How might test-taker gender affect test-score meaning in a test of writing? Using corpus tools to extend a DIF study

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Gender and Language Use

from Mulac et al., (2006)
Study Context

• The Canadian English Language Proficiency Index Program (CELPIP) – General Test
  • Purposes and test structure
  • The writing tasks
    • 1. Writing an email (27 minutes)
    • 2. Responding to survey questions (26 minutes)
Study Context

1. In a test, do male and female test takers write differently?

2. If male and female test takers write differently, does this difference result in a bias in the scores achieved?
An item is labeled with “DIF” when:

Test takers with equal ability, but from different groups have an unequal probability of item success.
Differential Item Functioning (DIF)

A DIF analysis strategy needs to address two major issues:

(a) define matching variable; and (b) accommodate the continuous responses.

Challenges

Item Score = Matching (M) + Grouping (G) + Interaction (M x G)

Proposed Method

Adopted from Chen, Lam & Zumbo (2016);
See also, Brelan & Lee (2007)
Differential Item Functioning (DIF)

Recap of a DIF study on writing prompts

- 81 writing prompts were tested
- 29 (35.8%) of the prompts were flagged
- Small magnitude of the Gender DIF effect: change of the $R^2 < 0.02$.

Results from Chen et al., 2016

![Graph showing writing, reading, and listening scores for female and male participants.](image)
Interpretation of DIF Findings

• DIF vs. Bias

Experts review items/prompts
Test takers report cognitive process

Analyzing test takers’ writing samples?
Research Questions

• To what extent do the gender groups differ in the linguistic features as elicited by a DIF writing task?

• How do the differences, if they exist, relate to test takers’ scores on the writing task?
The CELPIP Writing Construct

• Analytic scoring on four dimensions by multiple raters
  • Coherence/meaning: organization/clarity/depth of meaning
  • Lexical Range: word choice/natural use of vocabulary/precision and accuracy
  • Readability/Comprehensibility: word form/spelling, grammar, punctuation/format and paragraphing/transitions
  • Task Fulfillment: relevance/completeness/tone/length

• Final reporting levels: 11 levels (M, 3-12)

from CELPIP Study Guide: Reading and Writing
The Writing Prompt

• Selected CELPIP writing prompt
  • Write a letter to a restaurant manager to
    1) describe your food restrictions;
    2) complain about the unavailability of food options for you; and
    3) make suggestions to the restaurant.
## The Corpus

**Table 1. Summary of the CELPIP corpus of written samples**

<table>
<thead>
<tr>
<th>Gender</th>
<th>Level 4</th>
<th>Level 5-8</th>
<th>Level 9-12</th>
<th># of samples</th>
<th># of words</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>49</td>
<td>281</td>
<td>83</td>
<td>413</td>
<td>76855</td>
</tr>
<tr>
<td>Female</td>
<td>20</td>
<td>306</td>
<td>87</td>
<td>413</td>
<td>79619</td>
</tr>
</tbody>
</table>
## Analytical Tools

<table>
<thead>
<tr>
<th>Tool (category)</th>
<th>Feature groups used</th>
<th># of features used</th>
<th>Relevance to the scoring dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SEANCE 1.05</strong></td>
<td>The General Inquirer (GI)-based indices</td>
<td>85</td>
<td>Task Fulfilment</td>
</tr>
<tr>
<td>(sentiment/ social cognition)</td>
<td>The NRC Word-Association Emotion Lexicon (EmoLex)-based indices</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TAACO</strong></td>
<td>Adjacent lexical/semantic overlaps at sentence levels</td>
<td>28</td>
<td>Coherence &amp; Meaning; Readability &amp; Comprehensibility</td>
</tr>
<tr>
<td>(cohesion features)</td>
<td>Rhetorical connectives</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Type-token ratios and repeated words</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td><strong>TAASSC 1.4</strong></td>
<td>Clause-based complexity indices</td>
<td>21</td>
<td>Readability &amp; Comprehensibility</td>
</tr>
<tr>
<td>(syntactic features)</td>
<td>Noun phrase-based complexity indices</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Usage-based syntactic sophistication indices</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Indices from the L2 Syntactic Complexity Analyzer (L2SCA)</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td><strong>TAALES 1.0</strong></td>
<td>Frequency of words and n-grams (BNC)</td>
<td>11</td>
<td>Lexical Range</td>
</tr>
<tr>
<td>(lexical features)</td>
<td>Range of words and n-grams (BNC)</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MRC psychological properties of words</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>
Data Preparation & Analysis

