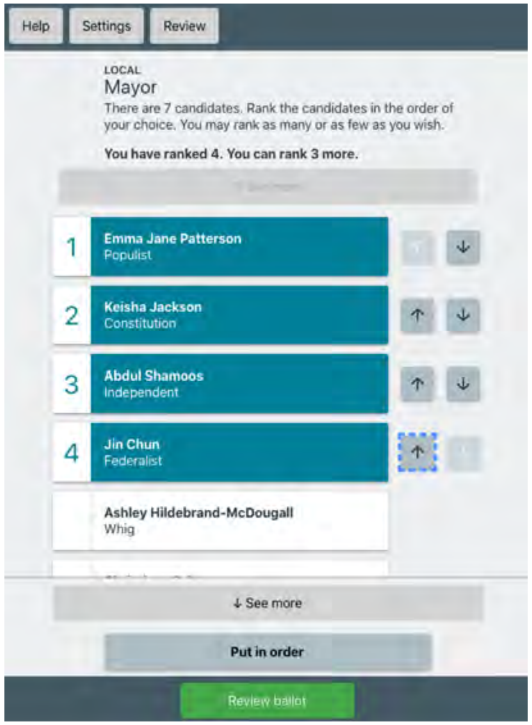
You have ranked 4. You can rank 3 more.

1 **Emma Jane Patterson** Populist ↓
2 **Keisha Jackson** Constitution ↑ ↓
3 **Abdul Shamoos** Independent ↑ ↓
4 **Jin Chun** Federalist ↑
Ashley Hildebrand-McDougall Whig

Step 3: Change rank of a candidate

Using the tactile keyboard equivalents (left, right, up, down, select/enter)

Move one of their lower-ranked candidates up in the rankings



LOCAL

Mayor

There are 7 candidates. Rank the candidates in the order of your choice. You may rank as many or as few as you wish.

You have ranked 4. You can rank 3 more.

1 Emma Jane Patterson, Populist

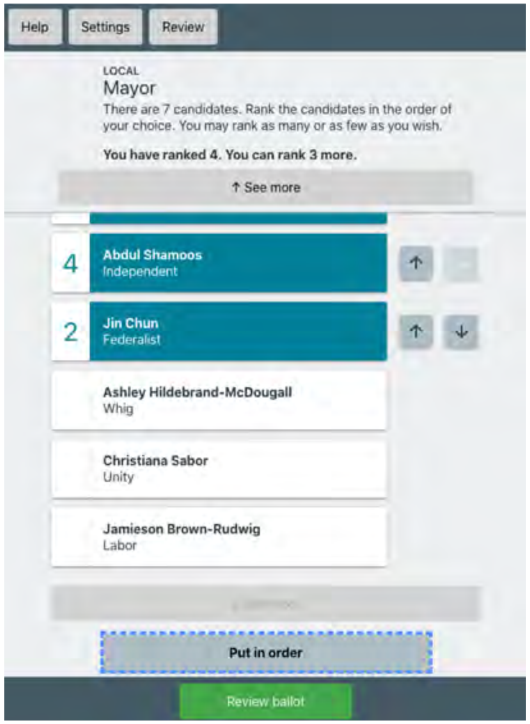
2 Keisha Jackson, Constitution

3 Abdul Shamoos, Independent

4 Jin Chun, Federalist

Ashley Hildebrand-McDougall, Whig

Put the list in order (sort) (if they haven't used this yet)



LOCAL

Mayor

There are 7 candidates. Rank the candidates in the order of your choice. You may rank as many or as few as you wish.

You have ranked 4. You can rank 3 more.

4 Abdul Shamoos, Independent

2 Jin Chun, Federalist

Ashley Hildebrand-McDougall, Whig

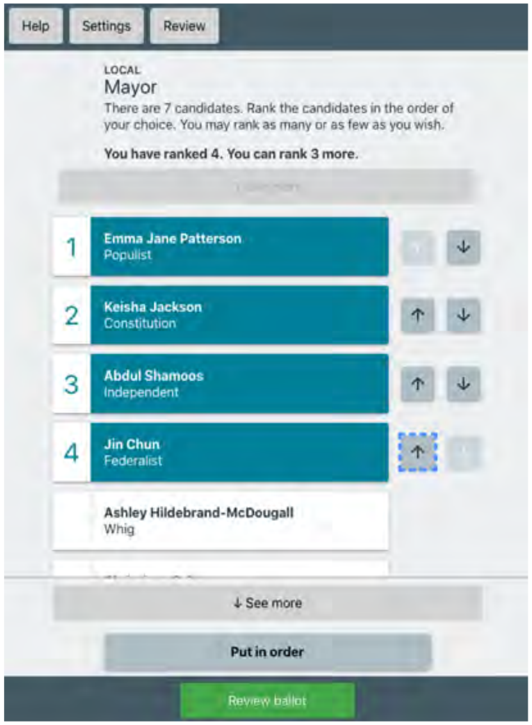
Christiana Sabor, Unity

Jamieson Brown-Rudwig, Labor

Step 4: Review again, get ready to move on

Using the tactile keyboard equivalents (left, right, up, down, select/enter)

Get back to the Review screen



LOCAL

Mayor

There are 7 candidates. Rank the candidates in the order of your choice. You may rank as many or as few as you wish.

You have ranked 4. You can rank 3 more.

