

Visualizing Dynamic Transformations In Interactive Electronic Communication

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Abstract

In this research animated patterns of graphics and text provide an overview of the information in an interactive computer program. The movement of the patterns creates a kaleidoscope of dynamic visual relationships. The changing patterns symbolize the process of defining new associations in computer programs where users link to different sources of information. This type of multiliteracy model requires new perspectives for organizing information structures and networks of relationships in multimedia databases. These interactive design models challenge traditional approaches to information design that emphasize fixed categories and hierarchies.

[Elements in the electronic writing space] function in a perpetual state of reorganization, forming patterns that are in constant danger of breaking down and recombining. This tension may lead to a definition of effective writing that supplements or replaces our traditional notions of the unity of voice and of analytic argument.

– Jay Bolter (2001, p. 12)

Introduction

Jay Bolter's reference to the changing patterns that emerge in hypertext/hypermedia environments is an accurate description of the semiotics of these fluid information spaces. Unfortunately, most interface designs for interactive multimedia programs do not visualize these dynamic patterns.

For several years I have been working on new design concepts for user interfaces in electronic communication. These designs are called HyperGlyphs. The HyperGlyph designs represent new approaches to user interface design that challenge traditional approaches to interaction design. The concepts behind the HyperGlyph designs are derived from audiovisual communication techniques in oral cultures. In oral cultures communication was subject to constant change and did not conform to fixed relationships and information hierarchies. Like Bolter's description of hypertext, oral communication represents ongoing patterns of new associations and links between ideas. Continuity of information and interrelationships between ideas are emphasized. These characteristics of oral communication are also the goals of many interactive multimedia environments that seek to create a dynamic information structure that stimulates creative inquiry and the synthesis of new ideas.

Traditionally, interaction design is based on Western approaches to information structure and visual design. Interfaces organize information into fixed hierarchies and categories, using figure/ground relationships and blank space to separate information into groups. The HyperGlyph designs introduce a more flexible approach to user interface design. The objective is to create a new form of interactive design that symbolizes

interrelationships and changing relationships, rather than fixed categories and information hierarchies. In previous papers I have discussed a number of design techniques and prototype interface designs (Search, 1999, 2002, 2003). This paper discusses some new prototype designs that use dynamic visual patterns to represent the changing semantic structure in an interactive information space.

Pattern Transformations

In these new HyperGlyph designs, form, space, color, and text move and rotate into visual patterns that change over time. As the patterns transform, dynamic visual designs carve out new visual and conceptual associations. Static information hierarchies give way to visual patterns that present information as parallel, synchronous formats as well as linear relationships. The designs highlight individual elements and relationships while also emphasizing the integration of ideas.

Metaframes, a new audiovisual aesthetic for interaction design, integrate important design elements into the pattern transformations. Metaframes use digital design techniques, such as animations, fades, dissolves, and changes in color and transparency, to create patterns that visualize the temporal dynamics of the interactive program and transcend the limitations of the static, two-dimensional screen (Search, 2003). This paper includes sample interface designs that illustrate these pattern transformations. The designs enable the user to view the topics in the program and then move to more detailed information. The visual transformations represent the flexible interrelationships within the information structure. I will briefly describe the interaction process and transformations in the examples and then summarize the design characteristics that define the metaframe aesthetic.

In all of the examples in this paper, the pattern transformations are continual animations composed of numerous pattern changes. The illustrations in this paper include just a few frames in the animations. In the first example, illustrated in Figure 1, the user moves the graphic along the navigation bar at the bottom of the screen to control the pattern

transformations. The design shown in the first frame (Figure 1a) opens and rotates to reveal a series of new visual patterns (Figures 1b-1e). Text appears and disappears as the patterns change. At any time during the navigation process, the user can select a word and link to more detailed information. This information appears on a new screen with the navigation pattern slightly visible in the background (Figure 1f). To leave this screen, the user clicks on the navigation bar at the bottom.

The second example (Figure 2) represents a similar type of information space. Like the first example, the pattern starts with a few individual elements that expand into multiple forms and relationships to create a visual whole. This design highlights the significance of individual elements and the numerous interconnections that are possible between those elements.

