

Usability of Gaze: A Virtual Reality Evaluation

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Introduction

Since the new age of Head Mounted Displays began a couple of years ago, introducing a series of possibilities to dive into Virtual Reality easily, immersively and without the former limitations of weight, latency or high costs, namely ZEISS VR One, Color Cross VR, MB-VR61, Google Cardboard, HOMiDO, Samsung GearVR and most prominently the Oculus Rift, possibilities for Virtual Reality applications and a wide distribution over end users are almost reachable. To test out the affordances of such a new generation Head Mounted Display, I designed a 3D Virtual Reality application called Gaze that challenges the user to solve puzzles with the mere input of head movements tracked by an Oculus Rift Development Kit 2. To evaluate the Head Mounted Display as well as the application itself, a Usability Study is conducted with an open number of participants, assessing several measured in-game factors as well as a post-study questionnaire.

Setup of Gaze

As stated before, Gaze is an application developed purposely to evaluate new paradigms of Human-Computer interaction, thus yields not only the implicit innovation of an explorable 3-dimensional space just by head movements (output), but also gives the user the explicit possibility to act via head movements to perform actions and reach the goals of the various tasks (input). The game in its current state (v.0.20) yields 20 levels (tasks), which are mostly similar in structure, but introduce a number of new objects which attributes are to discover and requires the combination of these to complete the level.

The game is set up in the inside of a 3D-cube, from which mostly one plane is used to depict a 2D board. On this plane, moveable game objects in the form of spheres, from now on called “atoms” are placed that follow the fovea of the player’s field of view as soon as they enter its range. Besides, there are static game objects in the form of discs, from now on called “fragments”, that either allow the user to gather points by leading the atoms to the green goal fragment, hinder him by acting as obstacles (blue freezers blocking movement, red melters destroying atoms) or offer possibilities to act with the atoms to alter the game state (purple portals move atoms, yellow switches spawn new atoms or fragments). When the required score is reached, the player may move on to the next level or in some cases score bonus points by leading more atoms than required to the goal.

