Visible Language has been concerned with research and ideas that help define the unique role and properties of written language. A basic premise of the journal has been that writing/reading form an autonomous system of language expression on its own terms.

To this must be added research and ideas that help define the presentation of information within the digital arena. The shift from page to screen is comparable in its significance to the shift from manuscript to print. Developing the knowledge base and conventions for this new media will take time and challenge our ability to move beyond the book and into more fluid, relational and responsive systems of presentation.

Published continuously since 1967, *Visible Language* maintains its policy of having no formal editorial affiliation with any professional organization—this requires the continuing, active cooperation of key investigators and practitioners in all of the disciplines which impinge on the journal's mission as stated above.

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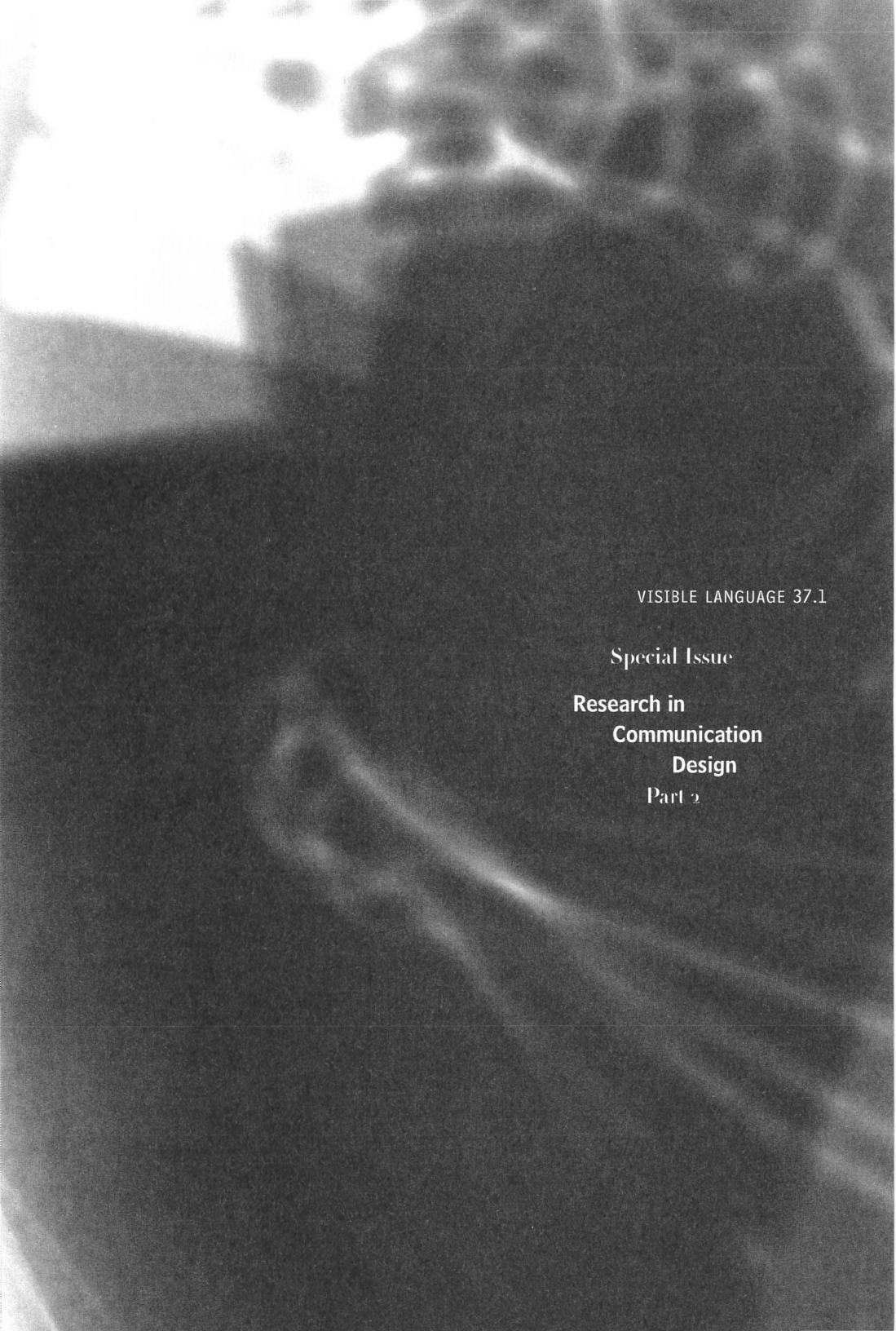

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Research in Communication Design

Part 2

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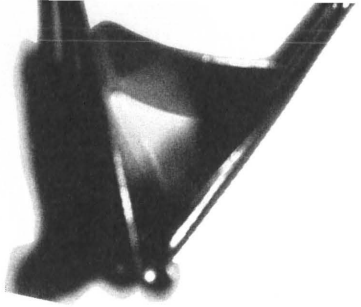

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Special Issue

Research in Communication Design Part 2

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DEVELOPING

Theory, Analysis and Effective Research Communication for **DESIGN**

Sharon Helmer Poggenpohl

Research in Communication Design, part 2, departs from the usual reporting of research to dig deeper into issues of importance to research and its development by design. The need for a change in relationship between education, practice and research is discussed along with the practical need for better research dissemination. Theory, method and tool are discussed as possible frames for research activity. The articles in this special issue are introduced in terms of theory, post analysis and conceptual development in relation to research. The issue concludes with a practical argument for the need for research.

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CONNECTING EDUCATION AND PRACTICE THROUGH RESEARCH

It may seem strange in a special issue on **Research in Communication Design** to reflect on the relationship between design education, design practice and research, but it is a necessary musing. Education and practice in design have long been estranged, due in no small part to its craft basis and the self-taught nature of many of the now retiring or just retired design professionals. For them the idea of an academic degree in design was foolish. However, since the middle of the twentieth century, design programs at universities have grown resulting in designers who have at least a bachelor degree. While a college education has become commonplace for those entering the practice of design, the relationship between education and practice has not become substantially more cordial. Educational programs today tend to be more diligent in preparing students for the technology that comprises the tools of their trade—employers demand this. Some more progressive practitioners value student experience with team work, multidisciplinary projects, user studies, even speculative thinking about not ready for primetime technology. Understanding something of human perception, aesthetics and communication strategy remains the price of admission to the field. Nevertheless the gulf between education and practice while somewhat diminished remains.

The communication context in which we now live is more complex as information is not scarce. It is unfiltered on the worldwide web, strains for our attention with annoying media tricks, evades our earnest search through engines now perverted by ratings derived from popular access and paid positioning of information. It is not only the physical format for information that has changed, it is also the institutional support and infrastructures that have changed.

The change in communication context opens new questions to which there are no easy answers. The transfer of information from one media to another has never been automatic. Different media afford different structures and opportunities, privilege information delivery and processing using different senses and codes. Altering information to take advantage of changed media affordance is an issue, while the largely untheorized and unstructured configuration of new media raises many questions. Practitioners are typically unable to address these questions as they require time and money that go beyond a quick, focused clinical research that is

designed for actionable results. Such research, when done, is not shared as there is no time or incentive for writing papers, even if the limited research is not proprietary. These very practical studies reveal the problems practice is addressing and this can lead to research questions that open the way to rigorous research, if these problems are communicated.

Educational institutions are just now waking up to their potential to do research as graduate programs begin to develop that are not remedial, not developed for those who failed to comprehend and develop design skill in their undergraduate programs. With the development of doctoral programs in design, the potential for communication design research expands and accelerates, but only if these programs understand research in a rigorous way.

A culture of design research needs to develop. This culture includes an ability to develop research questions that are answerable and lead to an actionable result. It requires an understanding of various research methods and how to apply them, an appreciation of the relation between question and answer through a quantitative, qualitative or comparative method. The ability to write a clear research paper, that accurately describes the research findings, the background, the previous research, the controversies and the challenges for the future, is an essential skill. Persistence is needed to get research results into the context of performance—to practitioners who will benefit from the research along with the end users of the applications in which the research is applied. This is a significant reorientation of advanced work in design education. Research may be the common ground where both education and practice find fruitful association. Research may be the bridge between education and practice.

Research does not happen effectively in a vacuum. Practitioners are seldom in a position to ask research questions that require extensive study, however, as mentioned, practitioners do uncover important questions that require research. These questions need to find their way to appropriate researchers for investigation so that knowledge develops. Answers to these questions need to be effectively disseminated and accessed for use by practitioners. Overly detailed and formal research papers do not resonate with those who daily practice design; these papers do not even reach them. This serious disconnect between research findings and their application needs to be addressed.

There is a difference between scholarly readers and those who read to apply findings to their work. Scholarly readers want to think critically with the researcher with a view to extending or challenging the work. As such they need research detail, a record of the thought and action behind the work. In contrast, the user of research wants the findings to interpret in the context of their own work. This is a different communication focus, perhaps calling for a compendium of results, edited by a reliable source for research credibility and with commentary explaining the extensibility or limitation of the findings.

THEORY—METHOD—TOOL

At the Institute of Design, those engaged in working with doctoral students routinely ask their advisees whether they are developing a theory, a method or a tool. These are useful ways to locate a research activity that slices the general activity differently than that of basic, applied or clinical research as mentioned in part 1 of **Research in Communication Design** (*Visible Language*, 36.3).

Theory, method and tool are concerns internal to design as they aid design performance. These three terms relate to design as a verb; they are substantially different from history-theory-criticism. Even 'theory' as the middle term in this threesome, has a different cast. The latter examine design as a noun and from the perspective of an outsider. Theory, method and tool offer an insider's perspective and as concepts they are practical and measurable from a performance standpoint. Theory, method and tool are clearly related.

To develop a tool requires an understanding of the method with which the tool will be used, who will use it and for what purpose. This involves procedural knowledge that may need to be gained through research. This may also require accessing existing knowledge of human factors: the size of a fingertip (physical), the limit of short-term memory for discrete but unrelated information (cognitive), the possibility of collaborative use (social) or whether a procedure (reading direction for example) suits a particular population (culture). Tools are practical; they perform and can be evaluated. We can determine whether they work—or not—or how well they work.

A method requires analysis of alternative actions as strategies with regard to quality of result or examination of efficiency, steps collapsed, performed automatically or eliminated or in terms of quantity or complexity handled. Methods also are practical;

they enhance performance—or not. They provide a sense of location in a problem or solution development and they coordinate understanding and activity among team members. Deep knowledge of a method can lead to development of a tool.

Theory is the least respected of these three. Often thought to be nothing but hot air by cynics or held in too high an esteem by others, theory is an ordinary part of practice. It often goes without notice, yet even in its hidden state it functions. Without theory we would be amazingly inefficient as all things would need to be considered as new or unique. There would be no pattern of expectation. Theory is often based on analysis from extensive experience. It can be likened to current best practice, a pattern of reliable expectation or principle that has been subjected to empirical (often qualitative) research.

Of course there are big and little theories; those that come and go subject to changing discourse or whim. Then there are profound theories that spark new knowledge and change our view of the world. Theories exist on a continuum from conjecture to proven; they are subject to revision through question, research, comparison and reason.

THEORY

If method underpins tool, theory underpins method—but often the theory beneath the method goes unstated. In the context of research development for theory, method or tool it is important to be explicit. All of these assist the designer to reduce uncertainty and enhance the ability of the designer to address the specifics of the problem at hand. They support the designer in focusing on their problem rather than being diverted into long and sometimes unproductive consideration of how to address their problem. Theory—method—tool are action oriented perspectives on design research.

The four articles in this issue examine either particular aspects of thinking about deepening or extending a research study or the connection between research and practice.

The first article, **Designing Theory in Communication**, is a post-research analysis; it moves from a consideration of research results and method to reflection on theory. It examines the need for theory in communication research. R.K. Merton's theory of the middle ground is the starting point. Research based on either too high a level of abstraction or too fine a granularity is of little use in communication design practice. Based on communication research in the area of new media, this article examines

the theory that underpins empirical work and the validity and reliability of its results. The author suggests that the theory-method combination can be effectively used to investigate the structured relations between human cognitive capacity and dynamic representation in new media.

CONCEPTUAL DEVELOPMENT

The second article, **Value-added Text**, explores the conceptual development of an idea that will be subject to future research. Research doesn't just happen, much investigation and conjecture go into formulating a research question or program. This is particularly true in an ill-formed discipline like design. Dealing with the problem of the impoverishment of email text and much formal text in general as compared to the nuances of spoken language, typography's affordances are seen as the enrichment mechanism. This article explores the possibility of a computer program that can enhance (add value to) text. Exploratory in nature, it searches for interdisciplinary connections among computer science, linguistics, design and practical human experience. It opens the path to formulating a research question. With an eye on practice, it examines the possibilities. But like many early stage research initiatives it seems too big, too inclusive as discussed here. The conceptual development points to meaning as a central concern. Can the meaning of value-added typographic coding be intuitively understood or will it be learned through exposure? How will the importance of context for meaning be handled? Many questions remain though a conceptual beginning is evident.

The third article, **User Analysis Framework**, is a post analysis investigation of previous research that involved observing users searching for targeted information on the web. Searching is an activity that is largely taken for granted, it is typically driven by various algorithms and linguistic analyses. Using Donald Norman's Seven Stages of Action to aid in the development of the Framework, the goal is a deeper analysis of information-seeking behaviors. This involves classification of cognitive factors and user characteristics as they intersect with search strategies already found through research.

POST RESEARCH ANALYSIS

If communication design is created to serve people's information needs, we need user models that account for human variation or similarity in cognition and

experience so that we can better design alternative structures based on human ability and need. Post analyses are an attempt to deepen the research context in order to establish a subsequent research project or frame an entire research program. Research is best considered not as an isolated, one time activity. Rather it is best considered in a context in which some research questions precede others and the current research builds on previously answered questions or extends the enquiry into another domain for comparative purposes. Research is strengthened by links to previous work, by foregrounding controversy and debate, by taking a deep dive into connections and detail.

RESEARCH AND PRACTICE

The last article, **Get Real**, takes designers to task for desiring respect and recognition without developing the discipline that can not only provide the foundation for respect but can continually validate and expand design knowledge. Research is an important element in disciplinary development. Without research both disciplinary development and the enhancement of design practice are constrained to a slow trial and error process. Research questions often remain hidden in the vagaries of practice and all levels of education tend to emulate practice. In this article, the relation between research and practice is brought to a common understanding with an example. The problem of medicine labeling provides the opportunity to demonstrate how practical research can be and how directly it can inform practice.

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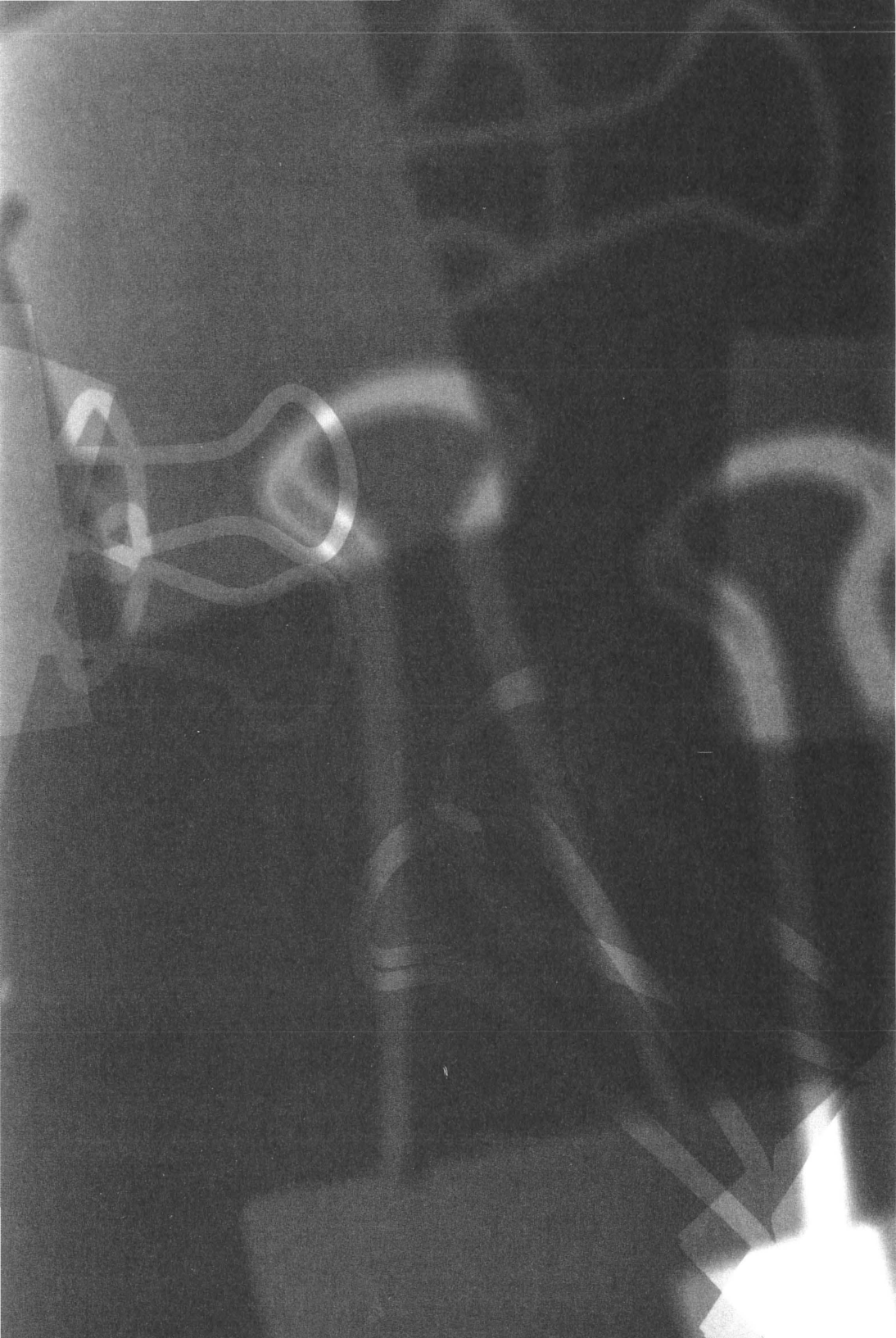

DESIGNING
Theory in **COMMUNICATION**

Peter Storkerson

WITHIN COMMUNICATION DESIGN, theory is in the process of formation. Within the profession, attitudes toward theorizing vary from an intuitionist rejection of theories to humanist positions, observational empiricisms and scientific reductive approaches. This heterogeneity reflects the many intellectual influences on design from the humanities, social sciences and hard sciences and engineering. We can even burrow to the philosophical foundations—Cartesian rationalism, positivism, constructivism—and their ontological and epistemological positions.

This paper presents a theoretical position with regard to communication design research and summarizes the findings of two experiments based on this theoretical construct. The theory points the way to rigorous and useful research for communication design in the future.

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WHAT IS THEORY GOOD FOR, ANYWAY?

Sociologist Howard Becker opened one of his books on research with an anecdote in which students at the University of Chicago asked their teacher about theory. "He looked up at us grumpily and asked 'Theory of what?' He thought that theories were about specific things... but there wasn't any such animal as Theory in general."[1] There is a wise attitude in this quote. Theories are, foremost, technologies for thinking: tools for accomplishing particular goals. Telescopes make it possible to look deep into space by excluding all but a tiny window of the visual field and gathering light from the remaining portion to disclose detailed structure. A theory excludes most of the flow of experience, focusing attention on the view through a tiny window of discourse to illuminate and specify that view and what is in it. Perception does this too, as it organizes the flow of experience into gestalts of discrete objects, events, relations and contexts. Technologies are often thought of in terms of how they transform perception.[2] Theory is another method for channeling and informing perception.

[1] **Becker, H. 1998.** *Tricks of the Trade: How to Think About Research While You're Doing It.* **Chicago: University of Chicago Press, 1.**

[2] **Ihde, D. 1990.** *Technology and the Lifeworld: From Garden to Earth.* **Bloomington: Indiana University Press, 226.**

The development of theory in communication design is in its formative stages. Its current limitations pose two problems that compound each other: one of means and one of ends. First, there is no clear, agreed upon taxonomy to isolate strategic communication variables. Put simply, we have difficulty accurately specifying and measuring which aspects of a communication are critical to communication and which are not. Second, the communication and design goals are themselves vague and ambiguous—is communication message, coding or behavior modification, and are form and content the same thing, are they unrelated, etc.? It is not surprising that there is a lack of direct ways to measure communication outcomes and relate them to design choices.

Take the following example: a photograph of a woman from the waist up. She is wearing a dark tight fitting jacket and sunglasses. Her left arm is extended toward the camera and the hand is palm facing the camera, so that the torso and the face are obscured except for hair and sunglasses. Most of the rest of the photograph is white, though a building is visible in the background. By itself, this image has little meaning. Now, forget the image and consider the following sentence: "Dianna used the press as the press used Dianna." By itself, this sentence is enigmatic. When, however, the text is placed next to or over the image, the two are combined. Now, it's a

picture of Dianna on a ski slope. We are looking through a picture taken by a press photographer whom Dianna is fending off by shielding her face. She is a celebrity and the press are 'using' her by invading her privacy. But, if she is using the press, her pose is also ironic. She is both fending-off and attracting the press. She is negotiating her celebrity. As receivers, we cannot 'know' these things in the veridical sense of warranted proof—the picture could be staged and the caption was certainly added—but the combined image and text convey the meaning and give us the sense of knowing what we are seeing. Such presentations are all the more persuasive because we, as receivers, are prompted to make the interpretations. We experience them as our conclusions rather than as somebody else's statements, at least until we become postmodern media-savvy consumers of 'constructed' images.

The meanings we create when we combine elements such as images and texts go far beyond what could be inferred from any element alone or by a summation of all. Rather, the elements transform and extend each other by specifying otherwise indeterminate domains, to create a new configuration of the whole or gestalt. We intuit when juxtapositions work and we are alike in our interpretations of composites like images and captions, which is why they are so commonly used. Designers have a vested interest in reliable communication, thus in making reception predictable. But we have little understanding of the mechanisms by which those interpretations work.

Communication designers function on the anatomical levels of communications. Designers engineer juxtapositions—planning the compositions of layout and image, appropriateness of gestures, etc.—and they design the text—both what text is used and how it is displayed. As communication technologies progress, design is in a basic transition from shaping to construction, thus communications are subject to more thoroughgoing, deliberately controlled design. With this increased control comes the increased need for designers to specify methods of construction and accurately predict results. In communication design, there is a gap between designers' spheres of knowledge and the practical problems they are asked to address.

THOMAS MERTON AND THEORIES OF THE MIDDLE RANGE

This situation in design can be illuminated by comparison with sociology. Over the last century and particularly over the last half-century, sociology has emerged from a situation of ill-defined theory, which is not unlike the one that communication design faces. Just after the Second World War, sociologist Robert Merton developed his notion of "theories of the middle range" to address what he described as the overwhelming gap between "the practical problems assigned to the sociologist and the state of his accumulated knowledge and skills."[3]

The natural and constructive initial desire to build broad approaches by which to make sense of the world made the early history of sociology a contest of general or 'grand' theories. Grand theories are a necessary beginning, but by themselves they are too general to make determinate, testable hypotheses about human behavior. As Merton stated it, the idea that such theories could alone be adequate reflected the misconception that "systems of thought can be effectively developed before a great mass of basic observations has been accumulated." This is a chicken and egg problem. Theories are needed to generate and give meaningful contexts for specific hypotheses, and the theories themselves are developed through research with specific results.

According to Merton, theories of the middle range are solutions to this problem. "Theories that lie between the minor [often ad hoc] but necessary working hypotheses that evolve in abundance in day-to-day living and the all inclusive systematic efforts to develop a unified theory...."[4] Merton's view of theories is neither competitive nor hierarchical, but stresses interdependence. Theories of the middle range provide operational links between grand theories and daily events (*see figure 1*).

Theories of the middle range are not positivist or naively empiricist. They begin as theorists' models—often simple and crude ones—and they are constructed from metaphors they are used to question (Merton's examples include Boyle's model of

[3] **Merton, R.K. 1949.** *Social Theory and Social Structure*. **New York: The Free Press, 50.**

[4] **Merton,** *Social Theory and Social Structure*, **39.**

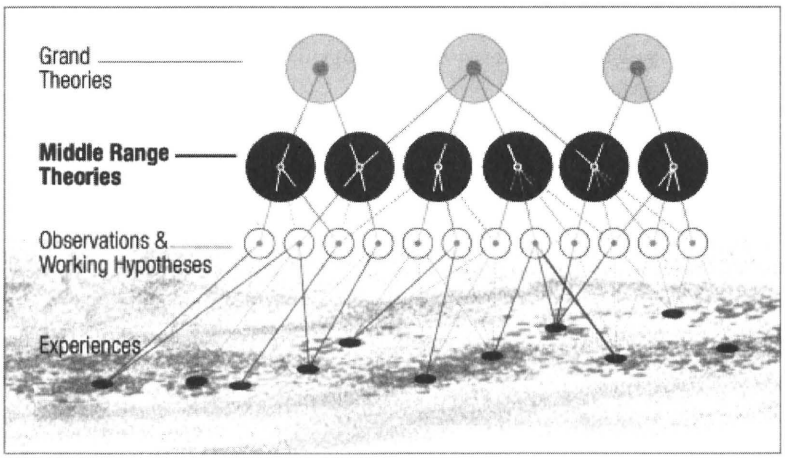


FIGURE 1
Observation, Grand Theories and Theories of the Middle Range

earth's atmosphere as a "sea of air").[5] The models are precise enough that they can be operationally researched and examined and the research findings can be used to judge the quality and usefulness of the models. Here, designers must be cautioned. If they do not keep in mind that they are working with mental models, they can easily build positivisms of the middle range in which facts and terms are used uncritically and thus prematurely reified.

