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The impact of intralingual subtitling on memory and comprehension

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LEAD-ME Summer Training School Warsaw 2021 (5-9 July 2021)
Eye tracking in media accessibility research - methods, technologies and data analyses

Introduction & Background

1. We live in an information and audiovisual age.

2. The standardisation needs for different audiovisual translation modalities and the advocated user-centred approach call for more research on this area focusing on users' reception.

3. Previous research:

(1) Subtitling's effects on COMPREHENSION centering on USERS:

SDH (Tamayo, A. & Chaume, F., 2017)

Subtitling speed and the layout of subtitles (Gerber-Morón, O., Soler-Vilageliu, O, & Castella, J., 2021)

As a tool for language learning (Beseghi, M., 2018)

Linguistic complexity (B.Braverman & Hertzog, 1980)

Subtitling versus dubbing (Matamala, A., Perego, E., & Bottiroli, S. 2017; Perego, Del Missier, & Straga, 2018)

Intralingual and interlingual subtitling (Matamala et. al., 2015)

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Introduction & Background

(2) Studies using eye-tracking:

Speech rate and language proficiency on subtitling reading (Szarkowska, A. & Bogucka, L., 2019) (interlingual subtitling)

Children's reception of standard and integrated subtitles (Black, S., 2020)

Subtitling training (Di Giovanni, E., 2020)

4. Research gap: scarcity of studies on reception of intralingual subtitling for TECHNICAL content

Our study: to investigate the impact of intralingual subtitling on memory and comprehension for non-native English speakers

Method

Participants - basic demographic profile:
- 28 survey respondents, 12 participants assessed but some excluded from analysis
- Aged 24-45 (10 participants), data not available (2 participants)
- Female (9 participants), male (3 participants)
- English proficiency (Cambridge General English assessment):
    - Native-like proficiency/C2 (5 participants), non-native proficiency/ B1-C1 (4 participants), data not available (3 participants)

Research materials:
- 25-question English level assessment (Cambridge General English)
- Stimuli: "Bari Olive Oil Mill Operation" video (1:17), Video 1 (without subtitles) and Video 2 (with subtitles)
- Post-video questionnaires to assess:
    - Memory - 4 fill-in-the-blank questions
    - Comprehension - 4 multiple choice questions

Method

Procedure:
- The experiment was performed remotely and online.
- Stimuli preparation: the video length was cut to 1:17 and subtitles were added.
    - AOIs were drawn over the subtitles for Video 2 in RealEye.
    - Five memory and four comprehension questions were devised based on the video script.
- Research design: two separate studies were set up in RealEye (Video 1 without subtitles and Video 2 with subtitles). Participants' access to the studies was randomized.
    - Participants were required to enable webcam access and calibrate the eye tracker prior to proceeding with the study.
    - The first stage of each study consisted of a Cambridge General English test to evaluate participants' English proficiency.
    - Participants were then asked to watch the randomised video and answer a post-video memory and comprehension questionnaire.
- Independent sample t-tests

Method

Eye tracking equipment:
- RealEye.io - webcam-based online eye tracking platform run in a web-browser
- Sampling rate - 15Hz (min) to 32 Hz (max)
- Screen resolution - 1280x720 px (min) to 2752x1152 px (max)
- 40-point calibration on 3 backgrounds (white, black and grey), followed by a 9-point calibration
- User-specific webcam, no data available

Research question & hypotheses

RQ1: Does the presence of intralingual English subtitles improve comprehension and memorisation of a technical video?

H1: Intralingual English subtitling will improve comprehension and memorisation of a technical video for non-native speakers.

RQ2: Is there a significant difference in eye movements (fixation number, total fixation duration, average fixation duration) depending on English L2 proficiency (native-like vs. non native-like)?

