The Added Value of Eye Tracking in the Usability Evaluation of a Network Management Tool

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Usability evaluation techniques have evolved over several years to assess the user interface of systems with regard to efficiency, interaction flexibility, interaction robustness and quality of use. The evaluation of the user’s thought process is difficult to access with traditional usability techniques. Eye movement data and eye fixations can supplement the data obtained through usability testing by providing more specific information on the user’s visual attention. Network Management (NM) tools have been developed to analyse the large amount of data generated by network applications and to display the data using various information visualisation techniques. The general increase in the use of information visualisation techniques has highlighted the need for methodologies to evaluate the user interface of software, including NM tools. This paper investigates how eye tracking data can supplement the usability evaluation data of NM tools. This paper further discusses the results obtained from a usability evaluation that used a methodology combining traditional usability methods and eye tracking methods for the usability evaluation of the visualisation techniques used by a NM tool. The results show that eye tracking does provide additional value to the usability evaluation results of NM tools.

Categories and Subject Descriptors: H5.2 [Information Interfaces and Presentation]: User Interfaces – Evaluation/methodology; Graphical user interfaces; Interaction styles; Screen design; User-centered design
General Terms: Human factors, Experimentation, Measurement, Verification, Design
Additional Key Words and Phrases: Eye tracking, network management, usability evaluation, visualisation evaluation

1. INTRODUCTION

Usability testing involves measuring the performance of users on tasks with regard to the ease of use, the task time, and the user’s perception of the experience of the software application or systems such as a NM tool (Preece, Rogers, et al. 2002). The role of the user’s visual attention can provide additional information on usability testing, but is difficult to assess with conventional usability methods such as click analysis, questionnaires or asking users what they paid attention to. Eye tracking has become a capable tool to answer research questions relating to where the user’s visual attention is on the screen.

Research has shown that the user’s eyes do not wander randomly and that people look at what they are working on (Sibert and Jacob 2000). Information can be obtained into where the user’s attention is and provide an indication to how the user perceived the information viewed. In usability engineering, eye tracking assists software designers to evaluate the usability of screen layouts. The assessment of the user’s visual attention cannot be measured by means of think-aloud protocols or questionnaires, utilised by traditional usability studies. Incorporating eye tracking into software usability evaluation can provide additional knowledge that is not obtained from traditional usability testing methods (Karn, Ellis, et al. 1999).

The ability for a network manager to assess the effectiveness of the network infrastructure, is greatly enhanced by visually representing the statistical information associated with network usage and directly associating that information with the network layout [Erbacher 2001]. Network management can be described as the monitoring and controlling of a computer network in order to function efficiently and provide value to users. The availability and ability of NM tools to generate data, in order to make informed decisions, has increased. However, the ability to access and analyse information in order to make informed decisions is on the decline [Spotfire 2001]. There is a growing need for usable solutions to facilitate and support the visualisation of data and the associated decision-making process. It is very important that these tools be evaluated to determine that these solutions are indeed usable. The usability evaluation of NM tools is traditionally conducted by means of task performance measures and subjective measures such as questionnaires. This paper investigates whether the addition of eye tracking will give insights that are not available from the traditional usability evaluation of a NM tool by using a methodology that combines traditional usability evaluation techniques, as well as eye tracking techniques.
2. BACKGROUND

This section will elaborate on usability evaluation and the added value of eye tracking. The importance of evaluating the user interface of a NM tool is discussed.

2.1 Usability

Usability is the quality of a system with respect to ease of learning, ease of use and user satisfaction [Rosson and Carol 2002]. ISO 9241 defines usability as the effectiveness, efficiency and satisfaction with which specified users achieve specified goals in particular environments [Barnum 2002].

Certain questions are difficult to answer effectively using traditional usability evaluation methods [Karn, Ellis, et al. 1999, Namahn 2001]. For example, a user may spend more time than expected looking at a particular screen, without making the appropriate selection to achieve a task. Think aloud protocols, questionnaires or interviews will not always reveal why the user did not achieve the task in the required time [Karn, Ellis, et al. 1999, Namahn 2001]. The user may have overlooked the appropriate button or component; a system component may have distracted the participant; the meaning of a control may not have been apprehended; etc. Different usability interpretations may lead to different user interface designs for a system.

Success rates and completion time metrics can indicate to designers when a user had difficulties with the user interface, but it can not necessarily highlight specific areas of the user interface that caused the specific problems [Cowen, Ball, et al. 2001]. The importance of objective usability evaluation techniques that can identify problems in user interfaces, has encouraged researchers to evaluate eye movements in order to comprehend how users view, search and process user interfaces [Cowen, Ball, et al. 2001].