Figure 3 shows frames from the third example which is a different type of information space. Here the overlapping forms unfold to reveal various relationships between the individual elements in the information structure. The design represents a complex information space that is built on layers of events or relationships. The overlapping layers in the beginning of the pattern emphasize the interdependence and equal significance of the relationships. As the pattern unfolds, text appears in the same position in the middle of the pattern to underscore the equality of the information structure.

All of these pattern transformations use several design elements to visualize flexible information structures in which relationships continually change and form new associations. These design elements include animation, form, space, color, and text.

Animation

The animation of the designs creates a range of dynamic patterns that change as the user moves the cursor along the navigation bar. Forms, space, color, and text change with the pattern transformations. As forms separate and converge, the movements highlight individual elements of information, the interrelationships between the elements, and the relationship of the individual elements to the integrated whole. The movements in the animations represent continuity and integration because the animations are cyclic transformations based on circular rotations.

Form

Individual forms create the visual patterns. The forms symbolize the individual elements in the information structure. Some of the forms include

curved edges that embrace the space and text as the patterns change. The curved lines in the forms suggest fluid continuity and flexible relationships.

Within the patterns there is an underlying structure that also symbolizes continuity and integration. That structure comes from the geometric shapes, such as circles, squares, and triangles, that periodically appear within the transformations (Figures 1c and 1e). These shapes create familiar patterns the user can easily recognize and remember within an array of changing patterns. These shapes become important landmarks for navigation.

Space

In traditional interface designs, graphics and text on the screen are the focus of the visual designs while the space between objects is a design element that separates information into categories and visual hierarchies. In Western design, this space is usually referred to as “negative” space. In the HyperGlyph designs, form and space are “positive” elements that share significance.

In these designs the space between objects takes on importance as new patterns change the shape of this space. The space suggests a flexible information network where ideas are fluid rather than fixed. The pattern transitions alter the shape of the space and change the relationships between the forms, color, and text. This transformation of space emphasizes the potential for new associations between ideas. As text emerges from the space, space becomes the place where new relationships and ideas are formed. In the HyperGlyph designs, space is a *positive* area that forms visual and conceptual connections between topics in the interactive program.

Color

Transparent colors in the forms overlap as the patterns change. These overlapping colors combine to form new colors. Gradations of colors within forms suggest connections between ideas. Color is a design element that symbolizes changing relationships as well as the integration of ideas.

Text

Text appears and disappears in the transformations and creates a rhythmic display of different visual combinations on the screen. Moving forms “sweep” text off the screen as new text appears, revealing new visual and cognitive relationships. These changing visual patterns suggest new links and associations in the information space.