H2: English speakers with native-like proficiency will process the subtitles more smoothly and effectively (e.g. making less regressive fixations and therefore less fixations overall)

Study design

- Fixed design
- Experimental
- Mixed design - 2 (native-level/non-native level proficiency groups) x 2 (with/without subtitles)
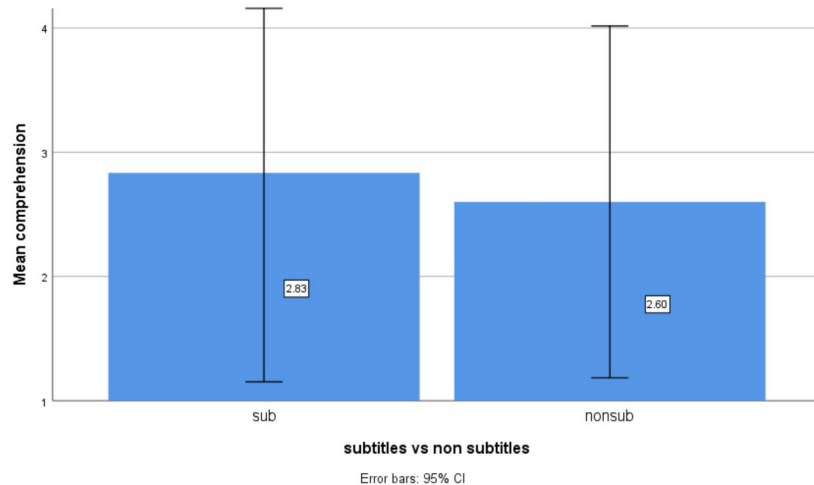
RQ1:
- Independent variables - viewing condition (the presence or absence of subtitles)
- Dependent variables - memory and comprehension scores

RQ2:
- Independent variables - English L2 proficiency
- Dependent variables - eye movements (fixation number, total fixation duration, average fixation duration)
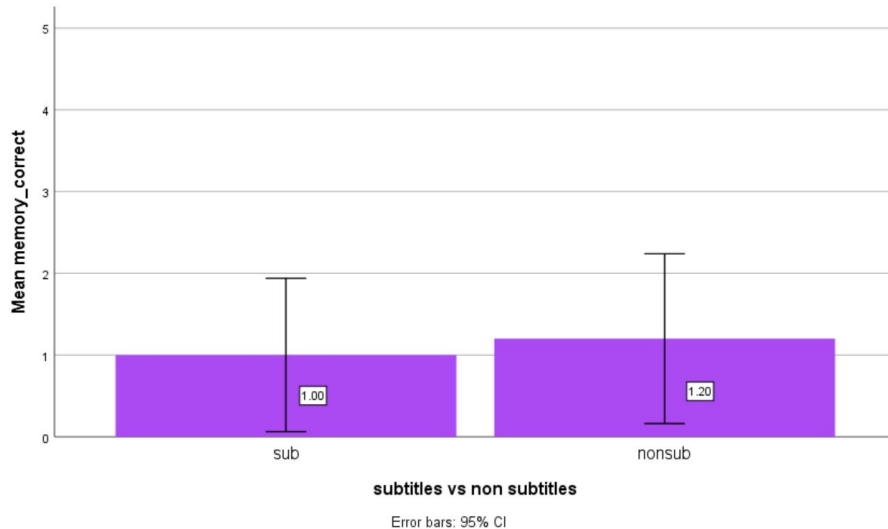
Results - Independent sample t-tests

1. Comprehension test

The t-test results show that there is no significant difference ($t(9) = 0.27$; $p = 0.79$, 95% CI: [-1.706; 2.172]) in **comprehension scores** between the six participants who watched the video with subtitles ($M = 2.68$, $SD = 1.6$) and the five participants in the control group who watched the video without subtitles ($M = 2.6$, $SD = 1.14$).

Results - Independent sample t-tests

2. Memory test

Error bars: 95% CI

The t-test results show that there is no significant difference (*t*(9) = 0.38; *p* = 0.71, 95% CI: [-1.391: 0.991]) in **memory scores** between the six participants who watched the video with subtitles (*M* = 1, *SD* = 0.37) and the five participants in the control group who watched the video without subtitles (*M* = 1.2, *SD* = 0.37).

