P/REFERENCES OF DESIGN

THINKING ‘TOOLS’; LOOKING AT OURSELVES.

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ABSTRACT | Conceptual Design practice case studies use design to bridge and rethink research tools in the fields of Brain Sciences and Computational Archaeology. Tools are central to the design discipline, they both allow for the realization of work, are expressions of design in themselves, and they tell the story of the people who made/use them. Tools are far from exclusive to Design. However, their fundamental standing in the discipline allows them to make a convenient and intimate point of entry into many scientific fields.

The showcased projects (Slide deck) are currently on show at the Hebrew University of Jerusalem's Brain Sciences art gallery and display the outcomes of the author's distinctive design interactions with the said gallery faculty as well as that of the Computational Archaeology lab at HUJI's Institute of Archaeology.

Both the fields of Archaeology and Brain Sciences create tools to study who we are/were. Increasingly, those tools are computational, processing data sets with outputs "translated" into visuals for easier human comprehension. An outsider's view of the scientific processes allows for spotting common ground, such as between methods used in these fields, e.g., convergence of individual instances into a more general digital model. Or, for instance, the realization that archaeologists creating digital tools for the study of prehistoric stone tools have inadvertently placed themselves into the hominin evolutionary lineage for having themselves created new tools. Tools, whether lithic or digital, are vehicles for studying the people who made them, understanding their interests, their technologies, their social organization/interactions, etc.

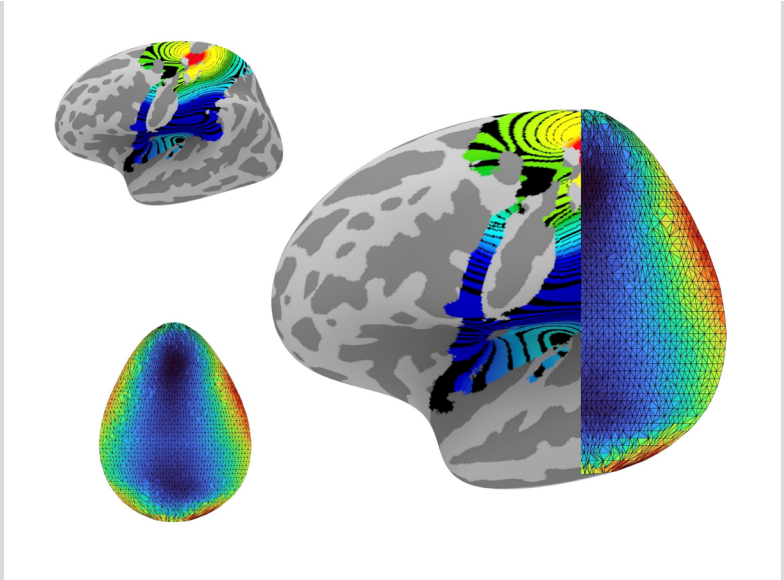
Dr. Gadi Herzlinger and Prof. Leore Grosman (Herzlinger, G. et al., 2018) developed software that analyses an assemblage of prehistoric hand axes (a popular "teardrop" shaped stone tool typology used by hominins for some 1.4 million years) found on an excavation, defining a typical average form, and identifying the extent of deviation from that average form. One series of design works subverts the computer program, using it as a creative tool and not for its anticipated analytics. For example, the use of a data set consisting of 10 hand-axes knapped by the designer and 10 Neanderthal hand-axes found in France. Based on his ancestry, the designer has 2-4% Neanderthal DNA, but through the creation of this new hand-axe form, the interspecies mix has been upped to 50/50. Or by questioning the assumption that a data set should include several (ideally many) artifacts to work properly instead of placing and flipping the same single artifact into the program twice, creating an overt self-symmetry assessment.

A parallel dialog with Prof. Yonatan Lowenstein's lab at the Faculty of Brian Sciences on fMRI-based research looking at selectivity in the brain cortex led to the design of shoes for the creation of brain analytics patterns as well as 3D printed brain infographics as a novel research dissemination tool. The design was used to bridge these two scientific fields by highlighting shared methods and interests, at the same time offering an alternative and subjective point of view through recontextualizing.

50% Neanderthal / 50% Human, Stratasys full-color 3D polyjet print, 2023

It is not by chance that many of the tools developed to study ourselves, whether through artifacts we created in the past or of our anatomical workings, rely on and output visual data. Both the fields of Archaeology and Brain Sciences make use of and develop such tools.

