IN SEARCH OF THE INVISIBLE

GPT in an Investigation of Hidden Semantic Information

Katarzyna (Kasia) Wiśniewska
PhD (DipTrans IoLET, MITI)
University of Eastern Finland (UEF)
University of Rijeka (UNIRI)
katarzyna.wisniewska@uef.fi

Benedikt Perak
DR.SC.
University of Rijeka (UNIRI)
bperak@uniri.hr

Digital Research Data and Human Sciences (DRDHum)
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Presentation Agenda

- Introduction
- Theoretical Background
- Methods Overview
- Preliminary Findings
- Key Implications

Introduction

Artificial Intelligence in Natural Language Processing

- **The Role of Artificial Intelligence (AI) in Language Processing**
  - Fluency of Large Language Models (LLMs) in language comprehension
  - Revolution in Natural Language Processing (NLP) due to high proficiency in tasks such as translation and text generation
- **LLMs in Action**
  - Understand and generate text across languages
  - Handle complex linguistic information

Introduction

Existing Literature

Research Gap

- **Neural Machine Translation (MT) Models versus Generative Pre-trained (GPT) 4o**
  - GPT models showcasing advancements in fluency and comprehension
  - Challenges observed in earlier neural machine translation (MT) models (Koehn & Knowles, 2017; Wan et al., 2022)
  - Issues in text-generation models (Wang et al., 2023)
  - Recent advancements in NLP (Perak et al., 2024; Riemenschneider & Frank, 2023) and human-like translation strategies (He et al., 2024)
- **Challenges and Opportunities**
  - While LLMs like GPT-4o exhibit impressive capabilities, challenges remain in capturing semantic nuances
  - Exploring LLMs' performance in uncovering causal relationships

Theoretical Background

Cognitive Semantics and Force Dynamics

- **Key Theoretical Framework:** Utilised Leonard Talmy's (2000) schematic system of **Force Dynamics** to assess retention of cognitive information during translation
- **Retention of Force Dynamics in Translation:** Drawing on recent research (Wiśniewska, 2022 & 2023) that highlights how Force Dynamics is largely preserved during translation, even when there are significant linguistic differences
    - How is the meaning of physical or mental force in verbal expressions describing motion or action **constructed**, **conveyed** and **understood** across languages?

Theoretical Background

Cognitive Structure of Force Dynamics

*The **ball** **kept rolling** down the hill.*

Agonist: The ball (the entity that is actively rolling and trying to overcome resistance)

Antagonist: In this sentence, an unknown force (such as friction or an obstacle) that resists the ball's motion.

*The **ball** **kept rolling** down the hill* (despite the tall **grass**).

Action: Indicates the ongoing effort of the ball to move despie resistance.

Theoretical Background

Force Dynamics in Translation

English: The river ice (Agonist) **gave way** to flowing water (Antagonist).

Finnish: Joen jäät (Agonist) **väistyivät** virtaavan veden (Antagonist) **tieltä**.

The river's ice withdrew from the path of the flowing water.

Polish: Skute lodem rzeki rozmarzły i znów płynęła w nich woda.

?

The frozen rivers thawed and water flowed in them again.

Methods Overview

Material Selection

GPT System Prompt

INPUT MATERIAL:

- **10 English sentences** (novel/film dialogue)
- Original translations of the sentences (translated novel/subtitles) into **Finnish** and **Polish**
- Translations of the sentences into **Croatian** prepared by the research team
- **Google translations** of the sentences into **Croatian**, **Finnish**, and **Polish**

SYSTEM PROMPT:

- ✓ You are an **expert linguist** and **translator**.
- ✓ You **know how** to evaluate translations.

Methods Overview

GPT Instruction Prompt

INSTRUCTION PROMPT:

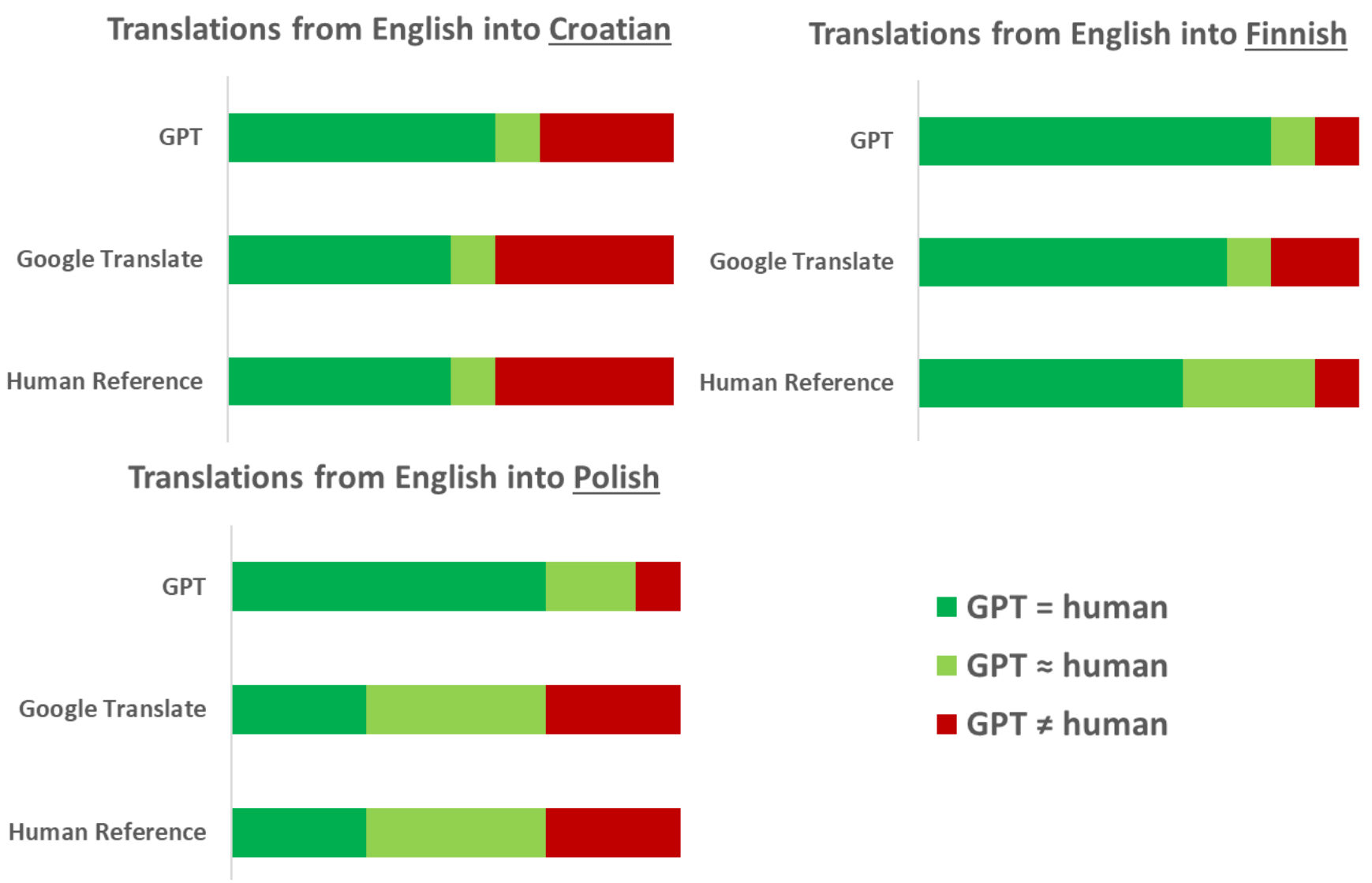
- Provide a translation of a given sentence from **English to Croatian/Finnish/Polish**.
- Describe your translation, as well as the **Google Translate** reference and the **human reference** provided, with an exclusive focus on their **verb phrases**.
- Describe the verb phrases in terms of **lexis**, **syntax**, and **semantics**, and evaluate the quality of the translations of these **verb phrases**.
- When describing the semantics of the verb phrases, consider **Talmy's notion of Force Dynamics**.
- The description of the verb phrase should be **qualitative**, and the evaluation of the verb phrase should be **numerical** as a float from **0 to 1**.

Preliminary Findings

GPT Qualitative Analysis

versus

Human Judgement



Preliminary Findings

Examples

(1) English: He let the greatcoat fall on the ground. **Agonist:** *greatcoat* **Antagonist:** *he*

Finnish (GPT): Hän antoi päällystakin pudota maahan. [He let the coat fall to the ground.]

Semantically, it conveys the same Force Dynamics as the original, where 'he' allows the coat to fall without direct force. **GPT = human**

(2) English: I suppose we should start by reading it. **Agonist:** *we* **Antagonist:** ∅

Polish (Google Translate): Sądzę, że powinniśmy zacząć od przeczytania tego. [I think we should start from reading it.]

Semantically, the phrase conveys a sense of obligation and initiatin of an action. According to Talmy's Force Dynamics, 'powinniśmy' implies a social force compelling the action. **GPT ≈ human**

(3) English: Being at odds with her father about anything at all made her uncomfortable. **Agonist:** *her* **Antagonist:** *being at odds*

Croatian (Human Reference): Bilo joj je neugodno to što je bila u svađi s ocem oko bilo čega. [She was uncomfortable to be in an argument with her father about anything.]