• Feature selection
  • Construct-relevance criterion
  • Distribution-based screening
  • Pearson correlations
• Mann-Whitney $U$ test (male vs. female)
• Multiple regressions

• Caveats
## Results

### Sentiment/Social Cognition

Table 3. *Distinctive sentiment and social cognition features*

<table>
<thead>
<tr>
<th>Sentiment/social cognition Features (dictionary or source)</th>
<th>Mann-Whitney U Test (M vs. F)</th>
<th>Correlation with writing proficiency level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ES</td>
<td>p</td>
</tr>
<tr>
<td>Positive (EmoLex)</td>
<td>-0.079</td>
<td>.022</td>
</tr>
<tr>
<td>Negative (EmoLex)</td>
<td>-0.070</td>
<td>.045</td>
</tr>
<tr>
<td>Know (GI)</td>
<td>-0.069</td>
<td>.048</td>
</tr>
<tr>
<td>Causal (GI)</td>
<td>-0.071</td>
<td>.040</td>
</tr>
<tr>
<td>Self (GI)</td>
<td>-0.080</td>
<td>.022</td>
</tr>
<tr>
<td>Strong (GI)</td>
<td>-0.071</td>
<td>.042</td>
</tr>
</tbody>
</table>

Legal (GI)
## Results

### Cohesion Features

Table 4. *Distinctive cohesion features*

<table>
<thead>
<tr>
<th>Features</th>
<th>Mann-Whitney U Test (M vs. F)</th>
<th>Correlation with writing proficiency level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ES</td>
<td>p</td>
</tr>
<tr>
<td>Overlap of noun lemmas (binary, 1 sentences)</td>
<td>-0.097</td>
<td>.005</td>
</tr>
<tr>
<td>Overlap of content word lemmas (binary, 2 sentences)</td>
<td>-0.093</td>
<td>.007</td>
</tr>
<tr>
<td>Overlap of preposition lemmas (binary, 2 sentences)</td>
<td>-0.095</td>
<td>.007</td>
</tr>
<tr>
<td>Number of logical connectives</td>
<td>-0.079</td>
<td>.022</td>
</tr>
<tr>
<td>Number of coordinating conjunctions</td>
<td>-0.110</td>
<td>.002</td>
</tr>
<tr>
<td>Number of connectives for reason and purpose</td>
<td>-0.078</td>
<td>.025</td>
</tr>
<tr>
<td>Number of causal connectives</td>
<td>-0.082</td>
<td>.018</td>
</tr>
<tr>
<td>Number of repeated content lemmas and pronouns</td>
<td>-0.100</td>
<td>.004</td>
</tr>
<tr>
<td>Ratio of pronouns to nouns</td>
<td>-0.140</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Number of subject personal pronouns</td>
<td>-0.092</td>
<td>.008</td>
</tr>
</tbody>
</table>
## Results

### Syntactic Features

Table 5. *Distinctive syntactic features*

<table>
<thead>
<tr>
<th>Features</th>
<th>Mann-Whitney U Test (M vs. F)</th>
<th>Correlation with writing proficiency level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ES</td>
<td>p</td>
</tr>
<tr>
<td>Possessives per direct object</td>
<td>-0.129</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Possessives per object of preposition</td>
<td>-0.096</td>
<td>.006</td>
</tr>
<tr>
<td>Possessives per nominal</td>
<td>-0.163</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Dependents per nominal subject</td>
<td>-0.094</td>
<td>.007</td>
</tr>
<tr>
<td>Prepositions per object of preposition</td>
<td>-0.086</td>
<td>.014</td>
</tr>
<tr>
<td>Complex nominals per clause</td>
<td>-0.129</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Existential ‘there’ per clause</td>
<td>-0.092</td>
<td>.008</td>
</tr>
<tr>
<td>Undefined dependents per clause</td>
<td>-0.152</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Subordinating conjunctions per clause</td>
<td>-0.145</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Faith scores (verb-construction, SD)</td>
<td>-0.110</td>
<td>.002</td>
</tr>
<tr>
<td>Faith scores (construction-verb, type)</td>
<td>-0.099</td>
<td>.005</td>
</tr>
<tr>
<td>Delta P scores (verb-construction, SD)</td>
<td>-0.115</td>
<td>.001</td>
</tr>
</tbody>
</table>
Table 6. *Distinctive lexical features*

