Measuring the Validity of Open-ended Questions

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Measuring validity in open-ended questions

- Open-ended questions are increasingly common. Computational social scientists have developed text-as-data methods for classifying, topic modeling, and scaling open-ended questions, facilitating their use in larger surveys (e.g., Hobbs 2019; Schonlau, Gweon and Wenemark 2019; Roberts, et al. 2014).

- Exercises like classification are subjected to validation in the machine learning sense, but there are conventional concerns of data quality — validity of the questions themselves — that are more difficult to address.

- We have ways of quantifying certain types of validity in closed-ended questions, but examination of validity in open-ended questions has been limited largely to broad indicators of quality like number of items left blank (Zuell, Menold Körber 2015; Zuell and Scholz 2015) or length of answers (Denscombe 2008), or to questions asking about verifiable facts (Burton and Blair 1991; Alwin 2007).

- We introduce here a method for measuring the convergent and discriminant validity of open-ended questions using the text of their answers.
Overview

- A question demonstrates **discriminant validity** if respondents answer it differently than they answer questions intended to measure different constructs.

- A question demonstrates **convergent validity** if respondents answer it similarly to how they answer questions intended to measure similar constructs. Questions intended to measure more [dis]similar constructs should evoke more [dis]similar answers.

- We leverage an NLP technique — “Fightin’ Words” (Monroe, Colaresi & Quinn 2008; Jurafsky & Martin 2020) — to quantify dissimilarity between two collections of answers.

- We apply a randomization technique to establish a reference distribution of the Fightin’ Words statistic under the null for any pair of questions that differences in the questions do not induce different answers.
Data - The Mood of the Nation Poll

- We draw from 13 waves of the Mood of the Nation Poll, run by Penn State’s McCourtney Institute for Democracy.

- These are independent samples from YouGov’s non-probability panel with field dates from June 2016 through January 2020, matched to be demographically representative of the American voting eligible population.

- Each survey contains 1,000 respondents for a preliminary sample size of 13,000 respondents. The poll asks four open-ended questions — about what makes them proud, angry, worried, and hopeful — per respondent, for a preliminary sample size of 52,000 open-text answers.

- 50% of respondents are asked “What is there about American politics today that makes you feel angry [proud]?”

- The other 50% are asked “What has recently been in the news that makes you feel angry [proud]?

- All respondents are asked the worry and hope questions in the form “Looking ahead, what makes you worried/hopeful about where America is headed in the next 12 months?”
Example Survey Questions

What is there about American politics today that makes you feel proud?

You said "<<piped text>>" makes you proud. How proud does that make you feel?

- Extremely proud
- Very proud
- Somewhat proud
- Just a little proud
- Nothing made me proud

What is there about American politics today that makes you feel angry?

You said "<<piped text>>" makes you angry. How angry does that make you feel?

- Extremely angry
- Very angry
- Somewhat angry
- Just a little angry
- Nothing made me angry
### Shared and contrasting content in Mood of the Nation questions

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<td>Looking ahead, what makes you worried</td>
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<tr>
<td>Positive</td>
<td>What in <em>news</em> makes you proud</td>
<td>Looking ahead, what makes you hopeful</td>
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<tr>
<td></td>
<td>What in <em>politics</em> makes you angry</td>
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<tr>
<td></td>
<td>What in <em>politics</em> makes you proud</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** Shading differences reflect the number of differences in polarity (negative/positive) and temporal orientation (present/future).

The dashed lines demarcate questions asking about the same time frame and emotion, but with different prompts (news/politics).

There are six question variants in the poll.
- all (1000) respondents are asked what makes them *angry, proud, worried, and hopeful*.
- respondents are randomly prompted under the angry and proud questions to contemplate recent *news* or *politics*.

Each emotion question can be contrasted with three corresponding questions, one that differs in polarity (positive/negative), one that differs in temporal orientation (present/future), and one that differs in both.

Each pride or anger question can be contrasted with three corresponding questions, one that differs in emotion (proud/angry), one that differs in contextual prompt (news/politics), and one that differs in both.
This is a difficult test case for discriminant validity

- Polarization, for example, causes similar answers to appear in response to different questions.

