

# Evidence-based Standards and Guidelines for Mobile Survey Instrument Design

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FCSM

March 8, 2018

# Motivation: Solve an Operational Problem

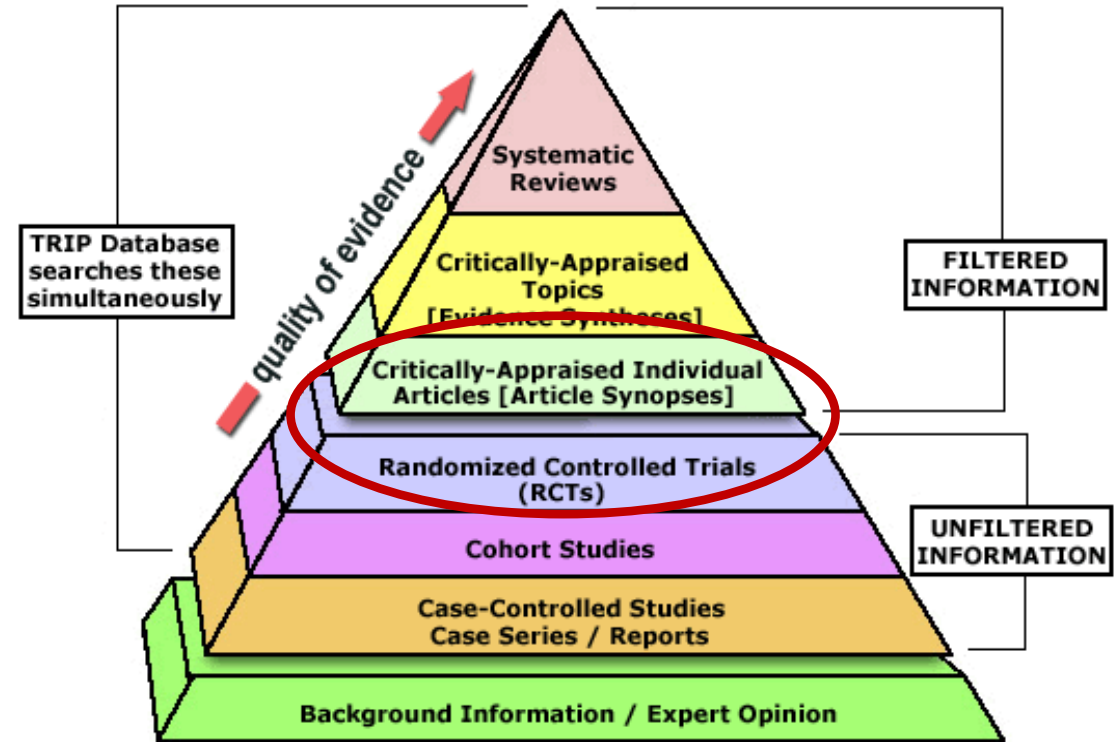
1:15



# Solution: Standards and Guidelines based on Evidence

1. **Standards** for the basic elements of mobile survey instruments (e.g., touch target size).
2. **Guidelines** for the building blocks of mobile survey instruments (e.g., date entry format).
3. The standards and guidelines are based on **empirical evidence**.
4. Evidence comes from existing **literature** and/or human

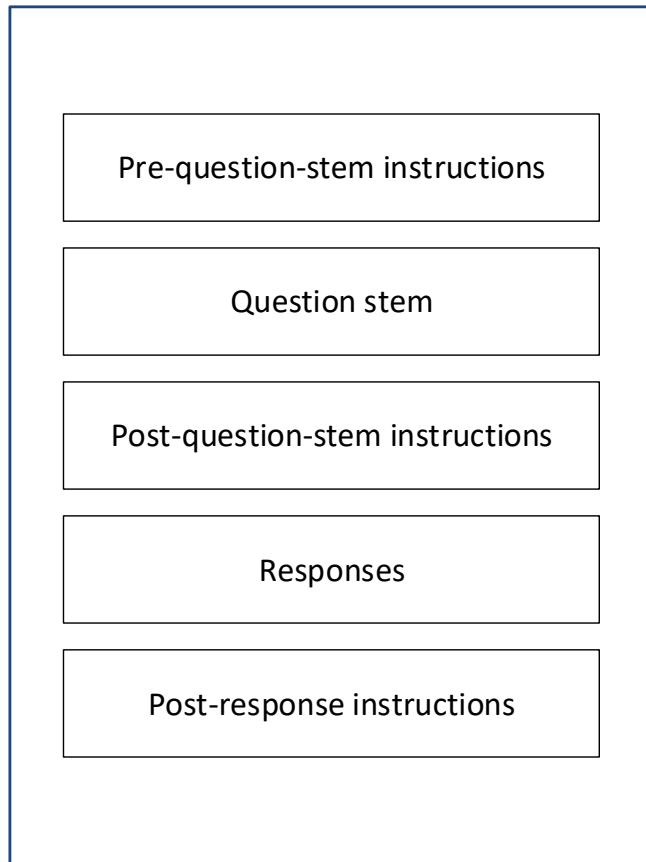
**behavioral experiments** designed and conducted for this project.



