The development of eye-tracking and pupillmetrics in the assessment of cognitive load

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Abstract

This study aims to develop a new paradigm, **pupillmetrics**, to measure the cognitive load with a high resolution eye-tracker. With a sensitive eye tracking device and an experimental design, the eye-tracker measures four pupillmetrics and the accuracy data in the task of word categorization on **mono- or poly-semous words**. We hypothesize that the number of meanings comprised in a word is going to influence cognitive load and thereafter the changes of pupillmetrics. This study uses objective measures including **relative changes of pupil size, and peak dilation time**, etc. It is hoped that the establishment of this promising technique and the data of various indicators will become effective tools for the **assessment of cognitive load** in the future.

Keywords: pupillmetrics; cognitive load; eye-tracker; monosemy; polysemy; Chinese

Figure 2. Experimental setting and EyeLink 1000/Remote.

1.4. Word materials

Being collected from the 10-million word corpus, Academia Sinica Balanced Corpus of Modern Chinese (v.4), Chinese words with usage frequency higher than 357 or lower than 21 among were classified as High and Low frequency, respectively. Half high frequency words and half low were used in the study in order to control the familiarity effect.

Secondly, according to the two dictionaries published by Education Ministry, the meanings of words were then classified into "monosemy" and "polysemy" for the pilot study, where eight people participated and made the "polysemy judgment". Finally, word materials with the judgment consistency 100% were Consistent group and less than 62.5% were Ambiguous group. Six types of words were used in the formal study with 30 words each.

2. Analysis and Results

Figure 4. Three pupillmetrics present significant interactions between Meaning and Ambiguity, where Consistent monosemy words show less relative change of pupil size, smaller peak dilation, and shortest time for dilation from stimulus onset.

*Ambiguity 1: Consistent · 2: Ambiguous.

Figure 1. Experimental procedure.

1.3. Pupillmetrics and Dependent variables

- DV 1 : Relative change of pupil sizes
- DV 2 : Size of peak dilation
- DV 3 : Peak dilation time from stimulus onset
- DV 4 : Velocity of change to peak dilation
- DV 5 : Accuracy

1.1. Participant

The experiment recruited 8 and 33 university students for pilot and formal study, respectively. Thirty two valid data were included in the final analysis. All participants were 20 to 30 years old, proficient in Chinese reading, with normal or corrected to normal vision and without any eye diseases.

1.2. Independent variables

- IV 1 : Number of meanings of a word
- IV 2 : Usage frequency of a word
- IV 3 : Ambiguity of the polysemy judgment

Figure 3. The heat zone of fixations.

3. Conclusions

In summary, the results support the hypothesis that the feature of lexicons are related with Accuracy, Relative change of pupil sizes, Size of peak dilation, and Peak dilation time from stimulus onset for consistent monosemies. Further studies are taking place to explore behavioural data and cognitive loads.