- For example, 1,535 of the 52,000 total responses -- 3% -- consist in their entirety of just a variant of Donald Trump’s name, and these are spread over all four emotions (172 on pride, 275 on hope, 430 on worry, and 658 on anger).

- In total, 9,616 (18%) of responses mention Trump somewhere in their text (right) and underlying partisan heterogeneity produces a relatively homogeneous aggregate distribution of mentions across questions.

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<td>936</td>
<td>346</td>
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Text preprocessing

- We focus here on a **bag-of-words representation** of the open-text answers.

- The raw data, entered by respondents themselves, has many words that are mistyped, misspelled, misunderstood by speech recognition, mispunctuated, miscapitalized, as well as profane or offensive.

- For our analysis here, we use a processed version of the responses, which includes case-folding to lower case, removal of most punctuation (not “!” or “?”), spelling correction, some usage and grammar correction, some bowdlerization (e.g., “f____”, “n_word”), and disambiguation and standardization of references to specific people (e.g., all references to Donald Trump become “donald_trump,” uses of “un” are disambiguated to “un_american,” “u_n,” or “kim_jung_un”) and other multiword entities like “supreme_court” or “not_much.”

- “Trump continues keeping poo romises” => “donald_trump continues keeping promises”
Fightin’ Words [FW]

• Fightin’ Words (Monroe, Colaresi, and Quinn 2008; Jurafsky & Martin 2020) is a technique for evaluating how word usage differs across two or more groups of documents.

• We leverage the primary output, $\zeta_w$, which provides us with a quantity for each word indicating the extent to which it is overused or underused by the target group relative to how unexpected this disparity is for the particular word. (Rarer words are more variable — more likely to display a disparity by chance — than common words.) We refer to this as the “FW-statistic.”

• The FW-statistic is, in effect, a conservative z-score, such that a value of more than about 2 (or less than -2) indicates there is a “significant” difference in usage of the word across groups. Greater values indicate greater importance.
Fightin’ Words [FW]

• The original usage was to identify partisan differences in US Senate speech.

• The example at right displays differences across parties in speeches on the topic of abortion.
Fightin’ Words [FW]

- Here, our comparison groups are answers to particular Mood of the Nation questions.

- For example, at right are the ten most extreme values, in each direction, of the FW-statistic in a contrast between the angry/news prompt and the proud/news prompt in September 2019.

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<th>$\zeta_w$</th>
<th>Angry/News</th>
<th>$\zeta_w$</th>
<th>Proud/News</th>
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<td>whistle_blower</td>
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Variance in FW-statistic as a measure of dissimilarity

• If two groups of documents are drawn from the same distribution, we expect the FW-statistic to be distributed like a conservative (shrunk toward zero) z-score. That is, we expect it to be normally distributed with a mean of zero and a variance somewhat smaller than one.

• As the differences grow between two groups of documents, increasingly more words have FW-statistics that are increasingly far from zero, and there is greater variance.

• We use the variance in the FW-statistic, which we will call “FW-variance,” as an indicator of dissimilarity between the answers to two given questions.
A randomization test for discriminant validity

- Any two questions intended to measure different constructs display discriminant validity by evoking different answers.

- This implies the null hypothesis that answers do not differ, that the distribution of answers observed for each of the two questions does not depend on which of the questions was asked.

- We use a randomization test (or “permutation test”) to establish the baseline distribution … how much variance in the FW statistic could be expected if the questions did not matter … by randomly redistributing the question labels among the observed answers.

- By doing this many times, we can evaluate how unexpected the observed differences between the answers would be under the null.
A randomization test for discriminant validity

1. Calculate observed FW-variance.

   **Original data**
   - **Angry** Donald Trump committing treason and going unpunished while he and his billionaire crowd punish women.
   - **Angry** The mainstream media lying about President Trump.
   - **Angry** everything
   - **Proud** To see people finally realize and say that the Civil War was more than just about slavery
   - **Proud** nothing
   - **Proud** Greta Thunberg addressing the United Nations

2. Permute question labels and calculate FW-variance.

   **Aggregate text by label**
   - Donald Trump committing treason ... The mainstream media ... everything ...
   - To see people finally ... nothing ... Greta Thunberg addressing ...
   - The mainstream media ... everything ... nothing ...
   - Donald Trump committing ... To see people finally ... Greta Thunberg ...

