

Cognitive Resonance

Jay L. Brand, Ph.D.
Haworth, Inc.
Holland, Michigan

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One Haworth Center
Holland, Michigan, USA 49423

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“The mind is a wonderful organ--it starts working the moment you get up in the morning and does not stop until you get to the office.” --- Robert Frost

While we may not readily accept Robert Frost's "Dilbertesque" observation, an increasing number of executives recognize the need for more creativity, originality, and innovation throughout their organization. Most corporate leaders readily concede that the "mind" value of their organizations has not yet realized its smoldering potential. Peter Drucker, only one among many like-minded voices, has asserted that the primary competitive edge in the new century will be afforded those companies with superlative leveraging of their knowledge workers' contributions. While Drucker's prediction certainly implies the need to recruit and retain highly talented workers from the increasingly attenuated labor pool, it also includes the additional responsibility of helping all our employees reach and maintain their true capabilities.

But haven't we heard all this before? After total quality management, downsizing, restructuring, re-engineering, work process analysis, and reconfiguration, how much room for improvement could possibly remain? Can we reasonably expect any more substantial gains in productivity in the wake of applying so many efficiency programs--all appropriately intended to cut costs and maximize output? I believe that in many cases the "thinking" contributions of workers have not yet reached their full potential, and this paper will develop the idea of "cognitive resonance" as one way to represent the possibility for continued progress.

First, I maintain that what people actually do when working "in the office" consists primarily of dozens of basic cognitive processes such as attention, perception, memory, decision-making, reasoning under uncertainty, application of schemas and stereotypes, interpreting the motives of self and others, making attributions, and many similar psychological activities. To the extent this contention is true, providing optimal organizational support for these abilities should contribute to workplace productivity. If office work requires good memory performance, then environments that support memory will no doubt serve to enhance office effectiveness.

Second, I will argue that these basic cognitive abilities depend critically on their external (the surrounding environment) and internal (relevant individual experience and expertise) contexts. Many of the factors that guide the clarity of conversations, ensure fluent speech, support reading comprehension, aid information analysis or synthesis, and support accurate interpretation of communicative intent--lie outside our conscious awareness; such factors provide a frame of reference for these and many similar activities. I also contend that providing adequate contexts becomes even more important as expertise develops, since the intuitive knowledge that experts rely on can be most efficiently accessed automatically by task-relevant cues in the environment.

Finally, I will develop a theory of corporate context (based on the concept from cognitive science of "mental models") that suggests how to include the powerful advantages of rich organizational environments within alternative officing strategies. This theory includes three levels: 1) The micro-environment of individual workers (typically offices or workstations); 2) The larger work or task-related environment (functional work group areas), and 3) The broader corporate setting, which includes corporate culture.

Office Work and Basic Cognition

Certainly office work relies on many cognitive processes in addition to perception and memory; however, these two will suffice as examples, although similar claims could be advanced and supported for each basic cognitive activity. Our ability to perceive and recognize objects rests on a number of brain processes that independently contribute to the construction of conscious perceptions. When we see and recognize an article, or a friend's face or voice, or the usefulness of an idea, all of our relevant past experience--together with the current environment--provides a powerful context that determines and supports our perception.

During development, toddlers must continually add to the number of categories that they apply to the process of making sense of their world. As experience accumulates, more and more of the constructive nature of perception becomes unconscious; we don't notice how automatic a very complicated process has become. We all essentially become "experts" at perception; what was once an effortful process requiring concentration and conscious effort becomes automatic, effortless, and largely unconscious. Even though a great number of brain regions independently process shape, orientation, motion, color, size and texture, we experience only the integrated, final products of these analyses. Much of the foundation for perceptual recognition, then, rests in the overlearned interaction between brain processes of which we are not aware and environmental cues with which we are mostly familiar.

Memory research has likewise demonstrated that during development, we essentially become "expert" at recall and recognition. Our wealth of knowledge and experience contributes and supports the process of reconstructing the past. Interestingly, an increasing body of research indicates that the recall context influences what we remember just as surely as does the original event to be remembered. As we gain expertise in a particular area, more and more domain specific knowledge becomes available automatically, from the interaction between current environmental conditions and our past experience. Such memory can operate entirely outside our awareness, and is termed "implicit" as opposed to "explicit."