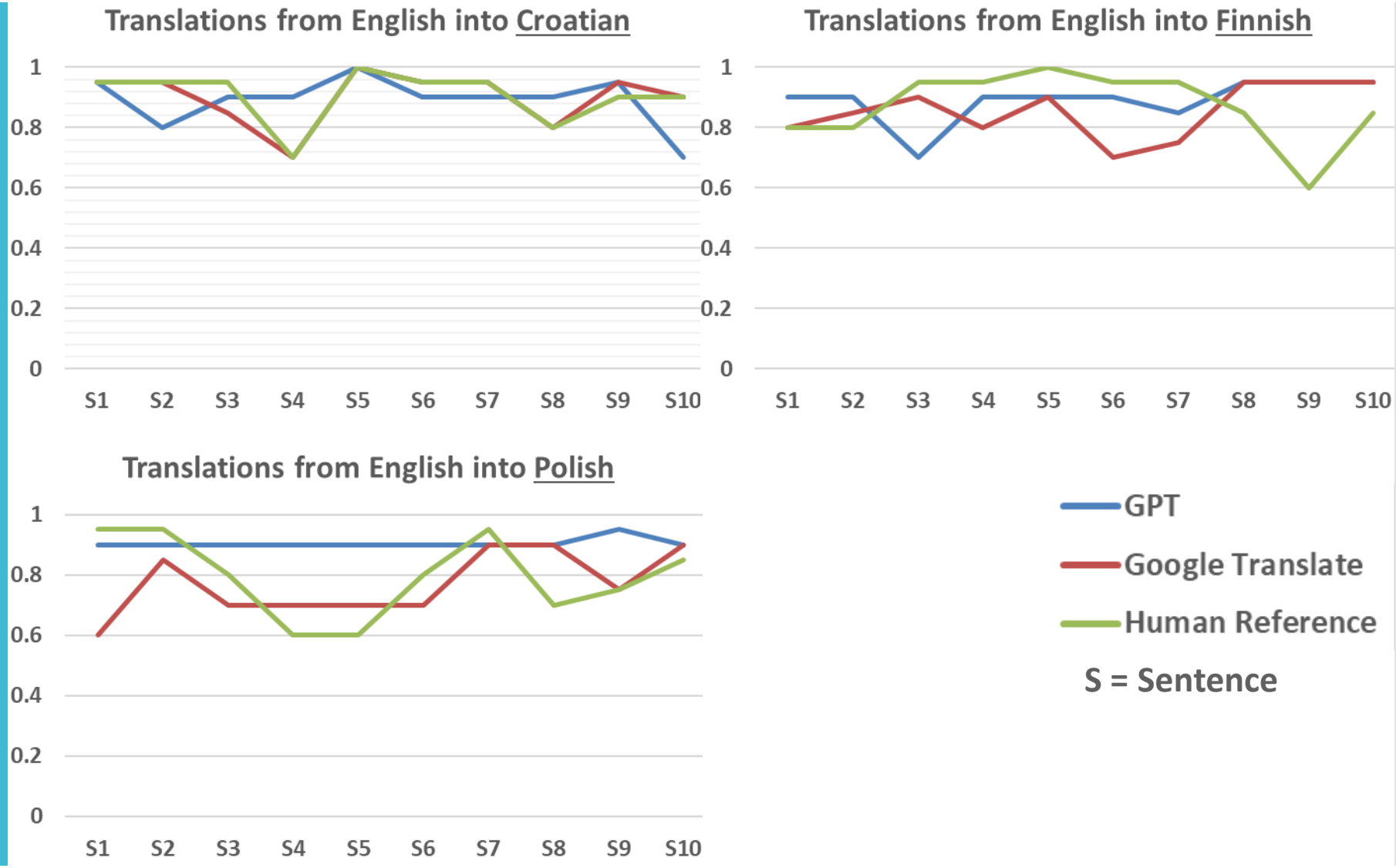
Semantically, it conveys a state of being in disagreement, aligning with Talmy's Force Dynamics as it implies a static oppostion. **GPT ≠ human**

Preliminary Findings

GPT Quantitative Measures

versus

Human Judgement



Preliminary Findings

Examples

ENGLISH → FINNISH	*Perhaps I **should have written** Leon a story.*
GPT/Google Translate: **Score: 0.95**	*Ehkä minun olisi pitänyt kirjoittaa Leonille tarina.* Perhaps I **should have written** a story for Leon.
Human Reference: **Score: 0.6**	*Miksen kirjoittanut Leonille tarinaa?* **Why did I not write** a story for Leon?
ENGLISH → POLISH	*He **let the greatcoat fall** on the ground.*
GPT: **Score: 0.9**	***Pozwolił, aby płaszcz spadł** na ziemię.* He **let the coat fall** to the ground.
Google Translate: **Score: 0.7**	***Upuścił płaszcz** na ziemię.* He **dropped (~let fall) his coat** on the ground.
Human Reference: **Score: 0.6**	***Rzucił** na ziemię **szynel**.* He **threw his greatcoat** on the ground.

Key Implications

Broader Contribution

- Contribution to **AI-Assisted Translation Research**:
  - Exploring capabilities and limitations of **LLMs** in handling **implied semantic information**
  - Examining interactions between **humans** and **AI**
- **Core Insights:**
  - Advancing our understanding of **Translation Studies** in the **NLP-driven digital age**
  - Emphasises the importance of **rigorous methodology** and **thoughtful evaluation metrics** (Alzahrani et al., 2024)

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Discussion and Q&A

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