ABSTRACT
Inspection based methods are not very well researched in the area of Child Computer Interaction. One such evaluation method is the heuristic evaluation that requires a small number of evaluators to inspect an interface for compliance to a number of guidelines or principles. This paper reports on the development of the Anti-Heuristic Game, a game that has been designed to violate all of Nielsen’s 10 heuristics. By developing a game whereby the problems are predefined and largely known, it will be possible to establish the effectiveness of children in identifying and reporting problems using the heuristic evaluation method. If children can perform a heuristic evaluation this will enable the benefits of inspection based methods to be realized within Child Computer Interaction.

Categories and Subject Descriptors
H.5.2 [User Interfaces]: Graphical user interfaces.

General Terms
Measurement, Design, Human Factors,

Keywords
Heuristics, Game Design, Evaluation Methods, Child Computer Interaction.

1. INTRODUCTION
Over the last decade there has been considerable research published on the evaluation of technology with children. Many of the studies have taken place within the context of evaluating games with children [1] [2], technology or software. These studies have tended to be user based, adopting a variety of different evaluation methods including Problem Identification Picture Cards [3], Fun Toolkit [4], Laddering [5] and This or That [2]. There has been less research focusing upon inspection based methods with children, with the SEEM method being the most appropriate to date [6]. The effectiveness of other inspection based methods with children such as cognitive walkthroughs and a classic heuristic evaluation are less researched and understood.

In a classic heuristic evaluation as described by Nielsen [7] a small number of expert evaluators independently identify usability problems based on compliance to a number of usability principles. Following this initial stage, the evaluator’s individual lists of problems are aggregated to form a single list of known usability problems within the system under investigation. The use of expert evaluators is one of the key requirements to successfully perform a heuristic evaluation [8, 9], this is because expert evaluators identify more problems than novices. It has been suggested that children are experts in the way they interact with their world and technology around them and capturing this expertise is believed to be key to designing meaningful artifacts for children [10]. Therefore, if children are domain experts in the use of technology designed for them, it would appear feasible that, given the correct training, they might be able to act as experts evaluators within the context of a heuristic evaluation. However, problems may still arise with the method due to the child’s cognitive ability and it is anticipated that the method and processes may need to be modified in order to be effective with children.

In order to determine the effectiveness of heuristics with children a piece of software or technology is required and a set of heuristics. Nielsen’s heuristic set is the most widely cited and have been used in a variety of different contexts such as evaluating computer assisted assessment applications [11] and music hardware [12]. However over recent years a number of different domain specific heuristics sets have emerged to enable the evaluation of games [13, 14]. Despite this Nielsen’s heuristics were judged to be generic enough to still be applicable for evaluating the usability of games, for example visibility of system status and error prevention would still be appropriate within the gaming context. This paper reports on the design of the Anti-Heuristic Game, a game that violates all of Nielsen’s heuristics. By developing a game whereby the problems are predefined and largely known (there will inevitably be other problems that emerge which were not part of the design) it will be possible to establish the effectiveness of the children in identifying and reporting the problems. The formulae proposed by Sears could be used to judge the effectiveness of the evaluation method [15]. This is a set of three formulae that establish Thoroughness, Validity and Effectiveness based on the number of problems reported in the evaluation and the number of problems that exist. Where success is defined as the extent to which problems are found (effectiveness), this is problematic as it assumes there is a known set of problems that can be listed. Therefore by designing problems into the game claims about the effectiveness can be formulated based on this known problem set.
In designing the game, careful attention needs to be paid to ethical implications of the design. Problems and issues are being deliberately incorporated into the game, which will have a negative impact on the user. It is essential that this does not cause any additional stress or anxiety to the child.

2. The Design of the Game

The game is designed for children aged between 7 and 9 and will be based upon a space invaders game. The game has been developed using Adobe Flash Professional® and requires the child to use a laptop or PC and a mouse to interact. During the design of the game, literature was consulted to ensure that the gameplay was designed to be effective and appropriate prior to problems being integrated into the game [16]. The storyline involves an alien invasion of earth, in which Fred the Farmer has to defend his farm from the aliens, and thus by defeating the aliens he saves the world. There are a total of 4 levels and the speed of the aliens increases per level and the final stage involves shooting the large alien space ship. The player has 3 lives and in order to go to the next level they have to shoot 15 alien ships. To add humor to the game and appeal to the children, the farmer shoots cowpats at the aliens in order to destroy their ships.

3. Nielsen’s Heuristics

Nielsen’s heuristics comprise of 10 guidelines that form the heuristic set. The heuristics were developed in the early 1990’s but were judged to be generic enough to be appropriate within the context of designing the anti-heuristic game. Each of these guidelines is presented below, with the explanation of the heuristics in its original context, followed by a discussion of how it has been violated as part of the design.

3.1 Visibility of System Status

The system should always keep users informed about what is going on, through appropriate feedback within reasonable time. In order to violate this heuristic, delays will be designed into the game. For example when the player starts the game, a 4 second delay will occur before it moves to the next page, this page will turn black with inappropriate feedback. The feedback message will say Data from the server is currently being processed the game will start once the packet has arrived at the desired location. This will be on the screen for two seconds before the game then starts.

