
Translation-based Lexicalization Generation and Lexical Gap Detection: Application to Kinship Terms

Senyu Li, Bradley Hauer, Ning Shi, Grzegorz Kondrak

Alberta Machine Intelligence Institute, Dept of Computing Science
University of Alberta, Edmonton, Canada



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An Error Case: Google Translate

- 堂哥 “elder **son** of father’s brother” => "cousin"
- 堂姐 “elder **daughter** of father’s brother” => "cousin"
- Other powerful translators make similar errors. (DeepL, Baidu, etc.)

Detect language English Chinese (Simplified) ↕ Chinese (Simplified) English Spanish ↕

我有一个堂哥，但是没有堂姐。 ×

Wǒ yǒu yīgè táng gē, dànshì méiyǒu táng jiě.

14 / 5,000 拼

I have a cousin, but no cousin. ☆

14 / 5,000

*Google Translate, February 15, 2024.

Sample Output of ChatGPT



You

Given a word that means [father's younger brother] in Chinese is [叔叔], and a word that means [mother's brother] in Chinese is [舅舅]. Is there a word that means [elder brother] in [English]? If yes, give me that word. If no, say no.



ChatGPT

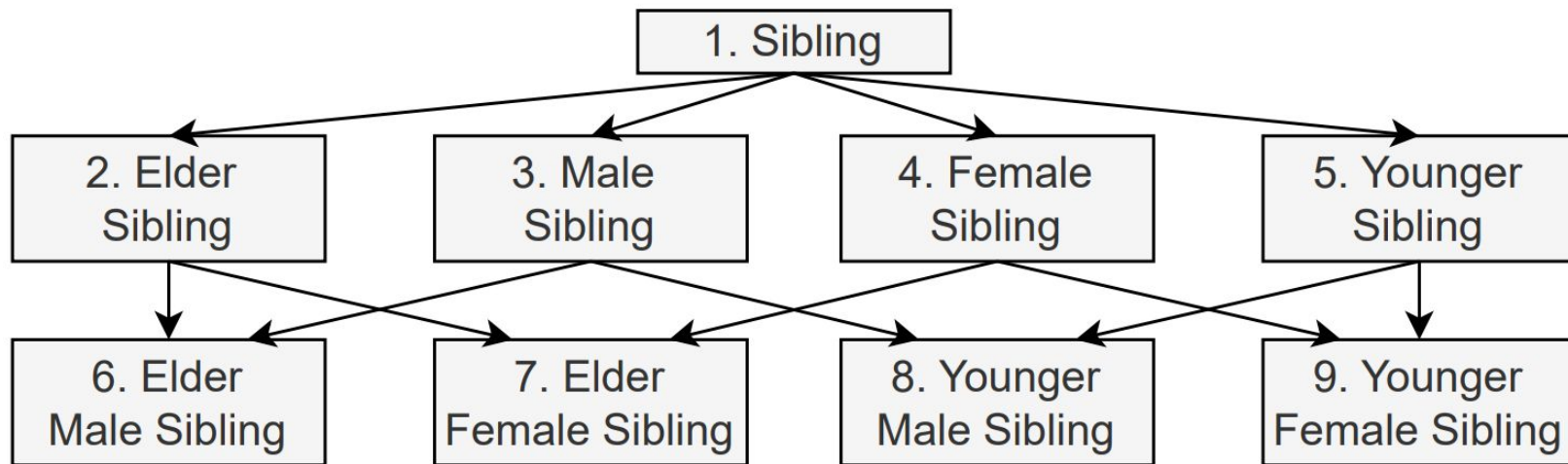
Yes, the word in English that means "elder brother" is "brother."

Outline

- **Problem:** How to identify concept lexicalizations and lexical gaps efficiently?
 - **Idea:** If a concept is an exclusive disjunction of its hyponym concepts then all three concepts should have different lexicalizations.
 - **Method:** Generate a candidate lexicalization for each concept by translating an unambiguous lexicalization into the target language in the context of the concept gloss. Then filter out incorrect translations using the above idea.
 - **Results:** Empirical evaluations demonstrate that our approach yields higher accuracy than BabelNet and ChatGPT.
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Concepts

- **Concept: discrete word meaning**
- Kinship concepts have clear definitions and hierarchical structure
 - Well-studied, good gold-standard dataset (Khishigsuren et al, 2022)