Merton does not see unified theory as a practical or desirable end. Rather, he projects multiple high level grand theories and multiple middle range theories, each with its foci, points of view, strengths and weaknesses,[6] in a set of colloquies with each other. Grand theories may inspire theories of the middle range, claiming them as 'applied' but the middle range theories are not governed by grand theories. Any middle range theory may relate to two or more grand theories. The data and confirmed hypotheses amassed by theory-generated research will often be compatible with several middle range and grand theories and can be used to compare and examine them.

Thus, theories of the middle range are methods of exploration and communication across theories. They build the 'mass of empirical observations.' They support the nuancing and consolidation of grand theories and the emergence of new theoretical orientations.

Merton's middle range theories fit into a larger picture of the social development of knowledge as an open and evolving, historical process of increasing organization and sophistication, in which theories and research refine each other. Designers will find theories of the middle range most immediately relevant to their practice.

Paul Feyerabend enlarges the notion of theoretical pluralism to science itself. He forwards a notion of this rhetoric of innovation that is familiar to designers and entirely at odds with everyday images of science. He sees theoretical innovation as a rhetorical and polemical process, which requires breaking the rules of rational inquiry. The new theory is not necessarily a better explanation of facts, but a 'new worldview.'[7] i.e. new principles, new facts and new ways of looking at facts that are often incommensurable with the old ones.[8]

[5] **Merton,** *Social Theory and Social Structure*, **40.**

[6] **Merton, R.K. 1996.** *On Social Structure and Science*. **Chicago: University of Chicago Press, 36**

[7] **Feyerabend, P. 1988.** *Against Method*. **New York: Verso, 116.**

[8] **Feyerabend,** *Against Method*, **218–219.**

While Feyerabend's position rejects the Cartesian construct of rationalism, we need not react with a call for postmodernist cultural relativism. Theories, old and new, are compared on the basis of their internal consistency, and their ability to promote adaptation, i.e., their ability to address needs and show intelligent ways forward. A half century of social sciences, psychology and cognitive sciences amply demonstrate how much we are not prisoners of specific discourses, whether scientific or cultural. Socially produced knowledge and world-views can be rapidly changed by people because they live outside of any of the discourses they enter into. As Stephen Toulmin puts it, rationality operates within discourses, while the rhetorical notion of reasonableness, its complement, operates outside and around them, representing the larger context of existence. "In focusing attention on rationality...academic writers have neglected to analyze the complementary concept of reasonableness. ...Only in the last few years, in this respect, has the tide turned. In medical ethics, ecology and other practical fields, the years since the 1960s have seen a revived interest in questions about values that for a while had come to appear foreign even to philosophy. This turning of the tide points to a future in which the rational demands of scientific technique will be balanced by attention to the demands of the human situations in which intellectual or practical skills can reasonably be put to use."[9]

The sociological view of knowledge building that emerges from Merton, Feyerabend, Toulmin and others is congenial to design and can be applied to the situation facing communication designers. Design theory has responded to its challenges with a variety of methods, often borrowed from other fields. Designers feel uneasy about design's relations to other sources of knowledge, its own claims to knowledge and its ways of thinking compared to the sciences, humanities and arts, especially as it borrows from fields that relate to design but are not entirely compatible with design. This malaise has been crystallized in the notion of "designerly ways of knowing"[10] which specifies design as a third culture, distinct from sciences and humanities, with its own distinguishing characteristics. Design problems are 'ill defined,' design goals are 'solution focused' and design thinking is 'constructive' rather than descriptive. Merton and Feyerabend demonstrate that other fields have had these characteristics as well.

[9] **Toulmin, S. 2001.** *Return to Reason*. **Cambridge: Harvard University Press, 2.**

[10] **Cross, N. 1982. "Designerly Ways of Knowing."** *Design Studies*, **3:4.**

The social and rhetorical views of the development of knowledge demonstrate how the challenges of theory building in design may not be unique to design. Perhaps, design's position reflects its historical level of development. Design needs to build models that are appropriate to it: not the models of hard sciences, humanities or fine arts, but models which will provide a sense of orientation and as secure a base for design as other fields have. Design must address the ambiguities of its current state, but it need not hypostatize them as permanent or inherent; it may be able to overcome them to build its own reasoned base. Moreover, the development of comprehensive theory infrastructures in other fields has not deadened them, but has brought with it greater effectiveness and creativity for practitioners. This is a hopeful sign for communication designers.

A COMMUNICATION THEORY FOR DESIGN

The first task for theory in communication design is the designation of a set of operational linkages to span the multiple degrees of separation between the everyday notions of meaning making and the specific decisions of designers. Figure 2 provides an overview of three models of communication underlying communication theories. The type I model, developed by Shannon and Weaver was originally intended for mechanical systems of transmission: to measure how much could be sent in a given time span, problems of noise interference, etc.[11] This model expressly disregards questions of interpretation. The type II semiotic model is based on symbol processing.[12] Type II model theories include language, behavior and receiver based theories.[13] They link sender and receiver through culturally shared symbol systems. They attempt to address the question of reception by postulating that meaning is to be found in the symbol systems themselves. The relationship between intended and received meaning depends on the common code system of a sender and a receiver.

In the type II model, the physical form of a communication is the enabling medium of communication, but it does not construct meaning. It is symbol systems carried over the medium that construct meaning. But communication design manipulates physical forms that are not in themselves taken as communication to alter meaning. Thus, while type II theories are powerful tools, the reliance on type II theories in design as critical tools can still result in the juxtaposition of the explication of

[11] **Shannon, C. and W. Weaver. 1949.** *The Mathematical Theory of Communication*. **Urbana: University of Illinois Press, 117.**

[12] **Eco, U. 1979.** *A Theory of Semiotics*. **Bloomington: Indiana University Press, 354.**

[13] **Fish, S. 1980.** *Is There a Text in this Class: The Authority of Interpretive Communities*. **Cambridge: Harvard University Press, 394.**

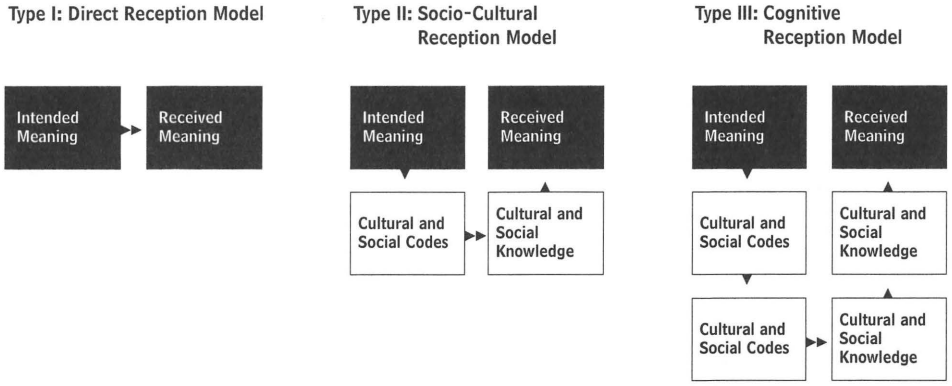


FIGURE 2
Three Models of Communication

communicative objectives (norms of practice and appearance) against a purely formal critique of the communication, which leaves a (cognitive) gap in the middle.

As a result of these limitations, in communication design, formal aesthetics such as style are often taken as communication goals. Conventions of appearance may carry conventional codes, e.g., the formality and objectivity of modern Swiss design, but designers do not just choose and plug in such conventions. Often working intuitively, designers and non-designers alike work around the conventions manipulating physical, spatial and temporal aspects to alter and clarify a communication.[14]

If the type I and II models concern what communications mean, the type III model concerns how they mean (*see figure 2*). The type III model focuses on the physical characteristics of communications as the point of contact to the receiver, via human cognitive faculties. Because they are sensitive to the sensory domain, type III theories are needed in communication design. They can address how the receiver cognitively construes the communication, relying on the affordances provided in the communication in relation to the user's cognitive procedures: procedures that are logically prior to the particular cultural codes in use at any time.

Ontological and epistemological bases for the type III model can be found in theories of embodiment which relate thought to material existence. These include

[14] **Walker, S. 2001. "Prescription and Practice for Non-Experts." In Walker, S., editor.** *Typography in Everyday Life*. **Essex, UK: Longman, 53–85.**

work by Varella and Maturana,[15] Piaget's theory of equilibration,[16] Lakoff and Johnson's philosophy of embodied thinking[17] and neural psychologist Antonio Damasio's model of consciousness as [literally] the experience of self-regulation or equilibration in interaction with the environment.[18] These theories point to specific variables and to cognitive psychology as an approach to the analysis of communications according to their physical characteristics.

PHYSICAL EXPRESSION AND COGNITION: DUAL MODE PROCESSING

Of the technologies available to access the interface between human beings and physical structure needed by the type III model, cognitive psychology operates on the most appropriate operational level and will provide base variables for the type III model. While clinical psychology operates on the level of motivations and actions, cognitive psychology operates at the anatomical grain of perception, thought, memory, comprehension and learning or concept formation.

In cognitive terms, meanings are often encountered in cognitive psychology at a viral level as mnemonic patterns. Cognitive psychology demonstrates that in order to make use of sensations, human beings need to organize them into discrete units of perception.[19] They do this by looking for and remembering patterns. Patterns can be either spatial as compositions or temporal, like rhythmic movements[20] or they can be conceptual. They rely on associative linkages: if a then b; a follows b; a causes b; a and b go together like wheels and roads. Linkages can be spatio-temporally or structurally defined, i.e. semantic.[21] Associative linkages are at the root of meaning. Perceptual memory may be limited to a few seconds, but linked perceptual units, enable large structures to be cognitively held as single units. Temporal extensions extend from single events to clusters, patterns and sequences. Underneath all of this is the orderliness that we find and remember, not what we perceive as noise.

On the anti-mnemonic side of cognition is cognitive load: how much is happening at a given time in one's environment that must be attended to, though here, we must be mindful of the discrete modes which can function simultaneously. It is much harder to remember a nine digit number than a three digit number, and it is very hard to listen to two conversations at once, but it is not particularly difficult

[15] **Maturana, H. and F. Varela. 1980.** *Autopoesis and Cognition: The Realization of the Living.* **Dordrecht: D. Reidel Publishing, 13–14.**

[16] **Piaget, J. 1977.** *The Development of Thought: Equilibration of Cognitive Structures.* **New York: Viking Press, 213.**

[17] **Johnson, M. 1987.** *The Body in the Mind: The Bodily Basis of Meaning, Imagination and Reason.* **Chicago: University of Chicago Press, 1–17.**

to drive a car and listen to the radio. Time interval is particularly important. Perception takes place within about one second. We perceptually relate those events that take place within about one second of each other, but not those events that are substantially further separated. Our knowledge that thunder and lightning are results of a single phenomenon is intellectual, but it is not experienced, as it would be if they took place simultaneously.

This sensory-cognitive view offers the possibility of illuminating physical communication as a sensory and cognitive interface between receiver and communication, in which meaning is constructed by combinations of perceptual and conceptual challenges and supports offered by the spatial and temporal configuration of the communication. By the same token, it offers the possibility of using cognitive principles to guide interpretation: to communicate meaning using the cognitive methods for organizing experience.

The fundamental units of a type III model comprise the spatial and temporal organization of the communication including entities and events, spatial and temporal patterns, hierarchies, proximities and serial order in interaction with fundamental cognitive variables of perception, thinking and remembering (*see table 1*).

SENSORY AND SYMBOLIC MODES

Clearly, sensory aspects of presentation affect meaning for all temporal and spatial media including language. Mystery writers hide clues by revealing them long before or after the events they link. Effective communication often requires a presentation in which spatial and temporal adjacencies correspond to conceptual linkages. Certainly, the last decade of experience with hypertext has conclusively demonstrated the importance of sequence and organization on interpretation and comprehension. But temporal and spatial aspects are not integral to meaning

[18] **Damasio, A. 1999.** *The Feeling of What happens: Body and Emotion in the Making of Consciousness.* **New York: Harcourt, 19–23.**

[19] **For a thorough discussion of auditory perception as integration and segregation, see Bregman, A. 1990.** *Auditory Scene Analysis: The Perceptual Organization of Sound.* **Cambridge: MIT Press, 773.**

[20] **Rubin, David. 1995.** *Memory in Oral Traditions.* **New York: Oxford University Press. 385.**

[21] **Tulving, E. 1985. "How Many Memory Systems Are There?"** *American Psychologist,* **40:4, 385–398.**

CATEGORY	VARIABLE	FUNDAMENTAL UNIT	EXTENSION 1	EXTENSION 2
PRESENTATION	Spatial variables	Mark: primary spatial event	Pattern: recurrent grouping of events	Sequence: extension of pattern with change; compositional whole
	Temporal variables	Movement, sound: fundamental temporal event	Pattern: recurrent grouping; tempo of rhythm	Sequence, narrative, melody
RECEPTION	Cognitive variables	Perception: immediate organization Thought, interference Recognition	Pattern recognition Attribution, linkage	Narrative recognition Theory construction

TABLE 1
Presentational and Cognitive Variables

structures of symbolic systems in the ways they are in sensory modes which directly express space and time.

The types of thinking that sensory and symbol systems support are different from each other. The thirty-year debate in cognitive psychology over the relations between sensory and symbolic cognition seems to have been resolved largely in favor of the position that sensory cognition is distinctly different from symbolic processing.[22] Sensory cognition mirrors physical movements and relationships. For example, people can mentally rotate or move imagined objects; such movement takes an amount of time that is proportional to the amount of rotation or movement. They can't for example, simply flip images left to right. "The…experiments…converge in demonstrating that images are functional, quasi-pictorial representations, the special properties of which can affect cognitive processes. We would not expect the results obtained… if people represented all information in abstract list-structures and if such structures were used in anything like a straightforward way."[23]

While symbolic structures are often a-temporal conceptual models, sensory structures are expressions of space and time, i.e., narratives, and the two work differently (*see table 2*). Conceptual models are concerned with what is theoretically possible, while narratives concern what actually did happen in a specific instance. For example, conceptual models often allow for multiple outcomes, while any narrative has only one outcome. While conceptual models disclose the mechanisms responsible for outcomes, those mechanisms must be retrospectively inferred or guessed at from narratives. But, lest we think that theories are simply superior to narratives, narratives are directly related to occurrences while conceptual models are reductive and removed.

The distinction between sensory and symbolic modes is of profound importance to communication design. Image-text and multimedia aggregates are combinations of sensory-narrative and conceptual modes, uniting experience with conceptualization. Cognitive process begins with perception and perceptual challenges (observations and inconsistencies), which prompt us to think about what we have perceived. We make inferences, and on the basis of those inferences, we project

[22] **Pylyshun, Z. 2001. "Is the Imagery Debate Over? If so, What was it about?" In Dupoux, E., editor.** *Language, Brain and Cognitive Development: Essays in Honor of Jacques Mehler*. **Cambridge: MIT Press, 59–83.**

[23] **Kosslyn, J. 1980.** *Image and Mind*. **Cambridge: Harvard University press, 91.**

TABLE 2

CHARACTERISTIC	CONCEPTUAL	SENSORY
Orientation	Internal: analysis of external object	External: the object itself
Concept structure: Attribution	Explicit attribution: category driven	Non-attributive: concrete entities with categories to be inferred
Movement	Static: potentials	Transformational: actual
Time	Reversible (a to b, or b to a)	Not reversible, altering sequence changes meaning set
Point of view	External	Pragmatically situated
Claims	Truth, fact	Coherence, causal linkage
Ends	Disinterested: value neutral	Involved: value driven
Occasion	Suppressed	Displayed
Entailments	Discourse: theory	Abduction: gestalt perception

possible sensory outcomes, which we compare with experience. When the two coincide we experience the phenomenon of knowing or recognition (*see figure 3*).

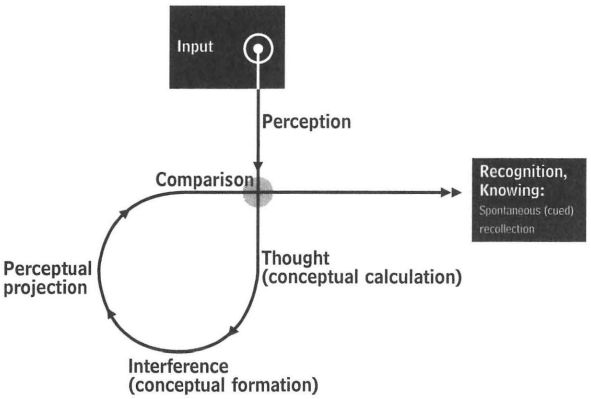
Recognition is more than conceptual inference. It is the combining of conceptual and perceptual, i.e. narrative modes to give the sense of knowing: that something has been grasped. For example, you meet a stranger who seems strangely familiar. You search in your memory for whom she looks like and how these two persons look alike. You remember and imagine physical characteristics of the imagined person and compare them with the person you are looking at. You recognize the ones that match. Beyond that, you are reminded of the other person and some relevant events and feelings you had about that person.

[24] **Heider, F. 1958.** *The Psychology of Interpersonal Relations.* **New York: John Wiley & Sons, 322.**

STRUCTURING ATTRIBUTION

In cross-mode communication, the different modes must be combined in some way by receivers. As the case of the Princess Dianna photo demonstrates, there are often no explicit links between image and text, so the receiver must assign or attribute aspects of each mode to the other. As illustrated by the Dianna image, attribution is an informed 'reading in,' in which linkages are attributed to events or relations as guided by the coherence of the whole. [24] If the image had been of a man standing with a microphone

FIGURE 3
Cognitive Process



and mouth open, looking at the camera, the image-text gestalt would be interpreted quite differently, and the domains of meaning would be transformed. The man might be a reporter and the caption might be a quote of his words. The observations of cross-mode attribution accord with both the psychological knowledge of the involuntary perceptual processes and intuitive organization of the flow of experience into coherent gestalts of objects and events. The work of designers is to coordinate many details of organization, color and gesture to create coherent and self-evident readings.

USING SENSORY COGNITION TO COMMUNICATE CONCEPTS

The recognition of symbolic forms is a matter of cultural knowledge or formal learning, while sensory cognition relies on physical experience. Sensory cognition is what keeps us from walking into walls and trees and cognitive procedures have consistency across individuals and cultures.

Diagrams, for instance, use attribution to apply sensory knowledge to symbolic realms. Symbols point to referents such as number of members and months, while graphic arrangement indicates such relationships as linkage, containment and change. In figure 4, the words and numbers are symbolic forms. The line operates by gestalt phenomena of visual organization.[25] It is perceived as having implied visual movement, involving height, velocity and gravity as they operate in experience.

[25] **Sless, D. 1981.** *Learning and Visual Communication*. **New York: John Wiley & Sons, 52–58.**

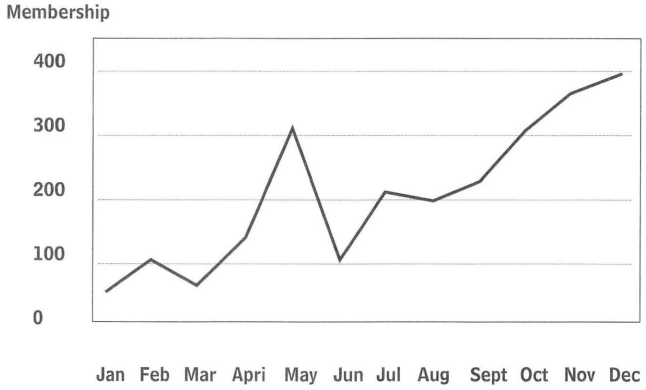


FIGURE 4
Organization Membership Across One Year

Membership 'rises' and 'falls' over time. As figure 4 demonstrates, the sensory cognitive resources that enable us to understand balls flying through the air and climbing hills help us understand line graphs and provoke us to ask about the membership 'spike' and 'dip' in May and June, which stand as potential indicators of important underlying factors. The graph harnesses sensory cognitive dimensions while using conventional notations to tie sensory experience to referents in other domains.

SUMMARY: COGNITION AND COMMUNICATION

The type III model of communication can be seen as a process of guided cognitive work in which the receiver is provided with a combination of cognitive challenges and resources with which to form appropriate cognitive frames that can yield an intelligible communication. The receiver searches for intelligible, valid and credible interpretations of external reality. Intelligibility means logical coherence (making sense or being imaginable), validity means logically coherent, credibility means factually coherent and interpretation means perceiving as having a determinate form; not just knowing that something is going on, but determining what it is that is going on.

COGNITION, INTERPRETATION AND MEANING

Interpretation is the construction of meaning. The cognitive frame by which a receiver makes sense of a communication is its meaning. The term meaning emphasizes the view that meaning is contained in the communication. If we wish to stress

the receiver's active participation and construction of meaning, we may use the term interpretation. Underlying these terms is the question of reliability: is it possible to reconcile a user-based theory of meaning making with communicative reliability? A cognitive process approach offers a method of reconciliation.

In the everyday world of experience, we use the term meaning as the fundamental communicative goal of communication, i.e., that the communication conveys a meaning. In the term as popularly used, we can find three substantially different components that must be distinguished for analytic purposes: identification, comprehension and evaluation.

> Identification is the recognition of a discrete object, under which the receiver integrates some perceptual qualities and segregates others, for example "that is an orange" or "that is a lie." The receiver may not have a specific word for the object, but it has a specific identity and can be separated from other objects in the field of perception.

Identifications are gestalts, which gather together certain lower level features and organize them into the cognitive objects that we perceive in the world. Dynamically, the constituents are brought under the gestalts as categories and the constituents also comprise and construct the gestalts.

Objectivity is critical in identification: reliable identification is what keeps us from walking into doors and out of windows. Identification grasps objects as they are, separate from our idiosyncrasies. We argue about identifications and try to come to agreements. If a consensus is not possible, there may be a question of observation—"It was too dark to see." "We don't know if he knew what he said was untrue,"—or there may be a question of what the meaning of a term is—"What is an orange?" "What is a lie?"

Identification also involves some level of specification, i.e., some set of constituents or characteristics that an object must have if it is an orange. To the extent that there is a well worked out theory of the object, the inner constituents and experiential characteristics are directly linked.

> Comprehension is with regard to the effects or consequences of an object within a frame of reference or discourse, such as "what it means to lie." If identification is the gestalt, which radiates from the object into its constituents, comprehension radiates out to the environment, implying possible outcomes. Of course, comprehensions are products of the object and its environment: as varied as the discourses or frames of reference into which the object can be put. Comprehension has both objective and subjective aspects. It is something that each person can ponder, and will often go beyond what any person can know, but it can still be discussed and each person can learn from others. Comprehension is incorporated into signs as their connotative aspects and we know how loaded signs can be.

> Evaluation is how one feels about the object given its identification and one's level of comprehension. That feeling is our motivation to act toward that object in any given situation. "Was it a good lie or a bad lie?" "Should it be allowed, supported or exposed?" This aspect of meaning is the most personal. It is built upon the other two, but it reflects the specific history and stance of each person. Evaluation is also reflected in implicature.

These three aspects are not exclusive and are often present simultaneously, but of the three, identification is logically prior to the other two; understandings and evaluations are based on our identifications of things.

> Emotional reactions are based on categorizations. In **The Odd Couple**, Oscar Madison muses that the green food in the refrigerator was either fresh salad or very old meat.

> Categorization applies to narrative, as the receiver's apprehension of a sequential whole or story, which is often, initially only dimly understood. It is a frame into which the events presented are placed.[26]

> Objects are perceived according to categories. Nelson Goodman has used the example of a painting of Winston Churchill as an infant to demonstrate the perception of resemblance as a negotiation of categories. "...a given picture

[26] **Scholes, R. 1989.** *Protocols of Reading*. **New Haven: Yale University Press, 20–21.**

represents Winston Churchill as an infant where the picture does not represent the infant Churchill, but…the adult Churchill as an infant."[27]

> Finally, the process of perception itself is the organization of the flow of experience into discrete entities and events by a process of integration and segregation based on exclusive allocation. "Any system that attempts to build descriptions of the natural world scene must assign the perceptual qualities that it creates to one organization or another. …The Gestalt psychologists made this point by introducing the principle of belongingness. …The belongingness may shift, for example, when we try to see the figure in a different way, but regardless of how we see it, it is always a property of something."[28] (*See figure 5.*) Bregman adds a corollary principle of exclusive allocation. "The exclusive allocation principle says that a sensory element should not be used in more than one object at a time." There is no room for halfway measures or sort of belonging in this scheme, things are either assigned to each other or separate from each other. There is also no room for multiple valences. Figures with multiple possible interpretations like Necker cubes are resolved into one of the readings or views alternatively with ambiguous instability. These are not qualities of physical objects, but artifacts of cognition and its demand for the construction of objects according to strict segregation and integration.

