Appraising the role of architectural proportion from a psychophysical perspective

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The theory of architectural proportion has a long and tangled history in which the definition of proportion emerged as elusive and controversial [10]. Three approaches dominated research of proportion: aesthetic, perceptual-cognitive, and symbolic. The first two approaches are often conflated, implying that proportion is significant mainly for the experience of aesthetic pleasure [3]. We attack this controversy in an interdisciplinary program of research inspired by work of the Dutch architect Hans van der Laan (1904-1991). We ask whether proportion could play other roles, facilitating perception of the structure and affordances of the built environment.

Van der Laan developed a proportional system centered on the concept of "plastic number" and studied just-perceptible differences between proportions [6, 8, 11]. We pursue these issues using methods of sensory psychophysics and eye movement research. We develop a measurement platform in which we study the perception of proportion in static and mobile observers. We begin by performing psychophysical experiments into the human ability to discriminate proportions of three-dimensional objects and volumes across distances and spatial scales (called "types of size" by Van der Laan) in place of previous studies of proportion with two-dimensional shapes [1, 2, 5, 9].

Human subjects view pairs of solid objects, presented monocularly (through a pinhole) or binocularly (free viewing) [7]. The stimuli are sampled from a proportional system of objects called morphotheek, determined by Van der Laan's system [11]. On each trial, the experimenter places two objects in the nodes of a 7x7 grid covering a 70x70 cm horizontal surface. At every node, the object can be positioned at one of 11 orientations. Object identities, locations, and orientations are selected randomly across trials. Subjects discriminate aspect ratios of the stimuli following a two-alternative forced choice protocol [4]. This way, we determine the threshold of discrimination between proportions under perspective distortion. The measurements are designed to establish a foundation for scientific studies of the perception of proportion in the architectonic space, helping to reinvigorate the research of the role of proportion in architectural design.

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Tiziana Proietti, Ph.D., is an architect and educator. She earned her doctorate from the Department of Architecture of the Sapienza University of Rome in collaboration with the University of Technology TUDelft. Her doctoral dissertation concentrated on the theory of proportion in architecture. She is an Assistant Professor at the University of Oklahoma where she directs the Sense-Base Laboratory. Together with the scientist Dr. Sergei Gepshtein of the Salk Institute for Biological Studies in California, she is developing an interdisciplinary program of research which will bridge neuroscience and architectural design and test age-old hypotheses about the human response to architectural proportion.

Sergei Gepshtein, Ph.D., is a scientist working in the areas of perceptual psychology, systems neuroscience and computational neuroscience. He is a member of the Center for the Neurobiology of Vision at the Salk Institute for Biological Studies in La Jolla, California, where he studies perception and active behavior from the mechanistic point of view of neuroscience and from a point of view that respects visual experience as a research focus in its own right. He also directs the Center for Spatial Perception & Concrete Experience at the University of Southern California, Los Angeles. He is the inaugural recipient of the Harold Hay Research Award from ANFA (2013).

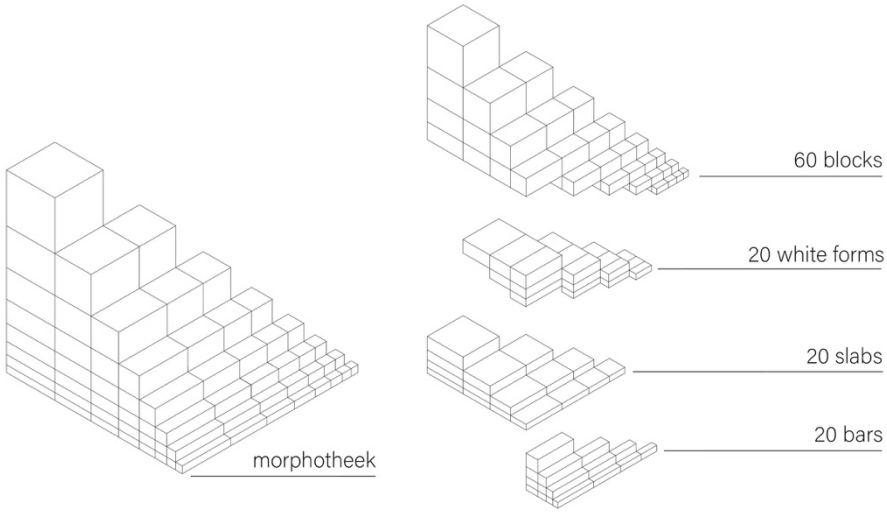

Figure 1. Van der Laan's *morphotheek*. One hundred twenty pieces of the *morphotheek* include objects of four kinds: 60 "blocks," 20 "slabs," 20 "bars," and 20 "white forms."

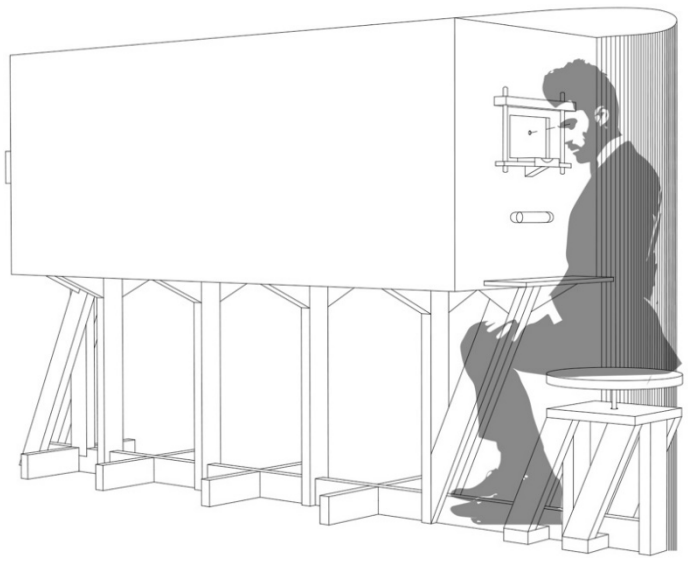

Figure 2 at LEFT. Perspective view of the measurement platform (the "perspective machine").

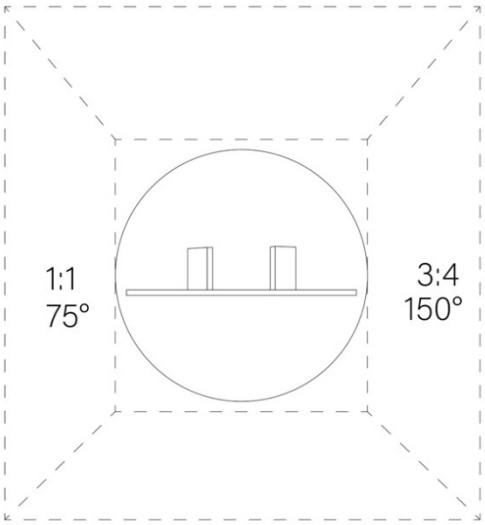

Figure 3 at RIGHT. Perspective view through the pinhole. The two objects are the stimuli with different proportions (1:1, 3:4). Stimulus locations and angles (here 75° and 150°) vary between trials.