

DESIGNING

Theory in **COMMUNICATION**

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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.

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.

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

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.

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.

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

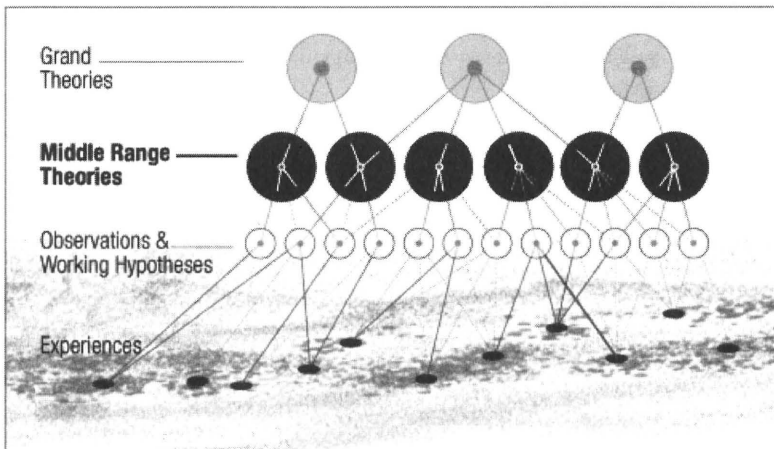
⁴ Merton, *Social Theory and Social Structure*, 39.

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

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



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.

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

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.

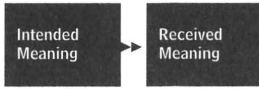
In the type II model, the physical form of a communication is the enabling medium of communication, but it does not construct meaning. It is symbol systems carried over the medium that construct meaning. But communication design manipulates physical forms that are not in themselves taken as communication 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.

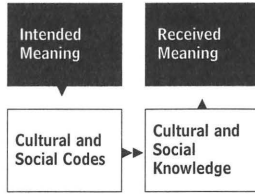
¹² Eco, U. 1979. *A Theory of Semiotics*. Bloomington: Indiana University Press, 354.

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

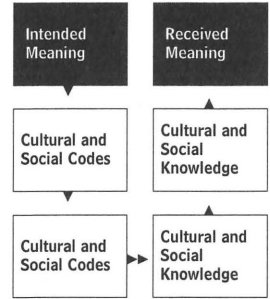
Type I: Direct Reception Model



Type II: Socio-Cultural Reception Model



Type III: Cognitive Reception Model



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

FIGURE 2
Three Models of
Communication

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 Varela and Maturana,¹⁵ Piaget's theory of equilibration,¹⁶ Lakoff and Johnson's philosophy of embodied thinking¹⁷ 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 movements²⁰ 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. *Autopoiesis 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*).

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.

**SENSORY
AND SYMBOLIC
MODES**

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 Pylyshyn, 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*).

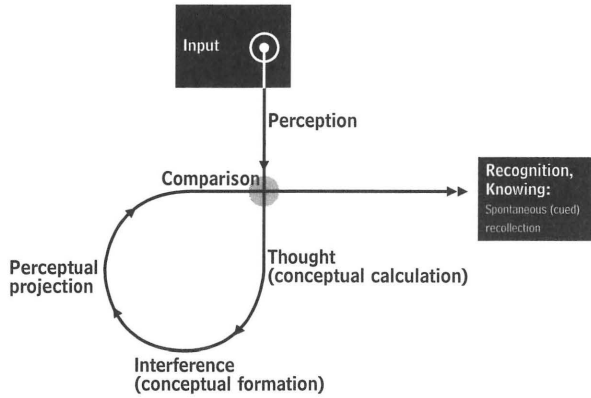
Recognition is more than conceptual inference. It is the combining of conceptual and perceptual, i.e. narrative modes to give the sense of knowing: that something has been grasped. For example, you meet a stranger who seems strangely familiar. You search in your memory for whom she looks like and how 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.

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

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

STRUCTURING ATTRIBUTION

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.

Membership

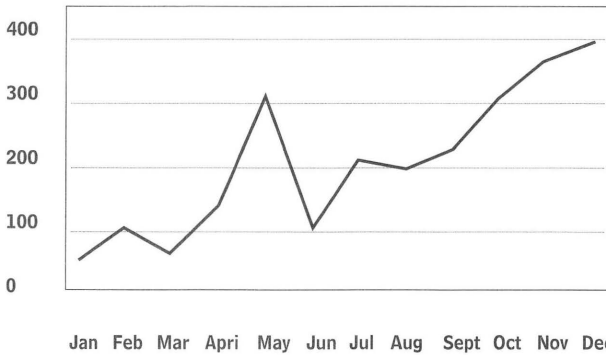


FIGURE 4
Organization
Membership
Across One Year

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.

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.

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

**SUMMARY:
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**COGNITION,
INTERPRETATION
AND MEANING**

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.

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.

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.

- > 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.

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 communion.

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

THE INTERDEPENDENCE OF PERCEPTION AND CONCEPT AND THE PRIMACY OF PERCEPTION

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:

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.

**SUMMARY:
THEORY AS
A SERIES
OF AXIOMS**

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**

³¹ Ericsson, K.A. and H. Simon. 1996. *Protocol Analysis: Verbal Reports as Data*. Cambridge: MIT Press, 1-10.

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

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.

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.

Two experiments were devised to study cognitive processing (the experiments are published elsewhere³² 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.

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.