   **Calculate FW-statistics**
   - $\zeta_w \quad W$
     - 5.44 donald_trump
     - 3.49 everything
     - 3.42 ukraine
     - -4.11 greta_thunberg
     - -4.30 i
     - -6.59 nothing

3. Repeat with new random permutations.

   **Calculate FW-variance**
   - $s^2(\zeta_w) = 2.33$
   - $s^2(\zeta_w^*) = 0.78$

4. These represent draws from the sampling distribution for FW-variance under the null that the question stems don’t differ. We can now evaluate how unusual the observed variance is under this null distribution.
## Discriminant Validity of Emotion Questions (Sept 2019)

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<th>Dissimilarity</th>
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Note: Observed dissimilarity, $s^2(\kappa_{w}^{obs})$ [FW-variance], for each emotion question pair, in answers to the September 2019 poll (Wave 12), compared to the mean and 99th percentile of dissimilarity under the null of randomized question labels. In every case, observed dissimilarity is substantially greater than is plausible under the null, indicating the questions capture different constructs.
Discriminant Validity, 13 Waves of Poll

The figure at right displays the observed dissimilarity of the angry questions with the three contrasting emotion questions and the mean dissimilarity under the randomization null for that contrast across 13 waves of the poll.

Discriminant validity requires the values of observed variance to be higher than the values under the corresponding null, which they unambiguously are in all 13 waves.
The null variance distributions are nearly identical in all contrasts, but not mathematically determined.

For example, a bump in contrasts with “hopeful” in Wave 10 is due to counting “!” as a separate token and a single respondent answering:

“IMPEACHMENT!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!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### Discriminant Validity of Question Context (Sept 2019)

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<th>Null (P&lt;sub&gt;99&lt;/sub&gt;)</th>
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*Note: Observed dissimilarity, $s^2(\zeta_{obs}^w)$ [FW-variance], for each emotion/context question pair, in answers to the September 2019 poll (Wave 12), compared to the mean and 99th percentile of dissimilarity under the null of randomized question labels. In every case, observed dissimilarity is substantially greater than is plausible under the null, indicating the questions capture different constructs.*
Discriminant Validity, 13 Waves of Poll

The figure at right displays the observed dissimilarity of the angry/news questions with the three questions with different emotion/context wordings and the mean dissimilarity under the randomization null for that contrast across 13 waves of the poll.

Discriminant validity requires the values of observed variance to be higher than the values under the corresponding null, which they unambiguously are in all 13 waves.
Convergent validity

• A question demonstrates convergent validity if it provides more similar (less dissimilar) answers to questions intending to measure more similar (less dissimilar) constructs.

• With the Mood of the Nation questions, we have unambiguous theoretical expectations about similarity, namely that for any given question, answers will be more similar to questions that share one facet — polarity, temporal perspective, or contextual prompt — than to questions that share no facet.
### Convergent Validity: Shared Polarity

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<th>More Dissimilar Prompt</th>
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<td>Hopeful</td>
<td>Worried</td>
<td>$2.08 &lt; 2.50 (\cdot 0.006)$</td>
<td>10</td>
</tr>
<tr>
<td>Worried</td>
<td>Angry</td>
<td>Proud</td>
<td>$1.86 &lt; 2.50 (\cdot 0.001)$</td>
<td>13</td>
</tr>
<tr>
<td>Hopeful</td>
<td>Proud</td>
<td>Angry</td>
<td>$2.08 &lt; 2.80 (\cdot 0.001)$</td>
<td>13</td>
</tr>
</tbody>
</table>

*Note:* We posit a strong expectation that for any given prompt, the dissimilarity of the prompt with the same polarity (positive / negative) and different temporal perspective (recently / next 12 months) will tend to be lower than the dissimilarity of the prompt with different polarity and different perspective. This corresponds to the expectation in figures that the solid line will tend to fall below the dotted line.
Convergent Validity, Shared Polarity

The figure at right displays the observed dissimilarity of the angry questions with the three questions about different emotions and the mean dissimilarity under the randomization null for that contrast across 13 waves of the poll.