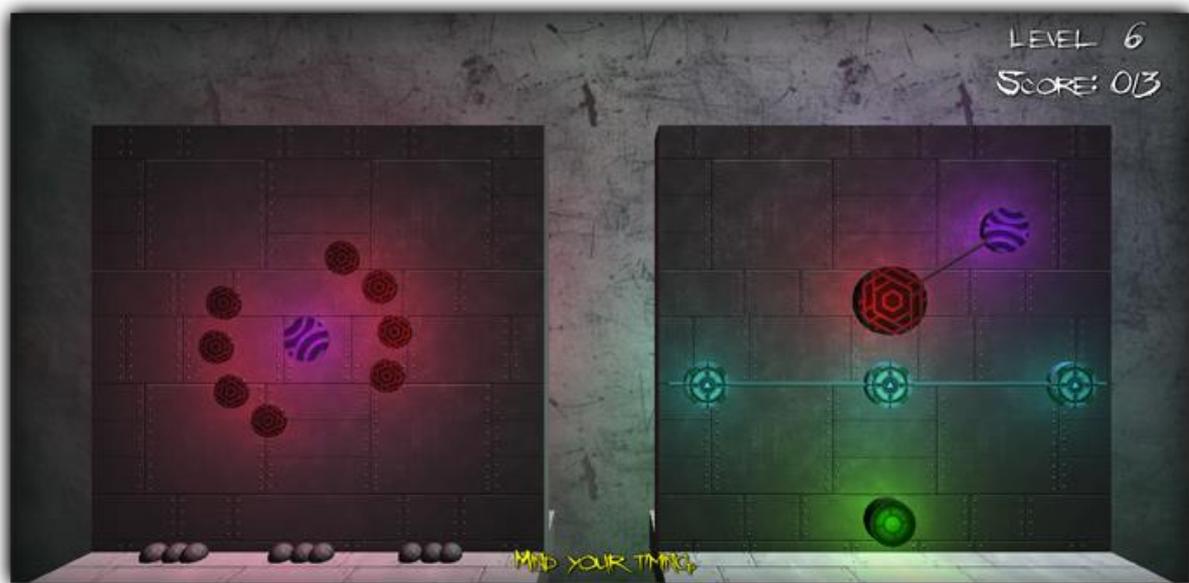


Figure 1: An example level of Gaze

Figure 1 depicts the sixth level of the game, at a time point where the user has already gathered knowledge about how to move atoms (three groups of three atoms in the lower left corner), to avoid melters (red spinning fragments around the purple one on the left side, as well as one large in the center of the right side), that the purple portal on the left leads to the one on the right side and that they have to reach the green goal fragment without being able to cross the blue freezing barricade. Also, the number of the level being currently in, as well as the current and needed score and a complementary help message (in yellow, centered below) are displayed in every level. When the task is completed or is not reachable anymore due to atom losses, an additional message pops up that suggests the player to proceed or restart.

The whole atom interaction can be done by mere gazing to the point where they ought to be, so as soon as they are “caught”, the atoms follow the players head movements. However, for certain meta level operations keyboard interaction is still required, which may be a possible critique point, but will be replaced by another viewing mechanism if the test yields the results of less usability due to keyboard needs. The keyboard commands are delivered while downloading the game, as well as in a complementary readme text file and also are displayed on the main menu screen of the game that appears when at launching, which are:

In Main Menu:

- | | |
|------------------------------|--|
| • Esc | Quit |
| • Left/Right/Up/Down/W/A/S/D | Parse through levels (that are already unlocked) |
| • Space/Enter/Return/E | Enter Level |

General:

- | | |
|------------------------|-------------------------------|
| • Esc | Return to Main Menu |
| • Space/Enter/Return/E | Proceed |
| • R | Reset Level |
| • V | Switch VRMode / DesktopMode |
| • S | Skip Level (Testing purposes) |
| • + | Zoom In |
| • - | Zoom Out |

Gaze is available over the official distribution page of developmental Oculus Rift applications (<https://share.oculus.com/app/gaze>), which but needs a registration, or directly from my own webserver (<http://nevermindcreations.de/>). Note that it is not obligatory to have an Oculus Rift to play this game, it can be tested in the Desktop Mode by simulating the gaze with the mouse cursor position!

For a general insight into the structure of the first 9 levels, there is a sketch on YouTube that was but recorded in the (non-Virtual Reality) Desktop Mode, so the control over the atoms via head movements is here replaced with the mouse cursor to only demonstrate the structure of the first levels: <https://www.youtube.com/watch?v=Uu7ouggRL8k>

Apart from this, a non-official play through is recorded from an independent gamer that illustrates the completion of some levels with the Oculus Rift while giving verbal comments that may also give insights of the usability of this version: <https://www.youtube.com/watch?v=CW4knRDzOOo>

Measurement

As DIN EN ISO-9241-11 suggests, for providing a valid usability to the end user, applications have to fulfil the criteria of effectivity, efficiency and satisfaction. However, since this is only a guideline, this does not necessarily applies to every kind of application, e.g. games. While the subjective satisfaction is one of the most important parts, efficiency in completing the tasks may not be the primary goal, since this contradicts with the principle of challenge that is crucial to provide an interesting game experience. Thus, I decided to measure the efficiency though, but do not let it influence the usability apart from extreme outliers (so, as long as the task is able to be completed and satisfies, usability is reached).

To broaden the scope of participants and, maybe more important, also get the concrete target audience, I designed the whole usability testing process mobile and accessible from every device with every popular operating system (Windows, Mac and Linux) by programming the recording of in-game related factors directly into the game logic and submitting it over the internet as soon as the game is completed. Thus, when the game ends, the standardly chosen browser is opened automatically, saves the in-game data onto my webserver and offers the opportunity to fill out also the usability questionnaire, which is found under the following link: (<http://nevermindcreations.de/nvmWeb/en/usability.html>). After completing it and accepting the legal usage of all collected data anonymously, it is saved in a static file presented later in the results section.

However, to present the new technology to people that haven't used or even heard about it before, I decided to also let some unexperienced participants do the experiment, representing the part of the community that is interested in this field but has no access to a Head Mounted Display yet, since especially the Oculus Rift is not officially distributed for now and only accessible to developers. By making the whole usability procedure portable, the conditions for this group do not change from the internet participants, but in this case I was able to note also some verbal comments that are not explicitly stated in the "comments" section of the post-test questionnaire.

