# How do we grasp (virtual) objects in three-dimensional space?

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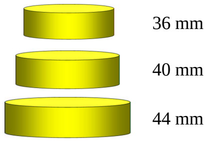
## Introduction

Virtual realities can be a useful tool for psychophysical experiments. The experimenter is enabled to fully control the haptic and visual parameters of the simulated objects. For example, he is enabled to easily vary objects after movement onset and therefore to explore the mechanisms of online control in visually guided movements. While grasping real objects, a well studied parameter to quantify the grasp is the maximum grip aperture (MGA) (cf. Jeannerod, 1981, 1984). The MGA scales linearly with the object size and with a slope less than 1 (app. 0.82, Smeets & Brenner, 1999).

In this Experiment, the size and position in 3D-space of a virtual disc was varied. We were interested in the question whether participants scale their MGA according to the object size and if the object position in 3D-space influences the MGA.

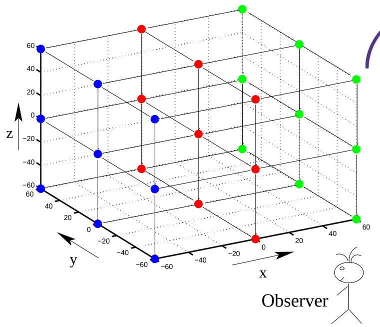
## Stimuli and Procedure

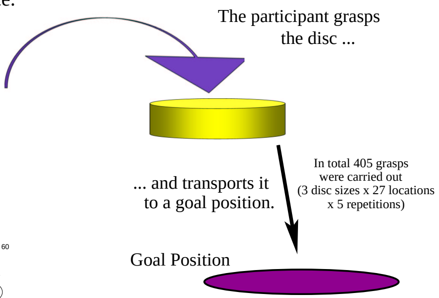
A virtual disc ...




10 participants
19 − 60 years
Normal or corrected
to normal vision
Normal stereo accuracy
Right handed

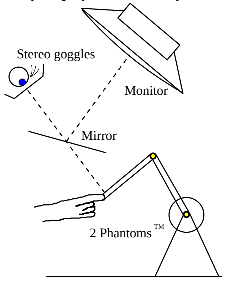
... was displayed at 27 positions in 3D−space.



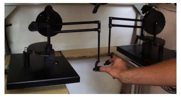




## Apparatus

Visual feedback. The object was rendered using OpenGL. It was stereoscopically displayed and overlayed onto the haptic scene.

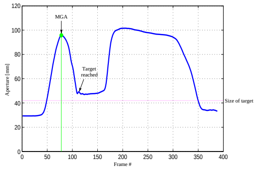



Haptic feedback was given using two Robot arms (PHANToMs™), of which one was connected to the index finger, the other one to the thumb, thus allowing a precision grip of the virtual disc.



## The Maximum Grip Aperture (MGA)

During the reach phase of a grasp (precision grip), index finger and thumb open to a maximal aperture.

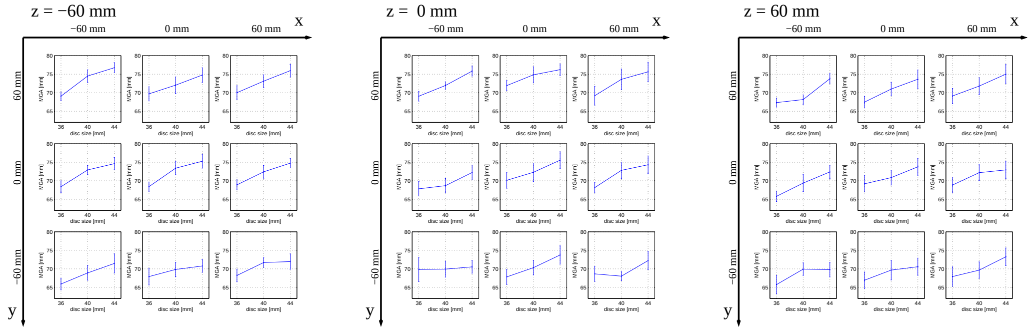



The MGA is:

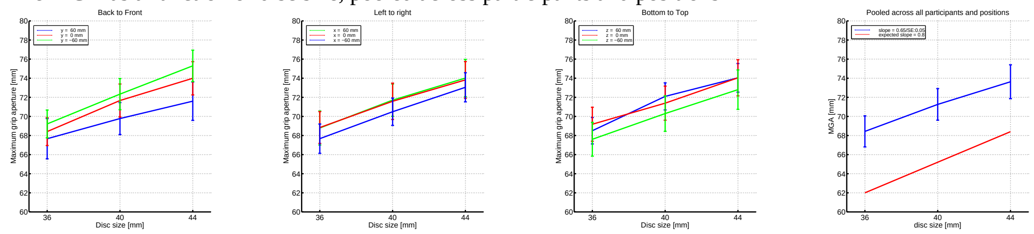
- linearly related to object size and
- a measure for the transfer of visual size information to the motor system.

## Results

The MGA as a function of disc size for each Position, pooled across participants




The MGA as a function of disc size, pooled across participants and positions




## Discussion

The participants scaled their MGA according to the size of the virtual disc, but with a slightly shallower slope than expected. The MGA was dependent on the location of the object in virtual space. Especially when the participants had to grasp a disc close to their body, the MGA was less responsive to a change in size.

Possibly this was due to the fact, that the participants interact more insecure with virtual objects compared to interacting with real objects. The overall shallower slope could be caused by grasping locations close to the body, where the participants hardly scaled according to the change in object size.

## References

Jeannerod, M. (1981). Intersegmental coordination during reaching at natural visual objects. In J. Long & A. Baddeley (Eds.), *Attention and performance* (Vol. 9, pp. 153 – 168). Hillsdale, NJ: Erlbaum.

Jeannerod, M. (1984). The timing of natural prehension movements. *Journal of Motor Behavior*, *16*(3), 235 – 254.

Smeets, J. B. J., & Brenner, E. (1999). A new view on grasping. *Motor Control*, *3*, 237 – 271.