Results - Independent sample t-tests:

Comprehension test

T-Test

[DataSet1]

Group Statistics

	subtitles vs non subtitles	N	Mean	Std. Deviation	Std. Error Mean
comprehension	sub	6	2.83	1.602	.654
	nonsub	5	2.60	1.140	.510

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
comprehension	Equal variances assumed	.553	.476	.272	9	.792	.233	.857	-1.706	2.172
	Equal variances not assumed			.281	8.842	.785	.233	.829	-1.648	2.115

Results - Independent sample t-tests:

Memory test

➡ **T-Test**

Group Statistics

	subtitles vs non subtitles	N	Mean	Std. Deviation	Std. Error Mean
memory_correct	sub	6	1.00	.894	.365
	nonsub	5	1.20	.837	.374

Independent Samples Test

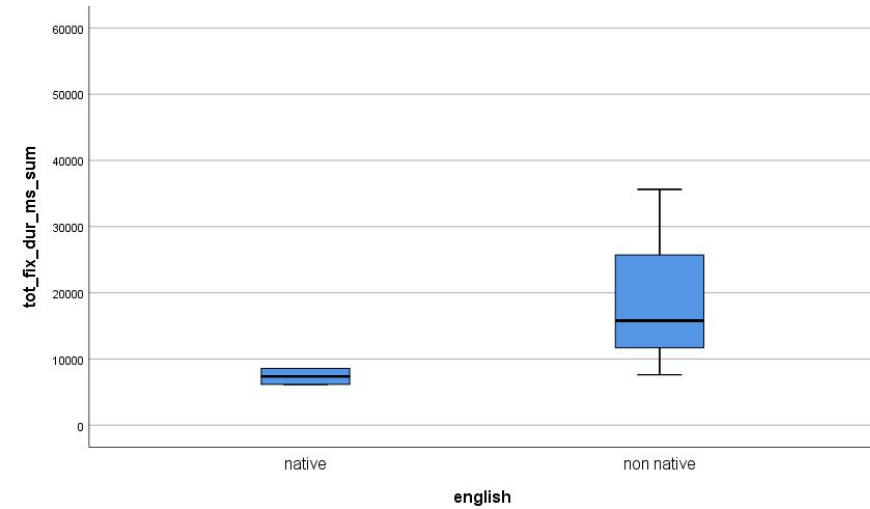|		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
memory_correct	Equal variances assumed	.008	.929	-.380	9	.713	-.200	.526	-1.391	.991
	Equal variances not assumed			-.383	8.836	.711	-.200	.523	-1.386	.986

Results - fixation analysis

Total fixation count
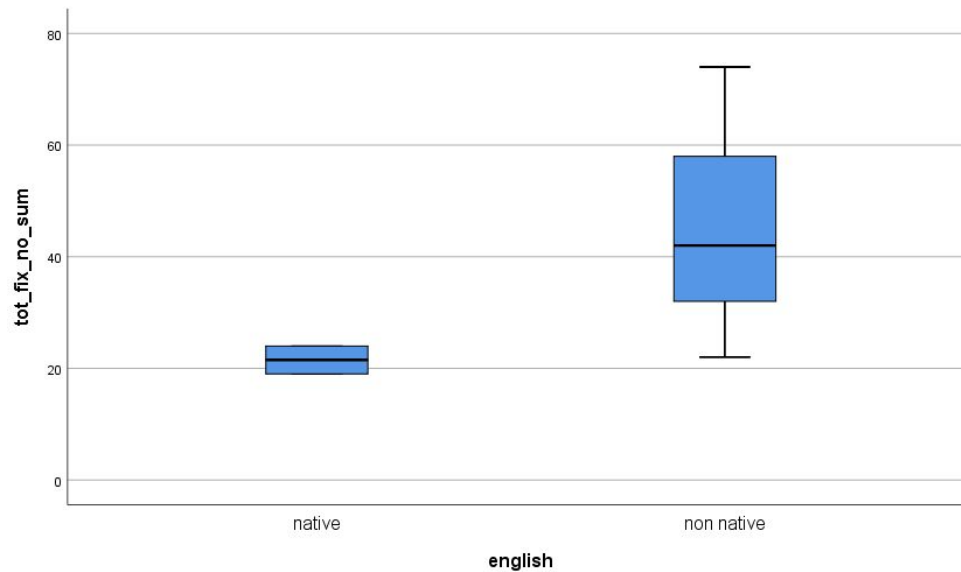
Results - fixation analysis

