

# Evaluation of a Multimedia Learning Exercise using Oculo-motors



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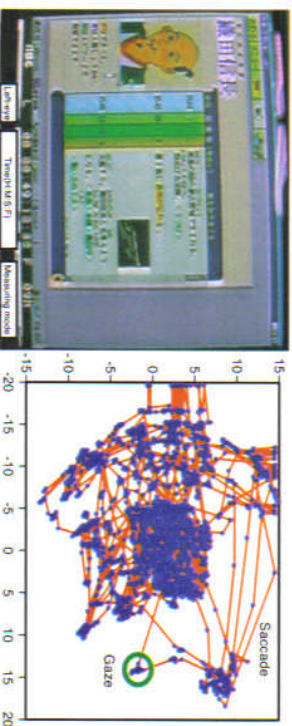
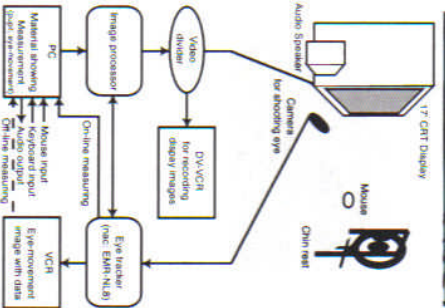


## 1. Introduction

A lot of multimedia learning materials and software have been developed as learning tools. Their "Usability" for learning has not often been discussed. The "Usability" of learning materials should also be evaluated. The indices of oculo-motors can be used for usability tests (Nakayama et al. 2002).

To examine the feasibility of using oculo-motors to evaluate multimedia learning materials, an exercise was tested.

## 2. Experimental Method



### Learning material:

A commercial material which is able to provide textual information, illustration, audio and movies about Japanese historical topics.

### Task for subjects:

Viewing 6 historical topics one after another. The subjects were asked to find a topic, which was assigned orally, and to view the linked objects. All objects could be accessed from a chronological list of historical events. To view the contents of a topic, the viewer has to search for an event by scrolling a list on the display, and clicking on the hypertext link with a computer mouse.

### Subjects:

Five postgraduate students who had a normal visual acuity.

### Three phases of the experiment:

**Searching:** searching for assigned topics on a screen

**Viewing:** viewing the objects

**Preparation:** including other processes

### Oculo-motor measure:

#### Pupil size:

An eye-tracker detects pupil shape as an ellipse, then measures the long and short diameters at 60 Hz.

#### Eye-movement:

Eye-movements are also measured using the pupil shape. Measuring as the coordinates of a CRT screen size (640, 480), and converted into visual angle degree values. Measuring resolution is 0.06 degree/pixel.

#### Saccade and Gaze:

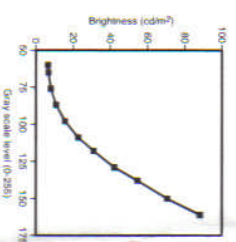
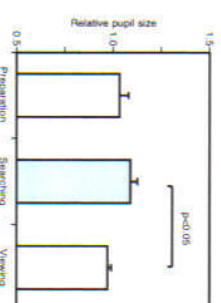
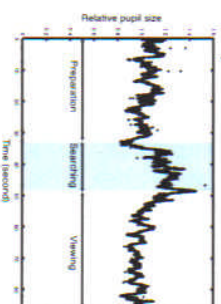
It is supposed that a saccade is eye-movement velocity over 40 degree/sec. (Ehisaawa & Sugiyama 1998), and the rest are gazes. Saccades are detected as components which have a velocity over the threshold between the frames. The series of saccades are defined as a single saccade. The saccade frequency is evaluated as an occurrence rate of saccades. Each saccade length is computed by differential summation of the x-y coordinates of the saccade. (Takahashi et al. 2000)

#### Blink:

The eye-tracker also can detect blinks by evaluating the ratio of the short pupil-diameter to the longer one; lower than 0.7-0.8. [display luminance: It was measured from the recorded display image as video level, then converted to the luminance.

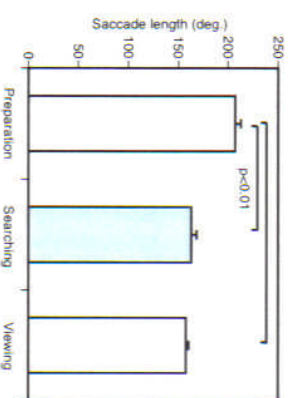
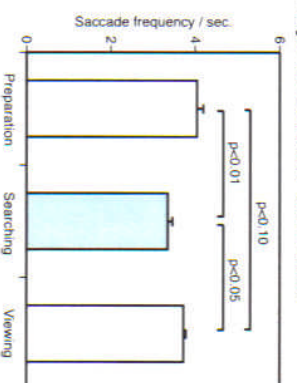
## 3. Results

### 3.1 Pupil size



Pupil is affected display luminance; the luminance was measured in considering display characteristics. Average luminance of PC display for "Searching" (40.9cd/m<sup>2</sup>) is significantly darker than one for "Viewing" (35.8cd/m<sup>2</sup>), therefore the order of the size of pupils does not depend on the display luminance. The mental work load for "Searching" is greater than "Viewing".

### 3.2 Eye-movement and Blink



#### Saccade frequency:

decreases in the order: "Preparation", "Viewing" and "Searching". The frequency for "Searching" is significantly lower than others.

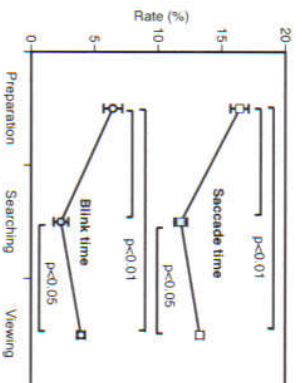
#### Saccade length:

The length for "Searching" and "Viewing" are significantly shorter than the length for "Preparation".

While a viewer searches for a topic from a chronological list, the saccade may be suppressed in order to find the target.

#### Total duration of saccade and blinking:

It was measured the duration of gazes without saccade and blink. Both duration decrease significantly in the same order of frequency: "Preparation", "Viewing" and "Searching".



## 4. Summary

The results show both saccade and blink are suppressed, and pupils are dilated to get as much as visual information as possible while the viewer is looking for the target. The mental work load is the highest during "Searching" phase. The results of the experiment show viewer's oculo-motor behavior, and these indices may help to improve the usability.

## Acknowledgement

The authors would like to thank Kenichi Arai, Director of the Educational Research and Development Center, Benesse Corporation, for financial support.