

Enhancing Blaise 4 Surveys for JAWS Screen Reader Compatibility

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1. Introduction

There are a number of initiatives within the U.S. Government to build a more representative and diverse workforce by hiring employees with disabilities. Some disabilities require accommodation by providing hardware or software that assists a person in using a computer. We have several interviewers that work in the U.S. Census Bureau's CATI call centers that have impaired vision and use such assistive devices. When conducting interviews, it is important that they are able to accurately read questions to the respondent and enter the given answers.

Job Access with Speech (JAWS) is a screen reader program for Microsoft Windows that allows visually impaired users to read the screen with a text-to-speech output or by a refreshable Braille display¹. JAWS operates by creating a virtual "JAWS Cursor" that may be moved around the screen via the keyboard in order to read text or describe certain text attributes such as color or the use of bold or italics. The visually impaired CATI interviewers at our call centers use both text to speech and the braille display with Blaise.

When the Census Bureau started to write instruments in Blaise 4, they developed a set of screen standards for Blaise instruments. Those screen standards created a consistent survey experience for interviewers and simplified their training. The standards also streamlined instrument programming by providing a known format for each screen. They included font settings for question text, interviewer instructions, and enumerated answer lists. We continue to use these standards for all of our Blaise instruments.

The JAWS users at the call centers reported to the Blaise authors that there were elements and screens in our instruments that could be better when used with JAWS. We decided to develop screen standards specifically for JAWS users to create a more consistent experience for the interviews and reduce potential confusion while using JAWS with Blaise.

2. Overview

2.1 Reviewing current survey instruments with JAWS

Our team was responsible for evaluating how well JAWS works with Blaise for three CATI instruments and making any necessary improvements. These instruments were the Telephone Point of Purchase Survey (TPOPS), the Medical Expenditures Panel Survey (MEPS) Pre-screener, and MEPS Telephone Follow-Up.

All of us were new to using screen readers and JAWS so we obtained feedback from our call center interviewers and supervisors who were already using the software. We arranged Skype meetings with a call center supervisor and watched her navigate through our instruments with JAWS. She identified screens where JAWS was not reading text accurately and screens that were difficult for the visually impaired interviewers to navigate. During the meeting, we learned about different settings in the JAWS software that the interviewers utilize to help with their interviews. At a later meeting, we listened to an interviewer conduct a mock interview while they were using JAWS.

¹ JAWS (screen reader). (2018, July). In *Wikipedia*. Retrieved from [https://en.wikipedia.org/wiki/JAWS_\(screen_reader\)](https://en.wikipedia.org/wiki/JAWS_(screen_reader)) 07/30/2018

Observing the supervisor and interviewer use the instrument with JAWS helped us conceptualize better solutions for our instruments. After gathering their feedback, we created a spreadsheet listing each of the comments we received from the call center and our notes from the observed interviews. Our team met on a regular basis to discuss a plan of action for each item.

2.2 JAWS users at Census

During our observations, we discovered which JAWS features our interviewers utilize. We learned that the “JAWS cursor” is used to navigate the visible screen space, and the “PC Cursor” is used for normal keyboard navigation. At the start of every screen, the interviewers pressed Ctrl + Home to move the JAWS cursor to the top of the screen. Then they pressed the down arrow key to move the JAWS cursor so that JAWS spoke the text line-by-line. The interviewers prefer to use the arrow keys to move the JAWS cursor rather than having JAWS read the entire text at once so they can control the speed and in case they need to repeat any text. We also observed how the interviewers switched to PC cursor mode from JAWS cursor mode when encountering Blaise tables and lookup tables.

2.3 Prototype development

Due to the complexities of our instruments, we developed a small-scale prototype to focus on the identified JAWS issues. We gathered “problem” screens from the different instruments we were evaluating. Each issue included an example of a current “before” screen and a corresponding “after” screen that implemented a suggested solution. At our meetings, we presented the prototype to the call center supervisor (with JAWS turned on) via Skype to obtain her feedback.

3. Proposed Issues and Resolutions

The team has incorporated resolutions to many issues in the instruments we are evaluating. We plan to incorporate these fixes into future instrument development.

3.1 JAWS User Flag and Parameter

It is possible for multiple interviewers to work a case before its completion. In order to minimize the impact of screen modifications for non-JAWS users, one requirement specified that screens should have the ability to display with either JAWS friendly or regular (non-JAWS) formatting. Our CATI system should have the capability to launch cases in JAWS mode or non-JAWS mode.