Convergent validity on shared polarity corresponds to an expectation that the (observed) solid line will tend to lie below the (observed) dotted line, which it does in 12 of the 13 waves.
## Convergent Validity: Shared Temporal Perspective

<table>
<thead>
<tr>
<th>Reference Prompt</th>
<th>Less Dissimilar Prompt</th>
<th>More Dissimilar Prompt</th>
<th>Mean Dissimilarities Across Waves (F-test)</th>
<th>Matching Waves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angry</td>
<td>Proud</td>
<td>Hopeful</td>
<td>$2.30 &lt; 2.80 ( .002)$</td>
<td>13</td>
</tr>
<tr>
<td>Proud</td>
<td>Angry</td>
<td>Worried</td>
<td>$2.30 &lt; 2.50 ( .119)$</td>
<td>11</td>
</tr>
<tr>
<td>Worried</td>
<td>Hopeful</td>
<td>Proud</td>
<td>$2.11 &lt; 2.50 ( .008)$</td>
<td>13</td>
</tr>
<tr>
<td>Hopeful</td>
<td>Worried</td>
<td>Angry</td>
<td>$2.11 &lt; 2.80 (&lt;.001)$</td>
<td>13</td>
</tr>
</tbody>
</table>

*Note: We posit a strong expectation that for any given prompt, the dissimilarity of the prompt with the same temporal perspective (recently / next 12 months) and different polarity (positive / negative) will tend to be lower than the dissimilarity of the prompt with the different perspective and different polarity. This corresponds to the expectation in figures that the dashed line will tend to fall below the dotted line.*
Convergent Validity, Shared Temporal Perspective

The figure at right displays the observed dissimilarity of the angry questions with the three questions about different emotions and the mean dissimilarity under the randomization null for that contrast across 13 waves of the poll.

Convergent validity on shared polarity corresponds to an expectation that the (observed) dashed line will tend to lie below the (observed) dotted line, which it does in all 13 waves.
### Convergent Validity: Shared Emotion

<table>
<thead>
<tr>
<th>Reference Prompt</th>
<th>Less Dissimilar Prompt</th>
<th>More Dissimilar Prompt</th>
<th>Mean Dissimilarities Across Waves (F-test)</th>
<th>Matching Waves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angry / News</td>
<td>Angry / Politics</td>
<td>Proud / Politics</td>
<td>$1.86 &lt; 2.44 (.001)$</td>
<td>13</td>
</tr>
<tr>
<td>Angry / Politics</td>
<td>Angry / News</td>
<td>Proud / News</td>
<td>$1.86 &lt; 2.64 (&lt;.001)$</td>
<td>13</td>
</tr>
<tr>
<td>Proud / News</td>
<td>Proud / Politics</td>
<td>Angry / Politics</td>
<td>$1.86 &lt; 2.64 (&lt;.001)$</td>
<td>13</td>
</tr>
<tr>
<td>Proud / Politics</td>
<td>Proud / News</td>
<td>Angry / News</td>
<td>$1.86 &lt; 2.44 (.001)$</td>
<td>13</td>
</tr>
</tbody>
</table>

*Note: We posit a strong expectation that for any given prompt, the dissimilarity of the prompt with the same emotion (angry / proud) and different context (news / politics) will tend to be lower than the dissimilarity of the prompt with the different emotion and different context. This corresponds to the expectation in figures that the solid line will tend to fall below the dotted line.*
Convergent Validity, Shared Emotion

The figure at right displays the observed dissimilarity of the angry/news questions with the three questions with different emotion/context wordings and the mean dissimilarity under the randomization null for that contrast across 13 waves of the poll.