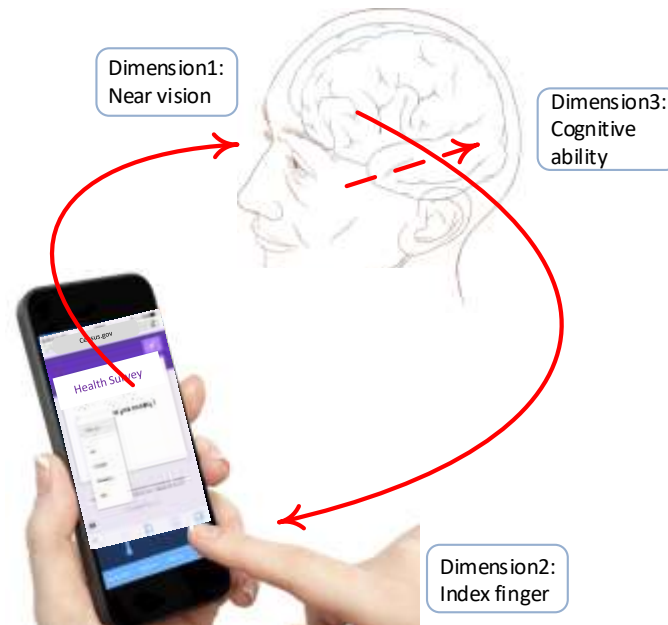
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# Approach: Systems Engineering

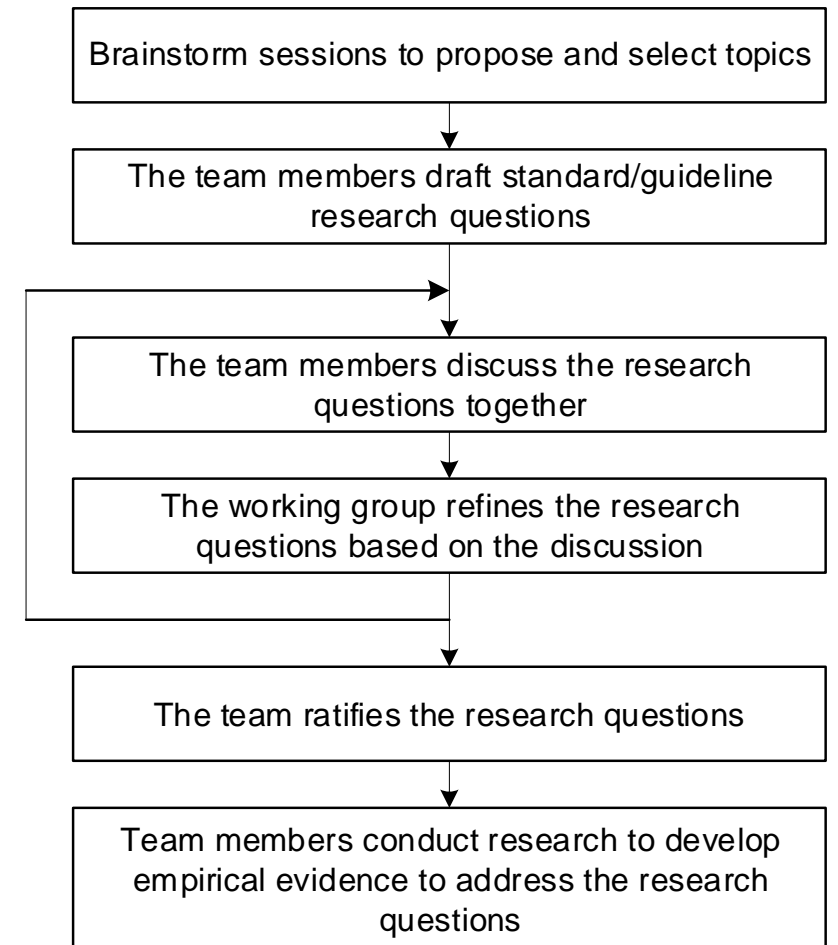
## Survey Question Model



## Mobile Respondent Model



## S&G Development Workflow



# Evidence Gathering: Comparative Outcome Analysis

Do participants <perform a task> **more** effectively, **more** efficiently, with **better** satisfaction <using> <**this method**> than <**other method(s)**>?

## Literature Review

<b>Guide No</b>	1
<b>Importance</b>	2
<b>Category</b>	General
<b>Topic</b>	Screen Orientation
<b>Research questions</b>	Should the survey instrument be designed for portrait or landscape display?
<b>Guide</b>	Design questionnaires optimized for portrait orientation.
<b>Evidence</b>	Paper 1 ... Paper 2 ...
<b>Evidence strength</b>	2

## Behavioral Experiment

**Research question:** Is Design A better than B, C ...?

**Performance measures:**  
Effectiveness, Efficiency, Satisfaction.

**Experimental factors:** Design A, B, C  
...

**Experimental paradigm:** task description.

**Experimental design:** Factorial design.

**Participants sample:** 30 individuals

# The Structure of the Standards and Guidelines Draft Manuscript

- Standards (3)
- Guidelines (13)
  - Screen Design (6)
  - General Question Design (3)
  - Question Responses (4)

The image shows the cover page and Table of Contents of a draft manuscript. The cover page features the title 'STANDARDS AND GUIDELINES FOR MOBILE SURVEY INSTRUMENT DESIGN' in a large, bold, blue font. Below the title, it lists the project team as 'IOE 2015 BCase 01 Project Team' and the 'Center for Survey Measurement'. It also includes 'Version 1.1' and the date 'February 26, 2018'. The Table of Contents on the right side lists the following sections and their page numbers: 1 INTRODUCTION (1), 1.1 Sub-Section (1), 1.2 Sub-Section (1), 1.3 Sub-Section (1), 2 STANDARDS (2), 3 GUIDELINES (4), 4 ADDITIONAL TOPICS FOR FUTURE RESEARCH (38), REFERENCES (39), APPENDIX A METHODOLOGY (40), APPENDIX B LIST OF STANDARDS (41), and APPENDIX C LIST OF GUIDELINES (42).