Although some investigators would question such a parallel, the distinction between implicit and explicit memory may relate to the difference between so-called 'declarative' (available for verbal report) and 'procedural' (skill-based, unconscious) memory. Perhaps our ability to ride a bicycle shares as much in common with implicit memory as our

ability to recount the rules of baseball does with explicit memory. Regardless of how that controversy gets resolved, it does appear from neuropsychological studies that memory for general information can be usefully distinguished from memory for personal events ("source" memory; formerly called "episodic" or "autobiographical memory"). This distinction can be illustrated by noting that your knowledge of the multiplication tables need not include the situation in which you originally learned them.

Still another important empirical milestone in the investigation of memory, "state-dependent memory" illustrates the encoding specificity principle, one of the more influential theoretical constructs ever devised within cognitive psychology. Essentially, this principle holds that if the cognitive context at encoding is reproduced at recall, memory will be enhanced relative to alternative situations. Notice that this implies memory must be individually idiosyncratic: Effective environmental cues for one person may be ineffective for another, since all have had different past experiences. Both state-dependent memory and the encoding specificity principle are now typically subsumed under the general area of cue-dependent memory.

In Steven Spielberg's wonderful yet horrific movie, "Saving Private Ryan," the protagonist learns that his three brothers have been killed in action, and he expresses dismay at not being able immediately to recall what they look like. In response, Captain Joseph Miller encourages him to reconstruct a context for remembering his brothers, and Private Ryan subsequently recounts the story of an amusing encounter with his brothers the night before they shipped out for basic training, providing vivid details of the event.

This serves to illustrate not only the power but the individuality of context in supporting the basic processes of memory; contexts thus provide the implicit cues necessary to reconstruct conscious recollections. The personal chronologies that give us our sense of individual identity rest on histories that are both implicit and explicit. Cues from the present can evoke memories of the past by exciting rich contexts not normally available to introspection or verbal analysis.

Expertise consists in the process of contextual representations becoming overlearned and thus automatic, both in the sense that they're easily re-activated by a modicum of environmental cueing, and also in the sense that they provide powerful associative networks for acquiring new information or skills. In effect, the effortful portion of carrying out cognitive tasks decreases with time and experience, while the automatic, unconscious neural foundations supporting those tasks increases. These automatic processes--more so than conscious awareness--depend critically on the guidance of contextual cues from the environment.

Furthermore, since our conscious awareness (known to psychologists as working memory) has very limited capacity; and a consistent, familiar environment can be monitored mostly unconsciously--then in well-known environments, more of our awareness will remain free to concentrate on dynamic, challenging task demands,

increasing creativity and innovation. After all, the more familiar a context or frame of reference, the more sensitive to subtle uniqueness perception tends to be, and the recognition of truly novel solutions will come easier. Although a common example, law enforcement officials learn to recognize counterfeit money by becoming very familiar with real money, thus rendering the recognition of "fake" bills almost effortless. An overlearned, familiar environment makes them sensitive to subtle uniqueness.

Organizations and Mental Models

Having seen how working effectively in an office depends on elementary cognitive skills such as perception and memory, as well as how these skills in turn depend on the environment, we will now explore the importance of our internal contexts: Mental models. Individuals create "mental models" or "schemas" that mediate their interaction with their environment; these models provide simplified versions of reality, much like a travel map represents the geography and spatial relationships of a particular region. Models leave out lots of detail and may vary greatly in accuracy, but they preserve the salient functional criteria of the realities they represent (e. g., cities and landmarks on a map).

Organizations have proven to be no exception to this process of mental representation. To the extent that the features of one's mental model correspond with the real corporation it represents, recruitment, retention and productivity will be enhanced. Significant discrepancies between one's corporate mental model and the organization it symbolizes can have the opposite effect. The title of this paper, "Cognitive Resonance," describes a situation when the organizational context matches (literally, resonates with) our internal representations, when our internal and external contexts harmonize. Before deriving some prescriptive ideals from cognitive resonance, I will briefly outline the content of a typical mental model of a corporation. Such models include at least three levels: 1) The microenvironment (office, or workstation); 2) The task environment (the larger work area); and 3) The organizational context (including the psychosocial foundations of the corporate culture).

- I. Micro Context (Workstation). The opportunity for and convenience of a personal location within the company should be clear to each worker. Some corporations rely more on a functional division of labor as opposed to a departmental division; the former might be less tied to a physical location than the latter. However, each individual's identity and importance must be clearly communicated--either by a sense of place, or by valued responsibility. The importance of proper design of and support for equipment and one's immediate work environment can be conveyed within alternative workplace strategies through various means (e. g., an "allowance" for adequate home office furnishings; a lap-top and/or cellular phone; easy access to technical support).

