Back to the Oral Tradition Through Skywriting at the Speed of Thought

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Abstract: From the origin of human language 100,000 years ago until the invention of writing 5000 years ago the oral tradition had been the principal creator, conserver and communicator of human knowledge. Our brains are biologically adapted to the tempo of oral interaction in real time. Lapidary writing lost all of that, but soon skywriting will again catch up with the speed of thought.

1. A Matter of Timing
2. The Adaptive Advantage of Hearsay Over Trial-and-Error
3. Recombinatory Knowledge and Reciprocal Altruism
4. The Oral Tradition
5. The Speed of Thought
6. Interdigitating Thought
7. *Verba Volant, Scripta Manent*
8. Phase Lag: *Lento Subito*
9. Skywriting: *Accelerando Poco a*

1. A Matter of Timing. As the stand-up comics tell us, it's all down to timing. But other aphorisms are relevant too: Necessity is the mother of invention. *L'apétit vient en bouffant* (*et l'idée vient en papotant*). There are no monologues, only dialogues; thought is discursive, discourse dialectical; communication interactive. And it all devolves in real-time.

But we are getting ahead of ourselves: What is it all about? Let us accept that the Darwinians offer a reasonable approximation in saying that it is all about survival and reproduction. But species other than our own managed to survive and reproduce for millions of years without saying a word. So our wordiness must have enhanced our adaptivity dramatically, somehow, to have engendered a language-specific organ (the brain, or rather certain specialized parts of it) and a proclivity to spend a goodly portion of our waking lives using it for that purpose.

2. The Adaptive Advantage of Hearsay Over Trial-and-Error. What was the adaptive advantage of language? It can only be measured in relation to the competition. Those who cannot acquire knowledge by hearsay must do it the hard way: by direct, trial-and-error sensorimotor experience. We have shown, in computer

simulations ([Cangelosi & Harnad 2001](#)), that little virtual creatures in virtual worlds survive and reproduce much more successfully if they can learn from overhearing symbolic descriptions of what's what provided by their fellow-creatures than if they have to learn by trial and error from their own direct sensorimotor experiences. In an evolutionary competition, the symbolic "thieves" quickly out-survive and out-reproduce the honest sensorimoter "toilers," who must learn everything the hard way, from experience.

Of course, as described, this is not an evolutionarily stable strategy, for once everyone who can tell us what's what has died out, there is no one left to steal knowledge from, and we are all back to having to do everything the old-fashioned way, through honest toil. Yet that is clearly not the way it works today, for a lot of our knowledge -- most of it, in fact -- is recombinatory. Consider the words in a dictionary. They are defined in terms of other words. Learning from a definition is symbolic theft, yet it cannot be theft all the way down ([Harnad 1990a](#)). Some of those words we must learn from direct sensorimotor experience. But once those words -- those elementary symbols -- have been "grounded" directly through honest toil, the good old way, all the rest of the dictionary (and encyclopedia, and every other kind of text, written or spoken) can then in principle be picked up by hearsay, recombinatory hearsay, composed out of the symbols we have already grounded directly through experience. (And there do exist such dictionaries, with a small, fixed defining vocabulary -- 2000 words or even less -- out of which all the rest of words in the language are then defined: http://www.ecs.soton.ac.uk/~ggc01r/dict/.)

But we have now gotten doubly ahead of ourselves, for we have not yet accounted for the origins of oral language, let alone the advent of writing. That is one of the hazards of mentation at the speed of thought, irrespective of the output medium.

3. Recombinatory Knowledge and Reciprocal Altruism. Back to the virtual world: Whereas an evolutionary competition between pure ungrounded symbolic thieves and pure grounded sensorimotor toilers would be an unstable one, and would just result in a constant evolutionary oscillation between thieves and toilers prevailing, if the complementary advantages of toil and theft are instead internalized within hybrid creatures who are capable of both, as we are, this results in the optimal combination, and a stable one. The child grounds his first word meanings through direct sensorimotor toil, the old way, and can then (in principle) acquire all the rest through symbolic theft, consisting of recombinations of his already-grounded symbols, rather as in the case of dictionary definitions. This hybrid sensorimotor/symbolic ability is a clear advantage over the pure sensorimotor one. To see how, one need only compare the potential difference in time, effort and risk, between learning which foods are edible and which are toxic (or learning which animals are dangerous predators to flee from and which can be safely foraged alongside) through direct trial-and-error experience versus through hearsay.

