Max Planck Institute for Social Anthropology
Department 'Resilience and Transformation in Eurasia'

Stephen C. Levinson

On 'Technologies of the Intellect'

Goody Lecture 2020

MAX-PLANCK-GESELLSCHAFT

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Jack Goody (1919–2015)

Sir John Rankine Goody was brought up near London and initially studied English at Cambridge. Formative experiences during the Second World War led him to switch to social anthropology. He undertook fieldwork in Northern Ghana during the last decade of British colonial rule and taught anthropology at Cambridge University alongside Meyer Fortes and Edmund Leach. After succeeding Fortes as William Wyse Professor of Social Anthropology in 1973, he began to explore long-term historical contrasts between sub-Saharan African societies and those of Europe and Asia. Following V. Gordon Childe, Goody emphasized commonalities across the Eurasian landmass since the urban revolution of the Bronze Age. In numerous publications he highlighted developments in East Asia and criticised the eurocentric bias of Western historians and social theorists. Core themes include productive systems, the transmission of property and class inequality in global history; kinship, marriage and the "domestic domain"; technologies of communication, especially writing, the transmission of myth, and of knowledge generally; and consumption, including cuisine and flowers. These topics are not approached in isolation but in their interconnections. Ethnographic insights are essential, but they form just one component of Goody's comparative vision. His best known works include *Death, Property and the Ancestors* (1962); *Technology, Tradition and the State in Africa* (1971); *Production and Reproduction* (1976); *The Domestication of the Savage Mind* (1977); *The Development of the Family and Marriage in Europe* (1983); *The Oriental, The Ancient and the Primitive* (1990); *The East in the West* (1996); *The Theft of History* (2006); *Renaissances: the one or the many?* (2010); *The Eurasian Miracle* (2010); *Metals, Culture and Capitalism: an essay on the origins of the modern world* (2012).

Goody's agenda is one which the Department 'Resilience and Transformation in Eurasia' at the Max Planck Institute for Social Anthropology seeks to continue. In an annual lecture series, a distinguished scholar addresses pertinent themes for anthropology and related fields:

Goody Lecture 2011: Keith Hart, "Jack Goody's Vision of World History and African Development Today".

Goody Lecture 2012: Peter Burke, "A Case of Cultural Hybridity: the European Renaissance".

Goody Lecture 2013: Martha Mundy, "The Solace of the Past in the Unspeakable Present: the historical anthropology of the 'Near East'".

Goody Lecture 2014: Francesca Bray, "Rice as Self: food, history and nation-building in Japan and Malaysia".

Goody Lecture 2015: David Wengrow, "Cities before the State in Early Eurasia".

Goody Lecture 2016: Martine Segalen, "On *Papies* and *Mammies*: the invention of a new relative in contemporary European kinship".

Goody Lecture 2017: Nur Yalman, "On Cultural Revolutions: observations on myth and history in Turkey".

Goody Lecture 2018: Sylvia Yanagisako, "Accumulating Family Values".

Goody Lecture 2019: Carola Lentz, "Class and Power in a Stateless Society: revisiting Jack Goody's ethnography of the LoDagaa (Ghana)".

The tenth Goody Lecture was given by Stephen C. Levinson on 6th October 2020.

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Introduction

Preamble: This lecture was written in the midst of the coronavirus pandemic of 2020, and thus with the likelihood it would never actually be delivered! This virus is just one of the pestilences that has swept over Eurasia from the east in the last two millennia, retracing the networks that have linked the continents over the vast temporal and geographic scales that interested Jack Goody. Thanks to the internet, the lecture originally scheduled for May was delivered on 6th October 2020. I was pleased to expunge at least partially the debt to one of my intellectual ancestors. Goody himself would surely have been fascinated by the effects of a new medium of communication, in the age of Zoom.

Jack Goody's work has a stupendous range, covering subjects from kinship to folklore, and flowers to metals; geographical foci from West Africa to Eurasia; and perspectives from the local to the global, and from the contemporary to the historical and archaeological. He has made important contributions in all these domains, as earlier Goody lectures have attested. It's an honour to be given the opportunity to pick up a thread in his work that has been relatively neglected, at least recently and within anthropology.

If I might be forgiven a personal note, I knew Jack Goody from the time I was a Cambridge undergraduate who suffered his lectures. They were as disorganized and as scruffy as his attire (as I later got to know, he was engaged in more serious stuff than undergraduate lectures). After I had become a Cambridge don myself, he was very influential in organizing my own later career! The story in brief is that he was a member of the Max Planck committee that founded a project group on Cognitive Anthropology, for which through his good offices I was selected as a founder. I remember vividly the meetings in Schloss Ringberg, the Max Planck kitsch castle in Bavaria, where he urged me to live dangerously and leave my tenured Cambridge post for an uncertain future. Having decided reluctantly that I should perhaps take the opportunity seriously after all, I thought I had better hurriedly compose a lecture for the occasion, instead of joining him rowing on the lake below. His response was "You swot Levinson!" I am glad I bothered with the lecture, though for complex reasons the project group didn't last long. I ended up in another Max Planck Institute which gave me plenty of opportunities for extensive cross-cultural work that otherwise would never have come my way.

The thread of Goody's work I want to pursue tonight is his concern with literacy, or as he usually put it, with modes of communication. In the *The Domestication of the Savage Mind* (1977; see also Goody and Watt 1963; Goody 1968; Goody 1987), Goody pursues the old but recurrent anthropological contrast between 'modern' and 'primitive' (or 'savage') thought, an idea also implicit in much historical research, in studies of classical Greece and Rome, in folklore studies and beyond. It is explicit, of course, in Durkheim, Lévy-Bruhl, and Lévi-Strauss, but also in the Soviet psychologists Luria and Vygotsky. While Goody rejects simple dichotomies of this kind, he has in mind longstanding contrasts of his own: East versus West within Eurasia, and at a different level the whole of Eurasia versus sub-Saharan Africa. These differences have much to do with the nature of capital and the kinship that channels it. But they must also be investigated via another causal chain, namely the slow historical transition to literacy, and then, initially exclusively in the West, to alphabetic writing, opening up the possibility of universal literacy. The contrasts between West (alphabet) and East (phonosemantic and complex syllabic scripts) nest within the grander contrast between Eurasia (ancient literacy) and Africa (ancient illiteracy).

