MASTER

A research into evaluating a usability test of a computer game designed for children

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A Research into Evaluating a Usability test of a Computer game designed for Children

Appendices

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The characters I and J are not used to refer to an appendix.

Appendix A: Task sheet for the children in phase 1

In this task sheet the tasks are described that the children have to perform. The tasks are in Dutch since the children that have participated in this study are Dutch children.

Opdracht 1

Je leert op school iets over dieren in het bos. Om je hierbij te helpen, heb je een spel gekregen dat je op de computer kunt spelen.

Wat moeten wij doen? Start het spel door op het plaatje op het scherm te klikken.

Je bent klaar met deze opdracht als je in het bos bent en op het scherm helemaal niets meer gebeurt. Je hoort alleen nog het geluid van fluitende vogels. Dit is het overzichtsscherm.

Opdracht 2

Je hebt informatie nodig voor een spreekbeurt over mieren. Je wilt iets vertellen over waaruit mieren geboren worden en hoe ze heten als ze een baby zijn, en hoe ze heten als ze groter worden totdat ze een echte mier zijn.

Wat moeten wij doen? Zoek informatie over hoe mieren heten als ze uit het eitje komen, en hoe ze heten als ze groter worden totdat ze een echte mier zijn.

De opdracht is af als je de informatie hebt gevonden. Keer dan terug naar het bos (dit is het overzichtsscherm).

Opdracht 3

Nu wordt het tijd een spelletje te spelen. In dit computer programma zijn 12 spellen verstopt.

Wat moeten wij doen? Zoek het spelletje waarbij je de dieren in het goede bed moet leggen. Dit spelletje heet 'welke dieren slapen overdag en welke 's nachts'. Speel dit spelletje.

De opdracht is af als je het spelletje hebt gespeeld en terug bent in het bos (dit is het overzichtsscherm).

Opdracht 4

In het bos wonen dieren. Bij ieder dier zit een spel verstopt. Het is wel leuk ook 1 van die spellen te spelen.

Wat moeten wij doen? Speel het spel dat bij de muizen hoort.

De opdracht is af als je het spelletje hebt gespeeld en terug bent in het bos (dit is het overzichtsscherm).

Opdracht 5

Je wilt het spel afsluiten. Een volgende keer kan het spel verder gespeeld worden.

Wat moeten wij doen? Sluit het spel af.

De opdracht is af als het spel is afgesloten en je weer terug bent op het scherm waarmee je bent begonnen.

Appendix B: Introduction for the children

Here the introduction with the children is described. Again, it is in Dutch.

Kennismaking etc. met de kinderen

Hoe heet je (mijn naam is Mathilde), hoe oud ben je, wat zijn jullie van elkaar, speel je vaker spelletjes op de computer, vind je het leuk om spelletjes op de computer te spelen, ...?

Waarom zijn de kinderen hier en wat wordt van ze verwacht?

Jullie gaan een spel spelen op de computer. Je gaat dit met zijn tweeen doen en ik wil graag dat jullie tijdens het spelen zoveel mogelijk met elkaar praten over wat je gaat doen, wat je verwacht dat er gaat gebeuren, wat je er van vindt, enz. Ik wil namelijk graag weten of het spel dat jullie gaan spelen beter gemaakt kan worden. Als jullie hardop met elkaar praten, kan ik goed volgen wat er gebeurt.

Het is heel belangrijk dat jullie je mening over het spel geven. Anders kan het niet beter gemaakt worden. Ik ga dus niet jullie testen over hoe goed jullie kunnen spelen, maar we gaan het spel testen.

Luid en duidelijk praten

Ik wil graag dat jullie luid en duidelijk met elkaar praten. Dan kan ik het goed horen en wordt het goed op de band opgenomen. Als ik jullie niet meer goed kan horen, vraag ik je om luider te praten.

Taken lezen van het papier dat ze krijgen

Op dit papier staan een aantal opdrachten die jullie moeten uitvoeren. Lees eerst de hele opdracht en voer deze dan uit. Er staat ook bij wanneer je de opdracht af hebt. Pas als de opdracht af is, kun je verder naar de volgende opdracht.

Taakverdeling

Een van jullie bedient de muis; de ander leest de taken en samen bepaal je wat je gaat doen in het spel.

Aanwezigheid en beantwoorden vragen door experimenter

Ik ben in de ruimte aanwezig. Ik beantwoord geen vragen, want jullie moeten samen bepalen hoe je speelt. Als je vragen hebt, stel die dan eerst aan elkaar. Waarschijnlijk komen jullie er dan wel uit. Alleen als er een groot probleem is, kan ik helpen.

Uitleg over het spel.

Het spel dat je gaat spelen heet 'Oscar de ballonvaarder en de geheimen van het bos'. In dit spel is Oscar in het bos waar diverse dieren wonen. Het spel is bedoeld om veel te leren over de dieren in het bos. Er zijn 12 spelletjes verstopt in dit spel. De taken vertellen je wat je moet doen.

Je hoeft alleen de muis te gebruiken.

Luister heel goed naar de stemmen in het spel, want deze geven belangrijke informatie.

Vergeet ook niet dat je samen moet spelen en hardop moet praten met elkaar.

Stel dat je per ongeluk uit het spel gaat, dan kun je gewoon weer starten door op het icoontje te klikken.

Als je alle taken hebt uitgevoerd, kun je vragen stellen. Hebben jullie nu al vragen die je wilt stellen?

Succes.

Appendix C: Questions asked of the children

This sheet is used to register the answers the children give when the questions on the sheet are asked.

Groepsnummer	
Naam en leeftijd kinderen	Kind 1: .... (links voor het scherm) .... Kind 2: .... (rechts voor het scherm) ....
Relatie tussen de kinderen	
Spelen vaker spelletjes op de computer	Kind 1: .... Kind 2: ....
Vinden het leuk om spelletjes op de computer te spelen	Kind 1: .... Kind 2: ....

|	
Wat vinden jullie van het spel?	
Wat vinden jullie van de tekeningen?	
Wat vinden jullie van de muziek?	
Wat vinden jullie van Oscar?	
Wat vinden jullie van de spelletjes die je kunt spelen?	
Zou je het spel op school of thuis willen spelen?	
Snap je wat de plaatjes (iconen) onder aan het scherm doen? (screenshot nodig)	
Snap je wat je kunt doen in een scherm? (screenshot nodig)	
Opmerkingen	

Appendix D: Screenshots shown to the children

These screenshots are used when the children are asked the questions that are described in appendix C.

This is a screenshot of the forest. This is the main screen of the game.
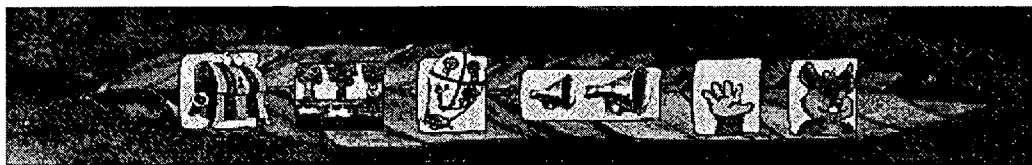
This screenshot shows the icons that are present at the bottom of the screen.

Appendix E: Evaluation session (phase 2)

This appendix gives the steps that are taken in phase 2. In this phase the evaluators observe the videotapes of the children.

Stap 1: Voorbereiding

Van tevoren ontvangen de evaluatoren:
- het spel, zodat ze dit een keer kunnen doorlopen
- de taken die de kinderen hebben uitgevoerd
- tips: waar kunnen de spellen gevonden worden
- planning van stap 2 en 3

De voorbereiding kunnen de evaluatoren zelf doen. De voorbereiding bestaat uit het spelen van het spel aan de hand van de taken die de kinderen uitgevoerd hebben.

Stap 2: Inleiding en introductie heuristics

De onderstaande stap zal klassikaal plaatsvinden en zal ongeveer 2 uur in beslag nemen, exclusief pauze.

Presentatie (de evaluatoren krijgen een hand-out van de sheets)

- wat is de bedoeling van deze stap (10 minuten)

    doel stap 2
    in het kader van mijn afstudeeropdracht
    opzet van stap 2

- uitleg heuristics Nielsen en Malone & Lepper (30 minuten)

    zie document 'Uitleg heuristics'

- uitleg hoe heuristics toepassen (10 minuten)

    er zijn 2 mogelijkheden:
    1. gelijktijdig kijken naar Nielsen en Malone & Lepper; dus gelijktijdig naar fun- en taakgerichte problemen
    2. ~~eerst naar Nielsen kijken en dan naar Malone & Lepper (of andersom); dus eerst naar taakgerichte problemen en dan naar fungerichte problemen (of andersom)~~

- uitleg sheet die moet worden ingevuld (10 minuten)

    Uitleg wat waar ingevuld moet worden en welke opties gekozen kunnen worden, indien van toepassing.

    Toelichting per kolom op papier zetten (zie document 'Datacollection sheet').

pauze

Oefenen (de evaluatoren krijgen een hand-out van de heuristieken, de data collection sheet en uitleg hiervan)

- oefenen met ander product en nabespreken

de opnames van Dave van Breukelen (omdat dit een computerspel is, ongeveer dezelfde leeftijd kinderen betreft, het fun kan meten (zie Kersten-Tsikalkina en Bekker)).

feedback geven over resultaat oefening

Na de eerste oefening wordt deze besproken, waarna een tweede oefening volgt.

- afsluiting van stap 2 (10 minuten)

terugkijken op wat er gedaan is

Stap 3: Evaluatie uitvoeren

Per evaluator wordt de onderstaande sessie gehouden. Eventueel kan per twee evaluatoren gewerkt worden. Iedere evaluator krijgt een pc waarop de video opnames van de kinderen getoond worden. De evaluator is vrij deze opnames te bekijken op zijn manier. De evaluator dient gebruik te maken van de datacollection sheet en deze in te vullen volgens de toelichting.

Tijdsduur: 2½ uur exclusief pauze

- uitleg evaluatie (10 minuten)

korte herhaling van wat de bedoeling is: de datacollection sheet en de heuristics

- evaluatie uitvoeren (2 uur, halverwege wordt een pauze ingelast)

Per paar kinderen is er ongeveer een kwartier opname dat geëvalueerd moet worden. De evaluator krijgt 2 uur om alle vier de paren te evalueren. Tussendoor wordt een pauze ingelast. De evaluatoren mogen terugkijken naar opnames van eerdere groepen indien wenselijk.

- de evaluatoren krijgen:
- cd met videobeelden van kinderen
- datacollection sheet met toelichting
- lijst met de heuristics en de bijbehorende betekenis
- een document met:
  - de gegevens van de kinderen
  - bijbehorende gesproken teksten op papier
  - de vragen en antwoorden die de kinderen gaven na het spelen van het spel
- de taken en scenario's die aan de kinderen zijn gegeven (zie ook stap 1)

- afsluiten van de sessie (10 minuten)

De evaluatoren krijgen een aantal vragen voorgeschoteld.

Appendix F: Norman's seven stages of action

Here the heuristics of Nielsen and the heuristics of Malone & Lepper are arranged per stag of action from Norman's model.

			Nielsen	Malone & Lepper
	Goals			
Before the action takes place *Vooraf (plannen, voorbereiden)*	Intention to act to achieve goals (see, think)	What can I do globally Does it seem to be fun, globally	N1: Visibility of system status N2: Match between system and real world N4: Consistency and standards N5: Error Prevention N6: Recognition rather than recall N7: Flexibility and efficiency of use N8: Aesthetic and minimalist design N10: Help and documentation	Ma: Challenge Mb: Curiosity Md: Fantasy
	Planned sequence of actions (see, think)	What can I do in steps Does it seem to be fun overall (not necessary every step)	N1: Visibility of system status N2: Match between system and real world *N3: User control and freedom* N4: Consistency and standards N5: Error Prevention N6: Recognition rather than recall N7: Flexibility and efficiency of use N8: Aesthetic and minimalist design N10: Help and documentation	Ma: Challenge Mb: Curiosity Mc2: Choice Md: Fantasy

During Uitvoeren	Execution of the action sequence (see, do)	What action do I do, does it contribute to progress Is the action fun to do, does it contribute to fun	N3: User control and freedom N4: Consistency and standards	Ma: Challenge Mb: Curiosity Mc: Control
After the action has taken place Achteraf (interpreteren)	Perceiving the state of the world (see, think)	What happened (task) What happened (fun)	N1: Visibility of system status	Ma3: Performance feedback
	Interpreting the perception (see, think)	What does it mean (task) What does it mean (fun)	N1: Visibility of system status N2: Match between system and real world N3: User control and freedom N4: Consistency and standards N6: Recognition rather than recall N8: Aesthetic and minimalist design N9: help users recognise, diagnose and recover from errors	Ma3: Challenge: Performance feedback Mb: Curiosity Mc: Control Mc3: Power (powerful effects) Md: Fantasy
	Evaluation of the interpretations (see, think)	Did I reach my goal, did I make progress Did I have fun, was it fun to do Do I want to do it again	N1: Visibility of system status	Mc3: Power

Appendix G: Screenshots of the game

These screenshots show the most efficient way of performing task 3 and task 4.