Traditional usability techniques are effective for evaluating user interface usability when tangible tasks are considered [Freitas, Luzzardi, et al. 2002]. However it is a much more difficult task to evaluate usability when intangible tasks such as “understand data” or “make decision based on information” is considered. These are the type of tasks dealt with when evaluating NM tools.

2.2 Eye tracking

Eye tracking can be defined as a technique to determine eye movement and eye-fixation patterns of a user [Namahn 2001]. The human eye moves by alternating between saccades and fixations. A saccade is the quick movement of the eye in order to move focus from one area to the next. A fixation is the time spent looking at the newly found area. An eye tracker follows the eye during its saccades and tracks the location of the fixation points.

Software designers can gain useful information about human eye movements, by tracking eye saccades and fixations [Newman 2001]. Eye tracking data can expose response biases of participants resulting from an artificial testing environment. This would be undetected in traditional usability testing techniques and therefore eye tracking data results in a higher validity of usability data [Schiessl, Duda, et al. 2003].

In a study conducted by Stasko et al. [2000], the strategies participants used in performing the required tasks, were observed. The study states that the task performance was clearly influenced by the strategy employed. If an eye tracker was used to collect this information, the observers would clearly see where the participant was looking when performing a specific task. Goldberg et al. states that variables that are derived from eye tracking methods can provide insight into users’ decision making while searching and navigating interfaces [Goldberg, Stimson, et al. 2002].

Morrison et al. [1997] studied the effects of eye tracking in tactical decision making environments. In order to evaluate the utility of a display, a researcher needs to know what information a test subject is looking for and where s/he is looking to obtain the information. The authors state that this is very difficult to achieve using traditional evaluation methods and that suitable measurement tools are required. Scan paths, the time spent looking at various areas of interest on the screen and the use of visual attention are some of the benefits that eye tracking can add to the usability testing of software and specifically NM tools.

2.3 Network Management

Networks are critical to modern society and a detailed understanding of how the systems are analysed is essential for network managers. Network data is difficult to display without the use of data visualisation techniques. The aim of visualisation techniques is to present data in methods that accurately communicate information, and need minimal effort for comprehension [Lee, Reilly, et al. 2003]. Internet traffic patterns, network throughput, usage patterns, application delay, downtime and other network management data sets, is made easier by visual representations of this complex data. The increased use of information visualisation techniques in NM tools has resulted in a need to combine other evaluation techniques with traditional usability evaluation methods for the evaluation of these tools.
3. FOCUS OF RESEARCH

3.1 Objectives and Research Questions

Traditional usability methodologies [Dumas and Redish 1999, Barnum 2002, Rosson and Carroll 2002] exist as well as several eye tracking methodologies [Goldberg and Kotval 1999, Xu 2000, Cowen 2001]. The research question arises if these separate methodologies can be combined for the evaluation of the user interface of NM tools? The methodology used for the usability evaluation of a NM tool is discussed in Section 4.1. The specific goal of this research is to investigate the added value of eye tracking data combined with usability evaluation data when evaluating the interface of a NM tool.

This research study will attempt to answer the following research questions:

- Will eye tracking give an added value to usability evaluation data when evaluating NM tools?
- How can eye tracking and usability evaluation metrics be combined to evaluate NM tools?

3.2 Pilot study: AppVis 1.0

AppVis 1.0 is a NM tool that allows network managers at the Nelson Mandela Metropolitan University (NMMU) to analyse and explore application performance on the NMMU networks. Application performance management entails the comprehension of how a network application performs from a user perspective [Rademan 2004]. NMMU has an extensive network infrastructure that supports several application services. This prototype system, AppVis 1.0, uses novel visualisation techniques to visualise the application delay performance of the Integrated Tertiary Software (ITS) application implemented at NMMU. AppVis 1.0 contains four different types of information visualisation graphs. The pilot study details are discussed in Section 4.

3.3 Previous AppVis 1.0 Usability Evaluations

A heuristic evaluation was conducted on AppVis 1.0 during the design phase when the application was developed. A heuristic evaluation makes use of a generic list of design heuristics or principles that is used to identify design problems. The heuristic evaluation was performed by two design experts who evaluated the user interface design by using a set of tasks. The purpose of the heuristic evaluation was to highlight any usability problems in terms of the presentation layout of the user interface and its user interaction with the visualisation techniques before user testing was performed. The identified problems were corrected before user testing was conducted.