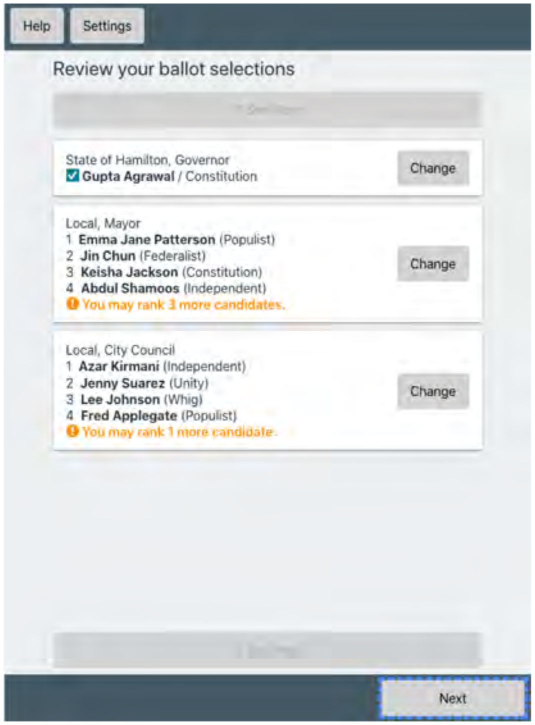
1 **Emma Jane Patterson** Populist

2 **Keisha Jackson** Constitution

3 **Abdul Shamoos** Independent

4 **Jin Chun** Federalist

Ashley Hildebrand-McDougall Whig



Review your ballot selections

State of Hamilton, Governor
☑ **Gupta Agrawal** / Constitution

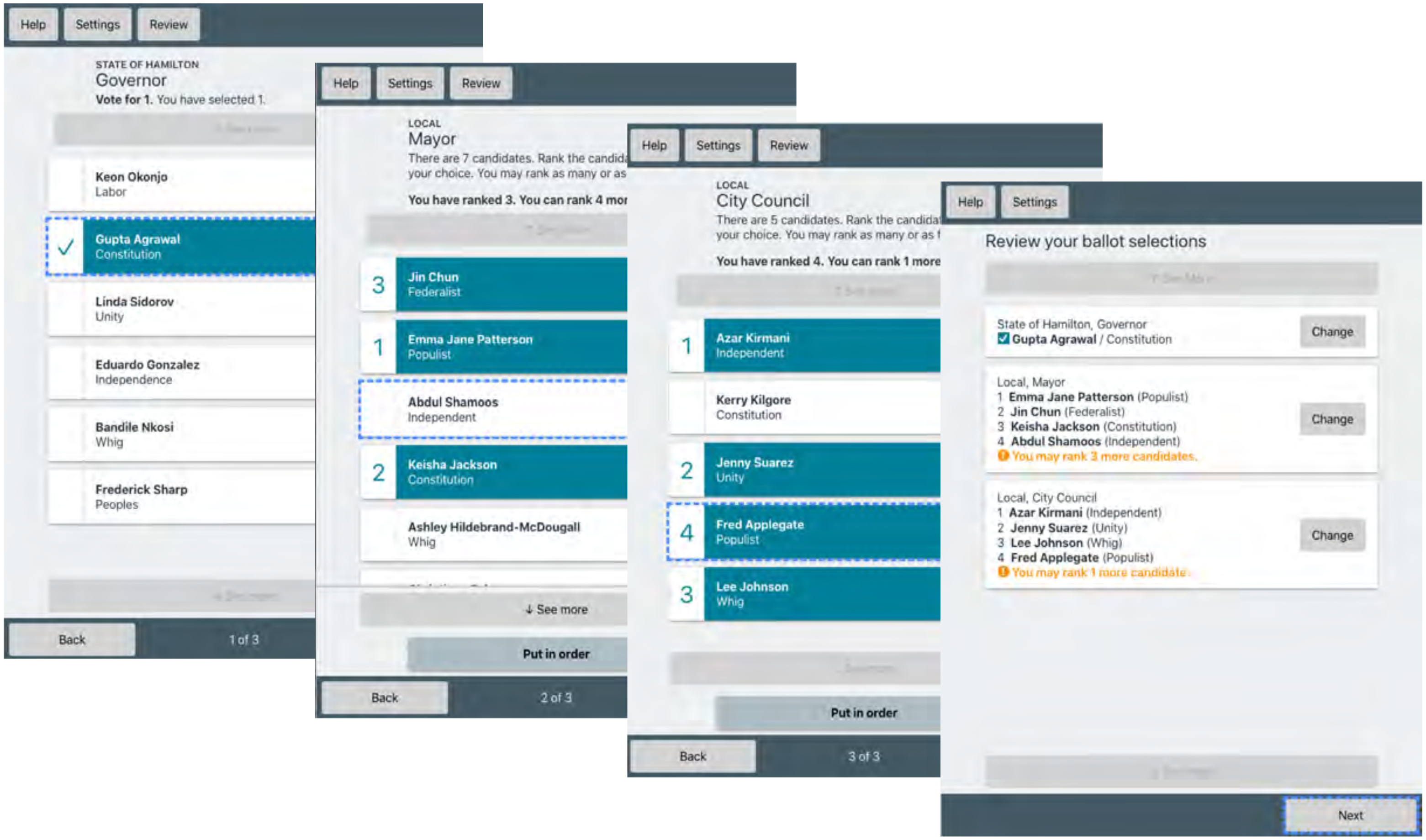
Local, Mayor
1 **Emma Jane Patterson** (Populist)
2 **Jin Chun** (Federalist)
3 **Keisha Jackson** (Constitution)
4 **Abdul Shamoos** (Independent)
! You may rank 3 more candidates.

Local, City Council
1 **Azar Kirmani** (Independent)
2 **Jenny Suarez** (Unity)
3 **Lee Johnson** (Whig)
4 **Fred Applegate** (Populist)
! You may rank 1 more candidate.

We stopped participants after the review screen, before starting the steps for printing and casting their ballot because we were not testing that function (and the prototype does not support printing)

Step 5: Repeat the ballot using the mouse/touch or dual switch interaction

Vote again! (we reset the ballot)



STATE OF HAMILTON
Governor
Vote for 1. You have selected 1.

- Keon Okonjo, Labor
- ✓ Gupta Agrawal, Constitution
- Linda Sidorov, Unity
- Eduardo Gonzalez, Independence
- Bandile Nkosi, Whig
- Frederick Sharp, Peoples

LOCAL
Mayor
There are 7 candidates. Rank the candida
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You have ranked 3. You can rank 4 mor

- 3 Jin Chun, Federalist
- 1 Emma Jane Patterson, Populist
- Abdul Shamoos, Independent
- 2 Keisha Jackson, Constitution
- Ashley Hildebrand-McDougall, Whig

LOCAL
City Council
There are 5 candidates. Rank the candidat
your choice. You may rank as many or as f
You have ranked 4. You can rank 1 more

- 1 Azar Kirmani, Independent
- Kerry Kilgore, Constitution
- 2 Jenny Suarez, Unity
- 4 Fred Applegate, Populist
- 3 Lee Johnson, Whig

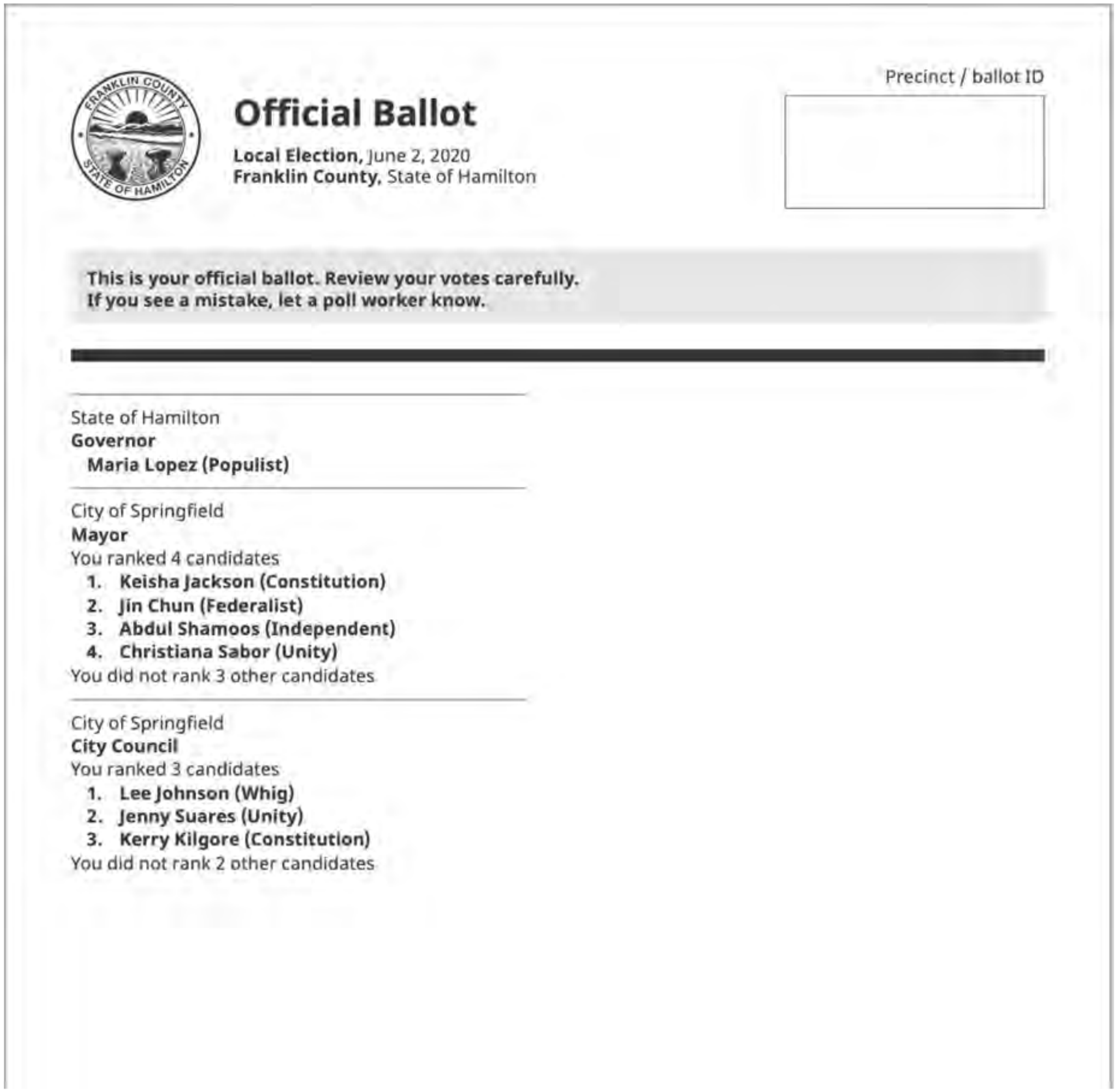
Review your ballot selections

State of Hamilton, Governor
☑ **Gupta Agrawal** / Constitution

Local, Mayor
1 **Emma Jane Patterson** (Populist)
2 **Jin Chun** (Federalist)
3 **Keisha Jackson** (Constitution)
4 **Abdul Shamoos** (Independent)
! You may rank 3 more candidates.