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1.2	Sub-Section ..... 1
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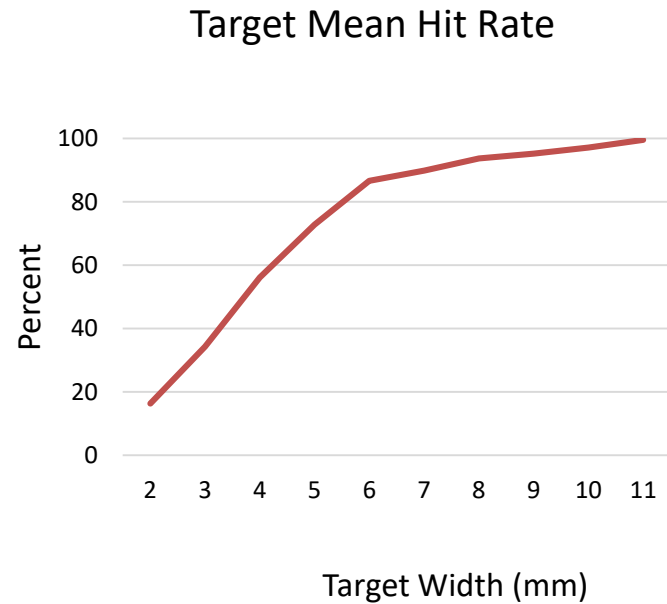
# Standards for Basic Design Elements

# Standard 1

## Size a touch target at least 6 mm in diameter or width

### Supporting Evidence:

- 52 participants performed a task of touching a round target with its diameter ranging from 2 mm to 11 mm, and other 45 participants a square target with its width ranging from 2 mm to 11 mm.
- Ps' rate of



Your neighborhood:

1 = no trust at all

2

3

4

5

6

7 = complete trust

Previous Next

Your neighborhood:

1 = no trust at all

2

3

4

5

6

7 = complete trust

Previous Next

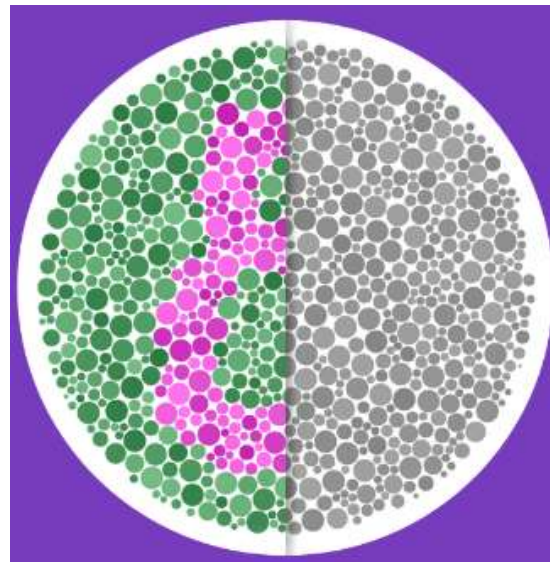


## Standard 4

# Maintain luminance ratio between text and background being at least **4.5:1**

### Supporting Evidence:

- Web Content Accessibility Guidelines (WCAG) 2.0, published by the World Wide Web Consortium (W3C), stipulates that **“the visual presentation of text and images of text has a contrast ratio of at least 4.5:1.”**

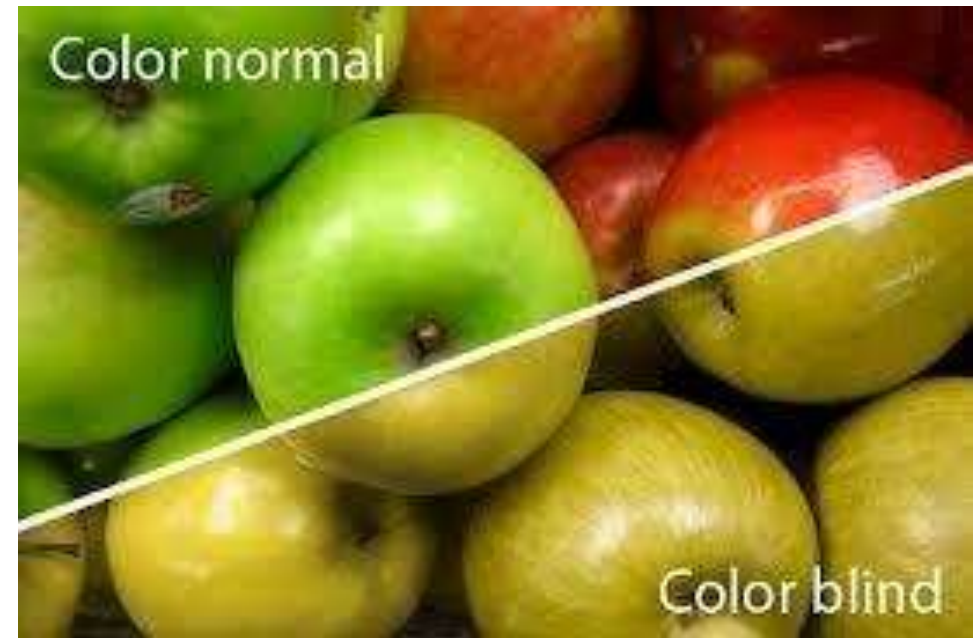


## Standard 5

# Avoid placing red and green colors next to each other

### Supporting Evidence:

- In the United States, **8.0% of men and 0.5% of women** with Northern European ancestry cannot easily distinguish red from green (**red-green color blindness**).
- Not placing red and green colors next to each other, e.g., red text against green background, can help make the information presented on the smartphone display legible for this user group.



# Guidelines for Screen Design

## Guideline 1

# Design questionnaires for portrait orientation with no horizontal scrolling

### Supporting Evidence:

- Most smartphone users **hold their smartphone upright in portrait view** for reading and browsing, rather than sideways in landscape view (Hooper 2013; Shirazi et al. 2013).
- Respondents show **less tendency or willingness to scroll horizontally**, than vertically, to read a complete survey question if portion of the question is outside of the display screen (Peytchev and Hill 2010).
- Unwillingness to scroll horizontally may result in higher item nonresponse rate (de Bruijne and Wijnant 2014), or biased responses (Stanleten 2013).



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WHERE DISCOVERIES BEGIN

Part A - Principal Job

A28. Thinking about your principal job held during the week of February 1, please rate your satisfaction with that job's...

Select one answer for each item.

1. Salary

Very Satisfied

Somewhat Satisfied

Somewhat Dissatisfied

Very Dissatisfied

2. Benefits

Very Satisfied

Somewhat Satisfied

Somewhat Dissatisfied

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Select one answer for each item.