User testing was conducted on AppVis 1.0 and focused on evaluating the task effectiveness and user satisfaction of the system. Task effectiveness of the system was measured by determining the percentage of tasks each participant completed in a task script based on direct observation. The mean completion rate of each task was shown to be over 70%. A post-test questionnaire using a five-point Lickert scale was used to measure the level of user satisfaction. The mean ratings calculated for each criterion were greater than 3.5.

The previous usability evaluations were informal user testing, however the usability evaluation explained in Section 5 was conducted in a formal usability laboratory at the NMMU. This allowed for more usability measures, such as video recordings and task completion times, to be utilised. Eye movements of the participants were also recorded. A task list, background questionnaire and post-test questionnaire, similar to those used in the previous usability evaluations, were used for the completion of this pilot study.

4. METHODOLOGY

This section discusses the methodology used for the usability evaluation of the NM tool. The usability and eye tracking measures are discussed. The participants, apparatus and task scenarios for the pilot study are explained. The procedure followed during the test is also elaborated.

4.1 The Evaluation Methodology

Usability evaluation methodologies suggested by Barnum [2002], Dumas and Redish [1999], Rosson and Carroll [2002], Rubin [1994] and Faulkner [2000] were investigated for this research. Eye tracking techniques by Goldberg and Kotval [1999], Xu [2000], Gao [2001], Goldberg et al. [2002], Cowen [2001], Renshaw et al. [2003] and Bennel and Ottens [1991] were used to combine with appropriate usability evaluation methods. The result was a methodology proposed for the formal usability testing of a NM tool incorporating eye tracking. This methodology combines usability evaluation techniques with eye tracking techniques. Table 1 lists the basic steps involved in planning and effectively implementing a formal usability test of NM tools. Step 13, conduct the usability test, is a major step in the process and includes briefing the participant, administering the forms, calibrating the eye tracker, recording data and debriefing the participant. Section 4.7 discusses this step in more detail.
Step | Step description
--- | ---
1 | Establish the team.
2 | Define the product issues and audience.
3 | Formulate the research hypothesis.
4 | Set goals and define usability measurements.
5 | Define eye tracking metrics.
6 | Establish the user profile.
7 | Select the tasks to include in the test.
8 | Determine how to categorise / analyse results.
9 | Develop and write the test plan.
10 | Prepare the test materials, environment and team.
11 | Recruit the test participants.
12 | Conduct a pilot test.
13 | Conduct the usability test.
14 | Tabulate and analyse the data.
15 | Recommend changes.
16 | Report the results.

Table 1: The proposed methodology

Including eye tracking in the proposed methodology has certain limitations. There are many eye tracking devices available today, some more suitable for usability laboratory tests and other more suitable for outdoor tests. It is important to select one which will comply with the experiment’s specific needs.

The eye tracker device needs to be calibrated for each participant during a test. Excessive head movements during an experiment can cause the eye tracking data to be incorrect. Participants’ eye movement accuracy should be tested frequently against a fix set of points to test for inaccuracy.

The selection of participants has to be done carefully, since not all participants can be calibrated and tracked successfully. Various persons can not be eye tracked because of external reasons such as glasses or contact lenses. Other issues may also cause problems, including the pupil of the eye not reflecting enough light, or the iris being too light in colour to distinguish it from the pupil reflection.

4.2 Usability Measures
The following standard usability measures were used in the pilot study:

i) Effectiveness:
   - **Task completion rate.** This metric consists of determining the percentage of tasks each participant completes successfully in the task list. This will include the percentage of tasks completed per participant and per task.
   - **Number and percentage of tasks completed with and without assistance.** This metric will show if the participant completed a task with or without the assistance of the team members.
   - **Error rate recovery.** This metric consists of monitoring the number of errors made by the participant, as well as the total errors from which the user could not recover.

ii) Efficiency:
   - **Task completion time.** This metric involves measuring the total time that participants spend performing the assigned tasks.
   - **Real-time events.** This metric involves monitoring and filtering events such as the click of a mouse, the push of a key or the participant making a comment.

iii) Satisfaction:
A post-test questionnaire using a five-point Lickert scale was used to collect participant responses about the user interface. This post-test questionnaire contains questions concerning the overall satisfaction, screen design, terminology, learnability and system capabilities of the NM tool.