Local, City Council
1 **Azar Kirmani** (Independent)
2 **Jenny Suarez** (Unity)
3 **Lee Johnson** (Whig)
4 **Fred Applegate** (Populist)
! You may rank 1 more candidate.

Step 6: Read and interpret a printed ballot



Precinct / ballot ID

Official Ballot

Local Election, June 2, 2020
Franklin County, State of Hamilton

This is your official ballot. Review your votes carefully.
If you see a mistake, let a poll worker know.

State of Hamilton
Governor
Maria Lopez (Populist)

City of Springfield
Mayor
You ranked 4 candidates
1. **Keisha Jackson (Constitution)**
2. **Jin Chun (Federalist)**
3. **Abdul Shamoos (Independent)**
4. **Christiana Sabor (Unity)**

You did not rank 3 other candidates

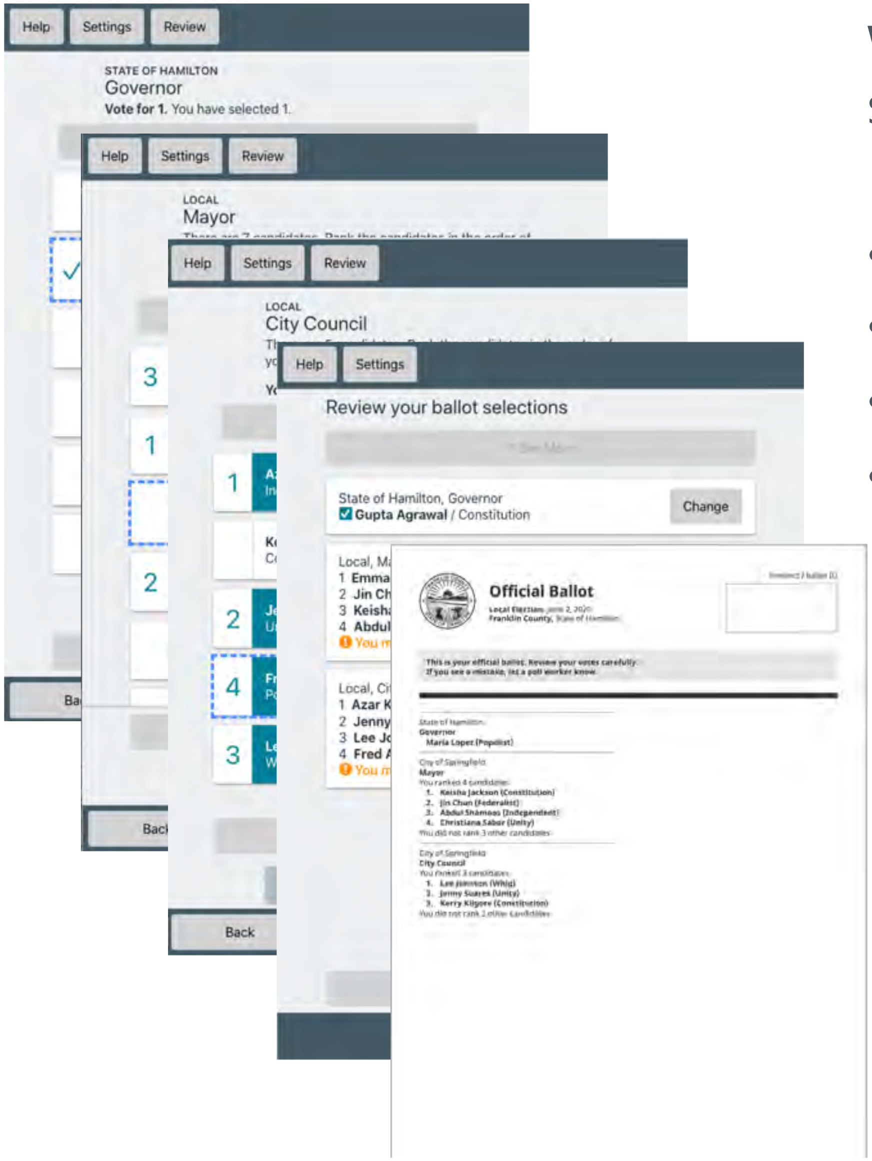
City of Springfield
City Council
You ranked 3 candidates
1. **Lee Johnson (Whig)**
2. **Jenny Suares (Unity)**
3. **Kerry Kilgore (Constitution)**

You did not rank 2 other candidates

Look at a printed ballot (on screen)
And tell us who this person voted for

The demo does not print this ballot, so we showed participants a pre-formatted ballot printed on letter-sized paper.

Step 7: Debrief



STATE OF HAMILTON
Governor
Vote for 1. You have selected 1.

LOCAL
Mayor

LOCAL
City Council

Review your ballot selections

State of Hamilton, Governor
☑ Gupta Agrawal / Constitution

Official Ballot
Local Election, June 2, 2020
Franklin County, State of Hamilton

This is your official ballot. Review your votes carefully.
If you see a mistake, let a poll worker know.

State of Hamilton
Governor
Maria Lopez (Populist)

City of Springfield
Mayor
You ranked 4 candidates:
1. Keisha Jackson (Constitution)
2. Jin Chun (Federalist)
3. Abdul Shamoos (Independent)
4. Christiana Sabor (Unity)
You did not rank 3 other candidates

City of Springfield
City Council
You ranked 3 candidates:
1. Lee Johnson (Whig)
2. Jenny Suarez (Unity)
3. Kerry Kilgore (Constitution)
You did not rank 2 other candidates

We ended with a conversation, revisiting screens as needed

- What they thought of the experience
- What concerns they had
- What ideas they had
- How marking a ballot digitally compared with their most recent voting experience

Audio workshops
(audio + tactile with 5-keys)

How we made the audio work using a “Wizard of Oz” approach, working with experienced blind voters.

The audio workshops were a chance to both test and consult with blind voters

Session setup

The participant was on the phone.

Three people ran the session, sharing a view of the ballot through Zoom

1. Facilitator – ran the session, took notes, talked to the participant.
2. Ran the computer, following instructions from the voter
3. Voiced the audio interaction

We worked with 3 blind voters:

- A long-time user of an accessible DRE, who had participated in voting system testing
- A new voter who had participated in voting system testing, but had never used one in an election
- An avid voter with no previous involvement in voting system design

We asked them to use the ballot just as we did with other usability testing first, then talked through all the details of the design, collecting input and suggestions.

Voicing the audio "live" meant we could consult with the participants and experiment with alternatives

We explored:

- Variations in words
- Variations in word order
- Variations in cadence
- Alternative functionality

🔊 Sample of the computer voicing

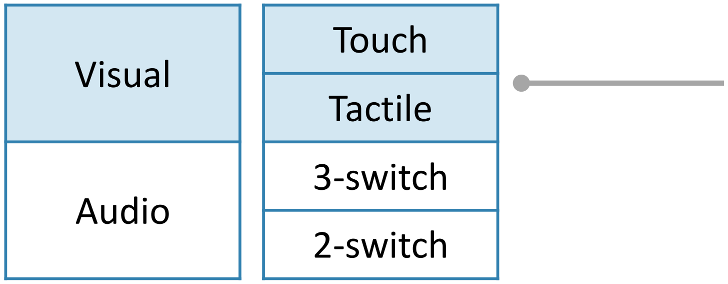
🔊 Participant discussing the audio with the "computer"

A deeper dive into the design details

Understanding the intersection of modes and how they affect the design for initial ranking and adjusting ranks.