The detailed project herein focuses on these tools and what they signify to rethink them and leverage them for the creation of novel designs.



A 'mean output' visual comparison from computed data sets in the fields of Brain Science, and Archaeology

The project required identifying common research approaches shared by the fields of Brain Sciences and Computational Archaeology and later highlighting this through their property - developed digital research tools. Tools that require data sets, and hence propose the altering of results (i.e., *design*) based on control over the input data, in essence transforming analytical tools into creative tools.

Digital tools used included CAD and visualization software, Artifact GeoMorph Toolbox 3D, fsaverage, 3D scanning, 3D printing in PLA/Stratasys's polyjet/quartz sand, as well as bronze casing and flint knapping.

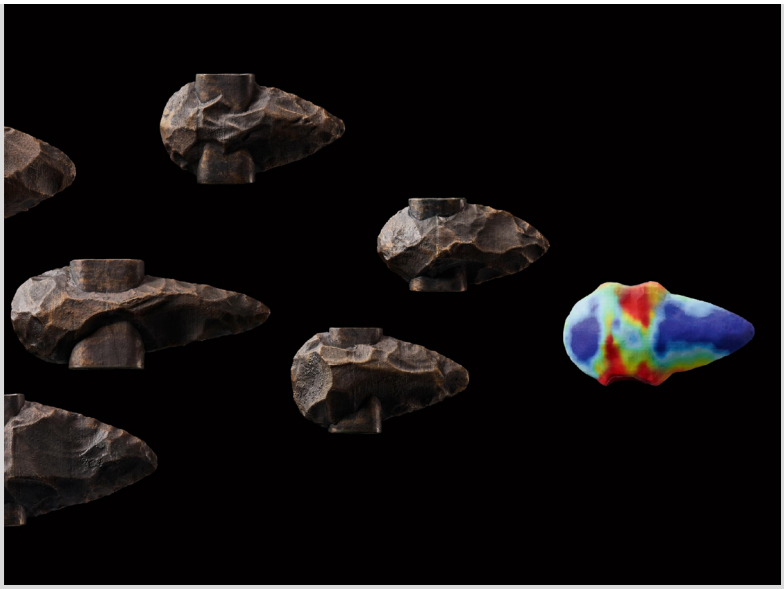
Creative process included physical-to-digital-to-physical workflows: sourcing flint, knapping stone tools, 3D scanning, CAD manipulation, 3D printing

Dialogues were upkept with researchers in the discussed scientific fields, including visits to archaeological dig sites, material archives, digitized artifact repositories, sourcing raw flint from the desert, and academic conference workshops.

The creative process consciously constructed narratives or context beyond the objective geometry/neurological activity being observed by researchers. This included the creation of new objects that, for example, point to the evolutionary link between the researchers/designer and a prehistoric artifact maker. Or the extraction of actions taken as part of a controlled lab study utilizing fMRI and recreating them in life by means of streetwear.

The Whole Earth Hand-axe, Stratasys full-color 3D polyjet print, 2023.

The Whole Earth Hand-axe is a gesture to *unity* combining evolutionary backgrounds, our own, as well as those of parallel hominins, through a geographically dispersed common tool - the hand-axe. This work was created using property computational archaeology software to process a large group of Paleolithic hand axes originating from Africa, Europe, Central Asia, China, and the Levant.



