Through *dick* & *dünn*: Cognates and the legacy of diachronic change in synchronic processing

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Cognates

- L2 research rarely distinguishes **cognates** from **loans**, (mis)using 'cognate' for *any* words with cross-linguistic form–meaning overlap:
  → e.g. English *chocolate* [tʃɔklət] – Mandarin 巧克力 [t͡ɕʰjaʊ̯³kʰɤ⁴li⁴].
- BUT: languages are ***structured systems*** and, in related languages, sound change leads to ***systematic correspondences*** between true (inherited) cognates, e.g. English–German [**θ**]–[**d**]: ***th***ick–***d***ick, ***th***ing–***D***ing, ***th***orn–***D***orn.
- A 'cognate facilitation effect' is often assumed for *any* two items with form–meaning overlap. However, there is increasing evidence these effects are orthographically driven. Rather, *phonological coactivation* leads to competition and inhibition (cf. Fritz et al. 2023).
- **For L2 speakers, are cognates or noncognates easier to access?**
- **How much of a 'slight mismatch' still results in cognate coactivation?**
- **What consequences does this have for synchronic processing?**

L1 = German
L2 = English

To what extent are cognates in the first language (L1) coactivated in L2 word recognition? Does coactivation **help** or **hinder** processing?

Fritz, Isabella, Aditi Lahiri & Sandra Kotzor. 2023. Shared Loanword Recognition in German–English Bilinguals: The Role of Metrical Phonology. *Journal of Cognitive Neuroscience* 35(12): 2028–2048. https://doi-org.ezproxy-prd.bodleian.ox.ac.uk/10.1162/jocn_a_02063

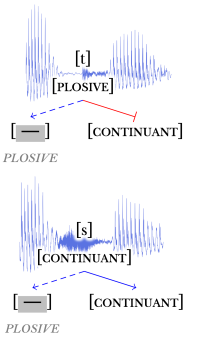
Research Questions

- German and English have many cognates, but do they **impede** or **facilitate** L2 word recognition?
- Certain classes differ systematically in their **initial consonant.**
- Cognates might differ in form, but they have a ***phonological* relationship.**
- Are the representations of cognate words somehow connected in bilingual speakers' minds?
- How does this affect processing, and **what role do the phonological feature specifications of cognates play?**

West Germanic		English			German	
/p/ > /p͡f/	*p	p	***p**ath* /pɑːθ/	***p**lant* /plɑːnt/	p͡f	***Pf**ad* /p͡fɑːd/	***Pf**lanze* /p͡flantsə/
/t/ > /t͡s/	*t	t	***t**in* /tɪn/	***t**ide* /tʌɪd/	t͡s	***Z**inn* /t͡sɪn/	***Z**eit* /t͡saɪt/
/θ/ > /d/	*θ	θ	***th**ick* /θɪk/	***th**in* /θɪn/	d	***d**ick* /dɪk/	***d**ünn* /dʏn/
no change	*f	f	***f**ish* /fɪʃ/	***f**inger* /fɪŋgə/	f	***F**isch* /fɪʃ/	***F**inger* /fɪŋə/
	*m	m	***m**ouse* /maʊs/	***m**ast* /mɑːst/	m	***M**aus* /maʊs/	***M**ast* /mast/
	*n	n	***n**est* /nest/	***n**et* /nɛt/	n	***N**est* /nɛst/	***N**etz* /nɛt͡s/

Underspecification

- Not all features are specified at all levels of representation and some may be **underspecified**
  → i.e. absent from the underlying representation (UR) but filled in production, extracted from the signal and mapped onto URs in perception.
- We take [PLOSIVE] to be universally underspecified.
- Underspecification is justified by the **asymmetric processing of certain features** in speech perception (cf. Cornell et al. 2013).
- The feature mapping process may therefore result in one of three outcomes: **MATCH**, **MISMATCH** or **NO-MISMATCH**.



Cornell, Sonia A., Aditi Lahiri & Carsten Eulitz. 2013. Inequality across consonantal contrasts in speech perception: Evidence from mismatch negativity. *Journal of Experimental Psychology: Human Perception and Performance* 39(3): 757–772.

Experimental Study

- Participants were **L1 German** speakers with high **L2 English** proficiency.
- Brain activity and reaction times were recorded.