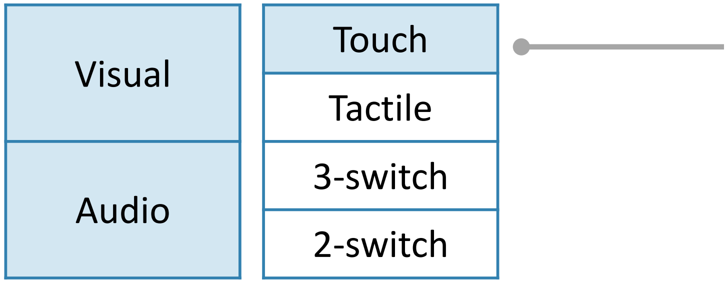
Design Issues: The different interaction modes have to work together to meet different combinations of accessibility needs

Voters may choose any combinations of presentation and interaction mods

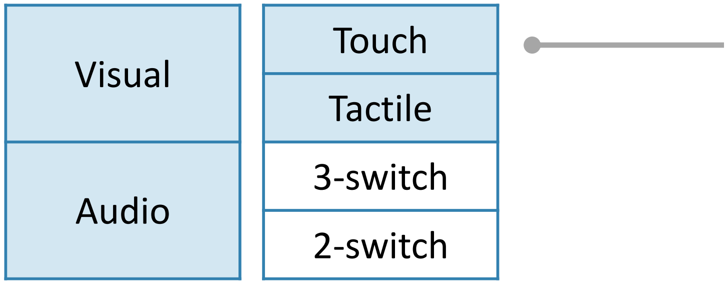


Voters using the visual presentation may use touch or tactile keys

- Voters with minimal use of their hands
- Voters use a mouthstick with either touch or tactile

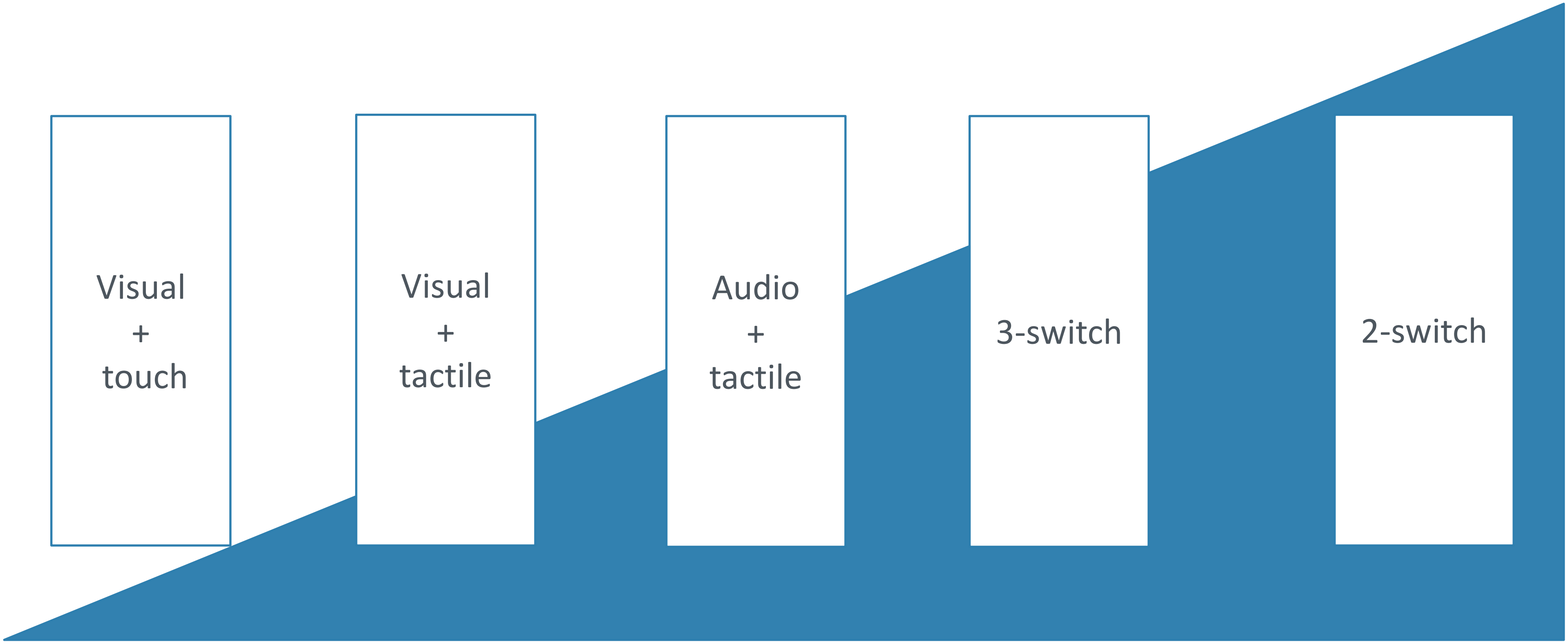


A sighted voter may use the audio in addition to reading, but not need the tactile keys



A sighted voter may listen to the audio in addition to visual reading, *and* primarily use the tactile keyboard, but also use touch.

Design usable in all modes, but less optimized for some



Easiest to use

- Most flexibility
- Fastest interaction
- Most contextual information

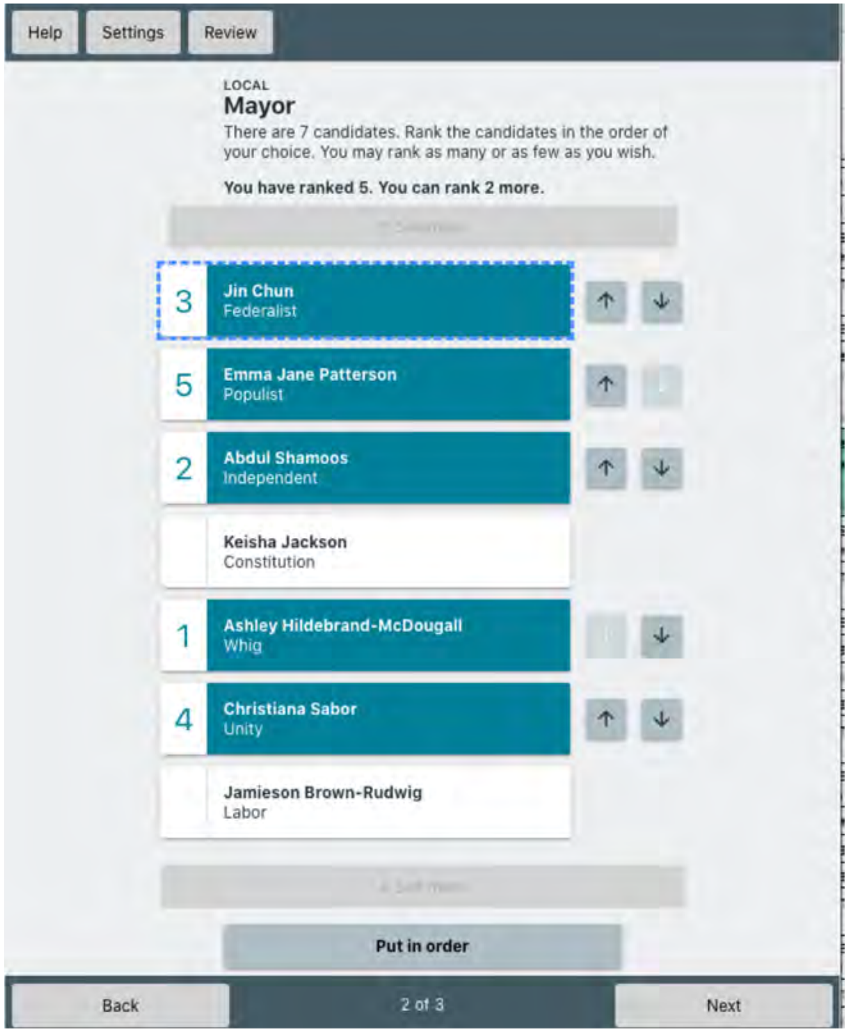
Audio has

- Least contextual information
- Best immediate instructions

Hardest to use

- Least flexibility
- Most tedious interaction

Example: conflicts between the audio and visual presentations make visual + tactile harder for some



LOCAL

Mayor

There are 7 candidates. Rank the candidates in the order of your choice. You may rank as many or as few as you wish.

You have ranked 5. You can rank 2 more.

3 Jin Chun
Federalist

5 Emma Jane Patterson
Populist

2 Abdul Shamoos
Independent

Keisha Jackson
Constitution

1 Ashley Hildebrand-McDougall
Whig

4 Christiana Sabor
Unity

Jamieson Brown-Rudwig
Labor

Audio-only users, having no visual frame of reference and hearing audio cues only, preferred left and right to move the rankings directly, rather than having to move to the up and down controls first.