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A Revolutionary Technology: Goody's Thesis

Goody held that writing was a revolutionary technology that has transformed both society and the human psyche. "The notion of representing a sound by a graphic symbol is itself so stupefying a leap of the imagination that what is remarkable is not so much that it happened relatively late in human history, but that it happened at all" (Goody and Watt 1963: 315). As far as we know it has been invented independently only four times, in Mesopotamia, Egypt, China and Mesoamerica (and perhaps the first sparked the second and third).[1]

Some of that sense of wonder can perhaps be regained by considering the impact of the first decipherment of the Gilgamesh tablet in the British Museum in 1872. The autodidact Akkadian scholar George Smith was so overwhelmed when he discovered the Biblical flood story lock stock and barrel that he took off all his clothes in the Museum and ran around naked![2] Royalty flocked to hear him explain this communication, which after 2600 years came across miraculously clear.

There's little doubt that Goody was drawn to the subject as a potential explanation of the 'great divide' between traditional and modern societies, and more specifically between East and West, and (especially) Africa and Eurasia. But in later works he was properly cautious about the revolutionary repercussions of writing. Literacy was not like gunpowder, an instant revolutionary technology. Crucially, he made the distinction between the technology of a writing system and the uses to which it is actually put (what he called the 'means' [or 'technology of the intellect'] as distinct from the 'mode' of communication; see Goody 1987: 59). He was interested in restricted literacies of different kinds, as where the orthographies were so complex that they were only mastered by elite bureaucrats or priests. Both Egyptian and

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[1] A number of still enigmatic scripts may or may not be indigenous orthographies, (as opposed to systems of mnemonics), e.g. the Rongorongo script of Easter Island. Most such cases, like the Cherokee syllabary, have been inspired by acquaintance with descendants of one of the four independent sources (see Harris 1986).

[2] See https://www.nationalgeographic.com/history/magazine/2018/01-02/history-gilgamesh-epic-discovery/

Mayan hieroglyphic scripts numbered a thousand or more intricate glyphs, combining pictographic, semantic and phonetic information, supplemented with determinatives (which had no role in the spoken language) pointing to the intended semantic category. Early Mesopotamian scripts were restricted to scribes, and Linear B to bureaucrats. Sometimes literacy has been restricted for religious reasons, as in the Brahmanical monopoly over Vedic learning or Arabic mastery in traditional West Africa (see Goody 1968: 11ff.). In medieval western Christianity it was restricted to the church (where it offered a route to social mobility) and later to the nobility, in part because Latin was the medium, until the rise of the mercantile classes in the last centuries before the invention of printing. In early modern England, female literacy remained negligible. It only reached 30% by 1750. World literacy levels as a whole only reached 50% with the dissolution of colonial rule around 1950.[3] It has always been in the interests of the ruling classes to restrict this radical agent of social mobility. Goody made the point that the potentially revolutionary effects of writing can be held at bay for centuries; but once the tiger is released, social and cultural change is massively accelerated. Even if he was wrongly interpreted as simply replacing one dichotomy (e.g. primitive vs. modern) with another, his focus on literacy was never purely descriptive, because it had an important causal component.

As always, Goody researched the issues deeply. He updated and softened his account of the revolutionary nature of the alphabet in *The Interface between the Written and the Oral* (1987). Here he also drew attention to the deep relationship of writing to visual art, for example in ancient Egyptian art, although he didn't dwell much on the special ontology of writing. A picture is (often) a representation of something; but a written word is a representation of sounds (at least on the standard alphabetic account) that in turn are a representation of something – that is, it is a representation of a representation. Although this curious ontology seems to open a gulf between writing and representational art, it is actually more of a gradation. Consider for example a road sign depicting falling rocks. This is also a representation of a representation ('beware possible rockfalls'; see Harris 1986). Road signs are intended to bypass language and have universal interpretability. In this respect they belong with musical and

[3] https://ourworldindata.org/literacy#historical-change-in-literacy

mathematical notation, which are forms of writing that have no dependency on any particular spoken language. Notice that Chinese, with very different phoneme inventories in its ten major dialects, has a writing system partly independent of the sounds of the languages thanks to a core set of symbols that are meaning based. The wider accessibility of Chinese writing systems (both the traditional and the simplified) comes at the cost of having to learn at least 3000 basic symbols. In many periods of history, we have been willing to give up the correspondence with spoken language in order to retain greater universality, as when a written archaic language is used as the medium (Latin in pre-modern Europe and Aramaic in the Assyrian empire). The virtues of the alphabet, with its ideal of a close correspondence with the phonemes of a specific language, can be overdone: there are costs as well as benefits of the close isomorphism of an orthography with a spoken language.

Goody explores the implications of literacy and the long causal chains it triggers off. As he puts it (1987: 53f.), the effects exist "at three related levels, storage (intergenerational transmission), communication (intra-generational) and internal 'cognitive' effects." The storage function enables records that in turn enable book-keeping, systematic inventories and taxation. More fundamentally, it enables the vast accumulation of knowledge and expertise on which modern polities are based, opening up the possibility of systematic science and history. Many observations and scientific theories rely on the accumulation of data over greater timescales than a single human's working life. Thus, it was the availability of astronomical records dating back hundreds of years that allowed Halley in 1705 to predict the 75-year periodicity of the comet that bears his name.

Literacy also fundamentally extends the nature of human communication, both over space and over time. The spatial dimensions contribute to the formation of large centralized polities and empires, while the temporal dimensions make possible a completely different order of cultural accumulation – an ability to engage with our long dead ancestors. But in addition, and this is crucial for my lecture tonight, literacy changes the nature of mental life, because it makes visible and recurrently inspectable what is otherwise a transient speech signal that rapidly fades from recall. Goody illustrates with lists, which seem to be the earliest uses to which literacy is put, and also with tabular representations, which in the early stages of literacy often have a magical function. Some forms of early writing are almost cryptographic, such as the twig runes deciphered by counting places in five segments of the alphabet (Findell 2014: 62ff.). In the more rational direction, written speech can be inspected for its logic and contradictions. This naturally gives rise to metalinguistic deliberation, without which dictionaries, the study of rhetoric and logic cannot easily arise. And clearly writing offers an extraordinary prosthetic to our poor memories.

