# Utilizing “natural mappings” in a VR environment

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**Abstract:**
“Natural mappings” are a well-defined topic within the real world and long existing game genres.
This paper will focus on the translation of “natural mappings” from the real world and those games to a virtual reality environment while heavily relying on the work of Donald Norman’s “The DESIGN of EVERYDAY THINGS” and comes to the conclusion that “natural mappings” in VR are quite similar to what we know about the real world but need additional clarifications in terms of visual, and audio feedback since these objects have no physical existence.

**Subject description:**
General – Games; General – Design; Game Design; VR;

**General Terms:**
Game; Design; Theory; VR;

**Keywords:**
Game Design; VR; Natural Mappings;

**1. What are “natural mappings” and what use could they have in a VR game:**
“Natural mappings” are the visual appearance, position, and sorting of interaction possibilities an object offers the user. An example for this are the heat controls of a common stove: A single control element has a round shape without any extensions which indicates the user, that the object must be rotated to interact with. In addition to that, every control element works the same way they must be rotated right to increase the heat and left to decrease it. But in terms of sorting, they are often mismatched since the heating plates on the stove are differently sorted than the interaction possibilities for the user. [1] What a user understands as “natural mapping” can vary depending on culture, education, etc. [2] This paper focuses on how the system structure of “natural mappings” could be integrated in VR games to allow players to easily understand control without any form of tutorial and to master these controls in a short amount of time.

**2. Donald Norman’s “natural mappings”:**
The author is not aware of any theoretic research to the subject extending the work of Donald Norman’s “The DESIGN of EVERYDAY THINGS” [3], which focuses on the design of objects within the real world, but there are a number of different works that build upon the work of Donald Norman.
Donald Norman shows in [1] the basic principle of “natural mappings” and clarifies that “natural mappings” take advantage of what the user already knows therefor relay “natural mappings” on a common system and understanding of functionality to work this results in different natural mappings for different cultures. [2] Donald Norman sorts the quality of “natural mappings” into three different levels:
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- Best mapping:

Controls are mounted directly on the item to be controlled.
- Second-best mapping:
  Controls are as close as possible to the object to be controlled.
- Third-best mapping:
  Controls are arranged in the same spatial configuration as the objects to be controlled.

“ [4]

This clarifies that perfect “natural mappings” are not always achievable because of other qualities a product should have, but should always be the main focus after all the basic requirement have been met.

**3. Testing “natural mappings” in a VR environment:**

To determine how to utilize the already existing theories listed in the “2. Donald Norman’s “natural mappings”” section for VR environments, playtests with different kinds of controls have been conducted with a prototype for a wrecking ball game and a selection of other VR games that feature direct interaction with objects have been tested in how users interact with them, how much of an introduction they need to understand the controls and how quickly they can use the controls without looking at them.

**4. Results:**

By utilizing the theories in the “2. Donald Norman’s “natural mappings”” section the player did not need much of an introduction to understand how the different controls work, as long as the result of the interaction was visible while the player was utilizing the control element the player was able to find out how to translate that interaction to achieve the objective he/she was trying to achieve. At most players needed to be informed about the fact that they can interact with objects within the game world.

But the basic utilization of the theories of “2. Donald Norman’s “natural mappings”” were not enough to allow a player to use the interaction possibilities without looking at them. While the players did understand how they would operate the interaction possibilities without looking at them the physical feedback and constraints are missing. This results in guessing movement of the player and leads to unintended gameplay results that frustrate the player.

**5. What use has “natural mapping” in VR environments:**

The theories of “2. Donald Norman’s “natural mappings”” work almost the same in a VR environment compared to the real world in terms of how to teach a user about the interaction possibilities and how they can be utilized to achieve the intended result. But because the physical feedback and constraints are missing it the player unable to use them without thinking about the controls instead of the task. This makes further research about how to replace or create physical feedback and limitations necessary.

**6. Future Work:**

Physical feedback and limitations are necessary the create controls that are usable without thinking about them. Therefore a replacement or a method to create physical feedback is the next step to create perfect “natural mapping” in a VR environment. One possible approach would be to create grey zones in which in interaction possibility counts as usable even if the hands are not really colliding with it, but this is only half the way and needs further development.

**References:**

[1] Norman, Donald. 2013. The DESIGN of EVERYDAY THINGS. Page 113-114:

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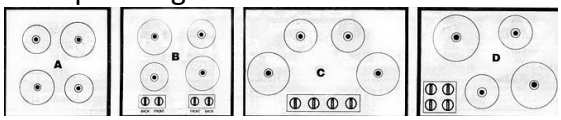

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