In this talk, I am going to present a study investigating the interference of morphosyntactic information in late-bilinguals. The category I have been looking at in particular is lexico-syntactic gender, reflected for example in the German articles *der*-*die*-*das*. The participants in the study were proficient non-natives speakers, who are often referred to as “late-bilinguals”.
In psycholinguistics, it is generally accepted that people recognize words by gradually centering in on them as the acoustic input comes in.

Moreover, in the case of multilingual listeners, there is evidence that words from irrelevant languages are also considered as lexical candidates, even in monolingual situations. This is well established in the case of L1 words being activated while bilinguals listen to their L2, but there is still conflicting evidence concerning L2 activation during L1 processing: Some studies have found that L2 words were activated while others have not.

Let us take an example with a German-French bilingual listening to French. Given that the French and German /R/ sounds are very similar, when a French “R” sound is heard, both French and German nouns the listener knows containing that phoneme will be activated, such as *Frucht, rose, crêpe, radio,* ... Then, depending on the next sound, for instance a short /a/, some words will drop out, like..., and so on until the correct word is identified.
Eyetracking with Bilinguals

- Eyetracking allows to observe lexical competition over time
- Fixations to objects can be linked with lexical activation
- Stimuli from the irrelevant language are never presented
- Bilinguals look at crosslinguistic competitors whose name is phonemically similar to the target: e.g., when asked to pick up a *marker*, Russian-English bilinguals also briefly look at a stamp, /marka/ in Russian (Marian & Spivey, 2003)

The fact that bilinguals consider words from several languages as lexical candidates has been confirmed using eyetracking, which is a paradigm that allows a very fine-grained observation of lexical competition over time.

Put simply, eyetracking consists in filming where people look while they listen to speech, and it has been shown that participants’ eye fixations can be linked with, for example, lexical activation.

In bilingualism research, one advantage of the method is that stimuli from the irrelevant language never need to be presented.

It has been shown is that when bilingual participants are given instructions to manipulate an object, they often briefly look at crosslinguistic competitors whose name is phonemically similar to the target: For example, Russian-English bilinguals who were asked to pick up a *marker* in the presence of a *stamp* looked more often at the stamp than at other objects, because in Russian the word for ‘stamp’ is similar to *marker*.
The Preceding Context: Gender

- Lexico-Syntactic gender: Arbitrary noun classes (masculine, feminine, neuter)
  - French: *le radis*\text{[masc]} ('radish')
  - *la rose*\text{[fem]} ('rose')
  - German: *der Rechner*\text{[masc]} ('computer')
  - *die Frucht*\text{[fem]} ('fruit')
  - *das Rad*\text{[neuter]} ('wheel')

- In gendered languages, such information is used by monolingual listeners: After a gender-marked article, only gender-matching nouns are considered, leading to faster recognition (e.g. Grosjean, 1994; Dahan, 2000)

Based on this finding, it is interesting to ask what the influence of the preceding context may be, and this is what I have been investigating, on the lexico-syntactic level, with gender.

In many languages, nouns are divided in several arbitrary classes, and the article changes depending on what class a noun belongs to. Moreover, we also know that monolingual listeners make use of such lexico-syntactic information, in particular of gender, to facilitate word-recognition: After hearing a gender-marked article, only gender-matching nouns are taken into account.
**Irrelevant Activation on other Levels**

- Is activation of irrelevant languages limited to the lexicon?
- For cognate nouns, L1 gender information can influence the competitor set when bilinguals listen to their L2.

In the case of bilinguals, what we asked ourselves here was whether they also activate lexico-syntactic knowledge, such as gender, from languages that are irrelevant in the current situation.

We already have some evidence in this direction in the case of cognate nouns: In a previous study, we found that L1 gender information can influence the competitor set when bilinguals listen to their L2.

(Explanation of eyetracking)
Gender Interference with Cognate Nouns

- In a study in German, French-German bilinguals inappropriately restricted the competitor set to nouns matching in gender in French
  - They fixated a ‘wig’ (French *perruque*[fem]) more than unrelated pictures when hearing German “*die*[fem] Perle”
  - But excluded a ‘canon’ when hearing “*die*[fem] Kassette”
- Monolingual Germans showed competition in both conditions

The study was run in German with French-German bilinguals and monolingual controls.

When L1 gender did not interfere, French-German bilinguals fixated objects with the same onset as the target significantly more than unrelated pictures: For example, a wig (French *perruque*[fem]) when hearing German “*die*[fem] Perle” because French “perruque” is of the same gender as German “*die Perle*”, so the gender of the noun in French agrees with the gender of the preceding article in German.

However, when the same French-German bilinguals heard “*die*[fem] Kassette”, which is also feminine, they did not consider the ‘canon’ as a referent, because *canon* is masculine in French (*canon*[masc]), although in German it is feminine and agrees with the article (*Kanone*[fem]).