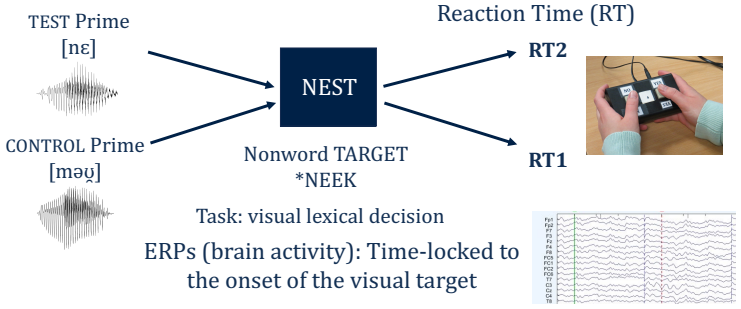
	English	Extracted feature (E)		German	Underlying feature (G)	Prediction
IDENTITY	[m] *mouse* [n] *nest* [f] *fish*	[NASAL] [NASAL] [CONTINUANT]	→	/m/ *Maus* /n/ *Nest* /f/ *Fisch*	[NASAL] [NASAL] [CONTINUANT]	Activated: **competition**
NO-MISMATCH	[θ] *thorn* [θ] *thing*	[CONTINUANT] [CONTINUANT]	⇢	/d/ *Dorn* /d/ *Ding*	*UNDERSPECIFIED* [PLOSIVE] *UNDERSPECIFIED* [PLOSIVE]	Activated: **competition**
MISMATCH	[t] *tin* [p] *path*	[PLOSIVE] [PLOSIVE]	⊣	/t͡s/ *Zinn* /p͡f/ *Pfad*	[STRIDENT] [STRIDENT]	Not activated: **no competition**
NON-EXISTENT	[p] *pig* [t] *take* [θ] *thug* [m] *meat* [n] *noon* [f] *fog*	[PLOSIVE] [PLOSIVE] [CONTINUANT] [NASAL] [NASAL] [CONTINUANT]				Not activated: **no competition**

Methodology

Fragment Priming Study

PRIME: Spoken CV fragment presented before the TARGET

TARGET: Full word which *does/does not* begin with the PRIME fragment

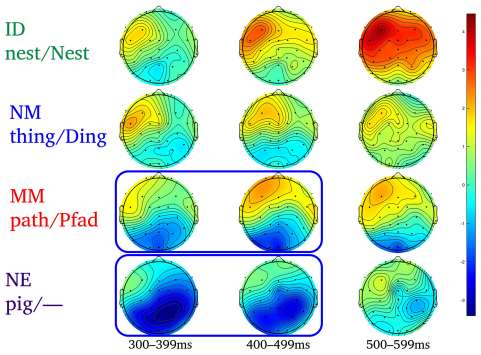


Task: visual lexical decision

ERPs (brain activity): Time-locked to the onset of the visual target

Results (ERPs)

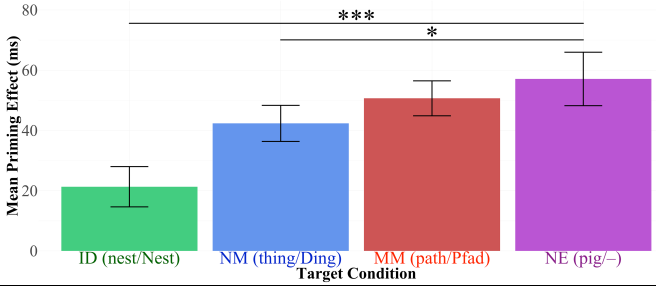
Topographical Plots (TEST – CONTROL items)



N400 (blue) 300–500ms
Reflects ease of lexical access and integration; indexes phonological expectancies (based on the activated cohort).

A **larger N400 effect (darker blue)** is expected with greater **facilitation** of target word retrieval by the experimental prime (but interference from the L1 cohort may prevent an effect).

Results (Behavioural)



		English		German	Priming Effect	N400
(i)	IDENTITY	*fish, mouse*	→	*Fisch, Maus*	21.3ms	—
(ii)	NO-MISMATCH	*thorn, thing*	⇢	*Dorn, Ding*	42.3ms	—
(iii)	MISMATCH	*path, tin*	⊣	*Pfad, Zinn*	50.7ms	attenuated
(iv)	NON-EXISTENT	*pig, thug*		—	57.1ms	attenuated

Discussion

- **The N400 was only significantly attenuated for the mismatching and non-existent conditions**. These English words were therefore **easier to access** than the other conditions (where the competing L1 German cognate was also activated, leading to competition and inhibition).
  → **Similarities in form and meaning across languages do not equate to faster processing (quite the reverse!).**
- Cognates are characterised by **systematic sound correspondences**, typically involving differences in a **small number of features.**
- **Activation depends on the abstract phonological representation and matching/mismatching of features**:
  → Provided the phonological representations don't mismatch and diverge too significantly, e.g. *twig* [twɪg] – *Zweig* [t͡svaɪk], L2 processing may lead to coactivation of L1 items in the cohort, **increasing competition for selection and hindering lexical access**.

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Linguists interested in the historical development of words have always differentiated 'cognates' and 'loans': English (E) *reptile* and German (G) *Reptil* are loans, as they were both independently borrowed from French, whilst E *pound*~G *Pfund* are cognates, as they were both inherited from the same West Germanic source (developing differently over time). However, most modern experimental research disregards this distinction (particularly in L2 literature). Instead, any words with form–meaning overlap across two languages are (mis)termed 'cognates': e.g. E *ambulance* ~ Welsh *ambiwlans* (or even E *chocolate* ~ Mandarin *qiǎokèlì!*). This definition furthermore excludes many true (inherited) cognates, e.g. E *starve* ~ G *sterben*.