Total fixation duration

Average fixation duration

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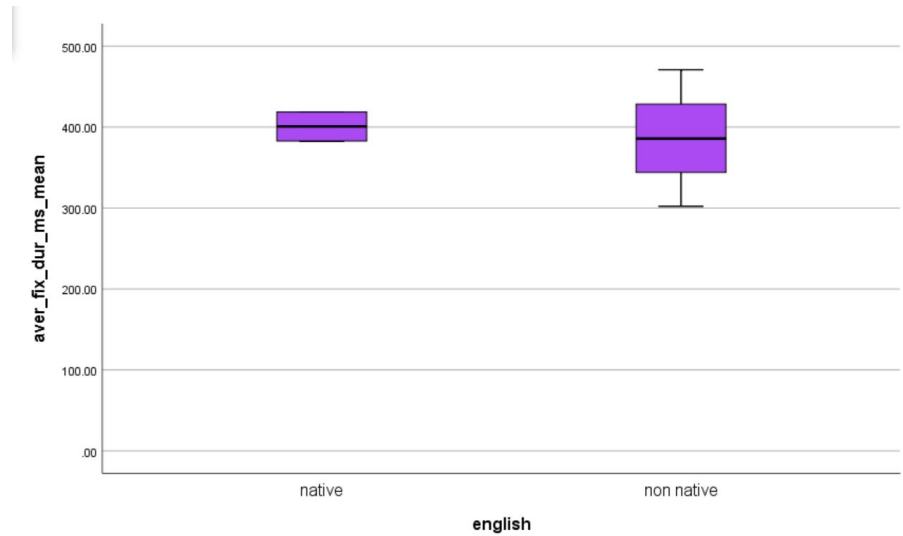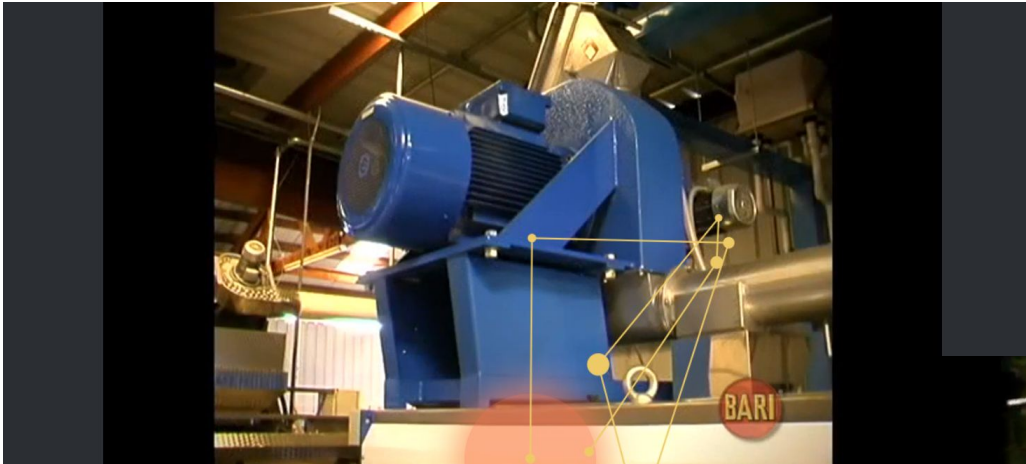
and then pass through a gate,
where they are augered up to the crusher.

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Future work

- Replicating the study with a bigger sample, and possibly with other languages
- Running a statistical power analysis to assess the number of participants required
- Incorporating more fixation data and types into the analysis, e.g. fixation ttff
- Performing the study analysis using more powerful statistical software
- Attempting the study in an another eye tracking tool, e.g. Gazepoint
- Performing a comparative assessment of participants' cognitive load (independent variables)

Limitations

1. The sample for our study was quite small, so the findings cannot be generalised.
2. Due to time limitation, we could not conduct a more thorough analysis of the collected data, having to exclude, for example, other fixation types.
3. Due to time limitations, we did not include a memory test as we planned at first, so that differences in individual memory capacity were not accounted for.
4. The watermark (Clideo.com) overlapped with the subtitles in some instances.
5. The eye tracker used is contingent on the quality of the participants' own hardware / software setup. A controlled testing environment might produce more consistent results. The scan paths often had an offset, which meant some valid fixation data was lost (see screenshot)

Discussion

Please ask away!

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