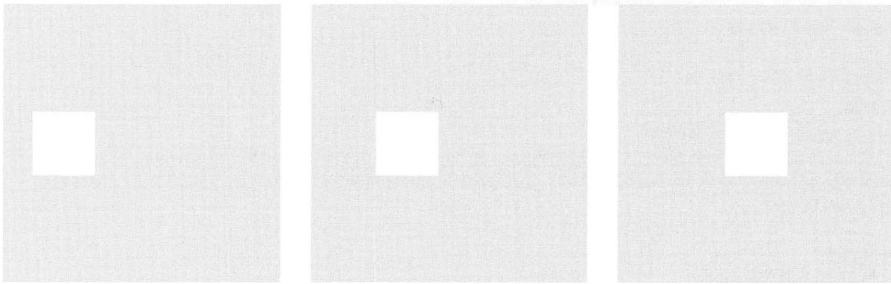


The METASTRUCTURAL  
DYNAMICS of

INTERACTIVE ELECTRONIC DESIGN

*Patricia Search*

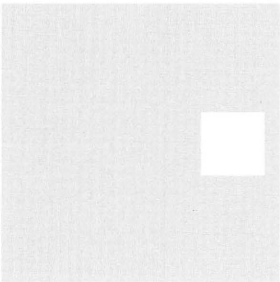


Interactive electronic computing enables users to manipulate text, graphics and sound into new multiliteracy models that emphasize patterns of relationships rather than discrete entities. However, most multimedia programs fall short of this objective because they reflect Western hierarchical concepts that have dominated communication since the development of writing. We need interface designs that help the user define dynamic patterns and synthesize information. The paper explores new forms of temporal, spatial and rhythmic links in interactive design that enable the viewer to explore information outside the framework of narrative and causality. The paper discusses the 'spatial grammar' of interaction and introduces the concept of kinesthetically articulated design in which the user builds cognitive maps by combining rhythmic patterns of interaction with audiovisual navigation cues. This new design syntax is derived from oral communication techniques used in aboriginal cultures.

## INTRODUCTION

*Finding meaning either in oneself or in the world depends not on a single perceptual standpoint and a bedrock of certain meaning, but on deciphering an unstable, ever-changing network of relations surrounding it.*

– Polly Ullrich



In interactive multimedia computing, the interface designs do not reflect the dynamic nature of interactive multimedia environments where relationships continually change. Instead the interface designs support hierarchical structures that separate information into specific categories or groups. Current design techniques emphasize the position of text and graphics on the screen and the sequence of links, rather than using space and time to define semantic relations. Links to information in an interactive environment provide flexible access to information, but that flexibility is stifled by the fact that we still read for “fixed links between screens rather than focusing on a network of dynamic relationships between ideas” (Search, 2001).

The dominance of the printed page in communication has limited our ability to visualize alternative formats for structuring information. In written text, printing conventions such as paragraphs, indices and punctuation affect the way we read by organizing information into predefined hierarchical structures. However, in interactive computer programs the process of navigation reveals new patterns of relationships between the groups. As Monge and Kalman point out, “. . . as processes unfold they constitute (i.e., reproduce and/or transform) structures” (Monge and Kalman, 1996, 87). Jay Bolter acknowledges that this interactive process should result in new forms of communication: “the dialogic structure of hypertext might also enable us, as Derrida put it, to ‘reread past writing according to a different organization of space’” (Bolter, 2001, 110).

The interface designs for interactive programs need to emphasize dynamic patterns of information as well as underlying structures. How do we visualize patterns that change over time? We need to combine logic and perception into a dynamic syntax that encourages a flexible, open interpretation of the matrix of patterns and relationships that evolve as the user navigates through a network of links. A new form of audiovisual logic is needed using Gestalt principles of perception to create a holistic synthesis of patterns that change in space and time. In these discursive environments, text takes on characteristics of visual imagery because words derive meaning from their relationships in space and time. In turn images and sound define a new audiovisual aesthetic in which graphics and sound have interchangeable or complementary meanings, creating multiple levels of semantic encoding. The new design syntax should enable the user to recognize the changing layers of associations, multiple dimensions of space and time and potential new connections that evolve as the interactive process transforms relationships. Within the context of this changing environment, the interface design should establish a flexible, underlying structure that helps the user recognize the continuity between ideas.

