NEW VISUAL GRAMMAR
DEVELOPING STUDENT UNDERSTANDING OF VISUAL INTERPRETATION THROUGH MORPHOMETRIC METHODOLOGY

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1. BACKGROUND

In the past, the appearance of products was developed through tracing mechanical components and specifications. Nowadays, the form of the product tends to embrace a concept found in the context of the users' lifestyle. The emphasis on user experience for developing product forms and shapes in turn requires for the product to rely more heavily on development and visual strategy. It is always a challenge for design educators to teach students how to develop visual forms in a studio-based environment. This research will illustrate visual methodology focused on articulating visual considerations that show how students can initiate their ideas easily for form development.

2. MORPHOMETRICS IN PRODUCT SHAPES

Morphometrics refer to the quantitative analysis of form, a concept that encompasses size and shape. Morphometric analysis is commonly performed on organisms, and is useful in analyzing fossil records, the impact of mutations on shape, developmental changes in form, covariances between ecological factors and shape, as well as for estimating quantitative-genetic parameters of shape (Morphometrics, Wikipedia).

The shapes of products are always reflected by the user's needs and demands. Through analyzing product forms that designers can find from extracting quantitative visual data of product dimensions and proportions of components on product history or comparison, designers can use this as a great resource for understanding how these morphing processes work. This information will provide students with visual literacy about the process of developing shapes reflecting environmental circumstance and the evolution of product shapes.

3. BISECTING PRODUCT SHAPES (PRODUCT ANATOMY: FUNCTION, PART, SHAPE, MANUFACTURABILITY, TECHNOLOGY)

As a comparison, archeologists have been applying visual morphometrics as a way to understand the transformation of the shapes of organs when they study distinct creatures and their circumstances. When studying products, a product as itself consists of three categories: skin (surface), skeleton (structure), solid (whole body). These three categories are similar to how a paleontologist can emulate the body of a dinosaur by reconfiguring the living conditions and environment based on the study of the remaining bones.
First, configuring manufacturability or functional aspects, a product developer will decide the layout of components in the right location on the product. This structure can be found by studying the product anatomy

from listing the skin, skeleton and solid components of products. With these three categories, a designer can then trace back to the mechanical components and the points that indicate tactile interaction with the human body. If students comprehend all visual layouts of the skeleton and organs of a product, they can start to imagine the skin or surface of the product and visualize product appearance. The following picture shows the Dremel hand tool identified by three different statuses (surface, structure and solid). To the left of Fig 1, the Dremel hand tool is shown in its solid form that a user can interact with. The images to the right represent the skin and structural frame of the tool.

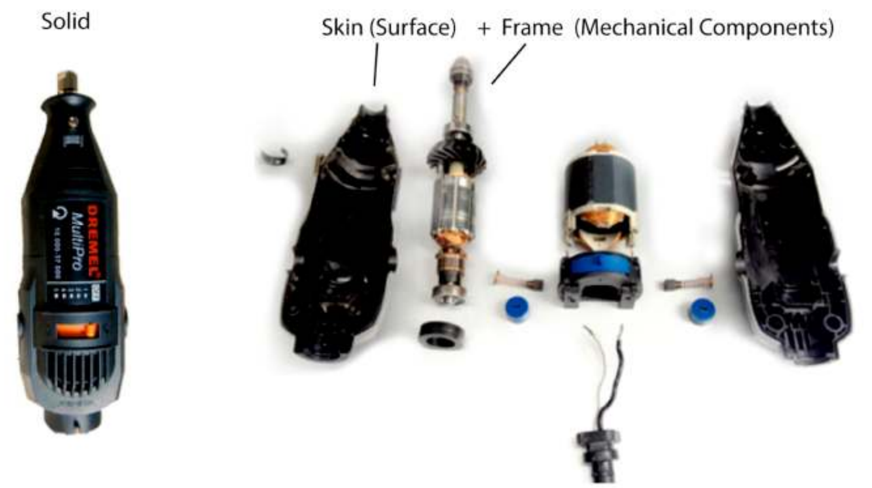


Fig 1**.** Product anatomy (Dremel tool: explain the categories of product body-Surface, Skeleton, solid)