Very Satisfied Somewhat Satisfied

1. Salary

2. Benefits

3. Job security

4. Job location

5. Opportunities for advancement

6. Intellectual challenge

7. Level of responsibility

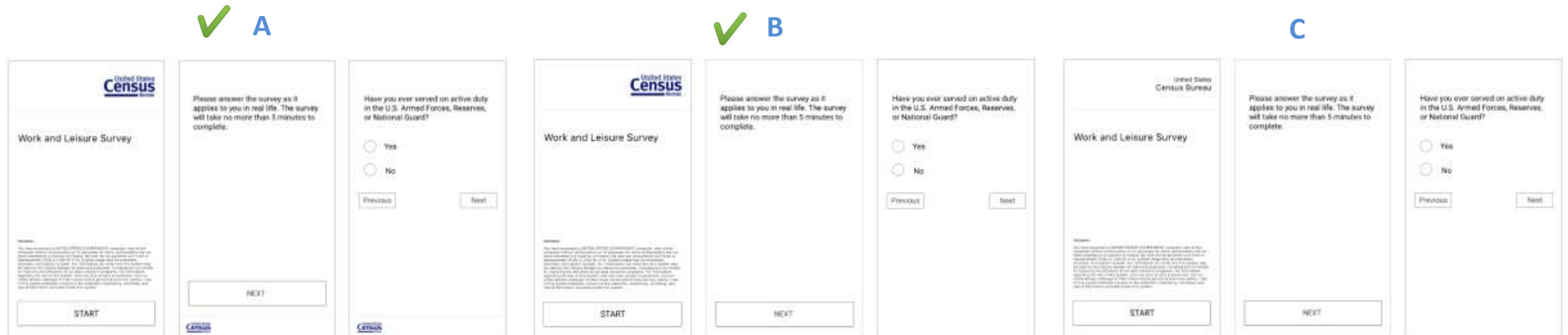
8. Degree of independence

## Guideline 3

# Place the logo of Census Bureau at least on the title screen

### Supporting Evidence:

Of 46 participants who were shown three survey instrument design – the Census Bureau logo (A) on every screen, (B) on the title screen only, and (C) no logo but the text of the Census Bureau on the title screen, **61% of Ps preferred (A), 35% (B), and 4% (C).**

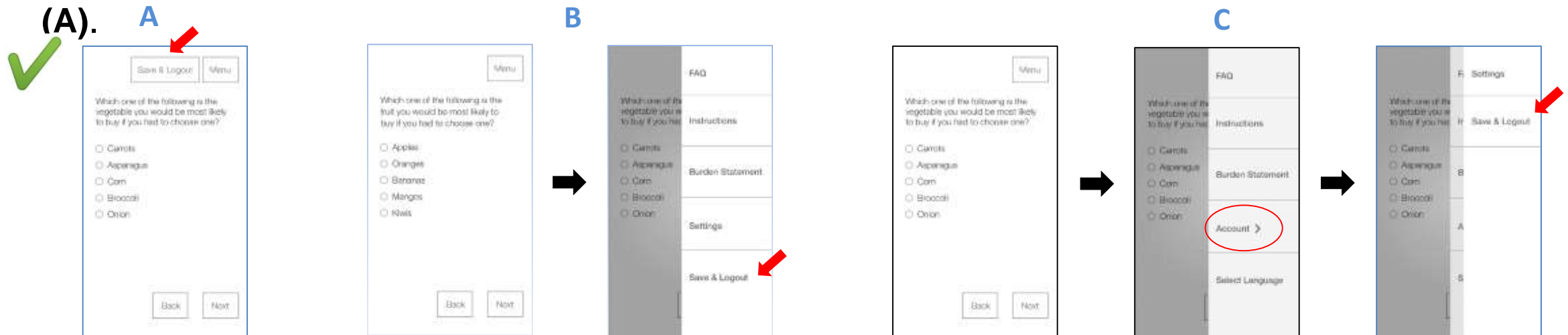


## Guideline 7

# Place the “Logout” action button on the screen to be visible

### Supporting Evidence:

Thirty participants performed a logout task with three different designs – (A) On survey question screen, (B) Inside main menu (Menu > Save and Logout), (C) Inside sub-menu (Menu > Account > Save and Logout). Results show that, though Ps succeeded in both (A) and (B), **Ps completed the task much faster ( mean = 4 sec) in (A) than in (B) (37 sec).** In addition, **85% of Ps favor Design**