There are many parallels between oral communication and electronic communication that can provide insights into ways to visualize the transformative process that occurs in interactive multimedia computing. These parallels include the pluralistic meaning of symbols, emphasis on actual events as well as potential events, the collapse of boundaries between space and time and the integration of individual elements into the whole (Search, 1999). Oral cultures used audiovisual design techniques such as geometric symbols, transparency, repetition and rhythm and space to communicate these dynamic dimensions (Search, 1999, 2001). Some of these design techniques can be adapted for electronic communication to create a dynamic syntax that encourages open interpretations and new perspectives. I have incorporated many of these techniques into audiovisual design concepts called HyperGlyphs. In previous papers I have focused on specific HyperGlyphs designs that communicate the integration of ideas within the context

of flexible, changing relationships (Search, 2001). This paper takes these ideas a step further and explores ways to use media techniques and the navigation process itself to define patterns of relationships.

## M E T A F R A M E S

*. . . with an electronic infrastructure,  
the dream of perfect forms becomes the dream of information . . .  
Filtered through the computer matrix, all reality becomes patterns  
of information.*

— Loretta Todd

Interactive multimedia environments consist of complex information matrices that evolve in space and time. The perception of events and relationships between events is relative to the user's perspective and interaction. Modern science paved the way for this perspective in electronic communication. In the nineteenth century, the linear determinism of Euclidean geometry and Aristotelian logic gave way to dynamic mathematical models that used terms like betweenness, translation, reflection, projective, inversive and hyperplanes to describe flexible, multidimensional relationships (Search, 1993). These same terms describe today's hypermedia environments where webs of information are subject to continual change.<sup>1</sup> As Bolter points out, the unity or coherence of an electronic text "derives from the perpetually shifting relationship among its verbal elements" (Bolter, 2001, 12). We can expand this statement to include audiovisual elements where patterns and rhythms create coherence.

Metaframes are a new media aesthetic for computer interface designs that enable the viewer to move beyond the static frame of the computer screen and use multidimensional patterns to underscore the perceptual and cognitive links in the information space. In the Hyper-

1

The HyperGlyphs designs derive from geometric forms used in early forms of oral communication to emphasize the fluid dynamics of interrelationships within an integrated whole. The geometry emphasizes individual elements as well as unity and continuity (Search, 2001).

## THE SPACE - TIME CONTINUUM

*Space [is] an active structuring  
medium, not a void.*

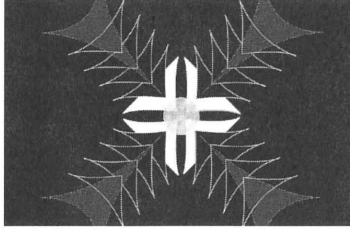
– Tarthang Tulku

The very nature of electronic communication underscores the significance of space since cyberspace is a medium for the transmission of information. In electronic environments space is not a void, but an active area defined by the events that take place in it, including possible events that are yet to happen. "Space and time serve as the contexts in which all these communication entities exist and unfold" (Monge and Kalman, 1996, 74). Space and time in electronic communication do not define objects or events per se. Space and time are flexible entities that describe relationships between events.

Metaframes help the user visualize this ubiquitous, all-inclusive dimension of space where multiple layers of objects, sounds, actions and perspectives are possible. Audio and visual designs create different levels and depths in space that represent the integrated whole and the temporal transformation of ideas. These designs break with traditional perspectives to create the impression of an all-inclusive space that is continually changing. The granularity of spatial representation ranges from contrast on the specific or localized representation, which is achieved with graphics, to contrast on the infinite or non-localized space, which is achieved with sound.

