German Morphosyntactic Gender and Lexical Access

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- Previous eye-tracking research has shown that, during spoken-word recognition, gender marking on preceding articles restricts the competitor set to gender-matching nouns: Upon hearing *"Cliquez sur le$_{[masc]}$ bouton"* ('Click on the button'), French listeners did not take the picture of a gender-mismatching 'bottle' (*bouteille$_{[fem]}$*) into consideration, despite onset similarity between *bouton* and *bouteille* (Dahan et al., 2000)
- In the interpretation of the gender effect, two issues need to be distinguished:
  - **When** does gender information influence noun recognition? Do gender cues pre-activate gender-matching nouns, or does the effect set in when the noun onset is heard?
  - **At what level** of processing does gender have an effect? What types of representations are involved: shallow co-occurence frequencies or deeper morphosyntactic gender categories?
- In another experiment, Dahan et al. (2000) found that, by itself, a gender marked article does not seem to prime all gender-matching nouns: Hearing *"la$_{[fem]}$ louche"* ('the ladle') did not increase fixations to a non-onset-overlapping 'sock', *chaussette$_{[fem]}$*. This goes against a pre-activation account.

- However, it is possible that in the study of Dahan et al. (2000), the time between article and noun was too short to observe pre-activation of gender-matching nouns, because the target onset immediately excluded them from consideration
- In German, adjectives usually precede the noun. Thus, it is possible to increase the delay between article and noun by inserting an adjective in-between
- The present study was devised to investigate more closely the time-course of the effect of gender on lexical access, by inserting an adjective before the noun

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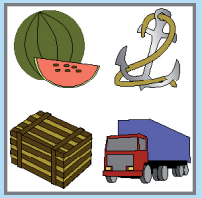
"Wo befindet sich die$_{[fem]}$ schwere Melone?"
'Where is the heavy watermelon?'

Target (the object the participants were asked to click on): e.g. *Melone$_{[fem]}$*, 'watermelon'

Gender-Matching Distractor (never mentioned in the instructions): e.g. *Kiste$_{[fem]}$*, 'chest'



Alternative Target for counter-balancing trials: e.g. *Anker$_{[masc]}$*, 'anchor'

Gender-Mismatching Distractor (never mentioned): e.g. *Lastwagen$_{[masc]}$*, 'truck'

(roles swapped in counterbalancing trials)

Method

- Participants: Forty-four Geman native listeners
- Head-mounted eyetracking, participants being asked to mouse-click on one of four pictures
- In the instruction, the noun was preceded by the correct, gender-marked, definite article, and by an adjective unmarked for gender

Stimuli (36 items)

- All adjectives were short, common, non-descriptive adjectives
- A plausibility pretest of the adjective-noun pairs ensured that the adjective fit all pictures in one trial equally well
- In a second pretest, the quality of the pictures was rated, in particular in relationship to the adjective
- Gender-matching and mismatching distractors were matched on frequency and goodness of fit based on the pretest scores, as were targets and alternative targets
- There were 6 items per possible gender combination in German (masculine-feminine, masculine-neuter, feminine-neuter + their symmetrics)

Fillers (54)

- The trials were interspersed with one-and-a-half times as as many fillers as experimental trials, in order to avoid regular patterns in the presentation
- Various other adjectives were included (color adjectives, polysyllabic adjectives)
- The majority of the displays contained more than two pictures belonging to the same gender category, so that gender could not generally be used to predict the target

Analysis

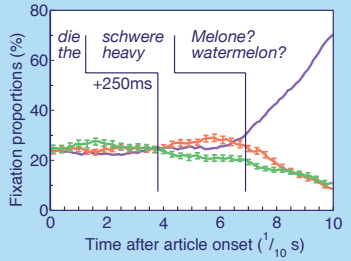
- Region of interest: Duration of the adjective in the sound file (between offset of the gender-marked article and onset of the noun), shifted by 250ms due to the latency of eye-movements
- Note that if the assumed 250 ms latency were too long, so that acoustic input from the noun onset had already been partially processed during the region of interest, fixations to the gender-matching distractor would be eliminated, thereby reducing the effect we seek
- Before gender information starts being processed, all pictures should be fixated equally often, unless the drawings or any uncontrolled factors introduced a bias
- Fixation proportions were computed in 10ms slices for each picture type (target, matching and mismatching distractors) and then averaged over each analyzed region (initial region and adjective)
- Prediction: If gender-marked articles pre-activate gender-matching nouns, more looks to the gender-matching distractor would be expected than to the gender-mismatching distractor before noun onset

Results

- Immediately after article offset, participants began fixating targets and gender-matching pictures more often than gender-mismatching pictures
- The advantage of gender-matching pictures over gender-mismatching pictures was highly significant during the adjective
- Fixations to gender-matching pictures only decreased after target noun onset
- The effect is numerically smaller than in studies with onset overlapping nouns (Allopenna et al., 1998; Dahan et al., 2000; Weber & Paris, CogSci, 2004), but it is statistically highly significant
- For similar findings, see Hartmann (2004)

	Initial Region	Adjective
Gender-Matching	24.40%	27.03%
Gender-Mismatching	25.77%	21.55%
ANOVA	F1 & F2 < 1	F1 = 10.65, $p \leq 0.005$; F2 = 14.69, $p \leq 0.00$

Fixations to target, gender-matching distractor and gender-mismatching distractor. The effect occurs in the window from 380 to 690ms, which corresponds to the duration of the adjective + 250ms latency.



Arguments against Strategicness

- The effect is very early, emerging immediately after the article
- Throughout the design of the study, special attention was given to avoid strategic results:
  - Large amount of fillers, in most of which gender could not be used to restrict the set of alternatives
  - Short preview time (delay between the appearance of the display and the start of instruction): 500 ms, as in Dahan et al. (2000), instead of 2000ms in Hartmann (2004) and earlier eyetracking studies of lexical access
  - No showing of the pictures to the participants before eyetracking necessary thanks to naming pretests
- The analysis of the first and second halves of the experiment revealed similar results, suggesting that no strategy was developed
- Debriefing confirmed that nobody noticed the article and its gender during the experiment

- The data extends evidence of the gender effect in lexical access to German
- **Time-Course Issue:**
- Gender cues carried by articles are clearly influencing referential processes before the noun, facilitating the recognition of matching nouns and/or inhibiting mismatching nouns
- The data provides some support for a pre-activation account, although this may be limited to the processing of visually present lexical candidates
- **Processing-Level Issue:**
  - In the Dahan et al. (2000) study, the effect seemed to be dependent on the surface form (onset) of the noun, thereby suggesting a rather shallow mechanism operating at the phonological or lexical level (e.g., based on co-occurrence frequencies between the phonological representations of article and noun)
  - However, we observe an effect of gender even though the nouns do not overlap in onset
  - The low frequency of our article-adjective-noun sequences confirms other findings (Jakubowicz & Faussart, 1998; Akhutina et al., 1999) which show gender effects with other types of low frequent sequences
  - Moreover, an effect of native gender categories has been observed during the recognition of spoken nouns in a second language by non-native listeners (Paris & Weber, 2004)
  - Together, evidence supports the existence of a deeper mechanism involving gender categories that influence lexical access
- **In Progress:** Follow-up study in which gender (matching vs. mismatching) and noun onset (overlapping vs. non-overlapping) will be crossed