

ChatGPT Meets the Constructicon

ChatGPT and similar new AI text generators have the potential to change our lives dramatically. The need for more knowledge about this societal challenge is acute. Linguistics has a lot to offer, and UiT is the perfect place to carry out this research, since the CLEAR group has developed the largest collection of linguistic constructions in the world. Our research question is: to what extent does ChatGPT tackle linguistic constructions? The proposed research will produce new insights about AI text generators and has implications for how we can cope with them in our daily lives. The research project also generates new knowledge about constructions with implications for the teaching of foreign languages.

1. Proposed research

AI text generators such as ChatGPT open up a plethora of theoretical, practical, and pedagogical questions, some of which will be addressed by this PhD project. Preliminary investigations show that ChatGPT is quite good at understanding linguistic constructions where the meaning is more than what could be predicted from the parts, what we call non-compositionality. We see a non-compositional construction in: *Inflation is by and large hard to control*. The meaning 'in general, overall' cannot be predicted by the combination of the words *by*, *and*, and *large*. ChatGPT, by contrast, seems to be fairly clumsy with interpreting constructions that involve social situations like hints, jokes, and insults. This is also known as pragmatic inference. As detailed below, we intend to probe the boundary between the types of constructions where ChatGPT is highly competent and the types of constructions where it fails. In this way we can learn more about theoretical modeling of language and how second language learning can benefit from using AI text generators for the construction types it handles well, while targeting other kinds of instruction for constructions that AI text generators cannot (yet) interpret adequately.

Theoretical linguistics

Construction Grammar (Goldberg 1995 & 2006, Fried & Östman 2004, Fillmore 2012) claims that the essential structures of language are form-function pairings, which are observed at all levels of complexity from morphemes to lexemes and multi-word expressions. While morphemes are usually described in grammars, and lexemes can be found in dictionaries, multi-word constructions are relatively under-described, and more crucially, such constructions are often non-compositional. In other words, constructions are not merely aggregates of smaller components, because their meaning is not transparent, often layered with metaphor and metonymy. For example, Russian has the construction VP *pod* NP-Acc, as in *Ona tancevala pod muzyku* [literally: She danced toward the underside of music], equivalent to English *She danced to the music*. Both the Russian and the English constructions are non-compositional since their meaning cannot be read off from their components. And both constructions are metaphorical since music doesn't have an underside as presumed in Russian, nor is it a destination as presumed in English. The use of the directional prepositions Russian *pod* 'toward under' vs. English *to* is somewhat arbitrary. Multi-word constructions frequently additionally entail pragmatic inferences, such as Russian VP *za glaza*, as in *Ivan za glaza nazyvaet Veru glupoj* [literally: Ivan toward a place behind eyes calls Vera stupid], meaning 'Ivan calls Vera stupid behind her back.' In addition to its non-compositional meaning, this construction entails intentional exclusion of Vera from a situation. The pragmatic inference is that Ivan is doing something that he doesn't

share with Vera. Furthermore, constructions comprise an integrated system, termed a “constructicon”, in which constructions influence each other and present challenges for linguistic description (Endresen and Janda 2020). AI text generators create a possible alternative model both of constructions and of the overall constructicon of a language.

Practical issues

The primary task of the Large Language Models (LLMs) that facilitate text generation in applications like ChatGPT is prediction of the next word (or “word piece”) in a text (cf. Mahowald et al. 2023: 7). LLM next word prediction is based on training with billions of words. This is essentially a “lego model” that breaks language down into component parts. In other words, ChatGPT is at its heart compositional. We would therefore expect it to fail when confronted with multi-word constructions like those described above. Remarkably, ChatGPT performs well with many multi-word constructions, at least for languages like English and Russian with large amounts of data. ChatGPT’s performance is apparently enhanced by parallel layering of training data, meaning that the process is not strictly linear (Vaswani et al. 2017). However, ChatGPT can be stumped by constructions that entail pragmatic inference. When fed the example of Ivan and Vera above, ChatGPT does not understand that Ivan has prevented Vera from receiving his message and assumes instead that Vera is feeling hurt about hearing Ivan’s insult. ChatGPT clearly has limitations, but the dimensions of these limitations are unknown. A thorough probe of ChatGPT and similar AI text generators is needed to determine where exactly they succeed and fail. The limits of AI text generators are probably not random. These limits are likely motivated by patterns in the structures and systems of constructions, and investigation of these limits will also reveal more about how constructions work in language, as well as about how to overcome such limitations. Furthermore, by identifying patterns of limitations, we can contribute to ongoing improvements in AI text generation.

