WICER Infographics Comprehension Testing
2015-2017

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WICER Visualization Working Group
Introduction

The purpose of this document is to present the full collection of infographics used for the WICER comprehension testing study, many of which have not previously been published.

WICER Infographic Development

The purpose of the Washington Heights/Inwood Informatics Infrastructure for Community-Centered Comparative Effectiveness Research (WICER) study was to understand the health of residents in Washington Heights and Inwood, two predominantly Latino neighborhoods in northern Manhattan. To achieve this goal, a survey was administered in English and Spanish to nearly 6,000 residents.

As investigators, we felt an ethical obligation to return the survey data to the respondents in a way that would be easily comprehensible, actionable, and culturally acceptable. To that end, we opted to create infographics tailored with respondents’ own survey data. Prototype infographics were developed using an iterative participatory design approach in collaboration with domain experts and respondents from the survey cohort. Additional details about WICER and the infographic development process can be found in the following publications.


Comprehension Testing

The participatory design process provided preliminary evidence that the prototype infographics were comprehensible to participants. The purpose of the comprehension testing study, conducted 2015-2017, was to more formally evaluate comprehension of the infographics in comparison to text alone. A description of the study design can be found in:


As described in that chapter, the original self-administered multiple choice assessment format proved to be inappropriate for our participant population. A subsequent attempt
to use an interviewer-administered assessment while still preserving the overall study design also was unsuccessful and the study was halted.¹

The Infographics

Most of the infographics used in the comprehension testing study were based on prototypes developed in the participatory design process. Those prototype designs were subsequently refined and made stylistically cohesive by graphic designer Sergio Benenson. However, new infographics had to be created for the comprehension study to achieve a balanced study design that required testing visually and/or conceptually similar pairs of infographics. As such, **some of the infographics went through a rigorous design process** (marked with a ★) and **some are essentially untested** given that the data obtained during comprehension testing were unusable.

In the interest of transparency, all of the infographics used in the comprehension testing study are presented here despite variations in design quality and rigor. To guide the reader, we have grouped them into sections according to our **subjective** rating of their utility, which is based on the evidence gathered during the participatory design process as well as our professional judgment, having conducted this kind of work for 10 years. English and Spanish samples of each infographic are provided in this document, along with explanatory notes.

Note About Colors

We used stoplight colors in many of the infographics because they have such strong communicative power and the relevant information was also encoded in words (e.g., very low vs. very high stress). However, stoplight colors can disadvantage people with color vision deficiencies. Therefore, in subsequent projects we improved our color choices by using reds and greens that are distinguishable from each other even with color blindness, as shown in this example drawn from pp. 26-27. The infographics are reproduced here in their original colors but updates are recommended.

<table>
<thead>
<tr>
<th>Original Colors</th>
<th>Improved Colors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hex Codes</td>
<td></td>
</tr>
<tr>
<td>#5BB049</td>
<td>#DD4844</td>
</tr>
<tr>
<td>RGB Values</td>
<td></td>
</tr>
<tr>
<td>(91,176,105)</td>
<td>(221,72,68)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal vision</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Protanopia</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Deuteranopia</td>
<td></td>
</tr>
</tbody>
</table>

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★ = Shown in participatory design sessions
High Utility
Body Mass Index, Female

Paired with Waist Measurement for comprehension testing.

Body Mass Index (BMI)

kg/m²

Underweight  Normal  Overweight  Obese

Body Mass Index (BMI) uses your height and weight to estimate how much body fat you have.

Índice de Masa Corporal (BMI)

kg/m²

Bajo Peso  Normal  Sobrepeso  Obesa

El índice de masa corporal (BMI en inglés) utiliza su estatura y peso para estimar cuanta grasa corporal usted tiene.

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Body Mass Index, Male

Paired with Waist Measurement for comprehension testing.

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Waist Measurement, Female ★
Paired with Body Mass Index for comprehension testing.
Waist Measurement, Male ★

Paired with Body Mass Index for comprehension testing.
Days Depressed ★

Paired with Days Anxious for comprehension testing.

Days feeling sad, blue, or depressed in the last 30 days

You 5 days

Other women in your age group 7 days

Días entre los últimos 30 días sintiéndose triste, deprimido, o melancólico

Usted 0 días

Otras mujeres de la misma edad que usted 4 días
**Days Anxious**

Paired with Days Depressed for comprehension testing.

Days feeling worried, tense, or anxious in the last 30 days

You
5 days

Other men in your age group
7 days

Días entre los últimos 30 días
sintiéndose preocupado, ansioso, o tenso

Usted
10 días

Otras mujeres de la misma edad que usted
4 días

---

Depression Symptoms A

Paired with Prolonged Stress for comprehension testing.

Depression Symptoms A

You
Low

Other women in your age group
Moderate

Síntomas de Depresión A

Usted
Alto

Otras mujeres de la misma edad que usted
Muy Bajo

**Prolonged Stress ★**

Paired with Depression Symptoms A for comprehension testing.