Identification is a form of interpretation in which individuals attempt to apprehend or grasp external objects as accurately as possible. Identification integrates and segregates qualities categorically into discrete objects. Identification forms the ground upon which other aspects of meaning making are built.

Psychologists observe that the links between perception and conceptualization are intimate. Charles Osgood comments, "Perception and conscious thought are closely related. Both are correlated to meaning. That there is an intimate relation between perceptual and meaningful phenomena is borne out by the confusion which psychologists display in using these terms."[29]

Conceptual thinking parallels perception. Both operate by making associations, enabling memorability and comprising identification.

[27] **Goodman, N. 1976.** *Languages of Art*. **Indianapolis: Hackett Publishing, 27.**

[28] **Bregman,** *Auditory Scene Analysis: The Perceptual Organization of Sound*, **12.**

[29] **Osgood, C. 1967.** *The Measurement of Meaning*. **Chicago: University of Illinois Press, 15.**

> Theories and concepts provide schemas of association.

> Analogies provide quality or component-based paths of association.

> Narratives provide schemas of serialized events in time.

> Rhymes and visual patterns provide schemas of repetition.

> Perceptions reflect temporal proximities based on the characteristic windows of perceptual cognition.

THE INTERDEPENDENCE OF PERCEPTION AND CONCEPT AND THE PRIMACY OF PERCEPTION

Perceptual and conceptual systems work with and against each other. In murder mysteries, the proximities of a flow of events are weighed against theories in order to solve a case. The narrative structures support retention of the events enabling consideration of those events and their possible meaning. Purely formal patterns such as rhymes can keep a saying in mind without requiring any understanding of what the rhyme is about. Different schematic methods and levels are typically used together, as in songs and epic poetry. Stories provide patterns of events, which support memorability enabling the reader to hold a set of events in mind long enough to think about them.

Perceptual methods are primary in that perception constructs direct experience providing base templates for thinking. For example, as Bregman notes, when two piano keys are played with less than one tenth of a second interval between them, they are heard as one. If the interval is much greater than one second, they are perceived as separate and with an interval between they are perceived in terms of rhythm. Visual effects include the production of apparent movement by alternating two images. Perceptual methods provide what Lakoff and Johnson call base metaphors,[30] the physical orientations underlying symbolic thought. They are pervasive, like the association of height and number (a higher score), and they energize metaphors like atmosphere as a 'sea of air' and sensory modes of communcation.

Conceptualization and repetition support the extension of the perceptual scale to encompass larger units through cognitive mechanisms. These include: chunking, e.g., perceiving a long number as a series of shorter ones or hearing a musical note in the

[30] **Lakoff, G. and M. Johnson. 1999.** *Philosophy in the Flesh: The Embodied Mind and Its Challenge to Western Thought*. **New York: Basic Books, 45–49.**

BASE METAPHORS AND COGNITIVE EXTENSION

context of the phrase of which it is a part, etc., anticipation of future events in a pattern as well as change or variation from expected pattern. In music, for instance, we hear notes, phrases and tunes as well as rhythmic and harmonic progressions.

Once the extension of perception takes place, the larger units become contexts for the perception of shorter or more immediate ones, as in gestalt visualizations or highly dissonant musical chords heard not as dissonances but as constituent parts of harmonic modulations.

This paper's approach can be summarized in a set of testable hypotheses or 'middle range' assertions:

SUMMARY: THEORY AS A SERIES OF AXIOMS

1. The first requisite of a communication is its intelligibility or potential for sense-making. It is intelligible when a receiver (reader, viewer, etc.) is able to construct an interpretation or reading. That reading is the communication's primary meaning or content.

2. The communication does not merely transmit, but prompts and guides the receiver in his or her interpretation. At its heart are unstated concepts or frames that the receiver needs to make the communication intelligible.

3. Cognitive processes are predictable. The more the communication is attached to cognitive processes, the more its interpretation can be stabilized across a population.

4. Knowledge is rhetorical. Rhetoric embodies thinking procedures, which are expressed in the selection and spatio-temporal organization of a communication.

5. Any communication begins in spatio-temporal experience. The receiver's perception organizes experiential flow into discrete entities using integration, segregation and selection. Perception is further developed by symbolic cogitation or thinking. The reading that results is a record of the cognitive assimilation: a lasting recollection that informs subsequent perceptions by recognition.

6. Sensory modes are directly linked to experience via perception and sense based cognitive systems with their own distinct properties. The experiential structure of a communication is a means of exercising sensory cognition to guide interpretation. Structuring of presentation is mnemonically powerful. Patterns of presentation, matched to temporal and spatial aspects of perception and cognition can be used to prompt retention, comprehension and interpretation.

7. The fundamental unit of interpretation is the event, which expresses both location and change, and the attributions or statements that specify it. Interpretation begins as something perceived immediately.

8. Interpretation extends perception, both in sensory complexity and duration, by combining immediate perceptual units into complex structures. Three levels of cognitive extension correspond broadly to: pattern recognition, whole sequence or narrative and theory. In communication, pattern is mnemonically powerful in inducing stable long term memory. That retention supports thought and inference, thus comprehension and interpretation.

9. Hypermedia extend the rhetorical possibilities of individual modes of communication by combining and juxtaposing symbolic and sensory modes of presentation. In hypermedia, characteristics of perception, perceptual cognition and cross-mode cognition as well as thought are integrated as meaning.

10. Reception can be thought of as long-term retention, comprehension and interpretation. Comprehension is the completeness of retention. Interpretation is the pattern of integration and segregation: the associative structure of retention. The levels of integration correspond to cognitive extension: pattern recognition or the association of perceptual units into stable groups; the narrative or production sequence as a series of elements with an order; outcome and semantic integration or theory, the association of elements by explicit qualitative links forming a manipulable structure.

11. Reception can be measured by assays of memory. If we know how much someone remembers of a communication, and the pattern of a person's memory, we can know a great deal about that person's comprehension and interpretation.

MEASURING INTERPRETATION BY INTEGRATION AND MEMORY

Measuring interpretation is a tricky matter, particularly when it comes to the interpretation of verbal responses. A subject's report of what he or she was thinking is not his or her thoughts, but a verbal account from memory, given in a social situation. Responses are as much related to the formulation of verbal accounts as to the information being reported. Thus, verbal reports cannot be taken at face value and every attempt should be made to avoid the unquestioning use of substantive verbal descriptions.[31]

[31] **Ericcson, K.A. and H. Simon. 1996.** *Protocol Analysis: Verbal Reports as Data*. **Cambridge: MIT Press, 1–10.**

Luckily, cognitive psychology gives powerful alternatives: cognitive integration and memory. Between them, they provide five measures: integration, latency, retention, comprehension and interpretation. Some variables can be measured directly, and while others require verbal reports, the problems of interpretation can be minimized by pre-structuring responses into multiple choices.

Cognitive processing is expressed by two aspects: integration, which is the completion of cognitive process, and cognitive work, which is expressed by processing time or latency.

Memory is intimately linked with cognition. Put most simply, we remember what we make sense of in the form in which we apprehend it. Memory can be decomposed into four aspects:

1. Retention: the fact of remembering something by recall (the calling back to mind of something which was presented earlier), or by recognition (the identification of something presented earlier when it is presented again).

2. Comprehension: the synthetic level and completeness of memory. There may be a memory of events or the memory may encompass aspects of the context.

3. Interpretation: the organization of memory, i.e. the internal linkages between the elements that comprise a memory and reflect its organization into discrete cognitive objects.

4. Cognitive extension: extension of cognitive units to larger units or contexts such as patterns, sequences, concepts of form, etc.

[32] Storkerson, P. 2001. *Cross Mode Communication in Multimedia*. Chicago: Institute of Design, Illinois Institute of Technology, Ph.D. Dissertation, 167.

Memory is the trace left by cognitive assimilation: its work and success. If we know what a person remembers of a communication, we know how he or she can think about it, thus his or her identificational interpretation of it. By testing memory, many of the vagaries of verbalizations can be avoided.

TESTING AND VERIFICATION

Two experiments were devised to study cognitive processing (the experiments are published elsewhere[32] so a summary is presented here). Both used short movies comprised of a brief event on video with a spoken text statement. The first experiment studied cross-mode integration with reference to semantic links or relations between videos and texts. The second experiment interfered with integration by disturbing temporal relations: delaying either sound or video, to see their effect on integration and memory.

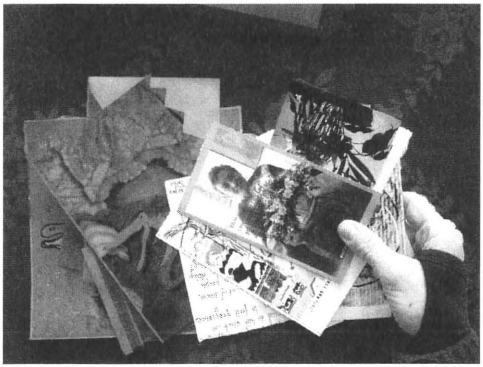
EXPERIMENT 1: SEMANTIC RELATIONS BETWEEN VIDEO AND SPOKEN WORDS

In experiment 1, each movie was eight to twelve seconds long with a single event on video and a spoken text with a single statement or proposition (*see figure 5*). There was no one-to-one correspondence between video and words as there would be, for instance, if there was a video of someone speaking with a synchronized audio of the spoken words. Video and words were independent as in news reports and documentaries. The semantic relations between the modes varied according to whether the video and words explicitly presented common subject matter or concepts, if they implicitly presented common concepts or if there were no credible common concepts or subject matter presented. Insofar as possible, movies were designed not to need specialized knowledge in order to be understood.

EXPERIMENT 1 TEST MOVIE

Interpretation was operationalized as the integration of video and words into a single gestalt: subjects' reports that the videos and spoken texts made sense together. Processing or cognitive effort was measured by latency: the length of

FIGURE 5
Video: gathering and tying letters together.



A: He pushes me around and he has threatened to throw me out of the sixth floor window of my apartment window twice.

B: Why do you put up with it? I don't understand.

A: Because he has my heart.

time required to integrate or decide that it was not appropriate to do so. Thus, at the conclusion of each movie, subjects were asked whether the video and words made sense together (yes or no). Then subjects were asked how confident they were of the response. A comprehensive record was made of responses and response times for each movie (*see figure 6*).

Scores were constructed for each movie. A movie's integration score could range from zero, if it was never integrated, to one hundred percent, if it was always integrated. Its confidence score could range from 1 if all responses reported low confidence to 3 if all responses were high. Latencies were also recorded so latency indices were made for each movie.

The range of integration scores was from nine to over ninety percent and mean integration score of all movies was forty-four percent indicating a broad range of responses. On average, it took almost 2 seconds to respond to the integration question, about 1 second of which was keying and reaction time. Confidence scores ranged from about 1.8 to 2.8, and the mean confidence score for all movies was about 2.4, indicating that most responses were in the moderate to high range. The confidence responses averaged near a second, so they were almost instantaneous, indicating that confidence report did not require extra thinking.

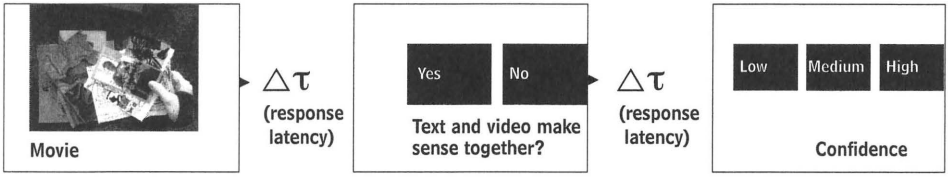


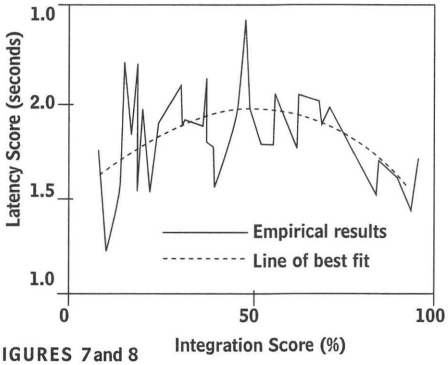
FIGURE 6
Experiment 1 Movies and Questions

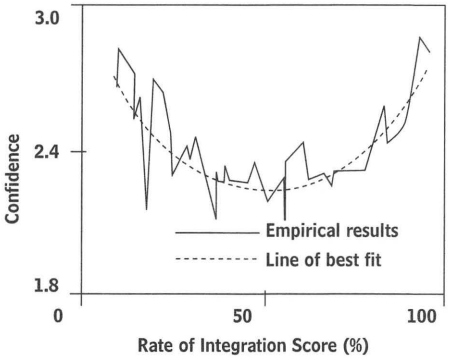
Integration latency showed a significant and strong, quadratic (U-shaped) relationship to integration score (*see figure 7*). It indicated that the movies that were most often either integrated or segregated were processed most quickly. Those with scores near fifty percent took substantially longer to process, indicating that they were more difficult and required more thinking.

Movies with integration scores near fifty percent were movies on which subjects were split as to whether movies could be integrated. In itself, this could be a matter of cultural or individual differences in interpretation, but the relationship between integration score and latency in figure 7 is telling. Behind the apparent differences in interpretation there is a widely shared difficulty in interpretation: movies with scores near fifty percent are more difficult and time consuming to process.

The movies that were more difficult to process were also experienced as ambiguous (*see figure 8*). Subjects were most confident of their judgment with movies scoring high and low on rates of integration. Their confidence dropped as the integration scores approached fifty percent. This relationship, like the last was significant at the .01 confidence level and strong, with an R.sq. or variance explained at sixty percent.

Finally, background information was collected including age, gender and educational attainment. There were some differences between groups. Some groups were more likely to report integration or report slightly different mean confidence levels but the relations between variables such as those in figure 8 and 9 were highly consistent.





FIGURES 7 and 8
Integration and Latency (left)
Integration and Confidence (right)

In short, there was strong evidence that underneath a variety of responses, a broad range of people were cognitively processing these stimuli in much the same way and were interpreting them similarly.

SECOND EXPERIMENT

Experiment 2 used a perceptual challenge: a cross-mode temporal disturbance that might affect integration. Experiment 2 used many of the same videos used in experiment one, but experiment 2 focused on the effects of delays on integration and memory. Videos or spoken texts were delayed in nine states. They were synchronized (identical to experiment one), delayed by one second, with one second overlap, with no overlap or with a one second gap between whichever mode was first and the mode presented second (*see figure 9*). This design yielded four delays, with either video or words presented first.

As in experiment 1, immediately after each movie was shown, subjects were asked if they could integrate video and words (if they made sense together) and to report their confidence in their judgment (low, medium, or high). Also, as in experiment 1, latencies were measured.

The Integration and Confidence results of experiment 2 showed the inhibiting effect of Delay State on Integration (*see figure 10*). Integration was highest in the synchronous 0 Delay State, with a score of fifty-two percent. It dropped to as low as thirty-five percent for Delay States 2 and 3. It dropped significantly with only a

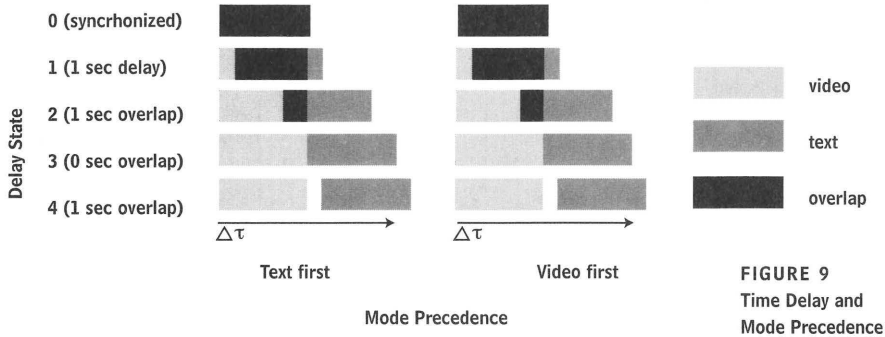


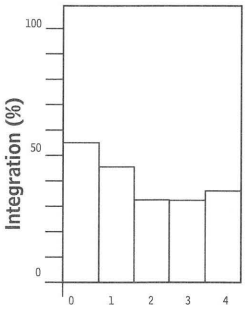
FIGURE 9
Time Delay and Mode Precedence

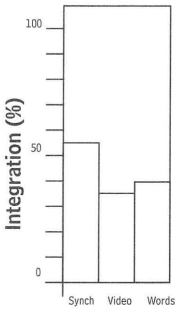
1 second delay in either video (Delay State 1 Integration = 43%) or words (Delay State 5 Integration = 42%). It did not matter whether videos or words were delayed, indicating that receivers needed both equally to achieve integration.

Since there was no one-to-one correspondence between videos and words, delays of one mode altered what were already arbitrary adjacencies of words and video and the relative onsets of modes. It appears that subjects took onsets as cues for cognitive processing and that subjects were trying to realign video and words to their respective beginnings using sensory memory. The lesser, but significant inhibition of integration caused by a one second delay was consistent with the limits of perceptual memory.

MEMORY

In the second part of experiment 2, subjects were tested on their memory (*see figure 11*). Each movie was re-presented in one of its two modes—either the video or the spoken words—while presenting the other mode from four movies including its match. Subjects were asked to correctly match video and words that were originally presented together in one movie as it was playing. In this way, either video or spoken words could serve as a cue for the recollection for the other and it might be possible to detect which movies were remembered. This tests recognition in a situation of intra-task interference, in which subjects have to distinguish the right matching item from a series of similar items that the subject was also shown in the same situation.





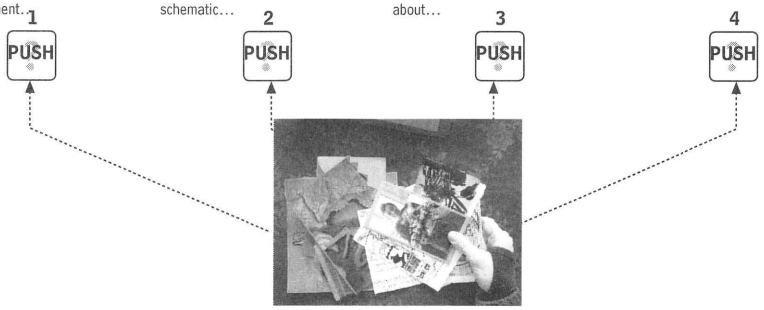
Which text belongs with the video?

He pushes me around and he has threatened to throw me out of the sixth floor window of my apartment.

One of the things we know about memory is that it is not a record of what has happened but a schematic...

It's very difficult after having a stroke. Depression's physical, but there's something to be depressed about...

One of the problems with U.S. policy to Indonesia has been the fact that it's off the map...



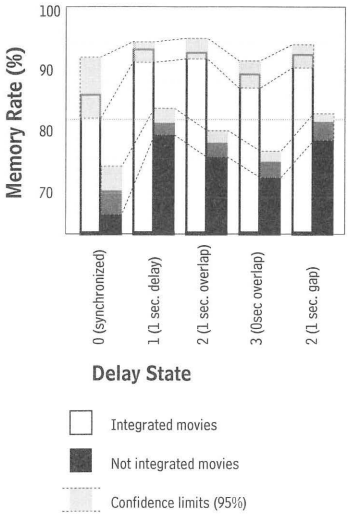


FIGURE 10 (top) Integration, Delay, and Mode Precedence

FIGURE 11 (middle) Matching Video with Text

FIGURE 12 (bottom) Integration and Recognition

RESULTS

The overall rate of correct identification (memory) was high: eighty-six percent of movies were correctly identified. The overall Memory Latency, i.e., the time it took to match video and words was 8.1 seconds, reflecting the difficult job of matching video and words which involved memory and discrimination between memories while presentations were being shown. The mean confidence was 2.55, indicating that subjects were moderately to very confident of their recollection. Given the high level of correct answers, most of the decisions were probably easy.

The movies that subjects integrated were substantially better remembered than movies that they did not integrate (*figure 12*). Only seven percent of integrated movies were not remembered while thirteen percent of not integrated movies were not remembered. For integrated movies, the differences in recognition caused by delays were too small to be statistically significant, regardless of which mode was presented first, but not for Not Integrated movies. Delay involving overlaps or gaps improved memory markedly (*see figure 12*).

This finding points toward a second factor beyond integration affecting memory—cognitive work itself. Research on intra-task interference and facilitation[33] indicates that challenges like delays may inhibit initial acquisition or integration, but it may also facilitate longer-term retention or memory. The results here suggest that while subjects may not be able to find conceptual or narrative linkages, they may find sensory patterns.

CONCLUSION

This paper is about building theory in communication design. It has indicated a general approach—a theory of the middle range—which is theoretically informed and specific enough to support empirical research. It has direct application to communication design on three levels: findings, theory and meta-theory, i.e., a theoretical base that can be used to produce hypotheses regarding design practice.

Findings: It generates findings in the domain of design practice, giving designers tools for measuring communication performance and analyzing structure. Memory provides a common metric against which to measure a variety of variables. The research indicates the relevance to integration of semantic and narrative relations across modes as well as the temporal

[33] **Battig, W. 1966. "Facilitation and Interference." In Bilodeau, E. editor.** *Acquisition of Skill*. **New York: Academic Press, 213–241.**

[34] **Battig, W. 1972. "Intratask Interference as a Source of Facilitation in transfer and Retention." In Thompson, R and J. Voss, editors.** *Topics in Learning and Performance*. **New York: Academic Press, 134–146.**

alignment of modes. It indicates the importance of both integration and sensory challenges to memory. The research also gives scales to these variables, indicating how much memory fades and how close is close enough. Some findings may be surprising, such as the facilitating effects of interference.

Modeling: It presents a theoretical model of communications that is testable. It can be used to make hypotheses that can be affirmed or refuted.

Empirical methods: It supports an experimental method that can be used to generate and test new hypotheses and in that way to refine, extend and produce new models.

This is a theory of the middle range. Just as Boyle described earth's atmosphere as a 'sea of air,' this model has described the reception of communications as memory resulting from cognitive processing. It is not the only possible model, but it is a grounded one. It is a partial theory, telling us nothing about other variables such as sound, color, duration or sequence, though other variables could have been and will in the future be explored. Because the findings and facts are conditioned by the theory, they are not fit for uncritical use. We have to try them out to see how well they work in practice. Moreover, the research poses many more interesting questions and possibilities than it answers. These are not indications of defect, but of the potential for growth. Further research findings and critical analysis will determine the reach of this theory, expose its limits and thus develop a more nuanced view of communication for design.

Author Notes

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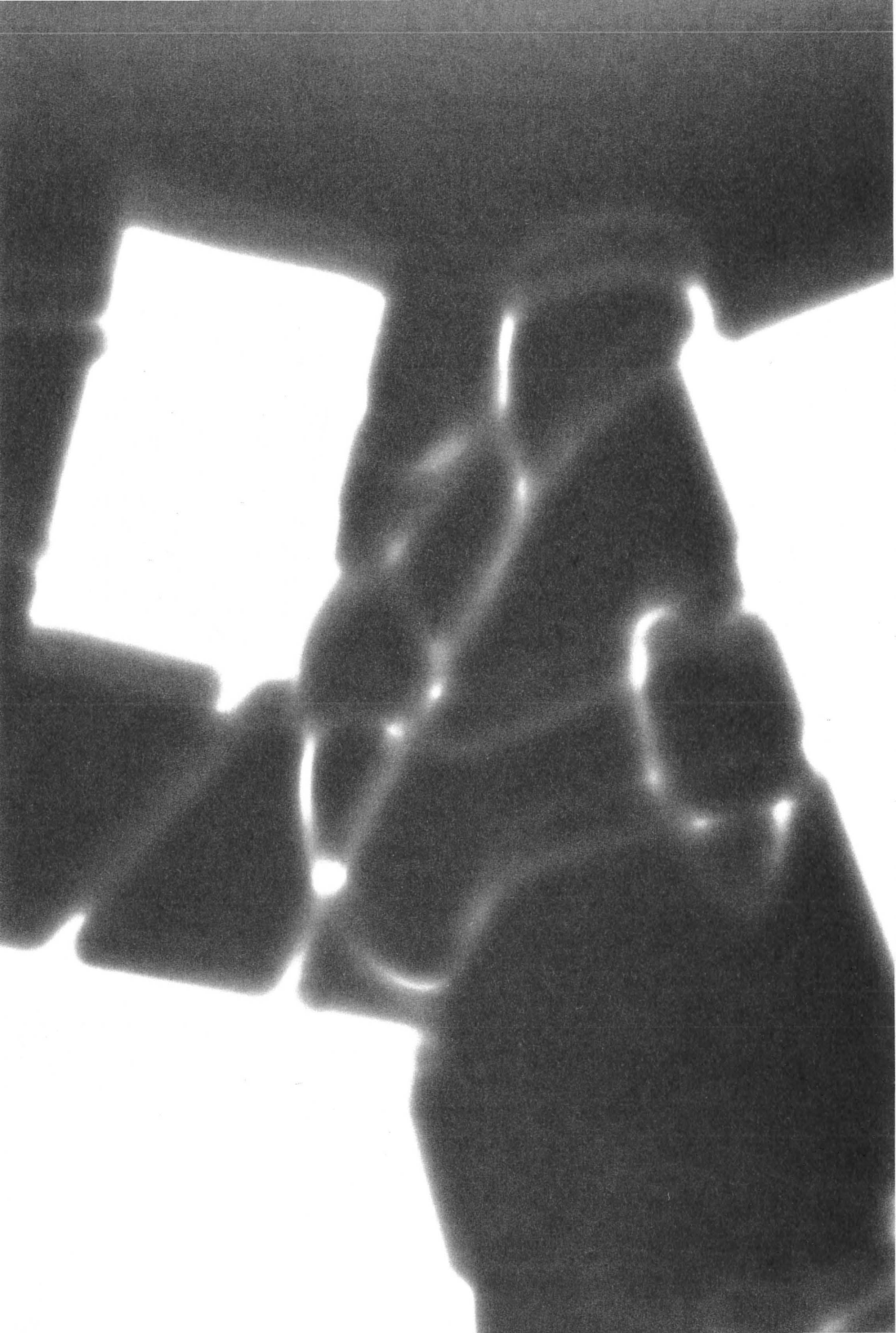

Value-Added Text : Where Graphic Design Meets Paralinguistics

Stuart Mealing

Expressive typography is the sine qua non of the graphic designer—font styles and parameters such as size and color are selected to lend additional interpretive potential to a plain text message. When applied by a designer the process is intuitive and is hardwired to a particular text. Value-added text (**VAT**) is an attempt to visually extend the semantic potential of a message still further in a computer-based environment and to render the process both algorithmic and dynamic, its principles being applicable to typographic (and to iconic) text. This paper emphasizes the exploration of potential paralinguistic mappings which exploit and extend the traditional vocabulary of typography. Much that can be communicated in human-to-human language is lost in its transfer to text but paralinguistics—which studies the features of communication that accompany, or substitute for, the bare words used—offers a gateway to an enriched presentation of text. **VAT** therefore proposes automated graphic proxies which communicate more in a typographic message than the literal semantics of the user's native language and also offers potential assistance in cross-language communication.

