The process of developing a questionnaire to assess nutrition knowledge in the general population

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Outline

• Learning Objectives
• Introduction
• Draft Questionnaire Development
• Field Test
• Validity and Reliability Testing
• Other Considerations
Learning Objectives

• Understand the basic principles of reliability and validity.
• Understand the uses of specific types of validity and reliability, such as test-retest reliability, internal consistency reliability, and construct validity.
• Understand the methods, benefits, and drawbacks of cognitive interviews.
Introduction

• Questionnaires are tool that can be used in variety of ways
• Importance of valid, reliable measure
• Improve likelihood that data are a more accurate representation of what is being studied
• Systematic development of a questionnaire
Development of first draft of questionnaire

Review by expert committee

Cognitive interviews (n=20)

Small-scale field test (n=94)

Validity and reliability testing (n=48)

Final questionnaire
Validity and Reliability

• Validity: Does the questionnaire measure what we intend it to measure?

• Reliability: When all else is held equal, are the results of the questionnaire consistent?

Where do we begin?

• Start with a pool of questions
  - Twice as many as the final intended questionnaire
• Questions from other, validated questionnaires
  - No need to reinvent the wheel
  - Allows for comparison
• New questions to address other areas of interest

Sources of Questions


Why validate when many of the questions already existed?

1. Culture
2. Language
3. Consumption patterns
4. Nutrition recommendations
5. Time since validation
First draft of questionnaire – 118 questions

Review by expert committee

Cognitive interviews (n=20)

Small-scale field test (n=94)

Validity and reliability testing (n=48)

Final questionnaire
Content Validity

• Deals with the relationship between the content of the test and some well-known domain of knowledge
• Built into the questionnaire as it is written
• Assessed by a panel of experts
  - Is the skill or knowledge measured by this question 'essential,' 'useful, but not essential,' or 'not necessary' to the performance of the construct

Expert Review

• Committee of nutrition faculty, postdoctoral scholars, and registered dietitians
• Modify, remove, or add items
• Resulted in the removal of 18 questions
• Could have benefited from review by experts in questionnaire development, psychometrics
First draft of questionnaire – 108 questions

Review by expert committee – 90 questions

Cognitive interviews

Small-scale field test

Validity and reliability testing

Final questionnaire
Cognitive Interviews

• Purpose is to ensure that items on a questionnaire are interpreted as intended by the researchers.

• Some issues they can help identify:
  - Ambiguity
  - Jargon
  - Double-barreled questions

• Two main types of cognitive interviews
  - Probing Methodology
  - Think-Aloud Methodology

Methods

• Interviews conducted by UC Cooperative Extension Nutrition, Family, and Consumer Sciences Advisors in 5 counties in California
  - Contra Costa, Fresno, Sacramento, San Diego, and Tulare
• Participants verbalize their thought process as they think through answering the questions.
• Interviewer probes as necessary.
  - E.g. “Tell me what you were thinking about as you decided your answer,” or “Can you tell me a little more about what you mean when you say _____”

Results

- Interviews conducted in Spring 2010 (n=20)
- Questions reworded (23)
- Question removed (2)
- Questions added (2)
- Most common issue was lack of clarity
Cognitive Interviews - Challenges

• Every person is different – can result in multiple interpretations
• Data is subject to interpretation
• No firm guidelines regarding number of cognitive interviews, number of rounds of cognitive interviews
First draft of questionnaire – 108 questions
Review by expert committee – 90 questions
Cognitive interviews – 90 questions
Small-scale field test
Validity and reliability testing
Final questionnaire
Small-Scale Field Test

• Identical to main study to be conducted later except:
  - Fewer subjects
  - Longer survey
• Results used to systematically identify questions that can be removed
Methods

• Random sample of 400 addresses in California
  - US Postal Service Delivery Sequence File
• Dillman Tailored Design Method
• Advance Letter
• Questionnaire with stamped addressed envelope
• Reminder/thank you post card
• Second questionnaire sent to non-responders

Statistical Analyses

- Item difficulty
- Item discrimination
- Internal consistency
- Data were analyzed using SPSS 19.0, 20, and 21 (IBM, Inc, Armonk, NY, 2010-2012)
Item Difficulty

- Items are not useful if they are too easy or too difficult
- Reject items if answered correctly by:
  - > 80-90% of respondents
  - < 20-30% of respondents
- Exceptions would be items where you want to demonstrate low or high knowledge in the population

### High Percentage Correct

**Which has more saturated fat per serving?**

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Valid</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Whole milk</td>
<td>85</td>
<td>90.4</td>
<td><strong>91.4</strong></td>
<td>91.4</td>
</tr>
<tr>
<td>Skim milk</td>
<td>2</td>
<td>2.1</td>
<td>2.2</td>
<td>93.5</td>
</tr>
<tr>
<td>Not Sure</td>
<td>6</td>
<td>6.4</td>
<td>6.5</td>
<td>100.0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>93</td>
<td>98.9</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td><strong>Missing</strong></td>
<td>99</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>94</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Low Percentage Correct