Hearsay has its risks too, you say? We might be misinformed? Yes indeed, and that risk never quite vanishes. But language almost certainly evolved in a kinship and tribal context where there was minimal motivation to mislead the co-bearers of our selfish genes. And language is a form of reciprocal altruism: Except if we are competing for the same finite resource, you lose nothing if you tell me, honestly, what is and is not edible, or which are and are not dangerous predators; and tomorrow it may be I who know something that you do not. So "cognitive barter" may be a better descriptor than "theft" for the adaptive advantage conferred by language.

4. The Oral Tradition. The oral tradition arose out of this reciprocal altruism. It can be thought of as a collective, serial form

of cognitive barter, whereby we inherit the knowledge of those who have it already, and in return, we add what we ourselves know, or at least pass on what we have learned. It is the oral tradition that allowed the benefits of language not only to be collected and passed back and forth within a generation, but to be passed on across generations.

But what about timing? Not time across generations but real-time, during "online," i.e., synchronous discourse: the timing of hearing and saying. We were constrained here by the time constants of our sensorimotor input/output organs. For various reasons that there is no time to discuss here, I don't think that language actually began in the oral modality but in the praxic one of body movement, gesture and imitation (Harnad 2000). Yet it is neither an instrumental connection nor a morphological resemblance to its referent that makes a symbol a symbol. It is the fact that we intend and use it -- by shared convention -- to refer to that referent. This is Saussure's "arbitraire du signe": Although the power of naming is more likely to be first discovered in an instrumental and imitative context, the instrumentality and the mimesis eventually become irrelevant to the naming, and the name itself might just as well have been in binary code, once it is used in symbolic discourse. Language is in this sense inherently digital.

Moreover, as the true advantages of language do not come from naming, but from combining and recombining strings of names into propositions that define or describe further truths, the optimal sending and receiving medium would need to be a faster and more independent one than bodily gesture -- a medium one can use even if one's hands are otherwise occupied, or if one's interlocutor is not watching, or in the dark. In short, once the advantages of language were discovered and being used, the oral medium was the optimal one to specialize for this purpose, and so it did (Steklis & Harnad 1976). Our inborn language capacity is closely linked to the

speaking and hearing parts of our brains (though it probably has not lost all its ancestral links to gesture either, as evidenced both by the sign language of the deaf and the various other gestural languages that have been spontaneously created in many cultures across the ages).

The means of specialization in question is called "Baldwinian Evolution." We are not born with an innate linguistic skill fully encoded in our brains. We are not born able to speak and understand fluent French or Chinese. We are born with a pre-adaptation to be able to learn language very quickly, and a strong predisposition to do so. Hence we have evolved brains that are born "language-prepared." (It is this organic adaptation that our computer simulations (Cangelosi & Harnad 2001) -- according to our interpretation of them -- show to have been shaped by the dramatic evolutionary advantages of symbolic theft over sensorimotor toil.) This kind of Baldwinian preparedness is shaped gradually by the benefits it confers on survival and reproduction in much the way that structures such as wings, fins, eyes and hearts were gradually shaped by the adaptive benefits they conferred (Harnad 1976).

5. The Speed of Thought. But in becoming specifically adapted to the hardware of speech and hearing, language also took on certain temporal, sequential constraints. A picture may be worth a thousand words, but the picture can be apprehended at once, through many parallel visual processors, whereas the words can only be apprehended serially, and at the limited speed of human speech and hearing. There is hence reason to believe that the speed of human thought itself is of approximately the same order of magnitude as the speed of speech (Harnad 1991). Some of us may speak a little faster than we think, others a little slower, but the the discrepancy is rarely great. Nor could it be, for if we thought much faster than we speak, we would encounter short-term memory and interference effects when we tried to vocalize our thoughts. Moreover, there is

another, perhaps more fundamental contraint on the speed of thought, namely, that discourse is *interactive*. It takes two to lingo (at least). So, again, it is better if you do not speak faster than I understand, and that I not think much faster than I can speak, for it is not only my own thoughts that must stay in phase with the words we exchange, but your thoughts too.

So although our stereotype for the oral tradition is that of one wizened bard or minstrel telling (or singing) his homeric tale as a monologue to many rapt but mute listeners, a more realistic and revealing primal picture would be a conversation or dialogue, one in which the cognitive interaction was bilateral, synchronous in real time, and the information exchanged was of some immediate (and, eventually, longer-term) practical benefit to one or both parties. That was the pragmatic context in which language acquired and exhibited its adaptive value and etched its permanent place in our brains about 100,000 years ago; the tale-telling came later.