Task 3

This is the forest. This is the main screen of this game. The player can click on the animals in the forest and on the icons.
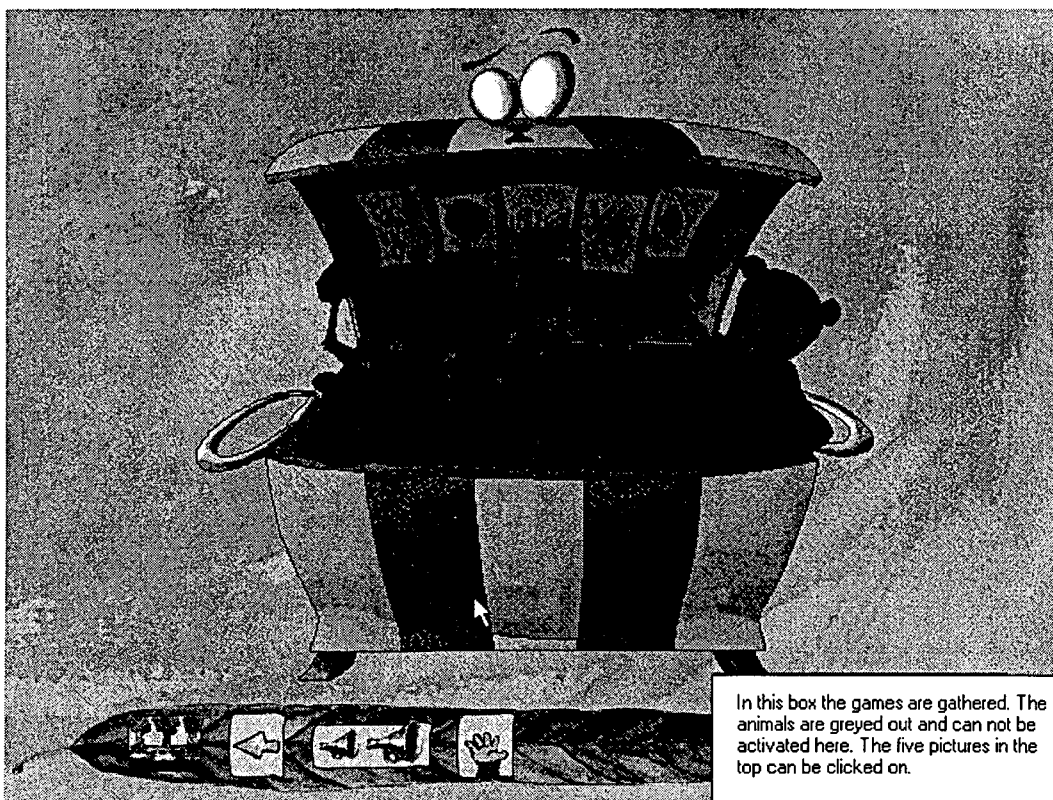
In this box the games are gathered. The animals are greyed out and can not be activated here. The five pictures in the top can be clicked on.

In Carmella, the box, the game with the bed has to be chosen.

In this game the children have to put the animals in the right bed. The clock is the checkpoint which can be activated by clicking on it.
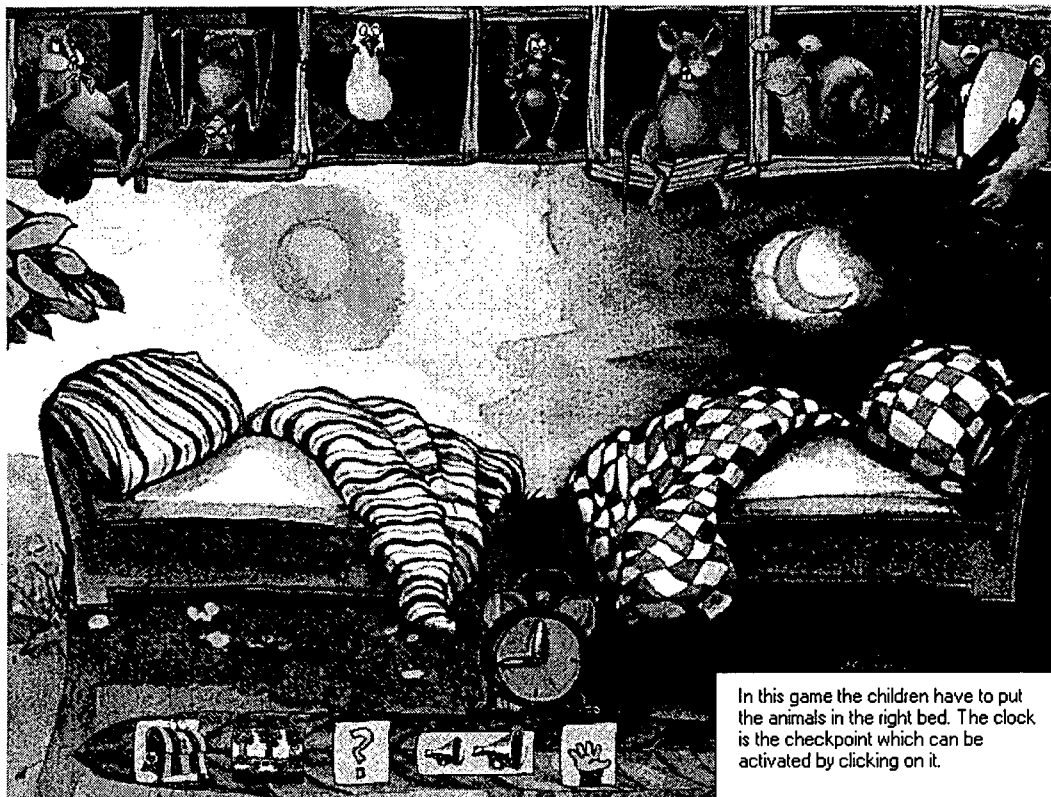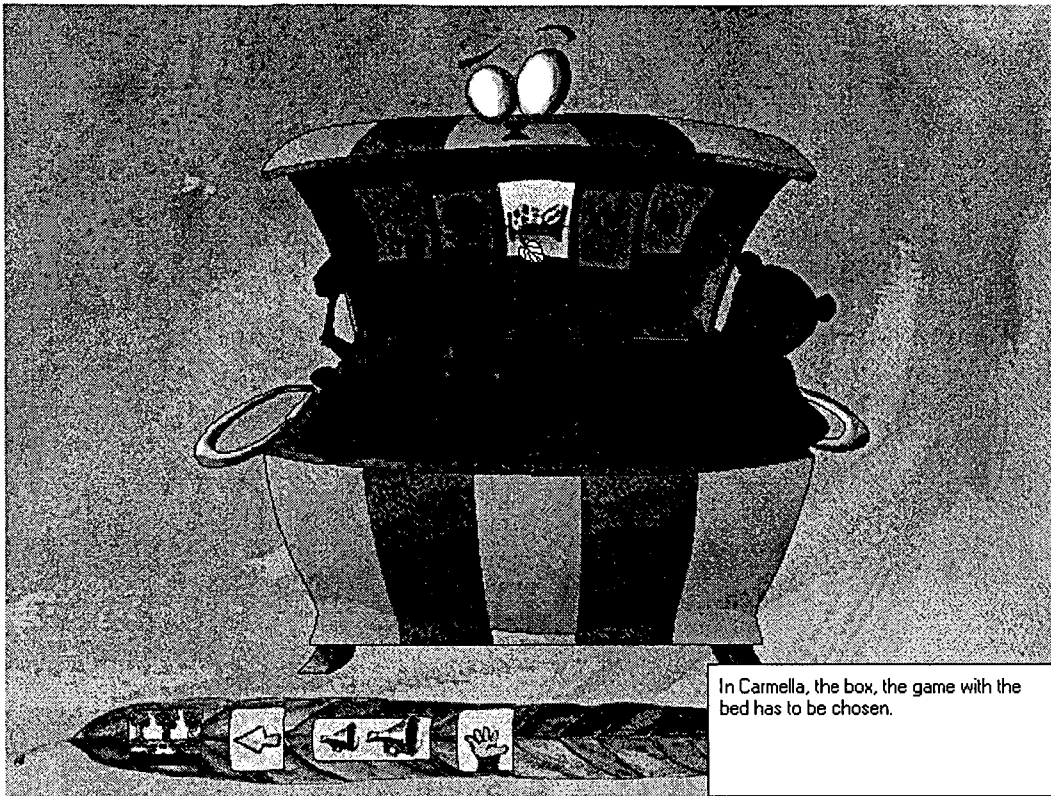
Task 4

This is the forest. This is the main screen of this game. The player can click on the animals in the forest and on the icons.
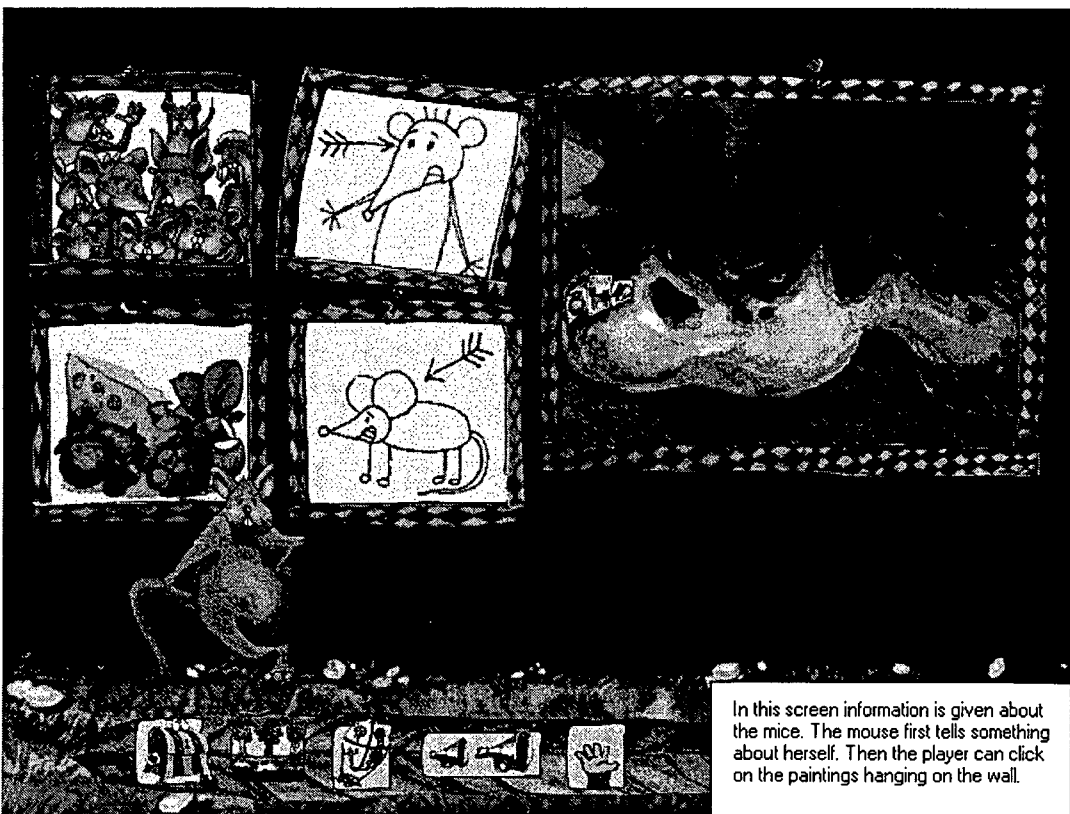
In this screen information is given about the mice. The mouse first tells something about herself. Then the player can click on the paintings hanging on the wall.

After the introduction story about the mice the player can return to the forest. By clicking on the mice again the next screen appears.
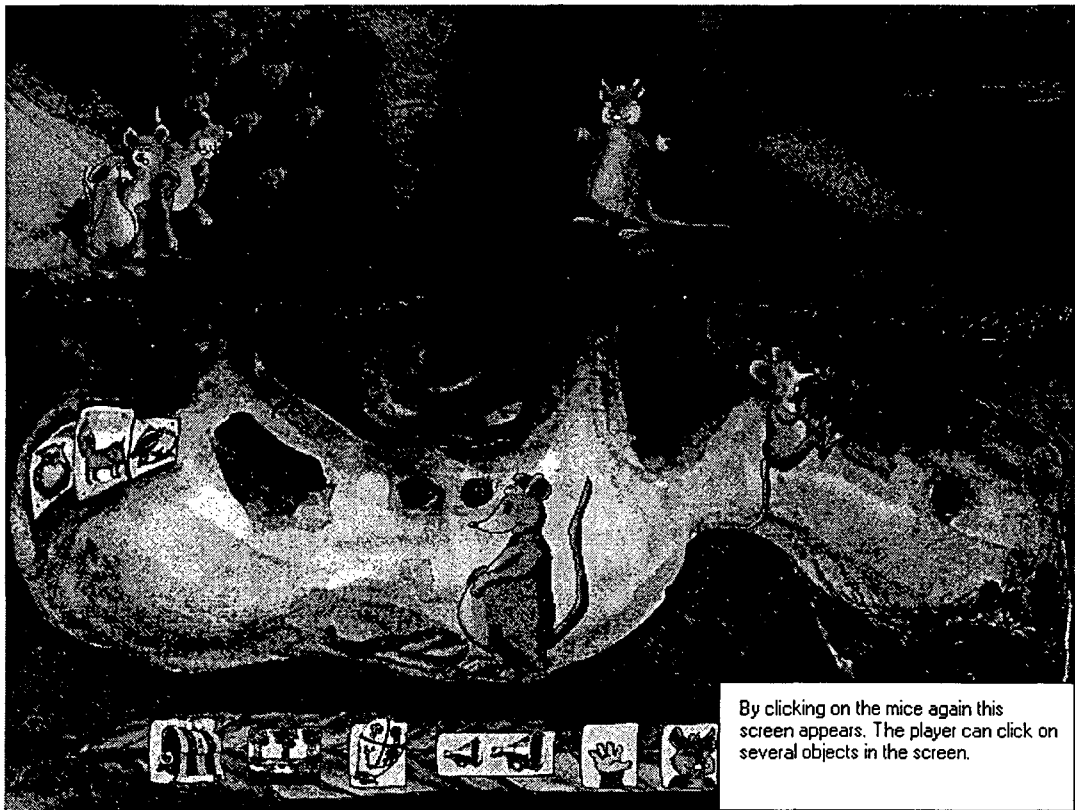
By clicking on the mice again this screen appears. The player can click on several objects in the screen.