Each of these causal chains could engender a dozen PhDs and a score of monographs. Take for example the relation of literacy to state formation. Large states have come into being without literacy. It is common to cite the Inca, whose *quipu* technology, however, performed some of the same functions as writing. Different kinds of information could be encoded by knots on different colours of string, but aside from precise coding of numbers the interpretations may have relied on verbal messages accompanying the strings. The main driver of state formation may often be military rivalry (Turchin et al. 2013), but literacy is a closely linked concomitant, a facilitator of the efficient bureaucracy that enhances state formation. Ancient Rome employed the same number of bureaucrats as the European Commission (Crooks and Parsons 2016). When empires fail, literacy erodes, as both the Mayan states and the Roman empire demonstrate. It may be in the self-interest of bureaucracies to restrict literacy to a specialist class, caste or cadre, as with imperial Chinese bureaucrats or the ancient Egyptian or Mayan priesthoods, where the formidable complexity of the writing systems helped to maintain monopolies of power. Goody (1968) suggested that restricted literacy was part of what marked off the East from the West. Compared to China, alphabetic urban literacy was higher in the Middle Ages and Early Modern period in the West. Unrestricted literacy was perhaps a key factor in the characteristically Western rational skepticism that underlay the growth of science and technology (a more nuanced view can be found in Goody 1987).

But these are not directions I shall follow tonight. I am particularly interested in changes in the mode of communication that radically affect our very mentation. Reducing – traducing perhaps – Goody's discursive thesis into a nutshell of propositions, his claims amount to something like this:

1. Literacy changes our modes of communication by adding a channel that allows communication over time and space. The spatial extension allows

integration of larger communities and polities, and unrestricted literacy affords democratization and the spread of radical doctrines, as it did in the Reformation or the rise of socialism. The temporal extension allows us to commune with our ancestors, thereby enabling an unprecedented accumulation of knowledge, opinion and regulation. The existence of a literary channel may also affect the oral mode of communication, as when oratory becomes informed by rhetoric (Goody 1977: 159). These are, as it were, the overt material and social affordances.

2. Literacy changes our inner life, our mentation and cognition. It does so by externalizing thought and language, which then become recurrently inspectable. This rumination or metacognition is transformatory, making possible the checking of deductions, the induction of generalizations, the addition of long lists of numbers or more complex calculations, even the exact scanning of poetry. "The written is externalised thought which is in turn reflexively interiorised by the reader and indeed by the writer" (Goody 2002: 26). By externalizing the thought or the language, patterns become visible, as in anagrams, in the diagonals of matrices, the realization of gaps in tables (still informing the discovery of new elements in the Periodic Table) or the emergence of the whole field of geometry, cartography and the related skills of navigation (Goody 1977: ch. 4). The externalization of thought then becomes internalized – our thoughts are channeled by the re-ingestion of externalized thoughts, and by the mental disciplines instilled by externalization. A simple example is the acronym or abbreviation, which by reducing the mental 'chunks' makes mental computation much more efficient (Miller 1956). In addition to the computational advantages, literacy offers a fundamental shift in our memory capacities, as reflected in the prevalence of lists in the early cultural stages of literacy (Goody 1977: ch. 5).

3. The changes in our mental life have potentially profound social consequences. Externalization of thought not only makes it available over time and space but it also grounds the critical inspection of others' messages, so engendering the kind of reciprocal skepticism that informs science and social and cultural change. The cognitive gulf between literate and illiterate peoples is indeed profound (as the Soviet psychologists Vygotsky and Luria had showed), but this does not support simple cultural dichotomies of the kind that Lévy-Bruhl or

Lévi-Strauss imagined. This is because of the varieties in the technology itself (e.g. alphabetic, syllabic or phono-semantic), its social distribution (restricted versus universal) and the cultural uses to which it is put (religious, bureaucratic, literary or scientific).

In the rest of this lecture I shall concentrate on the second of these propositions, which never ceased to intrigue Goody even though he was no specialist in the cognitive sciences. I shall not dwell on the way he mocked structuralist analyses (1977: 62ff.), or rebuked folklorists for mistaking artful variations on a theme for formulaic speech (1977: ch. 6). I am more interested in the central thesis itself. Let me quote from *The Domestication of the Savage Mind:*

> [List-making] it seems to me is an example of the kind of decontextualization that writing promotes, and one that gives the mind a special kind of lever on 'reality'. I mean by this that it is not simply a matter of an added 'skill', as is assumed to be the case with mnemonics, but of a change in 'capacity' (…) my intended meaning seems similar to George Miller's when he writes 'the kind of linguistic recoding that people do seems (…) to be the very life-blood of the thought processes (1956: 95). Writing, list making, involve linguistic recoding. (Goody 1977: 109)

He goes on to quote Bruner to the effect that

> cognitive growth (…) occurs as much from the outside in as the inside out. Much of it consists in a human being's becoming linked with culturally transmitted "amplifiers" of motoric, sensory and reflective capacities (Bruner 1966: 1–2).

Goody argues that

> (…) the graphic representation of speech (…) is a tool, an amplifier, a facilitating device, of extreme importance. It encourages reflection upon and the organization of information, quite apart from mnemotechnic functions (…). The existence of the alphabet therefore changes the type of data an individual is dealing with, and it changes the repertoire of

> programmes he has available for treating this data. Whether or not it changes the hardware, the organization of the central nervous system, (…) is another matter, but on the analogy of language the possibility is there (1977: 109–110).

