# Taking a Book Off the Shelf in a Virtual Library

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## Overview

Recent technology developments make it feasible now to store and access a large number of complete book images in high resolution in real time. Our project is working towards an immersive virtual library environment with focus on browsing. We want to bring together book selection and reading in a smooth immersive manner.

## The Problem

Using the HTC Vive virtual reality system and headset (Fig. 1a & b), and the Unreal 4 game engine, we have built a bookshelf (Fig. 2a) and populated it with interestingly varied, realistically depicted set of books. The user presses the trigger on the controller to 'grip' a book (Fig. 2b). The question is: How does the user get from this point to browsing the text of the book?

We seek to design an interface mechanism to cover this transition from grabbing to viewing a book. To better understand that process we present the results of a small-scale study in which participants interacted with a physical book. Their book selection and book opening gestures provide design insights for the interface to a virtual reality library.


Fig. 1. (a) HTC Vive Headset & (b) Controller


Fig. 2. (a) Virtual Bookshelf & (b) Holding a Virtual Book

## Methodology

Participants were asked to:

- Stand in front of a full bookshelf. The shelf was 120cm from the ground (not quite eye level but within easy sight and reach).
- Select the softbook *Web Dragons* and locate Chapter 4.
- Read out loud the chapter title and first sentence.

Thirty participants were recruited:

- 20 male and 10 female, 27 right-handed and 3 left-handed.
- Age distribution was 17 - 20 years old, 15; 21 - 30 years, 10; 31 - 40 years, 1; 41 - 50 years, 2; and 51 - 60 years, 2.
- Average time to complete task was 48 seconds.

## Results

To find the target book, the participants first positioned themselves within a comfortable reaching distance of the bookcase.

- 7 of the 30 participants ran their hand along the shelf as they linearly scanned for the book.

All participants used a single hand to pull the book from the shelf.

- They favoured their dominant hand by a roughly 2 : 1 ratio (18 out of 30).

When grasping the book on the shelf:

- 8 participants pulled it out by the top of the spine.
- 2 by the bottom of the spine.
- 4 shifted their hand on the spine as they pulled.

Once the book was completely away from the shelf, the next activity was to move the book into a comfortable position in order to find Chapter 4.

- 5 participants made two or more shifts in book position before settling on a stable position.
- 14 supported the book with the same hand with which they pulled the book from the shelves.
- 7 transferred the book to the opposite hand to hold.

- 9 held the book with both hands (grasping it by the edges of the pages; Fig. 3a).
- 21 participants who held the book primarily with one hand either balanced on the spine (Fig. 3b) or the back cover of the book (Fig. 4) in the palm of one hand.

Fig. 3. (a) Holding book in both hands & (b) Holding spine in palm

Fig. 4. Resting back cover on hand/forearm

To locate Chapter 4:

- 21 participants immediately began flipping/riffling through the book's pages.
- The remaining 9 first consulted the Table of Contents before flipping to locate Chapter 4.

The initial direction for flipping or riffling was:

- Forwards through the book for 20 participants.
- Backwards for 10.
- 18 "overshot" as they flipped, of these, 14 changed the direction in which they flipped after the overshot.

## Conclusion

Although there was quite an amount of variation, the most popular process was:

- Grasp a book with dominant hand.
- Turn the book over in the same hand.
- Hold it balanced on the spine.
- Use the other hand to rifle the pages.

Turning the book over and balancing it translates to a very clear gesture - turn the controller over and let go of the trigger. The page flipping process can be directed using the hand (controller) just above the book and move it left and right to control direction and the rate of flipping.