By using the balloon the player can change the season. The player is now in the springtime. To find the game the player has to change to the summer.

The player is now in the summer. In this screen the player can click on several options in the screen.
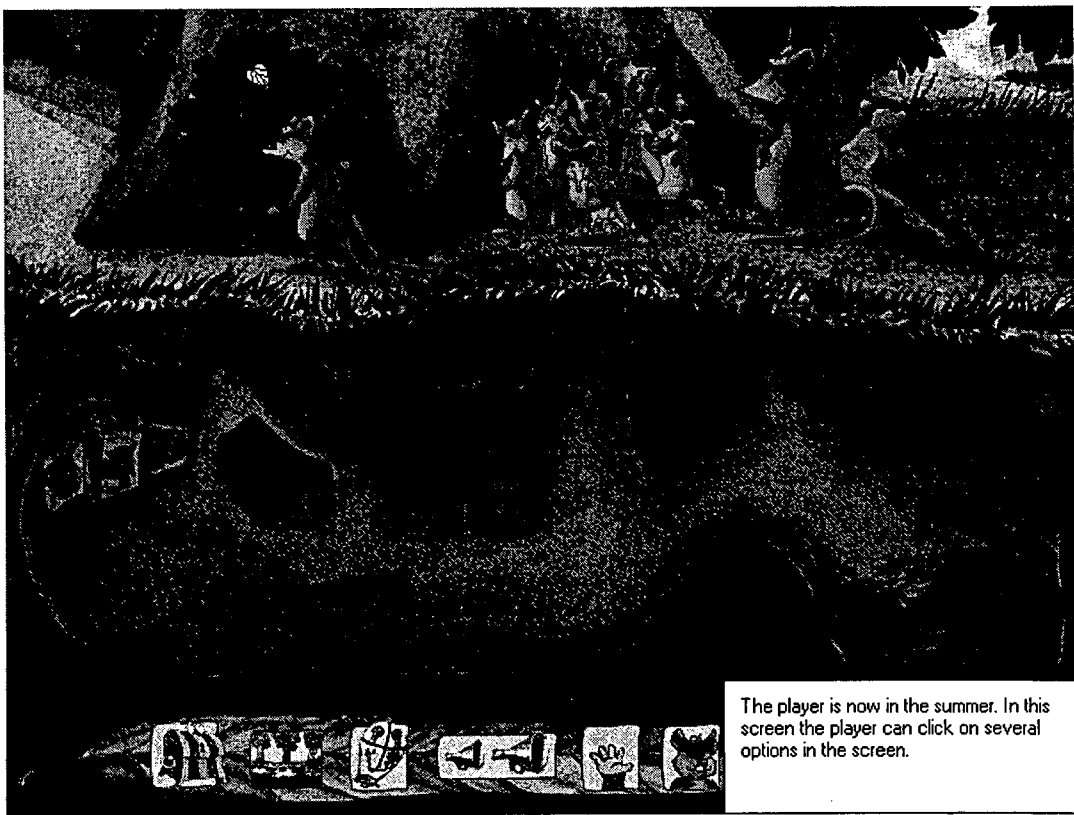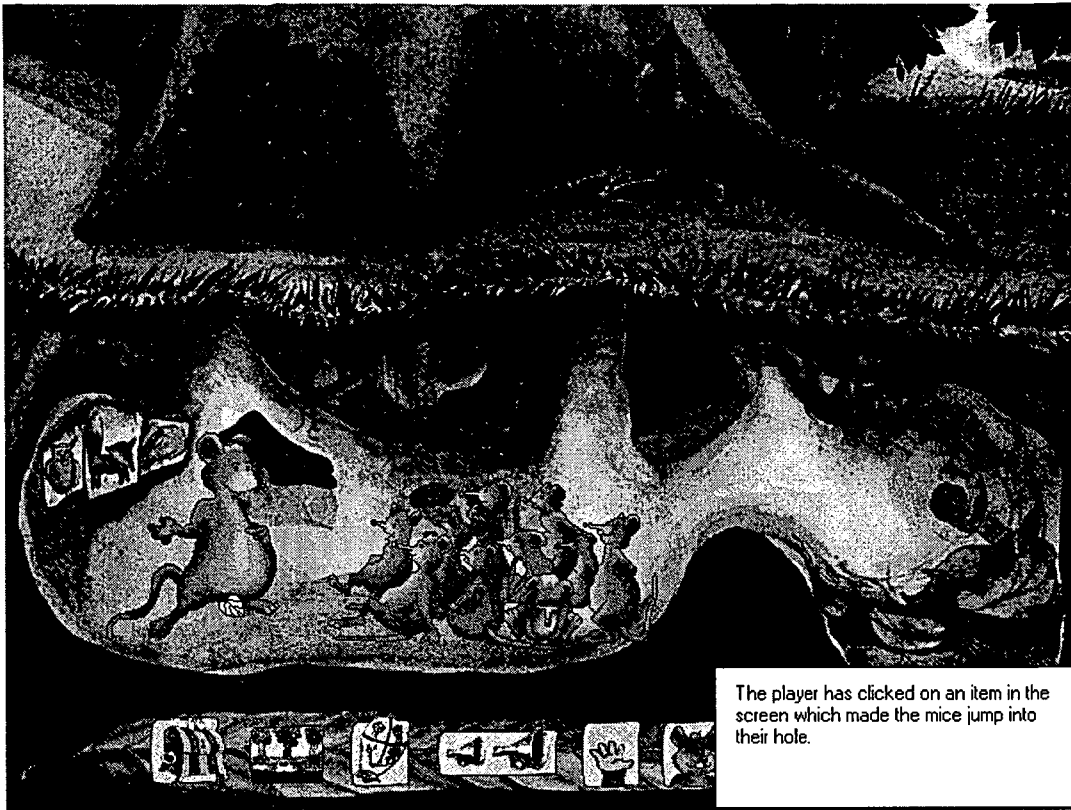
The player has clicked on an item in the screen which made the mice jump into their hole.
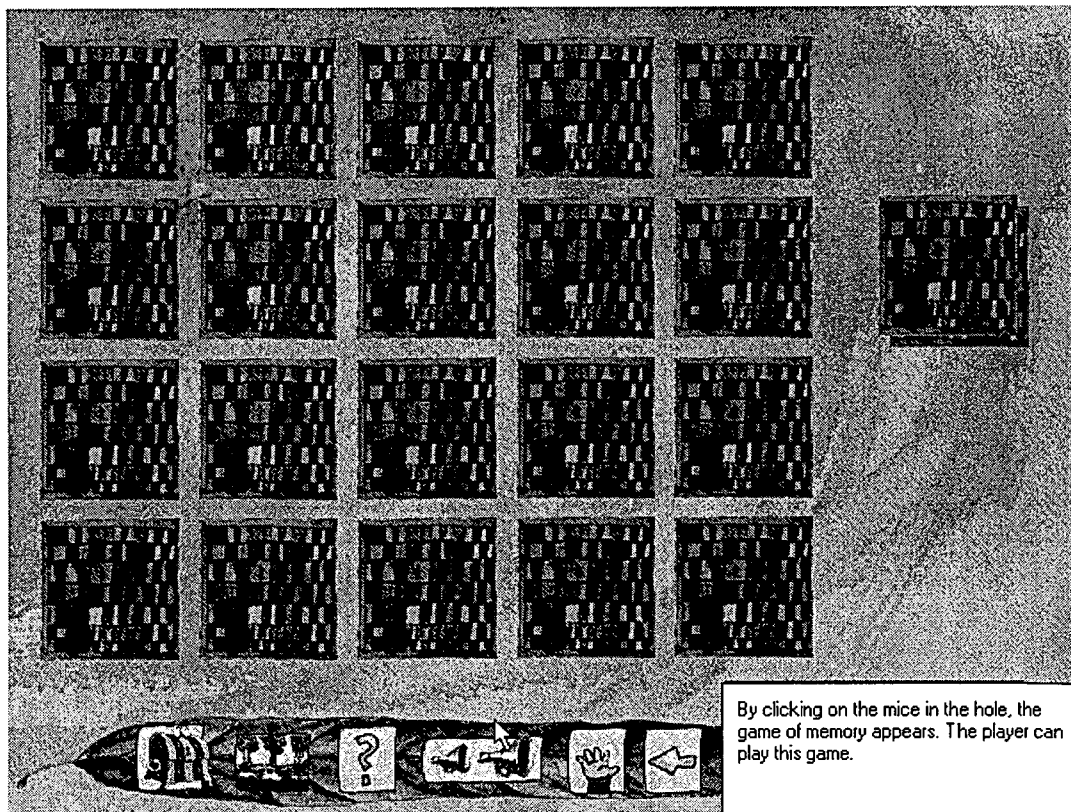
By clicking on the mice in the hole, the game of memory appears. The player can play this game.

Appendix H: Analysis of the reported problems

In this appendix the 31 reported problems are analysed by the author. The author matches the heuristics to the reported cause (freestyle) and the description of the problem.

The name of the first column of the template is a long name 'Description of the problem (observable breakdown (verbal and non-verbal) and the outcome)'. In this appendix the name is shortened to 'Description of the problem', which means less space is occupied.

Task 3: play the game of placing the animals in the right bed.

<u>Forest</u>

Problem 1

Description of the problem	Context	Cause (freestyle)	Cause (heuristieken)	Severity level
zucht (meerdere keren)	bij mannetje in boom	is het niet het goede spel, onduidelijk wat te kiezen	Ma (te moeilijk doel te bereiken), N6	F1, T2
zuchten	als ze weer terug gaan naar het menu (bos)	ze kunnen niet vinden waar ze naartoe moeten	Ma	T2
de een kijkt wat verveeld (al de hele tijd); de ander houdt hand onder de kin, grijpen terug naar de opdracht	mannetje in boom vertelt, specht praat	opdracht schiet niet op, introductie doet niet terzake voor de opdracht	Ma1	F1

After: interpretation

The children are searching for the game and have chosen an option that is not correct. So, they made a mistake determining what to click on. Since they are searching for quite some time now, their reaction is understandable.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

The children make this mistake, because it is not clear to them where to find the game. The cause of this problem is not in this phase of Norman's seven stages of actions. The problem is caused by making the wrong choice. Making the wrong choice is caused by a violation of Nielsen's heuristics *Error prevention* (N5), *Help and documentation* (N10) and *Visibility of system status* (N1). The children do not get any help or clues to find the game. And there is no prevention from making this error.

Since the children just started searching for the game and continue searching for it, Malone & Lepper's *Challenge* (Ma) is not too much. It is still fun playing the game and searching for the particular game to play.

The evaluators use the heuristics Ma, Ma1 and N6. The choice for Ma and Ma1 is understandable, it is possible that the challenge is too much. In this case, though, the challenge is not too much, for the children continue searching. N6 is not used correct: the pictures are not unclear or unrecognisable. The problem is that they do not know what to click on to find the game. The severity of the problem is rated as a 'minor annoyance' and a 'problem caused error', which means the problem is serious, but not too bad.

Therefor, this problem is a usability problem, but not a fun problem. The task progress is delayed, but the fun is not negatively influenced.

Problem 3

Description of the problem	Context	Cause (freestyle)	Cause (heuristieken)	Severity level
"zoek jij het maar"	na een aantal keer geprobeerd te hebben, geeft het ene meisje op	duurt te lang om het spel te vinden	Ma, N6	F1, T2
fronst wenkbrauwen "spelletjes, zoek jij ze maar"	wat heerlijk het is lente	taak lukt niet	N5	T3

Beforehand: sequence of actions

The children have tried several options to find the game. And they still have not succeeded. They do not know what to click on anymore. It takes too long to find the game. One of the children gives up and wants the other child to search for the game.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

Nielsen's heuristics *Error prevention* (N5), *Help and documentation* (N10) and *Visibility of system status* (N1) are violated. The children are not able to find the game, because there is no help or there are clues on the screen that help them to find the right option. The game also does not prevent the player from making the wrong choices.

The problem has also effect on fun: Malone & Lepper's *Challenge* (Ma) is too much, one child gives up and wants the other child to find the games. She does not want to look for it anymore. This makes it no longer fun to search for the game.