We added a flag to our CATI systems, set by supervisors, to indicate if the current interviewer is a JAWS user. By having a standard flag, our programmers know what variable to use when programming changes to the instrument. The flag passes in as a parameter when we call the instrument in CATI. If the flag’s value equals “1” then the JAWS-friendly screens display. If the flag has no value, the standard screens display.

3.2 Interviewer Instructions

Our Blaise screen standards include interviewer instructions, which the interviewer does not read to the respondent. A blue diamond precedes the instruction, and the instruction text is in blue Arial 14pt font. Since Blaise 4 displays any OpenType font, we use the Wingdings font (lowercase S) to display the diamond (see Figure 1).

We learned during the initial feedback that JAWS does not interpret the diamond as expected. By default, JAWS does not say or display that character as “diamond.” Instead it says or displays the code that is set for the Wingdings character itself, resulting in the interviewer hearing or reading “**Wingdings sixty one thousand one hundred fifty five**” (hereafter referred to as the Wingdings code). It is similar to the alt-text attribute for HTML images that is used by screen readers to say or display the text associated with the image. Whenever JAWS would read an interviewer instruction, the user would hear or read the Wingdings code followed by the instruction text, which slowed down the interview.

Another scenario was a screen with interviewer instructions displayed before question text, such as in Figure 3a. Additionally, other screens may contain multiple interviewer instructions after the question text but before JAWS would reach an answer list for an enumerated question. In both situations, we needed JAWS to alert the interviewer that they had reached the end of the instruction(s) and were moving on to a new type of text.

Initially we tried looking at the JAWS settings and even the JAWS dictionary to see if there was a way we could tell JAWS that if it read the Wingdings code to say or display a different phrase such as “diamond” or “interviewer instruction.” However, we were unable to use either method to change how JAWS was speaking or displaying the character as JAWS continued to read the Wingdings code.

We resolved the issue by substituting the diamond with a different character for JAWS users. After listening to how JAWS reads several different characters, our team decided that we would use the left brace, {, to denote the start of interviewer instructions and the right brace, }, to denote the end of the instructions. The braces also take up less space on the Braille reader and are easier for the interviewers to read. We do not use these characters regularly so they became the best choice for our requirements. For screens that have multiple interviewer instructions grouped together, we decided to use only one set of braces to eliminate redundant instruction notifications.

To display the braces for a JAWS user or the diamond for a non-JAWS user, we programed text fills for all interviewer instructions. The fills were simple to program but every question needed to be reviewed and updated if it contained interviewer instructions. We used the “find” option in the Control Centre to locate all text with the “diamond” code, which we program as “@Zs@Z.” We modified the instruction coding like this:

```
IF JAWSFLAG = 1 THEN
    FR_Instruction := '{ '
    FR_Instruction_2 := ''
    End_Instruction := ' }'
ELSE
    FR_Instruction := '@Zs@Z'
    FR_Instruction_2 := '@Zs@Z'
    End_Instruction := ''
ENDIF
```

```
@L^FR_Instruction Press Insert key to add to/edit field contents.@L
```

```
@L^FR_Instruction_2 Press Esc key to recall original field contents.
^End_Instruction@L
```

Figure 1 - Interviewer Instructions for non-JAWS users



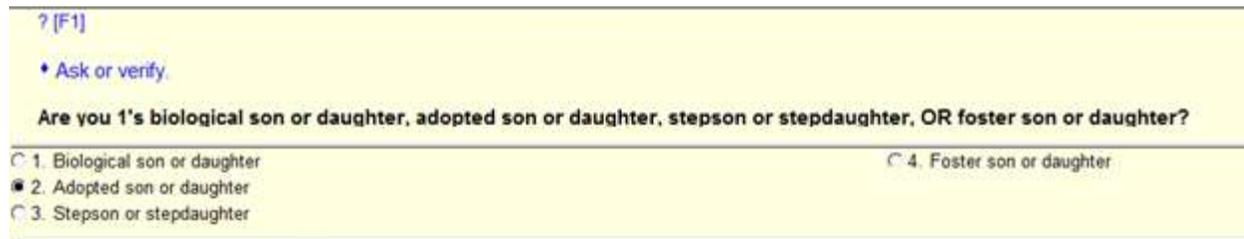
Figure 2 - Interviewer Instructions for JAWS users



