Automatic Generation of Distractors for Fill-in-the-Blank Exercises with Round-Trip Neural Machine Translation

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Task and Motivation

> **Carrier sentence**
> *Are these old plates of _____*
> *importance or can I put them into storage?*
> **Target word:** *vital*
> **Valid distractors:** *main, urgent, lively*
> **Invalid distractors:** *great, utmost*

❑ Given a <u>sentence</u> and <u>target word</u>, generate challenging **distractors.**

❑ A challenging distractor is a word that is semantically similar to the target but does not make the sentence valid.

❑ Distractors are created manually by language experts, which is time consuming and expensive.
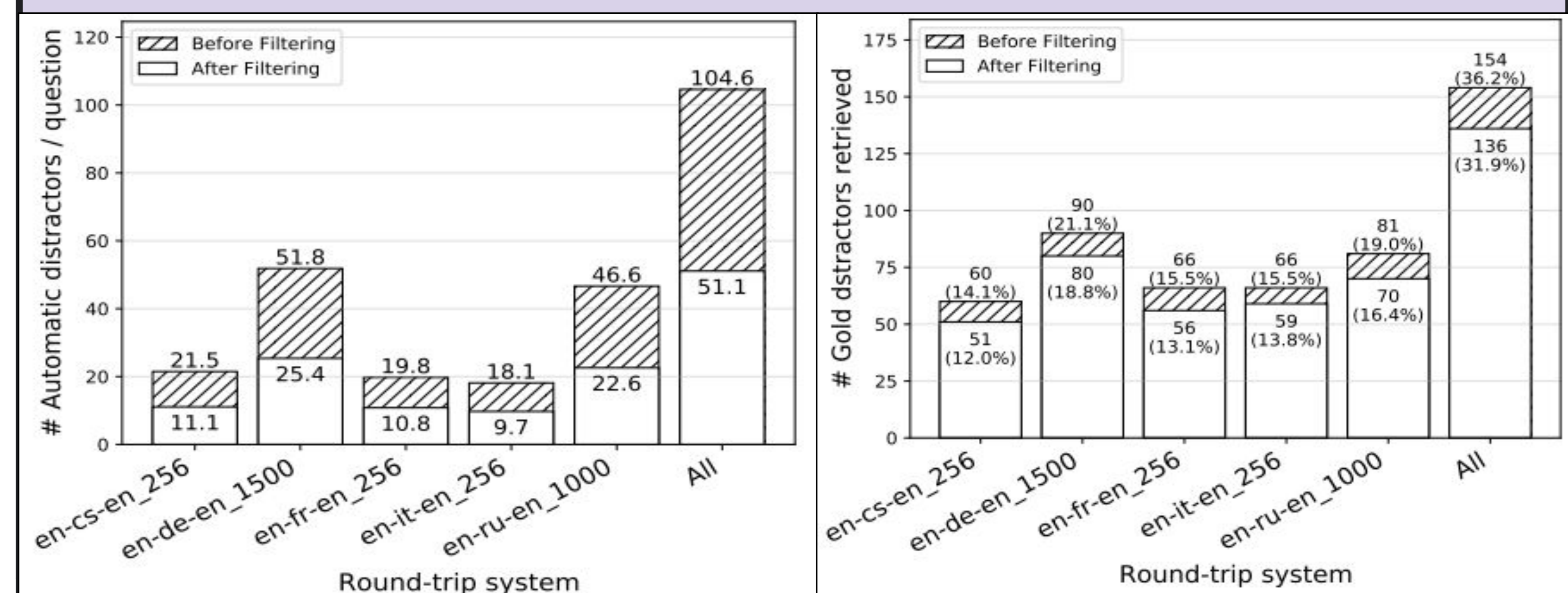
Approach

❑ We use **round-trip neural machine translation** (NMT) to generate a diverse set of distractors.

❑ **Intuition:** Lexical confusions, common among English learners, will manifest in round-trip NMT as back-translated words that are semantically close to the target.

❑ We use 5 language pairs to generate translations: Czech, German, French, Italian and Russian.

Contributions

❑ We propose a novel round-trip NMT method to generate challenging distractors.

❑ Using diverse language pairs yield diverse/challenging distractors.

❑ Comparison with state-of-the-art methods (Word2Vec, BERT) shows our approach is superior.

Evaluation

❑ Left: Average number of automatic distractors generated per sentence.

❑ Right: Union of all languages retrieves 31.9% of all gold distractors.

❑ Union of all languages produces more distractors than individual language systems, thereby demonstrating that **each language system contributes unique distractors.**

State-of-the-Art Comparison

❑ **Round-trip NMT** generates more difficult and semantically close candidate distractors compared to state-of-the-art NLP approaches.

Sentence: Police told everyone to stay at home until the ____ of thieves had been captured.
Target Word: band
Top-5 Word2Vec Distractors: keyboardist, vocalist, drummer, quintet, guitarist
Top-5 BERT Distractors: recommendations, assertions, observations, results, conclusions
Round-trip NMT Distractors: crew, group, orchestra, gang, squad

❑ **Manual Evaluation:** Our approach produces significantly more valid distractors compared to state-of-the-art methods, Word2vec and BERT.

Method	% of valid distractors			
	Rater 1	Rater 2	Rater 3	Avg.
MT-no-ranking	**67.9**	**73.5**	**75.4**	**72.3**
Word2vec	57.2	48.7	62.4	56.1
BERT	22.7	46.3	45.1	38.0
MT with re-ranking (Word2vec)	50.4	47.1	52.1	49.9
MT with re-ranking (BERT)	27.7	41.8	55.4	41.6