Convergent validity on shared emotion corresponds to an expectation that the (observed) solid line will tend to lie below the (observed) dotted line, which it does in all 13 waves.
### Convergent Validity: Shared Context

<table>
<thead>
<tr>
<th>Reference Prompt</th>
<th>Less Dissimilar Prompt</th>
<th>More Dissimilar Prompt</th>
<th>Mean Dissimilarities Across Waves (F-test)</th>
<th>Matching Waves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angry / News</td>
<td>Proud / News</td>
<td>Proud / Politics</td>
<td>1.90 &lt; 2.44 (.005)</td>
<td>13</td>
</tr>
<tr>
<td>Angry / Politics</td>
<td>Proud / Politics</td>
<td>Proud / News</td>
<td>2.13 &lt; 2.64 (.006)</td>
<td>13</td>
</tr>
<tr>
<td>Proud / News</td>
<td>Angry / News</td>
<td>Angry / Politics</td>
<td>1.90 &lt; 2.64 (&lt;.001)</td>
<td>13</td>
</tr>
<tr>
<td>Proud / Politics</td>
<td>Angry / Politics</td>
<td>Angry / News</td>
<td>2.13 &lt; 2.44 (.064)</td>
<td>12</td>
</tr>
</tbody>
</table>

*Note: We posit a strong expectation that for any given prompt, the dissimilarity of the prompt with the same context (news / politics) and different emotion (angry / proud) will tend to be lower than the dissimilarity of the prompt with the different context and different emotion. This corresponds to the expectation in figures that the dashed line will tend to fall below the dotted line.*
Convergent Validity, Shared Context

The figure at right displays the observed dissimilarity of the angry/news questions with the three questions with different emotion/context wordings and the mean dissimilarity under the randomization null for that contrast across 13 waves of the poll.

Convergent validity on shared context corresponds to an expectation that the (observed) dashed line will tend to lie below the (observed) dotted line, which it does in all 13 waves.
Discussion

• The FW-variance permutation test is a transparent and replicable method to assess whether open-ended question stems succeed in directing respondents to scan the most relevant considerations.

• Analogous to the comparison of correlations among measures of constructs that are theorized to have ordered patterns of similarity, FW-variance can be used to assess convergent validity (similar answers to questions intended to be similar) and discriminant validity (dissimilar answers to questions intended to be dissimilar).

• FW-variance can be applied without the need to employ human coders to quantify inherently qualitative data and it is suitable for testing a priori expectations, including those that might be posited in a pre-registered design.
Thanks for your attention!

Burt Monroe (burtmonroe@psu.edu)
Eric Plutzer (exp12@psu.edu)
Appendix slides — Results for all tests for all question pairs.
Discriminant Validity, 13 Waves of Poll

The figure at right displays the observed dissimilarity of the angry questions with the three contrasting emotion questions and the mean dissimilarity under the randomization null for that contrast across 13 waves of the poll.

Discriminant validity requires the values of observed variance to be higher than the values under the corresponding null, which they unambiguously are.
Discriminant Validity, 13 Waves of Poll

The figure at right displays the observed dissimilarity of the worried questions with the three contrasting emotion questions and the mean dissimilarity under the randomization null for that contrast across 13 waves of the poll.

Discriminant validity requires the values of observed variance to be higher than the values under the corresponding null, which they unambiguously are.
Discriminant Validity, 13 Waves of Poll

The figure at right displays the observed dissimilarity of the proud questions with the three contrasting emotion questions and the mean dissimilarity under the randomization null for that contrast across 13 waves of the poll.

Discriminant validity requires the values of observed variance to be higher than the values under the corresponding null, which they unambiguously are.
Discriminant Validity, 13 Waves of Poll

The figure at right displays the observed dissimilarity of the hopeful questions with the three contrasting emotion questions and the mean dissimilarity under the randomization null for that contrast across 13 waves of the poll.

Discriminant validity requires the values of observed variance to be higher than the values under the corresponding null, which they unambiguously are.
Convergent Validity, Shared Polarity

The figure at right displays the observed dissimilarity of the angry questions with the three questions about different emotions and the mean dissimilarity under the randomization null for that contrast across 13 waves of the poll.

Convergent validity on shared polarity corresponds to an expectation that the (observed) solid line will tend to lie below the (observed) dotted line, which it does in 12 of the 13 waves.
**Convergent Validity, Shared Polarity**

The figure at right displays the observed dissimilarity of the worried questions with the three questions about different emotions and the mean dissimilarity under the randomization null for that contrast across 13 waves of the poll.