In this project metaframes encourage multiple perspectives by helping the user visualize flexible information structures that reflect the actual and the potential. Curved lines replace straight lines in geometric forms and expand the spatial dimensions of two-dimensional line and form into three-dimensional space, thus eliminating the boundaries between two-dimensional and three-dimensional space and suggesting the integration

1: | 2:



of the actual and the potential (FIGURE 1). Transparent colors and textures, dashed lines instead of solid lines and forms without fixed borders expand space and convey a transient quality of space and time that underscores the flexible nature of this changing environment.

Animation can visualize the role the interactive process plays in defining these dynamic information structures. In the beginning of this project a matrix of squares appears on the screen. When the user moves the cursor over a square, an enlarged version of the square 'pops up' and overlaps the edges of the surrounding squares. This temporal transformation of space emphasizes changing relationships, the fluidity of these relationships, the integration of individual ideas into a whole and the potential for new links and networks of associations.

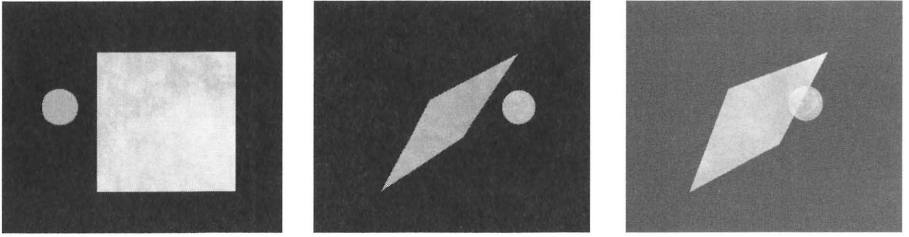
In this project, there is an emphasis on rhythmic transformations between positive and negative space. In some places positive shapes transform into 'ghosted' images or shadows that suggest the integration of the actual with the possible (see FIGURE 2). Textures derived from the physical world create spatial links between the real world and cyberspace. The same textures are used in different ways throughout the program. Sometimes a texture is static; sometimes it changes with the interaction. Sometimes a texture is physically linked to an object; in other places the texture appears or disappears with the interaction. These different uses of texture create tensions that unite diverse elements and emphasize betweenness and the space between ideas. For example, in one section of this program, a cloud-like texture changes from an intangible, floating reflection in the environment to a fixed texture on the cursor (FIGURE 3). Textures and designs become spaces within space. Space folds

| FIGURE 1: |

*Subtle curves in the forms suggest the inclusion of the surrounding space. Transparent forms symbolize the integration of diverse elements.*

| FIGURE 2: |

*Solid images transform into different levels of transparency and become shadows or 'ghosted' versions of the original forms. These visual transformations symbolize the dynamic flexibility of the information networks and the integration of the actual and the possible.*



| FIGURE 3: |

*A cloud-like texture drawn from the 'real' world floats across a reflective plane as the user rotates the plane. When the sequence begins, the cursor is a solid color. As the plane rotates, the cloud texture 'transfers' to the cursor.*

into itself uniting objects with surrounding space. The tension created by using the same texture in different forms or functions emphasizes the space between ideas. These new interpretations of space defy the 'either/or' perspective that traditionally prevails in Western diachronic logic.

The audio in the program combines drumbeats and chimes, both of which mark specific moments in time, with sustained tones that penetrate space and suggest infinity. This combination of audio and visuals creates a counterpoint of shapes and sounds that emphasize the space between events and the dynamic interplay between changing relationships. The low-pitch of the drums and the high-pitch of the chimes, represent both ends of the audio spectrum, symbolizing the integration of diverse dynamics into a continuous whole. Sound collapses space and time.

