

# Designing multi media user interfaces with eye recording data

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**ABSTRACT:** An eye movement recording experiment has been carried out to pinpoint the control of the primary attention focus. The user's attention focus is strongly influenced by dynamic processes on the screen. E.g., if a pop up menu of an appropriate size automatically appears on the static screen, then the user's attention focus changes to this new element. The results of our investigation indicate that design of a multi media screen layout can be validated and optimised using eye recording data.

## INTRODUCTION

One important problem in interface design of multi media interfaces is making appropriate design decisions regarding the positioning of visual feedback (e.g., messages, animation windows, icons, etc.) on the screen. While highlighting techniques can aid the user in locating important messages, it is not always possible to predict what may be important to the user at a given time. The traditional solution is a mask layout that allows the user to easily find any of the information on it by adopting a consistent format for all masks of a character user interface (CUI) [1]. In the context of the design of graphic user interfaces (GUIs) important messages are placed in the centre of the screen [5]. This solution is based on the strategy of minimising the distance between the unknown locus of the primary attention focus (PAF) of the user and the locus of the message on the screen.

The unanswered question is: what is an *optimal* screen layout? Where is the *best* place to put visual feedback on the screen? How the primary attention focus can be controlled by the dynamic on the screen? Results of an eye recording experiment can be used to optimise the strategy to control and influence the PAF.

One major determinant is *attention* both of the context and quality of perception [4]. It is known that at least the following variables play a role in controlling dynamic visual attention [2] [3]: (1) the rate at which the display varies: the greater the bandwidth is, the more frequently is the display sampled; (2) the value of the information: the more the information is worth, the more frequently is the display sampled; (3) the cost of observation: the more costly an observation is, the less frequently is the display sampled; (4) forgetting: as the time since the last observation elapses, the user becomes less certain of the value of the last observed information even if it varies only slightly or not at all; (5) the coupling between displays. To investigate the causes of visual attention control in man computer interaction we have to measure eye movements in the context of different conditions.

We try to prove the hypothesis that eye movements correlate with dynamic structures on the screen. To do this we carried out an eye movement recording experiment. The main assumption is that the visual focus measured with eye movement recording can be controlled by popping up windows and boxes at several positions on a screen.

## METHOD

**Subjects:** A total of 8 subjects participated. Group A consists of 4 men with the average age  $25.0 \pm 1.1$  years. Group B consists of 4 men with the average age  $26.8 \pm 3.1$  years. All subjects were students working as a probationer at the German enterprise DORNIER Inc.

**Experimental setting:** We used the eye tracking system (ETS) of DORNIER Inc.

The subject sat in a normal distance (30"-50") in front of a computer screen (17") without any contact to the eye recording measurement unit.

**Material:** The experiment was run on an PC (Olivetti M386) with colour screen (VGA, 17"). The standard Windows 3.0 environment with a multi media information system of a German bank association was used. One version was developed by the German multi media software house ADI Inc. in Karlsruhe. The second version was redesigned and programmed at our usability laboratory.

**Tasks:** Subjects were instructed to solve 11 tasks:

- (1) Search a house for a price of 450,000.– \$.
- (2) Who is responsible for the sales talk about immovable?
- (3) Where is the office of this person located in the building?
- (4) To buy the house I need a mortgage. Where can I get this?
- (5) Where can I get information about buying and selling of securities?
- (6) The bank offers different events of entertainment. I have a free day (April, 7th, 1993). Which events are offered?
- (7) I have not enough cash and I am nearby the main station. Where is the next cash service?
- (8) Where is the cash counter located in the building?
- (9) Which spectrum of services are available at the cash service desk?
- (10) Look for the next immovable, which you can find?
- (11) Look around in the whole information system for things you are interested in (2 min.).

**Procedure:** Factor A was the task type. Factor B was the difference between two multi media interfaces. All subjects had to solve the same eleven tasks in the same fix order with both interfaces.

**Measures:** To calculate the correlation of the PAF with the dynamic structures on the screen the distance ( $d$ ) between the fixation point and the dynamic structure of the screen was measured. The visual focus is given by the ETS as a crossing point of two white lines on the video. The frequencies of eye positions were counted with time increments of 20 ms.

## RESULTS AND CONCLUSION

**Empirical validation:** We can observe the strong influence of dynamic screen processes on eye movements. To solve the instructed tasks, most of the users are looking around on the screen to find the right information or a hotspot (mouse sensitive area). If something appears on the screen during this search process, then the normal reaction is to look on this new element. One important condition is the size of appearing elements. If the size is too small, then most of the users have no chance to react on this signal [7].

Analysing the recorded videos we have to differentiate two situations: (1) the user come to an unknown screen, (2) the user look on a known screen. In case (1) a user tries to orient himself. After this orientation phase he is looking for the task related information. A new element, that appears on the screen, interrupts the users' search behavior. If the new information is not task related, then the user is disturbed. In case (2) he has a strong expectation about the dynamics on the screen. If a user expects a specific information appearing on a certain place, then his eyes jump several times to the place, wether or not the information is given. In these cases a reduction of time to pop up information could be helpful.

**Multimedia interface design:** Our main design goal is the control of the user's attention focus. What is an *optimal* screen layout is till now the open and unanswered question. What we need, is a good indicator, which gives the interactive program the information, where the primary attention focus is actually on the screen. We found the actual position of the mouse cursor as such an indicator [7]. We are now able to present the actual information, feedback, etc. nearby the actual focus on the screen. This solution is not possible, if we have a touch screen. For this case we have to steer the attention flow of the user.

This steering can be done by popping up information, one after the other.

## REFERENCES

- [1] Burroughs Corporation. InterPro (TM) user interface standards, Version E (March 20, 1986).
- [2] Foley, P. & Moray, N. Sensation, perception, and systems design. In: G. Salvendy (ed.), *Handbook of Human Factors*, John Wiley, 1987, 45-71.
- [3] Graf, W. (1988) Ergonomische Beurteilung der Mensch-Computer-Interaktion anhand von Blickbewegungen. Dissertation ETH Nr. 8707, Eidgenoessische Technische Hochschule.
- [4] Groner, R., d'Ydewalle, G. & Parham, R. (eds.) *From Eye to Mind: Information Acquisition in Perception, Search, and Reading*. North-Holland, 1990.
- [5] OSF/Motif Style Guide. Open Software Foundation. Prentice Hall, Revision 1.1 (1991), p. 4/44.
- [6] Rautenberg, M. & Cachin, C. Locating the primary attention focus of the user. In: T. Grechenig & M. Tscheligi (eds.) *Human Computer Interaction*. (Lecture Notes in Computer Science, 733); Springer, pp. 129-140.