University of Plymouth
Visible Language 37.1
Mealing, 43–58

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INTRODUCTION

When I first visited France I spoke expressionless schoolboy French and was understood by nobody. My wife on the other hand spoke only English but accompanied it with appropriate gestures and expressions and was universally comprehended. It was clear that the paralinguistic features of her language carried more meaning than the actual words of mine and had transcended the barriers of foreign language. In a similar manner the graphic designer will aim to communicate more in a typographic message than its literal semantics.

Most people have experienced problems responding to emails where the 'tone' of the message is ambiguous. While the word choice and syntax of formal written text gives controlled clues about whether the writer is being factual, cynical, angry or ironic for example, the closer stylistic proximity of email to spoken language does less to protect the recipient from the absence of contextualizing facial expression and intonation.

Elam subtitled her book on expressive typography 'the word as image' and it is the visual characteristics of a message—its image—that **VAT** employs. It replaces some of the meaning lost when rich layers of verbal communication are stripped off in the transposition to naked text. To some extent punctuation marks retain the flavor of spoken language, providing symbolic representation**!?*!**, and typographic options such as **BLOCK CAPITALS** can restore emphasis to the mental elocution that accompanies silently read text. Much that can be communicated in human-to-human language is, however, lost and paralinguistics studies those features of communication that are additional to the bare words used.

PARALINGUISTICS

In direct communication between humans the words spoken are supplemented by, or on occasion replaced by, a range of paralinguistic features such as body language, expression, gesture, intonation, volume, etc. which serve to qualify the bare bones of the message. VAT provides visual mappings for these features, mappings that can then be combined with raw text to restore some of its lost semantic support. These mappings can be abstract, symbolic, representational or mimetic and either static or kinetic. Their application can readily borrow from the grammar, syntax and vocabularies of art, design, film, theater and existing sign languages (subject to cultural variations and familiarity). Their operation within a computer environment provides opportunities for dynamic presentation.

A semiotic division can be made of the major signs and signals of communication into verbal (in which the linguistic element of speech can be separated from the expressive, non-linguistic elements known as supra-segmentals) and non-verbal (which divides again into visual and tactile). Of these the visual elements potentially have a very direct relevance to VAT and the prosodic features of pitch, loudness and tempo (which together contribute to the rhythm of language) offer readily measurable input data that could be automatically mapped to visual characteristics.

Other voice qualities, such as timbre and intonation, can give clues about the emotional state and social group of the speaker as well as about the information structure of the utterance—for instance whispering can tell of secrecy or conspiracy. They are, unfortunately, prone to international variation in interpretation and therefore only useful within a limited language domain.

TYPOGRAPHY

Although VAT was originally conceived in the context of iconic text (Mealing, 1993)—as a means of adding proxies for those features of human communication which could improve its international comprehension—its initial application to typographic text is perhaps more obvious. If consideration of cross-language issues is temporarily suspended then typographic text has some advantages as a starting point. Its features are comprehensively embodied in and easily accessed through a range of technologies, in particular computer appli-

cations, it is universally understood (by the literate) and, in normal practice, it enables clear understanding. Clear, that is, within the terms of reference of written language but without paralinguistic accessories.

Typography is the branch of graphic design which focuses particularly on type—choice of typeface, font size, color, layout and so on. In its 'pure' form it would deal exclusively with type, as opposed to type integrated with other visual material, though even a page of type necessarily has its own image quality as well. The discipline is, however, typically subsumed into the broader armory of the graphic designer where other visual and communicative skills come into play.

While the ability of the graphic designer to add expressive qualities to the literal meaning of text is relevant to VAT, it is interesting to consider the extent to which any such transformation could be described as objective. Boyd Davis (2000) makes enlightening comparisons between the methodologies employed in art schools and those used in the sciences (in the context of design for human-computer interaction) and finds strengths and weaknesses in both disciplines. Talking of computer science he notes that:

> *Conference literature is dominated by papers reporting quantitative assessments made under experimental conditions. There is little emphasis on creativity, but much on learning from research undertaken by others.*

commenting on the lack of objectivity in art and design training Boyd Davis says:

> *This approach emphasises the experiential nature of design [and its practitioners tend to be] weak at using any sort of objective or qualitative approach. … [There is a] resistance to theory of all kinds; and a reliance on a tradition of visual, intuitive solutions which are not based on any form of textural research.*

Tradition embodies rules that might have become explicit in areas such as leading and kerning but not in how to suggest joy, fear or indifference.

Despite that there would probably prove to be a high level of agreement about how to achieve such ends, and a still higher one about the success of such attempts. VAT sets out to derive testable rules from this and similar bodies of subjective agreement in the visual media in order that its subsequent application can be objective.

VISUAL LANGUAGE

While typographic text has inherent visual qualities there are arenas for its use in which the visual qualities are paramount. Concrete poetry, for example, uses the visual form of a poem to convey meaning and Houédard (1965), in text accompanying the exhibition 'Between poetry and painting' explains that:

The area 'between' Poetry and Painting is where they overlap—they do this (a) since all writing originates in painting (writing is painting words) and (b) since it is possible to think in images alone—in diagrams, models, gestures and muscular movements, as well as in words alone, mind is the first place where Poetry and Painting meet.

Writing and painting are ways in which minds communicate—and it is only in the context of communication theory and Wittgenstein's investigations plus the way artists and poets were influenced by Zen concepts of mind and meaning that a critic can see the sort of forces that have drawn poets and painters together in a common field.

The visual presentation of text can, of course, enhance understanding in other contexts. The layout pattern alone of a page of a high-level computer language such as Pascal tells a programmer much about the structure and function of a program and experienced authors claim to be able to tell whether a book is well written by the visual rhythm of its text-block patterns.

Hand-written text clearly speaks of its author and, as well as the 'general impression' it gives the layman—untidy, organized, decorative, etc.—it is open to graphological analysis. While its efficacy is widely doubted, this parascience interprets character and personality from handwriting and is increasingly used in

business as part of the applicant assessment process. Variables such as proportion, evenness, slope, slant angle, size, spacing, width and weight are all considered (West, 1999) and used to extract information beyond the remit of the text.

Type itself is protean, its production involving the specification of a number of variables. Choice of typeface (from many thousands), weight, size, color, kerning, leading and layout are the most obvious and the possibility of customizing or inventing new type families also exists. It will be obvious that some of these parameters might be defined by the procedure used—a typewriter, for instance, prescribing the way in which many of them are set and a display surface defining the maximum available size. The interaction between these variables is what distinguishes at a glance an up market broadsheet newspaper from a populist tabloid.

Many of these variables can also be applied to marks in general, both on a surface and in three-dimensional space. Lines can be heavy or light, wide or thin, smooth or angular, widely or closely spaced. They can also be regular or erratic, mechanical in character or autographic (thus revealing of the person making the mark). Gestures too could be said to have similar characteristics. Rules for the application of mark-variables such as these could be applied equally to the elements of typographic or iconic text and to ancillary features such as a dynamic background.

GESTURE

Gesticulating is instinctive and an integral part of the speech process that may even help to shape the thoughts underlying speech (Hall, 1988), a gesture being conveniently defined as a significant movement of a limb or body and also the use of such movements especially to convey feeling or as a rhetorical device. It has become elaborated and formalized into a number of sign languages, for example British, American and Amerind, all of which have both symbolic and mimetic elements the latter of which are often accessible internationally.

Most interesting in terms of building interactive dialogue systems is the semantic and pragmatic relationship between gesture and

speech. The two channels do not always manifest the same information about an idea, but what they convey is virtually always compatible, both semantically, in that speech and gesture give a consistent view of an overall meaning to be conveyed, and pragmatically, in that speech and gesture mark information about the meaning as advancing the purposes of the conversation in a consistent way. ... The semantic and pragmatic compatibility seen in gesture-speech relationship recalls the interaction of words and graphics in multimodal presentations. (Cassell, 1999)

There is a clear opportunity for the accompaniment of text by dynamic material that simulates or represents the gestures that accompany speech. A symbolic abstraction which embodies the visual rhythms of gesture might be appropriate or a more literal mapping for a gesture which is mimetic. The former might operate in the background and the latter perhaps adjacent to the message. Gesture mapping will, however, be pursued in depth elsewhere.

SEMANTIC GRANULARITY

Spontaneous signing, when used by my wife on a foreign excursion, is likely to accompany a single word or phrase and communicate a single semantic unit but when used by deaf children can be constructed, untaught, into sentences (Goldin-Meadows, 1998). Gestural communication is most likely to map to a word when the form of an object is mimed.

Semantic units in a message (or dialogue) will often not match discrete grammatical units of written language and it is necessary for VAT to decide the granularity of meaning at which a visual match is to be attempted. A 'top down' approach would attempt a single mapping for the message in its entirety while a 'bottom up' approach would seek to separately match each meaningful item. It might be tempting to start with a word-level mapping but the expression to 'kick the bucket' (a slang expression in England meaning 'die') clearly shows one weakness of such an approach while waving a fist demonstrates another.

The smallest contrastive unit of grammar is a morpheme and it would be convenient to find a matching entity which was the smallest contrastive unit of visual or pictorial

meaning—perhaps a 'picteme' (Mealing, 2000)—to which it could be mapped. Since the picteme is currently hypothetical a more reasonable aim might be to map to a lexeme (the smallest contrastive unit of a semantic system) but how often would a message's gestalt be sacrificed by such a forced division?

MESSAGE PRESENTATION

It is not the purpose of VAT to try to imitate spoken language but to add meaning to the text which is its visual incarnation. We can therefore make our own design decisions about how the text is best presented. This freedom is, of course, subject to the constraints of a given medium. The sort of text message considered here is likely to be either a piece of constructed prose, assembled over a period of time before transmission, or a real-time translation of natural language transmitted as it is spoken. In the latter case the application of VAT would necessarily also be in real-time and would be mapped directly from the selected inputs provided by the speaker. However when listening to speech only a single moment of sound wave is 'heard' at any point in time with the moments accumulating and acquiring meaning in the brain. It follows that the length of time that transmitted words linger and accumulate on a computer screen is an important factor in their presentation.

In the case of a constructed message it could either be presented as a single block, as an email is, or in sequential chunks—chunk size corresponding to some meaningful unit of either written or spoken text. Existing presentational models include the ticker tape machine or teleprinter (delivering the message character-by-character at the typing speed of the operator) and bullet points sliding into place in computer-based presentations, typically word-by-word or line-by-line; scrolling allows a message to be run through at a user's own pace while subtitled films present text in units roughly matched to short bursts of speech, usually semantically coherent and with punctuation used to aid comprehension. Other, perhaps more adventurous, dynamic options can also be considered.

VAT features, applied to whatever chunk size is deemed appropriate, can remain hardwired to the chunk and active for the life of the message on screen or can be

applied temporarily to chunks in sequence. For example if volume was to be mapped to font size then a word (or chunk) spoken loudly, perhaps for emphasis, would be represented in a larger font size than the surrounding text. In hard-wired application the increased size would be constant for the life of the message. In the case of temporary application it would either increase its size only at its first appearance (in the case of a streaming message) or, if the message was presented as a single block, then the size increase might be part of a sequential application mirroring the timing of the message's speech pattern—a sort of linguistic 'Mexican wave.'

SYNTACTIC OPTIONS

Any direct mapping of spoken text would necessarily reflect the syntax of the verbal message. It is not the case, however, that English syntax represents the only available model (or that its model is static) and different languages organize the grammatical elements of Subject, Verb and Object into different word orders. While the order SVO is common to seventy-five percent of the world's languages (Crystal, 1989), it is not always the case. Sign language, for instance, often starts with the Object and Spanish precedes questions with a Question mark. Yoda ("Strong am I with the force"), a character from the Star Wars series of films, uses an OSV construction and the contextual clarity of starting with an Object is tempting both in an unfamiliar linguistic environment and for an iconic language.

SYSTEM INPUTS

The mapping process around which VAT is formed uses inputs derived from speech and its accessories. These will, through the process of its application, find visual form. Readily quantifiable features such as volume, pitch and tempo have already been identified as the source of potential inputs while other equally apparent but less obviously quantifiable features such as expression, gesture and intonation present themselves. Instinctive gesturing presents rhythms (likely to be synchronized with the meter of speech) and dynamic spatial locations of the hands that provide relevant input data. In addition, future consideration could be made of sensory inputs which match inflections of verbal presentation—changes to pulse rate and its strength, for instance, might be indicators of anger while skin capacitance is measured as an indicator in lie detector tests.

A text message can be created either by real-time translation from speech using readily available software; in close to real-time by dictation to a keyboard operator; or it can be constructed over a longer period of time. In the first and second cases the message could either be completed before transmission or could be transmitted as it was being created. In the last case the authoring period suggests that it would be transmitted only after completion. The application of VAT features might therefore be required either on-the-fly, in which case automatic mapping suggests itself, or in retrospect as part of a post-composition editing process.

In this context it is unlikely that cool, post-composition application of VAT would offer exactly the same range of mappings as its 'hot' application in real-time. The expression of anger, for example, might provide real-time inputs of raised volume, quickened pulse, aggressive gesture or tremulous enunciation. Adding retrospective qualifiers for the same emotion would be strangely calculating. A secretary taking dictation could note expressive symptoms and transcribe them with VAT but the process lacks conviction. For this reason it is likely that some VAT features would best map to live inputs while others would fit more formal application. The latter are likely to provide a better basis for any future migration of VAT from screen to paper.

MAPPING OPTIONS

Given that we can identify and quantify salient features of language and have suitable variables to which they can be mapped then a semantic and presentational relationship between the two needs to be established. A convenient starting point is to map color space to prosodic space; a clearly simple but potentially rewarding exercise. The three prosodic dimensions of pitch, loudness and tempo can be mapped to a number of three-dimensional color models that exist—RGB (red, green, blue), CMY (cyan, magenta, yellow), HSV (hue, saturation, value), HWB (hue, whiteness, blackness), YIQ and YUV (luminance, two color differences), DLP (dominant wavelength, luminance and purity) and others. Each model has its own appeal as a mapping target but RGB has the obvious convenience of being the model used for computer display screens.

If loudness is mapped to red, pitch to blue and tempo to green on a scale of 0 to 256 then the combination of quiet, slow and high-pitched (50,50,200) produces deep blue; loud, fast and low-pitched (200,200,50) produces light greeny-yellow; very loud, fast and high-pitched (250, 200, 200) produces a light, warm gray; three maximum values produces white and three zero values (or silence) produces black. This is, however, not as visually intuitive as using HSV since it would seem appropriate to map volume to visual tone (quiet = light, loud = dark perhaps) but this does not equate to any single dimension of RGB space. While there would be few firm 'translations' from prosodic intention to colored representation the mapping provides an alternative contextualization whose meaning would accrue with exposure.

A further step in the project is to further research associational links, coded or instinctive, for instance between color and emotion and to test out a range of mapping options. Is silence black or white? Is anger red or blue? Is tenderness pink? Volume could alternatively be mapped to size or weight or capitalization or all three:

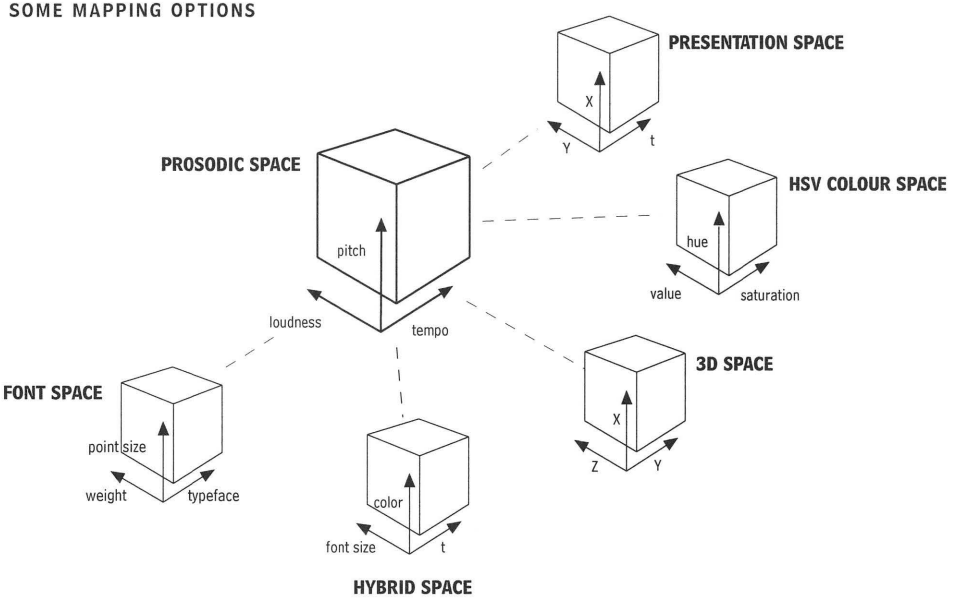
ok, **OK!**

Additionally in this simple example, the comma and ensuing space are diagrammatically suggestive of a pause, while the exclamation mark adds emphasis. You might merely read the first 'ok' but you almost hear the second.

A third option would be to map volume to spatial depth. Typographic convention offers each text chunk a canonical position in page space that can be subverted to good effect. In XYZ space mapping the Z-axis to volume suggests a closer (= larger) position for loud and a distant (= smaller) position for quiet. Three-dimensional manipulations such as this lead to interesting problems of overlap with which conventional leading and kerning are ill equipped to deal. The X- and Y-axes remain available for other mapping.

An emotional state which 'colors' a conversation or message could literally color text chunks or, perhaps more helpfully, the background of a text block. What dif-

SOME MAPPING OPTIONS



ferences would there be in the interpretation of a message on a rich red background as opposed to one on pale blue? The means of diagnosing an emotional state in order that it can be mapped using VAT is unresolved but since it is possible for an observer to recognize the existence of such a state in a speaker then symptoms clearly exist. Measured combinations of data from inputs already identified may prove sufficient for the recognition of quantifiable states; indeed mapping those individual inputs to visual variables might, of itself, give rise to a visual combination that could be recognized as representing the state.

One of the most evocative typographic features is the type family itself, each carrying hints and associations which can give clear inflection to a message. These are a few fonts that came installed on my current computer:

They can be modified in even the most basic word processors to: plain, bold, *plain italic*, *bold italic* and underlined. These simple modifications, combined with the few typefaces above, together produce fifty variations that could be selected by input mapping. The principles of line quality embodied in a sample range of fonts such as this could also be applied to the style of mark used in creating iconic or pictorial text.

METHOD

There are a number of distinct and separate elements to be dealt with in the realization of VAT, many of which can be developed in parallel. The speed and pattern of VAT's development will be partly dependent on cross-disciplinary collaborations. Contact is developing with departments in this and other universities regarding the range of useful data channels that can be derived directly from speech and from associated corporeal activity. Promising but far more speculative discussion is on the potential use of motion capture technologies to derive data (such as speed, scale and rhythm) from live gesturing and on the possible generation of data from expression by the inverse application of computer character animation techniques to facial analysis. Specific gestural semantics will be considered later in more depth.

Macromedia Director proves convenient for prototyping options with **Lingo** (its internal programming language) being called on for tasks such as the dynamic modification of font variables. Visual decisions such as those on choice of font and color derive from the extension of existing graphic conventions. Following informal user testing

the elements are then built into an application written in **REALbasic** which allows simple, flexible control and patching of input speech variables to screen-based output variables. This application will be used for rigorous user testing of the various options. At this stage a standard analogue-to-digital converter provides a small, hardwired range of data sets from pre-recorded texts and conversations.

With so many potential variables there is a clear need for constraint to prevent VAT from expanding into a fairground of visual information which could overpower rather than support the text it supplements. This will be treated as a graphic design decision by which active input channels will be restricted and/or the extremes of output parameters limited. The technical means by which VAT might be applied to computer-based transmissions such as email will not be considered until an effective mapping model has been proved.

OF DOGS, BABIES AND FOREIGNERS

Animals and babies do not understand the meaning of the words in spoken language. They are, however, likely to understand something of a spoken message addressed to them because it is often accompanied by exaggerated paralinguistic features in acknowledgement of their limited lexical comprehension. Firm hand signals accompany "SIT!", wide eyes and a dramatically large smile accompany "What a good little girl." Dog sits and baby smiles.

In the same way that television does not become rendered incomprehensible if the sound is turned off, so VAT is likely to convey some level of meaning when separated from the text it is designed to accompany. If therefore, VAT is successful in mapping paralinguistic features within its visual language then it is likely that they alone will elicit some response in receivers bereft of natural language. While not a primary objective of the project, the ability of the added features to communicate when divorced from text will be investigated.

Initial experiments with VAT are being conducted using English alone but if response to the visual accessories alone proves to communicate some useful part of, or context for, the message then its potential as an aid to cross-language communication would clearly be enhanced.

CONCLUSION

Written language can differ greatly in structure and function from speech but can also attempt, as often with casual email messages, to be a close substitute for the spoken word. Written text survives to be re-read while speech carries with it the preciousness of the ephemeral. VAT seeks to reinstate the semantic nuances lost when transient 'phonic substance' is translated to immutable 'graphic substance' (Crystal, 1989); to rehumanize text derived from spoken language through computer mediation.

Anything added to a message by VAT must add to its understanding or, at worst, be neutral to it. The VAT features must therefore be intuitively understood or their meaning comfortably acquired by exposure over time without a conscious learning process interfering with understanding of the underlying text message. It is not, therefore, necessary to concentrate on learning VAT but merely to experience it and let its meaning accrue. Even if no value is added all that is sacrificed is bandwidth.

