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# Comparing the reception of machine-generated subtitles to human-created subtitles

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Eye tracking in media accessibility research - methods, technologies and data analyses





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## Introduction & Background

Implementation of raw machine-generated subtitles (MST) | human-created subtitles (HST)

- explosion of web-based video content
- lack of resources: time, money, subtitlers
- quantitative access vs. acceptable lack of quality (guidelines)
- subjective and objective measurements for deeper insights



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## Research question & hypotheses

- RQ1: What are the effects on acceptability?  
H1: MST are sufficient, but need to be improved.
- RQ2: What are the effects on processing of subtitles?  
H2: MST are more cognitively demanding than HST.
- RQ3: What are the effects on user experiences ?  
H3: MST are less enjoyable than HST.



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## Study design

Survey and eye-tracking | insights from comparison on:

- self-reported cognitive load
- subjective quality
- enjoyment
- recall
- assumption of subtitle creation
- fixations



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## Method

- Participants: 26, 8 excluded because of poor data quality
- Research materials: 1 clip, educational video of 1:13 min, 2 subtitle files (MST | HST)
- Qualitative procedure: survey questions
- Quantitative procedure: Eye-tracking
  - ❖ creation of 2 areas of interest (AOIs): subtitle and video areas
  - ❖ number of fixations on subtitle area
  - ❖ Eye-tracking equipment: realeye.io (Version 8.2.13) – web-based



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## Results – Eye Tracking

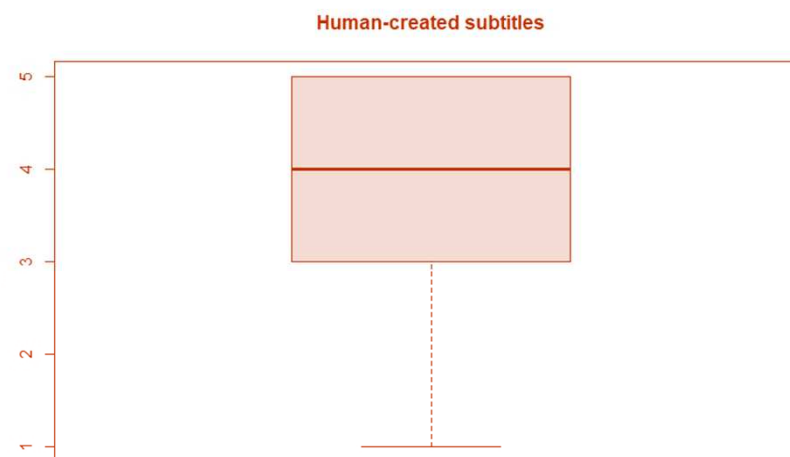
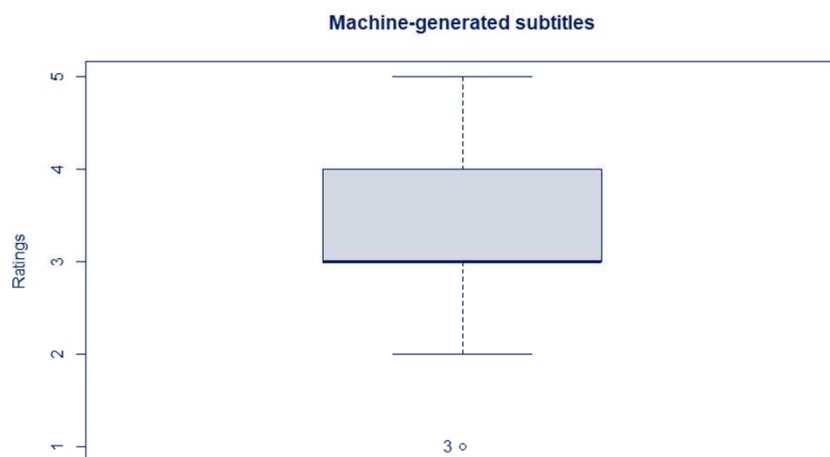
- Results of fixations on subtitling area: 720 (MST) | 781 (HST)
- Results of fixations on the video area: 1451 (MST) | 1451 (HST)
- Eye-tracking results falsified hypothesis 2:  
no significant difference of fixations on subtitles



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## Results – Survey



Enjoyment:  $t(17) = -2.3217$ , **p-value = 0.03293**

## Results – Survey

### Machine-generated subtitles

- Segmentation (52%)
- Grammar and punctuation (35%)
- Format (17.6%)
- No suggestions (11,7%)

Not going word by word, but rather line by line.

### Human-created subtitles (AOI)

- More verbatim (41%)
- Higher rate (11.76%)
- Font (11.76%)
- Segmentation (5%)
- No suggestions (23%)
- Compliments (23%)

As a hearing person, I am always distracted when subtitles are phrased differently than the speech.

The subtitles were carefully edited, I would not change anything.





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## Discussion & Limitations

### Methodological limitations

- Stimuli: Subtitle characteristics
  - ❖ Reception: scrolling MST – transition in content reception
  - ❖ Preparation: discussion on AOIs: positioning and time-coding
  - ❖ awareness of importance:  
pilot study for spotting potential errors (methodology | study design)
- More ambitious aspects in mind
  - ❖ but: time restrictions
  - ❖ further eye-tracking aspects



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## Discussion & Limitations

Eye-tracking tool | suggestions on further development

- questionnaire before
- visualisation | numeration | time-coding
  - ❖ fixations:  
for data on regressions and proportional reading time
  - ❖ saccades and gaze velocity



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## Discussion & Limitations

Eye-tracking tool | suggestions on further development

- (semi-)automation of AOIs | file import | AI tools
  - ❖ import: timed-text file
  - ❖ AI tools: automatic speech-recognition | audio alignment:  
time-stamps for words and subtitles
  - ❖ computer vision | image recognition:  
position of subtitles boxes (pixel-based)



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## Conclusion & Future work

### Methodology

- target groups: separate studies with different groups (hearing | impaired | deaf)
- eye-tracking data and AOIs on deviating display of MST
- qualitative data via survey: more questions on comprehension of content
- material: other text genres (visual | verbal dynamics)



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## Conclusion & Future work

Further research questions

- survey on acceptance of low(er)-quality MST
- threshold of (minimum) quality
- demand for light post-editing in the future?
  - ❖ content selection
  - ❖ TPR: time | cost (for minimum quality requirements of MST)
  - ❖ follow-up survey on acceptance of target groups



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