<table>
<thead>
<tr>
<th>Features</th>
<th>Mann-Whitney U Test (M vs. F)</th>
<th>Correlation with writing proficiency level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ES</td>
<td>p</td>
</tr>
<tr>
<td>Word frequency in BNC Written (content words)</td>
<td>-0.070</td>
<td>.044</td>
</tr>
<tr>
<td>Trigram proportion in BNC Written (all words)</td>
<td>-0.070</td>
<td>.045</td>
</tr>
</tbody>
</table>
## Results

### Summary

<table>
<thead>
<tr>
<th>Category (software)</th>
<th># of features studied</th>
<th># of distinctive features</th>
<th># of features w/ positive correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sentiment and social order features (<em>SEANCE</em>)</td>
<td>95</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Cohesion features (<em>TAACO</em>)</td>
<td>61</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>Syntactic features (<em>TAASSC</em>)</td>
<td>81</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>Lexical features (<em>TAALES</em>)</td>
<td>25</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>262</strong></td>
<td><strong>30</strong></td>
<td><strong>15</strong></td>
</tr>
</tbody>
</table>

Adjusted $R^2 = .698$ ($k_{all} = 262$); Adjusted $R^2 = .460$ ($k_{distinctive} = 30$); Adjusted $R^2 = .273$ ($k_{positive} = 15$)
Discussions

• Gender differences in the (timed) writing task
  • Sentiment/social cognition; Cohesion features/Syntactic features/Lexical features
  • Mulac et al., 2006; Leaper & Ayres, 2007

• Implications
  • Impact of gender differences on the equivalence of meanings of scores
Conclusions

• Overall, only a small number of linguistic features in the four aspects were found different between the gender groups with very small effect sizes.

• As a whole, these differences may have negligible impact on the comparability of writing scores.
How might test-taker gender affect test-score meaning in a test of writing? Using corpus tools to extend a DIF study

Questions & Comments?
research@paragontesting.ca
Selected References


Female

I am start diet current with my sister.

Few days ago, my best friend birthday invited, so we went special restaurant near by my house.

There are very clan and nice place and very favourite sea food restaurant.

So we attend new special menu sea food kind ordered but there were no menu option that were suitable for me.

So I made complain for restaurant manager, what kind of diet food do you have? he said just making fried seafood with salad.

I am really disappointed kind of food, so I required seafood made grilled but he can not accepted.

Really, feel bad with my friend and we just take diet drink.

We just few minutes stay away, and I was told to manager as for the service at the restaurant.

In your restaurant place very clan and very nice, but I think your if got more food kind then more came in customers and favourite restaurant.

Male

Dear, manager.

Last week I visit your restaurant and I disappointed because I cannot eat same food I like because your restaurant serve a sea foods and also nuts I cannot eat it. Your restaurant is clean and good but I suggest you serve all different kinds of food example like vegetable fruit and most specially chicken for the children. Next time when I visit again in your restaurant I bring my friends and relatives and also I help you to improve your restaurant to going up soon. I invite also my all coworkers too visit your restaurant because food is very good test.
Female
Dear Manager:
I went to your restaurant last week. I have some food **allergies**, specifically I cannot eat seafood or nuts. If I eat this kind of food I have a **severe allergic** reaction, and I must go directly to the hospital. I was told by my doctor that if I don’t get medical help soon after the event, I could **die**.

Usually when I go out for dinner, I ask to the waitress if they have some **alternative** dishes that are nut free. Also I ask for beef or chicken. But when I looked at your menu I didn't find any option. Everything contain seafood or nuts. You might have your guests **happy** if you include more **variety** of ingredients. Also it is **important** to have a small kitchen separated to avoid food **contamination**.

I am looking forward to visit your restaurant in the future, and have an option to **enjoy** your **excellent** kitchen.

Thank you
XXX

Male
To whom it may concern,
I recently visited your restaurant, on 3/11/16, to **celebrate my** birthday with a group of friends. I had been **excited** to try it out as I had heard **great** things about the quality of food. **Unfortunately**, looking upon the menu I found that there were no options for someone with **allergies** to nuts and also seafood.