Data Set, cast bronze, and Stratasys full-color 3D polyjet print, 2022

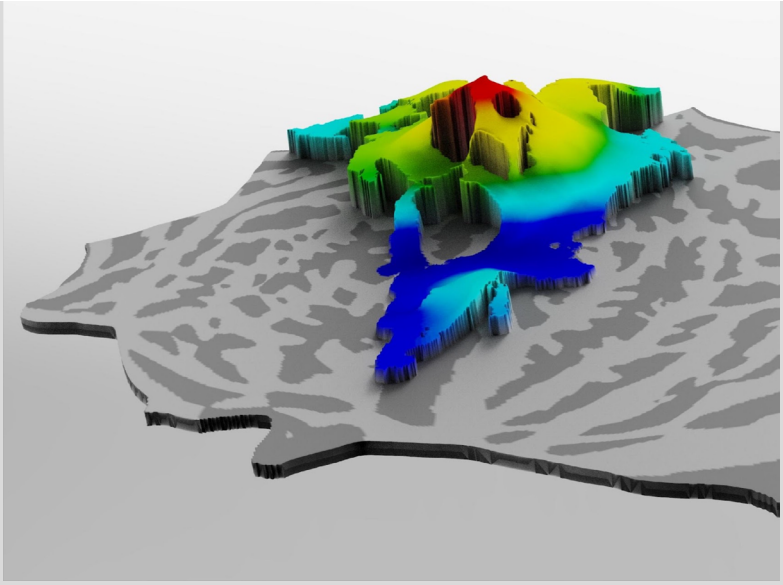
Six hand axes knapped from flint nodules were 3D scanned and then digitally manipulated, enabling them to be easily hafted to a shaft that could run through the artifacts as though they were forged metal axe heads. They were then cast in bronze – in accordance with the (pre)historic shift from the Stone Age to the Bronze Age. These new fictional artifacts were then fed as a data set to the AGMT3-D software, which produced a single multi-colored 'mean' artifact. A color scheme familiar from scientific and engineering analytic visualizations, the colormap here indicates deviation from the mean form, with red representing areas with the most form variability and dark blue representing areas where the artifacts were most similar.

Perpetual, 3D photopolymer and elastomer prints, 2D digital prints, synthetic hair, 2023

Brian selectivity levels correlating to the brushing of subject's limbs were displayed on an "inflated" brain model. The resulting analytics visualization was then "unwrapped" as a two-dimensional pattern. For the *Perpetual* shoes design, leg stimulation information was isolated from the overall data. The obtained two-dimensional color pattern was treated as though an animal hid and used to make the shoes upper, with the left hemisphere map applied to the correlated right shoe and vice versa.

The brushes incorporated in the shoe design pay homage to the way the scientific study was conducted and, at the same time, brush the wearer's legs when walking, thus stimulating the brain and producing color cortex maps, which can then be used in the creation of shoes…

Design works and scientific workflow illustrations incorporated in the exhibit *"Looking at Ourselves"* at the ELSC Martine De Souza-Dassault Brain Art Gallery, at the Hebrew University of Jerusalem

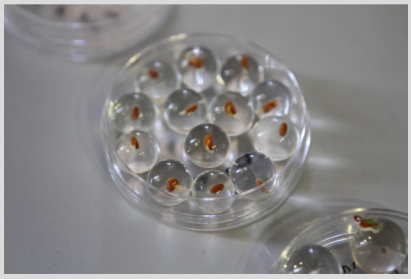
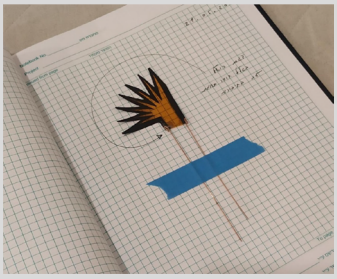


Mapping of the neural level of response in the brain to somatosensory stimulation, its *selectivity*, indicates the large-scale organization of hierarchies in the somatosensory domain. Degree of change is represented here by color as well as height.

An unanticipated outcome of the project was the development of a technique of showing brain activity data in a novel fashion; to date, the lab has used virtual 3D models with applied heatmaps (color correlated with degree of selectivity) to illustrate their findings.

Through 3D printing, researchers now have physical 3D brain activity models that can be handled and observed. Additionally, they regularly "flatten" the brain models to fully view the information on the folded brain surface. Taking those flat mappings and assigning a physical height value to the heatmap results in "mountains" materializing on the flat brain map, allowing for the intuitive reading of how rapidly the selectivity changes from one area to another simply by looking at the degree of incline.



MDes student projects in collaboration with HUJI's Physics, Chemistry, and Earth Sciences Department labs

The references and framing of this project rests, in part, on the backdrop of an academic collaboration I co-tutor with Maya Ben David held within the framework of an MDes course between design students and "hard science" labs at the Hebrew University of Jerusalem. The students are introduced to content – research topics in Physics, Chemistry, and Earth Sciences labs, and from there, embark on a hopefully collaborative 'response' through design. Projects at times propose applications, communicate science, speculate through alternative futures on implications, latch onto poetics identified in the lab environment, or otherwise give a subjective context to purposely objective research.

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This contribution was presented at Cumulus Budapest 2024: P/References of Design conference, hosted by the Moholy-Nagy University of Art and Design Budapest, Hungary between May 15-17, 2024.

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