Nor could either the initial or the primary value of the oral tradition have been in the tale-telling about ancestors and their exploits. The adaptive advantage must have been in all those practical, daily, survival/reproduction-related matters in which learning by hearsay minimized the lost time, errors, effort and risk entailed by having to fumble and find out everything for oneself -- either solo, or solely through direct behavioral observation and imitation of others. And in the cumulating store of knowledge -- the database, we would call it today -- that was being transmitted within and across generations by word of mouth.

6. Interdigitating Thought. And in the fact that two heads are better than one -- in fact, better than one plus one, if the individual heads would otherwise be doing whatever they were doing all on their own. Dialogue not only informs, and trades existing information: it also elicits and stimulates novel interdigitating

thoughts that, again, may never have occurred solo. In this sense, interactive cognition may *create* information. Language is already recombinatory: Combining the resources of two interacting heads opens up further possibilities that go beyond the sum of the two parts thinking alone, like monads.

And thinking itself -- at least the kind of thinking characteristic of human beings -- surely co-evolved with speaking, not only in tempo, but in its sequential and recombinatory nature. And its interactivity. So much of thought is inner dialogue, and even when an inner monologue, addressed to some remembered or imagined interlocutor.

So the interactivity came with the territory, and so did the tempo of the interaction, and hence of the action; and that interactive tempo was roughly that of speech. One could perhaps rehearse an uninterrupted mental monologue at some length internally, but overt speech in daily life in our ancestral environment was surely anything but soliloquy.

7. *Verba Volant, Scripta Manent.* So now imagine this: What if real-time dialogue were no longer permitted? Suppose oral interactions could only be unilateral monologues, with the turn-around time for a reply being at least a day, but possibly weeks, months, or years. It is unlikely that creatures with the kinds of brain specializations we had evolved -- even with our vaunted capacity for delayed gratification -- could or would voluntarily conform to such a slow-motion form of discourse. If short-term memory and interference problems precluded thinking or conversing much faster than we speak, then surely long-term memory and interference problems (not to mention the immediate practical demands for which the oral tradition originally evolved) preclude thinking or conversing much slower than we speak.

Yet that is precisely the constraint that the advent of writing and the written tradition 5000 years ago brought with them. First, the advantages, and they are legion: *Verba volant, scripta manent*. Writing leaves a (potentially) permanent record, guaranteeing continuity, allowing fact-checking, copying, copy-sharing, off-line/asynchronous reading, etc. Surely it is writing that made science and scholarship if not possible, then at least far more likely. It is hard to imagine that collective, cumulative, self-corrective, systematic and continuous enterprise arising and enduring within the oral tradition alone.

8. Phase Lag: *Lento Subito*. But writing also had a dramatic negative effect (unremarked, because the oral tradition remained available as a back-up and complement, and because no other alternative was known or imagined) on the temporal, interactive dimension of linguistic discourse: It instantly transformed it into asynchronous, off-line monologues instead of the synchronous dialogues for which our brains and our thinking capacity are optimized. It either eliminated the interactive dimension entirely, or slowed it to a pace that was almost a caricature of what the human brain is capable of. Writing is asynchronous discourse -- out of phase with the speed of thought and of synchronous mental interaction. (Perhaps having already developed the habit of listening quietly to tale-telling by the bards prepared us somewhat for this abrupt transformation.)

But because its benefits were so great (and because the oral modality was still there, in parallel, as the backdrop), literacy has been seen as almost as unalloyed a benefit and as revolutionary an advance as language was. And so it surely was, especially when its reach was incalculably enhanced by Gutenberg's invention 550 years ago. Note, though, that no compensatory organic change in our brain occurred, either as a result of the invention of writing or the invention of print. Both were purely cultural developments. And

writing seemed, by its very nature, to entail dissociating asynchronous written interactions from the speed and synchrony of interacting thought.