At the time Goody was first entertaining these ideas in the 1960s, similar notions were already in the air. Marshall McLuhan, famous for his dictum 'the medium is the message', was exploring how changes in the modes of communication had changed the cultural world. In *The Gutenberg Galaxy* (1962) he argued that the alphabet and subsequently moveable type had profound mental and social consequences through the dispersion of ideas.[4] Walter J. Ong, McLuhan's student and another literary and communication theorist, argued (1967, 1982) that there was a continuum from orality to literacy, from the early stages of scribal literacy through to the stage of residual orality. He associated orality with circular patterning and reasoning, and literacy with linear development and reasoning. From the viewpoint of the student of literature and the classics (whence Goody came), one could observe the colonization of the interior landscape by self-conscious deliberation. The emergence of articulated individuality was a consequence of literacy.[5] Closer to anthropological *terra firma*, the field-working psychologists Sylvia Scribner and Michael Cole were by the 1970s empirically investigating the transformatory role of literacy on cognition among the Vai in Liberia (Scribner and Cole 1981). Their finding that an indigenous script did not in itself cause radical transformations of memory, classification or inference tempered Goody's later work (Goody 1987: ch. 9). But literacy did have far-reaching effects when embedded in Western schooling, in line with Goody's insistence that it is the historical variety of the social institutions that inculcate, enhance and exploit the full potential of literacy. Michael Cole inspired an interesting but short-lived movement, variously known as Situated Cognition, Distributed Cognition, or Ecological Cognition, which combined insights from Vygotskyan psychology (as then

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[4] Although McLuhan studied in the English Faculty in Cambridge in between 1936 and the early 1940s, where Goody might well have met him, Goody never refers to him. References to Ong are, however, copious.

[5] "The fact that we do not commonly feel the influence of writing on our thoughts shows that we have interiorized the technology of writing so deeply that without tremendous effort we cannot separate it from ourselves or even recognize its presence and influence." (Ong 1986: 19).

becoming available in English) and sociocultural anthropology.[6] The movement emphasized the role of situated social interaction involving cognitive artefacts – that is, things which aid memory and computation. The insight, attributed to Vygotsky, was that external procedures can become internalized so that they come to be part of our mental architecture.[7]

More recent work has proven that literacy radically restructures the seat of cognition, the brain. Brain imaging of matched literates versus illiterates (e.g. nuns and their illiterate sisters, or schooled soldiers vs. unschooled guerillas) shows that reading exploits brain plasticity to build greatly enhanced connections (white matter tracts) between the hemispheres (the corpus callosum), and enlarged areas of grey matter in crucial locations (Carreiras et al. 2009; Castro-Caldas et al. 1998; Dehaene 2009; Paz-Alonso et al. 2019). The differences are substantial enough to form an anatomical signature of literacy. A particular visual area becomes a specialized grapheme detector (dubbed the visual word form area) at the expense of the neighboring area involved in face discrimination (the fusiform gyrus). These adaptations greatly facilitate and speed up the reading process. Just as the use of muscles changes underlying bone structure and density, so culturally specialized uses of the brain enhance its capacities in relevant areas. Indeed, it is well known that literacy, by virtue of exercising neural tissue, helps to protect against dementia and declining mental powers (Manly et al. 2003). Dehaene and Cohen (2007) describe this as the 'cultural recycling of neuronal circuitry', the cultural exploitation of pre-existing machinery (evolved in this case for fine line discrimination). The consequence is that orthographies tend to utilize the same recurrent sorts of lines, curves and angles. It's a mutual re-adaptation of culture and brain around a technology that enhances mental processing in one domain, at some cost to others (face recognition areas in this case).

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[6] Another important antecedent was the Cambridge maverick, Gregory Bateson (see Bateson 1972). See Overmann and Malafouris (2018) for an overview of this movement, which continues to flourish in cognitive archaeology (Overmann 2017).

[7] Vygotsky's 1934 book *Thought and Language* was not translated into English until 1962. A better version was published by MIT Press in 1986. His views probably had little influence on Goody's early work but are clearly evident in Goody 1977.

Figure 1: A young man records who gave which valuable to whom at a mortuary ceremony on Rossel Island, Papuan New Guinea.

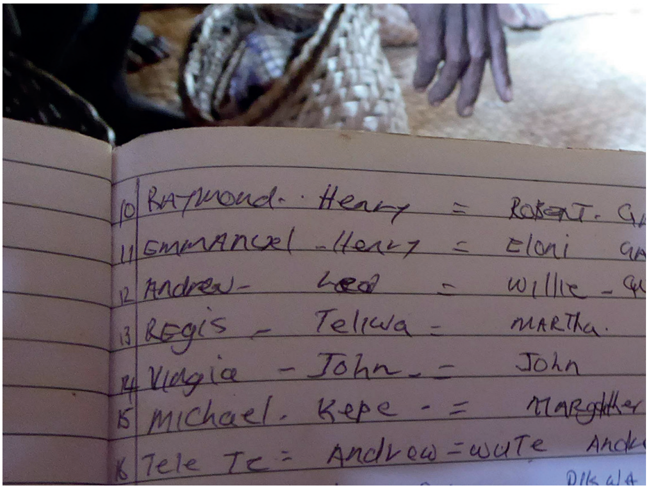

Figure 2: A typical written record of axe givers and receivers at a mortuary ceremony on Rossel Island (August 2016). It records for example that axe number 10 was given by Raymond Henry to Robert Guamowe (English names in the spelling used).

Goody's suggestion that changes in the modes of communication may have potentially deep mental impact was thus prescient. His characterization of the early stages of the impact of literacy also strikes a chord in myriad ethnographic observations. Let me illustrate here from my own work on Rossel Island, the 'ultima Thule' in the long line of islands trailing out to the east from Papua New Guinea. First contacted by Western sailors in the 1840s, but not effectively missionized until 1953, and neglected by governments and traders by virtue of its distance and isolation, this is a society where literacy has few functions. Thanks to mission schooling, most adults nowadays are capable of reading and writing in English, although in the absence of shops, state institutions or much reading matter, there is little use for these skills. There's a local bible translation, but because the indigenous language has 90 phonemes and the writing system involves complex diachritics, few master it. So what are the few examples of writing used for? As Goody predicts, primarily for lists, tables and religious purposes (for Christianity, of course, is a religion of the book).[8] At the major *rites de passage*, marriages and funerals in particular, spectacular exchanges of valuables (shell 'money', shell necklaces, stone axes) take place (Armstrong 1928; Liep 2009. A young man is pressed into service to note who donated which axe, or which high-ranking shell coin, and to whom it was entrusted for safe keeping – for within a generation or two it will flow back to the donors or their descendants (Figure 1). An elaborate table is constructed accordingly (see Figure 2). Although this allows public inspection of the records at the time (and the frantic nature of the transactions makes that invaluable), it does not serve as an effective long-term record – paper-devouring cockroaches or one of the frequent cyclones are likely to destroy it in a few years.