The in-game factor log records the most essential points for effectivity and efficiency of the levels by taking measurements of:

- LX_R : The number of "Restarts" needed in the level.
This is an indicator for the efficiency.
The more restarts needed, the less efficient, the harder is the task.
- LX_S : The indicator if the level is skipped.
This is an indicator of effectivity.
Either the level is skipped (1) or not (0).
- LX_% : The percentage of the score reached in the level.
This is an indicator of effectivity.
Either 100% (completed), or >100% (Bonus score), or <100% (skipped)
- LX_t : The time needed to complete the level.
This is an indicator of efficiency.
The more time needed, the less efficient, the harder is the task.

Replacing the X, these 4 factors are recorded for each level, resulting in a total of 80 entries/player.

The questionnaire requires only the fields of rough participant knowledge, namely age and country. From then on, participants are asked to fill out Likert-like scales of the most crucial usability points. This ensures the measurement of satisfaction both of the Head Mounted Display as well as of the application itself, represented by the following questions:

- How did you hear about the test? (Several options)

Questions about the Oculus Rift:

- Previous usage of the Oculus Rift (Never heard about it before - Regular usage)
- Ease of use (Hard – Easy)
- Motion sickness (Jittery – Fluent)
- Fun Factor (Boring – Very interesting)
- Recommendation (Improbable – Very Likely)

Questions about the Game: (Strongly disagree – Strongly Agree)

- The Menu structure was simple and obvious
- The amount of information presented at a time was appropriate
- I understood the tasks presented
- The functions of the game objects were clear
- I understood the feedback from the game
- I liked the graphics
- I liked the physics
- I liked the sounds
- I am satisfied with the game
- It is actually fun
- I would recommend it to a friend

- The game was (Too easy – Too hard)
- The average level time was (Too short – Too long)
- The innovation of the game was (Unimaginative – Innovative)

- Monetary value guess
- Overall rating
- Additional comments

With these modular questions the various aspects of the design are considered and strengths and weaknesses of the device and the application should be indicated.

Participants

In total, 13 participants filled out the post-test questionnaire and 7 of them made it to the final level, from which also the in-game records were submitted to the web server. The participants' age range from 17 to 62 while the method of providing the test over the internet reached various countries apart from Germany, like Italy, France and Canada.

Tasks

In the following, the specific tasks are described and explained to refer to the results measured by the in-game factor records. The whole completion of the tasks took up approximately 20 minutes to 1 hour, according to the previous knowledge of the Oculus Rift and Video Games in general.

Level 1:

Description: Three atoms are provided, one goal fragment.
Solution: Look at the atoms, then look at the goal.
Hint: "Lead the atoms to the green goal."
Purpose: Teach the user how to move atoms.

Level 2:

Description: Three atoms are provided, one goal fragment, one freezer obstacle.
Solution: Move the atoms past the obstacles to the goal.
Hint: "Beware of Freezers."
Purpose: Demonstrate freezing obstacles.

Level 3:

Description: Three atoms are provided, one goal fragment, three melter obstacles.
Solution: Move the atoms past the obstacles through a narrow path to the goal.
Hint: "Melters will incinerate your atoms."
Purpose: Demonstrate melting obstacles.

Level 4:

Description: Six atoms are provided, one goal fragment, one giant spinning tentacle melter.
Solution: Gather the atoms quickly and evade the tentacles to reach the goal.
Hint: "You can press 'R' anytime to reset."
Purpose: Teaching the importance of quick decisions in some situations.

Level 5:

Description: Three atoms are provided, one goal fragment, a wall of melters, two portals.
Solution: Move the atoms to the portal entrance and from the exit to the goal.
Hint: "Not all of these are vicious."
Purpose: Teach the user how to think with portals.

Level 6:

Description: Nine atoms are provided, a portal surrounded by spinning melters, leading to another field with a spinning portal exit, a freezing barrier and the goal.
Solution: Wait until the exit is in the right place, then move the atoms past the obstacles in the portal entrance, then to the goal.
Hint: "Mind your timing."
Purpose: Integrate the knowledge about the fragments and timing.