### What amount of whole grains is recommended?

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Half the total grains eaten each day</td>
<td>11</td>
<td>11.7</td>
<td>12.4</td>
<td>12.4</td>
</tr>
<tr>
<td>1 serving each day</td>
<td>18</td>
<td>19.1</td>
<td>20.2</td>
<td>32.6</td>
</tr>
<tr>
<td>2 ounces each day</td>
<td>12</td>
<td>12.8</td>
<td>13.5</td>
<td>46.1</td>
</tr>
<tr>
<td>Not Sure</td>
<td>48</td>
<td>51.1</td>
<td>53.9</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>89</td>
<td>94.7</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>99</td>
<td>5.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>94</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Borderline Percentage Correct

**Would you consider 100 mg of sodium to be high or low for one serving?**

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percent</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>29</td>
<td>30.9</td>
<td>31.2</td>
<td>31.2</td>
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<tr>
<td>High</td>
<td>41</td>
<td>43.6</td>
<td>44.1</td>
<td>75.3</td>
</tr>
<tr>
<td>Not Sure</td>
<td>23</td>
<td>24.5</td>
<td>24.7</td>
<td>100.0</td>
</tr>
<tr>
<td>Total</td>
<td>93</td>
<td>98.9</td>
<td>100.0</td>
<td></td>
</tr>
<tr>
<td>Missing</td>
<td>99</td>
<td>1.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>94</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Item Discrimination

• The ability of individual questions to discriminate between respondents with high and respondents with low scores
• Item-to-total score correlation
  - Pearson’s correlation
  - Reject items with $r < 0.2$

# Item-Total Correlation

<table>
<thead>
<tr>
<th>Item</th>
<th>Scale Mean if Item Deleted</th>
<th>Scale Variance if Item Deleted</th>
<th>Corrected Item-Total Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>OilMonoBin</td>
<td>49.87</td>
<td>167.369</td>
<td>.373</td>
</tr>
<tr>
<td>NTDVitBin</td>
<td>49.65</td>
<td>166.631</td>
<td>.359</td>
</tr>
<tr>
<td>BLCholeBin</td>
<td>49.69</td>
<td>168.760</td>
<td>.196</td>
</tr>
<tr>
<td>CalWtGainBin</td>
<td>49.77</td>
<td>166.891</td>
<td>.366</td>
</tr>
<tr>
<td><strong>PyramidBin</strong></td>
<td>49.96</td>
<td>170.927</td>
<td><strong>.053</strong></td>
</tr>
<tr>
<td>PolyHealthBin</td>
<td>49.79</td>
<td>167.855</td>
<td>.289</td>
</tr>
<tr>
<td>MonoHealthBin</td>
<td>49.86</td>
<td>169.666</td>
<td>.152</td>
</tr>
<tr>
<td>SatHealthBin</td>
<td>49.27</td>
<td>167.170</td>
<td><strong>.416</strong></td>
</tr>
</tbody>
</table>
Internal Consistency

- Type of reliability
- Similar to item discrimination
- Each item is analogous to a miniform of the test
- A measure of how well each item agrees with other items
- Measured overall and separately for each section
- Cronbach’s alpha
  - Minimum acceptable alpha = 0.7

Bland JM, Altman DG. BMJ. 1997; 314: 572
Cronbach’s Alpha

<table>
<thead>
<tr>
<th>Cronbach's Alpha</th>
<th>Cronbach's Alpha Based on Standardized Items</th>
<th>N of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>.913</td>
<td>.914</td>
<td>89</td>
</tr>
</tbody>
</table>

**Item-Total Statistics**

<table>
<thead>
<tr>
<th>Cronbach’s Alpha if Item Deleted</th>
<th>OilMonoBin</th>
<th>NTDVitBin</th>
<th>BLCholeBin</th>
<th>CalWtGainBin</th>
</tr>
</thead>
<tbody>
<tr>
<td>.912</td>
<td>.912</td>
<td>.913</td>
<td>.912</td>
<td></td>
</tr>
</tbody>
</table>
Final questionnaire

Validity and reliability testing

Small-scale field test – 60 questions

Cognitive interviews – 90 questions

Review by expert committee – 90 questions

First draft of questionnaire – 108 questions

Final questionnaire
Construct Validity

• How well does the questionnaire measure the defined construct of interest?
• Construct: nutrition knowledge gained in a classroom
• Compared the scores of two groups of undergraduate students:
  - Those who had taken at least one college-level nutrition course
  - Those who had never taken a college-level nutrition course
Test-Retest Reliability

• Are the results of the questionnaire consistent over time?
• Administer the questionnaire twice to the same group of participants
  - Spaced by about two weeks
• Correlation between the first and second score
• Remove questions that reduce reliability
Methods

• Convenience sample of university students.
• Respondents self-reported whether they had previously taken a college-level nutrition class.
• Questionnaire was administered to each participant twice, approximately two weeks apart.
Validity Results

Mean scores of those who had previously taken a college-level nutrition course, and those that had not.