Collective memory remains the critical instrument. I have noted in the field that Rossel people demonstrate spectacular memories, learning for example one of the local genre of light operettas which run all night and consist of up to 50,000 words in just 10 rehearsals. Participants (male, aged from 7 to 80) must learn all the words, since all may be picked on to sing solo at random intervals. Goody (1987: ch. 8) suggests that, at least in traditional West Africa, *verbatim* learning was not the aim. This he held is a preoccupation of literate cultures.

[8] The esoteric value of literacy is shown by the Rossel cultural origin myth in which the culture hero produces a little black book along with the first shell money – a book since lost but whose reinvocation figured in a recent cargo cult on the island.

The Rossel song performances, of similar length to the Bagre myths transcribed by Goody, show that exact repetition can in fact also be a characteristic of non-literate verbal performance.[9] As in many simple societies, Rossel children are given long verbal messages to deliver verbatim to another distant household. We have examined also Rossel peoples' knowledge of the vast kinship network that ultimately unites all 6000 of them (Casillas and Levinson, in preparation). We have found that children on Rossel Island are precocious, knowing and reasoning about relationships in a way that Piaget would have predicted was impossible at a young age. Kids of six or seven can recite their ancestors up to 11 generations back. Literacy trains short-term or working memory (the brief 20 second buffer with which we do immediate computations) and therefore confers some immunity to the inevitable erosion of working memory with age (Kosmidis et al. 2011). But on the other hand, it may well erode our rote-learning skills, our long-term memory. The inverse relationship between advanced literacy and trained long-term memory seems intuitively clear (most field workers have been subjected to the local astonishment at the ethnographer's abject failure to remember all the words or facts given to him or her), although I know of no science on the subject. Socrates relates in the Phaedrus (Fowler 1914: 274f.) how the Egyptian god Thoth[10] presented the Pharaoh with writing as his greatest invention, but Pharaoh responded,

> this invention will induce forgetfulness in the minds of those who learn to use it, because they will not practice their memory (...). You have invented an elixir not of memory but of reminding; and you offer your students the appearance of wisdom, not true wisdom.[11]

Indeed literacy has costs, as the Pharaoh saw, for those of us lost in the labyrinths of bookish learning.

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[9] "By and large in the simpler societies exact repetition of standardized verbal forms (…) is rare" (Goody 1987: 177).

[10] Thoth was also appropriately patron of all areas of knowledge and 'lord of time' and 'reckoner of years' (Wilkinson 2005: 216).

[11] I owe the citation to R. Harris (1986: 19). The Sumerians too had a myth about the origin of writing, which in their case was the invention of a king (Yushu 2010).

Generalizing the Notion of a 'Technology of the Intellect'

Let us now return to the central idea, the concept of a technology of the intellect, where externalization of a mental process has both social and mental consequences. One reason perhaps that current anthropology hasn't pursued the concept of the technology of the intellect is the woeful neglect of material culture – there is extraordinarily little work on the daily life of things.[12] Let me give a very simple example of a thing that serves a practical and mental function: the Mayan planting stick or dibber. Every Tzeltal man was traditionally armed with a planting stick, roughly standardized to about a meter long. It serves to prick the earth for inserting seed corn, 3 per dib. But it also serves to mark the distances between plants, and thus between rows of corn. In so doing, it enables a measure of the day's work, and the expected crop, and even the size of a field for land transactions. The farmer can think 'I've planted twenty rows of twenty dibs, so I've made 400 holes, with 3 seeds each, and thus I can expect 1200 plants each with 2 ears of corn, so 2400 cobs, or a quarter of a year's supply. So, this field is worth a quarter of my family's capital.' A hired planter can likewise be paid in tortillas according to the rows planted. In this way a simple tool can facilitate complex computations, and the same goes for all the traditional measuring baskets for grain (like the bushel) or other produce. English traditional measures of length and volume come from semi-standardized things or processes, from furlongs (the length an ox could plough without rest) to acres (the area ploughed by an ox in a day), from chains (100 links in a measuring chain) to perches (the measuring rod). These examples should open our eyes to the huge range of artefacts that have played an important role in our mental processes, long before the mobile phone or the GPS machine.

Mayan peasant cultures have had market economies, where measures flourish, for millennia. It is interesting to contrast Rossel Island, which has no market economy (Liep 2009: ch.5). Rossel families and villages are highly self-

[12] An exception is the work in ethnoarchaeology (e.g. Malafouris 2013), and the exceptional work of e.g. Hutchins (1995), Suchman (2007) in the Situated Cognition tradition. See also Jeanne E. Arnold et al. 2012. *Life at home*. Cotsen Institute of Archaeology Press, UCLA.

sufficient, but as is common throughout Melanesia they freely exchange goods in the expectation of future reciprocity. They use no standard measures. When they build a canoe or house, young men are sent to the bush and return with the longest poles they can carry. Constructions are judged optically, and the extra lengths are simply cut off and thrown away. Both labour and raw materials are not in short supply – why measure?

Dwelling on simple measures like the Mayan dibber may seem incongruous in our modern world, suffused by information technology. But their very simplicity offers our best bet for understanding the fundamental workings of ‘technologies of the intellect’. Let us call such objects ‘cognitive artefacts’: what we have in mind are external aids to solving internal cognitive problems, themselves mostly of course sparked by external problems of some kind. We shall return later to give a more precise characterization. Let us now traverse a series of domains, focusing on relatively simple cognitive artefacts and the principles that underlie their cognitive efficacy.

