Female gender is consistently under-expressed in pronoun production and under-inferred in comprehension

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1. Introduction

How do prior expectations and pronouns combine to form later beliefs?

2. Methods

a. Production
Before the baker took out the trash, ...

b. Gender recall
After the baker took a shower.

1, 4, or 8 stories

1, 4, or 8 stories

5 * 7 + 12 - 3 = ___

Female / Male / Other

Sample Stimuli:
After the shop on High Street closed for the night, a baker stayed to tidy up. Before the baker took out the trash, she swept the floor and wiped down the counter.

pronoun (he/she/they) or repeat of role noun (the baker)

80 role nouns

Experiment Participants Each Saw
a. Production 149 20 items
b. Gender recall 712 1, 4, or 8 items
c. Explicit Norm 51 All 80 nouns
d. Implicit Norm 569 1, 4, or 8 items

3. Production Results

After the cheerleader finished practicing, ...

Before the baker cleaned up, ...

50%

80%

... he took a shower.

... they checked the oven.

50% 80%

Fraction of pronouns produced

Implicit and explicit norms correlate (r=.83), but implicit norm labels nouns as more male.

4. Predictions

Using Bayes rule, (g = gender, p = pronoun)

P(g|p) = P(p|g) P(g) / P(p)

In production: P(she|female) ≤ P(he|male)

This implies P(male|he) ≤ P(female|she) if communicators are rational.

5. Gender recall results

He is recalled as male more than she is recalled as female.

P(male|he) > P(female|she)

Reduced effect of pronoun

6. Conclusion

Production and comprehension are inconsistent on pronoun gender.
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Language production and comprehension draw on a broad range of knowledge and beliefs, including general world knowledge and contextually variable information. Pronominal references to role nouns with diverse gender biases illuminate the interplay of these sources of information: violations of stereotypical gender elicit surprise (e.g., referring to a surgeon as she), but comprehenders can accommodate to non-stereotypical genders within a discourse (Duffy & Kier 2004, Sturt 2003, Osterhout et al. 1997). In two experiments, we investigate how gender expectations are reflected in the production and comprehension of pronominal references to role nouns. Our results indicate that female gender is consistently underused in English pronoun production (Fig. 1), and under-inferred in English pronoun comprehension (Fig. 2).

We experimentally estimated the gender stereotypes associated with 80 role nouns (e.g. diplomat, butler, nanny, reporter) that were then used in both experiments. In experiment 1, 149 Mechanical Turk participants each completed 20 passages designed to elicit pronouns referring to a role noun (e.g. The day before the championships, the gymnast worked out. Before and after working out, the gymnast stretched her muscles to avoid getting sore.). After reading 9 vignettes (plus a short working memory task to prevent verbatim recall), participants stated the gender of each role noun’s referent. As expected, participant responses regarding referent gender were influenced by role noun stereotype (upward slopes in Fig. 2). If inferences regarding referent gender take production biases into account, then the “female” response rate for role nouns referred to using she should be farther above the female stereotype than the “male” response rate for role nouns referred to using he is above the male stereotype, because our results in Experiment 1 show that she should be a stronger signal of a female referent than he is of a male referent. But we see the opposite pattern (Fig. 2): relative to the gender stereotype, he(him, his) is recalled as male well above the stereotype and far more often than she(her) is recalled as female at an equivalent stereotype strength.

Taken together, these results are scientifically interesting and societally troubling. First, feminine pronouns are consistently under-produced relative to the expectation for the referent to be female. Second, this bias is exacerbated, rather than compensated for, in comprehension: relative to role noun gender stereotype, comprehenders are more likely to remember the referents of female pronouns as male than than vice versa.