<table>
<thead>
<tr>
<th>Questionnaire Section (maximum possible)</th>
<th>Nutrition (n=27) Mean (SD)</th>
<th>No Nutrition (n=21) Mean (SD)</th>
<th>Mean Difference</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Familiarity with MyPyramid (23)</td>
<td>18.26 (2.97)</td>
<td>13.81 (4.03)</td>
<td>4.45</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Nutrient Content of Foods (26)</td>
<td>17.26 (4.66)</td>
<td>14.19 (3.74)</td>
<td>3.07</td>
<td>0.018</td>
</tr>
<tr>
<td>Diet-Disease Relationships (11)</td>
<td>9.15 (2.03)</td>
<td>6.29 (2.17)</td>
<td>2.86</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Overall (60)</td>
<td>44.67 (8.71)</td>
<td>34.29 (8.43)</td>
<td>10.38</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>
Test-Retest Reliability Results

Pearson correlations between first and second questionnaire scores.

<table>
<thead>
<tr>
<th>Questionnaire Section</th>
<th>Test-Retest Reliability r</th>
</tr>
</thead>
<tbody>
<tr>
<td>Familiarity with MyPyramid</td>
<td>0.93</td>
</tr>
<tr>
<td>Nutrient Content of Foods</td>
<td>0.92</td>
</tr>
<tr>
<td>Diet-Disease Relationships</td>
<td>0.84</td>
</tr>
<tr>
<td>Overall</td>
<td>0.95</td>
</tr>
</tbody>
</table>
First draft of questionnaire – 108 questions

Review by expert committee – 90 questions

Cognitive interviews – 90 questions

Small-scale field test – 60 questions

Validity and reliability testing – 60 questions

Final questionnaire – 58 questions
This questionnaire is so we can get an idea how familiar people are with nutrition. This is a survey, not a test. Your answers will help us identify what nutrition advice people find confusing. For each question, please use a pen or pencil to mark an ✐ or ☐ for the answer that fits you best.

It is important that you complete it without the help of others. If you don’t know the answer, please mark “not sure” rather than guess or look up the answer.

These next items are about what advice about nutrition you think experts are giving.
(Please choose only one answer for each.)

1. Which one of these is the current government food guide?
   - [ ]
   - [ ]
   - [ ] Not sure

2. How well would you say you know the government’s food guide, called MyPlate?
   - [ ] Never heard of it
   - [ ] Heard of, but know very little about it
   - [ ] Know some about it
   - [ ] Know a lot about it

3. How much would you say you know about whole grains?
   - [ ] Never heard of them
   - [ ] Heard of, but know very little about them
   - [ ] Know some about them
   - [ ] Know a lot about them

4. As far as you know, what are whole grains?
   - [ ] Grains that still have the bran and germ
   - [ ] Milled grains
   - [ ] Anything with added fiber
   - [ ] Refined flour
   - [ ] Not sure

5. Based on what you know, which of these isn’t usually a whole grain?
   - [ ] Popcorn
   - [ ] Oatmeal
   - [ ] Flour tortillas
   - [ ] Brown rice
   - [ ] Not sure

6. Based on what you know, grains are an important source of...
   - [ ] Vitamin B
   - [ ] Vitamin K
   - [ ] B vitamins
   - [ ] Vitamin C
   - [ ] Not sure

7. As far as you know, which of these should you look for on a label to tell if a loaf of bread is whole wheat?
   - [ ] 100% wheat
   - [ ] Stone-ground wheat
   - [ ] Cracked wheat
   - [ ] Whole wheat is first in the ingredient list
   - [ ] Not sure

8. As far as you know, what amount of cooked vegetables is generally considered a serving?
   - [ ] ¼ cup
   - [ ] ½ cup
   - [ ] 1 cup
   - [ ] 2 cups
   - [ ] Not sure

9. Based on what you know, what is the amount of vegetables MyPlate (the government’s food guide) recommends an adult should eat?
   - [ ] 1 to 2 cups each day
   - [ ] 2 to 3 cups each day
   - [ ] 6 to 7 cups each day
   - [ ] 5 to 6 cups each week
   - [ ] Not sure

10. Based on what you know, why does MyPlate (the government’s food guide) recommend people eat a variety of vegetables?
    - [ ] To increase protein intake
    - [ ] Helps you get all your nutrients
    - [ ] It’s better for the environment
    - [ ] To save money
    - [ ] Not sure

Please continue on the next page
Other Practical Considerations

• Psychology of questionnaire design
  - Layout, formatting
• Alternate response options
  - “Not sure” to discourage random guessing
  - “Prefer not to answer” to discourage skipped questions
• Web-based vs. mail-based vs. telephone
• Increasing response rate
  - Incentives
  - Survey sponsorship
References