9. Skywriting: *Accelerando Poco a Poco.* Until the online era and the advent of "skywriting" (Harnad 1990b): I am now going to draw your attention to certain relatively new capabilities that have already become quite familiar to all of us, and so I will have to make an appeal of the kind that Schopenhauer made: that we should try to "make it strange" again, as if encountering it for the first time, so we can see the hidden (and I think revolutionary) potential in skywriting that we have not yet realized or exploited:

Email is undoubtedly a great convenience and a time- and money-saver. It has consequently replaced a great deal of letter-writing; and it has no doubt generated more letter-writing where the old medium would have inclined us either not to bother -- or just to pick up a phone and call instead. But email certainly has not replaced phone calls the way it has replaced snail-mail (Odlyzko 2000). Why not? The answer is clear, and it isn't just because of the cosiness of hearing a voice. It's timing. The phone draws on the primal tempo of real-time discourse, which is what our brains -- and the speed of thought -- are specifically adapted to, one might almost say optimized for. The oral medium is (to borrow a metaphor from its successor and use it paradoxically) an on-line, synchronous real-time medium, whereas writing is an off-line, asynchronous, non-real-time medium.

10. Synchronous Versus Asynchronous Communication. What makes writing non-real-time, however, is not the fact that it is necessarily off-line, for typing can be done on-line too! But anyone who has tried real-time online interactions in writing knows that it is maddening to wait for and watch someone's slow typing materializing before one's eyes -- complete with real-time

backspacing to correct typos. And even if we could type error-free and as fast as we speak -- or if the "dictascript" capabilities of which Dan Sperber wrote were already advanced enough so our words were instantly converted to writing in real time -- that still wouldn't be a satisfying or satisfactory way to interact linguistically in real time. A little reflection shows that if I had real-time dictascript capability and you had real-time dictascript capability, we would not sit taking turns watching what the other had written, we'd switch to audio, and go back to the oral tradition, leaving our respective dictascripts to serve as an instant transcript -- to be looked at off-line at some later time!

And yet, and yet, email's almost-real-time capability, together with its capacity to preserve a permanent record -- a text on which one can then work off-line to edit and enhance it -- is not altogether non-interactive either. Surely it is relevant that the turn-around time for email is incomparably faster than any prior written medium had been (with the awkward medium of telegraphy -- mediated by the telegraph operator and prohibitively costly for iterative exchanges -- its only precursor). The cycle time for written exchanges had been, as noted, a day at its fastest, and more like days or weeks on average. Moreover, if the exchange had not just been that of written letters, but of published texts, then the delays could be more of the order of months or years (and not just because of the delays imposed by peer review, but because of the delays inherent in the Gutenberg technology of encoding, dissemination and access). Compared to such unbiological delays, the potential turnaround time of almost real-time email exchanges begins to take on a new interest.

11. *A Tempo: Allegro Assai.* And in some ways, email embodies the best of both the oral and the written traditions: Email is potentially almost as fast as synchronous oral exchanges, yet it preserves a written record, and allows optional off-line time for

reflection between iterations, if needed, unlike spontaneous real-time dialogue. It also has that other remarkable feature -- the one that motivated calling it "skywriting" -- namely, that email can be one-to-many (recapturing another of the long-lost features of the oral tradition, where the bard can tell the tale to a large audience in real time) in almost-real time: as if the email were being written in the sky for all to see. To the extent that the bards were inspired by their "live" audiences to feats of greater creativity in their (always extemporized and improvised) elaborations of the oral tradition in real time, skywriters too can know, as they compose and post a text (or a comment on someone else's text) to an email list that, almost instantly, many will see it, and some will reply (also almost instantly).

12. Quote/Commenting. Perhaps the most powerful optimization in the hybrid online/off-line -- yet potentially almost-real-time -- medium of skywriting is the quote/comment capability ([Harnad 1995](); [Light et al. 2000]()): One of the limiting factors in oral monologues is memory: If, in a conversation, you speak for too long without letting me reply, I will surely forget some of what you said, and my eventual reply is bound to be much less focussed than it could have been if the chunks between interventions had been smaller. But we don't always think in short chunks, and you might have lost your bard-like inspiration if I had interrupted you earlier, or you had cut yourself short out of courtesy.

Email has no such time or length constraints (except the number of real hours in a day, and the likely interest, attention-span and patience of one's skyreaders). Yet, in providing an instant written record, it makes quote/commenting possible in replying: deleting the portions on which one has no comment, and re-focussing attention on those portions one wishes to address -- with the pertinent quoted excerpt re-presented as a context (and the entire text potentially retrievable as well, as a broader background

context, and context-check). The PostGutenberg polyloquy[1] is readily translatable back to the Gutenberg medium too (see Hayes et al. 1992, Harnad 1994, Harnad et al. 2000).