But the up / down rank buttons are visually to the right which would cause a conflict for anyone listening to audio and looking at the screen

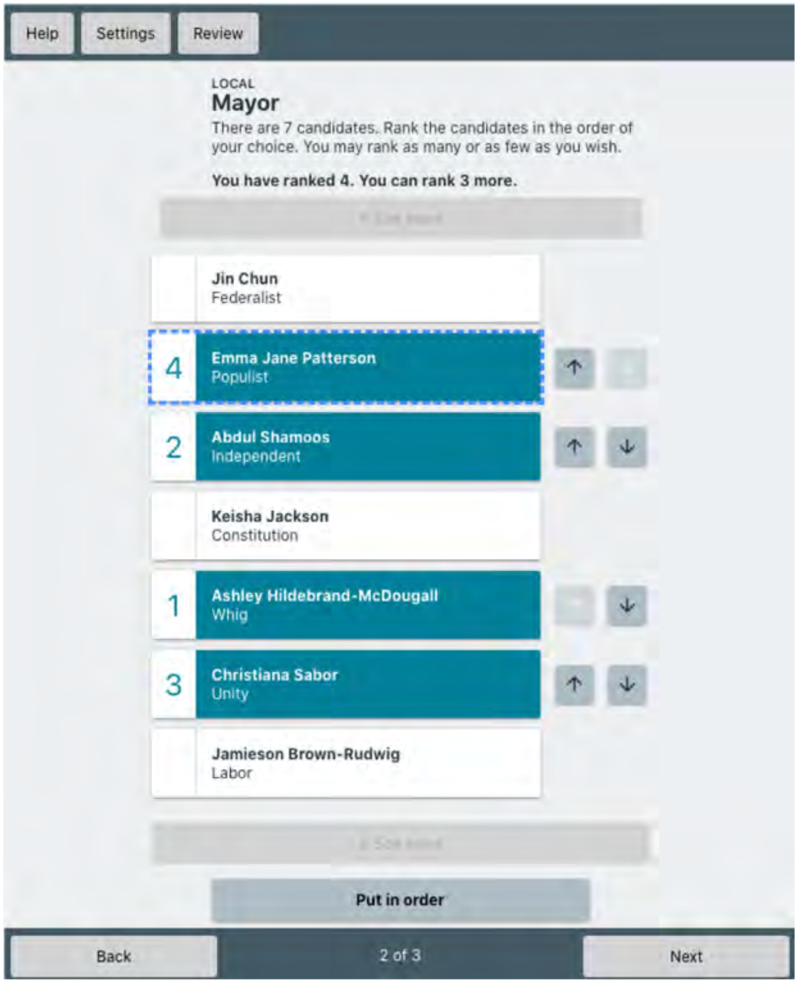
There are other, similar, conflicts between slower--but more consistent--interaction and efficiency.

Design Issues: Ranking candidates in the order they are selected is easier for some interaction modes than others.

The design is based on a process in which the voter selects candidates in the order they want to rank them.

Participants had no problems understanding this interaction. It was easiest with vision, especially using touch or both up and down keys.

Impact of rank-in-selection-order



LOCAL

Mayor

There are 7 candidates. Rank the candidates in the order of your choice. You may rank as many or as few as you wish.

You have ranked 4. You can rank 3 more.

	Jin Chun Federalist
4	**Emma Jane Patterson** Populist
2	**Abdul Shamoos** Independent
	Keisha Jackson Constitution
1	**Ashley Hildebrand-McDougall** Whig
3	**Christiana Sabor** Unity
	Jamieson Brown-Rudwig Labor

Visual + touch:

- Getting to the next desired candidate is easy

Visual + 5-key tactile:

- Getting to the next desired candidate requires moving up and down the list one-by-one

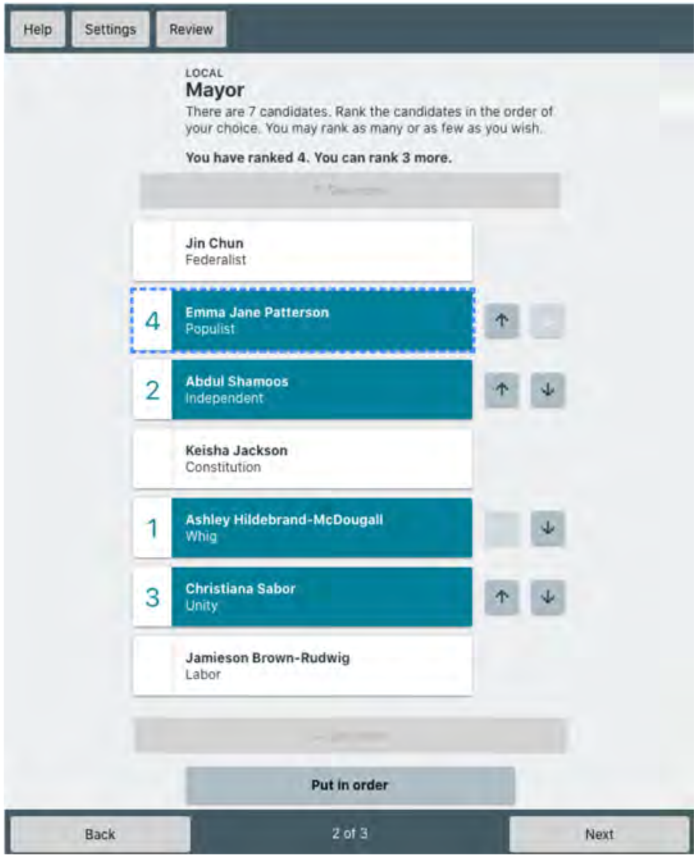
Audio + 5-key tactile:

- Getting to the next desired candidate requires moving up and down the list one-by-one
- And repetitive listening to candidates names and ranking status

Dual and 3-switch:

- Getting to the next desired candidate requires moving up and down the list one-by-one
- And moving through the up and down controls on each ranked candidate

Dual-switch limited navigation options mean that ranking adds burden to moving to candidates



LOCAL

Mayor

There are 7 candidates. Rank the candidates in the order of your choice. You may rank as many or as few as you wish.

You have ranked 4. You can rank 3 more.

Jin Chun
Federalist

4 **Emma Jane Patterson**
Populist

2 **Abdul Shamoos**
Independent

Keisha Jackson
Constitution

1 **Ashley Hildebrand-McDougall**
Whig

3 **Christiana Sabor**
Unity

Jamieson Brown-Rudwig
Labor

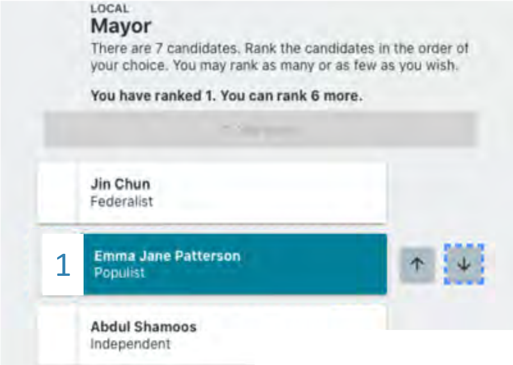
With dual-switch (Next, Select) the voter has no means to move backwards

As an example:

- After using ranking Emma-Jane as #4, selecting the previous candidate, Jin Chun for #5 means using Next to move through all the rest of the candidates and navigation buttons.
  - In this example, the Next key must be pressed 20 times to reach Jin Chun

- With 2-switch, after a candidate is ranked, the Next sequence includes the two buttons used to change ranking candidates.

Blind voters suggested being able to set the ranking for each candidate as they are reached in screen order



LOCAL

Mayor

There are 7 candidates. Rank the candidates in the order of your choice. You may rank as many or as few as you wish.

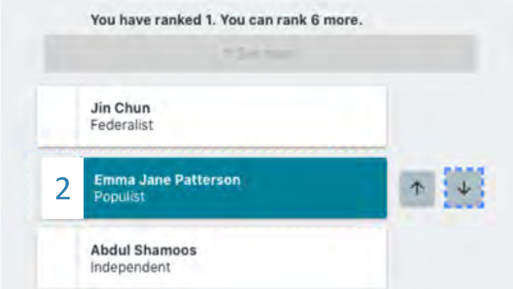
You have ranked 1. You can rank 6 more.

Jin Chun
Federalist

1 Emma Jane Patterson
Populist

Abdul Shamoos
Independent

Voter selects the Down-rank button



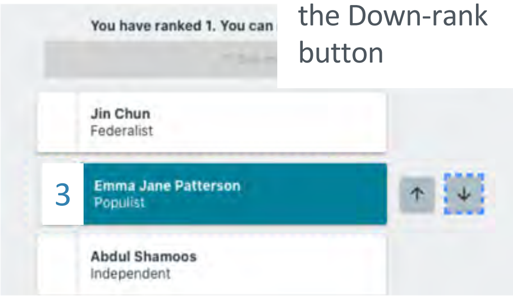
You have ranked 1. You can rank 6 more.