3.3 Multi-Column Answer Lists (Answer Choices)

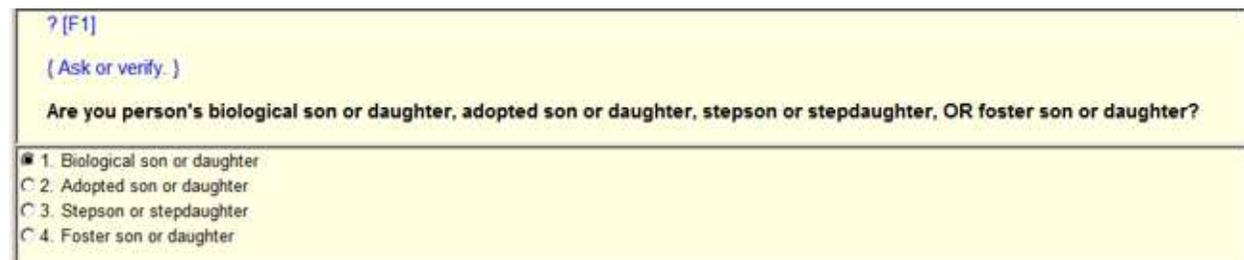
If an Info Pane allows for more than one column of possible answer choices in an enumerated question, JAWS will read the answers out of order since JAWS reads each line from left to right. In the figure 3a below, JAWS says or displays the choices as “**1 Biological son or daughter 4 Foster son or daughter 2 Adopted son or daughter 3 Stepson or stepdaughter.**”

Figure 3a - Multi-column answer list (before)



Our recommendation was to modify the layout instructions to use a one-column Info Pane for this screen so all options would align in one column. However, it is important to verify that the change does not introduce scrolling as JAWS does not have the capability to auto-scroll and it does not always alert the user that there is a scroll bar. We also made sure not to affect the display of other fields on the same pages.

Figure 3b – Multi-column answer list (after)



3.4 Multi-Column Form Panes

In Blaise 4, we can specify which questions to group together in a form pane with layout instructions specifying the grids and field panes to use for page of the instrument. For most of our instruments, we tend to have multiple columns of questions in the form pane area:

Figure 4 - Multi-Column Field Pane

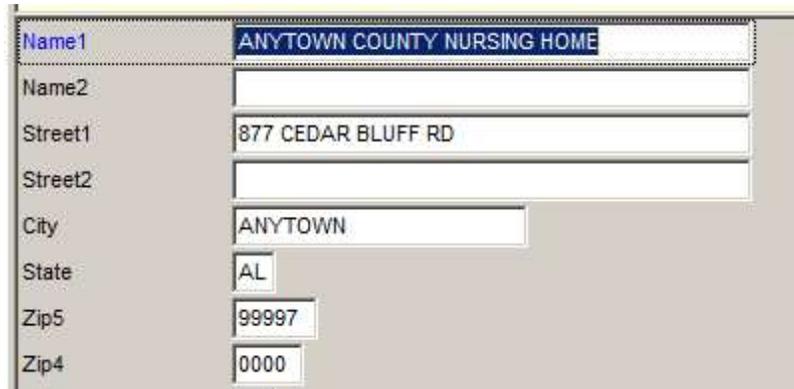


Name1	ANYTOWN COUNTY NURSING HOME	Street1	877 CEDAR BLUFF RD
Name2		Street2	
		City	ANYTOWN
		State	AL
		Zip5	99997
		Zip4	0000

As mentioned above, JAWS will typically read items on the screen from left to right. In Figure 4 above, JAWS would say “**Name one Anytown County Nursing Home Street one eight seven seven Cedar Bluff Road.**” We can program JAWS to pause on the field where the cursor is located, but that does not always tell the interviewer exactly where they are in the instrument.

We decided to update the instrument layout so that all questions in the form pane are in one column per page. As a JAWS user moves their cursor, it will be more apparent which question they are currently answering. This change does not adversely affect non-JAWS interviewers.

Figure 5 - Single Column Form Pane



Name1	ANYTOWN COUNTY NURSING HOME
Name2	
Street1	877 CEDAR BLUFF RD
Street2	
City	ANYTOWN
State	AL
Zip5	99997
Zip4	0000

3.5 Multiple Question Questions / Multiple Answer Questions

Some screens present multiple answer inputs based on one question.