4.3 Eye Tracking Measures
The following eye tracking measures were used in the pilot study:

- **Number of fixations.** The number of fixations is negatively correlated with search efficiency. Large numbers of fixations point to less efficient search perhaps resulting from poor display element arrangements.
- **Fixation duration.** Relatively long fixation duration is an indication of the complexity and difficulty of a display.
The Added Value of Eye Tracking in the Usability Evaluation of a Network Management Tool

- **Number of fixations on each area of interest (AOI).** This metric is an indication of the importance of a system element.
- **Number of gazes on each AOI.** The eyes are drawn to informative areas. This metric also reflects the importance of a system element.
- **Scanpath.** The strategy that a participant uses to complete a task can be obtained from this metric. We can get an indication of the efficiency of the arrangement of elements in the user interface.
- **Time to the 1st fixation on the target AOI.** This metric is useful for tasks where a precise search target exists.

The task list for this case study was designed in such a way as to allow these metrics to be captured.

4.4 Participants

The main criterion for the participants of AppVis 1.0 is to have a sound knowledge in the domain of network performance management. A background questionnaire was used to screen the participants for this evaluation. This questionnaire reflects the possible participant’s NM tool experience, computer experience, age and gender. Six participants were tested for the pilot study. Their right eye was calibrated for the eye tracking purposes. All participants indicated that they had experience working with one to three NM tools.

4.5 Apparatus

The SMI iView X RED eye tracker was used for this experiment [SMI 2002]. This remote eye tracker was developed for absolutely contact-free measurement of eye movements including automatic head-movement compensation. The eye tracker was placed directly in front of the participant just below the display screen. The video files and data files were recorded using the iView X software. The data was saved for further analysis. Fixations were defined as being at least 250 ms in duration in a radius of 50 pixels.

Participants were seated approximately 60 cm from the screen allowing minimal head movement. Tasks were read out to the participant as to eliminate the participant from looking down on a piece of paper. Several tasks required an answer from the participant. The answers, the tasks read, as well as any comments made by the participants were recorded.

4.6 Task Scenarios

The experimental tasks for the pilot study were divided into two scenarios each containing several tasks. These tasks, explained in Section 5.2, represented typical activities conducted using the NM software. The scenarios included importing application delay metrics and displaying a network overview of application delay.

4.7 Procedure During Test

The participants were welcomed and briefed about the experiment, which was followed by an explanation of the equipment to be used. It was explained that only the eye, voice and stimulus display would be recorded. The participant was required to complete an informed consent form. The think aloud protocol was explained to the participant and they were encouraged to utilise this method. A training task was given to the participants where they were briefed about the system goals and objectives as participants were not familiar with AppVis 1.0.

After the training tasks, the participants were given time to make themselves comfortable in front of the PC before the eye tracking calibration commenced. A 9-point calibration with corner correction was used at all times. The participants were asked to keep their head as still as possible during the experiment as to minimise inaccuracy caused by head movements. Participants were offered the opportunity to stand up and relax half-way through the experiment. After every three or four tasks, depending on the task length, the accuracy of the eye movements was checked. If the accuracy would appear to be incorrect, the participant’s eye would be recalibrated. Data recording commenced with the test administrator reading the task, and ended with the participant either answering or completing the task. The duration of the experiment was between 40 minutes and one hour. Following the tasks, a post-test questionnaire was administered. Finally an experiment debriefing was conducted.

5. ANALYSIS AND RESULTS

5.1 Data Collection

Data was collected and calculated as follows:

- Video recordings were captured live of each task and evaluated at a later stage. The video recording included a cursor which indicates the participant’s eye movements.
- Audio in the form of the participant or the test administer speaking were included with the video files.
- Eye tracking data files.
- A questionnaire was used to gather feedback on the users’ understanding of the user interface.
- Monitoring of tasks.
5.2 Usability and Eye Tracking Measures
The following section discusses each task of the usability test together with the traditional usability results obtained and the eye tracking results obtained.

i) Task 1: The participants were required to start the system and to determine whether new delay metrics have been collected.
**Usability Results:** This task had a 100 % completion rate and participants provided the correct answers in time. These results would usually suggest that not much can be done to improve this interface.
**Eye Tracking Results:** However, Figure 1 illustrates the fixations of a participant on the different AOIs on the screen. The System Information AOI is much smaller then the System Logo and Name AOI, but it has more fixations than the last one. The System Information AOI also had a mean of 18.5 fixations. While the participants spent a great deal of time on this small part of the screen, it also appears that they struggled to find the relative information from this part. The eye tracking data would suggest that the system designers should place emphasis on the System Information part of the screen by making it bigger and presenting the information in a more clear and uncluttered way.