Jin Chun
Federalist

2 Emma Jane Patterson
Populist

Abdul Shamoos
Independent

Voter selects the Down-rank button



You have ranked 1. You can

Jin Chun
Federalist

3 Emma Jane Patterson
Populist

Abdul Shamoos
Independent

On the surface, this seemed straightforward idea, but

High potential for mis-ranking. It can leave gaps in the ranking or overvoting a rank by marking more than one candidate for that rank. Addressing this requires either:

- Allowing the system to adjudicate, taking control away from the voter
- Explaining the problem so voter can correct the ranking.

More keypresses. It takes many more key presses to get N candidates into the desired ranks. That's N! (N factorial) in math.

More confusion: Changing rankings is harder, especially voters with even mild cognitive challenges and blind voters without strong memory skills.

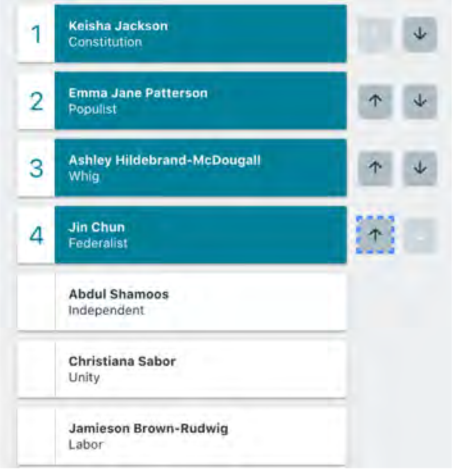
Design Issue: Adjusting the rank of a candidate

It is possible to change the rank of a candidate at any time.

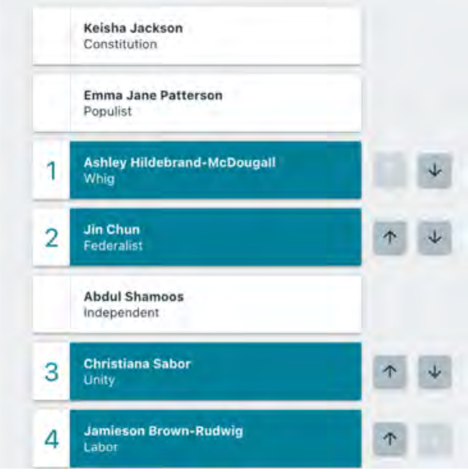
The candidates are re-arranged in rank order when a voter selects the Put in Order button, or on leaving the contest.

“Why doesn’t the candidate (actually) move?”

The arrangement of the candidates and rankings influenced people’s expectation on whether the candidate would visually move up or down as they changed rankings.

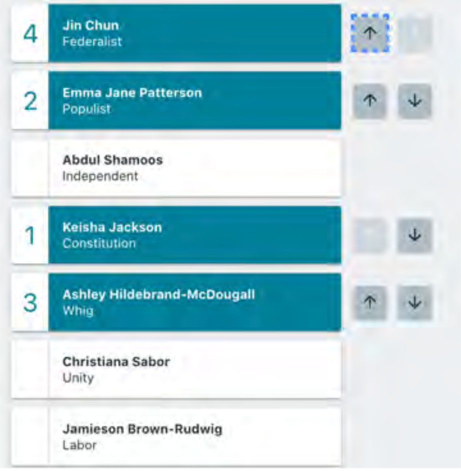


1	Keisha Jackson	Constitution
2	Emma Jane Patterson	Populist
3	Ashley Hildebrand-McDougall	Whig
4	Jin Chun	Federalist
	Abdul Shamoos	Independent
	Christiana Sabor	Unity
	Jamieson Brown-Rudwig	Labor



	Keisha Jackson	Constitution
	Emma Jane Patterson	Populist
1	Ashley Hildebrand-McDougall	Whig
2	Jin Chun	Federalist
	Abdul Shamoos	Independent
3	Christiana Sabor	Unity
4	Jamieson Brown-Rudwig	Labor

When the candidates were already in order, participants were more likely to think the candidate block should move – as though being dragged step by step.

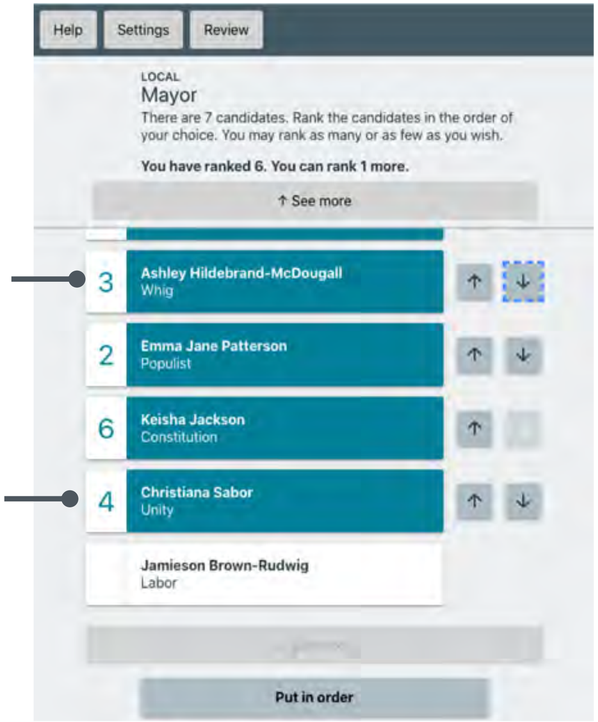


4	Jin Chun	Federalist
2	Emma Jane Patterson	Populist
	Abdul Shamoos	Independent
1	Keisha Jackson	Constitution
3	Ashley Hildebrand-McDougall	Whig
	Christiana Sabor	Unity
	Jamieson Brown-Rudwig	Labor

But not when they were not in order…. Or when not all candidates were visible

“Did my move (up or down) work?”

When only the number changes, without moving the position of the candidate, it can cause momentary uncertainty in visual mode



LOCAL

Mayor

There are 7 candidates. Rank the candidates in the order of your choice. You may rank as many or as few as you wish.

You have ranked 6. You can rank 1 more.

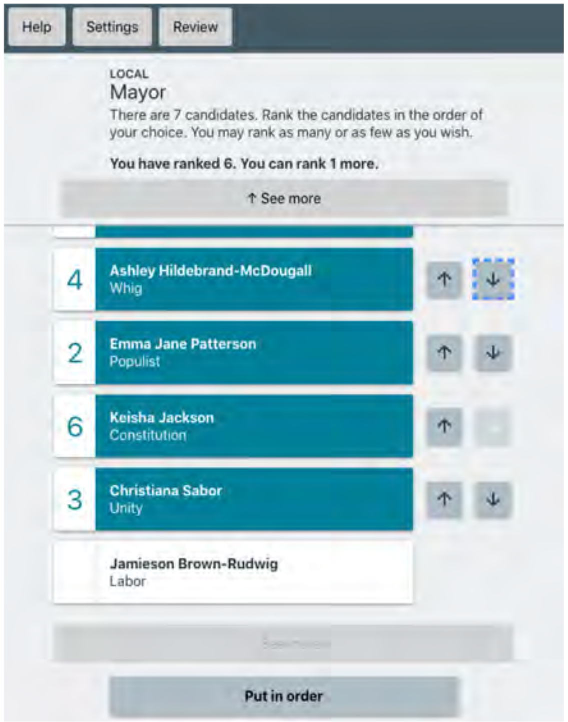
3 Ashley Hildebrand-McDougall Whig

2 Emma Jane Patterson Populist

6 Keisha Jackson Constitution

4 Christiana Sabor Unity

Jamieson Brown-Rudwig Labor



LOCAL

Mayor

There are 7 candidates. Rank the candidates in the order of your choice. You may rank as many or as few as you wish.

You have ranked 6. You can rank 1 more.

4 Ashley Hildebrand-McDougall Whig

2 Emma Jane Patterson Populist

6 Keisha Jackson Constitution

3 Christiana Sabor Unity

Jamieson Brown-Rudwig Labor

Pressing the down-arrow button causes the Ashley to move from #3 to #4, and Christiana to change to #3

- Some participants noticed the change in numbers right away.
- Others didn’t and were initially uncertain what had happened.