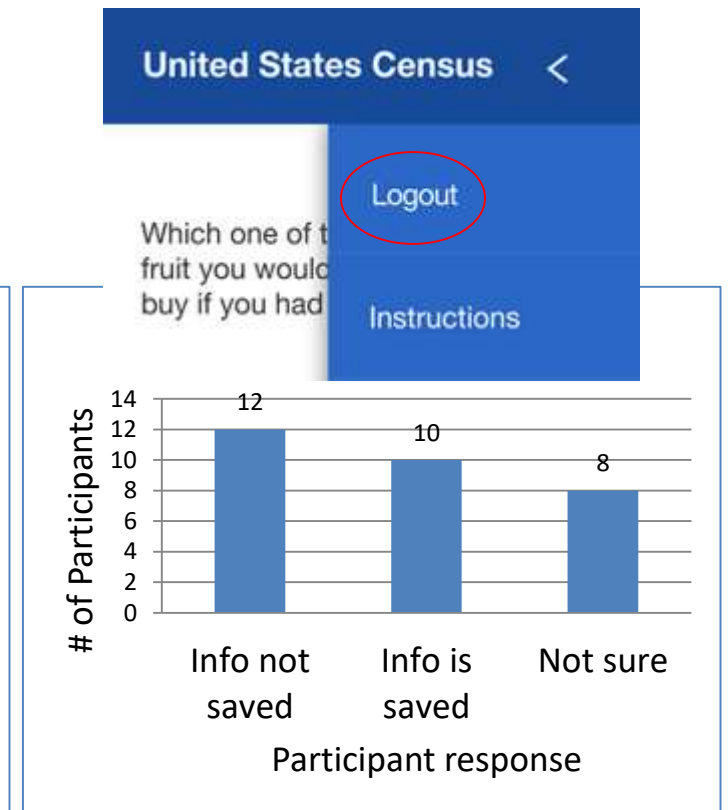
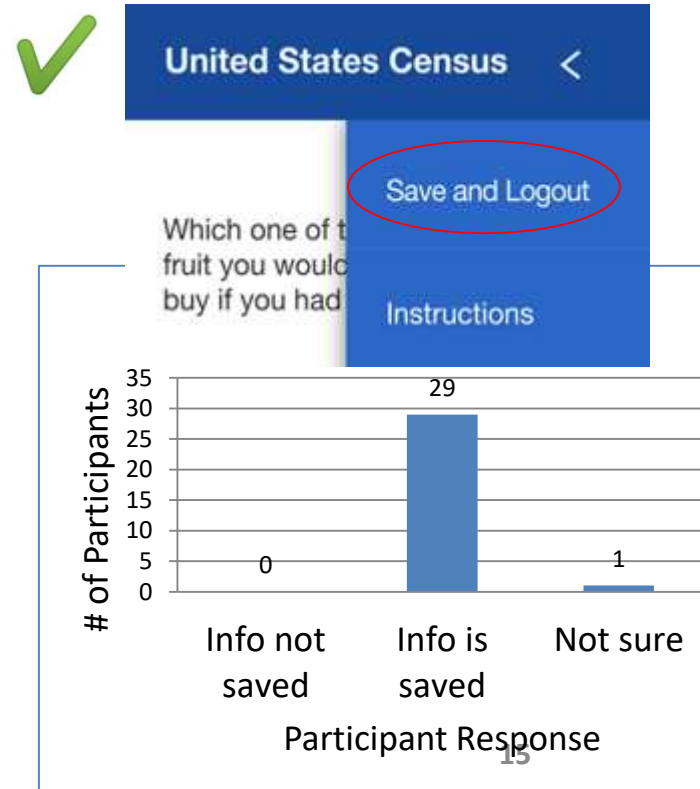
## Guideline 8

# Label all action buttons with text of semantic clarity

### Supporting Evidence:

- **Unlabeled action buttons have lower likelihood to be correctly interpreted of their actions by users** (Leung, McGrenere, and Graf, 2011).
- Users with different cultural backgrounds may interpret unlabeled action buttons differently (Kim and Lee 2005).
- In-house experimental results.

Do you think any of the information you have already entered will still be there when you return and log back into the survey later?



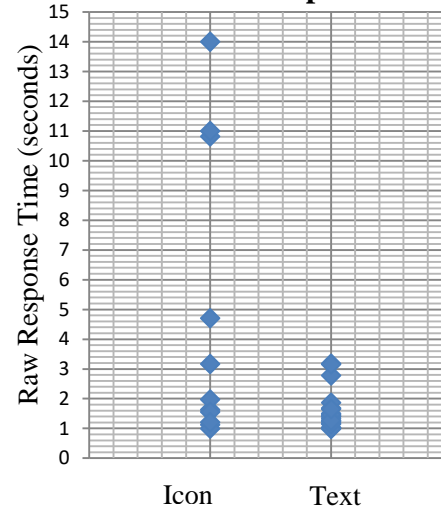
## Guideline 9

# Label navigation buttons with text of “Previous” and “Next”

### Supporting Evidence:

- Two groups of 16 study participants completed a short survey of same design except for navigation buttons, respectively:
  - (A) Text
  - (B) Icon
- The **Text group was quicker** to initiate forward navigation for the first time ( $M=1.53\pm 0.16$  vs  $M=4.16\pm 1.17$  sec).
- 70%** of the 32 participants preferred the text labeled navigation buttons.

First Trial Response Time



✓



## Guideline 11

# Need not to include breadcrumb trails in addition to other navigation tools

### Supporting Evidence:

- Two groups of 16 study participants completed a short survey of same design except for navigation methods, respectively:
  - (A) Navigation buttons only
  - (B) Navigation buttons + Breadcrumb trail
- 14 participants in Group B did not use breadcrumb trail.**

United States Census Menu

On April 1, 2016, was the house apartment, or mobile home at 100 Nowhere Lane:

- Owned by you or someone in this household with a mortgage or loan?
- Owned by you or someone in this household free and clear (without a mortgage or loan)?
- Rented?
- Occupied without payment of rent?

[Accessibility](#) [Privacy](#) [Security](#)

United States Census Menu

[Home](#) > [Household](#)

On April 1, 2016, was the house apartment, or mobile home at 100 Nowhere Lane:

- Owned by you or someone in this household with a mortgage or loan?
- Owned by you or someone in this household free and clear (without a mortgage or loan)?
- Rented?
- Occupied without payment of rent?

[Accessibility](#) [Privacy](#) [Security](#)

# Guidelines for General Question Design

## Guideline 12

# Use Sans Serif typefaces

### Supporting Evidence:



- **Sans serif** fonts (e.g., Arial) tend to be **preferred** by readers over serif fonts (e.g., Times New Roman) (Bernard, Liao, and Mills 2001; Bernard et al 2003; Bernard et al 2002).
- The use of sans serif fonts at very small sizes, like what might be encountered using a mobile device, can **increase reading speeds** (Morris et al 2002).

### Supporting Evidence:

- Sans serif fonts (e.g., Arial) tend to be preferred by readers over serif fonts (e.g., Times New Roman) (Bernard, Liao, and Mills 2001; Bernard et al 2003; Bernard et al 2002).
- The use of sans serif fonts at very small sizes, like what might be encountered using a mobile device, can increase reading speeds (Morris et al 2002).