Lexicalizations and Lexical Gaps

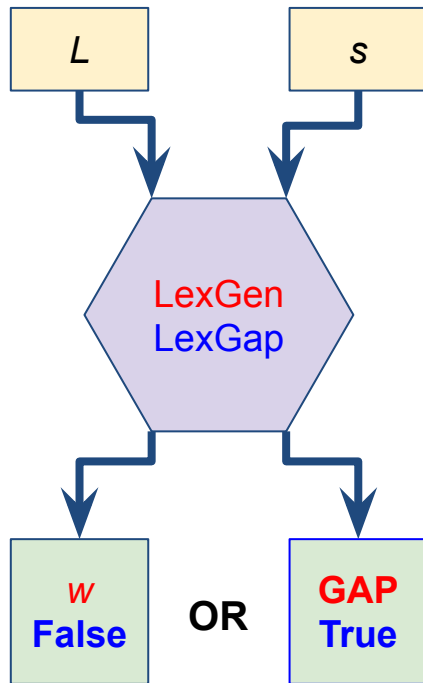
- **Lexicalization:** a single word which can express (i.e. lexicalize) a concept.
- **Lexical Gap:** a concept that has no lexicalization in a given language.

Concepts	En	Es	Fr	Ja	Fa	Zh	Pl
1	Sibling	∅	fratrie	∅	∅	同胞	∅
2	∅	∅	∅	∅	∅	∅	∅
3	Brother	hermano	frère	∅	برادر	兄弟	brat
4	Sister	hermana	sœur	∅	خواهر	姐妹	siostra
5	∅	∅	∅	∅	∅	∅	∅
6	∅	∅	∅	兄さん	∅	哥哥	∅
7	∅	∅	∅	姉ちゃん	∅	姐姐	∅
8	∅	tato	∅	おとうと	∅	弟弟	∅
9	∅	∅	∅	いもうと	∅	妹妹	∅

Data from *Using Linguistic Typology to Enrich Multilingual Lexicons: the Case of Lexical Gaps in Kinship* (Khishigsuren et al, 2022)

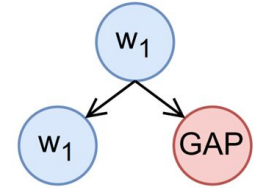
Task definition: LexGen and LexGap

- **LexGen:** Lexicalization Generation
 - Input: language L , concept s
 - Output: word w in L s.t. w lexicalizes s ,
OR a special token **GAP** indicating that no such w exists
- **LexGap:** Lexical Gap Detection
 - Input: language L , concept s
 - Output: **True** if no word in L lexicalizes s ,
False otherwise.
- $\text{LexGen}(L,s) = \mathbf{GAP}$
if and only if
 $\text{LexGap}(L,s) = \mathbf{True}$



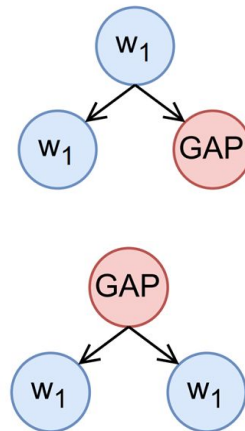
Theoretical Basis

- **Proposition 1:** If a concept P is an exclusive disjunction of its hyponym concepts $C1$ and $C2$, expressing P and $C1$ with the same word w can result in a colloquial contradiction.



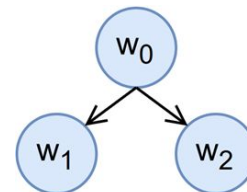
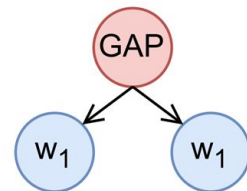
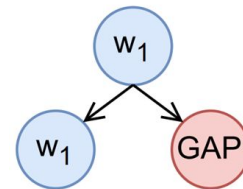
Theoretical Basis

- **Proposition 1:** If a concept P is an exclusive disjunction of its hyponym concepts $C1$ and $C2$, expressing P and $C1$ with the same word w can result in a colloquial contradiction.
- **Proposition 2:** If a concept P is an exclusive disjunction of its hyponym concepts $C1$ and $C2$, expressing $C1$ and $C2$ with the same word w can result in a colloquial contradiction.



Theoretical Basis

- **Proposition 1:** If a concept P is an exclusive disjunction of its hyponym concepts $C1$ and $C2$, expressing P and $C1$ with the same word w can result in a colloquial contradiction.
- **Proposition 2:** If a concept P is an exclusive disjunction of its hyponym concepts $C1$ and $C2$, expressing $C1$ and $C2$ with the same word w can result in a colloquial contradiction.
- **Corollary:** If a concept P is an exclusive disjunction of its hyponyms $C1$ and $C2$ then all their lexicalizations should be different.