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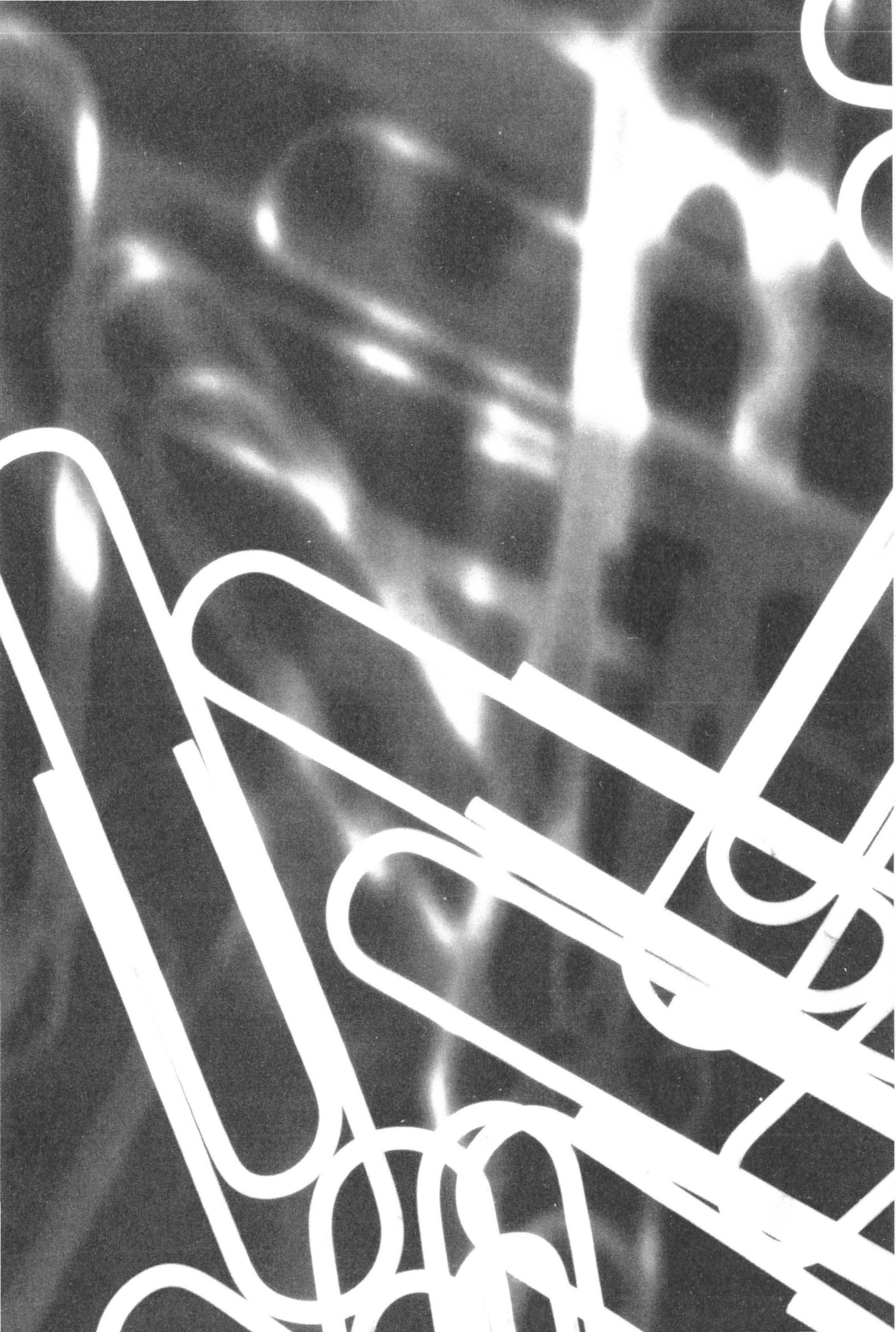

User Analysis **FRAMEWORK**

Thoughts on User's Cognitive Factors for Information Design on Web-based Media

Napawan Sawasdichai and Sharon Poggenpohl

Websites have passed through several developmental progressions, from simple textual information to more sophisticated interactive communication that engages a larger and more diverse audience. As an alternative channel to communicate, access information, perform a task or fulfill personal interest, more usability problems become apparent. Studying and solving these problems is increasingly essential. This study attempts to analyze and understand search problems based on user search behavior. To understand this behavior more profoundly, focus shifts to the user's cognitive factors that underlie and regulate behavior while searching though a website. These cognitive factors include generic goals, user modes of searching, user search strategies and methods, as well as different types of models to identify user characteristics. The study discusses classification of these cognitive factors and provides an analytic framework that helps systematically analyze and synthesize these factors in order to better anticipate user search behavior with the goal to eventually be able to determine the kinds of information and functions needed to include in different types of website design.

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BACKGROUND

As web-based media has already begun to dominate our everyday life, it has passed through several progressions—the earlier simple model refashioned only textual communication available to those in academia or research to the far more sophisticated visual-animated interactive medium which now engages much larger and diverse audiences. The development in communication and information technology enables content to evolve from the electronic version of a simple letter or textual report to the interactive version of newspaper, magazine, graphic advertising and merchandising catalog, consequently web-based media has become more prevalent than ever. It has transformed the ways we live by presenting us with alternative channels to communicate, access information, perform tasks or fulfill personal interest. These opportunities extend to the general technically literate population. However, as more audiences engage, more usability problems are uncovered. These problems can't be solved by the development of technically sophisticated systems alone. User behaviors need to be deeply understood in order to design systems that allow users to perform their tasks easily, without struggle and frustration.

PREVIOUS RESEARCH FINDINGS

A previous research paper "User Purposes and Information-seeking Behaviors in Web-based Media: A User-centered Approach to Information Design on Websites" (Sawasdichai, 2002) provides a new perspective on design considerations for a website by incorporating requirements from both website (client) intentions and user purposes. In this study, user purposes and their modes of searching were investigated simultaneously with website goals to reveal common search patterns associated with each case and to identify the primary problems that occur in each pattern. The results show that the patterns of user search behaviors are uniquely different depending on their purposes and current modes of searching. Even though each user (subject) performed his/her task in isolation and in her/his own way, similar search patterns appeared based on a shared purpose and/or the same mode of searching. Different search patterns were associated with different user purposes and website intentions. Ten cases were investigated ranging from very specific to open-ended purposes and searches.

The research findings also show that user purposes and modes of searching are the main mechanisms that play an important role in determining user behavior and the resulting search pattern (*see figure 1*). User purpose is the main factor regulating their task description, while user mode of searching provides the major impact on their search strategies and search methods. User purposes determine different lists of task they need to perform to achieve their goal. Their modes of searching influence their search strategies, how hard or easy the search can be and how much time is spent on their search. Users who begin with the same purpose will perform their search similarly in terms of what tasks are necessary to reach the goal. However, if they use different modes of searching—depending on their personal knowledge and experience and how precisely they know what they want, they will have different search strategies and consequently choose different kinds of search methods even though they begin their search with the same purpose. Since user purposes and user modes of searching are the main mechanisms determining user search patterns, more understanding in this area will help web developers anticipate search behaviors, needs and the expectations of their intended audiences. Consequently, they will be able to lay out web structures suitable for both the web contents and the user purposes, and consciously include various search methods or search tools suitable for different user modes of searching.

USER PURPOSES, USER GOALS AND USER INTENTIONS

Each user has a specific purpose when visiting a website. Different purposes suggest different task descriptions as stated earlier. To further investigate "user purpose" in this research paper, user purpose is elaborated into different levels as "user goal" which indicates something the user wants to achieve or attain and "user intention" which demonstrates a determination to act in a certain way to accomplish the goal. User goal originates from user needs; it is subjective and sometimes vaguely defined. User intention is then translated from user goal into an objective plan that the user can carry out to reach his/her goal. The relationship between user goal and user intention is further demonstrated in the Research Analytic Framework, discussed in the next section.

SEARCH STRATEGIES AND SEARCH METHODS

When performing their search, users need a search plan—how to perform their search and which kinds of search tools to use in order to easily achieve their original goal. This plan is different from person to person based on user search strategy. However, as stated earlier in the previous research findings, user search strategy is influenced by

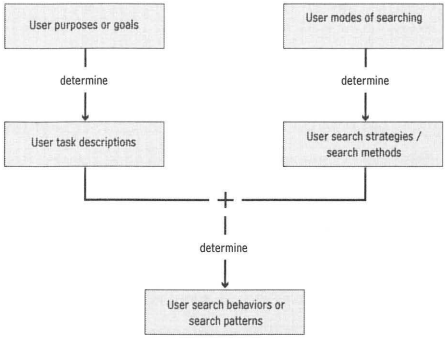


FIGURE 1
User Purposes and User Modes of Searching, the Main Factors Regulating User Search Behavior

user mode of searching. Search strategy can range from general or less objective search (browse) to more specific or purposeful search. These are directly proportional to user modes of searching which range from open-ended to specific search. Users may also plan a fast or slow search based on time available and the urgency of their need. Users who plan a slow search usually want to record their search results by using the bookmark function or simply print out the retrieval result pages for later use. User search strategy may change from time-to-time in accordance with user modes of searching, which are based on the current context or situation that unfolds while they are searching as well as the search results that they retrieve.

While search strategy is the scheme that generally characterizes users' search, search method is the procedure of how users actually perform their search. It is concerned with the types of search tools users choose to use in their search. These search tools include menu bar, table of contents, index, site map, shortcut, search field (box), search agent, etc. Users select a combination of these search tools to perform their search based on their strategy. For example, users who are in the mode of exploratory searching (open-ended search) will likely plan a slow and general search (search strategy), and mostly explore their search by browsing the menu bar and table of contents (search method). On the other hand, users who are in the mode of known-item searching (specific search) will usually plan a fast and purposeful search (search strategy), and comfortably use the index or shortcut to pursue their search (search method).

THE PURPOSE OF THIS RESEARCH

To gain more understanding within this area, user cognitive factors, user goals, intentions and modes of searching need to be further investigated in order to uncover how these cognitive factors have substantial impact on user iterative behavior when using the media. Furthermore, proper user models need to be established that take into consideration demographic, psychographic and technographic profiles. This paper serves as a post-analysis of the research on User Purposes and Information-seeking Behaviors in Web-based Media referred to earlier. It elucidates a classification of cognitive factors and illustrates how these factors can be considered simultaneously as an User Analysis Framework to anticipate various cases of user behavior and identify the main characteristics and potential problems associated with each case. Moreover, the framework identifies important functions to include in each case to support user tasks. Greater understanding in this area will help complement existing analysis and design methods such as task analysis or task mapping and scenario-based design.

THE RESEARCH ANALYTIC FRAMEWORK: MODEL OF USERS' GOALS/ INTENTIONS/ ACTIONS

Based on Donald A. Norman's model "Seven Stages of Action" (Norman, 1988), when people want to get something done, they have to start with a goal or some notion of what is to be achieved. However, despite its importance, it is often ill-formed and vaguely stated. To lead to action, a goal must be translated into an intention that indicates the appropriate action or method to take to achieve the goal. Consequently, the intention has to be transformed into a specific action sequence that can be performed or executed to satisfy the intention (*see figure 2*). Moreover, one could satisfy one's goal through different intentions and action sequences depending on the state of the world.

Likewise, in web-based media, users visit a website with unique goals. These goals are often subtle and vaguely stated. As a result, in some practices this important stage is sometimes intentionally or mistakenly excluded when performing the task analysis, but instead starts with users' intentions that are more obvious and precisely specified. This process may work successfully in interface design with a task-oriented approach such as used in software development. However, in web-based media,

FIGURE 2
Seven Stages of Action (Redrawn from the original in *The Design of Everyday Things*, 1988)

users are usually goal-oriented, and they will be satisfied only if their goals are met successfully. As a result, this process may mislead design development, and result in user frustration when original goals can not be fulfilled. Since one particular goal may be transformed into various intentions based on several factors such as users' knowledge, experience, time available, context or situation, it is important, in the early stage of a design process, to recognize these goals as well as the connections between the goals and the intentions translated from these goals. Otherwise, it is difficult to understand and predict users' behaviors, needs and expectations, and as a result fail to design the system that enables user success.

Based on the original goals, users form intentions for what they need to obtain the goals. These intentions guide specific actions. Users' intentions are varied based on their modes of searching, which can be differentiated by the three substantial factors as follows (*see figure 3*).

- Levels of specification or determination of user needs (how exactly they know what they want)
- Levels of urgency of user needs (how urgently they need to meet their goal)
- Levels of user contribution to the search tasks (how much time and effort they are willing to spend to complete the task)

These user modes of searching may change from time to time or from one search to another after users gain more experience or collect more information from their search task. As a result, the users' intentions may change accordingly, especially when users are struggling with search problems and feel overwhelmingly frustrated.

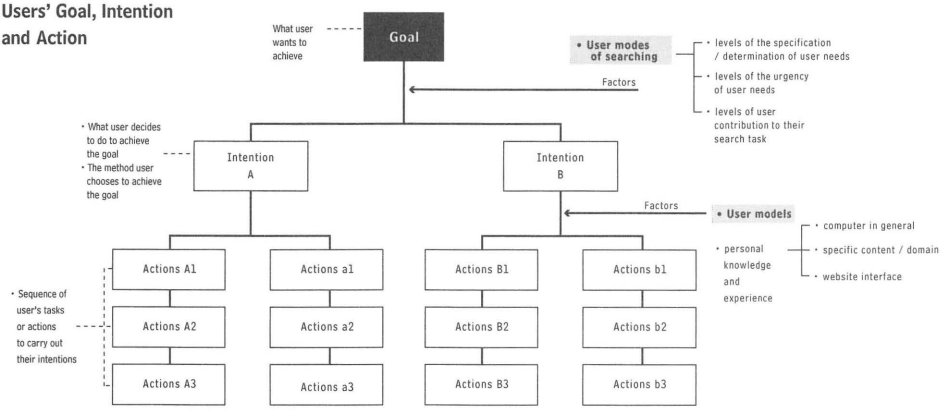
After intentions are formed, users transform their intentions into specific actions or descriptions of what they need to perform. Similar to the connection between the users' goals and intentions, a particular intention can be translated into various action sequences based on models that describe user characteristics, substantially based on users' demographic and technographic profiles as follows (*see figure 3*).

- Levels of users' knowledge and skill in the specific content or domain in which they are searching
- Levels of users' skill and experience in the particular task they are performing
- Levels of users' experience or familiarity with the particular website interface
- Levels of users' computer and internet literacy—users' knowledge, experience and ability to operate a personal computer, as well as connect and use internet

Due to differences among characteristics, each model of user will choose to perform the tasks differently for the very same intention. For example, users who are sophisticated and literate in computer operation will certainly feel confident when facing any technical problem and will be able to solve the problem successfully on their own. Similarly, users who have expertise in the particular domain they are searching will face less struggle since they have a familiarity with the structure and contents under exploration. These users will probably be able to take an easier, shorter action sequence since they have flexible category and content knowledge and feel confident when they come to make decisions. First-time users or users who lack any knowledge or experience in the domain they are searching will probably take a longer sequence of actions because they need to perform and learn from their mistakes simultaneous with their search.

In summary, one particular goal can be transformed into various intentions based on different user modes of searching, and further translated into various sequences of actions based on different user models. Therefore, it is important to recognize these connections among users' goals, intentions and action sequences, and understand the

FIGURE 3
Analytic Model of Users' Goal, Intention and Action



substantial factors that enable these transformations, so that users' behaviors, needs and expectations will be predicted more correctly or closely to how users really behave in actual cases.

GENERIC USER GOALS

Each user may access the same website with different goals at different times or they may change their goals from time-to-time in accordance with the context or situation that unfolds while they are performing their tasks. Furthermore, they often link several goals and explore them sequentially. These factors complicate the attempt to anticipate users' needs, expectations and search behaviors. However, generic user goals may be generalized and categorized based on website usage as follows.

1. Use a website as an alternative channel to access and search for information they need. In this category, the website is used as an alternative channel to other traditional channels such as books, magazines, newspapers, television, radio, consultants, etc. Some users may need information only to stay updated; others may need information to fulfill their specific inquiry or for additional decision making.
2. Use a website as an alternative communication channel to communicate and connect with other people or the world. The website is an alternative communication channel to other traditional ones, such as telephones, letters, conferences, etc.
3. Use a website as an alternative medium to perform specific tasks. The website is an alternative medium for shopping, organizing and paying bills, subscribing, etc.
4. Use a website as an alternative medium to fulfill personal interests. The website is an alternative medium to play games, download music, watch video clips, etc.

These generic goals are often subtle and vaguely stated by users; however, they play a substantial role in determining user tasks. Using a website as an alternative channel to access and search for information is a very different task from using the same website as an alternative medium to shop or pay bills. Moreover, these generic goals are not mutually exclusive since users tend to have several goals when visiting a website and pursue them sequentially. Users will feel more satisfied and successful if their goals

correspond to website goals, content and structure. As a result, web developers need to recognize these goals, so that they will be able to anticipate user tasks, and provide a web structure that is agreeable with those tasks.

GENERIC USER GOALS IN DIFFERENT KINDS OF WEBSITES

When exploring a website, users often pursue several different goals as primary and secondary ones. Secondary goals are often concerned with tasks that support primary goals. In a commercial website, users' primary goal is to perform a specific task—to purchase merchandise or service offered through the website. However, before purchasing, users need to know specific information about the merchandise or services in order to compare and make a decision. This becomes the users' secondary goal, which is to access and search for the information they need (*see figure 4.1*). In this case, users will be able to achieve their primary goal only if their secondary goal is satisfactorily fulfilled. If users are unable to find the information they need, they may leave the website without purchasing anything. Even though, in most scenarios, users are able to find some information, it is still not sufficient to make a final decision. In this case, users will postpone their decision and purchase until they have information that makes them feel confident. However, these purchasing behaviors are not exclusively based on user goals, but are also influenced by user modes of searching and types of user models, which are further discussed in the following sections.

In an information website, the users' primary goal is obvious—to use the website as an alternative channel to access and search for information. Some users may need information to stay updated or to learn about particular topics or subjects. Others may need information to fulfil their specific inquiries or to use for comparing and making decisions. These sub-goals become the users' secondary goals, which considerably influence their task descriptions (*see figure 4.1*). Users who need information to help with their decision processes or those who need information to fulfill their specific inquiries usually perform their search task more intensely than those who need information only to stay updated.

In an education website, some users may have only one primary goal to access and search for information they need for learning—to seek information or knowledge in a specific domain. However, other users may have two different primary goals that they need to pursue sequentially. One is to use the website as a channel to access informa-

Websites	User primary goals	User secondary goals	Possible user intentions (what to do to acheive the goals, varied by user modes of searching)
Commercial website	• **Buying merchandise / service** (use website as an alternative means to perform specific tasks)	• **Seeking specific information about the merchandise / service** • **Comparing and / or making decisions** (use website as an alternative channel to access information)	• Purchasing the merchandise / service only • Seeking information about the merchandise / service to compare and make decision, then purchase on-line • Seeking information about the merchandise / service to compare and/or make decision, but purchase somewhere else • Seeking information about the merchandise / service, then record or save to compare and make decision later
Information website	• **Seeking information** (use website as an alternative channel to access information)	• **To stay updated** • **To fulfill specific inquiry** • **To compare and/or make decision** • **To learn about a specific topic or subject**	• Seeking only specific information • Seeking specific information and all other relevant information • Seeking information (either only specific information, or all relevant information), record, then compare and make decision • Seeking information (either only specific information, or all relevant information) and record or save for later use
Education website	• **Learning** (use website as an alternative channel to access information) • **Learning and practicing** (use website as an alternative channel to access information and use an alternative means to perform specific tasks)		• Seeking specific lesson / topic, and learn step-by-step on-line until finished • Seeking specific lesson / topic, then record for learning later (off-line), or save for later use • Seeking specific lesson / topic, learn step-by-step on-line, then save to continue the lesson or re-visit later • Coming back or re-visiting the lesson for practising or reviewing
Identity website	• **Seeking information** (use website as an alternative channel to access information)	• **To stay updated** • **To fulfill specific inquiry** • **To compare and/or make decision**	• Seeking only specific information • Seeking specific information and all other relevant information • Seeking information (either only specific information, or all relevant information), record, then compare and make decision • Seeking information (either only specific information, or all relevant information) and record or save for later use
	• **Performing specific tasks** (use website as an alternative means to perform specific tasks)	• **Make transactions on-line** (such as paying bills)	• Making transaction only (may be first time or routinely done) • Seeking information about the transaction or account, then make transaction
		• **Get involved or make contact with the company, institution or person** (such as applying or subscribing)	• Making contact with the company, institution or person • Seeking contact, apply or subscribe to information, then make contact with the company, institution or person

FIGURE 4.1
Generic User Goals in Different Kinds of Website

tion and another is to use the same website as a medium to perform specific tasks—to practice and further develop skills they have learned (*see figure 4.1*). These behaviors may be found in some websites such as the "DIY—Do It Yourself" website or the academic websites that provide long-distance learning programs.

In an identity website provided by an individual, company, or organization, there are two different primary goals that are not mutually exclusive. Some users may entertain both goals and explore them simultaneously or sequentially. One goal is to use the website to search for information regarding the individual, company, or organization who owns the website, or to examine the merchandise or service provided by them. The information may be needed to stay updated, fulfill a specific inquiry, or compare and make a decision. Another goal is to use the website to perform specific tasks (*see figure 4.1*). These tasks are different from one website to another, however, they usually include making an on-line transaction (such as organizing and paying bills), or getting involved or making contact with whoever owns the website (such as applying or subscribing to a commercial, academic or government website).

In an entertainment website, users' primary goal is to fulfill personal interests—to engage in particular activities for their enjoyment (*see figure 4.2*). They may play games, download music or video clips. However, some users may also have a secondary goal to use the website to access and search for information they need to support a primary goal or intended activity.

For a community website, based on Digital Knowledge Assets's (dka) research on communities, there are three main types: community of interest focusing primarily on ideas and information, community of practice following a process or making something together and community of transaction (markets) engaging in buying and selling. In a community of interest website, some users may have a primary goal to communicate with other people—to socialize, make connections or get in touch with others who share the same or similar interests. Other users may use the website to access information they need— to seek advice from people in the community in order to answer a specific inquiry or compare and make a decision about something. However, to achieve the main goal, they need to contact and communicate with people in the community who share the topic of interest. This becomes the users' secondary or

supporting goal. This scenario also applies to the community of practice website (*see figure 4.2*). In the community of transaction website, users' primary goal is to perform a specific task—to engage in buying and selling activities (*see figure 4.2*). However, similar to the commercial website, some users need to know specific information about the items for sale in order to compare and make decisions before making a transaction. As a result, users also need to access and search for the information they need from the website. This becomes the users' secondary or supporting goal.

Since users may employ several goals at the same time either simultaneously or sequentially, it is important for the websites to be aware of the differences in these user goals. Each website needs to position and demonstrate its characteristics clearly as an information-driven website, service-driven website, task or activity-driven website or a combination of these attributes. However, to be able to anticipate users' search behaviors properly, user goals need to be considered together with user modes of searching and different types of user models. These are discussed in the following sections.

USER MODES OF SEARCHING

Similar to user goal, users approach a website with different timeframe, context and situation. They also have different levels of determination or specification of what they need. Some users may know precisely what they need, while others may only have a vague idea. Since these different search modes help transform a particular user goal into various intentions, as well as influence user search strategies and search behaviors, it is necessary to recognize and distinguish their characteristics. A current study (Rosenfeld and Morville, 1998) has categorized users' different modes of searching as exploratory searching, existence searching, known-item searching and comprehensive searching. In the previous research paper (Sawasdichai, 2002), user modes of searching has been extended to include topical searching which falls between existence and know-item searching (*see figure 5*).

Based on Rosenfeld and Morville's model, user modes of searching are further investigated in this study in order to establish the classification of these searching modes. By considering the differences in users' needs and their characteristics, user modes of searching can be primarily differentiated by three substantial factors: 1) specification or determination of user needs, 2) urgency, 3) user contribution to the search task (*see figure 6*).

Websites	User primary goals	User secondary goals	Possible user intentions (what to do to acheive the goals, varied by user modes of searching)
Entertainment website	• **Engaging in an activity for personal enjoyment** (use website as an alternative means to fulfill personal interest)		• Seeking an interesting topic or activity, engage in the activity on-line • Seeking an interesting topic or activity, record or download for later use • Seeking an interesting topic or activity, engage in the activity on-line, and save to continue or re-visit later • Coming back or re-visit the interesting topic or the saved activity to continue playing or reviewing
Community website: Community of interest	• **Socializing, making connection or getting in touch with others who share the same or similar interests** (use website as an alternative communication channel)		• Seeking an interesting topic, and engage in chatting or sharing information
	• **Seeking advice, information** (use website as an alternative channel to access information) — to fulfill specific inquiry — to compare and / or make decision	• **Socializing, making connection or getting in touch with others who share the same or similar interests** (use website as an alternative communication channel)	• Seeking a specific topic or group of people who might be able to offer an advice, and engage in chatting or sharing information • Seeking needed information in the community database
Community website: Community of practice	• **Socializing, making connection, getting in touch or making something together with others who are in the same practice (may be following a process or event).** (use website as an alternative communication channel)		• Seeking for the interested topic, and engage in chatting or sharing information
	• **Seeking advice, information** (use website as an alternative channel to access information) — to fulfill specific inquiry — to compare and / or make decision	• **Socializing, making connection or getting in touch with others who share the same or similar interests** (use website as an alternative communication channel)	• Seeking a specific topic or group of people who might be able to offer advice and engage in chatting or sharing information • Seeking needed information in the community database
Community website: Community of transaction (market)	• **Engaging in a buying / selling activities** (use website as an alternative mean to perform specific tasks)	• **Seeking specific information about the merchandise / service** • **Comparing and/or making decision** (use website as an alternative channel to access information)	• Making transaction or engaging in buying / selling activity only (may be first time or routinely done) • Seeking information about an interesting item, then engaging in buying / selling activity • Seeking information about an interesting item, compare and make decision, then engage in buying / selling activity • Seeking information about an interesting item to compare and/or make decision, but engage in buying / selling activity somewhere else • Seeking information about an interesting item, record or save to compare and make decision later or for later use

FIGURE 4.2
Generic User Goals in Different Kinds of Website (continued)

Known-item searching	Comprehensive searching	Topical searching	Existence searching	Exploratory searching
Users know exactly or specifically what they want. The answer is definite. There is only one answer.	Users know exactly or specifically what they want. However, they want to know all relevant or related answers that stay within the intended boundary.	Users certainly know what they want quite specifically, but don't know the name or term to identify it correctly, or where it is likely to be found. The answers will be very limited to a certain boundary.	Users know what they want in general, but not specifically. They may have an abstract idea of what they want, but don't know if it exists. The answer can be varied and flexible, but limited or restrained within a certain boundary.	Users don't know exactly or specifically what they want. They have a vague idea of their needs. The answer will be varied and open-ended.