The evaluators use the heuristics Ma, N5 and N6. The first ones are used correct. N6 is used incorrect: it is not the recognition that is the problem here, but it is the unclearness which option to choose that is the problem. Ma and N5 are used legitimate. The severity of the problem is different: from a 'minor annoyance' to a 'task failure'. One of the children gives up which is a 'task failure'. A 'minor annoyance' is an understatement for this problem.

The conclusion is that this problem is a serious usability and fun problem: one of the children gives up, because they do not make progress with the task, and because they do not have fun anymore.

Problem 19

Description of the problem	Context	Cause (freestyle)	Cause (heuristieken)	Severity level
"we kunnen het spel niet vinden" (komt nog veel vaker voor)	na Vladimir geven ze het op	onduidelijk hoe en waar je de spelletjes moet zoeken	Ma (ze kunnen hun doel niet bereiken)	F3
willen doorgaan, zeggen dat ze het spel niet kunnen vinden	kunnen spel niet vinden, gaan volgende opdracht lezen	te moeilijk	Ma	T3
opdracht nog een keer, onderzoeker geeft tip	kinderen zeggen dat ze het niet kunnen vinden	spel geeft te weinig clues	Ma2, N1	T2,T2

Beforehand: sequence of actions

The children have tried several options to find the game and try another one by clicking on one of the animals. It turns out that this also is not the game they are looking for.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

The children can not find the game, for they do not get help or clues on the screen to find the right option. The game also does not prevent the player from making the wrong choices. The game violates Nielsen's heuristics *Error prevention* (N5), *Help and documentation* (N10) and *Visibility of system status* (N1).

The children give up searching for the game, which means they probably do not have fun playing anymore. The *Challenge* (Ma) of finding the game is too much.

The evaluators use the heuristics Ma, Ma2 and N1. These heuristics are used correct. The severity rating is high: problem caused failure to 'task failure'. Since the children give up the severity rating should be high.

This problem is a serious usability and fun problem which influences the task progress and the fun aspect negatively.

Problem 24

Description of the problem	Context	Cause (freestyle)	Cause (heuristieken)	Severity level
"die spelletjes zitten wel erg verstopt"	als ze op de dieren klikken om het spel te vinden	spelletjes zijn moeilijk te vinden	Ma, N6	F3 (als ze geen hulp gekregen hadden), T2
"spelletjes zitten wel lekker verstopt" (2x)	terug in het bos	kunnen spellen niet vinden	Mc of Ma, N1	T3, T3
"spelletjes zitten wel heel goed verstopt in het bos"	bij verhaaltje	kinderen kunnen de spelletjes niet vinden	Ma	T1

Beforehand: sequence of actions

The children have tried several options to find the game and have clicked on every picture they could click on. And they still have not succeeded in finding the game. They have returned to the forest to look for the game.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

Nielsen's heuristics *Error prevention* (N5), *Help and documentation* (N10) and *Visibility of system status* (N1) are violated. The children can not find the game, for there is no help or clue available on the screen. The game also does not prevent the player from making the wrong choices.

The children do not give up, so Malone & Lepper's *Challenge* (Ma) turns out to be not too much. The children continue searching for the game.

The evaluators use the heuristics Ma, Mc, N1 and N6. Ma and N1 are used correct. Mc is not an issue, there are enough possibilities for the children to try, which means they have enough control over the game. N6 is also not used correct: the pictures are recognisable and have not to be guessed. The severity rating is very different. In this case a 'minor annoyance' would be suitable.

This problem is a usability problem, but not a fun problem, for the children still have fun playing the game.

Problem 17

Description of the problem	Context	Cause (freestyle)	Cause (heuristieken)	Severity level
"Mathilde, waar is het spelletje"	begin van het spel	niet meteen duidelijk waar spellen zijn	Ma	T3
"is het dit, Mathilde?"	bij koffer	niet duidelijk wat het is	N1	T2
kind vraagt veel aan onderzoeker	spel zoeken	onzeker over spel of gewoon graag vragen		T1

Beforehand: sequence of actions

The children have just started the game and immediately ask questions to the experimenter.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

Since the children only just started working on the task, they may have a small problem finding the game, which means the game is violating the heuristics *Error prevention* (N5), *Help and documentation* (N10) and *Visibility of system status* (N1). There is no help or clues on the screen that help the players find the right option. The game also does not prevent the player from making the wrong choices.

Concerning the heuristics of Malone & Lepper, there is no real problem. In this phase of searching the game, the *Challenge* (Ma) certainly is not too much. So, the fun aspect is not negatively influenced.

The evaluators use the heuristics Ma and N1. One evaluator does not assign a heuristics to this problem, for he may find no heuristics suitable for this problem. The use of Ma is understandable, but in this phase of playing determining that the challenge is to much is a bit too soon. N1 is used correct. The severity levels are rated very different: from a 'minor annoyance' to 'task failure'. Since the children have only just begun playing the game and have not tried many possibilities, the severity of this problem is a 'minor annoyance'.

The problem mentioned here is a usability problem, but not a fun problem. The children have just started playing and still have fun searching for the game.

Problem 2

Description of the problem	Context	Cause (freestyle)	Cause (heuristieken)	Severity level
kijkt weg, trekt met ogen	bij de vleermuizen	Fladdert teveel? Onduidelijk wat ze er zo erg aan vindt	Mb (geluid of beweging vervelend)	F1
kijkt heel verveeld, draait rond met haar hoofd	ze hebben de vleermuis aangeklikt	Verkeerde knop	N5	T3

After: interpretation

Children are searching for the game and have clicked on something that appears not to be the game.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

The cause (freestyle) described by the evaluators is very different:

- The first line is about not liking what they see: the *Curiosity* (Mb) is not stimulated in a positive way. So, there is a fun problem. But the evaluator is not sure if this is the cause of the problem, for he writes a question mark.

- The second line says something about the cause (freestyle) being a wrong button that is clicked. Because the children made the wrong choice, this problem occurs. The problem is caused by the violation of Nielsen's heuristics *Error prevention* (N5), *Help and documentation* (N10) and *Visibility of system status* (N1): there is no help and there a no clues on the screen to help the children. Also to prevent the children from making this mistake is not handled very well.

  Since the children keep searching for the game, the *Challenge* (Ma) is not too much. Which means that there is not a fun problem.

The first line rates the severity as a 'minor annoyance', which means that the problem is not too big.

The second line rates the severity as a 'task failure'. This is a very high rate which is not very relevant here. The children pushed the wrong button, but there are enough possibilities to straighten this problem out.

It is hard to conclude if the problem here is a usability and fun problem, for the evaluators describe two totally different causes for this problem. It is rated, though as a usability and fun problem. The severity is on level 1, minor annoyance.

Problem 18

Description of the problem	Context	Cause (freestyle)	Cause (heuristieken)	Severity level
in ogen wrijven en gaan verzitten	bij Vladimir de Vleermuis die ene verhaaltje vertelt	niet leuk om te luisteren, willen zelf iets doen (om het spel te vinden)	Mc2 (zelf geen controle, moet wachten)	F1
wenkbrauwen fronsen	als vleermuisverhaal lang duurt	lang verhaal	Ma, N8	F1, F1
kinderen moeten wachten op intro maar willen eerder iets doen	zitten bij Vladimir	kunnen intro niet skippen of weten niet hoe dat moet	Mc, N3	T1, T1
kijken moeilijk, hand voor de mond, draaien	Vladimir	uitleg / verhaal Vladimir is geen spel	N9	T2

After: interpretation

The children have clicked on one of the animals in the forest. A story about the animal is started. While the story is running, the input device is enabled. The children can not cancel or stop the story.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

Nielsen's heuristic *User control and freedom* (N3) is violated. The player can not use an 'emergency exit' to leave this part of the game.

Malone & Lepper's heuristic *Control* (Mc) is violated, since the players do not have control on their part. This makes the game less fun.

The evaluators use the heuristics Ma, Mc, Mc2, N3, N8 and N9. Mc, Mc2 and N3 are used correct. Ma is not a problem here, there is no challenge watching and listening to the story. The story gives no irrelevant information (N8), because it teaches children about the animals in the forest. The problem also is not about recovering from an error (N9), because no error is made. The severity level is rated as a 'minor annoyance' for this problem.

Both progress in task and fun are negatively influenced, which makes this problem a real usability and fun problem with a severity rating of "minor annoyance".

Problem 22

Description of the problem	Context	Cause (freestyle)	Cause (heuristieken)	Severity level
Op elleboog hangen, rondkijken, verzitten	bij het verhaal over de dassen (komt ook bij andere verhaaltjes voor)	vervelend om zelf niks te doen en te moeten wachten	Mc (geen controle, wachten), Mb (geen interessant topic?)	F1
"ga maar weer terug"	verhaal das	dit duurt te lang	Ma, N8	F1, F1
Kind gaat achterover zitten	bij verhaaltje	te lang / verveeld?	Mb, N8	F1, F1
Kijkt naar camera, hand onder kin "ga maar weer terug"	dassen verhaal	vinden het saai? Duurt te lang?	Mb	F1

After: interpretation

The children are searching for the game in which they have to put the animals in the right bed. They click on the animals in the forest. A story about the particular animal is started. While the story is playing the input device is disabled. The children can not stop or cancel the story.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

The children have no control over what is happening. Nielsen's heuristic *User control and freedom* (N3) is violated. Aesthetic and minimalist design (N8) is not violated, since the story enlarges the knowledge of the children. In this study, though, they are not interested in the story very much, for their task is to find a game.

Malone & Lepper's heuristic *Control* (Mc) is violated. The children can not control the game. According to the evaluators it is also a possibility that the children find the story boring, which influences Malone & Lepper's *Curiosity* (Mb). Both Control and Curiosity are influences negatively which causes the game to be less fun.

The evaluators use the heuristics Ma, Mb, Mc and N8. Ma and N8 are used incorrect: challenge is no problem, for this problem has nothing to do with the game being too easy or too difficult. Also, the children have determined to find the game (goal), and performance feedback and uncertain outcome are not a problem in this case. Aesthetic and minimalist design is also no problem: the story enlarges the knowledge of the children. If the children have had different tasks, they may have been interested in this information. The evaluators rate the severity level low, which means that the problem is a usability problem of a 'minor annoyance'.

This problem is a usability and fun problem, since it influences the progress with the task and the fun-aspect negatively. The severity rating of this usability problem is a 'minor annoyance'.

Problem 25

Description of the problem	Context	Cause (freestyle)	Cause (heuristieken)	Severity level
Kijken verveeld, zitten aan neus, t-shirt te trekken	verhaal eekhoorn	duurt te lang	Ma, N8	F1, F1
kind kijkt moeilijk / verveeld. Zit aan t-shirt, gaat achterover zitten	bij verhaaltje	weer een lang verhaal	Mb2, N8	F1, F1
moppert wat, hand op het hoofd, kijkt verveeld, hand onder shirt	Eekhoorn	vinden het saai? Duurt te lang?	Mb	F3

After: interpretation

The children are searching for a game. They have clicked on one of the animals in the forest. An introduction story starts playing. The input device is disabled while the story plays. The children can not cancel or stop the story.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

Nielsen's heuristics *User control and freedom* (N3) is violated, since the children do not have any control or 'emergency exit' to cancel the story.

Malone & Lepper's *Control* (Mc) is violated, since the children have no control. Because of the evaluators finding a possible cause in the story being boring, *Curiosity* (Mb) may also be a problem. The children are not interested in what is happening on the screen. This influences fun in a negative way.

Nielsen's Aesthetic and minimalist design (N8) is not violated. The story contributes to the knowledge of the children. In this study children have different goals: they want to find the game and not listen to the information that is given in the story.

The evaluators use the heuristics Ma, Mb, Mb2 and N8. Ma is not an issue for this problem: the challenge of the story is not too much or too little. The children experience no problem with the performance feedback or an uncertain outcome. Mb is used correct. N8, aesthetic and minimalist design is no problem: the story contributes to the game, for it teaches children about the animals. The severity level is very different: 'minor annoyance' and 'task failure'. 'Task failure' is rated too high for this problem, a 'minor annoyance' suites the problem much better.

The problem is a usability and fun problem, for it influences task progress and fun both in a negative way.

Problem 23

Description of the problem	Context	Cause (freestyle)	Cause (heuristieken)	Severity level
"dit vind ik niet echt mooi, dat zwarte beeld"	tussen elke beeldverandering krijg je een zwart scherm, een wekker en een stem	esthetisch niet aantrekkelijk	Mb1, N8	F1, T1
"dat vind ik niet mooi.....; waar is het spel nou"	verhaal eekhoorn	kunnen spellen niet vinden	Mc of Ma, N1	T3, T3
"dit vind ik niet mooi, zwart veld en dan zeggen ze al wat"	bij verhaaltje	systeem werkt niet synchroon	N1	T1, F1
"dat vind ik niet mooi, dat zwarte beeld"	Specht	esthetisch	Mb1	

After: interpretation

The children have clicked on one of the animals in the forest. The story about the animal is started. The animal starts talking almost immediately, but it takes a while before the picture of the animal appears. It looks like this is not synchronous. The children can not cancel this, because the input device is disabled.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

This problem violates Nielsen's heuristics *Aesthetic and minimalist design* (N8), since this is not relevant for the game. It is more disturbing than functional. It is also possible that *Visibility of system status* (N1) is violated, since the children do not see what is happening on the screen, they see a black screen for a few seconds. Because the input device is disabled, *User control and freedom* (N3) are also a problem: the user can not control the game.