By comparison, German monolinguals DID look at the canon. The difference between both groups therefore suggests that the bilinguals were using their L1 categories while processing L2.
But L2 gender could be stored differently for cognates and non-cognates! We know that in general, bilinguals produce cognates faster and react faster to them, presumably because part of phonetics are shared (the effects are stronger). So might gender interference be stronger for cognates than for non-cognates? Or even completely absent for non-cognates?

There is evidence that this could be the case in a lexical decision study by Lemhöfer...
The study I am going to present is very similar to the eyetracking study of gender with cognate nouns I have summarized previously, but this time, non-cognates were used.

If we assume that when they hear the onset of French *radis*, German-speaking listeners also activate German words containing the sounds /Ra/, such as *Radierer, Rakete, Rad*, and so on... What will happen if they heard *radis* preceded by its correct French definite article, *le*, indicating that the following noun must be masculine? Will they exclude the word for “rocket”, *Rakete*, due to its feminine gender in German? If they do, it would mean that German gender categories were somehow activated while listening to French.
Experimental Setup (1)

- Participants:
  - Proficient German-French late bilinguals,
  - Proficient French-German late bilinguals,
  - Control group of French natives

- "Cliquez sur le{masc}/la{fem}..." (‘Click on the...’)

We had two groups of bilingual participants in this study: Proficient German-French late bilinguals and proficient French-German late bilinguals. Moreover, we also had a control group of native speakers. Any effect of non-native listening should only show up with the non-natives but not with the controls.

The instructions were in French, and they were sentences like “Cliquez sur le{masc}/la{fem}...” (‘Click on the...’): In every sentence, a gender-marked article preceded the noun, thus providing gender information.

There were four pictures in each display, and participants were asked to click on one of them. For example, the target picture, the one that participants were asked to click on, could be a table, in French table. One of the other objects on the screen was a cross-linguistic competitor: It had a German name which overlapped in onset with the target, here Tanne. Moreover, there were two more objects with phonologically unrelated names on the screen: the distractors.
Two conditions were compared. In the first condition, target and competitor had the same gender in French and German, so the French article in the instruction also agreed with the German competitor, for example...

By comparison, in the second condition, the German competitor’s gender was different from the target: ‘rocket’ in German is feminine while ‘radish’ in French is masculine. Thus here the article did not agree with the German noun. I will call the two condition same-gender and different-gender pairs for short. There were 20 items in each case.

The competitor was always a non-cognate noun. In addition, in order to make sure that looks to the competitor picture would not be due to its French name, we chose only competitors whose gender in French was different from the target.

The predictions were that, for participants who knew both languages, if gender information is not taken into consideration, the competitor would be activated together with the target in both conditions, due to the onset overlap. Thus, the competitor picture should receive more attention than the pictures with unrelated names. In the same-gender pairs, gender should not interfere, since gender is the same for the French target and the German competitor. So we should observe a competition effect, that is more fixations to the competitor than to the unrelated distractors.

In the different-gender pairs, however, we expect the competition effect to go away, because of the gender-mismatch between French article and German competitor noun.

For the native control group, we expected no fixations to the competitor in any case, since they don’t know the name of the competitor in German.
Analysis

- Dependent variable: Fixations to different types of pictures (target, competitor, and the average of the two distractors)
- Launching an eye-movement takes between 150 and 300ms

In this type of study, what we are interested in are fixation proportions to the different types of pictures (targets, competitor and distractors), starting from the onset of the target noun in the acoustic input.

It has been shown that after an eye-movement is planned, it takes approximately 150 to 300 ms to actually launch it. So in general, there is an offset of about 200 ms between a given portion of the acoustic input and its effect on the observed fixations.

Following this delay, in the time-frame starting at 200 ms, we expect to see any influences of the noun in the spoken instruction on the participants’ fixations.

Since people are asked to click on the target, fixations to it will continue increasing until the mouse-click (much later, outside the graph). What we are interested in is a comparison of the behavior of competitor and distractor curves in the very first few instants after noun onset, when lexical candidates are at first activated. A time-frame of 200 to 600ms is frequent in the literature.

Since the names of the distractors do not overlap acoustically with the target, fixations to them are going to drop as fixations to the target rise. They are a good baseline against which to compare the competitor to judge whether it is being activated or not.

If there is no difference between the competitor and the distractors, the competitor was not activated.

By comparison, if the competitor rises with the target at first and drops later on (after the disambiguation point, the end of the overlap), then there was a competition effect - the competitor was activated, as long as it wasn’t clear to the participants on which object they would be asked to click.
Gender in Bilingual Spoken-Word Recognition

ISB6, May 30, 2007

When gender does not interfere (target and competitor have the same gender), German-French bilinguals activate non-cognate German competitors while listening to French.