Our Method

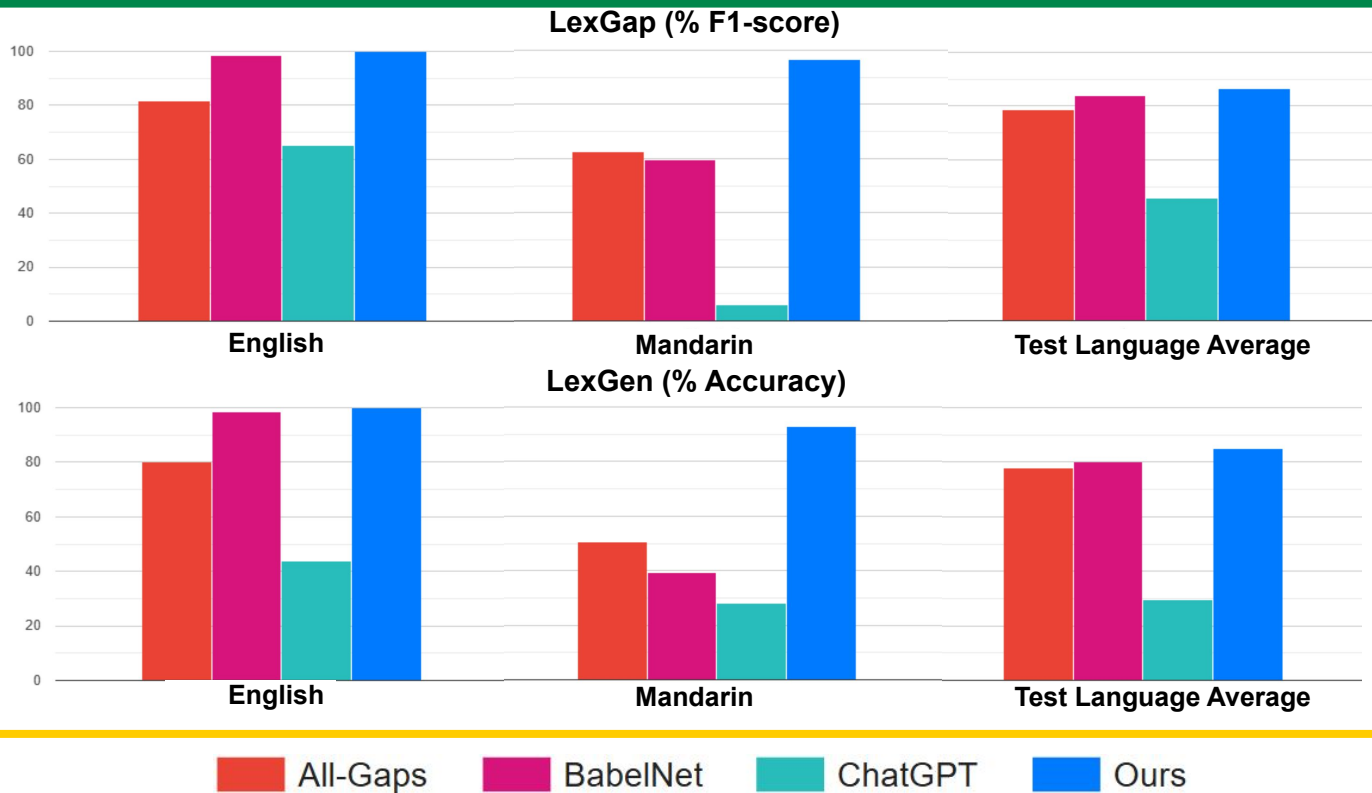
- **Generate** a candidate lexicalization w for each concept by **translating a seed word**.
- **Filter** using our four-step procedure:
 1. **Multi-word filter**: If w is not a single word (e.g. "male cousin"), **return GAP**
 2. **Horizontal filter (Proposition 2)**: If w was also generated for a sibling node of s , **return GAP**
 3. **Back-translation filter**: If back-translating w does not recover the seed word, **return GAP**
 4. **Vertical filter (Proposition 1)**: If w was also generated for a parent node of s , **and** another child of that parent node has already been tagged as a **GAP**, then **return GAP**
- If w makes it past the filters, return w for LexGen, **False** for LexGap

Experimental Setup

- **Data:** *Database of Lexical Diversity in Kinship* by Khishigsuren et al. (2022)
- **Translator:** Google Translate
- **Metrics:** Accuracy for LexGen, F1 score for LexGap
- **Comparison:** All-Gaps, BabelNet 5.1, and ChatGPT w/ GPT-3.5 Turbo
- **Languages**
 - Development languages: English, Mandarin, and Persian.
 - Test languages: Spanish, Russian, French, German, Polish, Arabic, Italian, Mongolian, Hungarian, and Hindi.

*GPT-3.5 Turbo and Google Translate were accessed on February 15, 2024

Results



Conclusion

- Novel translate-and-filter method for:
 - Generating **lexicalizations**
 - Detecting **lexical gaps**
- Grounded in linguistic theory, with clear definitions and and propositions
- Leverages translation and hypernym/hyponym relations
- Future work: Beyond kinship to other domains

github.com/UAlberta-NLP/KinshipAutoLex