![Figure 1: Fixations on AppVis 1.0 Introduction Screen](image)

ii) Task 2.1: This task required the participants to view the interface for a fixed amount of time.
**Usability Results:** The mean completion rate for this task was 100%. The only traditional usability method that could be obtained from this type of task was comments made by the participant by means of the think aloud protocol. However, no comments were made by the participants.
**Eye Tracking Results:** Participants showed the main interest in the area of the screen containing the graph, as it had the most fixations, largest fixation percentage and largest gaze percentage. The graph area of the screen had a mean gaze percentage of 54.5% versus the textual area of the screen which had a mean gaze percentage of 8%. Also, the graph area of the screen had a mean number of fixations of 24 versus the textual area of the screen which had a mean number of fixations of 4. This indicates that for this task, the participants had a much greater interest in the graph area of the screen, than the textual area of the screen.

iii) Task 2.2: This task was completed successfully by selecting the threshold option from the menu and then by adding a new threshold.
**Usability Results:** This task had a 100% completion rate. Task completion times showed that the participants took longer than what was expected to complete the task. Participants took a long time before moving the mouse onto the menu area and searching through it. Traditional usability data suggested that the participants did indeed struggle to find the information but the data could not indicate where the participants spent there time before searching through the menu.
**Eye Tracking Results:** The scanpaths from the different participants indicated that they mainly searched in the filtering area for the completion of this task before searching through the menu. This data suggests that the option of adding a threshold should be available from the filtering area as well. For example, one participant had 10 fixations on the filtering area and took 26 seconds before he fixated for the first time on the menu which is the target AOI. Figure 2 illustrates the raw gaze data of this participant together with the AOIs. The amount of gazes on the Filtering AOI can clearly be seen.
iv) Task 2.3: This task requested the participants to change the graph to a 2-Dimensional view.

**Usability Results:** A completion rate of 100% was obtained for this task and was completed with relative ease.

**Eye Tracking Results:** The scanpath data showed that the participants went to the target AOI (Menu or Toolbar) in a short amount of time.

v) Task 2.4: Participants were required to determine which virtual local area network (VLAN) had the highest maximum total delay.

**Usability Results:** This information could be extracted from the graph or from the textual view. This task had a 100% completion rate and all participants gave the correct answers.

**Eye Tracking Results:** The number of fixations, fixation percentage and gaze percentage favored the graphical AOI. All participants fixated several times on the graph and not once on the textual view.

vi) Task 2.5: This task first required the participants to display the mean total delay for June 2004 and then to determine which VLAN had the smallest total delay.

**Usability Results:** This task had a 100% completion rate. However, none of the participants answered the question correctly. This data indicates a definite usability problem and one would assume that this lies with the graph. However, the only means of finding out what causes the problem, is to question the participants on their thought process when they gave the answer. The problem with this is that the participants may have difficulty expressing themselves or may not recall their exact process.

**Eye Tracking Results:** Eye tracking data assisted as the participant’s strategy were obtained by looking at the gaze and fixation paths. Figure 3 illustrates the fixations of a participant for the completion of task 2.5. The participants searched for the VLAN with the smallest mean total delay indicated by the blue circles. However, the VLANs with no application delay are the smallest and are not indicated as blue circles on the graph. Participants could not tell this from the graph. This would suggest that VLANs with no delay should be indicated in a more clear way. Eye tracking data also showed that the participants had a mean total of 21 fixations on the updated graph and still gave the incorrect answer. Thus, it was difficult to extract the information from this graph.
vii) Task 2.6: Participants were required to display “details-on-demand” for a specific VLAN, which is an information box that pops up on the screen if the mouse is focused on a specific VLAN.

Usability Results: This term was explained to the participants during training, but participants still took exceptionally long to complete this task. This task had an 83% completion rate. It was concluded that the participants, being first time users of the system, did not understand the term “details-on-demand”. The task also required the participants to determine what the mean total delay for that VLAN was. This answer was displayed in the “details-on-demand” information box, but could also be retrieved from the textual area. Only one participant could not complete the task and provide the correct answer.