Usually I would never have this **problem** in restaurants as there is always at least one dish that caters to my dietary **restrictions**. I was **bitterly disappointed**, and resigned to drinking from a bowl of water, like a dog. What a way to spend your 5th birthday.

I would suggest that your company **take** the necessary measures to include **multiple** options on a new, redesigned menu. One that doesn't **discriminate** against people with **weak** immune systems. Maybe a **nice variety** of salads.

Yours sincerely,
XXX
Female

To whom it may concern,

I am writing to express my disappointment with a recent dining experience at Villa Italiano. As a long time customer of your restaurant, I feel the need to communicate my displeasure.

As you may recall, I visited your restaurant on the evening of March 15th accompanied by my husband and two close friends. Earlier that day, I had called to enquire about the evening menu. I took pains to call ahead of time because I have recently learned that I am allergic to seafood and nuts, and I wanted to ensure that it would be possible for your staff to accommodate these restrictions. I was assured by your hostess that it would not be a problem and that there would be lots of options available for me.

When we arrived for our 7:30 reservation, one glance at the menu was sufficient to show me that there was nothing I would be able to eat. We were forced to leave the restaurant. This problem could have been avoided if your hostess had been properly informed about the evening menu. I sincerely hope that you will improve your customer service in the future.

XXX

Male

Good day Mr. Smith (New Manager of the Northern Peninsula Restaurant),

I am writing to express my disappointment in the limited menu options at your restaurant and the apparent unwillingness to change. I have severe allergic reactions to seafood (mainly shellfish) and nuts (such as almonds). I was shocked when I went to restaurant last week with my wife, only to realize that there were no food options on the menu which were safe for me to eat. All items either had a seafood or nut ingredient. I informed the waiter and he noted that the chef could do nothing at the time to prepare a meal suitable for me. I left rather disheartened. This week was a repeat of the same issue.

I think you could solve this problem rather easily. For your menu options you could introduce meals with other meats, such as chicken, moose or venison. Another solution, might be to have variations of meals, excluding nuts for example. Lastly, I think that having a chef and staff that are flexible and can adjust meals to suit customers with dietary restrictions would prove useful. I hope you accept this advice.

A disappointed customer,

XXX
Female
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Male
Dear, manager.

Last week I visit your restaurant and I disappointed because I cannot eat same food I like because your restaurant serve a sea foods and also nuts I cannot eat it.
Your restaurant is clean and good but I suggest you serve all different kinds of food example like vegetable, fruit and most specially chicken for the children. Next time when I visit again in your restaurant I bring my friends and relatives and also I help you to improve your restaurant to going up soon. I invite also my all coworkers too visit your restaurant because food is very good test.
Female

Dear Manager:

I went to your restaurant last week. I have some **food** allergies, specifically I cannot eat seafood or nuts. *If* I eat this kind of **food** I have a severe allergic reaction, *and* I must go directly to the hospital. I was told by **my** doctor that *if* I don't get medical help soon after the event, I could die.

Usually when I go out for dinner, I **ask** to the waitress *if* they have some alternative dishes that are nut free. Also I **ask** for beef or chicken. **But** when I looked at **your** menu I didn't find any option. Everything contain seafood or nuts.

**You** might have your guests happy *if* you include more variety of ingredients. Also it is important to have a small kitchen separated to avoid food contamination.

I am looking forward to visit **your** restaurant in the future, *and* have an option to enjoy **your** excellent kitchen.

Thank **you**

XXX

Male

To whom *it* may concern,

I recently visited your restaurant, on 3/11/16, to celebrate **my** birthday with a group of **friends**. I had been excited to try it out *as I* had heard great things about the quality of **food**. Unfortunately, looking upon the menu I found that there were no options for someone with allergies to nuts and also seafood.

Usually I would never have this problem in restaurants *as* there is always at least one dish that caters to **my** dietary restrictions. I was bitterly disappointed, *and* resigned to drinking from a bowl of water, like a dog. What a way to spend your 5th birthday.

I would suggest that **your** company take the necessary measures to include multiple options on a new, redesigned menu. One that doesn't discriminate against people with weak immune systems. Maybe a nice variety of salads.

Yours sincerely,
Female
To whom it may concern,
I am writing to express my disappointment with a recent dining experience at Villa Italiano. As a long time customer of your restaurant, I feel the need to communicate my displeasure.

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Example texts – Level 4 (Syntactic features)

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