Consider first the technologies for measuring time, which came to play such an important role in Western social life, from regulating religious observances to coordinating work and warfare (not to mention finding longitude in eighteenth century navigation). We have, of course, an inner sense of time, based on internal cycles from the brain, the pulse, the breathing cycle, circadian rhythms, menstrual cycles, associative learning (as in Pavlov’s dogs) and other sources, but this sense is notoriously contextually variable. These internal rhythms take their cue from external sources like the diurnal, lunar and seasonal cycles. Precision only comes from controlling this external reference, for example by reference to the fruiting of trees or movements of celestial bodies. I know I was startled to be told by Mayan hosts to get up when the moon had just arrived at an indicated point in the sky, since I don’t keep track of the advancing movements of the moon, and indeed find its movements mysterious. Upper Paleolithic hunters seem to have kept track of the movements of the moon with the aid of notched calendars (Marshak 1972). Similarly, I’ve noted Rossel Islanders point to spots in the night sky and arrange a meeting when the sun will be just there at the indicated spot (Levinson and Majid 2013; see also Floyd 2016). Although we know something about ancient time measurement in the Americas and elsewhere (Aveni 1989), there is a relative dearth of ethnographic observation (but see e.g. Evans-Pritchard 1940 on the temporal organization of Nuer life).

For the coordination of complex societies and markets, a tool is needed to divide the day objectively. Sundials (with 12-hour divisions) go back to ancient Egypt and Mesopotamia (see Aveni 1989). At root, they are simple things. When running memory experiments with Aboriginal people in Cape York I used photos, and was startled to find people using the inadvertent shadows in the photos to estimate the time and direction of the shoot. So, one's own shadow gives a measure of time. But as greater accuracy was sought, it was found that the gnomon (shadow-casting structure) should be aligned with the celestial poles, and allowances had to be made for the oscillations of the earth's axis with regards to the sun's ecliptic. A great deal of careful observation and understanding of celestial motion goes into the construction of an accurate sundial (Rohr 1996). Water clocks (based on controlling drip or submersion) were used by the Greeks and Romans to allocate times to plaintiff and defendant in court. They also featured in traditional Persian irrigation, apportioning water shares by time.[13] Precise diurnal time measurement played an important role in ancient marketing, as it still does in international stock markets. Medieval mechanical clocks ushered in the search for ever more precise diurnal units, with the increasing interest in the measurement of the working day, the management of shifts, and in general the control of productive labour. A great deal of astronomical knowledge goes into calendrical time (Goody [1987: 213] is surely right that this presupposes literacy) and its externalization as cognitive artefacts like astronomical alignments and clocks, calendars and tables (see Aveni 1989).[14] What I want to stress, following Goody, is the intimate connection between the cognitive technology of time and socio-economic complexity and political organization.

Another domain where technologies of the intellect are obvious is the realm of number systems and mathematics. Our native grasp of number (as shown in infancy) is identical to that of most other mammals: we have an innate ability

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[13] Leach (1961:160ff.) describes how water rights are distributed in Pul Eliya, not in this case by time, but by gaps in miniature weirs that divide water by proportion of the flow. This is another kind of cognitive artefact where complex fractions of water flow are assigned by so many inches of weir after weir.

[14] Remarkable is the ancient Greek Antikythera mechanism, a gear-driven calendrical computer that predicted eclipses, lunar movements, and probably planetary motions (Marchant 2008). Perhaps in this account I have overemphasized the practical side of our computational interests, and underestimated the role of the pleasure we get from just understanding the workings of the natural world.

to subitize (assess numbers of items at a glance) up to about 4 items (compare your visual assessment of 000 versus 0000000). Beyond that we have only a sense of approximate number or mass (as when we choose the larger pile of chocolates). To bridge the two systems and make the approximate one precise, we need a number system (Dehaene 1996). Peoples like the Pirahã have no number system and cannot make this bridge (Gordon 2004; Frank et al. 2008), thus demonstrating the cultural nature of number. The first step is to make a 1:1 correspondence between the items of interest and some external counters. This is the basis of tally systems, which seem to have already been in use in the upper Paleolithic (as with the Ishango bone, made 20,000 years ago). Tallies also seem to be the ultimate origin of our writing systems, since Sumerian writing seems to have developed as a way of notating on the outside of a clay envelope the kinds of tallies within (Schmandt-Besserat 1996). Indeed, the earliest orthographies are almost certainly numeral systems. Tally marks could be made on a stick, and then split to create an unalterable record for both parties to a transaction. Such a system remained at the heart of the British Exchequer (named after the checker board used as a primitive abacus) until 1826.

Tallies come in many different forms. Rossel Island is famous in economic anthropology for its shell money system (Armstrong 1928; Liep 2009). In one of the few linguistic loans from surrounding Austronesian peoples, Rossel Island people use a decimal number system, with names for large numbers. One type of shell is a pierced polished roundel of Chama, a clam bivalve. These are kept strung on tough stick-like coconut thongs, ten shell ‘coins’ per string. When it comes time to pay brideprice, the groom travels around the island collecting contributions from all his kin, which will have to be repaid in due course. At the ceremony, the shell ‘coins’ themselves are taken off the thongs, and restrung on a long thread which is displayed at the marriage ceremony and judged by its rough length, as a celebratory show of the girl’s worth, and the groom’s kin support. How do they keep count of the over one thousand such shells typically given as bridewealth at a marriage, especially given the chaotic hubbub of the event? By unstringing the coins, the old thongs can be collected in the hand: counting them as the ‘coins’ are unstrung will give an immediate indication of the number of groups of ten. Thus, aided by the decimal system, the officiating men can announce the triumphal total number in real time. The thongs act as tallies.