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

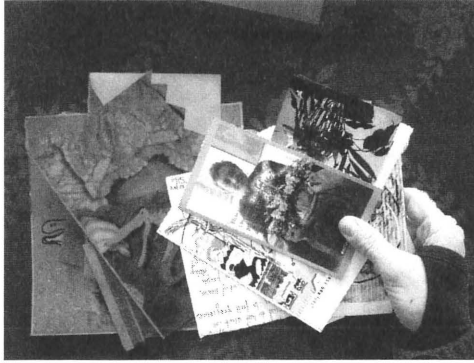
³² Storkerson, P. 2001. *Cross Mode Communication in Multimedia*. Chicago: Institute of Design, Illinois Institute of Technology, Ph.D. Dissertation, 167.

TESTING AND VERIFICATION

EXPERIMENT 1: SEMANTIC RELATIONS BETWEEN VIDEO AND SPOKEN WORDS

EXPERIMENT 1 TEST MOVIE

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.

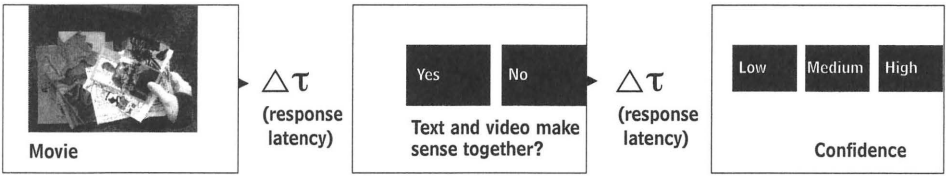


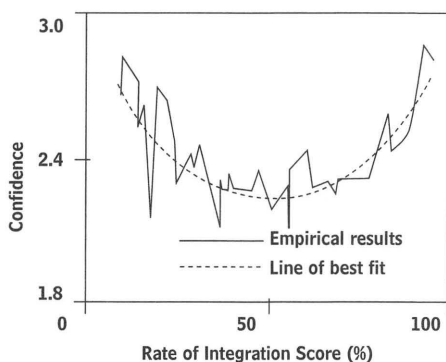
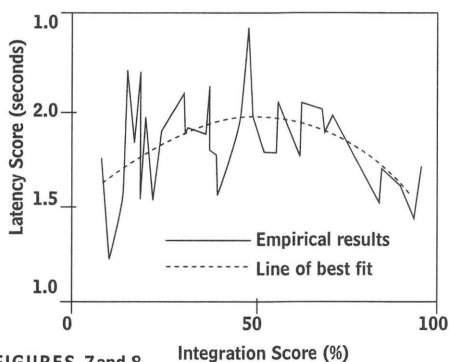
FIGURE 6
Experiment 1 Movies
and Questions

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

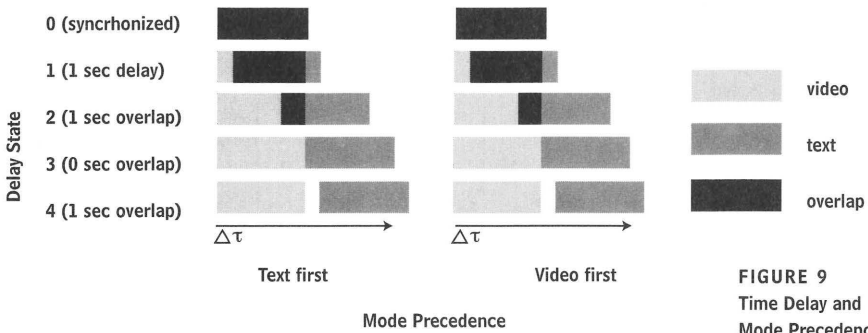


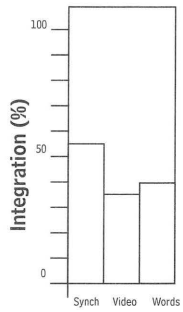
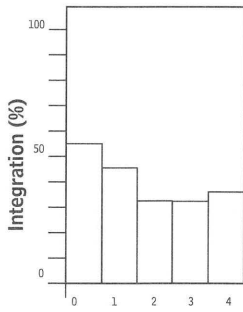
FIGURE 9
Time Delay and
Mode Precedence

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.

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.

MEMORY



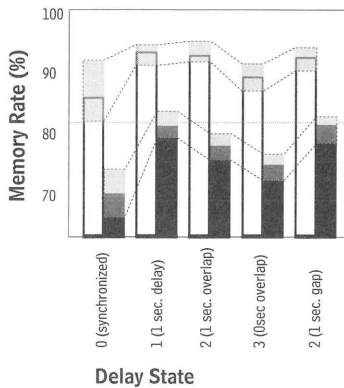
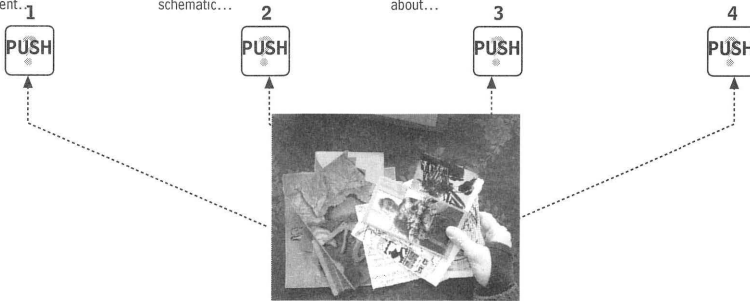
Which text belongs with the video?

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...



- Integrated movies
- Not integrated movies
- Confidence limits (95%)

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

FIGURE 11 (middle)
Matching Video
with Text

FIGURE 12 (bottom)
Integration and
Recognition

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 facilitation³³ 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.

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

RESULTS

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

³⁴ Battig, W. 1972. "Intrask 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.

CONCLUSION

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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