The Thinking of Things:
Cognitive Ecologies in an Age of Compression

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Introduction

You probably don't sleep in your kitchen. Chances are that you have distinct rooms for sleeping, cooking and showering, perhaps among other things. These rooms help organize daily life by assigning different functions to different spaces. Anyone who has lived in a single-room apartment, where all activities take place in the same space, knows how quickly it can become crowded and difficult to manage. In a similar way, human memory relies on contextual cues that help distinguish one piece of information from another. Cognitive scientists have long argued that thinking is shaped by the environments in which it occurs, and the field of cognitive ecology studies how cognitive processes emerge through interactions between individuals and the material world around them. However, when many experiences are encoded under the same conditions, those cues become less distinctive, making memories more difficult to separate and retrieve. Modern digital environments increasingly compress many cognitive activities into the same interfaces and physical spaces, and we may need to rethink how we use this technology if we wish to preserve our cognitive capabilities.

Cognitive Ecology

Cognitive scientist Edwin Hutchins defines the field of cognitive ecology as "the study of cognitive phenomena in context" (Hutchins, 2010). Rather than considering cognition as an isolated mental process, it treats the material surroundings of the person as part of their mental infrastructure. Anthropologist Gregory Bateson illustrates this principle, which he calls the "ecology of mind", by using the example of a blind man with a stick. If the man is dependent on his stick to navigate the world, and our goal is to explain any given piece of his behavior, then excluding the stick in our evaluation would leave many aspects of his thinking inexplicable. The stick is not just something that is taken into consideration when the man solves problems in his daily life but instead shapes the limits of his thinking (Bateson, 1972, p. 459).

Psychologist James J. Gibson developed an ecological approach to perception centered on the concept of affordances, or the possibilities for action that the environment offers the individual. According to Gibson, perception is not primarily a process of constructing internal representations from sensory inputs. Instead, organisms directly perceive affordances in their surroundings and detect opportunities for action that are relevant to their abilities and goals (Gibson, 1979, p. 119). If the individual sees a flat surface at sitting height, then sitting down becomes an affordance. Research on memory also suggests that environments play an important role in the storage and retrieval of knowledge. Memories are encoded together with contextual cues present during learning, which later help trigger their retrieval (Tulving & Thomson, 1973). Even cues that have very weak connections to the goal memory in theory, become very strong if they were present during the formation of the memory. Godden & Baddeley (1975) also demonstrated that recall improves when learning and retrieval occur in the same physical context, suggesting that environments can become associated with specific cognitive activities.

All in all, the environment can help improve memory and problem-solving by reducing the cognitive load of internal storage. In his book *The Design of Everyday Things* (1988), cognitive scientist Donald Norman argues that precise behavior can emerge from imprecise knowledge through “natural mappings”, which reduce the need for information in memory. This is because these natural mappings do two crucial things: they limit the affordances present in the situation and they work as cues for memory by being specifically encoded together with the information you need to retrieve. How to operate a computer or drive a car demands less space in our memory because the objects involved both limit our options for actions and cue memories tied to the objects (Norman, 1988, s. 23). However, the spaces we operate in look somewhat different today. New digital technology is transforming these environments in ways that compress these spatial and sensory distinctions.

Encoding Conditions

A smartphone is a wonderful little thing. It can communicate, both through text and speech. It can find all the information needed for basically any task, run games, play movies and music and translate languages in real time. It can measure your sleep pattern and the number of steps you take in a day. Any time you wish to complete any of these tasks, you're faced with the same cool metal and glass against your skin, the same fonts and colors, the same movements of the fingers to go back and forth between different windows or tabs. You go through these motions many times throughout your day, and if each new piece of information becomes encoded to the same impressions, the knowledge keeps folding on top of itself and compressing into one solid mass that can be difficult to break apart.