Given 1:1 correspondences, the next step in building a number system is to construct an ascending series. Here again, an external device is handy – and the hands indeed provide a ready beginning. Although the digits offer us both a ready-made decimal and vintegesimal system, many cultures have used other body parts as well, resulting in a huge diversity of body-counting systems (Bender and Beller 2012). Once we have names or graphemes for each place in the series, together with the idea of 1:1 correspondence, we have a number system (Ifrah 1998). For larger numbers, counters can be used, and many cultures have discovered that complex calculations can be carried out much more easily with an abacus made of counters and tablets, compartments or rods (Ifrah 1998: 125ff.). The Chinese abacus and its relatives are still in use today, greatly facilitating routine calculations. It has been shown that routine use of the external device soon gives rise to the ability to work with a virtual, mental abacus. Western children trained in this method are fast mental calculators (Barner et al. 2016), using visual imagery specific to the machine (Frank and Barner 2012). This re-internalization of an external aid parallels what Goody thought occurred with literacy, and is an important part of the efficacy of technologies of the intellect. As with literacy, changes in the neural anatomy reflect this re-wiring of the mind (Wang 2020).[15]

Another domain where cognitive artefacts have played a crucial role is navigation. First, there are directional aids, from the simple mast pennant indicating prevailing wind direction to the compass. Second there are the devices that have helped navigators to get a 'fix' – from the medieval cross-staff, to the celestial astrolabe or sextant, and the chronometer which made possible the Age of Discovery and Western colonization. The use of radar beacons by aviation and shipping has allowed for precise homing with limited visibility since the Second World War, while the development of GPS in the 1990s revolutionized navigation on land, at sea and in the air. Charts and maps (or their modern equivalent the GPS-enabled chart plotter) have played a critical part in the development of world commerce. All of these complex artefacts allow us to externalize computations, which can then be married with other calculations and observations to yield a probable location and heading. This has been much studied in the history of science. By the time

[15] Frank and Barner (2012) show that mental arithmetic involves fundamental visual processing in mental abacus users.

anthropologists investigated indigenous navigation techniques, most of the extensive knowledge had already been lost, but what we have shows how rich the lore was. Polynesian navigators (Gladwin 1970; Feinberg 1988; Lewis 1972) used celestial maps to help memorize star rising and setting points. As stars rise four minutes earlier each night, a great sequence of guiding stars must be remembered for each island destination (Lewis 1972: 45), and instructors lay out star rising and setting points with shells in the sand (Gladwin 1970: 129). Such navigation techniques allowed Austronesian languages and cultures to straddle the world from Madagascar to Hawai'i, just as the compass and astrolabe and paper charts facilitated Western colonization, the slave trade and globalization more than a millennium later.

Traditional Western navigation externalizes the process, plotting progress on charts as calculated from compass, ship's log (speed through the water), and astronomical observation (see Hutchins 1995). Traditional Polynesian techniques relied on internalization of star charts, or charts showing wave interference patterns around islands, wind compasses, knowledge of the signs of land over the horizon (orographic cloud, behaviour of sea birds, etc.). Both systems depended on formal instruction with graphical explanations, but the Polynesian navigator relied on observation, practice and memory rather than cognitive artefacts. As with literacy and the abacus, navigational cognitive artefacts can be internalized, i.e. used virtually in our mental lives. Although American interpretations of Vygotsky have come in for criticism of late (Miller 2011), his theories that instruction and practice lead to internalization of cultural solutions, opening up to fundamental reconceptualizations and new ways of processing data, seem a valuable underpinning of Goody's thesis.

Studies of indigenous wayfinding have revealed striking contrasts with Western everyday practice: while we find our way using instructions of the kind 'go left then right, then straight ahead', many indigenous cultures prefer 'go north, then south, then east' adding the actual direction of the overall trajectory (Levinson 2003a). The ability to do so relies, of course, on a constant sense of direction, a mental compass as it were. Working with an Australian Aboriginal group (the Guugu Yimithirr) in Cape York (Levinson 1997), I found the accuracy of the mental compass and the calculations using it quite extraordinary. Checks on bush walks showed an unerring precision, and formal experiments confirmed that bodily left and right played no role in participants' spatial memory. A gesture about where to buy fish-bait in a store which I took to mean 'on the left-hand side' meant 'in the freezer on the northern side'. Dreams were reported as oriented, photos inspected for shadows to help locate them, bible stories fixed in orientation: even the direction of heaven had to be ascertained! Asked how they manage to drive on the left, they gave me the simple algorithm: the driver keeps his body in the middle of the road. My efforts to disturb their extraordinary sense of direction, for example, by driving them down a winding road in the night with the cabin lights on, failed completely. The question is: where does this impressive 'mental compass' come from?

I believe the system is inculcated in childhood by language, gesture and example. Children would hear 'Move a bit east', 'Watch out for that deaf adder under the leaf just south of your foot', 'Go and get the fishing line I left west of the mango tree' and so forth, accompanied mostly by gesture which gives more precise indication of angle. Haviland (p.c.) has calculated that about one word in ten in Guugu Yimithirr is a cardinal direction term, so this is a system that is massively overlearned in childhood. Unfortunately, language transmission has been partially interrupted, and it wasn't easy to study the ongoing acquisition of the Guugu Yimithirr system by children (but see de Leon 1995). But in Tenejapa, a Mayan community in which Penelope Brown and I have worked (Levinson and Brown 1994), a similar reliance on internalized cardinal directions offered us the chance to study how children acquire this system. Both the Aboriginal and Mayan groups have labels for cardinal directions, and Mayan kids learn remarkably early the same non-egocentric mode of spatial calculation: kids are told to go and get the bush knife put aside north of the campfire, or at the southern boundary of the field, and so internalize a mental compass, without which the simplest of conversations is hard to understand (Brown and Levinson 2000). Alternative accounts of how children learn such a radically different solution to spatial conceptualization might emphasize things other than communication. Clearly ecology matters: we live in rabbit warrens with limited visual access to landmarks or celestial bodies, they live in the big outdoors; we follow meandering roads, they 'bush whack' innovating new paths. But ecology merely provides the functional challenges that culture must answer to, and individuals must learn to master. From the perspective of the Tzeltal child the linguistic input is crucial – it provides recurrent insistent training on the mental compass. Language and associated gesture become crucial tools for solving spatial problems, and what has been learned externally through communication comes to play a dominant role in internal mental life (as mentioned, Guugu Yimthirr speakers see orientation in photos through the shadows, and they even claim to dream in an oriented dreamscape).