13. Dead Authors and Live Interlocutors. There is also something intrinsically very conversational and interactive, hence very like the oral tradition, in this quote/commenting capability itself, over and above the accelerated rate of exchange with one's interlocutor(s) made possible by the email and web postings. Emulating this instant "text-capturing" power of digital-text processing would again have been prohibitively time-consuming in the Gutenberg medium, in which copying, retyping or real cut/pasting were the only options. This instant quote/commenting capability can even restore to digital interactions with inert texts (even when their authors are long-since dead) some of the "live" interactivity of the oral tradition -- albeit rather one-sided in the case of an expired author, but other skyreaders can in principle take up the interactive baton, and it can be rather exhilarating to carry on a live if unilateral dialogue with a long-dead author in almost real-time before a live audience that is potentially the entire planet! (The scholarly practise of learned footnoting, and the literary/rhetorical practise of presenting ideas in the form of dialogue or dialectic, are both early harbingers of the potential power of quote/commenting, and its rootedness in the oral tradition and near-synchronous mental interaction.)

Nor is it only the possibility of performing before a large audience that can inspire creativity in a skywriter: According to the anomaly-driven theory of human inventiveness, it is not agreement and praise that inspire and elicit the best from us (though we need some of that too), but challenges, criticism and encountering problems that our current ideas appear to be unable to handle. (In my case, my own better ideas were born whilst in the grip of "creative disgreement" with multiple skywriters critiquing and quote-

commenting them in almost-real time.)

14. Open Peer Commentary. There is of course always the possibility that a predilection for such celestial dialectics is peculiar to me, or an unrepresentative minority like me, but I do have some evidence that this may not be so: Twenty-five years ago, I founded an open peer commentary journal, Behavioral and Brain Sciences (BBS), modeled on a journal founded twenty years earlier by the anthropologist Sol Tax (1907-1995), called Current Anthropology (CA). The formal concept of "open peer commentary" was, as far as I know, original with Tax, though of course it had its precursors in symposia, both oral and written, in the past. CA had rapidly turned into the most visible and influential journal in its field, largely because of the peer-feedback feature, and BBS in its turn did so too, attaining a double-digit "impact factor" within a few years of its inception, making it one of the most cited journals in the multiple disciplines it covered (the biobehavioral and cognitive sciences). BBS authors, too, eagerly sought and kept coming back for peer feedback (some willingly running the peer guantlet as many as four times across the years, as one of its current co-editors did), each time eliciting 20-30 critiques from peers across disciplines and around the world, all co-published with the target article and the author's replies.

I take this as evidence that the perceived value of "creative disagreement" is not unique to the likes of me. But what is remarkable is that all of this occurred *before* the optimal medium for it had arrived! For, far from being near-synchronous skywriting, CA- and BBS-style open peer commentary had been implemented unbiologically, the old, plodding, terrestrial way, with months of delay between target article, commentaries, response, and their eventual co-publication. No doubt this form of off-line, sequential symposium has and will continue to have its uses and value. But is it not time that we also capitalized on the PostGutenberg possibility

of launching open peer commentary skyward, so it can draw upon the full speed and power of near-synchronous cognition and communication?

BBS does have a younger online cousin, Psycoloquy, which is in a position to accelerate the interaction to a speed much closer to that of interdigitating thought, yet authors are still much more reluctant to submit their best work to an online-only journal. Why?

15. Fear of Flying. What is holding us up? -- and particularly as the new medium is not only there and ready now, but is already being used informally for (pedestrian) skywriting in the many graffiti boards for trivial pursuit that are proliferating all over cyberspace, the cyberchat groups? My guess is that what is detaining the peers of the realm (the research community) is the feeling that there is something inherently ephemeral about the new medium -- that it occupies only a virtual space in the real republic of letters. They worry that words written in the sky will vanish into thin air as surely as words spoken orally do.

That is not the only retardant factor. (There are other worries, likewise unfounded -- about peer-review, about academic and career credit, about copyright, about priority and plagiarism, about online readability, about information overload, and more.) But the predominant worry is still about the apparent immateriality -- the virtuality -- of skywriting. Digital bits just don't have that reassuring lapidary feel that palpable terrestrial objects always had.