Digital technologies have also changed encoding conditions through spatial compression. Knowledge acquisition often used to be distributed across a range of locations. In schools and universities, students moved between classrooms, libraries, archives, and workplaces, interacting with different objects and materials in each setting. These movements differentiated between spatial contexts that could become associated with the information being learned. When you primarily use digital tools, however, many of these activities can take place within the same physical space. Reading, writing, searching for information, and communicating with others can all be performed while sitting in the same room in front of the same device. As a result, learning more often occurs across a small set of locations, and larger amounts of information become encoded to that space.

This development is reinforced by what Sparrow, Liu, and Wegner (2011) called the "Google effect." Their argument is that when information is readily accessible online, people become less likely to remember the information itself and more likely to remember how to retrieve it. Instead of retaining content directly, we remember search terms, websites, folders, or platforms through which the content can be found again (Sparrow, Liu, & Wegner, 2011). We mainly remember these associations and store the information externally that way, by knowing how to find it again. A certain degree of this is probably present in more analog learning, but the ease with which we can use this method becomes greater when external retrieval of the information is so much faster than it used to be. The objects we use therefore change the way we store information, which in turn changes the way we solve problems.

Informative Noise

If you have a large, printed user manual for a complicated machine and encounter a problem, you will likely have to read through parts of the manual before finding the answer. In doing so, you may notice the range of topics it covers, and perhaps even come across solutions to problems you have yet to encounter. These encounters with information that is not immediately relevant to the task at hand can be described as *informative noise*: material that appears incidental but may still contribute to the formation of broader knowledge. Each time you return to the manual, you are likely to find the relevant information more quickly, until eventually you may be able to solve the problem without consulting it at all. If the manual is digital and searchable, the process changes. You need only a few words associated with the problem to locate the relevant passage, making you less likely to scan the manual's general contents. You may not even search the manual itself, but instead turn to the internet more generally, finding an answer with a few taps and clicks. Irrelevant information can be bypassed, and there is little pressure to remember it.

Digital retrieval systems therefore optimize efficiency. Rather than wade through a vast body of information, the user can skip directly to the relevant parts. This makes access faster and reduces the need to engage with surrounding "irrelevant" content. Search engines and large databases allow users to retrieve extremely specific pieces of information within seconds, and in many contexts this improves productivity dramatically, particularly when faced with very technical or completely unfamiliar tasks. External memory also expands our capacity by allowing information to be stored outside the mind and accessed when needed. Instead of remembering every detail, you can rely on searchable systems to give you the facts when they become relevant, reducing the burden on your internal memory.

Yet the ability to retrieve information is not the same as the ability to think with it. Problem-solving rarely depends only on isolated facts. Instead, it relies on networks of associations that bring disjointed concepts together and help generate new ideas. When knowledge is stored internally, concepts become linked through repeated exposure and use, forming structures that support pattern recognition, analogy, and flexible reasoning (Hofstadter, 2001). They can also be mapped across different spaces as you move through the world. These internal connections can allow a person to move beyond what is generally and commonly connected information and draw on related experiences or principles from other domains. External retrieval can provide very precise answers, but it does not automatically build these internal connections. If information is only accessed in fragments at the moment it is needed, fewer of these connections would form. Over time, this could reduce the depth of understanding that enables people to generate new solutions to problems rather than just locate existing ones.

This trade-off becomes even more significant when considering the growing role of artificial intelligence in information processing. If digital systems can retrieve information faster and more accurately than people, it may seem natural to delegate increasing portions of cognitive work to them. In theory, artificial systems could take on more and more tasks as the systems advance, possibly relegating human cognition to function primarily as a point of access to machine intelligence. Yet this would introduce a kind of vulnerability. If knowledge becomes exclusively stored and processed externally, individuals would lose much of their ability to challenge or reproduce the results themselves. A society that relies heavily on machine cognition may therefore become dependent on infrastructures that few people fully understand or have the ability to replicate. While these systems can dramatically extend our capabilities, they also concentrate power outside the individual, making manipulation or loss of access far more dangerous.

For this reason, it becomes crucial to protect our capacity to think independently in spite of short-term consequences to productivity, and to guard our cognitive abilities against changing information environments. The challenge, therefore, is not to reject external cognitive systems, but to design environments that combine their efficiency with conditions that support internal encoding and associative knowledge structures.