- **French target: la [fem] table [fem]**
- **German competitor: Tanne [fem]**
- **Av. of distractors**

Here are the results:

In the case of the German-French bilinguals, in the same-gender pairs, we can see that there is a significant difference between the fixations to the competitor and to the distractor. The competitor is first activated together with the target before dropping. Given that gender does not interfere with competition (the gender of the French target is the same as the gender of the German competitor), the German competitor is activated, although the experiment is run entirely in French.
Moreover, the French-German bilinguals (who were living in Germany at the time they took part in the experiment) also show activation of German competitors. These bilingual listeners, who were currently living in an L2 environment, show an effect of their L2 while processing their L1.

However, the effect appears numerically smaller, supporting the idea that the magnitude of crosslinguistic competition depends on language proficiency.
By comparison, here are the results in the different-gender condition - the case in which the gender of the German competitor is different the target.

Here, between 200 and 600 ms, there’s no difference between the amount of fixations to competitors and distractors, for either group: Both German-French and French-German bilinguals did not look at different-gender competitors any more than at the distractors.
When the gender of the German competitor is different from that of the French article preceding the noun, the competitor wasn’t activated: The competition effect we observed in the same-gender condition disappears when there is a gender-mismatch between article and cross-linguistic competitor. The participants excluded gender-mismatching German competitors from the very start from the competition set. So, not only are German nouns activated during an experiment run entirely in French, but German gender-knowledge also seems to be playing an role!
In order to make sure that the results we obtained with bilinguals were really due to non-native listening, we also tested a group of monolingual French controls. These participants did not show any activation of the competitor in either condition: The effect we observed in the bilinguals in the same-gender condition was absent.
Here is a direct comparison of the competitor curve in the German-French bilingual group and in the French control group. In the same-gender condition, the difference in the amount of fixations to the competitor was significant, whereas there was no difference in the different-gender condition.
Conclusions

- Gender interference in bilingual processing also occurs for non-cognate nouns
  - German-French and French-German bilinguals activate German *Tanne*[^fem] when hearing French "*la*[^fem] *table*", but not gender-mismatching nouns such as *Rakete[^fem]* when hearing "*le*[^MASC] *radis*"
  - French monolinguals show no activation in either case
- The effect appears weaker for French-German (L2 activation in L1) than for German-French (L1 activation in L2) bilinguals
- Models of bilingual processing need to be able to account for interference at this level of processing
- These results may also have implications for monolingual models of language processing, in particular concerning the locus of the gender effect in lexical competition
- In planning: A study contrasting cognates and non-cognates

To summarize, the study I have reported extends evidence of gender interference in bilingual processing to non-cognate nouns...

Additionally, it should be underlined that the pattern we found for the French-German bilinguals was similar, but apparently weaker than for the German-French bilinguals. The difference with studies which have not found any activation of L2 during L1 processing may lie in the question of language proficiency/language dominance, since the participants’ German was probably very active at the time of the experiment because the participants were living in Germany at the time.

These results are interesting because of what they mean for the architecture of the language processing system. First, in the case of bilinguals, this type of interference needs to be explained by models of bilingual processing.

Second, the data is also interesting in what it can contribute to models of monolingual processing. From the existing literature, it is not yet clear where the effect of gender on spoken-word recognition originates. However, the present data seems to favor an explanation in which grammatical processing has a role, because the lexico-syntactic gender category of the irrelevant German nouns was activated.
Additional Slides
The effect we found with the German-French participants was stronger than the one found with French-German participants, and in the monolingual group, the effect disappeared completely. However, we also had more participants in the first group than in the two other groups (18 vs. 10 and 9).

Therefore, we wanted to exclude the possibility that the difference was purely due to a statistical artifact. The analysis was repeated with a sub-group of German-French participants chosen at random. The difference in fixations to the cross-linguistic competitor and to the distractor was significant in the same-gender pairs and non-significant in the different-gender pairs, thus supporting our conclusions.
Phoneme Interference Effects

- L1 phonemic categories influence lexical activation in L2
- For example, an recent eyetracking study with Japanese learners of English (Cutler, Weber et al., 2006):
  - Japanese find it difficult to distinguish between English /r/ and /l/
  - When asked to click on a rocket, they also looked at a locker

Besides interference from words and gender from other language, other interference effects are also well-known in bilinguals. For example, there is evidence that in late bilinguals, phonemic categories from the first language also influence which lexical candidates are activated during word recognition in their second language.

There is evidence for this with various paradigms. For example, in another eyetracking study, Japanese learners of English, who have a notably hard time distinguishing between /r/ and /l/, tended to look at a locker displayed on the screen when they are asked to click on the picture of a rocket.

This provides further support of the idea that linguistic categories (phonemic or lexico-syntactic) from the L1 may interfere when late bilinguals process their L2, although the mechanisms involved are likely to be very different on these two levels of language processing.