Level 7:

Description: Two atoms provided, one switch, the goal yet unreachable.
Solution: Use an atom to trigger the switch, which spawns a portal that leads to the goal.
Hint: "Switches devour your atoms, so be sure to use them carefully."
Purpose: Introduce switches.

Level 8:

Description: Two atoms are provided, three switch fragments, the goal yet unreachable.
Solution: Use one switch to get more atoms, one switch to spawn a portal, spare the 3rd switch because it would spawn a melter around the goal and render the task impossible.
Hint: "They offer you wealth as well as despair."
Purpose: Raise critical thinking about game object interactions.

Level 9:

Description: Same setup as in 8, with melters rotating and blocking the goal.
Solution: Trigger the right switch to spawn a freezer that falls down and freezes all the melters around the goal in a chain reaction to open a hole to reach the goal.
Hint: "Your fellows are not the only ones to interact in this game."
Purpose: Show fragment interactions.

Level 10:

Description: A single switch that spawns the first end boss.
Solution: Trigger the switch, evade the attacks of the boss and catch moving switches to spawn freezers falling from the top. Evade the freezers but carefully time the spawning so that they hit an arm of the boss. After both arms are hit (and dropped off), the boss starts to roll around, which has to be evaded. If dodged for 30 seconds, the level is completed.
Hint: -
Purpose: Integrate every knowledge of the first levels and challenge the player.

Level 11:

Description: The goal is obstructed by freezers. Three normal atoms are provided, as well as 2 red atoms.
Solution: Destroy two of the freezers by making contact with red atoms.
Hint: "To face the menacing obstacles, you can't rely on mere grey atoms."
Purpose: Introduce red atoms.

Level 12:

Description: The goal is on another platform together with a switch, the bridge narrow and obstructed by freezers. One normal and one red atom provided.
Solution: Move the red atom carefully between the freezers, because it will disappear if it destroys a freezer. Trigger the switch which spawns 5 additional red atoms with which you can de-freeze the bridge.
Hint: "But beware: The more powerful the atom, the less you want to waste it."
Purpose: Teach the user to use atoms for the right purpose.

Level 13:

Description: The goal is obstructed by melters, three normal and two red atoms provided.
Solution: Don't care for the normal ones, just move the red atoms which cannot be destroyed.
Hint: "As maybe predicted, red shall not harm red."
Purpose: Show other features of red atoms.

Level 14:

Description: The goal is obstructed by freezers, three normal and two blue atoms provided.
Solution: Don't care for the normal ones, just move the blue atoms which cannot be frozen.
Hint: "This clearly works also the other way around."
Purpose: Introduce blue atoms and the analogy to red ones.

Level 15:

Description: Same setup as in Level 12, but with 7 switches.

Solution: Same solution as in Level 12, but you have to guess the right switch, which spawns a yellow atom that can trigger switches without being consumed and therefore 6 other red atoms can be spawned from the remaining switches.

Hint: "At last, value the yellow ones, as they can serve any number of switches."

Purpose: Introduce yellow atoms.

Level 16:

Description: The goal is obstructed by melters, 1 red, 2 blue and 2 normal atoms provided.

Solution: Freeze one melter with a blue atom, then crush it with the red one.

Hint: "Guess what to do."

Purpose: Let the user figure out atom interactions.

Level 17:

Description: The goal, a spinning tentacle melter and 4 blue atoms.

Solution: Freeze the 4 tentacles to score 10 points which are needed to complete the level.

Hint: "Not only goal reaching yields points."

Purpose: Introduce new score mechanisms apart from goal reaching.

Level 18:

Description: The goal, two spinning tentacle melters, 7 blue atoms, 2 normal ones.

Solution: Freeze only one tentacle melter (because 7 are not enough for two) and lead the other atoms to the goal.

Hint: "But often, it is a combination of things."

Purpose: Let the user experience various combinations of making points.

Level 19:

Description: The goal is embedded in a very narrow complex labyrinth of melters, three blue atoms provided.

Solution: Either be very dexterous and guide all atoms through the labyrinth (yields bonus points) or freeze walls of the labyrinth to pass them with the other atoms, since one reaching the goal is sufficient.

Hint: "Thinking out of the box?"

Purpose: Challenging the player either in dexterity or puzzle solving, finding out what the user did.