Metaframes also challenge the user's traditional perspective of time. The process of interaction creates a sequential path with a Western perception of history (with a past, present and future). However this perspective is challenged by an all-inclusive interpretation of space, represented by overlapping patterns and sounds, that suggests simultaneity and a multidimensional definition of time that is non-linear. In this project diachronic references to place and time such as here and there, now and then, collapse space and time into the present. There is a focus on the present and the 'time within.' Timelessness is manifested by an awareness of time in the present. However, time is not fixed. Interactivity emphasizes the unpredictable and transient quality of the present.

4: |

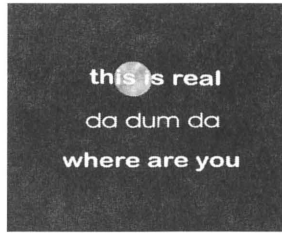


FIGURE 4: |

*The 'erasing' of text on the screen does not represent a void. It represents the link between ideas that have already appeared and ideas that are yet to come.*

Blank screens also play an important role in metaframes. They suggest the possible or that which is still to occur. In most interactive programs, there is very little blank space. There is an emphasis on 'filling the space' with objects because empty space is viewed as a void that contains no information. Traditional design uses 'white space' in layouts to separate objects into groups that create visual hierarchies. In this project empty space represents the connection between ideas. It is a place for the viewer to 'fill in' with new ideas and relationships. This space may appear as static black screens where text or other elements fade in and out, or the blank space may evolve as part of the interactive process. For example, in one section of this project, there are three lines of white text on a black background. The cursor is a circle, and the movement of the cursor creates a path of black circles that 'erases' the text on the screen (FIGURE 4). The action changes when all the text is gone and the screen is filled with black. The black screen, however, is not an empty void. The space represents an active area in which events, the actual and the possible, come and go. It represents a place where the user can integrate ideas and relationships represented by the text — a place where something comes out of nothing. The blank space encourages user participation and makes the virtual space more tangible, just as silence in oral storytelling encourages audience involvement. As Tedlock (1999) points out in storytelling, "A well-placed silence is as audible as anything else in a performance, so real the listeners can almost touch it" (xi).

Throughout this project the interactive process also highlights the role that space and time play in the formation of networks of associations and interrelationships. There will be more discussion of the importance of action as a design element later in this paper.

*. . . [rhythm] is a very high degree  
of formal art which displays itself here, in expressing the same idea,  
the same event, in the most varied manners, like a precious gem  
turned in all directions . . .*

– William Trask

The dominance of European art in contemporary culture led to the dismissal of symmetry and repetition as significant design elements. Western cultures fail to recognize and appreciate the layers of multiple rhythms that occur when there are repetitions in forms, space or time (Search, 1999). In multimedia programs there is the potential to use the rhythmic patterns of graphics, sound and action to create integrated layers of spatial and temporal tensions that symbolize the dynamics of these flexible information networks.

Rhythmic patterns that repeat throughout the program suggest new relationships and the integration of diverse elements into the whole. The repetition of similar rhythmic patterns in text, sound and animations suggests continuity and flexibility. For example, in this project the text “da dum da” represents the sound of beating drums (Beier, 1975).<sup>2</sup> The three parts of the text are displayed one at a time in a three-part, rhythmic animation that reflects the tempo of several quick drumbeats. The motion also echoes the rotating rhythm of an animated graphic that precedes the appearance of the text. This section integrates overlapping rhythmic patterns from words, motion and sound. The unfamiliar text and the repetitive patterns prompt the user to ‘sound out’ the rhythm of the text. This participation helps the user recognize the interrelationships between the patterns.

2

This text comes from a primitive “drum poem” created by the inhabitants of the Trobriand Islands who used the human voice to imitate the rhythm of drums in ceremonial rituals. This form of direct participation made drum poems a powerful memory or teaching aid (Beier, 1975).