Figure 1
Pattern Transformations: Example One

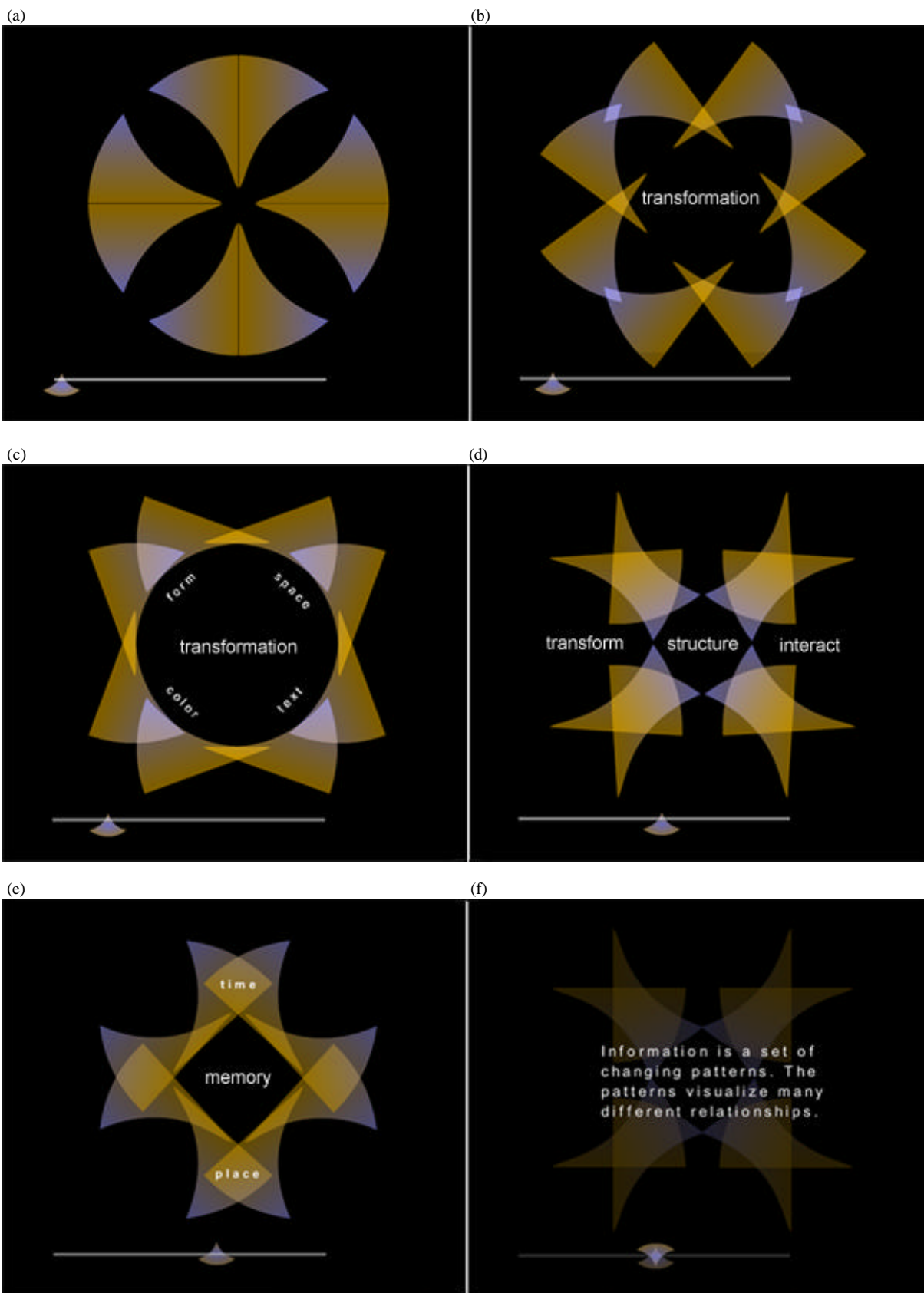
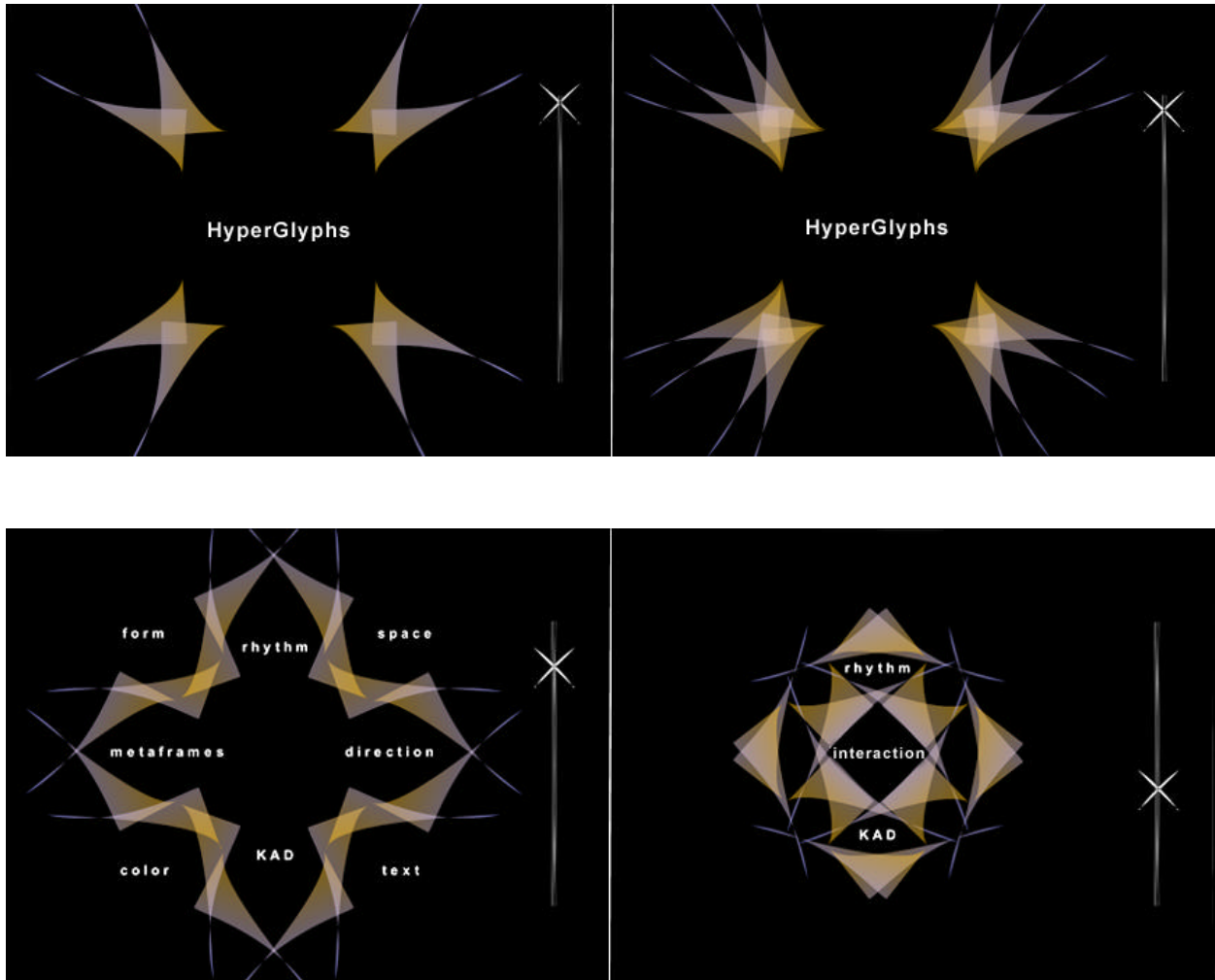