## Guideline 13

# Display text left-aligned with ragged-right margins

### Supporting Evidence:

- Thirty participants performed a reading task in two text layout:
  - (A) Left-aligned
  - (B) Center-aligned
- **80%** of the participants preferred the **left-aligned layout**.
- Using ragged-right margins can increase reading speed (Trollip and Sales 1986) and better information processing (Ling and van Schaik 2007), compared to fully-justified text.



In a small town a greengrocer had opened a shop that was located above a deep cellar. Every night, mice came in droves out of this cellar into the shop. They ate apples and pears, grapes and nuts and did not spare the vegetables and potatoes either. No goods that were in the shop were safe from the small intrusive rodents between midnight and sunrise. As long as there was noise in the streets at night and cars were driving by, the mice still stayed quietly in the cellar. But as soon as the old

The beaver is an excellent swimmer. It can achieve a speed of up to seven miles per hour in water. Its protection against the cold consists of a skin with thousands of single hairs and a thick layer of fat. With its big lungs it can easily stay under water for more than twenty minutes. The beaver is not only skillful in felling trees, but also an experienced craftsman in building dams. When the beaver fells a tree, it gnaws on the trunk in such a way that the upper and the lower part of the trunk are

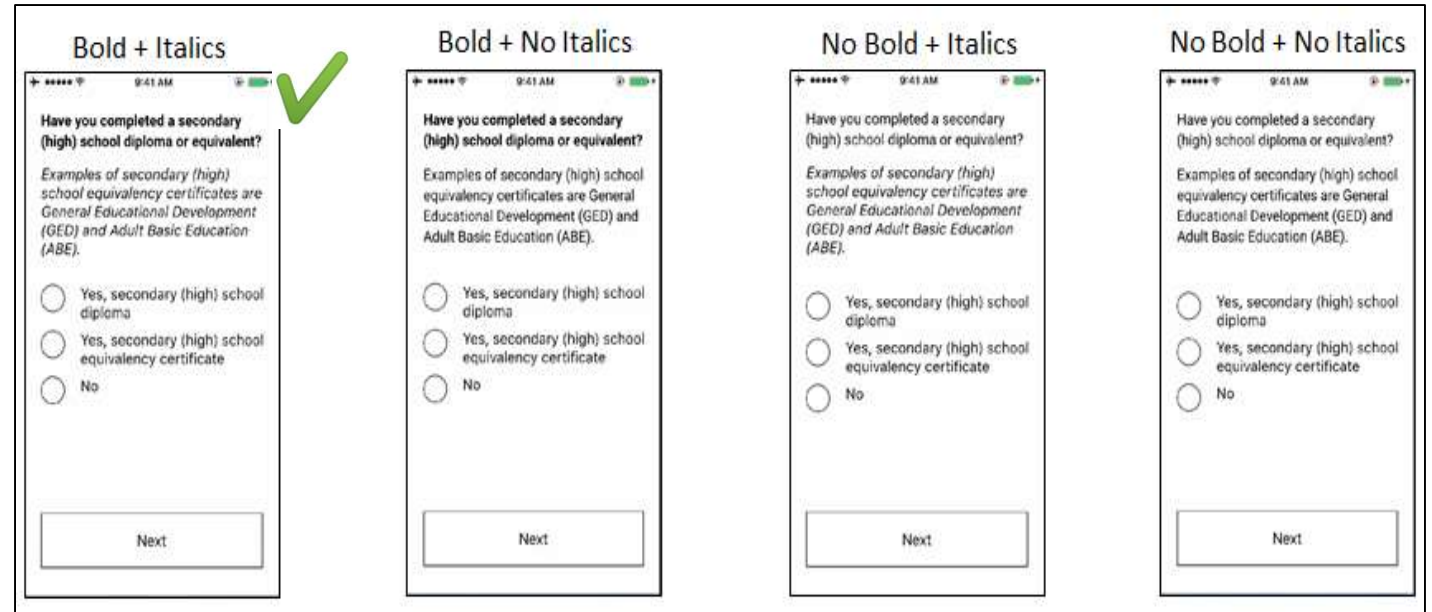
The beaver is an excellent swimmer. It can achieve a speed of up to seven miles per hour in water. Its protection against the cold consists of a skin with thousands of single hairs and a thick layer of fat. With its big lungs it can easily stay under water for more than twenty minutes. The beaver is not only skillful in felling trees, but also an experienced craftsman in building dams. When the beaver fells a tree, it gnaws on the trunk in such a way that the upper and the lower part of the trunk are only connected with each other at a small point. When the connection is narrow and the beaver has become tired, the wind will do the rest. The twigs and thin branches are cut off by the beaver and piled up near its den, which is built on a small island. The thick branches are

## Guideline 14

# Bold survey questions and italicize instructions

### Supporting Evidence:

- Two groups of 15 participants completed the same survey with 4 different typeface designs, respectively:
  - Bolded** question stem
  - Regular question stem
  - Italicized* instructions
  - Regular instructions
- Italicizing*** the instructions led to **shorter completion times**.
- 80%** of Ps preferred **bolded question stems**.



# Guidelines for Question Response Design

## Guideline 17

# Use radio buttons/checkboxes in 6 mm diameter/width for single-choice and multiple-choice questions

### Supporting Evidence:

- Sixty one participants completed an identical survey in one of the conditions as shown in the graphs, respectively.
- Ps in the Large (6 mm) icon condition make **least errant taps (2.9%** of screens), compared to Control (2 mm) (24.5%), Hybrid (5.5%), Plain (9.6%).
- **54.2% of Ps preferred the Large icon design and 35.2% the Hybrid,** compared to Control (5.1%), Plain

Your neighborhood:

1 = no trust at all

2

3

4

5

6

7 = complete trust

Previous Next

a. Control

Your neighborhood:

1 = no trust at all

2

3

4

5

6

7 = complete trust

Previous Next

b. Large icons

Your neighborhood:

1 = no trust at all

2

3

4

5

6

7 = complete trust

Previous Next

c. Hybrid buttons

Your neighborhood:

1 = no trust at all

2

3

4

5

6

7 = complete trust

Previous Next

d. Plain buttons

## Guideline 19

# Use single question items in place of grids

### Supporting Evidence:

- Grids introduce more straightlining (selecting the same response for every item) among smartphone users (Stern et al. 2015).
- More straightlining is found on grid questions among mobile users than PC users (Stern et al. 2015).
- Splitting grids into single items appears to help. Compared to traditional grids, single items reduce straightlining (Borger and Funke 2015; McClain and Crawford, 2013).