As these audiovisual patterns weave in and out of space, they create a sense of perpetual motion. Forms move in relation to one another and emphasize the 'design' or 'pattern' of interaction. The interweaving of the different design elements in the graphics, as well as animated transitions between the graphics, create layers of rhythms. Rhythms occur when audiovisual symbols that represent closure and continuity (e.g., circles, squares) contrast with shapes or sounds that suggest infinite time and space (e.g., straight lines, sustained sounds).

In this project, sound combines with visual information to create a multi-layered matrix of information and sensory stimuli. An overlay of patterns created by images, text, sound and action weaves a counterpoint of rhythms and tempos. Sound, syncopated with the display of graphics, creates an interactive dialog that suggests multiple layers of associations and the flexible interpretation of ideas. The integration of diverse elements is symbolized by the juxtaposition of curved, lyrical rhythms with angular, staccato sounds and movements on the screen. Vibratos underscore the changing dynamics in the space. Structure is juxtaposed with fluidity.

Sound, which surrounds the viewer in three-dimensional space, helps the viewer assimilate the three-dimensionality of the physical world with the two-dimensional patterns on the computer screen. Sound underscores the significance of space and is a constant reminder that space is not an empty void. Blank screens encourage the user to 'visualize' the audio as well as visual rhythms. Pauses in the audio rhythms create a 'rhythm of silence' that encourages the viewer to hear the rhythms and 'feel' the patterns and connections.

The rhythm of the physical interaction also adds to these layers of patterns. The rhythmic movement of the viewer's interaction creates a syncopated backdrop to the visual and audio patterns. This accumulating rhythm, with its changing dynamics, encourages a broader range of interpretations and perspectives. The rhythm of interaction will be discussed in more detail in the section titled Action.



## LANGUAGE

*... the structure of language determines ways its users sense reality.*

— Jerome Rothenberg

Print communication emphasizes fixed positions of text in sentences and paragraphs, thus structuring and restricting the meaning of text. Interactive multimedia communication creates new opportunities to explore language within the context of visual and aural semiotics where interpretations are more abstract and open. In the HyperGlyphs designs, language is a dynamic structure that encourages flexible interpretations. Text is not locked into a specific meaning or association. This flexibility is achieved by juxtaposing text with abstract visual and audio patterns. When coupled with abstraction, text takes on the discursive characteristics of the visual imagery and sound, creating layers of meaning. This dynamic quality of text is enhanced when text is combined with three-dimensional graphics that move and change shape in space and time (Search, 2001). This indeterminacy in language underscores the actual and the possible by creating an open framework for interpretation.

Language can also create a sensory experience in which text defines a 'sense' of place or time rather than a specific location or event. For example, in this project, words like 'where are you' and 'the center of time' reflect the cyclical nature of the interactive experience where relationships are always in flux. The semantic structure of the words is underscored by the rhythm of the interactive process itself.

Language can also symbolize the dynamic relationships in an interactive program. In this program, language adds layers of cognitive associations and rhythmic patterns to the sound and graphics. In one section of the program, individual lines of text on the screen actually comprise multiple layers of text that create a graphical representation of complex relationships in space and time. As the cursor moves over a line of text, the line

is replaced with new text. The layers of text create new semantic structures that reveal a matrix of changing associations. Tonality shifts, derived from phonetics and the mental pronunciation of words, add rhythms to the audiovisual patterns. The lack of capitalization and punctuation in the text eliminates visual and conceptual boundaries and contributes to a sense of integration and unity. Language creates a rhythmic flow in and out of space and time that defines specific actions as well as the space between events. Once again, structure is juxtaposed with fluidity.

In another part of the program, the words 'the sky is what I was telling you about'<sup>3</sup> move across a circle in the center of a black screen. The black text is visible as it moves into the circle, but disappears as it moves into the surrounding black space. The design incorporates several symbolic representations of continuity and the integration of events or relationships:

- a) present/past tenses of the verb to be;
- b) lack of punctuation and capital letters; and
- c) words that move in and out of blank space.