Visual mode

The ranking number is on the other side of the candidate name, so not in the immediate visual field when using the up or down arrows.

Audio mode

The audio feedback confirms the change in rank.

Blind, technically savvy participants preferred faster, but more expert interactions

For example, changing a candidate ranking currently requires navigation to a button and then pressing select. The voters in the audio workshops wanted a single hotkey.
The example below shows moving a candidate from ranked #4 to ranked #4

The current interaction matches the visual interface cues

[The highlight moves to Jin Chun]

Audio: Jin Chun Federalist is ranked number 3. Press right to make adjustments to ranking. …

[voter presses Right]

Audio: Move Jin Chun to position 2 button

[voter presses Right]

Move Jin Chun to position 4 button

[voter presses Select]
[ranking number changes to

Jin Chun Federalist is ranked number 3. Press right to make adjustments to ranking. …

The voters suggested an interface in which Left and Right are immediate actions

[The highlight moves to Jin Chun]

Audio: Jin Chun Federalist is ranked number 3. To make ranking adjustments, press left or right …

[voter presses Right]

Audio: Jin Chun Federalist is ranked number 4. To make ranking adjustments, press left or right …

The suggested interaction is faster, but requires voters to infer, for example, that right is ”down in ranking”. It also loses the 1:1 relationship between the visual and audio interaction.

Our current design

Changes numbers only

Doesn't move the candidates when up/down is executed

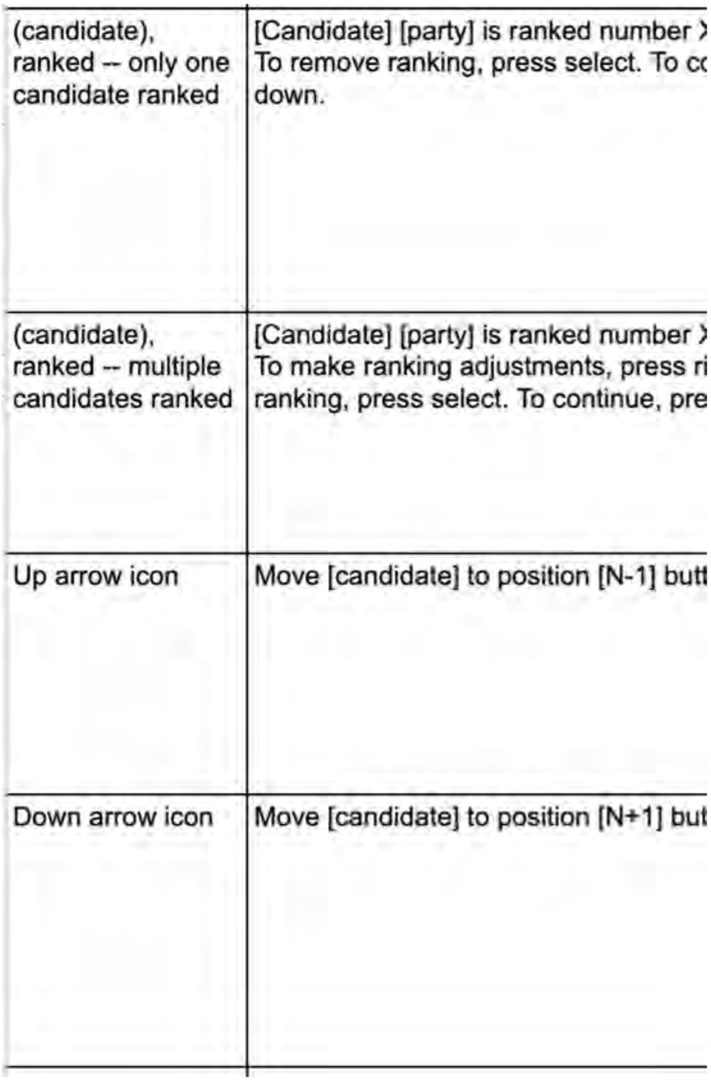
Possible enhancements

- Add a subtle animation to draw people's attention to the change in the ranking number
- Add an additional interaction, allowing touch users to drag a candidate into the ranking position they want.
  - This can only be an addition to the interaction, not the primary method of ranking.
  - It will work best if allowed only after candidates are put in order
  - We'd have to think about whether unranked candidates can be moved
  - And we'd need think about how to prevent unintended activation of the drag function.

Designing the audio

Constructing audio cues to enable non-visual navigation and support the use of audio for language or literacy needs.

Designing the audio



Focus	What the audio should say
(candidate), ranked -- only one candidate ranked	[Candidate] [party] is ranked number X To remove ranking, press select. To co down.
(candidate), ranked -- multiple candidates ranked	[Candidate] [party] is ranked number X To make ranking adjustments, press ri ranking, press select. To continue, pre
Up arrow icon	Move [candidate] to position [N-1] butt
Down arrow icon	Move [candidate] to position [N+1] but

The audio design mixes the text on the screen with additional status information and instructions.

Contest information

- Contest information (from screen text)
- Number of candidates
- Voting status (from screen text)

Candidate information includes

- Name and party (matching screen text)
- Status – if ranked, the ranking

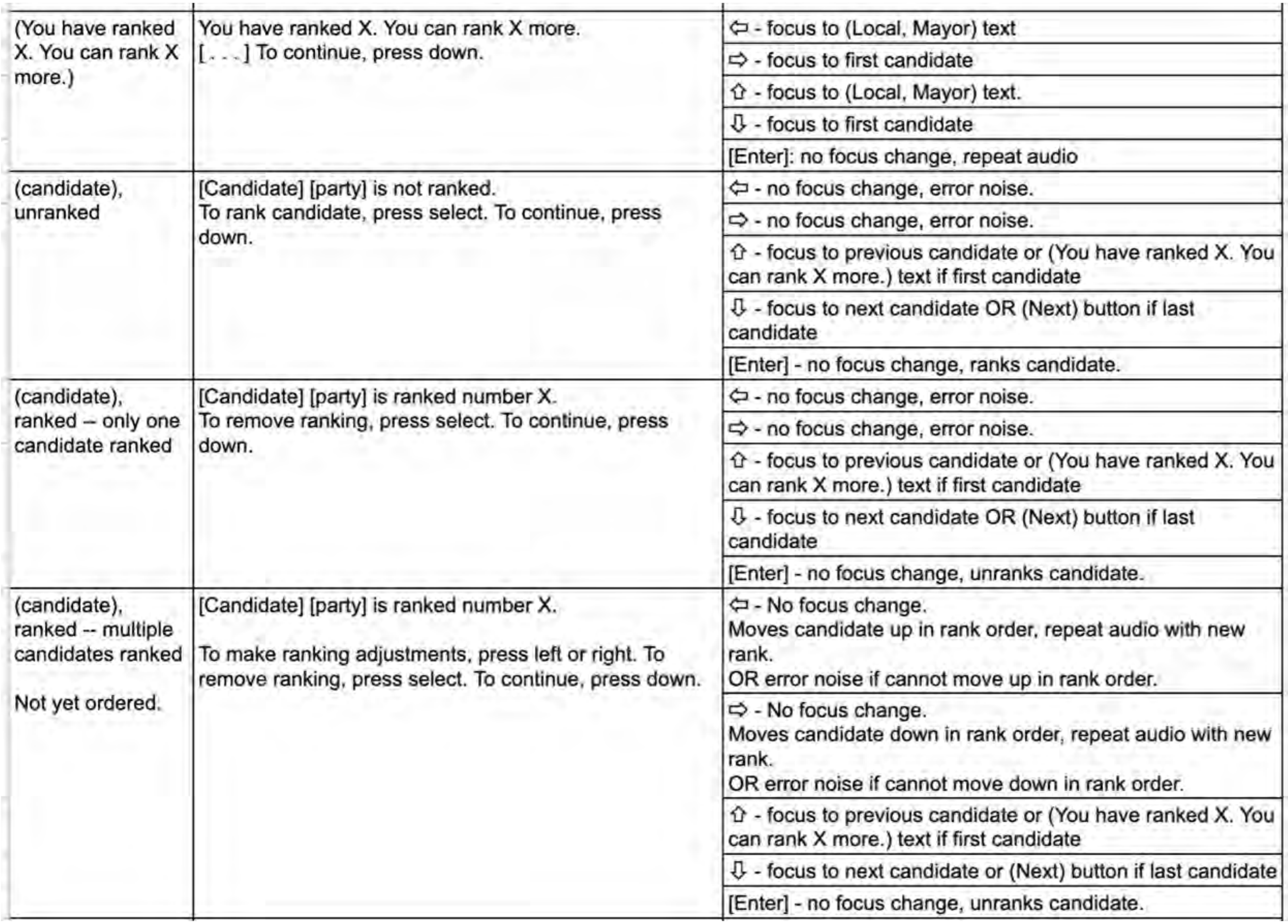
Active elements

- Button label (from screen text) OR action the button will take
- Buttons identified as buttons