It violates Malone & Lepper's *Curiosity* (Mb), especially the sensory curiosity (Mb1), for the audio and visual effects are not attractive. Therefor it influences fun negatively. Also *Control* (Mc) is influenced negatively, because the children have no control over what is happening.

The evaluators use the heuristics Ma, Mb1, Mc, N1 and N8. N1, N8, Mb and Mc are used correct. Ma is not an issue, challenge is not a part of this problem. It is not a challenge to listen to the story and watch an initially black screen. The severity level gives a 'minor annoyance' and a 'task failure'. The 'task failure' is too strong, the 'minor annoyance' is more applicable. It is annoying that the pictures and the audio do not start at the same time.

This problem is a usability and fun problem, for the fun aspect and the task progress is disturbed.

Game 'put the animals in the right bed'

Problem 11

Description of the problem	Context	Cause (freestyle)	Cause (heuristieken)	Severity level
"ah!" als het spel niet goed is (2x)	de dieren zijn niet helemaal goed naar bed gebracht en springen terug	feedback is niet erg motiverend	Ma3	F1
"oh, nou" (2x)	als het fout is	alle dieren gaan terug, die goed zijn blijven niet staan	Mc, N8	F1, T1
"tss, nou"	na tweede keer niet goed	helaas, nog een keer proberen. Niet aan het spel, gewoon niet leuk		F1
kijken moeilijk, een begint met neuspeuteren	spelletje voor de 2e keer	eerste keer niet goed	Ma3	F1
"yes ..... Aah"	spelletje voor de 3e keer	denken dat het goed is, blijkt niet goed	Ma3	F1

After: interpretation

The children are playing the game in which they have to put the animals in the right bed. When they have placed all the animals in the bed, they click on the alarm clock. That is the sign for the game to check the result. It appears that not all animals are in the right bed. All the animals are returned to the starting position and the children have to start all over again.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

Nielsen's *Help users recognise, diagnose and recover from errors* (N9) is violated. The children do not get enough information to recover from their error.

In Malone & Lepper, the *Challenge – performance feedback* (Ma3) is poor. The children do not give up on the game, so maybe the performance feedback is not that bad, because they still have fun trying to put the animals into the right bed. The fun aspect deteriorates very fast each time the animals are returned to the starting position. Which means that Challenge is becoming a real problem, and fun is getting less each time the clock is consulted.

In the questionnaire afterwards, the children say they do not mind if all the animals are returned to the starting position, more games work like that.

The evaluators use the heuristics Ma3, Mc and N8. Ma3 is used correct, even though fun is not yet diminished to an unacceptable level. Mc and N8 are used incorrect: Control (Mc) is not a problem here, the children have control over what happens. The aesthetic and minimalist design (N8) is also not a problem, since returning the animals to their starting positions is something functional, even though it would be more useful if the animals that are in the right bed would stay there and only the wrong ones return to the starting position. But then the game may become too easy. The severity rating is 'minor annoyance', which suites this problem.

This problem is a usability and fun problem, even though it is not yet very serious. But it can become a serious problem when children are not able to put all the animals in the right bed. Therefor some help after a few trials would be useful.

Problem 12

Description of the problem	Context	Cause (freestyle)	Cause (heuristieken)	Severity level
het klikken op de wekker werkt niet	na het naar bed brengen, proberen ze op de wekker te klikken	systeemfout ?	N5	T3
"kan niet meer op wekker klikken"		bug		T3
"klikt niet op wekker"	kind probeert op de wekker te klikken	net er naast ofzo, wil in ieder geval iets wat niet kan	N3	T2
"he mag ik eens", de een neemt de muis over "hij klikt niet"	spelletje voor de 4e keer	?		

After: interpretation

The children are playing the game where they have to put the animals into the right bed. When they have put all the animals into the bed, they have to click on the alarm clock. In this case they click on the alarm clock but the clock does not react anymore. This is a bug in the game.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

The children have chosen the right option. So Nielsen's heuristic Error prevention (N5) is not violated. But *Help users recognise, diagnose and recover from errors* (N9) is violated. The children can not do anything anymore, because the game does not react to their actions because of the bug. It is also a problem concerning the heuristic *User control and freedom* (N3), since the user is not given any 'emergency exits' to leave this unwanted state.

Malone & Lepper's *Control* (Mc) is violated. The user has no longer control over what is happening. This makes the game less fun.

The evaluators use the heuristics N5 and N3. Some of the evaluators leave the box for the heuristics empty, probably because they can not find a heuristic that suites this problem. N5 is used incorrect, the children click on the clock which is a correct action. The clock does not work, which is a bug. N3 is used correct. The severity of the problem is rated high: from an error caused failure to a 'task failure'. The problem is rather severe, so the rating seems correct.

The problem is a usability and fun problem, both task and fun are negatively influenced.

Task 4: playing the game of the mice

<u>Forest 1</u>

Problem 4

Description of the problem	Context	Cause (freestyle)	Cause (heuristics)	Severity level
"ik weet niet zo goed wat er bij muizen hoort" en frons	op het scherm met de kist	onduidelijk wat welk spel is	Ma, N6	F1, T2
"ik weet niet zo goed wat er bij de muizen hoort"	als ze muizenspel aan het zoeken zijn	onduidelijk waar muizenspel is	Ma	T3
"ik weet niet zo goed wat er bij de muizen hoort"	kist	hints in kist zijn niet zichtbaar	N8	T2

Beforehand: sequence of actions

The children are trying to find the game. They have tried several options in the forest and are now checking the possibilities in the box (the box is named Carmella), this is also no success. They say they have no clue what belongs to the mice.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

Taking the heuristics of Nielsen into account this problem is a usability problem, since the heuristics *Error prevention* (N5), *Help and documentation* (N10) and *Visibility of system status* (N1) are violated. The children are not able to find the game, for there is no help-option to consult and there are no clues on the screen that can help them. Also the user is not prevented from making the wrong choices.

Considering Malone & Lepper, this problem not necessarily is a usability problem: as long as the children make progress, for example by gaining knowledge, this problem does not have to intervene with fun. If the *Challenge* (Ma) of finding the game is too big, this problem is a real usability problem. At this point children are still continuing the search for the game. This could mean that they make progress: they learn what not to click on and therefor continue trying different options. What keeps them going is the possibility that they will find the game. Based on this the conclusion is that the challenge is not too much.

The causes described by the evaluators say something about Nielsen's heuristics *Match between system and the real world* (N2) and *Recognition rather than recall* (N6). Because the children do not recognise what is in the box, they are not able to find the game. If N2 and N6 are not violated too seriously, it may have positive influence on *Challenge* (Ma) and *Curiosity* (Mb): if the meaning of the picture is not clear, it could be interesting to find out what it is and what it does. In this case the children continue searching for the game, which means that Challenge and Curiosity are not violated.

The evaluators use the heuristics N6, Ma and N8. N6 is used correct, as described above. The severity rating T2 indicates that the problem is a 'problem caused error'. The evaluators use Ma which is understandable, but challenge is not a problem in this case. The severity level used indicated the problem is a 'minor annoyance'. Severity level T3 is far too high for this problem. The use of N8 is not in place for this problem: the pictures in the box are useful for this game, the children only need to learn how to use the pictures. The pictures certainly are not irrelevant.

A valid conclusion is that at this point the game is still fun, even though the particular game has not been found yet. This is a usability problem.

Problem 5

Description of the problem	Context	Cause (freestyle)	Cause (heuristics)	Severity level
"ts, dat is toch geen spel!" handen voor ogen	klikt op iets in het overzichtsscherm	onduidelijk wat voor activiteit je waar moet zoeken (ander meisje legt het wel uit)	Ma, N6	F1, T2
"He, dat is toch geen spel!"	als ze weer op iets fout geklikt hebben	ze kunnen muizenspel niet vinden	Ma	T3
Kinderen doen hand voor hun gezicht en roepen uit "dat is toch geen spel"	drukken op verschillende spelletjes	onzinnige info voor het spel	Ma3, N8	T1, T1
"dat is toch geen spel, we moeten een spel, dan moet je eerst naar het koffertje gaan"	het bos popt op	denken dat spelletjes alleen in de koffer zitten	Mb1	F1

After: interpretation

The children do not see how to find the games. They have tried the box and several options in the forest, but still no success. They clicked on an option and conclude that that is no game.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

The children made the wrong choice, which they conclude when the new screen appears. Taking the heuristics of Nielsen into account, there is no heuristic violated that belongs to this phase of Norman. One could say that the children made the wrong choice for there is a problem with the heuristics *Error prevention* (N5), *Help and documentation* (N10) and *Visibility of system status* (N1). These heuristics belong to the phase of Norman when the children plan the sequence of actions. In that phase the problem is caused: there is no prevention for the children to make the wrong choices, there are no help options and there are no clues on the screen to help them make the right choice.

Malone & Lepper's *Challenge* (Ma) is not violated, since the children continue searching for the game after they diagnose this screen is also not the game. They have had a little repercussion, but they continue searching for the game. The children expected a different effect, which concerns *Power* (Mc3). Power is influenced in a negative way. The children are not interested in what is happening on the screen, which violated *Sensory Curiosity* (Mb1). This could be different if the children had different tasks. In this case they had to find a game, which they were focused on. Therefor ending up in a screen that is not the particular game is not a positive move. But the children continue searching for the game, which means that fun is not effected negatively.

The evaluators use the heuristics Ma, Ma3, Mb1, N6 and N8. Using Mb1 is correct. The use of Ma is understandable, since Challenge is present, but it does not cause this problem. In two of the three cases, Challenge scores 'minor annoyance' on the severity rating. T3 is used once, which indicates the problem is far worse than it really is. N6 and N8 are not applicable for this problem. The children recognise the screen and come to the conclusion that this is not the right one. So, there is no problem with recognition rather than recall (N6). Also, the picture on the screen is not irrelevant: the screen gives the children new information which they could consume if they were interested. The information is relevant for the goal of the game.

In this case Nielsen would say it is a usability problem, and the fun is influenced negatively. This is a usability and fun problem. The severity level is a minor annoyance.

Introduction mice

Problem 6

Description of the problem	Context	Cause (freestyle)	Cause (heuristics)	Severity level
draait zich af als het verhaal / animatie te lang duurt	verhaal door muizen	te weinig controle, geen interesse om het hele verhaal te horen	Ma1 (geen goal uit zichzelf) of Mc (geen controle)	F1
kijken naar buiten (2x)	als ze weer op muizen geklikt hebben	weer intro verhaal (zijn verveeld)	Ma	F1
kind leunt achterover en kijkt weg, andere kind kijkt ook weg	de muizen vertellen wat	het spel lijkt minder te boeien	Mb	F1

After: interpretation

The children are searching for the game and clicked on the mice. The introduction story about the mice is started. In this story the animals give information about how they live, what they eat and so on. The input device is disabled while the story is running.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

Nielsen's heuristic *User control and freedom* (N3) is violated. The user can not leave the unwanted state, there is no 'emergency exit'. This means there is a usability problem.

Malone & Lepper's *Control* (Mc) is violated: the user does not have a feeling of self-determination and control. He can not stop the story, he is forced to listen to it. The children are not interested in the story, which violates *Curiosity* (Mb), especially cognitive curiosity.

Aesthetic and minimalist design (N8) is not violated, since this game is designed to teach children about animals. The stories contribute to the teaching. In this case the children are not interested in the story, they want to find the game. If the story was interesting enough and contributed to the children's goal of finding the game, it might have been a different situation.

The evaluators use Ma, Ma1, Mb and Mc. Mb and Mc are used correct. The severity rating is F1 which means the problem is a 'minor annoyance'. Challenge (Ma) is not an issue for this problem, it is not too easy of too difficult to listen to the story. There is no problem with determining the goal of finding the game, there is no problem with the performance feedback and the uncertain outcome. The children have determined the right goal, but are now a bit delayed in reaching that goal. This delay is not necessarily a problem.

In this case both task and fun are violated: there is no progress in the task and the player does not enjoy listening to and viewing the story. The children do not make progress in fun, because they are not interested in listening to the information. Taking the severity ratings into account, the problem is not too bad, it is rated as a 'minor annoyance'. If the children were interested in learning about the mice, the problem would be less severe, or would be no problem at all.

Problem 26

Description of the problem	Context	Cause (freestyle)	Cause (heuristieken)	Severity level
zitten aan haar	verhaal muis	te lang	Ma, N8	F1, F1
kind gaat weer achterover zitten	bij verhaaltje	weer een lange intro	N3, N7, N8	F1

After: interpretation

The children clicked on the mice after they have tried several other animals in the forest. By clicking on the mice a story about the mice is started. The children have seen several of these stories, by now, and are not interested.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

Nielsen's heuristics *User control and freedom* (N3) is violated. The user has no 'emergency exit' to leave this state, since the input device is disabled.

Aesthetic and minimalist design (N8) is not violated, since the stories contribute to the knowledge of the children. If the children had different tasks to work with, they might have been interested in the stories.