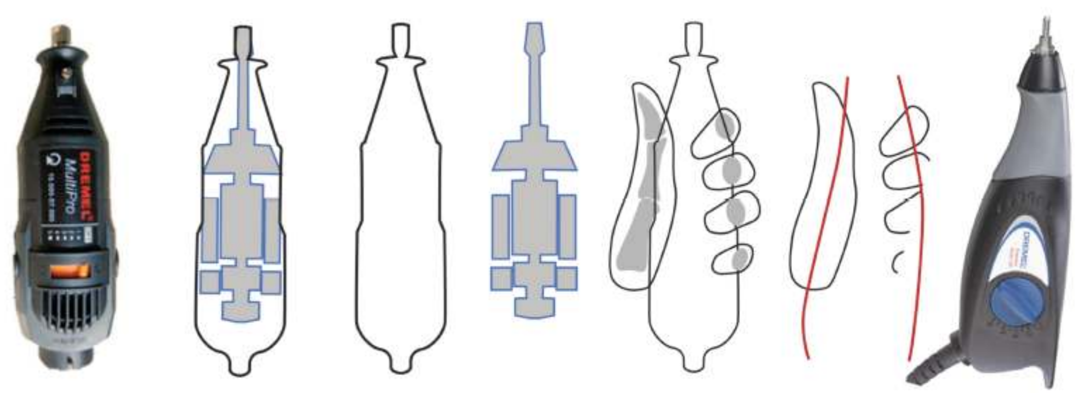


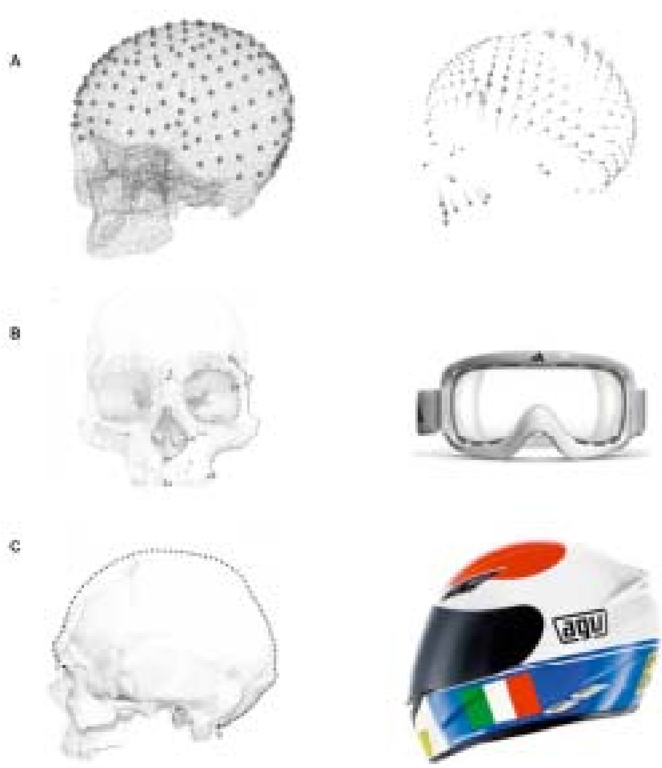
Fig 2. Product anatomy filtered by different aspects exampled by old and new Dremel tool.

Shown in Fig 2, the left side of the picture shows how the product is structured (Solid= Surface + Skeleton). Towards the right side of picture, the diagram illustrates how the human fingers' skeleton and skin interact with the old version of the Dremel tool that has a surface with visual traits focused on mechanical components. The tactile areas shown by the two red lines were extracted from the skeleton of a hand. These two lines are analogous to the surface of the new Dremel tool design. By applying the method of visual morphometry to the design of a small hand device, the visual component incorporates the ideal tangible experience by using form to suggest to the user to grip the device based on visual cues that simulate this interaction. With careful analysis of the form of the new Dremel tool this example shows how a product shape can be studied in order to determine the origin of its shape.

4. TRACING ANTHROPOMETRIC INPUT FROM A HUMAN BODY

Anthropometry (from Greek άνθρωπος anthropos, "man" and μέτρον metron, "measure") refers to the measurement of the human individual. An early tool of physical anthropology, it has been used for identification, for the purposes of understanding human physical variation, in paleoanthropology and in various attempts to correlate physical with racial and psychological traits (Paleoanthropology, Wikipedia)

Especially for designing objects that require interaction with the user's body, an Industrial Designer needs to study the human body in order to optimize the usability of the products. Moreover, by applying anthropometric dimensions by extracting and applying contour lines from anthropometric measurements, this provides students with a method to create a visual template that can be utilized as a visual grid or framework for ideation and exploration. In addition, these guidelines can be used as a good way to use visual grammar to configurate proportions, sizes, ratios, etc. Eventually, by using this methodology, the goal is for designers to perceive the ideal gesture through form in order to indicate how users interact with a product. Switching the viewpoint from object to human will bring better physical satisfaction to users. The following picture (Fig 3) illustrates the visual contour lines drawn from the shape of a human skull, and how these visual traits can be applied to the process of helmet and goggle design.



Pic 3. Explaining visual transform from dimensions to object. Source from the Sliding semilandmarks quantifying the surface of a skull (Mitteröcker, 2001; Mitteröcker and Gunz, 2002).