Hybrid Environments

If contextual cues play an important role in how memories are encoded and retrieved, then environments that differentiate between cognitive activities may support deeper structures of knowledge than those that compress many activities into the same interface. One possible response to the cognitive trade-offs of digital technologies is to reconsider how we use and design those tools. Reading, researching, writing, messaging, note-taking, and entertainment all take place on the same screens, often within the same applications. This consolidation maximizes convenience, but it may also compress the contexts that help structure attention and memory.

Hybrid cognitive environments would move in the opposite direction. Rather than concentrating every activity into a single device, different digital tools could be designed or used for different kinds of cognitive work. A device dedicated to reading, such as an e-reader, already illustrates this principle, and does so successfully. Although a phone or tablet can perform the same function, the e-reader creates a more distinct cognitive environment through its limited functionality, its characteristic display and the texture of the tablet itself. Similar distinctions could exist for other activities. For example, digital tools used for research in libraries could focus on research and archival exploration without simultaneously presenting messages, social media feeds, or entertainment. Writing environments could be designed in the same way, primarily for the writing itself rather than multitasking across many unrelated activities. Occasional and deliberate use of reading material that cannot be copy-pasted and/or searched, would also improve how much information a student would actually gain from the material. None of these changes would be easy or necessarily feel natural to implement, but they might be beneficial to learning in the long run.

The goal of this differentiation would not be nostalgia or the rejection of efficiency. Instead, it would acknowledge that different forms of thinking may benefit from distinct environments that support sustained attention and clearer boundaries between tasks. When all cognitive activities are consolidated into a single device, these boundaries become increasingly difficult to maintain. Whether deliberate differentiation of digital tools significantly improves encoding or understanding is ultimately a question in need of further research. However, it is at least reasonable to question the opposite assumption: that we can compress more and more cognitive functions into the same interfaces without altering the quality of the thinking that takes place within them.

Conclusion

I don’t do work from my bed. Even if digital technologies have dramatically expanded our ability to store, retrieve, and manipulate information, thinking does not occur independently of the environments in which it takes place. When many cognitive activities are compressed into the same interfaces and contexts, the cues that help organize memory and guide attention may become less distinct. The result is an environment optimized for rapid retrieval but less suited to the slower processes that form deeper knowledge. Recognizing this tension does not mean we have to reject digital technology or return to exclusively analog methods, it just means that we should think more carefully about how cognitive environments are designed. Just as homes separate different activities into distinct rooms for the sake of keeping things tidy, intellectual work may benefit from environments that distinguish between reading, writing, research, and communication. As our informational infrastructure continues to evolve, the question is not only how efficiently we can access knowledge, but what kind of cognition our methods actually allow.

References

Bateson, G. (1972). *Steps to an Ecology of Mind.* San Fransisco: Chandler Publishing Company.

Gibson, J. J. (1979). *The ecological approach to visual perception.* New York City: Taylor & Francis Group.

Godden, D., & Baddeley, A. D. (1973). Context-dependent memory in two natural environments: On land and underwater. *British Journal of Psychology, 66*(3), pp. 325-331.

Hofstadter, D. (2001). Analogy as the Core of Cognition. I D. Gentner, K. J. Holyoak, & B. N. Kokinov, *The Analogical Mind: Perspectives from Cognitive Science* (ss. 499-538). Cambridge: The MIT Press.

Hutchins, E. (2010, April 1). Cognitive Ecology. *Topics in Cognitive Science*, pp. 705-715. Retrieved from https://onlinelibrary.wiley.com/doi/10.1111/j.1756-8765.2010.01089.x

Norman, D. A. (1988). *The Design of Everyday Things.* New York City: Basic Books.

Sparrow, B., Liu, J., & Wegner, D. M. (2011, July 14). Google Effects on Memory: Cognitive Consequences of Having Information at Our. *Science*, pp. 776-778.

Tulving, E., & Thomson, D. M. (1973). Encoding specificity and retrieval processes in episodic memory. *Psychological Review, 80*(5), pp. 352-373.