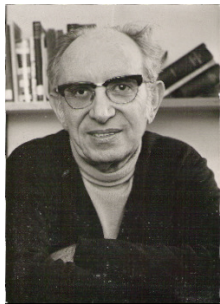


# ***THE PRESENT STATE OF RESEARCH ON MECHANICAL TRANSLATION***

YEHOASHUA BAR-HILLEL\*

[Bar-Hillel 1951]

*For high accuracy ...pure MT has to be  
given up in favor of **mixed MT in**  
**which a human brain intervenes.***



## **mixed-initiative**

describes a discourse in which humans and machine agents  
collaborate to complete some task

# Experimental Design

<b>Task</b>	Translate English Wikipedia to ...
<b>Target Languages</b>	Arabic, French, German
<b>Conditions</b>	Unaided and Post-edit (pe)
<b>Expert Subjects</b>	16 per target language

# Experimental Design

## **Two-way, mixed design**

Translation conditions – within subjects

Source sentences – between subjects

## **Two timed translation sessions**

Condition A / Break / Condition B

Idle timer

About 60 min. per subject

**MT from Google Translate**

[March 2012]

# Design | Unaided UI

Text from a document  
about: **a mathematical  
theory.**

The physicist Arthur Eddington drew on Borel's  
image further in The Nature of the Physical World  
(1928), writing: If I let my fingers wander idly over  
the keys of a typewriter it might happen that my  
screed made an intelligible sentence.



Idle: 00:09 (maximum: 03:00)

Submit

# Design | Post-edit UI

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Si je laisse mes doigts se promener les bras croisés sur  
les touches de la machine à écrire, il peut arriver que  
mon chape fait une phrase intelligible.

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# Research Questions

1. Does post-edit reduce **time**?

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1. Does post-edit reduce **time**?
2. Does post-edit increase **quality**?
3. Do suggestions **prime** the translator?
4. Does post-edit reduce **effort**?

## Analysis | Fixed Effects Fallacies

**Fixed effect** – Data includes all factor levels

Condition (unaided, post-edit)

Gender

# Analysis | Fixed Effects Fallacies

**Fixed effect** – Data includes all factor levels

Condition (unaided, post-edit)

Gender

**Random effect** – sampled levels

Human subjects

Target languages

**Sentences**

*Language as fixed-effect fallacy*

[Clark 1973]

# Analysis | Linear Mixed Effects Models (LMEM)

$$y = \underbrace{x^T \beta}_{\text{Linear predictor}} + \overbrace{z^T b}^{\text{Random effects structure}} + \underbrace{\eta}_{\text{Error term}}$$

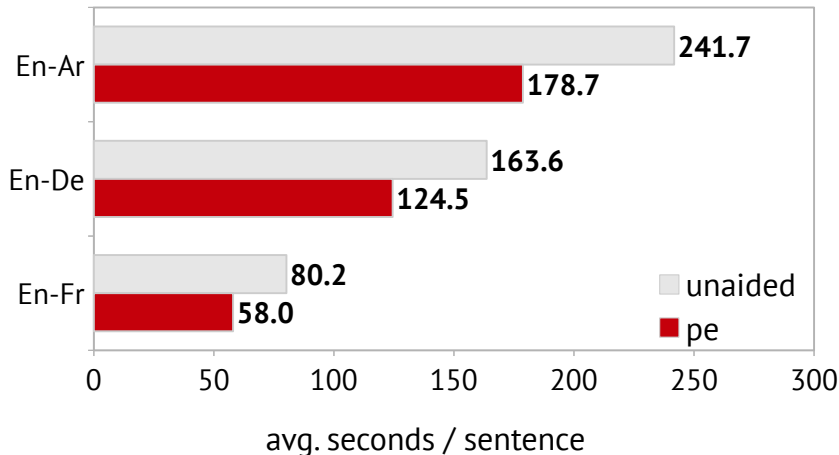
[Laird and Ware 1982]

## Response Variables

Time – per segment

Quality – from pairwise ratings

## Question #1 | Time



**LMEM** – Post-edit reduces time ( $p < 0.001$ )

# Source Hover Patterns Predict Time?

The latter may range from loss of train of thought, to  
sentences only loosely connected in meaning, to  
incoherence known as word salad in severe cases.