- a. *Human Factors/Ergonomic Support.* Assuming this sense of place takes the form of a personal office, the furniture, furnishings, and work tools within that office should be adjustable to fit individual workers performing their several tasks. Human factors and ergonomics involves fitting the physical and task environment to the worker, rather than requiring the worker to conform to an arbitrary arrangement. Workers should be encouraged to change their environment as necessary for different tasks and problem situations. After all, if workers have sore backs, sore eyes, sore seats, and sore wrists, they're unlikely to reach their potential.
 1. *Biomechanics.* The loads placed on the musculoskeletal system by the various static and dynamic postures necessary to perform one's job should be analyzed, with the goal of reducing these loads as far as possible. Workers should also be trained in appropriate bending and lifting behaviors within their work areas, particularly in industrial settings.
 2. *Anthropometry.* The dimensions of individual workstations should be adjustable in order to "fit" each worker, and the means of adjustment should be user-friendly with very clear affordances. It should be obvious to a novice how to adjust and re-configure the work surfaces; storage capacity; lighting; seating (chair); computer monitor, keyboard & mouse placement; and privacy requirements.
- b. *Spatial Configuration/Control.* Workers should ideally be able to re-configure their entire work area, moving tables, files (and other storage items) in relation to their current work as needed. Placement of the computer monitor, phone, white board, and other work tools should be individually adjustable and movable. This becomes all the more important in alternative officing strategies such as hotelling and hot desking, or within distributed satellite office locations.
 1. *Cognitive Ergonomics.* Configuring the immediate work environment to conform to and support basic cognitive processes has only recently attracted the attention of the officing industry. Designing desks, tack boards, and other features of individual workstations to allow "off-loading" of important information into the environment--thus unburdening working memory while continuing to cue attention in a conceptually organized and coherent manner--represents just one of many possible applications of cognitive ergonomics to office environments. The ultimate goal includes environments that merely extend individual workers' personal mental models into their environments. Some of the concept desks (e. g., the Wake, Drift, Space Buck, Flo, Eddy) designed by Jeff Reuschel and Brian Alexander, at Haworth, Inc., represent this approach.

Whether or not certain advantages for optimum cognition may only be

available within consistent, individualized offices that provide unique opportunities for personal accumulation of work context and support remains to be seen. From the review above of some of the basic research in cognitive science, it would seem that this might be the case. At the very least, it will be important to understand precisely what benefits accrue from a consistent, personal office, and systematically integrate these features at some level of abstraction within the company's chosen alternative officing framework.

2. *End-user Adjustability.* When corporations change, undergo transitions, and re-organize themselves, the primary psychological experience for individual workers typically involves uncertainty. Whatever can be done to eliminate this uncertainty will contribute to restoring their sense of personal control. One important way to convey this sense is by providing workstations that can be adjusted by workers. Ideally, workers should retain flexible control over the availability of office space in hotelling and hot desking programs, rather than being required to conform to an arbitrary schedule, months in advance.
- II. Task Context (Work Area). In addition to workers' immediate environments reflecting their own psychological realities, the surrounding task/work group should also conform to their mental model of the corporation. If their tasks and responsibilities require a lot of communication and coordination, then an open environment should be readily available--either by design or through adjustable features (e. g., privacy screens, portable barriers, flexible power and cabling delivery). Within alternative workplace schemes, attention can be paid to one's work group context by providing the technologies necessary to allow team members constant access to one another. Furthermore, incentives for sharing information and keeping each other "in-the-loop" can be incorporated through team-level rewards and bonuses contingent on the manifestation of these behaviors--in addition to the attainment of more traditional project goals.
- a. *Proximity/Availability of Work Group (Team) Members.* Research has shown that many workers invariably get necessary task information within six feet of their desk, mostly from other people. Given these realities, such work group proximities should be functionally if not physically available. Whatever the technologies chosen to keep distributed team members in touch should be completely mobile, easy to use, and maintained error-free.
 1. *Dynamic Consulting/Feedback.* In alternative workplace strategies, immediate access to team members represents a fundamental necessity. All team members who do not occupy adjacent workstations within a central office need technologies that can provide continuous potential for communication, preferably on-demand. This latter feature could be altered to accommodate sensitive or confidential situations. Turn-arounds of more than a few minutes would begin to negatively impact productivity compared to

teams located together within an office.

- b. *Storage/Information Access.* Individual workers maintain a range of proportions of visible to stored work-related items. Lack of availability or access to stored, task-relevant materials should never discourage its use. Alternative officing workers need technologies that give them controlled access to stored, task-related information on an as-needed basis.