Figure 2
Pattern Transformations: Example Two



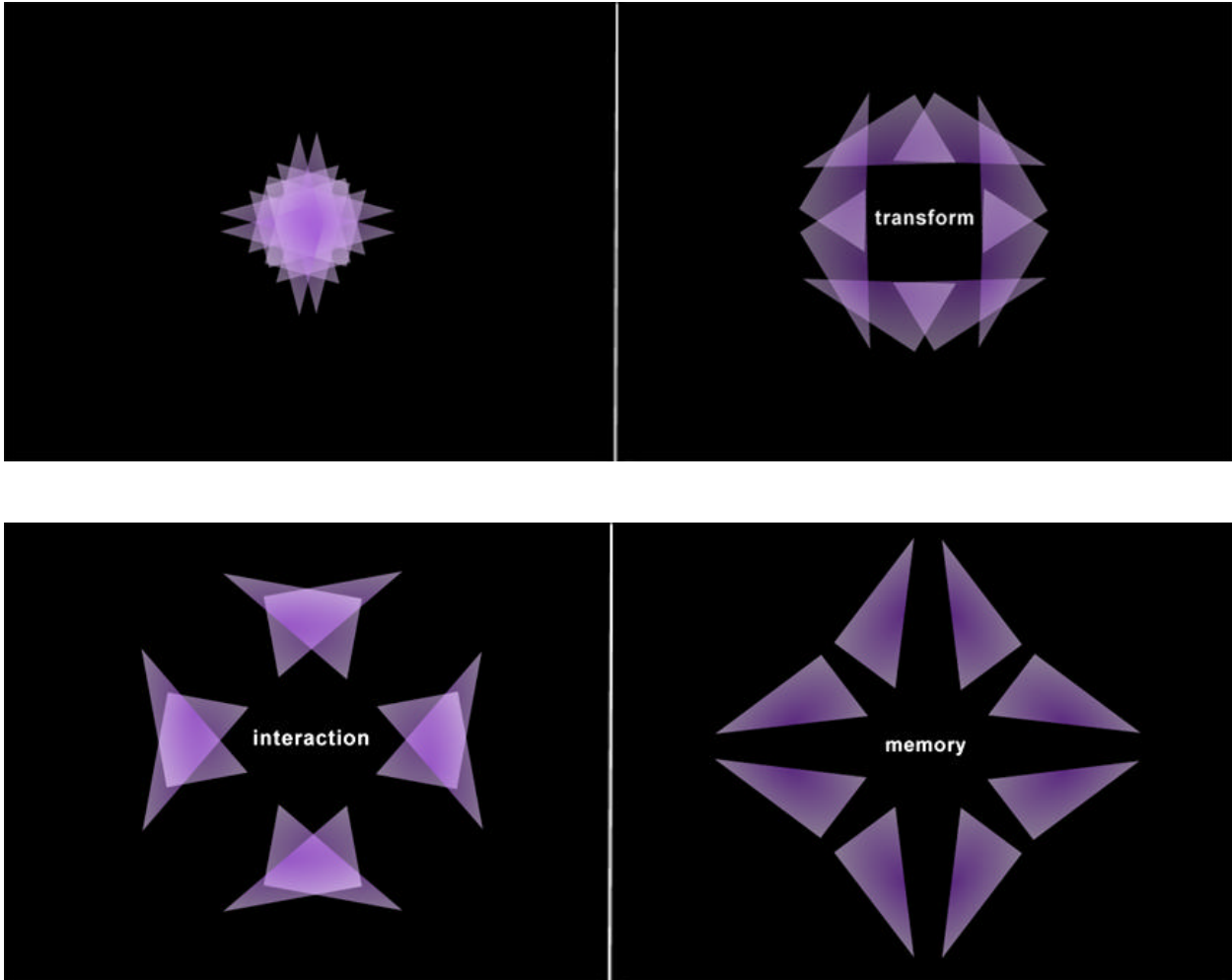
Interaction

In these programs the user creates the dynamic patterns in the interface design by using a graphic navigation device in the screen design. The user navigates through the patterns by moving the cursor along a navigation bar in a continual motion (as opposed to selecting points at specific intervals). This continual movement underscores the continuity of the ideas and interrelationships represented by the pattern transformations. The continual physical movement represents the fluidity of the information space. This integration of the physical interaction itself with the overall patterns and conceptual ideas presented on the screen is called kinesthetically articulated design (KAD). The interaction underscores the visual dynamics of the screen designs and establishes a

tangible connection between the user, the pattern transformations, and the network of conceptual associations. The interface between *observer* and the *observed* becomes a fluid space within a matrix of dynamic interrelationships.

In these interface designs, the cursor is not the traditional “arrow” or “hand” graphic. Instead it is a unique shape that mirrors an element in the visual pattern. The cursor is also transparent, and the user navigates by moving the cursor over the graphic on the navigation bar (Figure 1f) and selectable text. This overlay of transparent graphics creates new designs that echo the layers of transparency in the main pattern. This additional layer of transparency is another visual cue that represents the semiotics of an interactive electronic environment where ideas overlap and change

Figure 3
Pattern Transformations: Example Three



relationships. The movement of the transparent cursor over the graphics and text in the pattern transformations also integrates the physical navigation of the user with the virtual information space. This type of interaction is another example of kinesthetically articulated design.

Information Structure

Traditional interface designs separate information into categories and create visual hierarchies with fixed relationships and categories. In the HyerGlyph designs, information hierarchies are replaced by dynamic patterns that symbolize new associations and relationships. These patterns define the multiple dimensions of a complex information matrix that includes simultaneous and parallel relationships.

This approach to interaction design requires new perspectives for organizing information structures in interactive programs. Information no longer consists of static elements. The information space is transformed into arrays of changing connections or patterns. The examples in this paper show how different pattern transformations alter the meaning of an information structure.

The first and second examples (Figures 1 and 2) place an emphasis on individual elements or topics. Each design begins with a few forms and then expands into multiple forms and textual links. The transitions between the patterns highlight different relationships between the topics as the text and forms weave into different combinations. As the number of individual elements increase, they become critical components of

a complex network of patterns. These information structures prioritize the individual components of the information space and their interrelationships.