- Verbs
- Nouns
- Adjectives
- Adverbs

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- Nouns
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- Adverbs

**Noun %** – significant covariate in time LMEMs



## Question #2 | Quality

LMEM based on **expected wins metric**

[Callison-Burch et al. 2012]

**Intuition** – biased coin flip between two conditions

$$ew(a) = \frac{wins(a, b)}{wins(a, b) + wins(b, a)}$$

$wins(\cdot, \cdot)$  – estimated from pairwise judgments

# Quality | Collecting Pairwise Judgments

3/3

Sentence #132

English → German

Depending on the file, the document into which you want to place the file may need to be opened first. **Scripts listed vary depending on the Creative Suite 4 components you've installed.**

— Source

Je nach Datei muss das Dokument, in das diese eingefügt werden soll, erst geöffnet werden. **Welche Skripte aufgelistet werden, hängt davon ab, welche Creative Suite 4-Komponenten installiert sind.**

— Reference

Best ← Rank 1 ● Rank 2 ● Rank 3 ● Rank 4 ● Rank 5 ● → Worst

**Aufgelistete Stichwörter hängen von den von Ihnen für Creative Suite 4 installierten Komponenten ab.**

— Translation 1

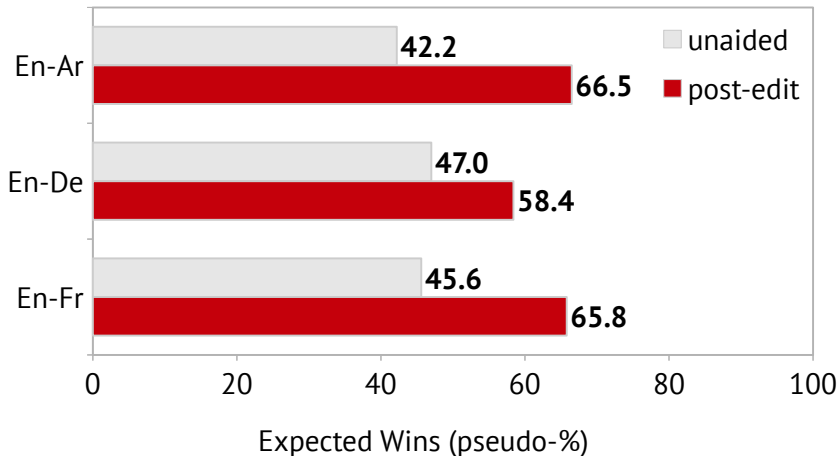
Best ← Rank 1 ● Rank 2 ● Rank 3 ● Rank 4 ● Rank 5 ● → Worst

**Die aufgeführten Skripte variieren je nach den Creative-Suite-4-Komponenten, die Sie installiert haben.**

— Translation 2

[Federmann 2010]

## Question #2 | Quality



**LMEM** – Post-edit increases quality ( $p < 0.001$ )

## Question #3 | Priming

Do suggestions prime the translator?

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Do suggestions prime the translator?

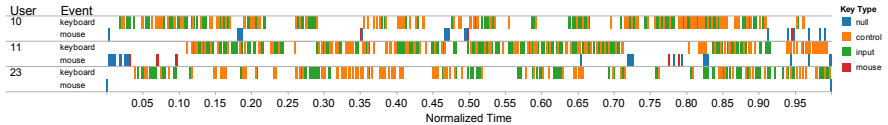
Yes!  $p < 0.001$  for each language

### Test setup

Edit distance to MT

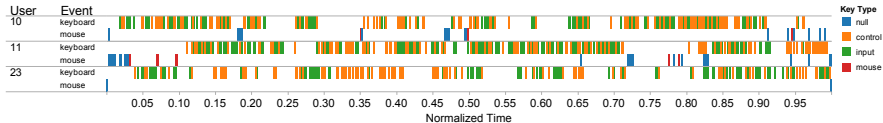
Paired  $t$ -test

## Question #4 | Effort

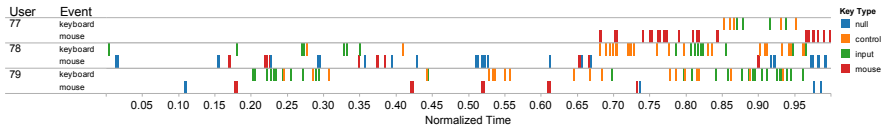


Unaided condition

## Question #4 | Effort



Unaided condition



Post-edit condition