Eye Tracking Results: Eye tracking data indicated that the participants had a mean number of 12.5 fixations in the filtering AOI in their process of completing this task. Once again, the participants expected to find the information in the filtering AOI. Participants did spend the majority of their time fixating and scanning the graphical AOI. However, the mean time for the first fixation on the target AOI (“details-on-demand” information box) was 27 seconds. This data substantiates that the participants did not have full clarity of the meaning of the term “details-on-demand”. It must also be noted that one participant did use the textual AOI to confirm his answer, after looking at the “details-on-demand” information box.

viii) Task 2.7: Participants had to drill down into a specific VLAN which resulted in a new graph being displayed to complete this task.

Usability Results: This task could be achieved in several ways. Three participants completed the task by double-clicking the relevant VLAN in the filtering area. Two participants selected the drill-down tool on the toolbar and then clicked on the relevant VLAN in the graph. One participant could not complete the task and asked for assistance. A completion rate of 83% was achieved. The majority of participants did not have trouble completing this task.

Eye Tracking Results: The eye tracking data for the participant that could not complete the task suggested that the filtering area was searched several times but the task could not be achieved. After searching through the graphical and textual AOIs the participant asked for assistance. Other participants completed the task easily once they first fixated on either the filtering AOI or the toolbar.

5.3 Post-test Questionnaire
The results of the post-test questionnaire were analysed by calculating the mean across all participants for the overall rating that was given for each usability criteria. The mean ratings calculated for each usability criteria indicated a positive response by participants towards the prototype system. Good ratings were given by the participants with regards to the system capabilities, system terminology and screen design. Participants had a positive overall reaction to the system.

5.4 Conclusions and Limitations of Pilot Study
The usability results of one of the tasks showed that the user interface was sufficient. However, eye tracking data suggested that a crucial part of the screen was too small. This area had the most fixations and indicated the importance of the area. The eye tracking data also indicated that the participants had difficulty extracting information from this area of the screen. It was suggested that this area should made bigger and that the information should be displayed in a more clear and uncluttered way.

The graphical AOI and textual AOI of the interface showed the same information. One task showed that the participants spent the majority of their time looking at the graphical area of the screen and little time looking at the textual area.

Other eye tracking results showed that participants were searching in irrelevant areas of the screen to obtain specific information. The eye tracking data suggested for several tasks that participants expected to find certain information in the filtering AOI, which were not available there.

Eye tracking data suggested a problem with one of the graphs, showing where the participants read required information. Not one participant had a fixation on the required VLAN displayed in the graph. This indicated that the information displayed in the graph did not come across in a clear way.

The pilot study conducted had the following limitations:

- Future research will have more participants completing a more comprehensive set of tasks. The analysis of the data obtained by increasing the number of participants should yield more significant results.
- The participants used in the pilot study did not have prior knowledge of the NM tool used. Future studies will use participants who have been exposed to the use of the system.
- This is a pilot study and therefore the sample size is small.
6. CONCLUSIONS AND FUTURE WORK

There has been an increase in the use of NM tools by network managers to effectively manage large networks. Traditional usability evaluation methods have been employed to evaluate these graphical reports, used by NM tools. With the increased use of information visualisation techniques, a need has arisen to use other evaluation techniques with traditional usability evaluation methods.

Previous user testing results indicated that the user interface was sufficient. However, eye tracking data suggested that a crucial part of the screen was too small. This area had the most fixations and indicated the importance of the area. The eye tracking data also indicated that the participants had difficulty extracting information from specific areas of the screen and that they were often searching in irrelevant areas of the screen to obtain specific information. The eye tracking data added to the understanding of the users’ data interpretation strategies as it allowed the scanpaths to be analysed.

This pilot study showed that the participants preferred the graph, illustrated in Figure 3, to the textual view. Future research may include inter-disciplinary studies on the preferences of participants of textual view versus graphical views of interfaces. Future research should also include how participants interact with 3-Dimensional graphs found in AppVis. Testing the significance of this eye tracking methodology on other applications is also possible future research.

This paper showed that by adding eye tracking evaluation methods to traditional usability evaluation methods, value will be added to the evaluation of NM tools. Not only will such a combined method offer the opportunity to measure user actions, but to also record eye movements which are critically important when dealing with network management.

Pilot studies have been conducted to combine usability evaluation methods with eye tracking methods and the proposed combination of these methodologies has been successfully implemented. Preliminary analyses and results of the pilot studies indicate that eye tracking does give added value to the usability evaluation of NM tools. Future work will include further tests and more detailed analysis of the results.

7. ACKNOWLEDGEMENTS

The authors would like to thank the Telkom Centre of Excellence Programme and the Department of Computer Science and Information Systems at the NMMU for making this research possible.

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Proceedings of SAICSIT 2005