III. Organizational Context (Corporate Culture). This area might be the most overlooked factor in the success of any alternative officing strategy. The psychosocial dimensions of a particular management approach usually dwarf the technical, economic and logistics considerations. The organizational commitment, job satisfaction and productivity of each individual employee and the success of project teams depend on proper alignment of everyone's expectations, responsibilities and commitments. At the very least, the rationale for alternative workplace approaches must be made clear both to those workers participating in the program and to those that are not. Perceptions of fairness and equity invariably overshadow the objective realities in this regard.

- a. *Personal/Group Identity.* One of the fundamental shifts from "baby-boom" to "Gen-X" workers involves the relationship between personal and corporate identity. Traditionally, workers' personal identities have tended to become integrated with their psychological impressions of the corporation that employs them. However, as both corporate and worker loyalty to the basic "work-employment" contract has eroded, this integration of personal and corporate identities has also attenuated. Workers with mobile skills such as those in information technology may continue to thrive in this more flexible environment. However, for the majority of workers, to the extent that personal and corporate expectations regarding mutual commitments can be communicated clearly, increased identification with the organizational can result.

1. *Local Leadership.* The role of immediate managers and supervisors in encouraging identity relationships cannot be overestimated. Such readily available leaders provide individual workers with their primary opportunities to contribute to corporate success, as well as an estimate of the value of their contributions--together with the ways and means to improve that value through performance reviews and feedback. These personal relationships are critical to team building and team success, particularly in alternative officing arrangements, where confidence and trust must be assumed by all constituencies involved.

While dictating personal agendas and "to-do" lists for their subordinates are largely things of the past, leaders can still plot general strategies for the group that involve broader goals and perspectives. Deciphering the right level of abstraction for goal descriptions and project expectations constitutes perhaps

the fundamental challenge for emergent leadership within self-organizing work groups. But again, all workers need opportunities to contribute and the knowledge that their contributions are valued.

2. *Global Leadership.* While managers and supervisors can increase corporate loyalty by providing opportunities for valued contributions, executives should communicate an even broader message. In addition to encouraging and nurturing a general acceptance of (and accommodation for) change and innovation, they must provide a strategic vision that includes meaning, compelling workers not only to pursue personal goals and rewards, but to participate in the improvement of society. The perception that one is involved within a larger community, within defining relationships beyond the confines of one's own personal concerns, embody fundamental elements for experiencing meaningfulness. To the extent that organizations can provide individual workers with this sense of meaning and place, then workers will be more likely to include identity with the corporation within their own personal identities. Recruitment and retention usually improve within such an atmosphere, and productivity can reach its optimum.

Another component of meaningfulness includes the idea of one's job being somehow independent of time and place. The perception that the effects of one's work transcend one's immediate work environment and impacts society at large should be conveyed. Again, choosing the precise level of abstraction--from the corporate mission statement down to descriptions of day-to-day operations--for communicating goals as "messages of meaning" represents a fundamental challenge for the executive team. Although being independent of time and place seems to be a natural condition for participants in most alternative officing programs, maintaining a sense of cohesion with the larger, meaningful context becomes even more important for such distributed workers.

The characteristics and preferences of individual workers, the needs of work groups and tasks, and the availability of necessary environmental and technological support structures all need to be considered in the design and implementation of alternative officing strategies. In what ways do all workers contribute to broader corporate goals? What physical and social resources must be available for participants to make valued contributions? How is the meaningful corporate vision dynamically communicated to workers who do not consistently occupy offices with their colleagues at corporate headquarters? Have project and team definitions been framed at appropriate levels of abstraction to convey their larger meaning and purpose? Have all affected constituencies accepted the rationale and strategic foundations for the alternative officing program?

Adequately addressing each of these questions will ensure that your company's organizational strategies maintain organizational commitment and create an enriched

context that supports and nurtures individual cognition, an environment characterized by cognitive resonance. Such an environment will balance personal, group, and corporate realities; and integrate personal, corporate and societal goals.

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Illustrates how broad contexts impact activities at lower levels of abstraction within community (and other) systems.

Murray, S. A., & Caldwell, B. S. (1996). Human performance and control of multiple systems. *Human Factors*, 38, 323-329.

Suggestive evidence that the increased complexity of dynamic environments also increases monitor workloads and thus the likelihood of monitoring errors.

Nicholson, N. (July-August, 1998). How hardwired is human behavior? *Harvard Business Review*, 135-147.