3.2 Match between system and the real world

The system should speak the users’ language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. The software should follow real-world conventions, making information appear in a natural and logical order. Throughout the application jargon and instructions will be presented that children will not necessarily understand, for example the error message in 3.1.

3.3 User Control and Freedom

Users often choose system functions by mistake and will need a clearly marked emergency exit to leave the unwanted state without having to go through an extended dialogue. It is important to support undo and redo. There will be no facility to skip the animation in the introduction and the process of restarting the game will be long, requiring 3 steps. At end of the game the child will be asked if they want to play again which will require a yes or no response; if they click yes it will ask are you sure you want to play again Yes or No and if they click yes they will be prompted by a Click here to play again.

3.4 Consistency and Standards

Users should not have to wonder whether different words, situations, or actions mean the same thing. It is important to follow platform conventions. Within the game items will be positioned in different locations throughout, for example the score will be in four possible locations and randomly move, see Figure 1 below.

Figure 1: Score presented in four different locations

In addition the order the buttons are presented to the children on the home page randomized and may change each time they visit the page.

3.5 Error Prevention

Even better than good error messages is a careful design, which prevents a problem from occurring in the first place. To achieve this there are two viable options either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action. In order to design to violations of error prevention the main focus was on ensuring that no validation occurred in certain situations. For example, the child is required to enter their name at the start, no validation is preformed when the button is pressed and it is feasible to leave this blank.

Figure 2: Enter name screen with no validation
3.6 Recognition rather than recall
Minimize the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate. The decision was made to have information presented to the child on the enter name screen (the number on the sign) and the child must enter this number on a later screen in order to play the game. There will be no facility to go back to the previous page, users will have to quit and start again. This problem is also a breach of the heuristic described in section 3.9 below.

3.7 Flexibility and efficiency of use
Accelerators which are unseen by the novice user and may, often speed up the interaction for the expert user, such that the system can cater to both inexperienced and experienced users. This involves allowing users to tailor frequent actions. The primary action within the game is to move the canon and fire the weapon. In order to slow down the interaction, the shooting will relate to the level the player is on. For example on level 1 you will just press the mouse button once to fire, whilst on level 3 it would require 3 presses to fire. This will make the process of shooting the aliens more difficult on the higher levels and impact on the efficiency of the interaction.

3.8 Aesthetic and Minimalist Design
Within the software dialogues should not contain information, which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility. The decision was made not to make the entire game cluttered but just focus on one screen, the help page, this will be cluttered with unnecessary buttons and information. If all the pages were cluttered, then this may detract from the other problems that have been incorporated into certain pages and stages of the game.

3.9 Help users recognize, diagnose and recover from errors
Error messages should be expressed in plain language, precisely indicate the problem, and constructively suggest a solution. In order not to affect the first play of the game an error message will appear once they restarted the game for the second time, as it might cause the child to quit the game. The following message will appear Error: 728890XC12RR you system settings are at a critical level for the continued playing of this game, without reconfiguring the Z2UB protocol the aliens will win! Do you want to do this or not? Click to cancel, see Figure 3. The only action available for the child is to press cancel, which will continue the game. However, it is expected that the child might ask for assistance at this point or they may simply just ignore the message.

3.10 Help and Documentation
It is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large. In the game there will be a help button available but only on the first page, when clicked it will take you to the help screen (which will be cluttered as per the description in Section 3.8) and the font size will be small making the information very difficult to read.

4. Discussion and Further Research
In total 16 problems have been designed into the game, with the number ranging from 1 to 3 problems per heuristic. The next stage of the process is to get feedback from experienced researchers within Child Computer Interaction to determine the appropriateness of the problems incorporated into the game. This is to ensure that it is ethical and no undue stress will be caused to the children whilst playing the game. At this stage further modifications of the game may occur before it is piloted with children. Once it has been judged to be appropriate and the game has problems that violate each of the heuristics, a small pilot study will be performed with a number of children. The purpose of this pilot study is to establish how they play the game, identify the problems they encounter and how they react to the errors within the game. This will enable the procedure to be established for conducting the heuristic evaluation, which will be the next stage.

Once the game is judged to be suitable then research will be performed to establish if children can perform a heuristic evaluation. Observational techniques will be used to gather data relating to the problems children encounter whilst performing the heuristic evaluation. This will involve looking at each stage of the process to try and identify the problems children encounter and modifying the process if necessary. For example the language used within the heuristic set might not be appropriate and therefore may need modification. However, in changing the terminology in the heuristic, careful attention needs to be taken in order to ensure the underlying meaning of the heuristic is not altered.

The game will enable the effectiveness of the heuristic evaluation method to be determined, as the number of problems in the system is already largely known. If children are not discovering the problems or are classifying the problems to the wrong heuristic
then further modifications to the game, heuristics or procedure may be necessary.

Some of the problems within the system might be perceived to be obvious and potentially annoying for the end user. When designing the game it was essential that all the evaluators would report the same problem to establish how effective the children are at aggregating their individual problem lists. If all the problems were unique then there would be no discussion and the effectiveness of the aggregation process would be difficult to analyze.

If heuristics are found to be an appropriate evaluation method and the procedure can be adapted to work with children, then the benefits of using inspection based methods such as requiring only a small number of evaluators can be realized for software developers and manufacturers of toys and games. Children will be able to inspect and report issues with a wide range of software, toys and games.

5. REFERENCES