The third example (Figure 3) represents a different type of information structure. The pattern begins with the display of several layers of overlapping, transparent forms. The multiple layers create an intense color. This initial image represents multiple, simultaneous relationships and the supportive role of those relationships. These layers unfold into separate forms with subtle colors and less intensity. The design of this transformation emphasizes the integrated whole over individual elements or topics. The text supports this information design. Words always appear in the same place in the center of the patterns. New text simply displaces the existing text. The overlap of text in the center of the pattern transformations reinforces the concept of an integrated, vertical information structure that is built on parallel relationships.

Pattern Recognition And Memory

In the HyperGlyph designs, symmetrical, geometric forms are an important part of the interaction design. Psychologists and scientists have shown that viewers recognize and remember symmetrical forms and geometric shapes better than irregular, asymmetrical forms (Attneave, 1955; Campbell, 1941; Casperson, 1950). Research has also shown that viewers need less time to visually orientate themselves to visual information when symmetry is detected (Locher & Nodine, 1987). All of these aspects of visual perception play important roles in navigation in interactive computer programs where viewers need to locate information quickly.

In the HyperGlyph transformations, the changing patterns form simple geometric shapes, such as circles, squares, diamonds, polygons, and stars, in the center of the designs. The words that link to additional information appear when these geometric shapes emerge. These shapes are recognizable landmarks that add visual structure to the diverse patterns. These landmarks also help the user return to specific locations in the patterns.

In these pattern transformations, memory helps the user “complete” the shapes and patterns. After the user navigates through the program and becomes familiar with the pattern transitions, he/she can anticipate the transitions and mentally complete the movements and shapes. This type of “closure” in visual perception is well documented in Gestalt research. The use of closure and memory to complete the patterns helps the user learn how to navigate and relocate information. The process of remembering the patterns adds another level of interactivity to the program.

Pattern recognition and memory also play an important role in kinesthetically articulated design.

The user’s interactions reinforce the location of landmarks by linking the physical act of navigation with the patterns. As a result, users learn to associate positions during navigation with specific locations in the patterns.

As previously mentioned, Western design tends to focus on the forms that define *positive* space rather than the *negative* space surrounding the forms. Western design does not realize the full potential of negative space in interaction design. In the HyperGlyph designs, geometric shapes that emerge in the center of the pattern transformations mark the location of the words that are interactive links. These geometric shapes are formed by the negative space in the center of the designs. Research has shown that viewers quickly recognize geometric shapes that are formed by negative space because contour or outline recognition plays a significant role in the perception of shapes. In a research experiment, Dorothy Washburn tested the perception of shape in a dynamic visual space by using a computer program that gradually filled in select areas on the computer screen with small black dots. Washburn found that 70% of the viewers, regardless of training in art or design, quickly recognized shapes in the negative space of the dynamic test patterns because the viewers defined the shapes by the contours or outlines created by the dots (Washburn, 2000). Only 30% of the viewers saw shapes in the positive space, formed by the dots, in the emerging patterns. This research demonstrates that interaction designers can use negative space to signify landmarks and/or new levels of information in visual communication.

Future Directions

In future research I plan to expand the concept of kinesthetically articulated design by exploring new forms of input devices that enable the user to create patterns with the physical interaction of the input hardware. Hardware can enhance the visual patterns and conceptual ideas in the interface design. For example, if a trackball was used with the interface designs in this paper, the circular motion of the hardware would emphasize the cyclic transformations and the continuity of the changing patterns (Search, 2003). Other forms of input devices might enable the user to create patterns that differ from the patterns on the screen. My research will evaluate the role this matrix of interactive patterns plays in the interpretation of the information on the screen.

Future research will also explore the role that collaborative input plays in the creation of visual transformations on the screen. For example, what can we learn about the changing dynamics of an information structure by observing how different users navigate through pattern transformations? How does

this knowledge translate into new types of information structures and visual designs for interactive computing? The answers to these questions can lead to new developments in software and hardware for interaction design.

Another area of future research includes an investigation of the role cultural differences play in the interpretation of these pattern transformations. Do cultural differences impact the way users navigate through the transformations? Do cultural differences alter the interactive dynamics of the information space? This knowledge can help designers create interactive environments that support and communicate cultural identities in various forms of electronic communication and global networking.

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