Figure 6 - Asking for the name and title with different input boxes for each



May I have your name and title please?

- ◆ Press [Insert] key to add to/edit field contents.
- ◆ Press [Esc] key to recall original field contents.

Respondent Name	Mary Citizen Supervisor
Respondent Title	

We learned that our JAWS users were not always clear that they needed to type this information into two different response items. In the above example, they would type the name, “Mary Citizen,” and the title, “Supervisor,” into the name field.

As we have identified these screens, we have worked with the survey sponsors to modify the screens so clarifying instructions are displayed on the screen for JAWS users. The instructions were updated for both JAWS and non-JAWS users.

Figure 7 - Same question as Figure 6 with additional clarifying instructions



May I have your name and title please?

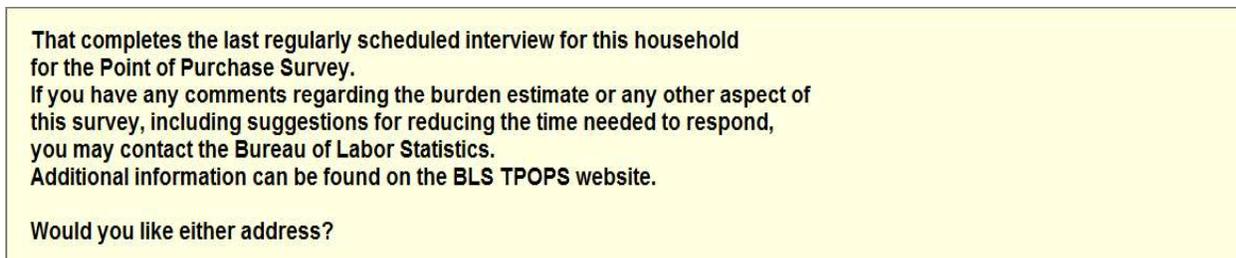
{ Enter name or press Enter key to accept field contents.
Press Esc key to recall original field contents. }

Respondent Name	Mary Citizen
Respondent Title	

3.6 Hard Returns in Question text

We use hard returns in our surveys to add spacing to questions, interviewer instructions, and to split long questions or fills into multiple lines. This helps the interviewers or respondents follow the flow of the survey and makes it less likely for interviewers to misread or overlook questions or instructions.

Figure 8 - A screen with extra hard returns for the question text

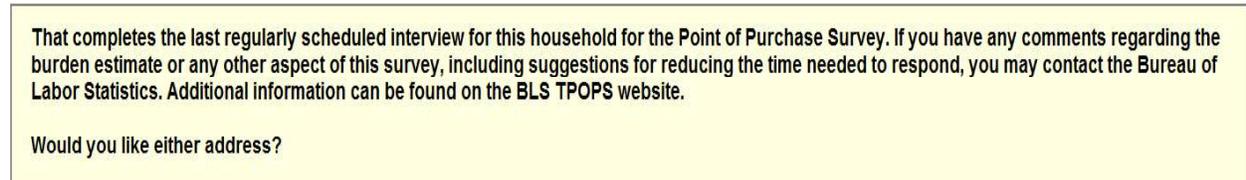


That completes the last regularly scheduled interview for this household for the Point of Purchase Survey.
If you have any comments regarding the burden estimate or any other aspect of this survey, including suggestions for reducing the time needed to respond, you may contact the Bureau of Labor Statistics.
Additional information can be found on the BLS TPOPS website.

Would you like either address?

Despite the usefulness of hard returns in formatting some of our surveys, this practice does not work as well for JAWS users. The issue with using hard returns in question text is the more lines the interviewer has to navigate using JAWS, the more “pauses” they hear from JAWS. To alleviate the burden on the JAWS users we decided to remove all unnecessary hard return “@/” from within the question text and fills in the CATI instruments.

Figure 9 - The figure 8 screen with extra hard returns removed



The effort to remove all the hard returns was tedious. We could not do a search and replace for “@/” in the code as we might inadvertently delete hard returns that were intended to be included in the question text. Together, sponsors and authors identified each screen to be modified and thoroughly tested the changes to make sure the screens work for both JAWS and non-JAWS users.

3.7 Info Pane and Form Pane Scrolling

The JAWS software does not alert the user if there is scrolling in the info pane or form pane. Since many of the interviewers are exclusively using their keyboard, they may not be aware that there is more question text or even additional answers for an enumerated question. As we made changes to the layouts, we tested each screen to make sure they displayed all text without a vertical scrollbar.