"Evolutionary psychology suggests where--and why--managers may be working against our inner circuitry." A basic introduction to contemporary applications of Darwinism from the perspective of individual psychology rather than an emphasis on the larger competition among firms in the marketplace; suggests that organizations should understand and cooperate with basic human instincts rather than superimpose the latest management fad on tendencies locked in our genes since the stone age.

Obradovich, J. H., & Woods, D. D. (1996). Users as designers: How people cope with poor HCI design in computer-based medical devices. *Human Factors*, 38, 574-592.

Evidence that many devices used even in critical care settings systematically violate user expectations and abilities.

Ornstein, R. (1998). *The right mind: Making sense of the hemispheres*. New York: Harcourt Brace.

Argues that while the left hemisphere specializes in sequential, (e. g., language; analysis) fact-based processing, the right hemisphere provides a meaningful context for this information, both in terms of personal chronology and more general semantics.

Pacanowsky, M. (1995). Team tools for wicked problems. *Organizational Dynamics*, 23, 36-51.

Argues that only the flexibility of self-organizing teams can adapt quickly enough to accommodate the rapidly shifting, changing corporate environment.

Perkins, D. (1995). *Outsmarting IQ: The emerging science of learnable intelligence*. New York: Free Press.

Argues that intelligence is more a matter of thinking strategies and processes than an "inherited, intrinsic characteristic," and such skills can be taught and learned.

Pinker, S. (1997). *How the mind works*. New York: W. W. Norton & Co.

A quality defense of the computational theory of mind, grounded in evolutionary psychology. Argues that the computational modules that collectively contribute to mind must be "reverse-engineered" as adaptations spawned by natural selection.

Quinn, J. B. (1985). *Technological innovation, entrepreneurship, and strategy* (pp. 3-14). *Managing Change and Uncertainty--A collection of reprints from the Sloan Management Review*, MIT.

Argues that the traditional "engineering-process" orientation of large corporations shackles the creative and innovative juices; suggests an analysis for strategic planning at a higher level of abstraction that cuts across traditional department lines, and dedicated funds and focus for risky ventures.

Ratz, L. (August, 1997). Roller Coaster 2000. *Mobility*, 49-58.

A wave of technological innovation and organizational restructuring is rolling across the world's economies (particularly the US) and, according to forecaster David Pearce Snyder, the greatest impact of information technology is yet to come. Among other things, argues that more and more sophisticated systems (e. g., expert systems; simulators) and capabilities will be available to more and more workers, increasing the value of individual decisions. Also argues that learning works best in context (i. e., "on-the-job;" mentoring; one-on-one).

Roach, S. S. (September-October, 1998). In search of productivity. *Harvard Business Review*, 153-160.

Argues that since gains in knowledge worker productivity depend largely on the limitations of the human brain rather than on technological developments, the claim for vast productivity improvements in the service sector may be premature and overstated.

Repetti, R. L. (1987). Individual and common components of the social environment at work and psychological well-being. *Journal of Personality and Social Psychology*, 52, 710-720.

A classic empirical investigation of the role of the social environment in workers' adjustment and attitudes within the workplace.

Rouse, W. B., & Boff, K. R. (1998). Packaging human factors for designers. *Ergonomics in Design*, 6, 11-17.

"Human factors/ergonomics professionals need to focus on designers, not product end users." Suggests that by concentrating on the real customers of human factors research and information--designers--better communication between the disciplines can be achieved to the benefit of all constituencies.

Sarter, N. B., & Woods, D. D. (1991). Situation awareness: A critical but ill-defined phenomenon. *The International Journal of Aviation Psychology*, 1, 45-57.

Explores the difficulties of specifying how the environment influences the unconscious and conscious contexts for complex decision making.

Schacter, D. L. (1996). *Searching for memory: The brain, the mind, and the past*. New York: BasicBooks (HarperCollins).

An elegant description of memory and its inner workings that integrates information from cognitive science, cognitive psychology, neuroscience, neuropsychology, and artistic explorations

Schein, E. H. (1996). Culture: The missing concept in organization studies. *Administrative Science Quarterly*, 41, 229-240.

Argues that within the subtle, often unpredictable, psychosocial context only available from a broad, organizational perspective, hides many important determinants of organizational effectiveness.

Schein, E. H. (1985). *SMR forum: Improving face-to-face relationships* (pp. 26-35). *Managing Change and Uncertainty*--A collection of reprints from the Sloan Management Review, MIT.