Malone & Lepper's *Control* (Mc) is violated for the same reason as Nielsen's heuristics: the children have no control over what happens. This causes less fun when playing the game. In this case, the evaluators have not been to clear in their description of the cause (freestyle) whether or not the children find the story interesting. This may be the case, which means that Malone & Lepper's *Curiosity* (Mb) is also violated.

The evaluators use different heuristics: Ma, N3, N7 and N8. N3 is used correct, as can be read above. The other heuristics are not appropriate for this problem. There is no challenge considering this problem: the children have determined the right goal of finding the game, the get proper feedback for they can see this is not a game, there is still a uncertain outcome, since the children do not know if they will find the game and if they will be able to play it. This problem has nothing to do with Nielsen's Flexibility and efficiency of use (N7) for the children have no control to use accelerators. N8 is not an issue, as is described above. The problem is rated on severity level 1, which means the evaluators find the problem a 'minor annoyance'.

The problem causes no progress with the task and less fun playing the game, so it is a usability and fun problem. The severity rating is low: 'minor annoyance'. If the children were interested in the information given by the story this problem would be a problem of less severity or be no problem at all.

Problem 13

Description of the problem	Context	Cause (freestyle)	Cause (heuristieken)	Severity level
"hij klikt niet"	bij de plaatjes van de muizen	heeft niet door dat hij door te klikken het verhaaltje start, hij verwacht meer te zien	Mc3, N1	F1, T1
"hij klikt niet"	intro is nog gaande	intro kan niet ge-canceled worden	N3	T2

After: interpretation

The children have clicked on one of the animals in the forest. A story about the animal is started. While the story is playing, the children can not use the input device. So, they are not able to cancel the story.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

This violates Nielsen's *User control and freedom* (N3) since there is no 'emergency exit' for the children to leave this unwanted state.

It also violates Malone & Lepper's *Control* (Mc), since the children have no feelings of self-determination and control. The problem harms the fun of the game. Therefor this problem is a serious usability problem.

The evaluators use the heuristics Mc3, N1 and N3. N1 is used incorrect: the children can see in what state they are. The system status is clear. Mc3 and N3 are used correct. The severity rating is F1 and T2, which means the problem is a 'minor annoyance' or a 'problem caused error'. This last one is too severe, since disabling the input device is functional. It forces the children to listen to the story and gain knowledge about the animals.

The conclusion is that this problem is a usability and fun problem, for it harms heuristics of Nielsen and Malone & Lepper. The children make no progress with their task and they have less fun. The problem is not too serious, it causes a 'minor annoyance'. If the children were interested in the story, this problem might be less severe.

Forest 2

Problem 7

Description of the problem	Context	Cause (freestyle)	Cause (heuristics)	Severity level
kind dacht dat muis een vleermuis was	klikken in koffer met dieren	iconen / plaatjes niet herkenbaar	N2	T1
"nee, daar klikte ik net ook al op, dat is een vleermuis hoor"	???	obscuur wat is in de koffer	Mb1, N8	F3, T3

After: interpretation

The children check the box (Carmella) and see some animals presented in the box. The pictures are greyed out, so they are not too bright. They mix up the mouse and the bat. Both can not be activated.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

Nielsen's heuristics *Match between system and the real world* (N2) and *Recognition rather than recall* (N6) are being violated. The children do not recognise the pictures in the box, which is certainly connected to N2 and has some connection with N6.

If N2 is not violated too much, it has positive effects on *Challenge*: it is a challenge to find out what to do. If N6 is not violated too much, it has positive effects on *Curiosity*: the children may have fun not recognising the images immediately. It seems like N2 and N6 are not violated too much, since one of the children says he already found out that the bat was not the mouse. Which means *Challenge* (Ma) and *Curiosity* (Mb) are positively influenced and the game is still fun.

The evaluators use the heuristics N2, Mb1 and N8. N2 is used correct. The severity rating is a 'minor annoyance'. This is very likely to be true, for the problem is not too serious. It is understandable that the evaluators use Mb1, but in this case Curiosity is not influenced negatively. The severity rating is very high: T3, a 'task failure'. This is overrated. N8 is not applicable for this problem: the information in the box is not irrelevant, but is useful for the game.

The problem is a usability problem, but it is not a fun problem.

Problem 16

Description of the problem	Context	Cause (freestyle)	Cause (heuristieken)	Severity level
"waar is de muis?"	zijn bij de das	kunnen muis niet vinden, weinig verschil das / muis	N1	T1
"dit zijn geen muizen, dat zijn muizen, dit zijn geen muizen"	dassenscherm	verschil tussen muizen en dassen onduidelijk	N8	T3

After: interpretation

The children do not see the difference between the mice and the badgers in the forest. When they click on the animals a new screen appears, which shows them the badgers instead of the mice.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

Nielsen's *Match between system and the real world* (N2) is violated, since the children do not recognise the animals.

Violating N2 not too much may have a positive influence on *Curiosity* (Mb), but in this case the visual effects and the surprise is not fun. The children made the wrong choice, which hinders them in making progress.

The evaluators use the heuristics N1 and N8, which are both not applicable for this problem. First, the system status is clear, the children ended up with the badgers which they recognise as being badgers. There is no problem concerning aesthetic and minimalist design: the animals are both useful in this game. The severity ratings are very different: one says it is a 'minor annoyance', while the other evaluator rates the problem as a 'task failure'. The last one is too severe, the first one is too light, for the problem is more serious than just a 'minor annoyance'.

The conclusion is that this problem is a usability and fun problem. The children make a mistake which hinders them in making progress with the task and influences the fun negatively.

Problem 8

Description of the problem	Context	Cause (freestyle)	Cause (heuristics)	Severity level
Met hand onder kin, fronsend naar scherm kijken; kijken vervelend, wangen opgeblazen	Kunnen bij koffer geen spel vinden	weten niet meer wat ze moeten doen, raken verveeld, duurt te lang	Ma	F1
spelen met haar, staren voor zich uit, proberen niks nieuws	na de koffer	er zijn niet genoeg clues in het spel	N10	T2, F1
vinger in mond, hand voor mond en blazen	Muizenscherm	verveelt met taak?	Mb1, N8	F3, T3

Beforehand: sequence of actions

The children can not find the game they are looking for. They have tried several options in the forest and also tried to find the game in the box. They seem bored and frustrated.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

According to Nielsen the heuristics *Error prevention* (N5), *Help and documentation* (N10) and *Visibility of system status* (N1) are violated. The children do not get enough hints, clues or help to find the game. They are also not prevented from making the wrong choice.

Since the children have tried several options in the forest and the box, they are running out of options, which could mean that the *Challenge* (Ma) to find the game is too much. They do not gain knowledge anymore since they have tried so many options, so there is no progress concerning gaining knowledge. This makes it no longer fun to be searching for the game. They seem not interested in the information anymore, since the do not try anything anymore. Malone & Lepper's *Curiosity* (Mb) is violated, especially the cognitive curiosity (Mb2).

The evaluators use the heuristics Ma, N10, Mb1 and N8. These last two are not applicable for this study. There is no problem with the sounds and images of the game, the children do not indicate that these are annoying or not interesting. There is also no problem concerning Aesthetic and minimalist design, for the pictures are relevant for the game. Ma and N10 are used correct. The severity rating is on the level of 'minor annoyance' to 'problem caused error', which means the problem is serious.

This problem is a usability and fun problem: the children do not make progress with the task and it is no longer fun to be playing. The children have not given up, yet. But it looks like something has to happen soon, otherwise they will give up.

Problem 20

Description of the problem	Context	Cause (freestyle)	Cause (heuristieken)	Severity level
"we hebben alles al een keer uitgeprobeerd"	als ze op het overzichtsscherm komen na de kost geprobeerd te hebben	niet duidelijk dat er ook op een andere manier naar spelletjes gezocht kan worden	Ma, N1	F1, T1
"waar moeten we dan op klikken, hebben alles geprobeerd..."	als ze weer in het bos zijn	kunnen spel niet vinden	Ma	T3
kind zegt "we hebben alles geprobeerd"		geen clues voor verder spel	Ma2, N1	T2, T2

Beforehand: sequence of actions

The children have tried several options to find the game and do not have a clue how to find it. They say they have tried everything that is possible.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

Nielsen's *Error prevention* (N5), *Help and documentation* (N10) and *Visibility of system status* (N1) are violated. The children do not see any possibilities left to click on, there is no help available, and there is nothing that prevents them from making the wrong choice.

Since the children are a bit desperate, it can be said that Malone & Lepper's *Challenge* (Ma) is also violated. It is too difficult to find the game. This makes it no longer fun to be playing the game.

The evaluators use the heuristics Ma, Ma2 and N1. These heuristics are used correct. The severity ratings are very different. This problem can be considered to be serious, so rating 1 'minor annoyance' is too low. The task is not failed yet, so rating 3 'task failure' is too high. Rating 2, 'problem caused error', is a medium rating which suites this problem.

The conclusion is that this problem is a usability and fun problem: the children can not find the game which means they make no progress with the task, and they do not have fun playing the game.

Problem 21

Description of the problem	Context	Cause (freestyle)	Cause (heuristieken)	Severity level
gaan met hand onder hoofd zitten (denkend)	als ze weer fout spel hebben	2 soorten manieren om spel te vinden, onduidelijk	N4	T3
hand onder kin, spelen met haar "andere kunnen niet, eentje kan er"	proberen de spelletjes	muizenspel zit hier niet	Ma	F1

After: interpretation

The children are trying the options in the box, because they think it is the only way left to find a game. They have tried all the animals in the forest. They try all the options in the box, but still do not succeed. There is only one option in the box left to click on.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

It is not clear to the children how to find the game. Taking the heuristics of Nielsen into account, there is no heuristic violated that belongs to this phase of Norman. One could say that the children have no idea what to do anymore for there are problems with the heuristics *Error prevention* (N5), *Help and documentation* (N10) and *Visibility of system status* (N1) when determining the sequence of actions. There is no prevention for the children to make the wrong choices, there are no help options and there are no clues on the screen to help them make the right choice.

The children do not see any other options left to try, which means that Malone & Lepper's *Challenge* (Ma) is too much. This influences the fun negatively.

The evaluators use the heuristics N4 and Ma. N4 is used incorrect: there is no problem concerning the Consistency and standards (N4) since it is legitimate to use different ways to find games. Ma is used correct. The severity rating with Ma is 'minor annoyance'. The problem may be a little more serious than just a 'minor annoyance' for the children are hindered in making progress.

The problem mentioned here is a usability and fun problem, since both some of Nielsen's and Malone & Lepper's heuristics are violated: the children do not make progress with the task and they no longer have fun searching for the game.

Problem 14

Description of the problem	Context	Cause (freestyle)	Cause (heuristieken)	Severity level
"oh, nee he!"	weer terug op het scherm met info over muizen	had niet verwacht hier weer te komen	Mc (spel lijkt zelf iets te doen zonder dat kind het wil)	T1
"oh, nee he, ik snap het niet, mogen we verder gaan?"	als ze weer bij verhalenscherm muizen zitten	irritant muziekje en lang praten, kunnen niet klikken, dan onduidelijk waar spel zit	N8	F3
"oh nee he"	zelfde scherm komt weer waarvan kind denkt dat het fout is	niet zichtbaar hoe de hiërarchie in het spel zit	Ma2, N1	T2, T2
"oh, nee he. ik snap er echt niets van, mogen we verder gaan"	gaan terug naar muizen, overzichtsscherm		Ma3	F3

After: interpretation

The children can not find the game. They tried several options and ended up in a screen which they did not expect to see. They activated the screen which starts the story of the mice. The input device is also no longer enabled.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

Using Nielsen's heuristics the heuristic *User control and freedom* (N3) has been violated. The children have no 'emergency exit' to leave the screen they ended up in.

Since the children ask the experimenter if they can continue with the next task, one can say that the fun of the game is violated. The *Challenge* (Ma) to find the particular game is too much (jumping to the next action, in Norman's seven stages the sequence of actions is brought forward) and the user's *Control* (Mc) is too small. The evaluators also say something about annoying music, which violates the sensory *Curiosity* (Mb1).

The evaluators use the heuristics Ma2, Ma3, Mc, N1 and N8. Only N8 is used incorrect, there is no problem concerning the aesthetic and minimalist design. The story of the mice gives information to the children so they can learn about the mice. Having no control (Mc) is a problem which severity is rated at level 1, 'minor annoyance'. Too much challenge and lack of visibility of system status is rated as a 'problem caused error' and a 'task failure'. This last one is a very high rating, level 2 (a 'problem caused error') is a proper severity level for this problem.

The conclusion is that this problem is a usability and fun problem: is harms the task progress and it harms the fun at a serious severity level. If the children were interested in the information given to them, this problem would be less severe and might even not be a problem at all.

Problem 15

Description of the problem	Context	Cause (freestyle)	Cause (heuristieken)	Severity level
"oh, nee he, ik snap het niet, mogen we verder gaan?"	als ze weer bij verhalenscherm muizen zitten	irritant muziekje en lang praten, kunnen niet klikken, dan onduidelijk waar spel zit	N8	F3
kind vraagt "mogen we verder gaan" onderzoeker geeft tips	niet meer leuk	kinderen vinden het niet meer leuk	Ma, Mb, Md, N1	T2, F3
"oh, nee he. ik snap er echt niets van, mogen we verder gaan"	gaan terug naar muizen, overzichtsscherm		Ma3	F3

After: interpretation

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

The children do not like the game anymore, they do not like the music and the stories. The children want to continue playing the game. Malone & Lepper's heuristics *Sensory Curiosity* (Mb1) and *Power* (Mc3) are violated.