German and English share many genuine cognates, but the question we ask is whether they *hinder* or *facilitate* L2 word recognition. How do systematic sound relations affect processing, and do the phonological feature specifications of cognates matter? Does the phonological representation of *Pfund* affect the access of *pound* for fluent L2 E speakers? We present the results of a recent EEG study, arguing that the distinction between cognates and (shared) loans is as relevant for work on synchronic language processing as historical linguistics.

Although modern speakers have no knowledge of their language's history, sound change is *systematic*, resulting in *regular correspondences* between related languages. This necessarily plays a role in the phonology (even where there is no segmental or semantic identity). Much L2 literature relies on algorithms of orthographic or phonemic similarity, but not all change is equal: *the direction matters*. Due to a phonological change known as the 'Second Sound Shift' and subsequent loss of /θ/ in G (see Table 1), certain classes of E–G cognates systematically differ in their **initial** consonant, which might be a stop, fricative or affricate.

In our experiment, native G speakers (with high E proficiency) completed a cross-modal lexical decision task in E, hearing a CV fragment prime (e.g. [θɔː]) before seeing a visual target. Their task was to identify whether or not the target was an E word. Reaction times and brain activity were recorded. We entertained the hypothesis that lexical access is not language-selective and fragments may thus *not only* activate the relevant E word, *but also* its G cognate (recall that word-initial sounds are critical in word recognition). Our predictions are given in Table 2. We expected near-identical G cognates to compete and thus *hinder* the activation of the E word (cf. [1]); furthermore, depending on whether the feature specification of the initial consonant of the corresponding cognate **matches**, ***mis*matches** or is tolerated (**no-mismatch**), lexical activation of the target might be inhibited or facilitated.

The results support our predictions. First, the priming effect was affected by condition, with 'identical' cognates having the **slowest** reaction time (and thus smallest priming effect): competing cognate forms were activated and hindered access. However, the features of the initial consonant were crucial. Although the identity condition was significantly slower than all others, the non-mismatching cognates (e.g. *thorn*) also had significantly slower reaction times than the non-existent condition (where there was no competition and access was facilitated). This was not true of the mismatching condition (which showed no activation of an L1 competitor, behaving as though no cognate existed). Results are summarised in Table 3.

Of particular interest was the 'N400' ERP component, which reflects ease of lexical access (more attenuated with greater facilitation). We expected fragments to activate and prime targets, but that interference from competing L1 cognates would lead to an increased reaction time and less-attenuated N400. **Most strikingly, the N400 was only significantly attenuated for the mismatching and non-existent conditions.** These words were therefore easier to access than the other conditions (where the competing L1 cognate *was* activated, leading to competition and inhibition).

	Proto-Germanic	English		German	
/p/ → /p͡f/	p	p	[pɑːθ] *path*	p͡f	[p͡faːt] *Pfad*
/t/ → /t͡s/	t	t	[tɪn] *tin*	t͡s	[t͡sɪn] *Zinn*
/θ/ → /d/	θ	θ	[θɪk] *thick*	d	[dɪk] *dick*
—	f	f	[fɪʃ] *fish*	f	[fɪʃ] *Fisch*
—	m	m	[maʊ̯s] *mouse*	m	[maʊ̯s] *Maus*

Table 1: Summary of the effects of the Second Sound Shift and subsequent loss of /θ/ on initial consonants in German

	English	Extracted features	German cognate feature representation	Feature matching	Activation effect
(i) identical	***m**ild*	[NASAL]	[NASAL]	MATCH	Activated: competition (+)
(ii) tolerated	***th**ick*	[CONTINUANT]	*UNDERSPECIFIED* [PLOSIVE]	NO-MISMATCH	Activated: competition
(iii) mismatching	***t**in*	[PLOSIVE]	[STRIDENT]	MISMATCH	Not activated: no competition
(iv) non-existent	***p**ig*	[PLOSIVE]	—	—	Not activated: no competition

Table 2: Predicted activation effect of the G cognate, depending on whether the initial consonant's feature specification is a match, mismatch or no-mismatch for those accessed from the E; [PLOSIVE] is underspecified and thus not stored in the lexical representation (but is present in the signal, cf. [2]).

	English	German	Priming Effect	N400
(i) identical	*fish, mild*	*Fisch, mild*	21.3ms	—
(ii) tolerated	*thorn, thick*	*Dorn, dick*	42.3ms	—
(iii) mismatching	*path, tin*	*Pfad, Zinn*	50.7ms	attenuated
(iv) non-existent	*pig, thug*	N/A	57.1ms	attenuated

Table 3: Summary of experimental results

[1] Fritz, I., Lahiri, A. & Kotzor, S. 2023. Shared Loanword Recognition in German–English Bilinguals: The Role of Metrical Phonology. *Journal of Cognitive Neuroscience* 35(12), 2028–2048. doi: https://doi-org.ezproxy-prd.bodleian.ox.ac.uk/10.1162/jocn_a_02063

[2] Lahiri, A. & Reetz, H. 2010. Distinctive features: Phonological underspecification in representation and processing. *Journal of Phonetics* 38: 44–59.