16. Automatic Skywriting. But here we might be able draw on some of our innate biological resources: Just as when the neurologist needs to tell the alexic (but non-agraphic) patient (who can see, but has lost the ability to read, and understandably assumes that he also cannot write) not to worry, and just to launch fearlessly into "automatic writing" -- with the result that the patient discovers he can indeed still write after all (even though he cannot read what

he has just written) -- so we need to be told by veteran fliers not to worry[2], and just to launch fearlessly into automatic skywriting: confidently quote/commenting back and forth on what we have skyread, and otherwise doing exactly what has come so naturally to our talking heads for at least 100,000 years. Thinking, after all, like speaking and remembering, is all virtual too! It leaves no palpable record (although it does leave a trace -- in our brains). We just have to learn to trust the traces on the web, as we already trust our brains, confident that the information will always be there, accessible whenever we need it, even though we cannot literally put our fingers on it. We need only generate the digital corpus itself; its navigability and preservation will be ensured by a new breed of celestial curators and conservationists and their cosmonautical tools. (Google has already resurrected 20 years' worth of legacy skywriting from the Usenet archive that many thought -- and a few hoped -- had vanished for ever in the aether! Peripherals perish, but bits perdure!)

Nor should we underestimate the awesome power of boolean searches over an inverted index tracking every word in every text that has ever been skywritten: Google, covering over 3 billion documents, already has an information-finding and retrieving capacity -- ranging (potentially) over all of human knowledge -- that not only exceeds that of any human brain, but that places any untutored layman within a few keystrokes of being as well-informed as the most diligent scholar of (paper) days past, on just about any topic. This virtual search-and-retrieve capacity is the one we have to learn to rely on, as we propel our brainchildren into the PostGutenberg Galaxy.

17. Open Access. And the last papyrocentric habit we need to break is the notion that access-toll-gates must always separate our skywritings from their would-be skyreaders, commentators, and users (Harnad 2001). This will certainly continue to be true of

skywritings we write for trade (royalty revenue, fees, salary), but it is already obsolete for skywritings we write only for their scholarly/scientific research impact (our peer-reviewed journal publications). Such writings profit (and have profited in the past) from access-blocking toll-gates about as much as commercial advertising does! (Imagine charging potential consumers admission for the right to see the "Buy Coppertone" ads that smoke-trailing planes skywrite over our beaches in summer!)

18. A Matter of Time. There is every reason to believe that our talking heads and their interacting minds will be incomparably more fecund once those lazy iterative cycles by which our knowledge had been created and cumulated in the Gutenberg era are restored to the speed of stone-age thought by skywriting in the PostGutenberg Galaxy. It's all a matter of timing. And reaping its rewards is just a matter of time.

FOOTNOTES

1. Yes, "pluriloquy" would have avoided the barbarism here, but it would also have been less mellifluous and homologous with "soliloquy." And, just as they say that the nicety of the distinction between *echt* and *ersatz* gothic (collegiate pseudogothic) will fade with the centuries, so the distinction between pure latinate or hellenine coinages and philistine hybrids has just about vanished from memory (along with the study of the two classical tongues themselves). Evolutionary advance though language itself may have been, when it comes to *form* rather than content, it's aesthetically downhill all the way, with ignorance and error always triumphing -- or at least so it is bound to sound to earlier passengers, during their brief portion of our voyage down the entropic slope.

2.

> *...this discovery of yours will create forgetfulness in the minds of those who learn to use it; they will not exercise their memories, but, trusting in external, foreign marks, they will not bring things to remembrance from within themselves. You have discovered a remedy not for memory, but for reminding. You offer your students the appearance of wisdom, not true wisdom. They will be hearers of many things and will have learned nothing; they will appear to be omniscient and will generally know nothing; they will be tiresome company, having the show of wisdom without the reality.* [Plato, "Phaedrus" 275a-b, on

the discovery of writing, as quoted in Odlyzko 1997]

There may be some validity to the concern that too-early reliance on computers for information-retrieval by children may weaken their internal memory-retrieval powers, just as too-early reliance on calculators for arithmetic operations may weaken their calculational and even conceptual powers. The cure for this is of course not to let children use or rely on these nonbiological resources too early in development. By the same token, it will probably become a part of early educational strategy to suppress hyperlink-hopping (or what has come to be called "zapping" in French) to allow the capacity and motivation to read and understand sustained sequential text and reasoning to develop first. This will be as natural as teaching children to listen when spoken to, rather than constantly interrupting after the first few words -- or to walk for themselves, rather than always being carried or chauffeured. No risk of losing one's ambulatory ability because of reliance on rapid transport in adult life (though no doubt a degree of "use it or lose it" applies to all biological functions, throughout the life-cycle).

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