Another factor we also must keep in mind is that the interviewer may be running at a different resolution so our instrument should be able to display without scrolling for multiple resolutions. The best way to design to avoid scrolling for JAWS users is to make sure the screens do not scroll at the lowest possible resolution of the hardware that is used.

3.8 Exiting Household Rosters and similar Tables

As a standard in our Blaise 4 instruments when collecting a household roster of names, if there are no other members in the household to collect, the user enters “999” in the first name field to exit the data collection screen.

We found instances where JAWS users accidentally entered “99” or “9999” in first name, which added an additional person to the table. Once added, it can be difficult to remove this accidental person from the table. It proved to be even more difficult for a JAWS user.

To mitigate this problem, we added an edit for all users to prevent them from entering “9,” “99,” “9999,” or “99999.” The edit message displayed upon those conditions is:

“Please enter “999” to exit this table.”

Figure 10 - Edit check to prevent exiting a roster if user did not enter "999"

Solution: Set up checks to ensure the user does not enter "99" into the FName field.

{ Enter First Name
Enter 999 if no more persons }



The screenshot shows a 'Hard Error' dialog box with the message: [Please enter "999" to exit this table.]. Below the message is a table with two columns: 'Questions involved' and 'Value'. The table contains one row: 'FNAME: First Name' with the value '99'. At the bottom of the dialog are three buttons: 'Suppress', 'Close', and 'Goto'.

Stat	Stat	First Name	Last Name	Mem	Ure	Sex	Rel	Birth Month	Day	Year
1]		Mary	Citizen	1	2	2		1	1	1990
2]		99								

4. Challenges Encountered

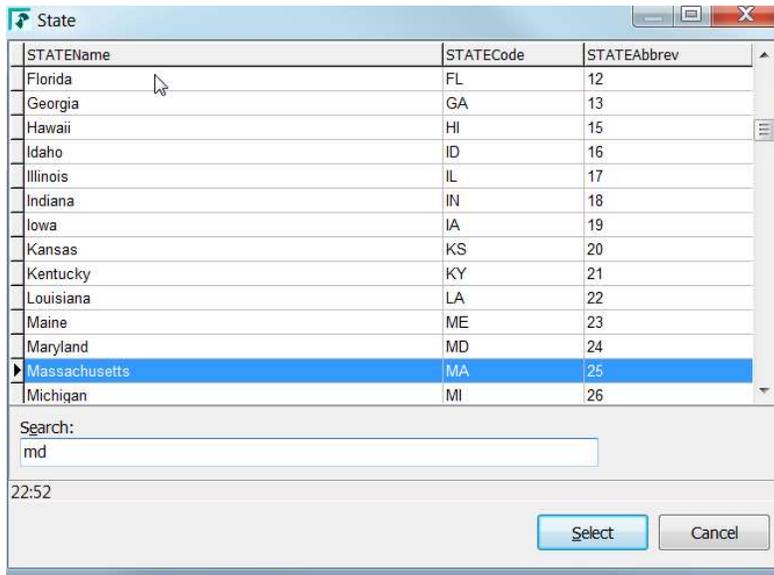
There are still a few requirements that are being actively developed and refined to create the best experience for our JAWS users. As we get feedback, we will incorporate their recommendations into our JAWS screen standards.

4.1 Lookup Tables

By default, Blaise displays all the fields listed in the datamodel of a lookup table. Some reports from our JAWS users are that they experience some potential issues when accessing lookup tables, especially when there are multiple columns displayed.

- JAWS reads the text that the user types into the lookup table, but it does not read the highlighted selection in the table.
- JAWS reads the first line of the table automatically before starting to read the search line that shows up when the first few characters were typed.
- Interviewers do not know immediately that they are in a lookup table.
- Interviewers cannot move through the list with the JAWS cursor. They must switch to the PC cursor to do this and then switch back to the JAWS cursor when they are finished.

Figure 11 - State lookup table with default view



STATEName	STATECode	STATEAbbrev
Florida	FL	12
Georgia	GA	13
Hawaii	HI	15
Idaho	ID	16
Illinois	IL	17
Indiana	IN	18
Iowa	IA	19
Kansas	KS	20
Kentucky	KY	21
Louisiana	LA	22
Maine	ME	23
Maryland	MD	24
Massachusetts	MA	25
Michigan	MI	26

Search:
md

22:52

Select Cancel

Ideally, JAWS should read the highlighted selection in the table so the interviewer knows they selected the correct option. Otherwise, there could be a mistake and the interviewer would not know.