Level 20:

Description: A pyramid of switches is located in the center of the screen, surrounded by freezers with narrow gaps.

Solution: Quickly move the red atom to the core, another wave of surrounding freezers will spawn, as well as two red atoms. Use the first one to make a hole in the outer ring and proceed with the second one as before. The 3rd ring will spawn with melters, as well as blue and red atoms, again a hole with the right atom has to be made and another right atom has to be passed. The 4th circle consists of melters and switches, one yellow atoms is spawned with which you can trigger the switches to get some atoms spawned used for completion as before.

Hint: -

Purpose: Integrate every knowledge learned about atoms, fragments, interactions between them and to challenge the player.

Results of the in-game factor log

Since the whole table of logged entries dealing with 80 columns and X rows is too big to state it here, I'll just mention the average/summed values for every level to have a reference point for extreme outliers listed below that may predict possible usability errors. For a complete overview over the raw data, the entries can be viewed at <http://nevermindcreations.de/nvmWeb/logs/outputLog.csv> using a standard table calculation program like Microsoft Excel. Note that Level -1 and 0 are describing the behavior of the main menu, which is not related at all.

Due to an error in time recording the entries for some of the levels are corrupt, possibly because of some unwanted game crashes that occurred for an unknown reason yet, so that I unfortunately cannot quantify the time needed for the levels.

	Total Resets	Avg. Resets	Total Skips	Avg. Percentage
Level 1	1	0.14	0	100%
Level 2	0	0	0	166%
Level 3	6	0.85	0	161.85%
Level 4	16	2.29	0	185.71%
Level 5	4	0.57	0	100%
Level 6	27	3.86	0	214.14%
Level 7	0	0	0	100%
Level 8	11	1.57	0	242.85%
Level 9	15	2.14	0	185.71%
Level 10	33	4.71	0	142.86%
Level 11	9	1.29	0	114.14%
Level 12	42	6	0	114.29%
Level 13	2	0.29	0	100%
Level 14	0	0	0	100%
Level 15	54	7.71	0	207.14%
Level 16	22	3.14	0	121.42%
Level 17	20	2.89	0	100%
Level 18	13	1.86	0	110.58%
Level 19	110	15.71	0	100%
Level 20	202	28.86	10	14.29%

The above in-game factor log table can be categorized in mainly three categories of levels:

- **Easy** (No Skips needed, not many Resets needed)
- **Challenging** (No Skips needed, but some Resets)
- **Infeasible** (Mostly skipped)

From which just one falls into the category of a probably bad usability, which will be evaluated later.

Results of the Questionnaire

As before, I will list the average values coming from the post-test questionnaire here and go deeper into the comments. The whole raw data can also be accessed at the following link:

<http://nevermindcreations.de/nvmWeb/logs/output.csv> using a table calculation program.

In the calculations below one participant is considered as an outlier since he obviously did not fill out any field or put in a meaningful value other than a comment, which will be considered later.

Age: Range 17-62 years Average: 30.91 years

Country: Mostly Germany, occasionally Italy, Canada and France

About the Rift:

Previous usage of the Oculus Rift: Mostly "Regular Usage" in the internet group, "Heard, but no own experience" and "Tested it already" otherwise.

How did you hear about the test?: Half "Internet", half "Friends & Family"

(All of the scales below range from 1-5, 1 as the least respective value, 5 as the highest one.)

	Average Value	Meaning of the Value
Ease of use:	4.1	Easy
Motion sickness:	3.8	Somewhat Fluent
Fun Factor:	4.1	Fun
I would recommend it:	4.1	Recommendable

About the game:

	Average Value	Meaning of the Value
The Menu structure was simple and obvious	4.1	Simple
The amount of information presented at a time was appropriate	4.3	Appropriate
I understood the tasks presented	4.4	Understandable
The functions of the game objects were clear	4	Clear
I understood the feedback from the game	3.8	Somewhat understandable
I liked the graphics	3.3	Somewhat liked
I liked the physics	3.6	Somewhat liked
I liked the sounds	2.9	Somewhat disliked
I am satisfied with the game	3.7	Somewhat satisfied
It is actually fun	4.2	Fun
I would recommend it to a friend	3.5	Somewhat recommendable
Too Easy / Too Hard	1.9	Somewhat easy
Average Level Time	1.5	Somewhat short
Innovation	1.2	Somewhat Unimaginative
Overall rating	2.2	Good

Comments

Maybe the most important part, concerning qualitative measures of satisfaction and usability problems, revealed the additional comments part of the questionnaire, stated below with further remarks rephrasing the insights.