Throughout this program, blank space plays a role in defining the indeterminacy of language. When text 'disappears' into blank space, the temporal dynamics of the linguistic syntax changes. This transformation signifies the integration of past (what was), present (what is) and future (what will happen). Everything is possible.

3

The line is from an Ojibwa poem titled "An Imploration for Clear Weather" (Rothenberg, 1985, 205).

## ACTION

*Sense of place is not just something that people know and feel, it is something people do.*

- Albert Camus

In electronic communication, knowledge is usually removed from action and becomes highly symbolic (Zuboff, 1988). Researchers have focused on increasing the physical involvement of the viewer in cyberspace by using input devices such as helmets and data gloves to put the viewer 'inside' three-dimensional, virtual reality worlds. However, there are other ways to use the process of interaction to increase viewer involvement in an electronic information space. The patterns and rhythms of the interactive process can become part of the metastructural syntax of the interactive design. Action defines events in space and time, and it defines changing relationships. The process of interaction creates patterns and rhythms that define a spatial grammar of action that encodes space and time into tangible representations of the transformation of ideas. Designers can use this spatial grammar of action to create kinesthetically articulated designs that integrate the rhythm of action into the overall interface design.

Action encodes multiple dimensions of space and time. Action represents 'now' by its immediacy with the physical world. However, each action is the culmination of past actions, and each action represents future possibilities. Action represents the integration of space over time.

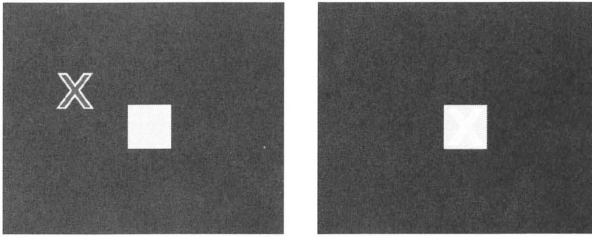
Action enables the viewer to move from one space to another and experience this integration. Action is the link between the viewer and the virtual world, a link that also bridges the actual and the possible. The rhythm of action emphasizes the 'space' between the links and the information that appears on the screen. Action defines the simultaneous existence of multiple spaces and times. Action is more related to a state of existence than a particular event or time.

This program uses layers of rhythmic patterns created by form, color, texture, sound and action. The patterns exist on multiple levels including the audiovisual designs, the movement of the input device and the cursor. Throughout the program there is interplay between the forms, colors and textures in the audiovisual screen designs and the interactive process itself. Action becomes part of the discursive syntax. Symbols, text and action have overlapping meanings that reinforce each other.

For example, in this program, a trackball is the input device. The circular pattern the user makes with the trackball echoes the circular patterns of designs and animations on the screen as well as cyclic patterns in the audio sequences. The circular movement of action suggests integration. This interplay of patterns and rhythms adds to the multidimensionality of the interactive program.

In the program there are three cursors. One cursor is an 'X,' the other two are circles. The cursor symbolizes the input action and becomes a visible link between the physical and virtual worlds — a link between the actual and the potential. The cursors are all transparent graphics. As the transparent cursors move over objects and colors on the screen, they visually merge with the underlying objects and create new visual images and integrated patterns that change over time. These perceptual transformations symbolize the synthesis of multiple relationships into a whole. Action reminds the viewer that relationships change and create flexible networks of associations in which all relationships are possible.

The 'X' cursor appears at the beginning of the program. It marks the beginning of the program and symbolizes the unity between the action (i.e., the user) and the screen. The program begins when the user moves the 'X' cursor into the center of a white square that is located in the center of the screen (FIGURE 5). At that moment the 'X' is no longer a separate visual. It merges visually with the white square. This transformation suggests interrelationships and the integration of individual



elements into the whole. It symbolizes the integration of the tangible world, represented by the action itself, with the elusive sensory and cognitive world in the virtual program. The 'X' also signifies a location in space ("X marks the spot."). The movement of the 'X' into the center of the screen to start the program signifies the center of space and time and the beginning of the cycle of continuity.