We tried different approaches to remedy this issue such as writing a Manipula program and creating a custom data viewer. The Manipula program activated a box that looked like the lookup table but it had a Title Bar that included text to tell JAWS users to switch to the PC cursor. The contents of the table are shown to the user with only the necessary fields, such as State Name and State Code in Figure 11. The Manipula attempt looked promising but we discovered that the Manipula script treated the first character keyed as what activates the lookup so it is not carried into the search bar and would not be spoken by JAWS.

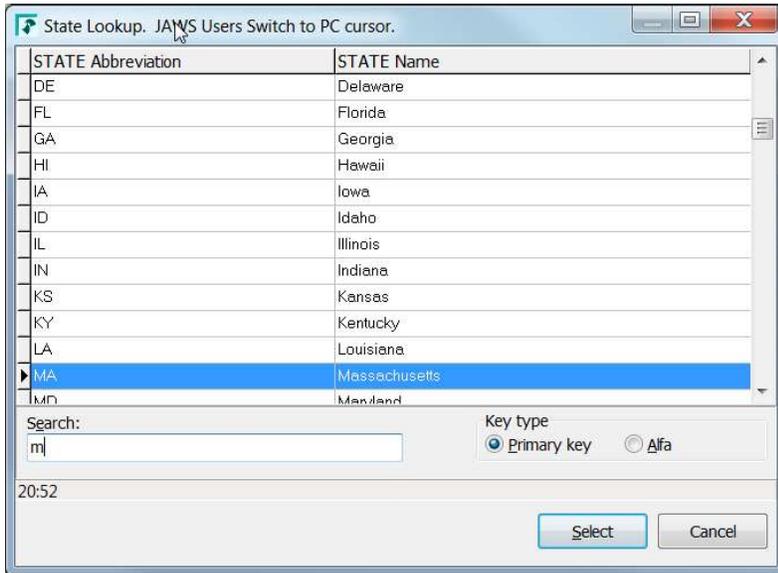
We decided to proceed with a custom lookup table using the Blaise Data Viewer. The goals are to alert the JAWS users that they have accessed a Lookup table and they need to switch to PC cursor to navigate through the Lookup table and to remove any unnecessary columns in the Lookup table to eliminate extra text read to the user.

We created a Blaise Data Viewer (.BDV) file for each lookup table to filter and customize content displayed to the user. We can reuse this file for other survey instruments that use the same lookup tables. However, if the database structure of the lookup table changes, then the BDV file needs to be re-created. This change to the lookup tables will be available to all users.

A JAWS-friendly BDV file should:

- Add a Lookup Table Title and Standard wording: <Table Name> + “Lookup” + “JAWS Users Switch to PC Cursor.”
- Modify Column Headings so that JAWS can clearly read them to indicate the information contained.
- Remove any unneeded extra columns from the view.

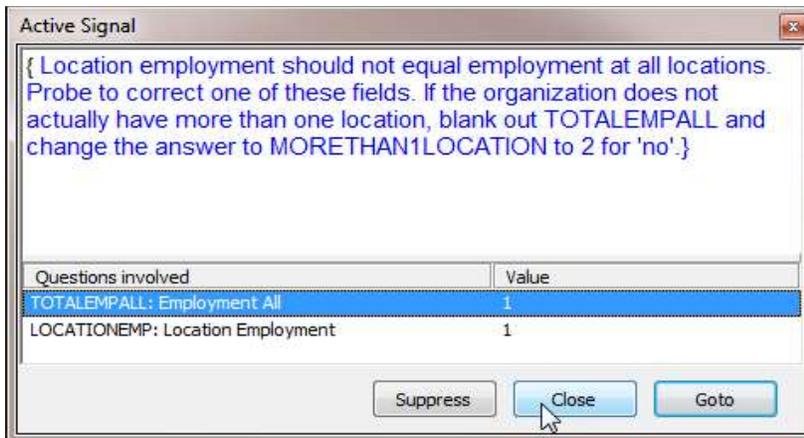
Figure 12 - State lookup with BDV for JAWS



4.2 Edit Checks

JAWS users have encountered issues with edit checks that are similar to the issues with lookup tables. When the edit check window pops up, JAWS reads the title of the edit check (Active Signal or Hard Error) and then skips to the bottom of the screen without reading the text from the edit check. Like the lookup tables, the users do not always know immediately that a popup window has appeared and they should use the PC Cursor to navigate.