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WHERE DISCOVERIES BEGIN

Part A - Principal Job

A28. Thinking about your principal job held during the week of February 1, please rate your satisfaction with that job's...

Select one answer for each item.

**1. Salary**

- Very Satisfied
- Somewhat Satisfied
- Somewhat Dissatisfied
- Very Dissatisfied

**2. Benefits**

- Very Satisfied
- Somewhat Satisfied
- Somewhat Dissatisfied

National Science Foundation  
WHERE DISCOVERIES BEGIN

Part A - Principal Job

A28. Thinking about your principal job held during the week of February 1, please rate your satisfaction with that job's...

Select one answer for each item.

	Very Satisfied	Satisfied
1. Salary	<input type="radio"/>	<input type="radio"/>
2. Benefits	<input type="radio"/>	<input type="radio"/>
3. Job security	<input type="radio"/>	<input type="radio"/>
4. Job location	<input type="radio"/>	<input type="radio"/>
5. Opportunities for advancement	<input type="radio"/>	<input type="radio"/>
6. Intellectual challenge	<input type="radio"/>	<input type="radio"/>
7. Level of responsibility	<input type="radio"/>	<input type="radio"/>
8. Degree of independence	<input type="radio"/>	<input type="radio"/>

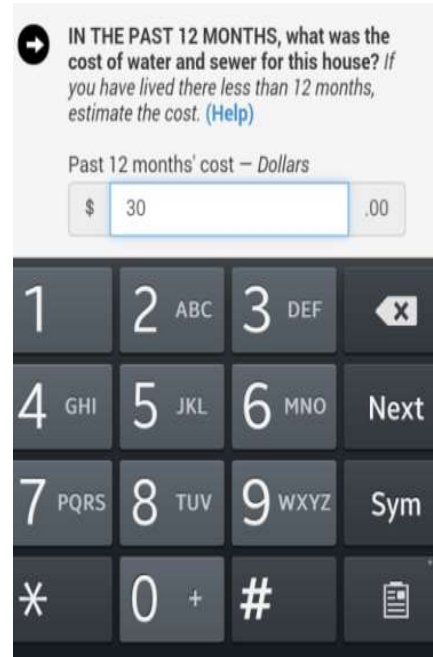


## Guideline 20

# Use auto-formatting for currency entry

### Supporting Evidence:

- Thirty one participants performed a series of currency entry tasks using the following methods:
  - Fixed formatting (the decimal and \$ sign are in place and not manually changeable)
  - Post-entry auto formatting (the decimal and \$ sign are automatically added after data entry)
  - Instant auto formatting (the decimal and \$ sign are automatically added during data entry)
- Participants entered data **more accurate with auto formatting** than fixed formatting, and preferred auto



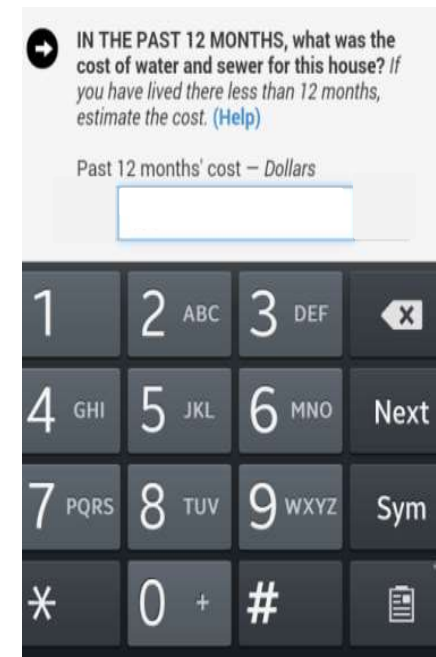
IN THE PAST 12 MONTHS, what was the cost of water and sewer for this house? If you have lived there less than 12 months, estimate the cost. (Help)

Past 12 months' cost – Dollars

\$ 30 .00

1 2 ABC 3 DEF X  
4 GHI 5 JKL 6 MNO Next  
7 PQRS 8 TUV 9 WXYZ Sym  
\* 0 + # 📄

A

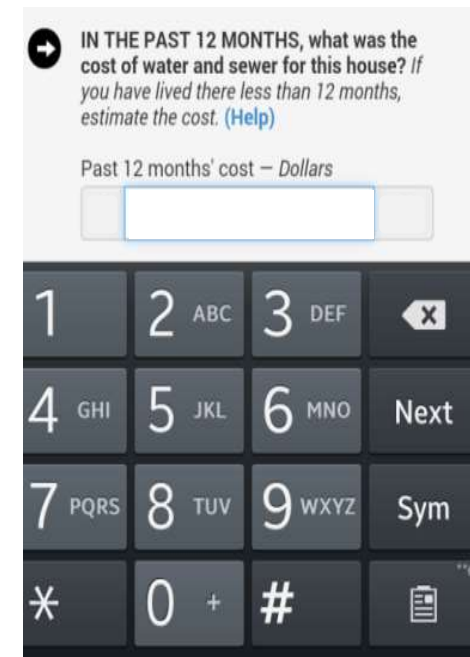


IN THE PAST 12 MONTHS, what was the cost of water and sewer for this house? If you have lived there less than 12 months, estimate the cost. (Help)

Past 12 months' cost – Dollars

1 2 ABC 3 DEF X  
4 GHI 5 JKL 6 MNO Next  
7 PQRS 8 TUV 9 WXYZ Sym  
\* 0 + # 📄

B



IN THE PAST 12 MONTHS, what was the cost of water and sewer for this house? If you have lived there less than 12 months, estimate the cost. (Help)