“Gerne weitere Levels, die mit der Zeit schwieriger werden. Längere Levelzeiten“

- Suggesting harder and longer levels, supported by the questionnaire results of “Too Easy / Too Hard” and “Average Level Time”.

“I love the "head-ridden" game play ... The level design is maybe a bit flat/grey/boring... Some levels are a bit long (but not all of them)”

- Contrary to the first comment.

“Der Rift ist nicht unbedingt meine Art von Steuerung. Bewegungen mit dem Kopf sind absolut grundlegend und essentiell, sodass bei einer so sensibel eingestellten Steuerung schnell Abläufe im Spiel passieren, die gar nicht gewollt waren.“

- A major critique on the input device. Although that person is not the target audience for Oculus Rift games, the sensibility should be able to calibrate and “breaks” while being in a level should be possible to cope with normal head movements.

“Habe das Spiel nur kurz angetestet und nicht alle Levels gesehen. Den Ansatz der reinen Blicksteuerung finde ich super (z.B. auch behindertengerecht) und spaßig. Die Bedienung ist eher schwierig. Z.B. bei den Portal-Elementen (die die Kugeln von einem Punkt zum anderen teleportieren: Ich konnte mit den aufgenommenen Kugeln das andere Portal-Element nicht richtig sehen, bei entsprechender Kopfdrehung fallen sie natürlich runter. Die Steuerung ist insgesamt noch zu grob. Ich würde nochmal an der Steuerung arbeiten (sonst sind die Leute vllt. so schnell frustriert, dass ihr kein brauchbares Feedback bekommt) und die Optik völlig verändern. Ein simplerer 2D-Stil, vielleicht im Retro-Look, insgesamt heller und übersichtlicher. Als werbefinanzierte App könnte ich mir das Spiel durchaus vorstellen.“

- Also critique on the controls that had to do with no perceived possibility of pausing the following of the atoms. Actually there is a method to stop the following for a while by holding the Space bar, but it was just shown at the main menu and not recognized further.

“This game needs work but it could be good. One thing that absolutely needs to be added is a way to look around the level without affecting the balls. There is one level where I have to watch which side of the hazard a teleporter is on but I can't do that while I'm holding the balls. I also realized in that level that if I picked up a ball and moved my head fast enough across the gap the ball would make it and I didn't even have to use the teleporter. I assume that wasn't supposed to happen. It's a neat idea, and it was fun for a while, but the fun wears off quickly. I'm not much of a puzzle game fan though, so I'm not your target audience.”

- Same critique as mentioned before.

“Couldn't figure it out. I see the main screen. Nothing happens.”

- This subject didn't recognize the need to press Enter or a similar key to start the level. Although it is stated multiple times, I should make this more obvious.

"I'd make the demo start in VR mode right away, I waited a good 20 seconds with the dk2 on my face before realizing it was displaying on my monitor."

- This subject seems to have opened the Desktop-Mode-Version of the .exe in the first place. It is possible to start in VR-Mode right away, but the mode is changeable in-game.

"Ich hatte meinen Spaß damit obwohl man sich auch zum Ziel teilweise Glitchen konnte. Dass wäre ein Punkt den man verbessern müsste."

- One bug exists that allows atoms to skip gaps between platforms that could be found.