Figure 13 - Active Signal with JAWS interviewer instructions



Unlike lookup tables, we do not have a setting to customize the edit check windows display. To provide an indicator for the JAWS user, we are considering using the JAWS dictionary so that if it encounters the phrase “Active Signal” or “Hard Error” JAWS speaks or displays the title of the edit check window plus “JAWS Users Switch to PC Cursor.”

4.3 Help Screens

Some survey questions have the option to provide additional information if the respondent requires more help. This is displayed to the interviewer as ? [F1], which alerts them that they can press F1 to open a window with the additional information.

Figure 14 - Display of F1 help available for this screen

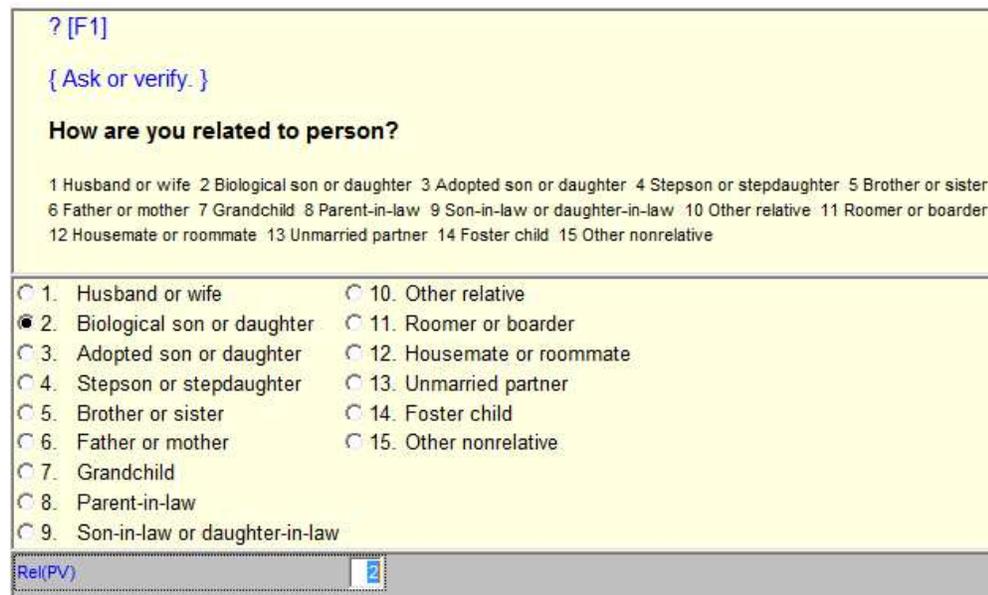


JAWS reads ? [F1] as: **“Question Mark Left Bracket F1 Right Bracket.”** We found that the description read was not ideal. By adding a new entry to the JAWS dictionary, we could translate the above characters, so that when encountered JAWS reads **“Press F1 for Help.”**

4.4 Large Response Lists

Some survey questions have a large enough set of responses that it is impossible to put them into one column for JAWS users. One solution that our team made available to help JAWS users is adding a fill to the info pane that lists the answer set in the left to right order that JAWS reads the screen.

Figure 15 – Additional fill for a large response list (for JAWS users only)



Another solution in the early stages of prototyping is to create a lookup table that contains the answer list. This would be useful for very large lists such as one containing the list of languages primarily spoken in the household. However, implementation of this solution requires buy-in from our survey sponsors and interviewers as it would change the display and implementation of the question.

4.5 JAWS Settings

We have described the majority of changes to accommodate screen reader compatibility by modifying the Blaise 4 code and redesigning the screen presentation. However, we can also customize JAWS by using screen reader parameters.