Past 12 months' cost – Dollars

1 2 ABC 3 DEF X  
4 GHI 5 JKL 6 MNO Next  
7 PQRS 8 TUV 9 WXYZ Sym  
\* 0 + # 📄

C



# A: Fixed formatting

➔ IN THE PAST 12 MONTHS, what was the cost of water and sewer for this house? *If you have lived there less than 12 months, estimate the cost.* [\(Help\)](#)

Past 12 months' cost – Dollars

\$ 1 1 5 2 .00

1	2 ABC	3 DEF	← x
4 GHI	5 JKL	6 MNO	Next
7 PQRS	8 TUV	9 WXYZ	Sym
*	0 +	.	☰

## B: Post-entry auto formatting

➔ IN THE PAST 12 MONTHS, what was the cost of water and sewer for this house? *If you have lived there less than 12 months, estimate the cost.* (Help)

Past 12 months' cost – Dollars

\$1,254.00

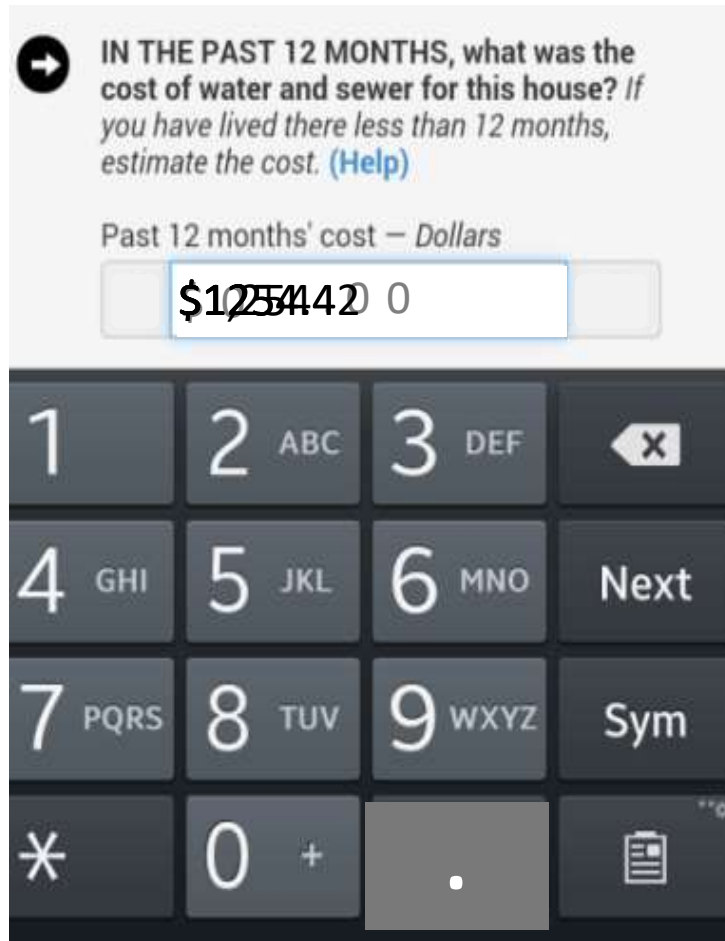
1	2 ABC	3 DEF	Done
4 GHI	5 JKL	6 MNO	Next
7 PQRS	8 TUV	9 WXYZ	Sym
*	0 +	.	☰



## C: Instant auto formatting

➔ IN THE PAST 12 MONTHS, what was the cost of water and sewer for this house? *If you have lived there less than 12 months, estimate the cost.* [\(Help\)](#)

Past 12 months' cost – Dollars



## Guideline 22

# Use a numeric keypad for number entry

### Supporting Evidence:

- Two groups of 15 participants completed a short survey of same design but different numerical data entry, respectively:
  - (A) Alphanumerical keyboard
  - (B) Numeric keypad
- Ps using number keypad made **less errors**.
- 93%** of Ps preferred to use a number keypad for data entry.



Last month what was the cost of electricity for the place where you live? If you don't know, use your best guess.

Last month's cost – Dollars

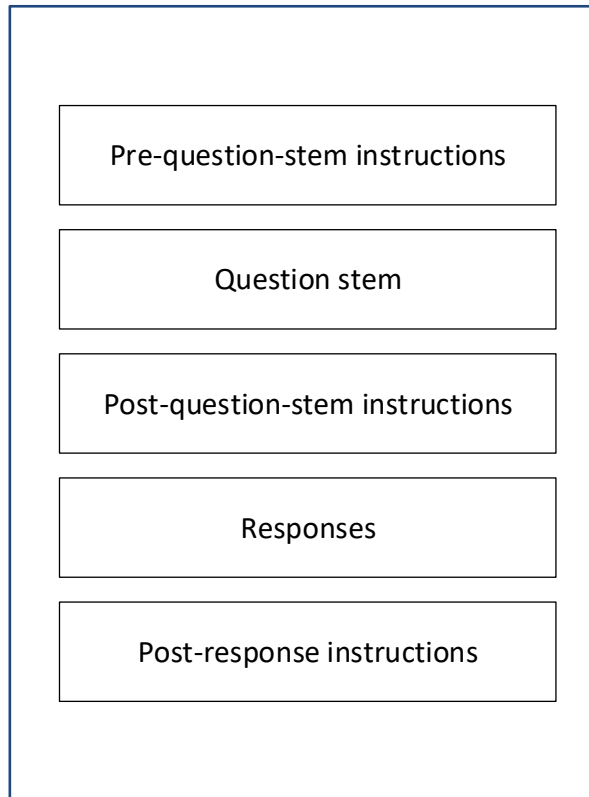
How many separate rooms are in the place where you live?

Number of rooms

How many of these room are bedrooms?

# Summary

- Standards
- Guidelines
  - Screen Design
  - General Question Design
  - Question Responses



# Acknowledgement

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Associate Directorate for Research and Methodology  
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