„Sounds: An den Sounds ist noch was zu verbessern, der Ton bei der Zerstörung vielleicht etwas zu krass, der beim fertigstellen eines Levels sehr harmonisch und genau richtig. Einfachheit: Die ersten Level sehr leicht müssen sie jedoch auch sein, um in das Spielgeschehen rein zu kommen, später wird es schwieriger, was es dann auch interessanter macht. Der zweite Endgegner leider etwas sehr schwer, dadurch verliert man schnell die Lust daran weiter zu spielen, da man meist sofort am Anfang stirbt. Dann wird erst die "Vorschau" zu dem Endgegner gezeigt und wenn man sich dass alle zwei Sekunden nach dem Tod angucken muss verliert man auch schnell den Spaß daran. Besser: Vorschau weg lassen oder kürzer machen und den beginn des Endgegners leichter machen, sodass man erst nach der zweiten oder dritten Schicht an Kugeln um die Mitte herum öfter stirbt. Dadurch verliert man nicht so schnell die Lust daran. Das Spiel hat leider kein Suchtfaktor. Beim ersten Endgegner ist es anfangs etwas unverständlich, was mit dem Portal ist (man versucht sich damit selbst zu teleportieren) und was man mit den Freezern tun soll, wird jedoch verständlich wenn man es zufällig schafft ihn auf den Arm fallen zu lassen. Habe es letztens geschafft mit einem Freezer gleich beide arme zu zerstören 8)Viel Spaß beim Weitermachen :)“

- Rephrasing the last-level-problem, also giving some hints about general minor changes.

"Mehr Sounds: - Wenn Kugeln vom Boss gefressen werden. - Wenn der Boss die Arme bewegt - Kugelfarben könnten jeweils eine Note bekommen- Text eher unschön. Vielleicht durch HUD ersetzen oder ersatzlos entfernen und benötigte Kugeln durch den Ausgang anzeigen lassen?- Startanimation vom Endboss nur ein Mal zeigen.- Labyrinth Level: Die Erste Kugel geht häufig versehentlich verloren- Zufallsgenerator braucht Obergrenze für Wartezeit- Gesten? Schütteln um Kugeln fallen zu lassen? Werfen? Rammen?- Physikrätsel? Gewicht, Geschwindigkeit, Elastische Gegenstände?- Der dunkle Raum mit heller Kugel war super! Lichträtsel?"

- Suggesting more sounds, as also the questionnaire revealed ("I liked the sounds."), as well as a lot of cosmetic changes and level proposals.

Evaluation

Finally, integrating all the insights from the various sources, i.e. in-game factor log, questionnaire values and additional comments, some usability issues could be found that more or less severely have to be worked on.

Most of the levels, as the in-game factor log shows, are rather easy and do not need improvement in their particular instance. For the levels marked as “Challenging”, it is not obvious whether the challenge comes from the puzzle setup of the task or from a bad usability that provoked some restarts. In the most cases, as additional verbal reports mentioned and as recognized while watching the subjects, restarts occur while exploring the levels and trying different things to solve the puzzle. However, as also some comments revealed, there are some particular usability problems in some levels, e.g. the lack of a good overview over level 6 was stated in the 4th and 5th comment, represented by an average reset need of 3.86 and the reoccurring loss of one atom when restarting in level 19 lead to an average of 15.71 resets, also confirmed by the statement in the last comment. Above that, one level seems to be “infeasible”, the last level, which no one managed to complete with the exception of one subject. However, this had nothing to do with subjects not understanding the task presented, or disliking the challenge, but as more and more fragments spawned (see description on page 8: Level 20), the computational power of the test machine was too less to deliver a fluent experience anymore and the scene was full of motion latency which rendered the completion of the task almost impossible. Since the one subject that managed to complete it was one of the internet subjects, it is supposed that better computers can do this level, but to ensure a broader compatibility, the graphical requirements of this level should be adapted.

Apart from the last example, the Oculus Rift was perceived as easy to use, fun and fluent, as well as the overall game experience. Improvement should be done clearly in the field of sounds, level challenges and required level time, so more of the deep, complex levels are requested.

Adding some cosmetic changes to ensure a faster understanding of the purpose of some game elements seems to be also useful, the glitch that could be found that could ruin the puzzle aspect in some of the levels has definitely to be fixed, but the most severe critique point is a very basic one, namely the not completely satisfactory control system. Most of the time, it appears to be very easy and fun to play but when it comes to complex situations, like differentiating between certain atoms, looking around without taking atoms along or just perform normal, unconscious head movements without altering the game state, the mechanism is not fully fledged. Thus, before releasing the successive version, the control mechanism has to be refined in terms of selection choices, easy displacement of atoms and a generally better influence on the game states compared to the naïve approach used in the first version that served this usability test.