Instructions

- Actions possible with contextual choices first, ending with default action to continue

The audio script



Focus	What the audio should say	Possible actions
(You have ranked X. You can rank X more.)	You have ranked X. You can rank X more. [. . .] To continue, press down.	⇦ - focus to (Local, Mayor) text
		⇨ - focus to first candidate
		⇧ - focus to (Local, Mayor) text.
		⇩ - focus to first candidate
		[Enter]: no focus change, repeat audio
(candidate), unranked	[Candidate] [party] is not ranked. To rank candidate, press select. To continue, press down.	⇦ - no focus change, error noise.
		⇨ - no focus change, error noise.
		⇧ - focus to previous candidate or (You have ranked X. You can rank X more.) text if first candidate
		⇩ - focus to next candidate OR (Next) button if last candidate
		[Enter] - no focus change, ranks candidate.
(candidate), ranked – only one candidate ranked	[Candidate] [party] is ranked number X. To remove ranking, press select. To continue, press down.	⇦ - no focus change, error noise.
		⇨ - no focus change, error noise.
		⇧ - focus to previous candidate or (You have ranked X. You can rank X more.) text if first candidate
		⇩ - focus to next candidate OR (Next) button if last candidate
		[Enter] - no focus change, unranks candidate.
(candidate), ranked -- multiple candidates ranked Not yet ordered.	[Candidate] [party] is ranked number X. To make ranking adjustments, press left or right. To remove ranking, press select. To continue, press down.	⇦ - No focus change. Moves candidate up in rank order, repeat audio with new rank. OR error noise if cannot move up in rank order.
		⇨ - No focus change. Moves candidate down in rank order, repeat audio with new rank. OR error noise if cannot move down in rank order.
		⇧ - focus to previous candidate or (You have ranked X. You can rank X more.) text if first candidate
		⇩ - focus to next candidate or (Next) button if last candidate
		[Enter] - no focus change, unranks candidate.

The audio is structured for efficient listening

Script samples

[Candidate], [party] is not ranked. [.] To rank candidate press Select.
[...] To continue, press down.

[Candidate], [party] is ranked number 5. [.] To make ranking adjustments, press Right. To remove ranking press Select. [.]
[...] To continue, press down.

To put candidates in order and review your rankings, press select. To continue, press down

The audio script includes planned pauses to help voters in two ways:

- Short pauses to separate chunks of text and allow a moment to absorb the more important information.
- Longer pauses to allow 'space' for the voter to interrupt the audio.

The list of instructions is always ordered so the most specific is first, any general instructions follow, and the generic instruction on how to continue is last.

The instructions are written in a consistent syntax:

To [do something] **press** [key]

Learning curve

At the bottom of the contest there is a shift from voting the contest, to a larger set of navigation possibilities (Next, Back, Help, Settings) .

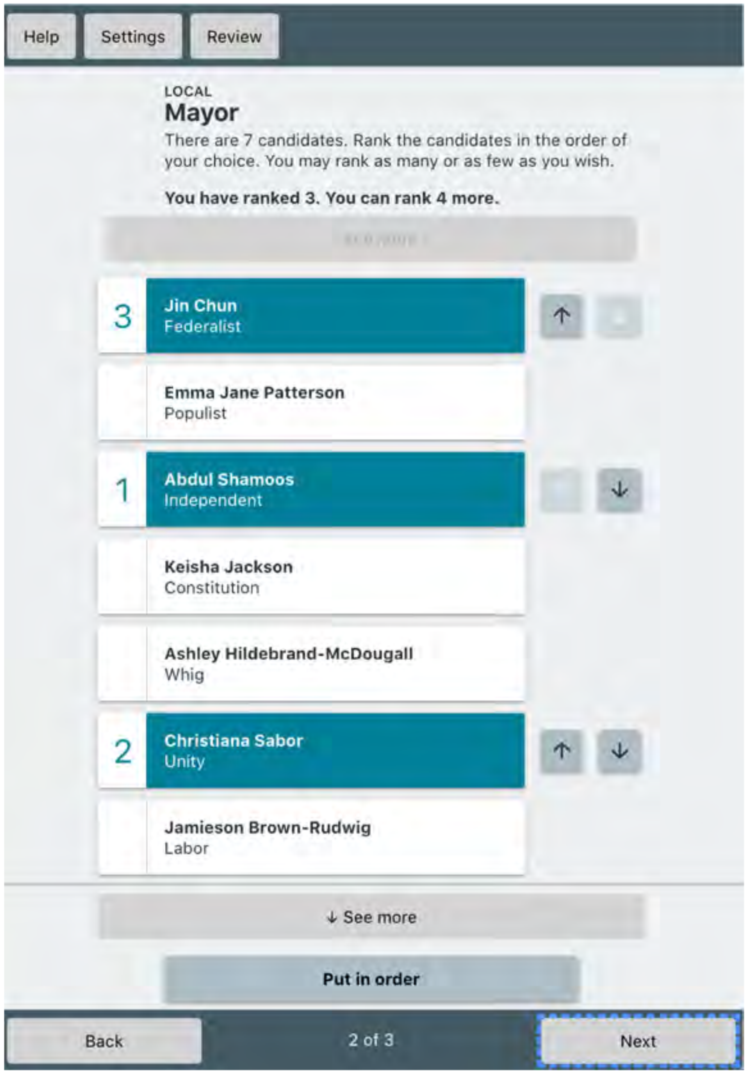
The audio needed to alert listeners to this shift and at least allude to what else is available outside of voting that contest.

What we used for in our 1st audio workshop:

Next button.

What we ended with:

Next button.
To go to the next screen, press select. For more options, press down.



LOCAL

Mayor

There are 7 candidates. Rank the candidates in the order of your choice. You may rank as many or as few as you wish.

You have ranked 3. You can rank 4 more.

3	**Jin Chun** Federalist
	Emma Jane Patterson Populist
1	**Abdul Shamoos** Independent
	Keisha Jackson Constitution
	Ashley Hildebrand-McDougall Whig
2	**Christiana Sabor** Unity
	Jamieson Brown-Rudwig Labor

Next steps

Status of the prototype

Updates being made for Precinct 30

- Change button name to “Show in ranked order”
- Change button name to “Return to ballot review” and move button to the right.
- The left and right arrow buttons will be
  - Trapped on a single candidate row (not move to the next candidate)
  - Only work when a candidate has been ranked
- On the interstitial screens, the text and button will all be contained in the dashed focus as one element.

Known bugs

- Using [Tab] navigation, pressing [Tab] from the Review button leaves the prototype to cycle through the browser controls

Ideas to explore within a full ballot interface

These issues address how the ranked-choice voting interface fits into a complete voting system design. In some cases, they were difficult to do within the prototype. In others, they require decisions beyond the work on the ranking interface.

- Some form of animation to reinforce visually when the ranking number changes (matching the audio confirmation). This was too difficult to do in the prototype.
- Decide how to replace the left/right keys in the context of an entire ballot interface. We used these buttons for changing ranking for convenience. Options include:
  - Dedicated buttons on the keypad
  - Long hold on buttons
- Decide how to set the navigation mode to dual switch. It can be a setting or automatically detected.
- Program the audio interface. This is a serious programming effort

Next steps: where does this work go?

- Keep the prototype active. In its current location
- How do we make this available through Election Guard? (Whitney to talk to RC Carter)
- VotingWorks is interested in how we designed the audio. (Whitney to add our notes to their repository with appropriate credit.)
- Do we want to find a programmer who can do any additional work and create a fully working voting system?
- Can we interest a vendor is using the interface?

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