Suggests that establishing, maintaining & mending personal relationships is the key to successful management and corporate progress; stresses the importance of empathic understanding and cross-cultural sensitivity--within families, companies and countries, as well as between these entities.

Shipley, P. (1998). The ethical turn and the workplace. *Ergonomics*, 41, 1-19.

Analyzes ethics in modern and historical context; explores the potential conflicts between professionalism and employer mandates for ergonomists, and suggests that resolving these discrepancies can contribute to the larger society's increasing concern for personal and collective ethics; rejects the engineering/machine/process orientation to occupational design in favor of a more humanistic perspective.

Simons, D. J., & Wang, R. F. (1998). Perceiving real-world viewpoint changes. *Psychological Science*, 9, 315-320.

Demonstrates that orientation changes (due to object movement) are not identical to viewpoint changes (observer movement); environmental recognition seems to depend critically on updating a viewer-centered representation during real movement through real environments; this mechanism is unavailable to orientation changes.

Smith, K., & Hancock, P. A. (1995). Situation awareness is adaptive, externally directed consciousness. *Human Factors*, 37, 137-148.

Offers a potentially unifying approach to defining the awareness-context interaction within dynamic environments.

Stanney, K. M., Maxey, J. L., & Salvendy, G. (1997). Socially centered design. In G. Salvendy (Ed.), *Handbook of human factors and ergonomics*, 2nd ed. New York: John Wiley & Sons.

Explores the implications for the design of business, industrial and military environments if the people who will occupy the space remain the central design consideration.

Stout, R. J., Salas, E., & Carson, R. (1994). Individual task proficiency and team process behavior: What's important for team functioning? *Military Psychology*, 6, 177-192.

Evidence that training individuals in time-sharing techniques improves team resource allocation performance; more broadly, this implies that team performance depends on the skills and ability levels of individual members.

Sutton, R. I., & Hargadon, A. (1996). Brainstorming groups in context: Effectiveness in a product design firm. *Administrative Science Quarterly*, 41, 685-718.

A qualitative, ethnographic analysis of brainstorming within a product-design firm that suggests the unfavorable conclusions from laboratory-based, quantitative research on brainstorming may have been premature.

Urban, J. M., Weaver, J. L., Bowers, C. A., & Rhodenizer, L. (1996). Effects of workload and structure on team processes and performance: Implications for complex team decision making. *Human Factors*, 38, 300-310.

Suggests that time pressure might degrade team performance more than resource demand. In addition, since most adjustments to environmental challenge occur early in a team's development, this may be when leadership or training could have the greatest impact.

Verespej, M. A. (January 5, 1998). Formal training: 'Secondary' education? *Industry Week*, pp. 42-44.

Summary of a research project of several large US firms that suggested that the majority of learning within organizations takes place informally, mostly within teams and unstructured mentoring applications; formal training should always be supplemented by informal opportunities for workers to apply what they've learned.

Wilson, J. R., & Haines, H. M. (1997). Participatory ergonomics. In G. Salvendy (Ed.), *Handbook of human factors and ergonomics*, 2nd ed. New York: John Wiley & Sons.

Explores how best to involve an entire company in an ergonomics program by addressing the organizational level of abstraction.

Wingfield, A., & Byrnes, D. L. (1981). *The psychology of human memory*. New York: Academic Press.

An excellent overview of the research on human memory prior to the 1980s; some topics discussed seem very prescient in retrospect (i. e., Bartlett's emphasis on reconstructive memory).

Worchel, S., & Shackelford, S. L. (1991). Groups under stress: The influence of group structure and environment on process and performance. *Personality and Social Psychology Bulletin*, 17, 640-647.

An empirical demonstration of the influence of task environment and group structure on group process (communication and other activities) and performance.

Xiao, Y., Hunter, W. A., Mackenzie, C. F., Jefferies, N. J., Horst, R. L., & the LOTAS Group. (1996). Task complexity in emergency medical care and its implications for team coordination. *Human Factors*, 38, 636-645.

Evidence that team performance can be enhanced if the team shares an accurate mental model of their task situation.

Zacks, J., Levy, E., Tversky, B., & Schiano, D. J. (1998). Reading bar graphs: Effects of extraneous depth cues and graphical context. *Journal of Experimental Psychology: Applied*, 4, 119-138.

Suggests that with additional inspection times, people can be as accurate with 3-D bar-graphs as 2-D; furthermore, graph reading performance can be influenced by task contextual cues. Question: Can the increased inspection time necessary for 3-D graphs improve memory for the information?