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**Prolonged Stress**
*(lasting at least 6 months)*

- **You**
  
  *Low*

- **Other men in your age group**
  
  *Very High*

---

**Estrés Prolongado**
*(dura por lo menos 6 meses)*

- **Usted**
  
  *Moderado*

- **Otras mujeres de la misma edad que usted**
  
  *Muy Bajo*
Overall Health ★

Paired with Feeling Run Down for comprehension testing. Our oldest participants, who did not use the internet, were unfamiliar with this format and did not know how to interpret it. It was easily understood and well-liked by the remaining participants.
Feeling Run Down ★

Paired with Overall Health for comprehension testing. Our oldest participants, who did not use cell phones, were unfamiliar with this imagery and did not know how to interpret it. It was easily understood and well-liked by the remaining participants.
Servings per Week of Beverages Containing Sugar

Paired with Number of Days Feeling… for comprehension testing. In retrospect, we should not have used both red and green in these images as they could unintentionally convey value judgements (e.g., regular soda is good but 100% pure juices are bad).

Most of our participants could accurately interpret bar charts, which are not as engaging as other formats, but are useful for requiring the viewer to attend to details in the text.
Number of Days Feeling… ✨

Paired with Servings per Week of Beverages Containing Sugar for comprehension testing. In contrast with the charts on the preceding page, red and green are used here intentionally to help support the meaning of the category labels.

Most of our participants could accurately interpret bar charts, which are not as engaging as other formats, but are useful for requiring the viewer to attend to details in the text.

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**Number of days in the last 30 days…**

- Feeling very healthy and full of energy: 21 days
- Physical health was not good: 5 days
- Mental health was not good: 4 days

---

**Número de días entre los últimos 30 días sintiéndose…**

- Muy saludable y lleno de energía: 30 días
- Mal de salud física: 0 días
- Mal de salud mental: 10 días
Fruit Servings per Day

Paired with Vegetable Servings per Day for comprehension testing. Most of our participants were comfortable using bar charts. We did interact with a few participants who did not know how to read a bar chart and/or did not know how to interpret numbers with decimals (e.g., 1.5).

Fruit Servings per Day

Porciones de Frutas por Día

Most of our participants were comfortable using bar charts. We did interact with a few participants who did not know how to read a bar chart and/or did not know how to interpret numbers with decimals (e.g., 1.5).
Paired with Fruit Servings per Day for comprehension testing. Most of our participants were comfortable using bar charts. We did interact with a few participants who did not know how to read a bar chart and/or did not know how to interpret numbers with decimals (e.g., 1.8).

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Vegetable Servings per Day

Paired with Fruit Servings per Day for comprehension testing. Most of our participants were comfortable using bar charts. We did interact with a few participants who did not know how to read a bar chart and/or did not know how to interpret numbers with decimals (e.g., 1.8).

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Porciones de Vegetales por Día

Paired with Fruit Servings per Day for comprehension testing. Most of our participants were comfortable using bar charts. We did interact with a few participants who did not know how to read a bar chart and/or did not know how to interpret numbers with decimals (e.g., 1.8).
Minutes of Moderate Physical Activity per Week\textsuperscript{7} ★

Paired with Minutes of Vigorous Physical Activity per Week for comprehension testing. Most of our participants were comfortable using bar charts. We did interact with a few participants who did not know how to read a bar chart. Note how the y-axis labels must be rescaled to accommodate extreme values as shown in the Spanish example, below.

\textbf{Minutes of Moderate Physical Activity per Week}

\begin{figure}[h]
\centering
\includegraphics[width=0.8\textwidth]{minutes_moderate.png}
\end{figure}

\textbf{Minutos por Semana de Actividad Física Moderada}

\begin{figure}[h]
\centering
\includegraphics[width=0.8\textwidth]{minutes_moderate_spanish.png}
\end{figure}

\textsuperscript{7} Another example of this design was first printed in: Arcia, A., Woollen, J. & Bakken, S. (2018) A systematic method for exploring data attributes in preparation for designing tailored infographics of patient reported outcomes. \textit{eGEMs (Generating Evidence & Methods to improve patient outcomes)}, 6(1): 2, 1–9. https://doi.org/10.5334/egems.190
Minutes of Vigorous Physical Activity per Week ★

Paired with Minutes of Moderate Physical Activity per Week for comprehension testing. Most of our participants were comfortable using bar charts. We did interact with a few participants who did not know how to read a bar chart.
Health Compared to Ideal\textsuperscript{8} ★

Paired with Your Health Summary (p.33) for comprehension testing. This infographic was highly favored by participants.

Risks of High Blood Pressure

Paired with Risks of Excess Weight (pp. 28-29) for comprehension testing. Of all the infographics shown to participants, this was the most favored.