Pedagogical applications

Mastery of constructions is a major stumbling block for second language learners, who must tackle thousands of non-transparent multi-word structures that differ from those of their first language in arbitrary ways. The situation for language learners is very different from AI machine learning, since human beings do not have access to billions of training tokens and virtually unlimited memory. However, human learners face some similar challenges, both in making sense of metaphoric and metonymic associations and in interpreting pragmatic implications. The more we learn about the systems of constructions, the more we can strategically target language teaching to maximize achievement. We can make use of the constructions that AI text generators are adept at to provide individualized interactive practice sessions for learners. Identification of the constructions that ChatGPT fails to understand will make it possible to optimize language instruction: ChatGPT can provide virtually unlimited opportunities for practice with the types of constructions that it handles well, and the constructions that ChatGPT cannot interpret can be strategically targeted in other resources for language learning and practice.

Why UiT is the best place to undertake this research

The CLEAR group at UiT (together with partners at HSE Moscow) has developed the largest digital resource of constructions for any language of the world, namely the Russian Constructicon (<https://constructicon.github.io/russian/>), with over 2200 multi-word

constructions. Our Russian Constructicon resource has numerous features that will prove especially valuable in the research described above, such as definitions of meanings, corpus examples of usage, tagging that models the relationships among constructions, and rating of constructions according to CEFR (Common European Framework of Reference) language proficiency levels. For example, the CEFR levels reflect the complexity of constructions in terms of how arbitrary and non-transparent they are, as well as the need to make sense of pragmatic inference. We are currently developing parallel constructicon resources for other languages, namely Ukrainian and Persian. UiT therefore already has the most sophisticated constructicon resources that can be pitted against AI generators to address a variety of research questions such as those suggested above. In keeping with ongoing practices in the CLEAR group, all materials and results of this project will be made available open access. UiT's CLEAR group has launched several electronic resources that can be used to leverage this project, among them Construxercise! (an exercise resource that helps learners to achieve native-like fluency for a set of common Russian constructions; <https://constructicon.github.io/construxercise-rus/>) and the SMARTool (a resource that implements findings of a learning simulation experiment and corpus research to optimize the acquisition of Russian vocabulary and morphology; <https://smartool.github.io/smartool-rus-eng/>), as well as several textbooks, a digital introductory language course, and other pedagogical materials.

2. Strategic anchoring / Strategisk forankring

This project aligns with the following UiT strategic documents as detailed below:

- *Eallju – Drivkraft i nord* UiTs strategi mot 2030: This project addresses the major societal challenge posed by the advent of AI text generators. Furthermore, this project focuses on Russian, Ukrainian, and Persian, three languages most relevant to current geopolitical challenges (note that Iran is contributing military assistance to Russia).
- *Strategi for HSL 2018-2022*: This project involves active research addressing global societal challenges, foregrounds the relationship between linguistic research and language teaching, contributes to the creation of additional digital learning resources.
- *Strategi for ISK 2019-2023*: This project involves implementation of research-based language teaching, and strengthens an existing research group, namely CLEAR (Cognitive Linguistics: Empirical Approaches to Russian).

3. Anchoring in a research group / Forankring i fagmiljø

This project is anchored in the CLEAR research group at ISK. CLEAR is an internationally leading research group focused on Russian linguistics, construction grammar, research-based pedagogical applications, corpus linguistics, and linguistic analysis of hybrid threats. CLEAR is an active, visible research group with an excellent track record, including over 1200 research results registered in Cristin. The CLEAR group has received external funding for numerous multi-year projects from HK-Dir, NFR, and CAS (Centre for Advanced Study in Oslo).

4. Quality of proposal / Kvalitet på søknaden

This project builds on several projects that have recently received external evaluations and funding, in particular grant number 300002 from the Norwegian Research Council (NFR),

and grant numbers CPRU-2017/10027 and UTF-2020/10129 from Direktoratet for internasjonalisering og kvalitetsutvikling i høgare utdanning (HK-Dir).

5. Completion of PhDs / Gjennomstrømmingsevne (navn fullførte dr.gradskand.)

All PhD students connected to CLEAR have completed their degrees within the standard time period:

Nordrum, Maria. 2020

Reynolds, Robert J. 2016

Endresen, Anna. 2015

Makarova, Anastasiia. 2014

Kuznetsova, Julia. 2013

Sokolova, Svetlana. 2012

6. Basis for recruitment / Rekrutteringsgrunnlag

This project can recruit candidates both within Norway and globally. We will recruit candidates with a background in Cognitive Linguistics who have excellent proficiency in Russian and English. Knowledge of computational linguistics and/or computer science and of another relevant language can also be relevant to the project. We additionally know of possible candidates who have been displaced by the war in Ukraine. The project can therefore contribute to supporting researchers affected by the war.

7. Future plans and ambitions / Fremtidsplaner og ambisjoner

Engaging with ChatGPT in this project is a steppingstone to broader engagement with AI in the future research of the CLEAR group. We have already begun exploring possible collaborations in this direction with colleagues at Princeton University. This project may lead to further externally funded projects based on international collaboration.

8. Potential supervisors / Forslag til kvalifiserte veileder(e)

prof. Tore Nasset

prof. Laura A. Janda

References

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