FIGURE 5
User Modes of Searching (Modified from the original classification by Rosenfeld and Morville, 1998)

The specification or determination of user needs may be distinguished as five sequential levels as follows:

Definitely conclusive

User needs are certainly determined. They know exactly or specifically what they want and look for a definite answer.

Expansively conclusive

User needs are conclusive. They know exactly or specifically what they want. However, they look for extensive answers. They want to know all relevant or related answers that stay within the intended boundary.

Specifically confined

User needs are well defined. They certainly know what they want quite specifically, but don't know the name or term to identify it correctly, or where it likely to be found. The answers can be varied, but will be very limited in a definite boundary.

Generally confined

User needs are generally defined. They know what they want in general, but not specifically. They may have an abstract idea of what they want, but don't know if it actually exists. The answer can be varied and flexible, but limited or restrained within a certain boundary.

Indistinct

User needs are vague and undetermined. They don't know exactly or specifically what they want. The answer will be varied and open-ended.

The urgency of user needs may be divided into three levels as follows:

Extreme

Urgency is extreme. They need to fulfill their goals immediately. They search for the expected answer and find the quickest way to complete their task.

Moderate

Urgency is moderate. They are working in a certain timeframe. In the beginning, they browse for various answers, experiment with methods or try other alternative ways to achieve their goals. Later, they search seriously in order to meet the expected timeframe.

None

There is no urgency. User goals can be fulfilled anytime, depending on their satisfaction. They explore for various answers, experiment with methods or try other ways to fulfill their goals. Their search ends when they feel satisfied with the results or answers they retrieve.

User contribution to search task can be constrained in terms of available time (both duration and frequency) and effort contributed (*see figure 6*). In terms of time, the user contribution may be divided into three levels as follows:

Long

Users are willing to spend a long period of time for searching.

Moderate

Users are willing to spend a reasonable period of time for searching.

Short

Users are willing to spend only a short period of time for searching.

In term of frequency, user contribution may be differentiated in three categories:

Several times

Users are willing to come back to search several times until their goals are completely met, or when they feel satisfied with the results.

Limited times

Users are willing to come back to search a limited number of times. They want their goals met as soon as possible.

Once

Users don't want to come back to search again.

Lastly, in term of user effort, user contribution falls into three levels:

Much

Users are willing to put much effort in their search. They persevere and don't give up easily, even when they experience trouble.

Moderate

Users are willing to put some effort in their search. They tend to persevere to find the expected answers, but only in a reasonable period of time.

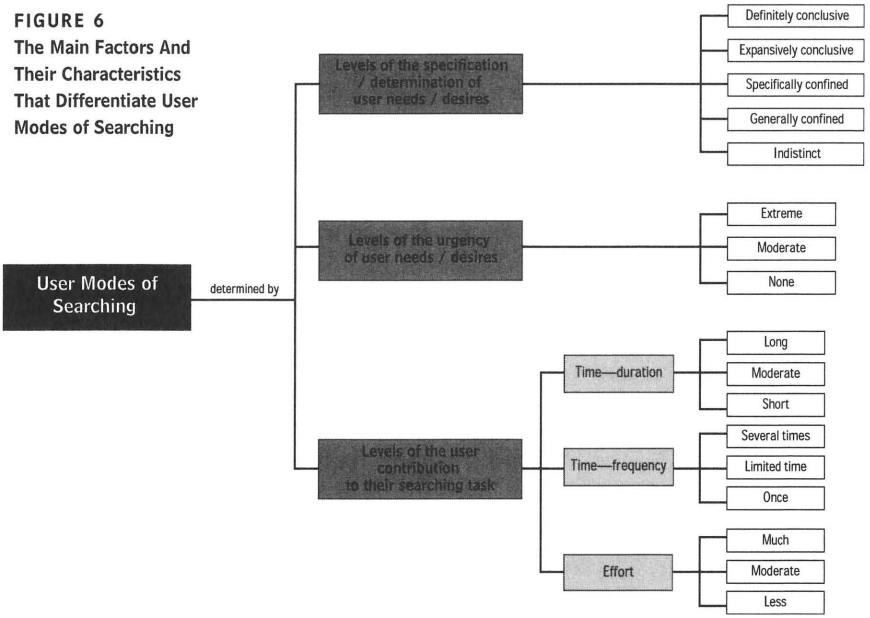
Less

Users are willing to put only a little effort in their search. They give up easily if they can't find what they want or feel unsatisfied or frustrated.

When considering all of these factors simultaneously, there are twelve categories of user searching modes identified from this cross-analysis. These categories include intensive, limited or extensive cases of known-item, comprehensive, topical, existence and exploratory searching respectively (*see figure 7*). Moreover from this cross-analysis, the levels of user contribution to their search (the third factor) generally illustrate the urgency of user needs. Users who arrive with urgency to fulfill their needs will spend only a short time for their search. Goals must be met within one search. If frustrated, they will leave the website, and instead try to find other ways to fulfill their goals.

Significantly, these modes of searching change from time-to-time depending on the situation that unfolds while users perform their search or upon the retrieval results they found. Generally, users move from general, open-ended modes to more specific and confined ones once they retrieve information that helps them to frame their search. Users who start from an open-ended mode need to find sufficient information to help them limit and refine their search; then they move up to a more confined mode before their goals can be completely reached. On the other hand, users who start from a confined mode can reach their goals more quickly since they already know what they are looking for; their search terrain is limited and well defined. As a result, users who arrive with an open-ended mode of searching usually spend more time for searching and collecting information than those who begin with a more confined mode.

FIGURE 6
The Main Factors And Their Characteristics That Differentiate User Modes of Searching



Furthermore, since user modes of searching influence how users determine their search strategies and methods when they move from one mode to another, their search strategies and search methods change accordingly. For example, users with a confined mode of searching, who know exactly what they want, normally perform their search in a particular domain and find that a simple alphabetical index can be a powerful search tool. On the contrary, those who have only a vague idea of what they are looking for usually prefer browsing through various categories and find the alphabetical index completely useless. Instead, a simple table of contents, systematically categorized, is more accessible and useful. Consequently, web developers can help ease users' search tasks by recognizing these factors and offering various search tools that are suitable to user modes, strategies and methods in order to increase search success.

Besides user goals and their modes of searching, users also approach a website with varied profiles including knowledge, skills, experience, backgrounds, capabilities, limitations, resources, roles, environments, attitudes, values, interests and needs, which lead to extensive variations in user search behavior—how they actually perform their search with different actions. Since these characteristic differences of users significantly influence how a particular user intention alternatively transforms into various courses of action (patterns of user search behaviors), it is important to understand and categorize these differences into distinctive types of user models. This will clarify user search behaviors. User models can be established based on user analysis data, including demographic, psychographic and technographic data, and then categorized into particular groups of users.

User demographic data may include the following categories: **1** user ethnic background and origin such as culture, country of origin and native language, **2** general knowledge, skill and experience such as education, ability to read a certain language, reading grade level and occupation, **3** physical capability and limitation such as gender, age and disability, **4** resource and economic status, **5** social role, **6** contextual and environmental surrounding such as region or country of residence.

Psychographic data may concern the following categories: **1** user response to external stimuli, **2** problem-solving skill, **3** learning skill, **4** memory, **5** emotion, **6** judgment, **7** concentration, **8** attention span, **9** effort, **10** motivation, **11** expectation, **12** attitude, **13** value, **14** interest.

Technographic data may involve the following categories: **1** computer/internet sophistication such as type of computer or speed of internet connection, **2** computer/internet literacy such as amount of time spent or frequency of use, **3** website interface familiarity such as first-time, return, or regular user, **4** task-specific skill and experience such as amount of time, frequency and method of acquiring skill and experience, **5** content/domain–specific knowledge and depth and breadth of the specific knowledge/skill and method of acquiring knowledge and skill.

Each of these user characteristics alters the process of website design differently. Some may provide major impact on the design during the process of identifying,

Specification / determination of user needs

Urgency of user needs

	Definitely conclusive	Expansively conclusive	Specifically confined	Generally confined	Indistinct	Contribution of user to search task
Extreme	**Intensive known-item searching** Users know exactly or specifically what they want. The answer is definite. There is only one answer. Users need to fulfill their goals immediately. They tend to search for an answer seriously. They try to find the quickest way to complete their tasks and achieve their goals. Users are willing to spend only short period of time, and want their goal to be met in one search. They tend to give up easily.	**Intensive comprehensive searching** Users know exactly or specifically what they want. However, they want to know all relevant or related answers that stay within the intended boundary. Users need to fulfill their goals immediately. They tend to search for an answer seriously. They try to find the quickest way to complete their tasks and achieve their goals. Users are willing to spend only short period of time, and want their goal to be met in one search. They tend to give up easily.	**Intensive topical searching** Users certainly know what they want quite specifically, but don't know the name or term to identify it correctly, or where it likely to be found. The answers will be very limited in a certain boundary. Users need to fulfill their goals immediately. They tend to search for an answer seriously. They try to find the quickest way to complete their tasks and achieve their goals. Users are willing to spend only short period of time, and want their goal to be met in one search. They tend to give up easily.	**Intensive existence searching** Users know what they want in general, but not specifically. They may have an abstract idea of what they want, but don't know if it exists. The answer can be varied and flexible, but limited or restrained within a certain boundary. Users need to fulfill their goals immediately. They tend to search for an answer seriously. They try to find the quickest way to complete their tasks and achieve their goals. Users are willing to spend only short period of time, and want their goal to be met in one search. They tend to give up easily.	**Intensive exploratory searching** Users don't know exactly or specifically what they want. They have a vague idea of their needs. The answer will be varied and open-ended. Users need to fulfill their goals immediately. They tend to search for an answer seriously. They try to find the quickest way to complete their tasks and achieve their goals. Users are willing to spend only short period of time, and want their goal to be met in one search. They tend to give up easily.	**Time : Short + Frequency : Once + Effort : Less**
Modera	**Limited known-item searching** Users know exactly or specifically what they want. The answer is definite. There is only one answer. Users need to fulfill their goals in a certain timeframe. In the beginning, they tend to browse for various answers, experiment with several methods, or may try other alternative ways to achieve their goals. Later, they will search more seriously in order to meet the timeframe. Users are willing to spend a reasonable period of time, or come back to search for a few times. They tend to persevere at reasonable level.	**Limited comprehensive searching** Users know exactly or specifically what they want. However, they want to know all relevant or related answers that stay within the intended boundary. Users need to fulfill their goals in a certain timeframe. In the beginning, they tend to browse for various answers, experiment with several methods, or may try other alternative ways to achieve their goals. Later, they will search more seriously in order to meet the timeframe. Users are willing to spend a reasonable period of time, or come back to search a few times. They tend to persevere at reasonable level.	**Limited topical searching** Users certainly know what they want quite specifically, but don't know the name or term to identify it correctly, or where it likely to be found. The answers will be very limited in a certain boundary. Users need to fulfill their goals in a certain time-frame. In the beginning, they tend to browse for various answers, experiment with several methods, or may try other alternative ways to achieve their goals. Later, they will search more seriously in order to meet the timeframe. Users are willing to spend a reasonable period of time, or come back to search for a few times. They tend to persevere at reasonable level.	**Limited existence searching** Users know what they want in general, but not specifically. They may have an abstract idea of what they want, but don't know if it exists. The answer can be varied and flexible, but limited or restrained within a certain boundary. Users need to fulfill their goals in a certain time-frame. In the beginning, they tend to browse for various answers, experiment with several methods, or may try other alternative ways to achieve their goals. Later, they will search more seriously in order to meet the timeframe. Users are willing to spend a reasonable period of time, or come back to search for a few times. They tend to persevere at reasonable level.	**Limited exploratory searching** Users don't know exactly or specifically what they want. They have a vague idea of their needs. The answer will be varied and open-ended. Users need to fulfill their goals in a certain timeframe. In the beginning, they tend to browse for various answers, experiment with several methods, or may try other alternative ways to achieve their goals. Later, they will search more seriously in order to meet the timeframe. Users are willing to spend a reasonable period of time, or come back to search for a few times. They tend to persevere at reasonable level.	**Time : Moderate + Frequency : Limited + Effort : Moderate**
None	**Extensive known-item searching** Users know exactly or specifically what they want. The answer is definite. There is only one answer. User goals can be fulfilled anytime, depend on their satisfaction. They tend to explore for various answers, experiment with several methods, or try other alternative ways to fulfill their goals. They will end their search when they feel satisfied. Users are willing to spend a long period of time, and may come back to search for several times. they tend to persevere and being persistent.	**Extensive comprehensive searching** Users know exactly or specifically what they want. However, they want to know all relevant or related answers that stay within the intended boundary. User goals can be fulfilled anytime, depend on their satisfaction. They tend to explore for various answers, experiment with several methods, or try other alternative ways to fulfill their goals. They will end their search when they feel satisfied. Users are willing to spend a long period of time, and may come back to search for several times. they tend to persevere and being persistent.	**Extensive topical searching** Users certainly know what they want quite specifically, but don't know the name or term to identify it correctly, or where it likely to be found. The answers will be very limited in a certain boundary. User goals can be fulfilled anytime, depend on their satisfaction. They tend to explore for various answers, experiment with several methods, or try other alternative ways to fulfill their goals. They will end their search when they feel satisfied. Users are willing to spend a long period of time, and may come back to search for several times. they tend to persevere and being persistent.	**Extensive existence searching** Users know what they want in general, but not specifically. They may have an abstract idea of what they want, but don't know if it exists. The answer can be varied and flexible, but limited or restrained within a certain boundary. User goals can be fulfilled anytime, depend on their satisfaction. They tend to explore for various answers, experiment with several methods, or try other alternative ways to fulfill their goals. They will end their search when they feel satisfied. Users are willing to spend a long period of time, and may come back to search for several times. they tend to persevere and being persistent.	**Extensive exploratory searching** Users don't know exactly or specifically what they want. They have a vague idea of their needs. The answer will be varied and open-ended. User goals can be fulfilled anytime, depend on their satisfaction. They tend to explore for various answers, experiment with several methods, or try other alternative ways to fulfill their goals. They will end their search when they feel satisfied. Users are willing to spend a long period of time, and may come back to search for several times. they tend to persevere and being persistent.	**Time : Long + Frequency : Several + Effort : Much**

FIGURE 7
The Classification of User Searching Modes

collecting, organizing and structuring information, while others may influence the process of formatting information, as well as determining the appearance—look and feel of a particular website (*see figure 8.1 and 8.2*).

However, to establish the classification of user models, this study particularly focuses on users' personal and prior knowledge, their skill and experience in the specific content or domain they are searching or their performance of intended tasks, their familiarity with a particular website interface, as well as their ability to operate a personal computer and use the internet. These categories are relatively new compared to other typical demographic and psychographic data. However, these areas provide the most impact on users' search behaviors and their success in searching and/or performing a task in web-based media. Based on users' demographic and technographic profiles, these categories can be defined as follows:

1. Users' knowledge and skill in the specific content or domain they are searching—concerned with different levels of users' prior knowledge and skill with the particular contents as well as their ability to understand terminology and classification generally used in that domain.
2. Users' skill and experience in the particular task they are performing—concerned with different levels of users' prior skill and experience in performing the intended task, either in the particular environment such as performing task on internet, or in other environments. This includes users' ability to transfer prior skill and experience to perform the same or similar task in the new setting.
3. Users' experience or familiarity with the particular website interface—concerned with different levels of users' experience with the interface of a particular website, including accuracy and details of users' cognitive map of website structure, which is built from users' prior experience in that particular environment.
4. Users' computer and internet literacy—concerned with different levels of users' general knowledge, skill, experience about computer and internet use, including their ability to operate a personal computer,

User characteristics	Classification approaches			Impact to design process			
	Demographic data	Psychographic data	Technographic data	Identifying and collecting information	Organizing and structuring information	Formatting information	Appearance, look and feel
Physical capabilities / limitation							
• Gender	●						●
• Age	●						●
• Disability	●			●	●	●	
General knowledge/skill							
• Education	●			●	●	●	
• Occupation	●			●		●	
• Ability to read certain language	●			●		●	
• Reading grade level	●			●	●	●	
Background/origin							
• Culture	●	●		●		●	●
• Country of origin	●			●		●	●
• Native language	●			●		●	●
Resource/lifestyle/environment							
• Country of residence	●			●		●	●
• Region	●			●		●	●
• Economic status	●						●
• Social role	●	●		●	●	●	
Task-specific skill/experience							
• Amount of time spent	●			●	●	●	
• Frequency of performing task	●			●	●	●	
• Method of acquiring knowledge	●			●	●	●	
Content/domain-specific knowledge/skill							
• Depth and breadth	●			●	●	●	
• Method of acquiring knowledge	●			●	●	●	

FIGURE 8.1 (top)
Types of User Characteristics and Their Different Impacts on Website Design Process

	Classification approaches			Impact to design process			
	Demographic data	Psychographic data	Technographic data	Identifying and collecting information	Organizing and structuring information	Formatting information	Appearance, look and feel
Response to external stimuli		●				●	●
Problem-solving skill		●			●		
Learning skill		●			●	●	
Memory		●			●	●	
Emotion		●					●
Judgement		●		●		●	●
Concentration		●			●	●	
Attention span		●			●	●	
Effort		●			●	●	
Motivation		●		●		●	●
Expectation		●		●	●	●	●
Interest		●		●			●
Attitude		●		●			●
Value		●		●			●
Computer sophistication							
• Type of computer used/owned			●		●	●	
• Type of internet connection			●		●	●	
Computer/internet literacy							
• Amount of time spent			●		●	●	
• Frequency of use			●		●	●	
• Method of acquiring knowledge			●		●	●	
Website interface familiarity							
• Amount of time spent at a time			●		●	●	
• Frequency of use			●		●	●	

FIGURE 8.2 (bottom)
Types of User Characteristics and Their Different Impacts on Website Design Process (continued)

connect and use internet, ability to perform their intended tasks via the internet, as well as ability to solve basic technical problems regarding computer or internet uses.

All of these categories should be taken into design consideration since they provide major impact on the processes of organizing, structuring and formatting information for a website (*see figure 8.1 and 8.2*). Especially the first two categories: users' knowledge/skill in specific content/domain and users' skill/experience in specific task performance, show considerable impact upon the processes of identifying and collecting information as well (*see figure 8.1*).

Users' knowledge and skill in specific content or domain divides into four levels:

Novice

Users have no prior knowledge about the particular content or domain they are searching. They are not familiar with terminology and classification generally used in the content.

Learner

Users have some prior knowledge about the content or domain they are searching. They may gain their knowledge and skill from previous reading or second-hand experience. They are at a basic level familiar with terminology and classification used in the content.

Advanced learner

Users have good prior knowledge of content or domain from first-hand experience and previous reading. They are familiar with terminology and classification used in the content.

Professional

Users have very good prior knowledge of content or domain from their education, occupation or practice, where they are properly educated or trained. They are very skilled in using the terminology and classification.

Users' skill and experience in performing a particular task, is usually related and in direct proportion to users' knowledge and skill in specific content or domain.

This divides into four levels as follows:

Novice

Users have no skill and experience with the task they need to perform. They don't know how to begin and are unable to perform the task efficiently.

Trainee

Users have some skill and experience with the task they need to perform. They may do it occasionally and can complete the task nicely.

Experienced trainee

Users have good skill and experience with the task they need to perform. They may often do it and can complete the task efficiently.

Professional

Users have very good prior skill and experience with the intended task they need to perform. They may perform regularly and are able to complete the task very efficiently.

Users' experience or familiarity with a particular website interface may be divided into three levels as follows:

First-time user

Users are unfamiliar with the system and website interface, which prevents them from navigating effectively. They don't know where to begin or what information resides in each menu or category.

Return user

Users are somewhat familiar with the system and website interface. They are able to navigate effectively. They are certain where to begin and generally know what information resides in different menus or categories.

Regular user

Users are well familiar with the system and website interface, which makes them navigate very effectively. They are certain where to begin and know very well what information resides in different menus or categories.

Users' computer and internet literacy may be divided into four levels as follows:

Novice

Users are unable to use computer and internet in any way. They know nothing regarding computer operation and internet use.

Beginner

Users are able to use the computer and internet at a basic level. They know how to operate a personal computer and use the internet in general. They may use the computer and internet occasionally.

Advanced user

Users are able to use computer and internet well. They know how to operate a personal computer and use the internet efficiently, or have much experience. They may use computer and internet quite often.

Expert

Users are able to use computer and internet very well. They are well informed about computer operation and internet use, or have extensive experience from proper training in their education, occupation or practice. They use the computer and internet regularly.

The first two categories: users' knowledge in specific content or domain and users' skill and experience in particular task, are both concerned with users' prior knowledge, skill and experience acquired over time, either through self development or proper training. They are usually related and demonstrate a direct proportion to one another. As a result, in this study, these two categories are considered together and are combined as one category when performing cross-analysis. Simultaneously considering all four selected categories of user characteristics, to their fullest extent, provides thirty different user models. These user models include first-time, return and regular users with different levels of knowledge, skill and experience in a particular domain, as well as different levels in computer and internet use (*see figure 9.1, 9.2 and 9.3*). However, novice users, those without computer and internet literacy, are not included in this study.

In a particular website design, only some of these models, considered by the website (client) as the intended audience, should be covered and thoughtfully investigated with regard to user goals and possible modes of searching. Some websites may implement a system that serves only one particular group of users, while others may want to include as many groups as possible. To determine which models of users should be included, the web developer needs to examine the website (client) intentions and the possible extent of the website. Significantly, the variations of user models covered in a website may change over time, when the website (client) decides to limit or expand its extent. If so, the user models need to be reconsidered as well.

APPLIED ANALYTIC FRAMEWORK: ANALYSIS AND SYNTHESIS

The analytic framework demonstrated earlier in this study (*see figure 3*) can be used to help systematically analyze several factors essential to website design, including users' generic goals, user modes of searching and user models. By using the proposed framework, these essential factors can be analyzed step-by-step to assist user intentions, user search strategies, user search methods, as well as user courses of actions. This analysis helps web developers to foresee problems that may occur in different cases. The framework can be further used to help synthesize the results from analysis in order to understand and summarize user needs and user search behaviors. This synthesis helps determine and present the appropriate kinds, formats and amount of information and functions needed to be included in a particular website based on different types of user models and cognitive factors.