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Blood Pressure A & B

In the participatory design sessions, the few people who preferred the stoplights (A) over the number lines (B) appeared to struggle more than their peers with comprehension across infographics. In the comprehension test, we asked “Both of these graphics show the same information about your blood pressure. Which do you prefer?” The purpose was to test the hypothesis that people who preferred the stoplights would have the lowest health literacy scores. If that were indeed the case, preference between the images could potentially serve as a screening tool.
Moderate Utility
Depression Symptoms B

Paired with Anxiety Symptoms for comprehension testing. Both were created after participatory design sessions concluded to display $t$-scores, such as are used in the Patient Reported Outcomes Measurement Information System (PROMIS)\(^\text{10}\). As such, we did not receive participant feedback about them. We rated utility as moderate because we have had success with many other infographics that use the reference range number line format. See the note on p. 3 about colors.

\[\text{Your Symptom Score} \quad 54\]

\[\text{Better} \quad \text{Average} \quad \text{Worse}\]

---

\[\text{Su Puntuación de Síntomas} \quad 52\]

\[\text{Mejor} \quad \text{Promedio} \quad \text{Peor}\]

---

\(^{10}\) https://www.healthmeasures.net/explore-measurement-systems/promis
Anxiety Symptoms

Paired with Depression Symptoms B for comprehension testing. Both were created after participatory design sessions concluded to display t-scores, such as are used in the Patient Reported Outcomes Measurement Information System (PROMIS)\(^\text{11}\). As such, we did not receive participant feedback about them. We rated utility as moderate because we have had success with many other infographics that use the reference range number line format. See the note on p. 3 about colors.

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\(^\text{11}\) https://www.healthmeasures.net/explore-measurement-systems/promis
Risks of Excess Weight, Female

Developed after participatory design sessions concluded to be paired with Risks of High Blood Pressure (p. 23) for comprehension testing. As such, we did not receive participant feedback about this infographic. We rate utility as moderate because of its similarity to Risks of High Blood Pressure and because it incorporates aspects of Body Mass Index (pp. 6-7). Our rating is restrained because the images depicting blood sugar testing and insulin injection in the lower right corner have not been evaluated by participants as a means of representing Type 2 diabetes.
Risks of Excess Weight, Male

Developed after participatory design sessions concluded to be paired with Risks of High Blood Pressure (p. 23) for comprehension testing. As such, we did not receive participant feedback about this infographic. We rate utility as moderate because of its similarity to Risks of High Blood Pressure and because it incorporates aspects of Body Mass Index (pp. 6-7). Our rating is restrained because the images depicting blood sugar testing and insulin injection in the lower right corner have not been evaluated by participants as a means of representing Type 2 diabetes.

![BMI Chart]

**Your Body Mass Index (BMI)**

Body Mass Index (BMI) uses your height and weight to estimate how much body fat you have.

![Excess Weight Chart]

**Risks of Excess Weight**

- **Heart Diseases**
  - Cardiovascular Diseases
- **High Blood Pressure**
  - Hypertension
- **Arthritis**
  - Osteoarthritis

![Type 2 Diabetes Chart]

**Type 2 Diabetes**

- **Diabetes Mellitus Tipo 2**
- **Cancers**
  - esófago
  - páncreas
  - riñón
  - colon & recto

![Arthritis Chart]

**Arthritis**

- **Osteoarthritis**

**Su Índice de Masa Corporal (BMI)**

El Índice de masa corporal (BMI en inglés) ayuda a esti
mar el porcentaje de grasa corporal total que tiene.

![BMI Chart in Spanish]

**Los Riesgos de Exceso de Peso**

- **Enfermedades del Corazón**
  - Enfermedades Cardiovasculares
- **Presión Arterial Alta**
  - Hipertensión
- **Artritis**
  - Osteoartritis

![Diabetes Chart in Spanish]

**Diabetes Tipo 2**

- **Diabetes Mellitus Tipo 2**
- **Cáncer**
  - esófago
  - páncreas
  - riñón
  - colon y recto
Moderate Physical Activity Recommendation\textsuperscript{12}

Paired with Sugary Beverages Recommendation (p. 32) for comprehension testing. Both were created after participatory design sessions concluded. As such, we did not receive participant feedback about them. Our utility rating is driven by the inclusion of the physical activity bar charts (pp. 20-21) and the relative simplicity of the recommendation panel.

Unknown / Limited Utility
Sugary Beverages Recommendation

Paired with Moderate Physical Activity Recommendation (p. 30) for comprehension testing. Both were created after participatory design sessions concluded. As such, we did not receive participant feedback about them. Our utility rating is driven by concerns about the degree to which the right-hand panel is interpretable.
Your Health Summary ★

Paired with Health Compared to Ideal (p. 22) for comprehension testing. Although shown in participatory design sessions, we give a limited utility rating because participants had little enthusiasm for this infographic. We also have concerns about interpretability when every row shows the same data as in the English example below.