The children do no like the music and the stories, which is Sensory Curiosity (Mb1), and they do not get powerful effects (Mc3), which causes the game to be not interesting anymore.

The evaluators use Ma, Ma3, Mb, Md, N1 and N8. There is no problem with the challenge when it comes to this problem, they simply do not like the game anymore. There is also no problem with the Fantasy (Md) since the children do not complain about the metaphors and the characters of the game. Also, no heuristics of Nielsen are violated, since the children do not like the game, but they can continue doing something else in the game.

The conclusion is that this problem is a fun problem: it harms the fun of the game. The children do not like the game anymore, they want to discontinue the current action. Therefor the severity rating is on level 3, task failure.

Mice

Problem 10

Description of the problem	Context	Cause (freestyle)	Cause (heuristics)	Severity level
"oepsie, dat is fout"	als ze ergens bij de muizen klikken	klikken verkeerd	Mc	T1
"oepsie, dat is fout"	andere kind klikt ergens op	het is niet fout	N1	T1

After: interpretation

The children are searching for the game and have tried several options to find it. The children click on something that appears to be the wrong item.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

Using Nielsen's heuristics non is violated, when considering the phase "Interpreting the perception' in Norman. One can say that the children made the wrong choice because the game does not prevent them from making errors (*Error prevention* (N5)), and because there is not enough *Help and*

documentation (N10) or the *Visibility of system status* (N1) is not fulfilling. These heuristics belong to Norman's phase 'Planned sequence of action'.

Since the children complain in a cheerful way, they probably find the game *Challenging* (Ma) and still have fun searching for the right option.

The evaluators use the heuristics Mc and N1. Mc is used incorrect, there is no problem with being able to control the game. Using N1 is possible, but then a different phase of Norman's seven stages of action is referred to. The severity of the problem is not rated very high: it is only a 'minor annoyance'.

The conclusion is that this problem is a usability problem, but not a fun problem. It does not influence fun negatively.

Problem 27

Description of the problem	Context	Cause (freestyle)	Cause (heuristieken)	Severity level
"nou is het in een keer een ander plaatje"	weer terug bij de muizen	onduidelijk waarom iets verandert, hebben ze dat zelf gedaan? Hoe dan	Mc, N1	F1, T1
"nu is het een ander plaatje"	als ze op muis geklikt hebben en hol verschijnt	snappen niet dat eerste keer en tweede keer klikken anders is, niet transparant	N1, N4	T2
kind verwacht dat spellen anders worden vanuit de muizen	is toch hetzelfde	spel voldoet niet aan verwachtingen	Ma2	T1

After: interpretation

This is the second time the children click on the mice in the forest. The first time the story about the mice started. Now a totally different screen appears. Apparently the children expected the same screen as the first time they selected the mice.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

This problem can violate *User control and freedom* (N3), since the children do not understand how they caused the picture to change. It can also violate *Consistency and standards* (N4), since there is no consistency between the first time clicking on the animals and the second time clicking. On the one hand, the fact that the first time clicking causes a different picture than the second time is not a bad thing. Though, on the other hand, not knowing that there is a difference between the first time clicking and the second time clicking may prevent players from clicking on the same animal a second time.

Malone & Lepper's *Curiosity* (Mb) is positively influenced: the children are pleasantly surprised by what happened. It is possible that the user has feelings of less *Control* (Mc). But this problem does not cause less fun in playing the game, since the children keep searching for the game they have to find.

The evaluators use the heuristics Ma2, Mc, N1 and N4. Ma2 is used incorrect, since there is no problem concerning uncertain outcomes, it is only a different picture than the children expected to appear. There is no problem concerning the visibility of the system status (N1): the players see that a different picture appeared than they expected. The other heuristics are used correct. The severity level is described as a 'minor annoyance' and as a 'problem caused error'. In this case, the problem is not very serious, it is rather a pleasant surprise, therefor a 'minor annoyance' is a suitable description of the severity of this problem.

The conclusion is that this problem is a usability problem, but not a fun problem. The task is not influenced negatively and the fun is not diminished since the children keep searching for the game.

Summer

Problem 9

Description of the problem	Context	Cause (freestyle)	Cause (heuristics)	Severity level
Geïrriteerd zeggen "je moet onderaan zoeken"	als ze op herfst geklikt hebben	ze hebben tip gevolgd, nog verkeerde spel	Ma	T1
"nee, klik nog eens op het bos, je moet onderaan"		balk functie niet duidelijk	N8	T2

After: interpretation

The children have been searching for the game for quite some time, now. The experimenter has given them a tip to use the icons at the bottom of the screen. Since the audio is not synchronous to the images, the children make a mistake when clicking on one of the icons. The children think they make progress, but again it appears that they don't.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

In Nielsen the heuristic *Help users recognise, diagnose and recover from errors* (N9) is violated. There is no help available for the children to recognise they made an error.

The usability problem violates Malone & Lepper's *Control* (Mc), especially the Power (Mc3): the user has clicked on an icon and expects it to have a certain effect, but it appears not to have the effect they expected. Also Challenge – performance feedback (Ma3) is a problem: the children do not get the right feedback which shows them they made a mistake. This makes the game less fun.

The evaluators use the heuristics Ma and N8. Ma is used correct, to be more specific it should be Ma3. N8 is not correct, since the icons are not irrelevant information. The icons can be used to perform certain activities. The problem is rated as 'minor annoyance' and 'problem caused error'.

The conclusion is that this problem causes the game to be less fun and the progress with the task being to little, and therefor being a usability and fun problem. The problem is serious, but not too bad.

Mice in the hole

Problem 28

Description of the problem	Context	Cause (freestyle)	Cause (heuristieken)	Severity level
"er zitten geen spellen bij"	als ze in hol zitten	kunnen spellen niet vinden, staat niet duidelijk	Ma, N1	T3, T3
"er zitten geen andere spellen bij"		kind vind geen clues	N10	T2

Beforehand: sequence of actions

After some searching the children have found the mice and try to click on several options on the screen. They have tried a lot of possibilities and still have not found the game. They think that there are no games present.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

They can not find the game, or a clue to find the game. Nielsen's heuristics *Error prevention* (N5), *Help and documentation* (N10) and *Visibility of system status* (N1) are violated. There is no help available,

or no clues on the screen that can help them. The children are not prevented from making the wrong choice.

The children have tried several options and do not think that there are any possibilities left. They make no progress anymore, so Malone & Lepper's *Challenge* (Ma) is influenced negatively. This influences the fun aspect of the game. Since the children continue searching for the game, they do not mind very much and still have enough fun playing the game.

The evaluators use the heuristics Ma, N1 and N10. These are used correct. The severity ratings are high: from 'problem caused error' to 'task failure'. Which means the evaluators find the problem serious. Since the children continue searching the problem appears not to be too bad. Which means the rating of 3 is too high, because there is still some fun left to continue the search for the game.

The conclusion is that this problem is a usability and fun problem.

Game: memory

Problem 31

Description of the problem	Context	Cause (freestyle)	Cause (heuristieken)	Severity level
zucht en beweegt hoofd	uitleg over het spel met de muizen	uitleg duurt te lang, ze willen beginnen met spelen	Mc (geen controle, moet wachten)	F1
kinderen raken wat geïrriteerder		intro duurt lang, ook het vinden van het spel	Ma, N7	F1, F1
zucht, wenkbrauwen	uitleg memorie	te makkelijk? Te lang?	Mb2	F1

After: interpretation

The children have found the memory game. The game starts with an explanation about the way the game has to be played. The introduction can not be cancelled, since the input device is disabled.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

This problem violates Nielsen's heuristic *User control and freedom* (N3). The user has no 'emergency exits' to leave this state of the game. The children are forced to wait for the introduction to end.

It violates Malone & Lepper's *Control* (Mc), since the children can not control what is happening. The children can not make any progress. Therefor the game is less fun. The children are not interested in the introduction, which influences Malone & Lepper's cognitive *Curiosity* (Mb2).

The evaluators use the heuristics Ma, Mb2, Mc and N7. Mb2 and Mc are used correct. The other heuristics are not an issue for this problem: the challenge is not too big or too small and there is no problem with accelerators, since they are not used here. If there were accelerators, they could not be used, for the input device is disabled. The severity level is low, which means the problem is a 'minor annoyance'.

This problem is a usability and fun problem, since both progress of task and fun are negatively influenced. The severity is a 'minor annoyance' which means that the problem is not very bad.

Problem 29

Description of the problem	Context	Cause (freestyle)	Cause (heuristieken)	Severity level
"vind het een beetje raar dat ze het hele scherm gebruiken"	bij muizenmemory	?	?	
"vind het een beetje raar dat ze het hele scherm..."	begin kaartspel	lange inleiding	N8	F1
kind vindt het een beetje raar dat je het hele scherm moet klikken	bij muizenspel	is ook raar	N3	T2

Beforehand: sequence of actions

The children have found the game of memory. They are going to play the game. The cards are spread across the screen in lines and columns.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

The children find the cards to be presented in a strange way. It is possible that the children find the *Match between the system and the real world* (N2) a problem, for the cards are presented in a way they are not familiar with. Using Malone & Lepper's heuristics the *Curiosity* (Mb) may be harmed, for the children do not like what they see.

It appears that this problem is a usability and fun problem. The problem is not severe, since the children continue playing the game. Therefor the severity rating is on level 1, minor annoyance

Problem 30

Description of the problem	Context	Cause (freestyle)	Cause (heuristieken)	Severity level
"raar dat ze niet vanzelf gaan"	bij het memory-spel	je moet zelf kaarten wegleggen, terwijl het eigenlijk om het zoeken gaat	N7 (efficiency)	T1
"beetje raar, niet vanzelf"	eind kaartspel	moeten eerst klikken als twee dezelfde gevonden zijn, extra handeling	N4	F1
"ik vind het een beetje raar dat ze in dit spel niet vanzelf gaan"	memorie		N7	T1

After: interpretation

The children play the game of memory. When they have found two identical cards, the cards have to be clicked on again to place them on the pile of matched cards. The children find this strange.

Cause (freestyle) translated to the heuristics of Nielsen and Malone & Lepper:

This problem violates *Consistency and standards* (N4) to some extent: in most games a match means an action is performed by the game. In this case the children have to perform the action themselves. It may also violate *Aesthetic and minimalist design* (N8), since the action the children have to perform could be done by the system.

The problem does not violate any heuristic of Malone & Lepper. The children have control over the game, and nothing special is happening to the curiosity and fantasy, the pictures and sounds are familiar and acceptable. There is no challenge involved, since the goal is clear, the performance feedback is not an issue and the uncertain outcomes remain the same.. So, this problem does not influence fun.

The evaluators use the heuristics N4 and N7. N7 is not applicable, since there is no problem with the flexibility and efficiency of use: the user has to perform the action himself, there are no accelerators present. The only accelerator possible is the cards to be placed on the pile automatically. The severity rating of the problem is low, level 1, which means that the problem is a 'minor annoyance'.

The conclusion is that this problem is a usability problem, but not a fun problem. It is not useful for the children to place the cards on the pile themselves, but the fun of the game is not negatively influenced.

Appendix K: Reported cause (freestyle)

In the table per reported problem the cause (freestyle) is summarised. The number of evaluators that have described that cause are shown in the third column.

	Cause (freestyle)	Described by this number of evaluators
Pr 1	The children can not find the game	2 evaluators
	The introduction story is not important	1 evaluator
Pr 2	Not clear what the child finds so bad	1 evaluator
	The children choose the wrong button	1 evaluator
Pr 3	Takes too long to find the game	1 evaluator
	Task does not succeed	1 evaluator
Pr 4	It is not clear what the game is	2 evaluators
	It is not clear where to find the game	1 evaluator
Pr 5	They cannot find the game	2 evaluators
	The information is not useful for the game	1 evaluator
	They think the game can only be found in the box	1 evaluator
Pr 6	Too little control over what is going on and not interested in the story	1 evaluator
	Not interested in the story	2 evaluators
Pr 7	It is not clear what is in the box	2 evaluators
Pr 8	Children are bored	2 evaluators
	There are not enough clues in the game	1 evaluator
Pr 9	The children clicked on the wrong game	1 evaluator
	The function of the icons is not clear	1 evaluator
Pr 10	The children clicked on the wrong item	1 evaluator
	It is not wrong	1 evaluator
Pr 11	Feedback is not very motivating	2 evaluators
	They did not succeed in playing the game	3 evaluators
Pr 12	Bug in the game	2 evaluators
	Children did something wrong	1 evaluator
	?	1 evaluator
Pr 13	The child expects to see more than just the story	1 evaluator
	The story can not be cancelled	1 evaluator
Pr 14	Can not find the game	2 evaluators
	Did not expect to end up at that point again	1 evaluator
	<empty cause>	1 evaluator
Pr 15	Can not find the game	1 evaluator
	Children do not like it anymore	1 evaluator
	<empty cause>	1 evaluator
Pr 16	Do not see the difference between the mice and the badgers	2 evaluators
Pr 17	Not clear where to find the game	2 evaluators
	Insecure or just asking	1 evaluator
Pr 18	Can not cancel the story	2 evaluators
	Long story	1 evaluator
	The story is not a game	1 evaluator
Pr 19	Not clear where to find the game	2 evaluators
	Too difficult	1 evaluator
Pr 20	Can not find the game	2 evaluators
	Not clear that the game can be found in two ways	1 evaluator

	Cause (freestyle)	Described by this number of evaluators
Pr 21	Not clear that the game can be found in two ways	1 evaluator
	The game is not in this screen	1 evaluator
Pr 22	Boring to be waiting	4 evaluators
Pr 23	It is not an aesthetically view	2 evaluators
	Can not find the game	1 evaluator
	The system does not work synchronous	1 evaluator
Pr 24	Children can not find the games	3 evaluators
Pr 25	The story takes too long	3 evaluators
Pr 26	Story takes too long	2 evaluators
Pr 27	They do not understand why the screen is changed	1 evaluator
	They do not understand that the screen is different the first time and the second time	1 evaluator
	Game does not do what the children expected	1 evaluator
Pr 28	Can not find the game	1 evaluator
	Can not find a clue	1 evaluator
Pr 29	Introduction is long	1 evaluator
	It is weird	1 evaluator
	?	1 evaluator
Pr 30	The children have to do an extra action	2 evaluators
	<empty cause>	1 evaluator
Pr 31	Introduction takes too long	3 evaluators

Appendix L: Reported cause (heuristics) by the evaluators

In the following tables per problem the number of times the heuristics have been used by the evaluators are listed.