To apply the proposed framework, the extent of a website needs to be defined clearly. This includes website (client) goals, expected or intended users (selected user models), user goals and user modes of searching. When analyzing these factors systematically, the analytic framework will help predict possible user intentions, search strategies, search methods, courses of action, as well as foreseeing different kinds of problems that may occur with various groups of users. Initially, user generic goals need to be clarified. Next, based on user goals, user intentions are drawn out in accordance with potential modes of searching. These illustrate what tasks users decide to do, based on their current modes of searching in order to achieve or come closer to their original goals. Additionally, user search strategies

User Models	with beginning level of computer and internet literacy	with advanced level in computer and internet literacy	with professional level in computer and internet literacy
Novice (knowledge/skill in the content and intended task) **First-time user** (familiarity in the particular website interface)	First-time user, totally unfamiliar with the interface Knows nothing about the content Has no skill or experience in the intended task Knows something and has some experience with computer or internet—occasional use	First-time user, totally unfamiliar with the interface Knows nothing about the content Has no skill or experience in the intended task Knows a lot of things and has good experience with computer or internet—often use	First-time user, totally unfamiliar with the interface Knows nothing about the content Has no skill or experience in the intended task Knows very well and has extensive experience from training in education or occupation—regular use
Learner (knowledge/skill in the content and intended task) **First-time user** (familiarity in the particular website interface)	First-time user, totally unfamiliar with the interface Knows the content from reading, story telling or second-hand experience Has some skill or experience in the intended task—occasional performing Knows something and has some experience with computer or internet—occasional use	First-time user, totally unfamiliar with the interface Knows the content from reading, story telling or second-hand experience Has some skill or experience in the intended task—occasional performing Knows a lot of things and has good experience with computer or internet—often use	First-time user, totally unfamiliar with the interface Knows the content from reading, story telling or second-hand experience Has some skill or experience in the intended task—occasional performing Knows very well and has extensive experience from training in education or occupation—regular use
Advanced learner (knowledge/skill in the content and intended task) **First-time user** (familiarity in the particular website interface)	First-time user, totally unfamiliar with the interface Knows the content well from reading and first-hand experience Has good skill or experience in the same task—often performing Knows something and has some experience with computer or internet—occasional use	First-time user, totally unfamiliar with the interface Knows the content well from reading and first-hand experience Has good skill or experience in the same task—often performing Knows a lot of things and has good experience with computer or internet—often use	First-time user, totally unfamiliar with the interface Knows the content well from reading and first-hand experience Has good skill or experience in the same task—often performing Knows very well and has extensive experience from training in education or occupation—regular use
Professional (knowledge/skill in the content and intended task) **First-time user** (familiarity in the particular website interface)	First-time user, totally unfamiliar with the interface Knows the content very well from education or occupation Has very good skill or experience in the intended task from training in education or occupation—regular performing Knows something and has some experience with computer or internet—occasional use	First-time user, totally unfamiliar with the interface Knows the content very well from education or occupation Has very good skill or experience in the intended task from training in education or occupation—regular performing Knows a lot of things and has good experience with computer or internet—often use	First-time user, totally unfamiliar with the interface Knows the content very well from education or occupation Has very good skill or experience in the intended task from training in education or occupation—regular performing Knows very well and has extensive experience from training in education or occupation—regular use

FIGURE 9.1
Thirty Categories of User Models Emerged from Cross-Analysis of Users' Characteristic Differences

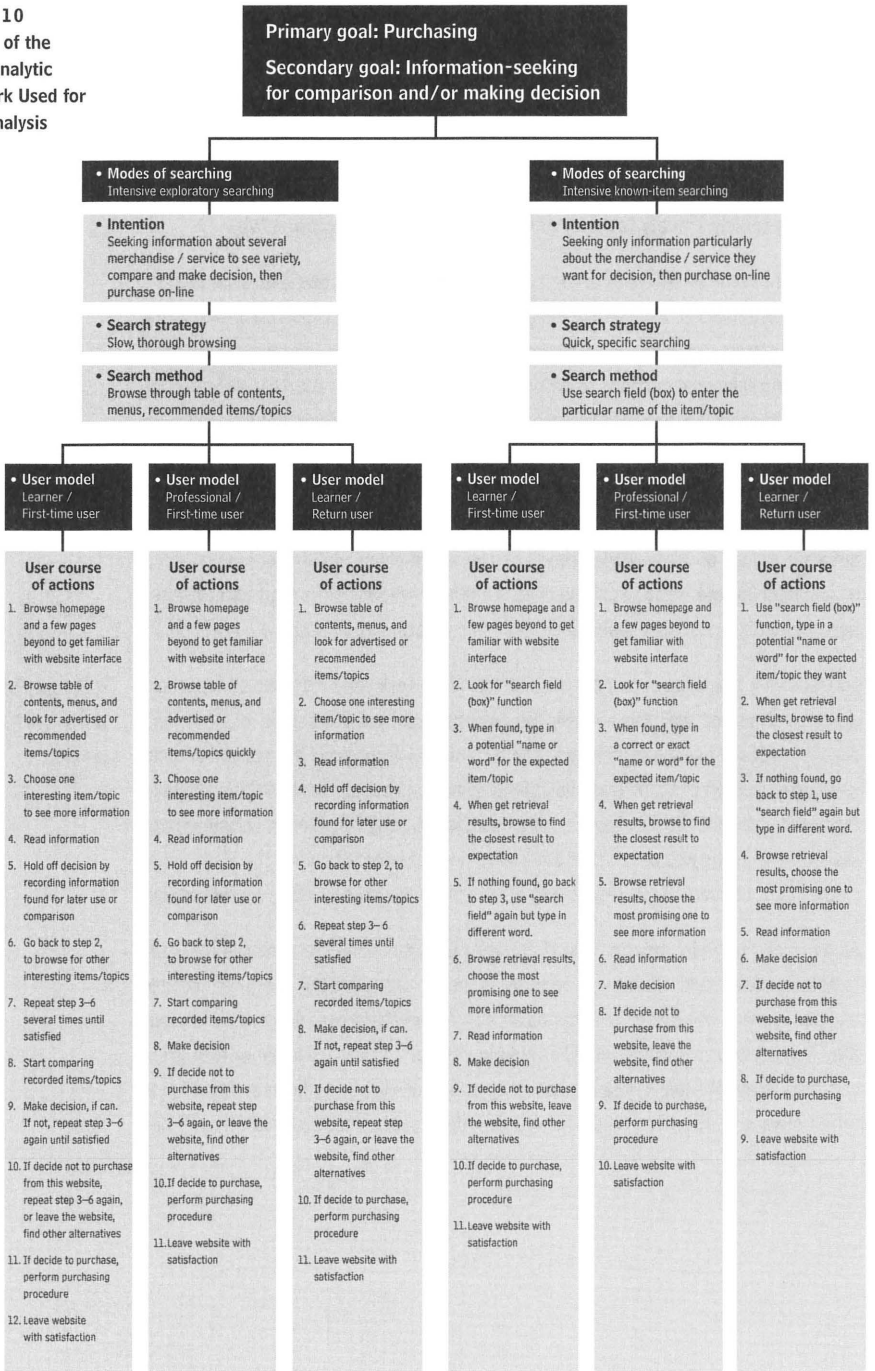
User Models	with beginning level of computer and internet literacy	with advanced level in computer and internet literacy	with professional level in computer and internet literacy
Learner (knowledge/skill in the content and intended task) **Return user** (familiarity in the particular website interface)	Return user, somewhat familiar with the interface Knows the content from reading, story telling or second-hand experience Has some skill or experience in the intended task—occasional performing Knows something and has some experience with computer or internet—occasional use	Return user, somewhat familiar with the interface Knows the content from reading, story telling or second-hand experience Has some skill or experience in the intended task—occasional performing Knows a lot of things and has good experience with computer or internet—often use	Return user, somewhat familiar with the interface Knows the content from reading, story telling or second-hand experience Has some skill or experience in the intended task—occasional performing Knows very well and has extensive experience from training in education or occupation—regular use
Advanced learner (knowledge/skill in the content and intended task) **Return user** (familiarity in the particular website interface)	Return user, somewhat familiar with the interface Knows the content well from reading and first-hand experience Has good skill or experience in the same task—often performing Knows something and has some experience with computer or internet—occasional use	Return user, somewhat familiar with the interface Knows the content well from reading and first-hand experience Has good skill or experience in the same task—often performing Knows a lot of things and has good experience with computer or internet—often use	Return user, somewhat familiar with the interface Knows the content well from reading and first-hand experience Has good skill or experience in the same task—often performing Knows very well and has extensive experience from training in education or occupation—regular use
Professional (knowledge/skill in the content and intended task) **Return user** (familiarity in the particular website interface)	Return user, somewhat familiar with the interface Knows the content very well from education or occupation Has very good skill or experience in the intended task from training in education or occupation—regular performing Knows something and has some experience with computer or internet—occasional use	Return user, somewhat familiar with the interface Knows the content very well from education or occupation Has very good skill or experience in the intended task from training in education or occupation—regular performing Knows a lot of things and has good experience with computer or internet—often use	Return user, somewhat familiar with the interface Knows the content very well from education or occupation Has very good skill or experience in the intended task from training in education or occupation—regular performing Knows very well and has extensive experience from training in education or occupation—regular use

FIGURE 9.2
Thirty Categories of User Models Emerged from Cross-Analysis of Users' Characteristic Differences (continued)

User Models	with beginning level of computer and internet literacy	with advanced level in computer and internet literacy	with professional level in computer and internet literacy
Learner (knowledge/skill in the content and intended task) **Regular user** (familiarity in the particular website interface)	Regular user, well familiar with the interface Knows the content from reading, story telling or second-hand experience Has some skill or experience in the intended task—occasional performing Knows something and has some experience with computer or internet—occasional use	Regular user, well familiar with the interface Knows the content from reading, story telling or second-hand experience Has some skill or experience in the intended task—occasional performing Knows a lot of things and has good experience with computer or internet—often use	Regular user, well familiar with the interface Knows the content from reading, story telling or second-hand experience Has some skill or experience in the intended task—occasional performing Knows very well and has extensive experience from training in education or occupation—regular use
Advanced learner (knowledge/skill in the content and intended task) **Regular user** (familiarity in the particular website interface)	Regular user, well familiar with the interface Knows the content well from reading and first-hand experience Has good skill or experience in the same task—often performing Knows something and has some experience with computer or internet—occasional use	Regular user, well familiar with the interface Knows the content well from reading and first-hand experience Has good skill or experience in the same task—often performing Knows a lot of things and has good experience with computer or internet—often use	Regular user, well familiar with the interface Knows the content well from reading and first-hand experience Has good skill or experience in the same task—often performing Knows very well and has extensive experience from training in education or occupation—regular use
Professional (knowledge/skill in the content and intended task) **Regular user** (familiarity in the particular website interface)	Regular user, well familiar with the interface Knows the content very well from education or occupation Has very good skill or experience in the intended task from training in education or occupation—regular performing Knows something and has some experience with computer or internet—occasional use	Regular user, well familiar with the interface Knows the content very well from education or occupation Has very good skill or experience in the intended task from training in education or occupation—regular performing Knows a lot of things and has good experience with computer or internet—often use	Regular user, well familiar with the interface Knows the content very well from education or occupation Has very good skill or experience in the intended task from training in education or occupation—regular performing Knows very well and has extensive experience from training in education or occupation—regular use

FIGURE 9.3
Thirty Categories of User Models Emerged from Cross-Analysis of Users' Characteristic Differences (continued)

FIGURE 10
Examples of the Applied Analytic Framework Used for Design Analysis



and methods can be defined based on their search mode. After user intentions, search strategies and methods are identified, user course of action (detailed task descriptions) is described according to various kinds of user model. Besides the differences in search mode, users also arrive with different levels in knowledge, skill and experience. As a result, each group of users will refine their search and perform tasks differently. The traditional task analysis method can be applied at this stage to help identify tasks by different user groups (*see figure 10*).

The results from the analysis can be synthesized to help understand user needs, the main characteristics of their search behavior, time spent, and problems they experience. Different patterns of user course of action are considered with user intentions, user search strategies and methods to uncover major differences in search characteristics and search problems among various groups of users. Accordingly, the synthesis can help determine the kinds, formats and amount of information, as well as the features or functions that should be present on a particular website to help users complete their tasks more successfully. Some information and functions may be shared among different groups of users, while others may be specifically helpful to only a particular group. Appropriate functions, as well as a suitable amount of formatted information compatible with user tasks and needs are identified (*see figure 11.1 and 11.2*).

CONCLUSION AND FURTHER STUDY

The following examples show how the analytic framework can be applied as a part of a design analysis and synthesis process. The analysis helps web developers to understand different types of users and their cognitive factors, and accordingly assist them to anticipate user courses of action (task descriptions) more precisely since all the cognitive factors that regulate user behaviors have been deliberately considered. Consequently, the synthesis helps web developers determine kinds of information and function needed by the intended users. These results help in both planning and evaluating website design.

As more and more information and task-performing functions are available for users to access, search and use through web-based media, users become more comfortable and confident to use these websites as an alternative channel to access information they need, perform specific tasks, or simply use for personal enjoyment. Search capability in a website becomes increasingly essential. However, the search functions aren't always sufficient to help users realize their goals. These problems can't be

FIGURE 11.1
Examples of the Applied Analytic Framework Used for Design Synthesis

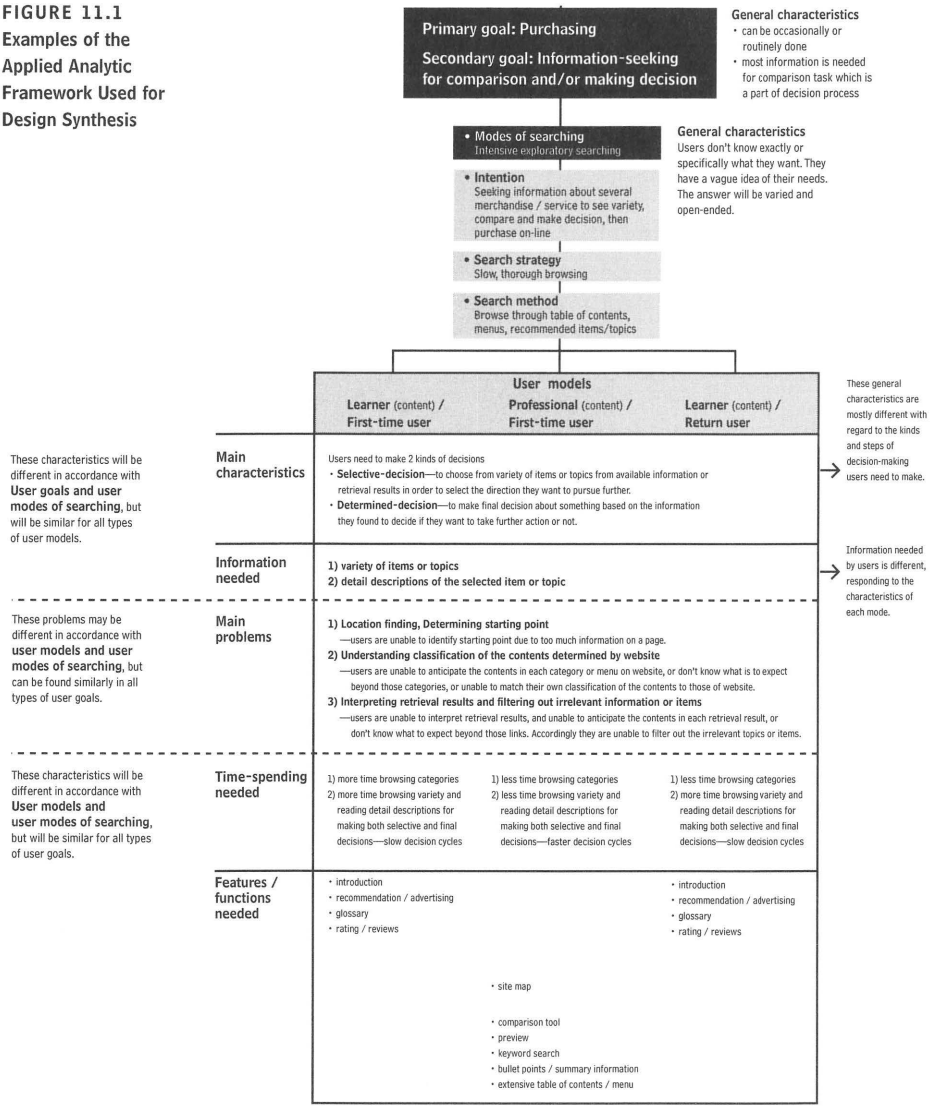
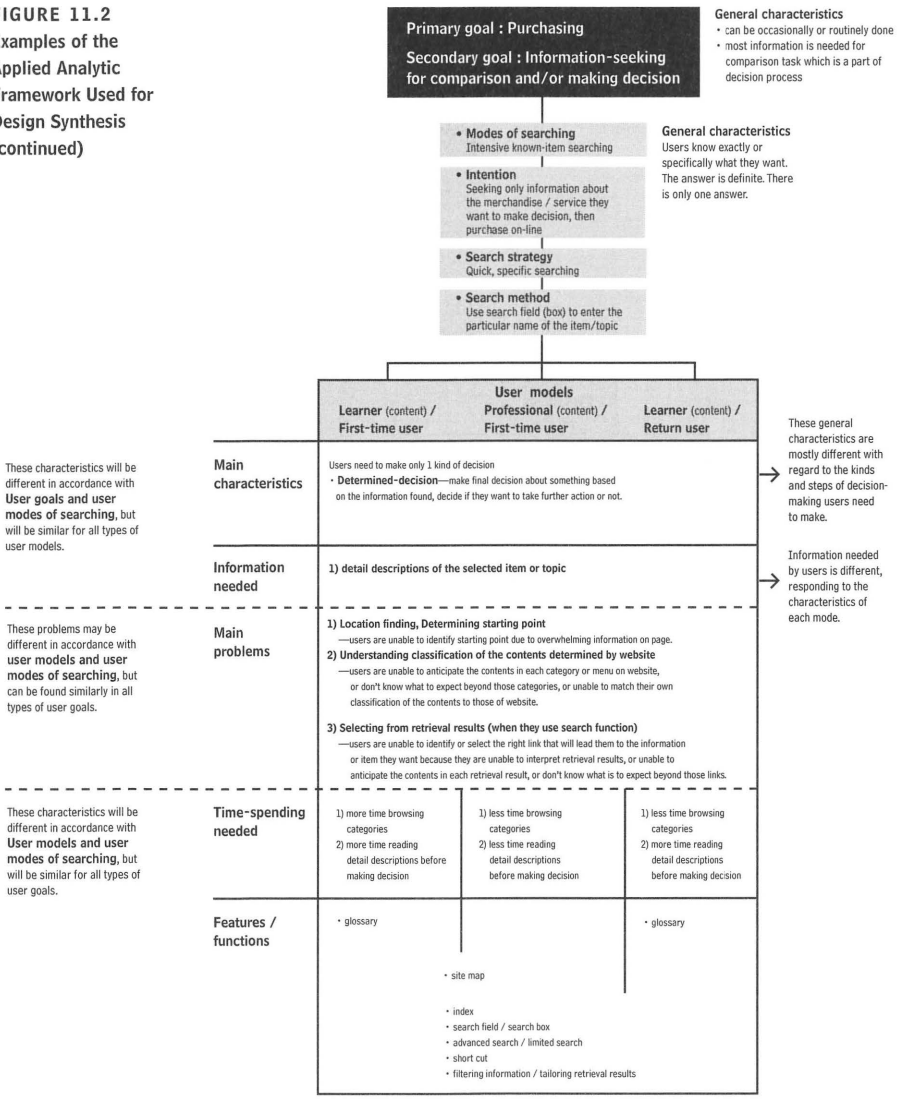


FIGURE 11.2
Examples of the Applied Analytic Framework Used for Design Synthesis (continued)



solved by the development of search engines alone. User search behavior needs to be understood at both the physical and cognitive level. User cognitive factors, especially, should receive more attention in the earliest stage of design since they are substantial factors that regulate how users behave physically. These cognitive factors can be systematically analyzed and synthesized by applying the analytic framework in order to understand the mechanisms that regulate or underlie user needs, user tasks and their search behaviors. By anticipating user action, both information delivery and appropriate functions can be better identified and planned for. However, to gain a more profound understanding of user search behaviors, certain cognitive factors including, user modes of searching, user search strategies and search methods need further investigation at a finer level of granularity in order to identify relationships, establish classification and create working systems.

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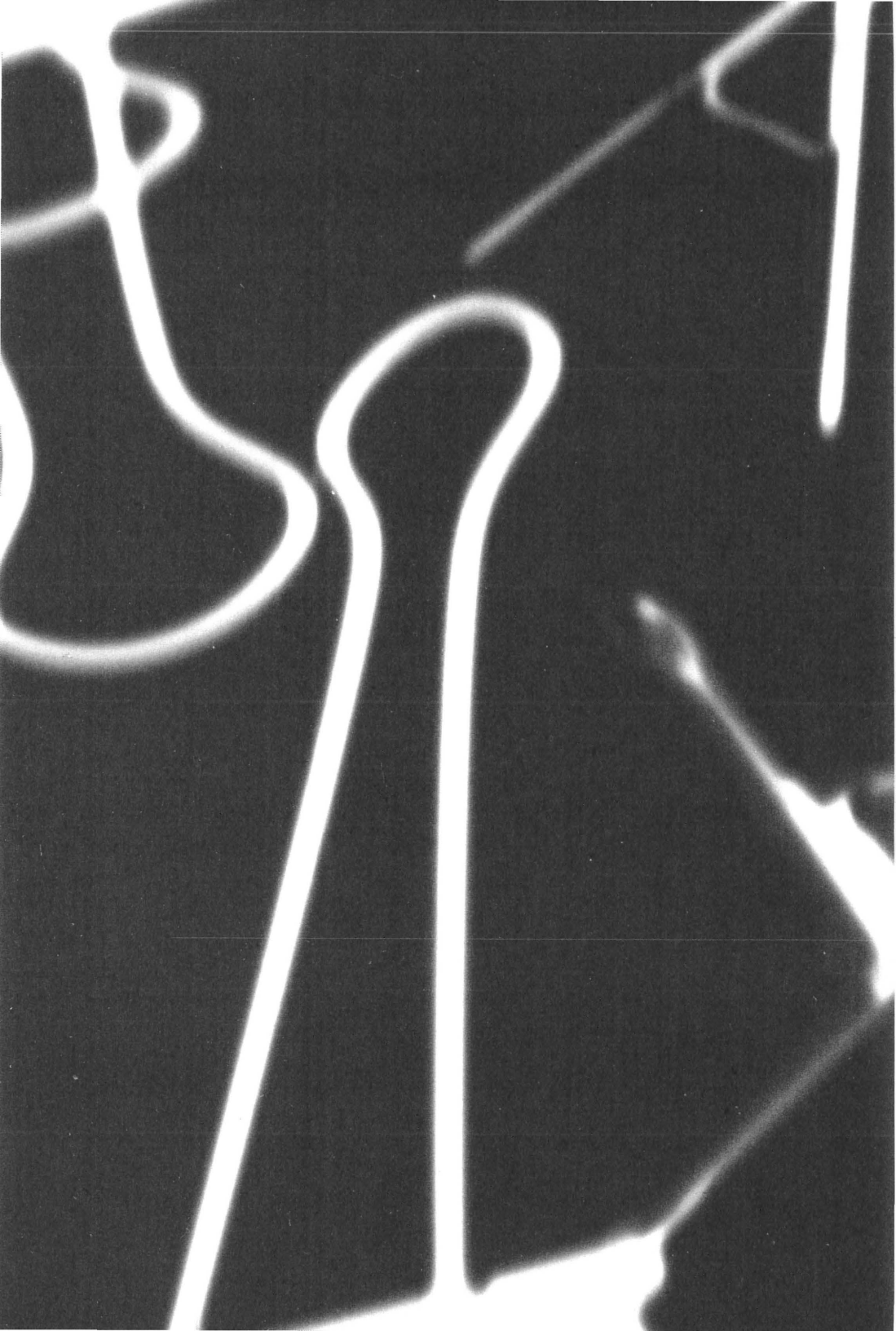

Get **REAL**

The Need for Effective Design Research

Christopher Nemeth

Designers use intuition in order to envision possibilities. In that strength also lies a weakness: a disinclination to account for what exists in reality. That prevents design from evolving into the powerful role that it could otherwise be. Learning about reality requires the tools that are necessary to perform research such as theory and methods. Research tools are essential in order to support an opinion or position, to build design solutions in technically challenging application areas, or to advance design as a leadership role instead of a support role. Better understanding and use of research would enable the designer to evolve from craft-bound artisan toward professional. This essay addresses recent influences on design practice, the opportunity for design to evolve in a professional direction and the methods that will support that evolution.

DESIGN PRACTICE

Herbert Simon (1998:4, 111–4) contends that "the engineer, and more generally the designer, is concerned with the way things ought to be—how they ought to be in order to attain goals and to function." For Simon, the designer takes action to "change existing situations into preferred ones" by "devising artifacts to attain those goals." The term "designer" represents the disciplines that work to create and develop new systems and products for human use. Traditionally, that includes architects and space planners, urban planners, product (industrial) designers, communication (graphic, information) designers and environmental designers. In recent decades, software interface designers and software architects and fashion and interior designers who deal with functional issues have assumed a design role.

Addressing each one of these design disciplines would result in a book, not an essay. Instead, this essay will use one discipline as an example: communication design. The role of communication design stems from the human need to negotiate between our inner self and the outer (natural) environment. (Simon, 1996:5–6) It is a natural extension of the human need to make sense of the world. In this context, communication design is the practice of visualization in order to inform and/or persuade. The communications designer detects and demonstrates patterns, making the implicit or abstract evident. Table 1 summarizes the kinds of knowledge that comprise communication design. The examples that it contains are not intended to be exhaustive. Rather, they demonstrate the relationships among theory, knowledge and skill.

Philosophy

Philosophy informs design practice by framing views of reality and the human role in it. Semiotics, the understanding of reality through perceptions, is one of many philosophical approaches. Designers structure properties in order to send messages, using hierarchies

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Nemeth, 93–109

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(taxonomies) in order to organize them into purposeful wholes.

Social Sciences

Anthropology and sociology provide theories of culture and society. Methods such as fieldwork make it possible for the designer to learn about both through observation.

Human Factors

Designers rely on human factors knowledge about human limits and abilities, primarily in visual sensation and perception and in cognition (e.g., learning, decision-making and memory). Designers can employ methods such as flow analysis to decompose, analyze and experiment with new models of complex environments.

Design

As there is no current body of knowledge that represents design theory, the theory section in the design column contains no examples. Designers use visualization as a means to embody possibilities by creating physical models.

Management

Through management, the designer leads project teams that include vendors who can be monitored through quality assurance and control methods in order to achieve optimal results. The designer also relies on management skills to develop business relationships and to compete.

As an applied artist, the designer accepts the responsibility for solutions to work, but on what basis? The norms of a discipline are developed and taught through education. Design's apprenticeship tradition relies on formal or informal mentoring programs among groups in order to "become proficient in standard techniques that involve motor-physical coordination" (Byrne and Sands 2002: unpaged). As a result, design education does not provide students with theories, methods or the tools to collect, analyze, interpret or apply data. Donald Norman (2002:41) contends that many designers and design schools cannot distinguish prettiness from usefulness and as a result practice 'facade design' to 'make things pleasant.'