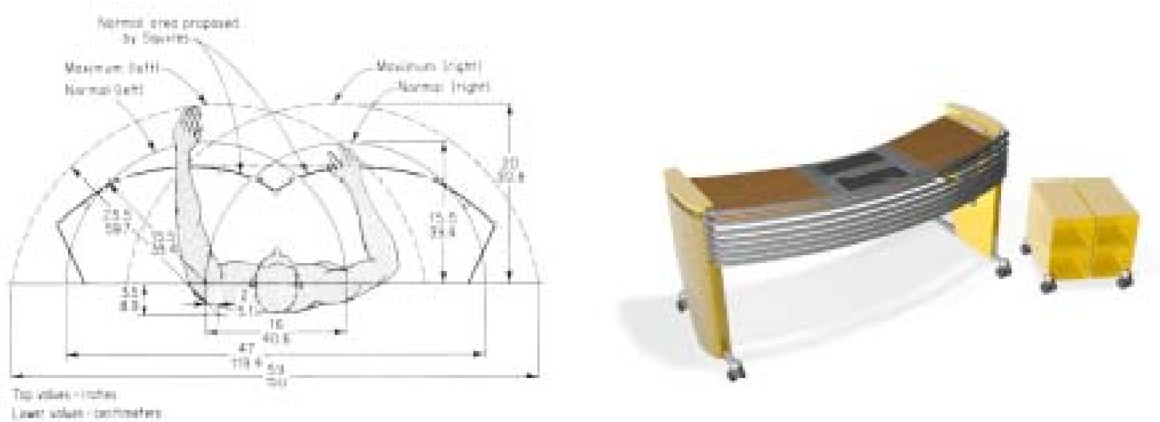
A: The dotted areas show the morphing space that is affected by human growth. Except for all sensory organs (Eyes, nose, ears) occupied on blank areas where designers avoid any changes in shapes, a designer can define where all visual components should be placed.

B: The visual traits of a skull and the extracted contour lines can be translated into the shape of a goggle (Proportion, size, length, angle of lines, etc).

C: An orthographic view from the side of a skull that illustrates several visual traits.

5. TRACING TACTILE INTERACTION BETWEEN OBJECT AND HUMAN

In addition to focusing on approaching design development based on visual preferences or trends, designers should build a keen insight for design that reflects on the user's body movements and perception.
Like how choreographers focus on describing their story through body movements, designers should focus on designing objects that represent the user's physical interaction and movements. For example, when designing a workstation, it is important to consider the measurements of all distances in space based on the user's interaction as critical information that directly influences the shape of the workstation.
Specifically for body movements that can be defined in four categories (Head – where all sensory are located, torso, legs and arms), each part of this category has different insights to physical dimensions in the areas where separable profiles are applied. For example, space reachable by the user's feet is different from the watchable area from the angles of head movements. Extracting all paths and dimensions from users can guide designer to design the shape of a workstation that reflects on user interaction with the object. The following drawings explain how paths from hand and head movements can be integrated into the design of a workstation.



Pic 4. Left drawing: Dimensional top view of seated user showing the "reach envelop" and arm rotation of target workstation users (Barnes). Right drawing: workstation design reflected by human anthropometric dimensions (designed by Sang Ahn, 1999).

6. TRANSFORMING SHAPES IN TECHNOLOGY (SEMANTIC)

Significance, as a concept in design, explains how forms assume meaning in the ways they are used or the roles and meaning assigned them, often becoming powerful symbols or icons in patterns of habit and ritual (Basalla).

Especially for product, technology has been tremendously influencing the forms in product design. For example, heavy presses were used that made it difficult to produce a simple box-like shape until the mid 1950s. *The problem was that, in the press, "flow-lines" could appear as a consequence of the intense pressure applied, which marred large, plain surface.* Understanding the relationship between technology in terms of usability and manufacturability in the industry is the key not only to understanding the shapes of products based on user experience but also in comprehending the shapes based on the manufacture process and movement of tools. For example, if designers are under a situation where manufacture can only provide access to a metal bending and folding facility, the shape of the product appearance will be influenced by the unfold to fold mechanism. Tracing the involvement of technology behind a product will provide a basis for developing shapes.

Pic 5. Illustrating the history of game controllers integrated by technology.

In Pic 5, the picture shows the history of game controllers. By analyzing the buttons and interactive controller body, the product form shows how manufacture technology is integrated. The concaves of buttons and the size of hardware unit represent the manufacturability of technology in the status of integrating design ability. For old controllers (Top left and middle), the shapes of the bodies and the areas of the grip are the simple geometric form that reveals the drill paths of traditional milling machine (Vertical, horizontal paths generated by traditional milling machine rather than applying Computer Numerical Control technology-this technology was prevailed yet in manufacture world in 1980). These geometric primary forms can be tracked by the result of accessing hand crank milling machine that can go only in horizontal and vertical straight lines as compared to applying computer programmed drill paths that can generate the paths of organic shapes).

7. CONCLUSION

In this paper, several Morphometric methods are applied to investigate the process of visualization for product design. Offering this method is a great tool for students who are struggling to initiate visual form development (Start development by investigating visual clues and fundamental visual frames that work for building rational shapes). For further study, this research will aim to collect more visual data representing visual morphing transitions in product development.

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