	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10
Pr 1						1				
Pr 2					1					
Pr 3					1	1				
Pr 4						1		1		
Pr 5						1		1		
Pr 6										
Pr 7		1						1		
Pr 8								1	1	
Pr 9								1		
Pr 10	1									
Pr 11								1		
Pr 12			1		1					
Pr 13	1		1							
Pr 14	1							1		
Pr 15	1							1		
Pr 16	1							1		
Pr 17	1									
Pr 18			1					1	1	
Pr 19	1									
Pr 20	2									
Pr 21				1						
Pr 22								2		
Pr 23	2							1		
Pr 24	1					1				
Pr 25								2		
Pr 26			1				1	2		
Pr 27	2			1						
Pr 28	1									1
Pr 29			1					1		
Pr 30				1			2			
Pr 31								1		

	Ma	Ma1	Ma2	Ma3	Ma4	Mb	Mb1	Mb2	Mc	Mc1	Mc2	Mc3	Md	Md1	Md2	Md3
Pr 1	2	1														
Pr 2						1										
Pr 3	1															
Pr 4	2															
Pr 5	2			1			1									
Pr 6	1	1				1			1							
Pr 7							1									
Pr 8	1						1									
Pr 9	1															
Pr 10									1							
Pr 11				3					1							
Pr 12																
Pr 13													1			
Pr 14			1	1					1							
Pr 15	1			1		1							1			

Reported cause (heuristics) by the evaluators

	Ma	Ma1	Ma2	Ma3	Ma4	Mb	Mb1	Mb2	Mc	Mc1	Mc2	Mc3	Md	Md1	Md2	Md3
Pr 16																
Pr 17	1															
Pr 18	1								1		1					
Pr 19	2		1													
Pr 20	2		1													
Pr 21	1															
Pr 22	1					3			1							
Pr 23	1							2	1							
Pr 24	3								1							
Pr 25	1					1		1								
Pr 26	1															
Pr 27			1						1							
Pr 28	1															
Pr 29																
Pr 30																
Pr 31	1							1	1							

Appendix M: Reported severity levels by the evaluators

In this table per problem the number of times a severity level is used by the evaluators is listed.

	F1	F3	T1	T2	T3
Pr 1	2			2	
Pr 2	1				1
Pr 3	1			1	1
Pr 4	1			2	1
Pr 5	2		2	1	1
Pr 6	3				
Pr 7		1	1		1
Pr 8	2	1		1	1
Pr 9			1	1	
Pr 10			2		
Pr 11	5		1		
Pr 12				1	2
Pr 13	1		1	1	
Pr 14		2	1	2	
Pr 15		3		1	
Pr 16			1		1
Pr 17			1	1	1
Pr 18	3		2	1	
Pr 19		1		2	1
Pr 20	1		1	2	1
Pr 21	1				1
Pr 22	6				
Pr 23	2		2		2
Pr 24		1	1	1	2
Pr 25	4	1			
Pr 26	3				
Pr 27	1		2	1	
Pr 28				1	2
Pr 29	1			1	
Pr 30	1		2		
Pr 31	4				

Appendix N: Summary of the heuristics and categorisation of the problem by the evaluators

This table shows the heuristics that are used by the evaluators and the categorisation of the problems: are only heuristics of Nielsen used, or only the heuristics of Malone & Lepper, or are both heuristics of Nielsen and Malone & Lepper used?

	Which heuristics are used	Only Nielsen	Only Malone & Lepper	Both Nielsen and Malone & Lepper
Pr 1	N6, Ma, Ma1			X
Pr 2	N5, Mb			X
Pr 3	N5, N6, Ma			X
Pr 4	N6, N8, Ma			X
Pr 5	N6, N8, Ma, Ma3, Mb1			X
Pr 6	Ma, Ma1, Mb, Mc		X	
Pr 7	N2, N8, Mb1			X
Pr 8	N8, N10, Ma, Mb1			X
Pr 9	N8, Ma			X
Pr 10	N1, Mc			X
Pr 11	N8, Ma3, Mc			X
Pr 12	N3, N5	X		
Pr 13	N1, N3, Mc3			X
Pr 14	N1, N8, Ma2, Ma3, Mc			X
Pr 15	N1, N8, Ma, Ma3, Mb, Md			X
Pr 16	N1, N8	X		
Pr 17	N1, Ma			X
Pr 18	N3, N8, N9, Ma, Mc, Mc2			X
Pr 19	N1, Ma, Ma2			X
Pr 20	N1, Ma, Ma2			X
Pr 21	N4, Ma			X
Pr 22	N8, Ma, Mb, Mc			X
Pr 23	N1, N8, Ma, Mb1, Mc			X
Pr 24	N1, N6, Ma, Mc			X
Pr 25	N8, Ma, Mb, Mb2			X
Pr 26	N3, N7, N8, Ma			X
Pr 27	N1, N4, Ma2, Mc			X
Pr 28	N1, N10, Ma			X
Pr 29	N3, N8	X		
Pr 30	N4, N7	X		
Pr 31	N7, Ma, Mb2, Mc			X
	Total	4	1	26

Appendix O: Summary of the heuristics and categorisation of the problem by the author

This table shows the heuristics that are used by the author and the categorisation of the problems: are only heuristics of Nielsen used, or only the heuristics of Malone & Lepper, or are both heuristics of Nielsen and Malone & Lepper used?

	Which heuristics used	Only Nielsen	Only Malone & Lepper	Both Nielsen and Malone & Lepper
Pr 1	N1, N5, N10	X		
Pr 2	N1, N5, N10, Mb			X
Pr 3	N1, N5, N10, Ma			X
Pr 4	N1, N5, N10, N2, N6	X		
Pr 5	N1, N5, N10, Mc3, Mb1			X
Pr 6	N3, Mc, Mb			X
Pr 7	N2, N6	X		
Pr 8	N1, N5, N10, Ma, Mb2			X
Pr 9	N9, Mc3, Ma3			X
Pr 10	N1, N5, N10	X		
Pr 11	N9, Ma3			X
Pr 12	N3, N9, Mc			X
Pr 13	N3, Mc			X
Pr 14	N3, Ma, Mc, Mb1			X
Pr 15	Mb1, Mc3		X	
Pr 16	N2, Mb			X
Pr 17	N1, N5, N10	X		
Pr 18	N3, Mc			X
Pr 19	N1, N5, N10, Ma			X
Pr 20	N1, N5, N10, Ma			X
Pr 21	N1, N5, N10, Ma			X
Pr 22	N3, Mc, Mb			X
Pr 23	N1, N3, N8, Mb1, Mc			X
Pr 24	N1, N5, N10	X		
Pr 25	N3, Mc, Mb			X
Pr 26	N3, Mc, Mb			X
Pr 27	N3, N4	X		
Pr 28	N1, N5, N10, Ma			X
Pr 29	N2, Mb			X
Pr 30	N4, N8	X		
Pr 31	N3, Mc, Mb2			X
Total		8	1	22

Appendix P: Summary of reported severity levels by evaluators and author

In this table the severity levels the evaluators have reported are listed together with the severity level the author matches to the problem.

	Evaluators' severity level	The author's severity level
Pr 1	F1, T2, T3	Level 1 of 2
Pr 2	F1, T3	Level 1
Pr 3	F1, T2, T3	Level 2
Pr 4	F1, T2, T3	Level 1
Pr 5	F1, T1, T2, T3	Level 1
Pr 6	F1	Level 1
Pr 7	F3, T1, T3	Level 1
Pr 8	F1, F3, T2, T3	Level 1 of 2
Pr 9	T1, T2	Level 1 of 2
Pr 10	T1	Level 1
Pr 11	F1, T1	Level 1
Pr 12	T2, T3	Level 3
Pr 13	F1, T1, T2	Level 1
Pr 14	F3, T1, T2	Level 2
Pr 15	F1, T2	Level 3
Pr 16	T1,T3	Level 2
Pr 17	T1, T2, T3	Level 1
Pr 18	F1, T1, T2	Level 1
Pr 19	F3, T2, T3	Level 3
Pr 20	F1, T1, T2, T3	Level 2
Pr 21	F1, T3	Level 2
Pr 22	F1	Level 1
Pr 23	F1, T1, T3	Level 1
Pr 24	F3, T1, T2, T3	Level 1
Pr 25	F1, F3	Level 1
Pr 26	F1	Level 1
Pr 27	F1, T1, T2	Level 1
Pr 28	T2, T3	Level 2
Pr 29	F1, T2	Level 1
Pr 30	F1, T1	Level 1
Pr 31	F1	Level 1

Appendix Q: Summary of the heuristics and severity levels reported by the author

In this table the heuristics and the severity levels matched to the problem by the author are listed.

	Which heuristics used	Only Nielsen	Only Malone & Lepper	Both Nielsen and Malone & Lepper	My severity level
Pr 1	N1, N5, N10	X			Level 1 of 2
Pr 2	N1, N5, N10, Mb			X	Level 1
Pr 3	N1, N5, N10, Ma			X	Level 2
Pr 4	N1, N5, N10, N2, N6	X			Level 1
Pr 5	N1, N5, N10, Mc3, Mb1			X	Level 1
Pr 6	N3, Mc, Mb			X	Level 1
Pr 7	N2, N6	X			Level 1
Pr 8	N1, N5, N10, Ma, Mb2			X	Level 1 of 2
Pr 9	N9, Mc3, Ma3			X	Level 1 of 2
Pr 10	N1, N5, N10	X			Level 1
Pr 11	N9, Ma3			X	Level 1
Pr 12	N3, N9, Mc			X	Level 3
Pr 13	N3, Mc			X	Level 1
Pr 14	N3, Ma, Mc, Mb1			X	Level 2
Pr 15	Mb1, Mc3		X		Level 3
Pr 16	N2, Mb			X	Level 2
Pr 17	N1, N5, N10	X			Level 1
Pr 18	N3, Mc			X	Level 1
Pr 19	N1, N5, N10, Ma			X	Level 3
Pr 20	N1, N5, N10, Ma			X	Level 2
Pr 21	N1, N5, N10, Ma			X	Level 2
Pr 22	N3, Mc, Mb			X	Level 1
Pr 23	N1, N3, N8, Mb1, Mc			X	Level 1
Pr 24	N1, N5, N10	X			Level 1
Pr 25	N3, Mc, Mb			X	Level 1
Pr 26	N3, Mc, Mb			X	Level 1
Pr 27	N3, N4	X			Level 1
Pr 28	N1, N5, N10, Ma			X	Level 2
Pr 29	N2, Mb			X	Level 1
Pr 30	N4, N8	X			Level 1
Pr 31	N3, Mc, Mb2			X	Level 1
Total		**8**	**1**	**22**	

Appendix R: Correlation: Spearman's rho

In this table the correlation between the severity levels given by the evaluators is shown. The correlation is determined using spearman's rho, two-tailed.

		F1	F2	T1	T2	T3
F1	Correlation Coefficient	1.000	-.298	-.145	-.353	-.397*
	Sig. (2-tailed)	.	.103	.438	.051	.027
	N	31	31	31	31	31
F2	Correlation Coefficient	-.298	1.000	-.141	.207	.048
	Sig. (2-tailed)	.103	.	.450	.264	.799
	N	31	31	31	31	31
T1	Correlation Coefficient	-.145	-.141	1.000	-.054	-.057
	Sig. (2-tailed)	.438	.450	.	.773	.761
	N	31	31	31	31	31
T2	Correlation Coefficient	-.353	.207	-.054	1.000	.155
	Sig. (2-tailed)	.051	.264	.773	.	.406
	N	31	31	31	31	31
T3	Correlation Coefficient	-.397*	.048	-.057	.155	1.000
	Sig. (2-tailed)	.027	.799	.761	.406	.
	N	31	31	31	31	31

* Correlation is significant at the .05 level (2-tailed).