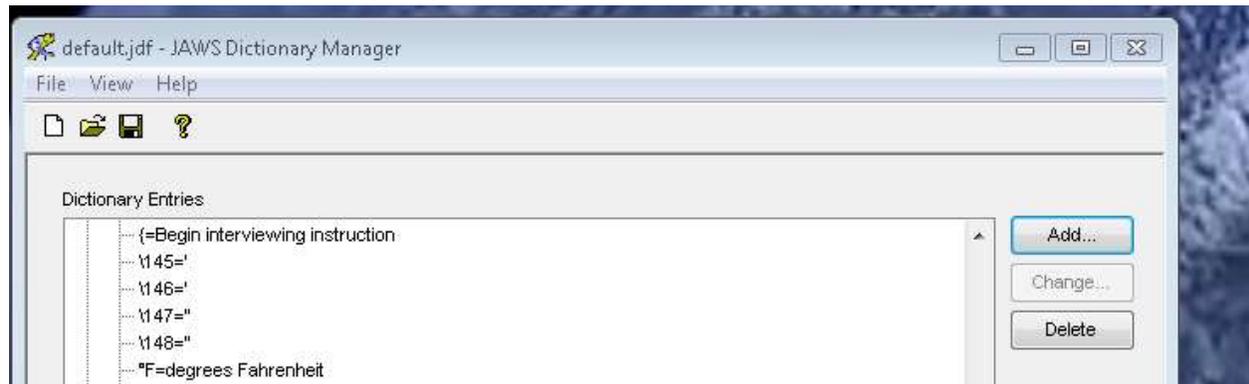
4.5.1 Customizing JAWS Settings

During our initial review of JAWS use at our call centers, we learned that interviewers have the capability to personalize their own JAWS settings. These features include text presentation on the screen, the question reading speed if they are using text-to-speech, the voice used for text-to-speech, and the buttons used for navigating their screens.

A few of the solutions that the team came up with are standards for how certain elements such as edit checks are presented to the interviewers and how certain characters or phrases are translated. The JAWS screen reader has its own dictionary feature that can be refined to update what it speaks or displays to the user. By default, when JAWS sees CATI, it says it with a much different inflection than what is commonly used (Cah-Tee). We updated the dictionary so that JAWS uses the expected inflection (Cat-ee).

Besides being able to tweak the pronunciation of words for text to speech, we used the JAWS Dictionary Manager to customize how JAWS reads a particular character, word, or phrase. By default, JAWS reads the braces we would use for interviewer instructions as **“left brace”** or **“right brace.”** We added an entry in the JAWS dictionary so when a “{“ is encountered JAWS speaks or displays **“Begin interviewing instruction”** or **“End interviewing instruction”** for “}”. Not only can we create custom text, we can program JAWS to play a sound if it encounters this character or phrase.

Figure 16 - Translating characters to words



4.5.2 Centralizing JAWS Settings

One feature that is offered by JAWS is the capability of having one centralized repository for settings that can be used by all interviewers. By having one common dictionary and other settings, a centralized configuration file can be stored to a common directory on the network. Every time an interviewer starts JAWS, it imports this configuration file for their use. Using this file would ensure consistency of what is said or displayed to the interviewers. This also eases the burden of troubleshooting when issues arise on JAWS settings, since we are not dealing with customized individual settings.

This is still undergoing refinement as we want to be able to capture the settings and dictionary entries the interviewers will definitely need, plus create a baseline that all interviewers can use that would need little to no tweaking.

5. Next Steps

Besides the refinements mentioned in Section 4, we will be adding these enhancements to the instruments on a rolling basis as scheduled. The MEPS and TPOPS surveys currently have the layout changes and clarifying instructions in their instruments. In 2019 we are planning to add the updated interviewer instructions and lookup table enhancements to MEPS and any other approved changes. The team is still meeting regularly to get feedback from our interviewers on the planned changes.

As we continue our research into Blaise 5, we will review our changes to the Blaise 4 instruments and determine how to implement them in Blaise 5. Blaise 5 represents an opportunity to write new screen standards that can take into account the needs of users of JAWS and other hardware or software so that they are able to conduct a survey without a need to overhaul the instrument.

6. Conclusion

Blaise 4 works well with JAWS even if we need to revise some of our screen standards to make our instruments more JAWS-friendly. We have learned several ways to improve our instruments so that anyone who uses JAWS or similar hardware or software will be able to conduct surveys with minimal issues. However, as technology changes it remains important to get feedback from our users at every stage in the development lifecycle. This ensures delivery of the best quality instruments that work with any hardware or software that they will need in order to be able to complete their tasks.

7. Acknowledgements

The authors wish to thank Heidi Casey and the staff of the National Processing Center for their feedback on using JAWS and helping suggest improvements to our instruments.

The views expressed in this paper are those of the authors and not necessarily those of the U.S. Census Bureau.