



Title	Time course of the mental imagery generation and inspection: An ERP study
Author(s)	Yamazaki, K.; Katayama, J.
Citation	2006 Annual CNS Meeting. April 8 - 11, 2006, San Francisco, CA
Issue Date	2006-04
Doc URL	http://hdl.handle.net/2115/8295
Type	conference presentation
File Information	06CNS_keiko.pdf



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TIME COURSE OF THE MENTAL IMAGERY GENERATION AND INSPECTION: An ERP study

Keiko Yamazaki*, Jun'ichi Katayama

Graduate School of Education, Hokkaido University, Japan

E-mail: keiko115@edu.hokudai.ac.jp

Introduction

Mental imagery process: generation, maintenance, inspection, and manipulation (Kosslyn 1994)

In a previous behavioral study, it was indicated that image generation is a sequential process whereas inspection can be parallel (Kosslyn 1988). Image generation and inspection are neighboring temporally so that ERP is a useful measure to examine the brain activity involved in these processes for their very high time resolution.

Purpose: to investigate the time-course of brain activity related to generating and inspecting images

Methods

Participants:

12 students: Mean age 25.3 years.

Procedure:

Participants visualized a corresponding uppercase letter to the cue stimulus on the probe grid and decided whether the mark fell on (**ON trials**) or off (**OFF trials**) the visualized letter as quickly as possible.

Half of the trials were "early trials"; when the probes placed on a segment drawn early in the order if they would be drawn on paper, and the other half were "late trials".

Conditions:

Generation condition

ISI between Cue and Probe: **100 ms**
Both image generation and inspection were needed.

Inspection condition

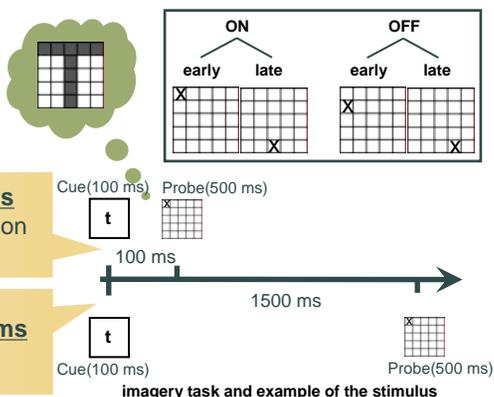
ISI between Cue and Probe: **1500 ms**
Only image inspection was needed after the probe.

Recording:

EEG from 25 scalp sites
reference: averaged earlobes
Sampling rate: 200 Hz
band-pass filter: 0.05-30 Hz
Analysis interval: 1200 ms
(with a 200-ms pre-probe baseline)

Stimulus:

Cue stimulus: a lowercase letter ("c", "g", "h", "i", "l", "t", "s", or "u")
Probe stimulus: 5 x 5 grid with an "X" mark probe in one cell

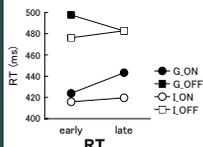


Analysis:

P300 component was defined as the largest positive-going peak occurring within 300-1200 ms window. Behavioral measure and P300 was assessed with repeated measures ANOVA (condition x response x probe position).

Results & Discussion

Behavior



RT: three-factor interaction was significant

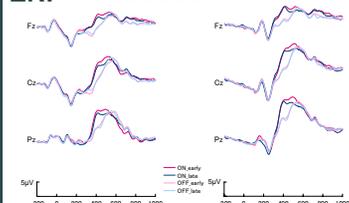
Generation condition ON early trials < late trials
OFF late trials < early trials

Inspection condition ON, OFF early trials < late trials

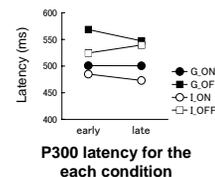
Generation condition: RT pattern in ON trials supported the previous study that segments of block letters were imaged in the order in which most people draw the letters, but the RT of OFF trials showed an inverse pattern.

Hit rate and F.A. rate: N.S.

ERP



Generation condition Inspection condition
Averaging waveform for each condition



P300 peak latency at the Pz

Main effect of Response
ON < OFF

P300 peak latency reflects stimulus classification speed. Participants classified imagery representation earlier in ON trials than OFF trials in both conditions.

The diverging point between ERP waveforms

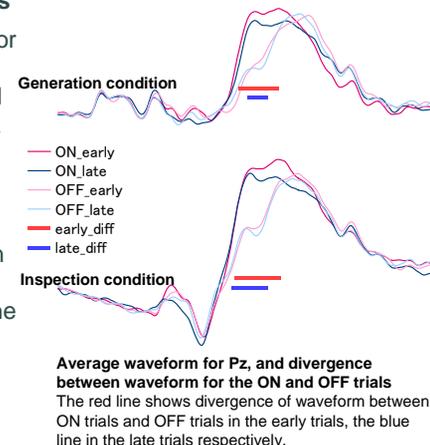
The first diverging point between waveforms for the ON trials and OFF trials indicates the time point when different neural activity had started according to whether the trial was ON or OFF.

Generation condition early trials < late trials

Inspection condition early trials ≈ late trials

The divergence for early trials was earlier than for late trials in the generation condition, although these results were not observed in the inspection condition.

Divergence of waveform indicated that image generation had sequential property which was not shared by inspection.



Average waveform for Pz, and divergence between waveform for the ON and OFF trials
The red line shows divergence of waveform between ON trials and OFF trials in the early trials, the blue line in the late trials respectively.

Conclusion

RT and ERP results supported that image generation is a sequential process and inspection is not a sequential process.