Convergent validity on shared polarity corresponds to an expectation that the (observed) solid line will tend to lie below the (observed) dotted line, which it does in all 13 waves.
Convergent Validity, Shared Polarity

The figure at right displays the observed dissimilarity of the proud questions with the three questions about different emotions and the mean dissimilarity under the randomization null for that contrast across 13 waves of the poll.

Convergent validity on shared polarity corresponds to an expectation that the (observed) solid line will tend to lie below the (observed) dotted line, which it does in 10 of the 13 waves.
Convergent Validity, Shared Polarity

The figure at right displays the observed dissimilarity of the hopeful questions with the three questions about different emotions and the mean dissimilarity under the randomization null for that contrast across 13 waves of the poll.

Convergent validity on shared polarity corresponds to an expectation that the (observed) solid line will tend to lie below the (observed) dotted line, which it does in all 13 waves.
Convergent Validity, Shared Temporal Perspective

The figure at right displays the observed dissimilarity of the angry questions with the three questions about different emotions and the mean dissimilarity under the randomization null for that contrast across 13 waves of the poll.

Convergent validity on shared polarity corresponds to an expectation that the (observed) dashed line will tend to lie below the (observed) dotted line, which it does in all 13 waves.
Convergent Validity, Shared Temporal Perspective

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Convergent validity on shared polarity corresponds to an expectation that the (observed) dashed line will tend to lie below the (observed) dotted line, which it does in all 13 waves.
Convergent Validity, Shared Temporal Perspective

The figure at right displays the observed dissimilarity of the proud questions with the three questions about different emotions and the mean dissimilarity under the randomization null for that contrast across 13 waves of the poll.

Convergent validity on shared polarity corresponds to an expectation that the (observed) dashed line will tend to lie below the (observed) dotted line, which it does in 11 of the 13 waves.
Convergent Validity, Shared Temporal Perspective

The figure at right displays the observed dissimilarity of the hopeful questions with the three questions about different emotions and the mean dissimilarity under the randomization null for that contrast across 13 waves of the poll.

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Convergent Validity, Shared Emotion

The figure at right displays the observed dissimilarity of the angry/news questions with the three questions with different emotion/context wordings and the mean dissimilarity under the randomization null for that contrast across 13 waves of the poll.

Convergent validity on shared emotion corresponds to an expectation that the (observed) solid line will tend to lie below the (observed) dotted line, which it does in all 13 waves.
Convergent Validity, Shared Emotion

The figure at right displays the observed dissimilarity of the angry/politics questions with the three questions with different emotion/context wordings and the mean dissimilarity under the randomization null for that contrast across 13 waves of the poll.

Convergent validity on shared emotion corresponds to an expectation that the (observed) solid line will tend to lie below the (observed) dotted line, which it does in all 13 waves.
Convergent Validity, Shared Emotion

The figure at right displays the observed dissimilarity of the proud/news questions with the three questions with different emotion/context wordings and the mean dissimilarity under the randomization null for that contrast across 13 waves of the poll.

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Convergent validity on shared emotion corresponds to an expectation that the (observed) solid line will tend to lie below the (observed) dotted line, which it does in all 13 waves.
Convergent Validity, Shared Context

The figure at right displays the observed dissimilarity of the angry/news questions with the three questions with different emotion/context wordings and the mean dissimilarity under the randomization null for that contrast across 13 waves of the poll.

Convergent validity on shared context corresponds to an expectation that the (observed) dashed line will tend to lie below the (observed) dotted line, which it does in all 13 waves.
**Convergent Validity, Shared Context**

The figure at right displays the observed dissimilarity of the angry/politics questions with the three questions with different emotion/context wordings and the mean dissimilarity under the randomization null for that contrast across 13 waves of the poll.

Convergent validity on shared context corresponds to an expectation that the (observed) dashed line will tend to lie below the (observed) dotted line, which it does in all 13 waves.
Convergent Validity, Shared Context

The figure at right displays the observed dissimilarity of the proud/news questions with the three questions with different emotion/context wordings and the mean dissimilarity under the randomization null for that contrast across 13 waves of the poll.

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Convergent validity on shared context corresponds to an expectation that the (observed) dashed line will tend to lie below the (observed) dotted line, which it does in 12 of the 13 waves.