The circular cursor plays an important role in expanding the semantic structure of the program. When the circular cursor first appears, it has a transparent gray color with no texture. As previously described (FIGURE 3), in one section of the program a three-dimensional, rotating plane appears that reflects a 'cloud-like' texture. As the user rotates the plane, the gray cursor slowly takes on the cloud texture and assimilates the characteristics of the surrounding environment into the action. The syntax of the patterns and forms change with the interaction, adding to the metastructural syntax of the program. The cloud texture creates a reference to the tangible, physical world. When the cursor assumes the texture of the environment, the interaction integrates the tangible and virtual worlds. Within this flexible syntax, objects and actions exchange symbolic representations and enhance the feeling of an integrated network of associations where relationships change over time.

FIGURE 5: |

*In the beginning of the program, the cursor is a large 'X.' When the user moves the cursor into the square, the program begins, and the 'X' merges visually with the square. This visual integration of the forms symbolizes the integration of action, space and time.*

## CONCLUSION

*. . . human existence is irrevocably*

*situated in time and space.*

– Keith Basso

Metaframes and kinesthetically articulated designs define new forms of navigation in and out of different types of spaces. These designs foster a perceptual awareness of relationships between audiovisual designs, space, time and action that can lead to new cognitive associations. As Peter Anders points out, "Spatial thought forms the foundation of our awareness . . . we have the innate abilities to navigate in space . . . and we have the ability to recognize symbols and think abstractly (iconic mentality and symbolic mentality)" (Anders, 1999, 12).

Research has shown that temporal orientation is linked to differentiated patterns of activity that are usually defined in relation to landmarks on the calendar (Friedman, 1990). This type of navigation or mapping of temporal space is similar to navigation in a geographic space. However, navigation in an interactive electronic environment, where audiovisual information continually changes, does not rely on static landmarks. Navigation in cyberspace requires the arrangement and rearrangement of dynamic patterns defined by events and relationships between events.

HyperGlyphs use audiovisual designs to define these types of cognitive maps. New interactive techniques such as metaframes suspend the viewer between information structures, thus enabling the viewer to transcend the limited perspective of a specific action and explore new associations. The repetition of spatial and temporal patterns in graphics, sound, text and action creates a matrix of rhythms and patterns that the user weaves into a coherent whole. Kinesthetically articulated designs use the tangible process of interaction to underscore the rhythm of the patterns and create links between the physical world and the metastructural syntax of the interactive program. The user employs Gestalt principles of perception and memory to construct relationships between patterns and define semantic associations. Hierarchical structures defined by traditional Western design, give way to fluid, dynamic pat-

terns of information where logic is tempered by the holistic integration of layers of information. In traditional forms of interactive design that emphasize categories and hierarchical organization, users seek resolution or closure derived from causality. In the HyperGlyphs designs, closure is a cyclic, ever-changing dynamic that is defined in terms of the space between events and the patterns that result from the integration of changing relationships.

These types of interactive designs have important implications for global networking. A shift away from Western analysis and logic as the primary means of organizing information creates opportunities to use audiovisual interfaces that transcend cultural boundaries. The rhythm of visual symbols, sound and action formed the basis for oral communication in many cultures throughout the world. The use of sensory stimuli in user interfaces can capture some of the intuitive immediacy of oral communication and create isomorphic bridges between cultures (Search, 1999). Incorporating the perceptual dimensions of patterns, rhythms and action into interactive design creates a flexible information structure that accommodates different cultural perspectives. The designs create an intercultural grammar that enables users to become part of another cultural space in which they can explore new perspectives within the context of their own cultural backgrounds (Search, 2001).

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## AUTHOR NOTE

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