Design has been assimilated into university curricula comparatively recently through a variety of routes that include art programs, architecture schools and technical colleges. This has led to the 'strange ground' of design being "anchored in a range of trades or vocations or

Communication Design Knowledge

Communication design is comprised of four knowledge areas: philosophy, juman factors, design and management. The examples that are shown are not intended to be exhaustive. Rather, they demonstrate the relationships among theory, knowledge and skill. Of the four knowledge areas, only design lacks theories to drive its methods and skills. The practice of design research will be one of the factors that enables design theory to evolve by creating what (Byrne 2001: unpaged) calls "generalizable, publicly examinable forms of knowledge about design..."

	Theory	Method	Skill
Philosophy	semiotics	taxonomic development	organization
Human Factors	perception, cognition	flow analysis	experimentation
Social Sciences	culture, society	field work	observation
Design		ideation	visualization
Management	leadership	quality assurance, quality control	planning, outcome assessment

TABLE 1
Communication Design Knowledge

crafts" while simultaneously being a "contemporary field growing within the university" (Friedman, 2000:8). Because of this brief tenure in academia, disagreement reigns "on whether the practice of design constitutes a trade, a vocation, an art, or a discipline" (Friedman 2002a:unpaged). Evidence indicates that "scientists problem solve by analysis whereas designers problem solve by synthesis; scientists use 'problem-focused strategies' and designers use 'solution focused strategies'" (Cross 2000:24). Managers and technical practitioners such as engineers rely on data to make such decisions. Designers, on the other hand, tend to use subjective judgment in order to determine success. Professional design presentations tend to describe case studies instead of objective principles that can be used in order to improve design practice. These traits have led other technical disciplines to perceive designers as creative artisans, but hardly as professionals.

The basis for communication design to add value has changed in the past twenty years. New electronic media have also popularized the skills that designers once considered their exclusive turf. Personal computers now enable any individual who has the right software to create the products of visual design. Design's traditional claim to form giving has now become a commodity and no longer serves as the standard for success in design. Emphasis has shifted to other issues. For example, Edward Tufte (2001) sets the standard of web page success at whether the layout has eighty percent or more content, not on its visual form.

More complex concepts such as interactive software require designers to cultivate the ability to analyze a problem, to develop a solution direction and to evaluate how well the solution solves the problem. Nemeth (2003) accounts for impediments to problem solving that all disciplines face, both as individuals (failure and lack of expertise, fixation, set and motivation, confirmation bias, availability and conjunction) and organizations (role in the project, culture, characteristics of problems, events, installed base of product and resources).

Design practice is also hemmed-in by practical constraints.

> Time is allotted according to what is cost-effective, not according to the character and scope of a problem. If there is money, research can be done. If the money is inadequate for research it is not performed, however important the questions are.

> Designers respond to client guidance. A talented designer will challenge client conditions but will rarely run counter to them. Client guidance is subject to competitive pressures. As a result, design activity tends to be market-driven. The challenge for the conscientious designer is to perform research at a level that is appropriate to the problem, yet to still fit within client and commercial constraints.

> Designers are rewarded more for performance that is related to form and style rather than substance. This leads design attention away from significant problems, which are often complex and require a substantial amount of time and patience to understand them.

Design must change or risk being co-opted by other disciplines. How can design practice evolve into the role that new media and opportunities call for? How will communication design add value?

NEEDED CHANGE

As a practice, design can be assessed along five considerations: language, process, role, applications and tools.

Language

Those who insist that design deserves to be a peer among other professions such as medicine and law have it backwards. A discipline does not become valued through its own practitioners' insistence. Rather, it becomes valued by others who find that it meets needs that other practices do not offer, or do not offer as well. The value of a discipline needs to be expressed in terms that others can understand. Among Howard Gardner's (1983: 60–235) seven intelligences, designers tend to rely on spatial intelligence. However, other technical staff members tend to rely on logical-mathematical intelligence and management favors lingustic and logical-mathematical intelligences.

Design practitioners need to learn verbal and the numerical languages in order to speak the language of other professions and to demonstrate the value of design. Both design and engineering practitioners need to cultivate verbal language in order to demonstrate the meaning and use of their analyses and solutions.

Process

Each design discipline uses objective knowledge in combination with subjective intuition in order to engage and solve a problem. The amount and depth of that objective knowledge can be insufficient to understand the problem. Design's heuristic solution-based approach may be the best way to approach ill-defined problems. However, seeing what might work is not enough to form the basis for a profession. Design practice will need to cultivate an aptitude for thorough, objective inquiry as well.

Role

The separation of activities in research and development is blurred when the designer in a sole practice or small group is required to take on additional roles such as human factors/ergonomic specialist. This does not make the designer an ergonomist, any more than it makes an ergonomist who builds a mock-up a designer. What it does require is that the designer become as capable with investigation and evaluation as with visualization.

Applications

Traditionally, those who were known as graphic designers have created informational products such as books, posters, handbills, packaging and signage. They also developed insignia, logotypes and programs for organizational identity. More recently, graphic design has become known as communication design as electronic applications including computer software user interfaces, compact disks (CD) and the Worldwide Web have opened new opportunities. Control interfaces for appliances and equipment also present opportunities. Their creation requires an understanding of user behavior and original problem solving that have previously been the province of other disciplines such as the social sciences. Designers need substantial knowledge about human performance, particularly in the realm of perception and cognition, to meet the challenge that these new media present.

Tools

A Harvard Business School (Harvard Business Review 1994:10) study found that "Despite the billions spent on research, development and marketing, the failure rate of high tech products is staggering." Among high technology products, interactive information systems have existed for decades and designers have participated in

their development. Has this design attention resulted in better systems? Apparently not. Instead of improving work practices, many information systems that were meant to improve on manual processes have actually impoverished them. For example, McGovern and Norton (2001) contend that most web sites overlook essential considerations such as usability and legibility in a mistaken zest for freedom of content. As a further example, the United Kingdom National Health Service's Value-Added Medical Products (VAMP) is one among many information systems that have failed in recent years. Information systems are not the only instance.

There appear to be three reasons for the demise. The first reason is designers' disregard for those whom they studied, treating "the general practitioner, the user, as a judgmental, or cultural, dope." Second, designers pay only 'cursory attention to circumstances.' Human-computer interface (HCI) designers 'misconceive the user' by oversimplifying what actually occurs in the daily work environment (Heath and Luff 2000: 10–11,59). Third, the mental models and methods they use are not suited to understand the complexity and sophistication of collaborative work.

Sociologist Lucy Suchman (1987:178–89, 2001: unpaged) agrees, criticizing the traditional notion that people act in predetermined goal-directed ways. Human behavior is far more complex, sophisticated, nuanced and fluid than designers understand. Systems that are intended for human use should reflect human sophistication and complexity. This requires models of design thought that are sophisticated and sensitive enough to understand human behavior. Other fields have already taken up this cause. For example, sociologists have recently developed workplace studies as a way to better observe and understand human behavior and to ensure that design is grounded in reality.

The transition to better design research starts with understanding what separates practice from profession and the role that research plays.

PROFESSION VERSUS TRADE

It is not unusual to hear designers and design students express a desire for their role to be considered as a profession (apparently presuming that a professional is held in higher

esteem and earns more). What makes a trade different from a profession? By contrast with Byrne and Sands' earlier definition of a trade, the learned professions such as medicine, law, business and engineering are grounded in what Donald Schön (1983:21–4, 308–25) calls "systematic fundamental knowledge, of which scientific knowledge is the prototype." Schön considers the knowledge of a profession to be "specialized, firmly bounded, scientific, and standardized." So, design currently falls short of Schön's definition of profession. However, Schön does offer four approaches for practitioners who are not bound in science to function at the professional level: frame analysis, repertoire building research, research on fundamental methods of inquiry and overarching theories and research on the process of reflection in action. Each offers a way to think about design thinking: an epistemology of reflective practice. For each of these four approaches, Schön contends that "reflective research requires a partnership of practitioner-researchers and researcher-practitioners." How can design develop the researcher half of these two dyads? Design research offers a promising direction.

DESIGN RESEARCH

"Research is a systematic investigation (including development, testing and evaluation) designed to discover or contribute to a body of general knowledge" (National Institutes of Health 2002). Through inquiry the researcher seeks to learn about reality, which does not yield answers easily (Blumer 1969:22–3). Research can be basic (a search for general principles), applied (adapting general findings to classes of problems) or clinical (related to specific cases). Most design research is clinical, because time and budget allow for little else (Friedman 2000:18).

There is no single best way to do design research. Instead, it takes a range of research approaches to learn what one needs to know about reality. For example, some rely on focus groups. Others consider ethnographic studies to be the sum of design research. Heath and Luff (2000:246) are among many authors who disagree, countering that the relationship between ethnographic studies and design 'remains problematic' due to significant differences between the agendas, philosophies, thought processes and methods of naturalistic researchers and of designers.

Design research methods are not design methods. Design methods are procedures that are used to assist idea generation. For example, morphological analysis is a design method that is used to combine vari-

ous options into solution possibilities. By contrast, design research is a deliberate process of inquiry in order to discover and interpret new knowledge. To conduct that inquiry the designer needs to use methods in order to collect, to interpret and to apply knowledge on human performance as well as to understand how artifacts effect performance. Design research, then, is the means to combine both design visualization and methodical inquiry throughout the concept development process.

Nemeth (2003) inventories five groups of methods that designers can use to ground their work in reality: analysis, design guidance, evaluation, self-reporting and simple experimentation.

> Analysis methods are used to collect information on the problem as it is given in order to create a new grasp of the problem as it is understood.

> Design Guidance methods are used to translate knowledge that was garnered during analysis in order to model existing conditions or prospective concepts.

> Through Evaluation methods, the designer can assess circumstances that already exist or solutions that are under development. Usability assessment is a popular means to evaluate new concept simulations.

> Questionnaires and interviews can be used to elicit qualitative responses of individuals or groups to current conditions or proposed concepts.

> Experimentation is the infrequent but sometimes necessary practice of creating and controlling circumstances to collect specific kinds of information in order to determine cause and effect.

Figure 1 shows how design research methods can be used to investigate and evaluate in parallel with design methods. The interaction between analysis and synthesis occurs from initial analysis, through prototype development, to final solution model, to finished product, then implementation and use. As the process unfolds, new knowledge and new methods are used to develop a notion into a concept and then into an artifact. Investigation provides the basis to develop a design direction at each stage as a concept evolves. It informs design problem definition and ideation. Evaluation provides the means to determine the fit between the concept and the real

world at each stage of evolution. It informs design implementation and idea selection.

Exploration

During exploration, both the problem and its solution are unknown. Analysis methods such as Analysis of Similar Systems enable the investigator to assess how others have approached the problem. Workplace studies can be used to understand how individuals and teams have crafted the circumstances of their work environment. Exploratory usability assessment can be used to discover how subjects respond to concepts.

Definition, verification

During definition the problem is known but the solution is not. Usability assessment can be used to find out how subjects' performance is effected by using a new concept. During verification, a solution has been created but the means of production are yet to be specified. During verification, validation usability assessment can be used to collect data on subjects using pre-release versions of a product (Rubin 1994). In both stages, analysis methods such as Workload Assessment can be employed to learn how those who are using a product can handle the work that they need to accomplish.

Use of these methods opens the way to ground design work in reality. For those who already work in interdisciplinary teams that perform rigorous research, some of these steps will sound familiar.

Develop an original line of inquiry

Identify the problem and components. Define it in a broader context outside of the specific case. Choose the appropriate methods to answer pertinent questions. Qualify and explain the methods' strengths, limitations and value in the research.

Account for the work of others

Thoroughly review and analyze publications by others in design and other fields who have already done work in an area of interest. Determine what has already been accomplished and what work would break new ground.

Develop prospective solution models

Create study models in order to simulate new concepts.

The Design Research Process

The research and development process follows a pattern regardless of application area. Traditionally, designers have used visualization techniques at each stage of concept development to envision possibilities. Designers also rely on both investigation and evaluation in order to create concepts. Incorporation of both into design practice holds the promise for a number of benefits. It could improve the designer's grasp of actual problems, verify how well human subjects perform using solution concepts, and build a stronger position for design as a practice. (Source: Adapted from Nemeth, in press)

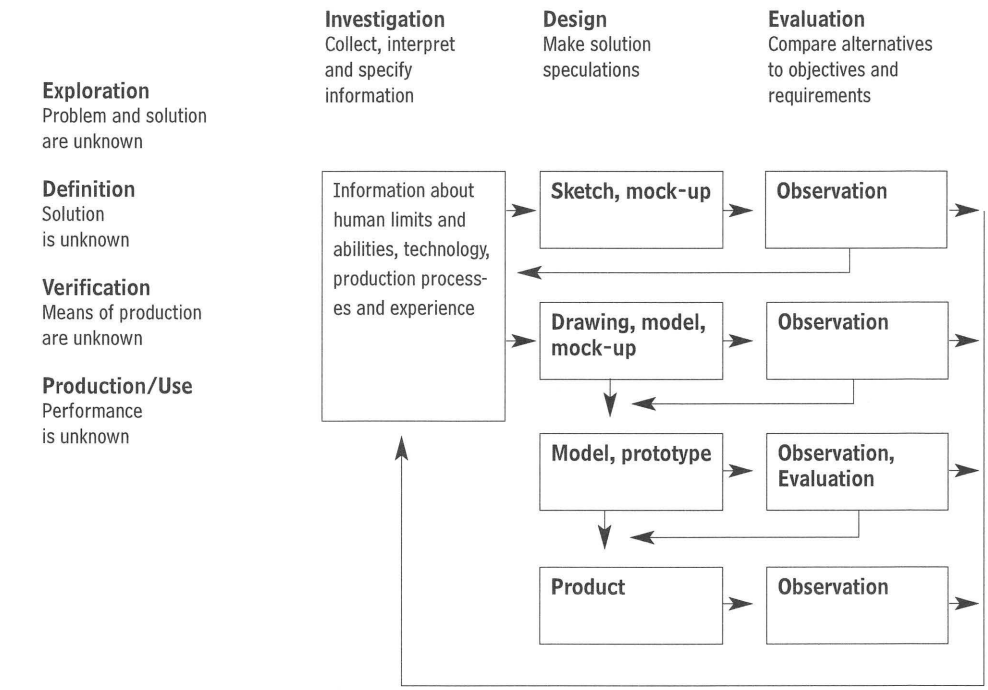

FIGURE 1
The Design Research Process

Collect original observations and data

Observe human subjects who are performing activities that are part of the problem under study. Spend enough time and effort to understand and reliably analyze what is observed. Explore the use of early concept models with human subjects. Use more than one method such as usability assessment, activity analysis and interviews in order to understand how the subjects perceive and use the artifacts.

Analyze and interpret findings

Focus on the information that observations reveal. Spend time with the results to ensure that important aspects of what is observed are not overlooked. Extract patterns on important areas such as activity or attitudes and determine how typical they are. Relate the findings to the broader context outside of the specific case.

Assess one's own success and failure

Account for what was learned. Describe the limits of the work that was performed and what did not succeed. Identify changes that might compensate for shortcomings in the concept or in the research approach.

Serve as a critic of one's own practice

Turn a critical eye on what did and did not work and translate it into a narrative account. Reflect on what went wrong as well as right.

Publish results in a public forum for review and replication

Product concepts may be proprietary. However, methods and insights into their use are not. Commit conclusions to paper in order to capture what did and did not meet project goals. Publishing such discussions for other designers and researchers to review expands the wisdom of the field and enables the design community to progress.

Here is an example of how a project in communication design would follow such an approach.

COMMUNICATIONS DESIGN EXAMPLE: HEALTH CARE

The role of information in health care provides an example of the use of design research methods. The adverse drug reaction (ADR), which is 'any undesirable effect produced by a drug,' is one of five major threats to patient safety. ADR's have a number of causes. Chief among them are physicians' inadequate knowledge of medications, care providers' incorrect provision of medications and patient noncompliance. Improved information that is organized and presented effectively at the right time may significantly reduce the potential for errors that bring about ADR's. That is because "a relatively high percentage of errors occurs at the time of drug administration..." (Sharpe and Faden, 1998:175–89).

The requirements deal with information and human performance, so the problem is squarely in the realm of communication design. The designer cannot know what information to include, who to inform or what the optimal medium or timing might be unless he or she does the research that is necessary to guide the design process.

What kind of design activity would address such a circumstance? The following actions and questions that can be answered through research suggest an effective approach.

1. Determine actual issues

Review regulatory agency standards and professional practice guidelines in order to determine the terms and information that are required. Read recent papers in journals and proceedings that deal with medications compliance and patient safety issues. Review previous reports of ADR's in which labels or product information were identified as a cause.

2. Quantify user performance using critical incident data

Develop a line of inquiry to direct research. What are the current aspects of performance related to such labels? Do technicians and users correctly understand what the labels mean? How long does it take for subjects to read and understand the information? What information needs does the label meet or fail to meet at first dosage or during subsequent use? What medication errors occur?

3. Controlled observation of users

Develop a sense of the issues from the data. Rather than simply conduct focus groups, recruit a representative sample (in number and composition) of those who use the current labels. Observe pharmacy staff and patients in order to understand actual use issues. How do care providers select, interpret labels? How do users understand the information that is shown on the labels?

4. Create new artifacts

Research (Cheatham and Wogalter 2002:5–6) indicates that patients tend to discard over-the-counter medications packaging. Consider how staff and patients use information to make medications decisions. Consider alternatives to printed material that could provide different kinds of related information about the medications. As some kind of label will be necessary, develop new label models that reflect the findings obtained during the previous steps. Base the new approaches on the requirements of regulatory standards, legibility and care provider and patient ability to accurately understand the information.

5. Controlled observation using new labels

Observe a representative population using the new artifacts. Conduct a usability study in order to detect errors as well as success.

6. Assess results of observation, comparison

Use the data on staff and patient performance to draw conclusions about the effectiveness of the new approach. The results that were obtained by using the new label must show improvement over the previous approach in order to justify its adoption.

7. Communicate results to key audiences

Capture the lessons learned regarding user performance using the original and proposed approaches. Convey the conclusions, substantiated by the evidence, to the project client. Convey lessons learned about the design process to others in the research and development community via professional writing.

Many applications, not just those that are technical, will benefit from this approach. In fact, for any product to be 'truly beautiful, wondrous and pleasurable' Norman (2002:42) asserts that it 'has to fulfill a useful function, work well, and be useable and understandable.'

THE FUTURE OF DESIGN RESEARCH

Work by authors such as Senge (1999: 247–50, 287–90, 328–34, 371–80, 425–34, 496–500), Conner (1992:70–8) and Kotter (1996:25–36) demonstrate that change will need to occur on more than one level for design research to evolve.

Organization

Design organizations can begin to recognize well-researched design. Design competitions can include categories for projects that demonstrate the effective use of design research. Organizations already exist to promote effective design research. For example, the Design Research Society, based in the United Kingdom, operates a web site <www.drs.org.uk>, a LISTSERV and monthly e-mail newsletter. It also produces the journal *Design Studies* and sponsors other research-related activities. Members are drawn from diverse backgrounds, from within and outside of the traditional areas of design.

Design can benefit from methods and theories that have been developed in other fields. Other disciplines can also benefit from design thought. That migration of ideas relies on reading and publication in professional journals. In addition to *Design Studies*, other design-related journals provide a resource for thinking about design issues including research: *Design Issues, Design Journal, Design Methods and Theories, Design Science and Technology, the Journal of Design History, the Journal of Design Management, Korean Journal of Design Research, the Scandinavian Journal of Design History, the Journal of Design Communication, Visible Language* and *Art Design and Communication in Higher Education*.

Client

Allowing for some portion of budgets to be devoted to research would improve

the likelihood that design concepts are grounded in reality.

Design departments/offices
Including design research in proposals will demonstrate the link between reality and concept. Allowing for staff to learn new approaches will encourage research.

Practitioner
Ultimately, it is the designer who must commit to this new design role. Educational institutions that include such an approach in their design curriculum will create a community of practitioners who have the values and tools that will be needed to realize it. Byrne (2001:unpaged) acknowledges that design is rooted in reflexive and interpretive modes of discovery. "The issue, therefore, is whether future designers will ALSO [author's emphasis] be taught how to create generalizable, publicly examinable forms of knowledge about design and to use it to design."

Such initiatives would lead the way to a new future for design practice. What is the risk if such change does not occur? Clients will not allow continued information systems failures such as those that Heath and Luff (2000) describe. Other disciplines that can perform research will change to assume the design role if designers choose to abdicate it.

CONCLUSION

This essay has reviewed recent influences on design practice, indicated an opportunity for design to evolve in a professional direction and presented methods that will support that evolution.

Research will enable designers to get real, by taking account of what exists in reality. The combination of investigation and evaluation with intuitive foresight can bring about significant benefits:

> Concepts that are well founded and actually do improve human performance.

> Improved rigor and validity, enabling the designer to support an opinion or position.

> An increase in the value of design, particularly in technically challenging applications.

> Designers performing in a leadership role instead of a support role, sharing results and reflections on practice in order to build knowledge about design among designers.

This combination of reality with intuitive ability holds the promise to build the power and impact of design practice.

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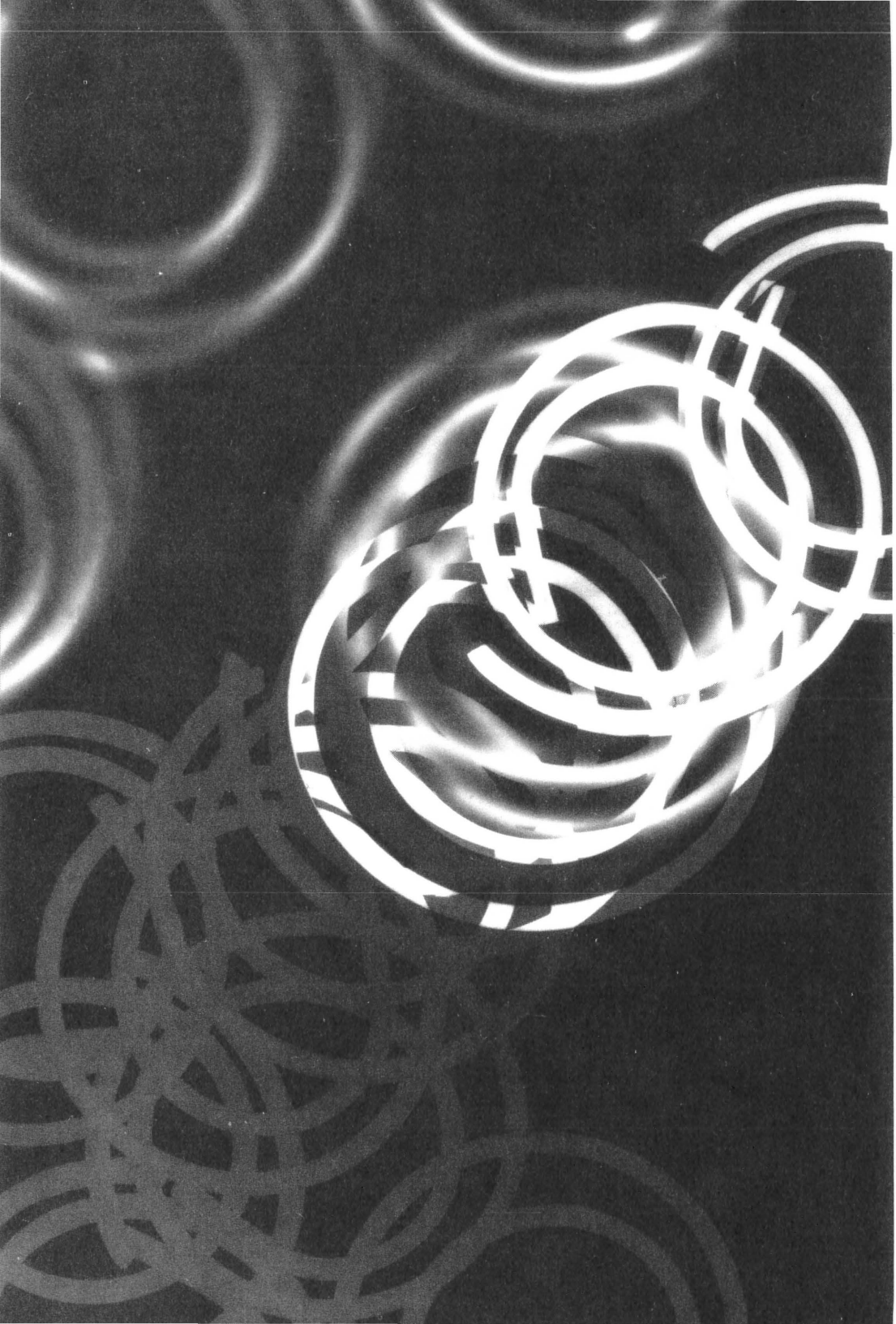

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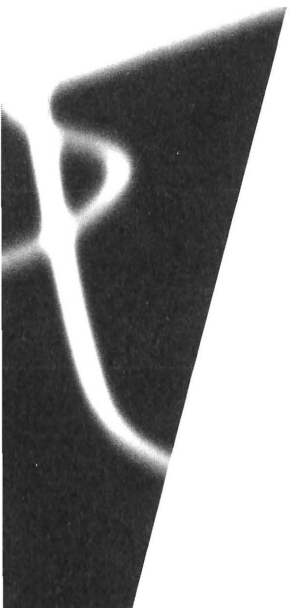

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