Language as a Technology of the Intellect

This brings us to the central realization that language itself is a cognitive technology. This obvious implication has been resisted in the language sciences due to the Chomskyan emphasis on the innate and arbitrary character of language, with nooks and crannies of anti-functionality. That emphasis is thankfully fading (Evans and Levinson 2009), and in any case it is both self-evident and an established fact that languages, in the way that they frame concepts, can aid computation. Take for example number words. People who speak languages without number words, or with only limited ones, have restricted mathematical abilities: the previously mentioned Pirahã are a famous case in point. With only words that at first sight mean 'one', 'two', or 'many', without recursive uses, they apparently have a hard time doing simple matching of N objects in a row (where N was greater than 2 or 3; see Gordon 2004). A later restudy showed that the three number words don't have precise cardinality, and while showing that the Pirahã could match visible arrays if aligned, they could not match those that needed to be held in memory (Frank et al. 2008). Number words provide a crucial kind of cognitive technology for mathematics. The Pirahã are unusual in having no true number words, but there are many languages with very restricted number words. Some languages use the names of body parts (and a procedure of traversing the body) to yield a total of, say, 31 numbers. Thereafter large numbers are cumbersome at best, making the notion of an infinite series obscure (Mimica 1988). Having a decimal system in language (rather than e.g. a system to base six like Ndom) makes it much easier to compute relatively large numbers, whereas old imperial feet, inches, chains and perches are downright cumbersome.

More generally, language plays a critical role in providing us with ready-made complex constructs packed up as single words. Concepts like *cousin,* *concerto, logarithm, architrave,* or *sonnet*, pack a vast compendium of specialized knowledge and experience. The critical role that these bundles or chunks play in our thinking was explained by Miller (1956) in a landmark paper (quoted by Goody): our short-term memory – the store we hold in mind when we compute – can only hold between 4–7 chunks of information. So we condense complex information into holistic chunks. That's why we commonly break down telephone numbers into chunks of four or five to remember them, and why acronyms and other abbreviations help us reason. So, a crucial part of the cumulative nature of culture is simply the great inventory of complex concepts that comes embedded in our lexica, our mental dictionaries (Levinson 2003b).

Chomsky has argued influentially that the essence of language is its internal syntactic structure, playing down what he calls 'externalization'. I argue, on the contrary, that it is because language is externalized, part of a shared code used in social interaction, that it is so fundamentally culturally shaped, and through eons of cultural evolution as a set of cognitive tools, can play the transformative role it does in our mental life.

This raises the question of language difference and its significance. At one point Goody (1977: 161) considers the "exciting attempt of Benjamin Lee Whorf to specify the implications of different languages for cognitive patterns and social systems," the thesis widely known as 'linguistic relativism'. Goody was no relativist, yet he held that "the problems of human thought cannot be treated in terms of universals alone." Although he valued Whorf's thesis for emphasizing difference he thought it overplayed the role of specific languages and underplayed the role of social change – above all the role of literacy in forming the distinctive character of what Whorf called 'Standard Average European'. Here we can usefully turn to another Goody essay, 'The Anthropology of the Senses and Sensations' (2002). Again he steers a path between relativism and universalism by showing that the overall scheme of five traditional senses in the Western tradition can also be found in the Indian and Chinese traditions, but not in the West African traditions that he was familiar with, suggesting that sensory perception is also connected to literacy. Among the LoDagaa the verb for hearing and smelling is the same. He notes also that the traditional hierarchy of the senses, with vision in prime place, may owe something to the visual access of literacy, and that cultural preoccupations such as elaborate cuisines may influence the categorization and awareness of taste and smell. Although there may be little underlying physiological difference in sense perception (as the 1898 Torres Straits expedition already seemed to establish), "the senses are differently conceived and emphasized in different cultures, with the conceptual inter-relationships being especially elaborated in written ones" (Goody 2002: 27).

My colleagues and I (Majid et al. 2018a) recently undertook a wide comparative study of perception vocabulary in 20 languages, of which 15 were unrelated. We experimentally tested in the field how the consultants described visual arrays (colour, shape), samples of odorants, five basic tastes, tactile surfaces and recorded sounds (pitch, loudness, tempo). A leading question was whether the Aristotelian hierarchy of the senses (sight, hearing, smell, touch, taste) held up cross-culturally. We measured the extent to which communities had consistent nomenclatures in these perceptual fields, taking that as an index of the importance and salience of the terms. There was no support for a single hierarchy – taste was at least as dominant as colour and more dominant than shape across cultures, with no clear order between shape, sound and touch. Although smell was usually ranked low by the criterion of community consensus on terminology, it was the most codable of perceptual domains tested among the Umpila, a Cape York aboriginal group. Malay uniquely had shape as the most codable domain. Taste was dominant in Farsi, Lao, the Balinese sign language Kata Kalok, Zapotec and six other languages, half the sample. The Dogul Dom of Mali and the Siwu of Ghana both had touch as the most codable perceptual domain. In short, the Aristotelian hierarchy collapses in cross-linguistic and cross-cultural perspective. We also tested for correlations with other cultural features. Codability as a whole correlated with population size (the larger the population, the greater the consistent use of vocabulary), and yes, with formal schooling and thus with literacy, as Goody would predict. But literacy did not account for the different hierarchies of the senses in different cultures: for example, while vision was the most precisely coded domain in English, it was taste in literate Cantonese, Farsi, Turkish and Lao populations. Although precise shape coding went along with formal schooling, it was also associated with house shape and decorated pottery. Sound coding associated strongly with specialist musicians, and smell coding with hunter-gatherer subsistence style.

Following up on one hunter-gatherer group who showed high codability of smell, the Jahai of Malaysia, Majid et al. (2018b) found that they were much quicker and more consistent in their use of terms for odorants compared to a Dutch control group. Moreover, the Jahai terms were all abstract, that is more like 'yellow' than like 'banana coloured,' whereas the Dutch terms were nearly all object based ('smells like lemon'). The conclusion seems inescapable – the Jahai have a dedicated smell vocabulary which they use faster and more accurately than anything we have available. The language and the way of life that motivates it have made them odour experts: language sharpens perception.

Thus languages, closely reflecting cultural preoccupations, provide their speakers with ready-made cognitive chunks, namely lexical items that are good to think with – and in so doing distinct languages introduce differences in cognitive functioning, making some degree of cognitive relativism undeniable.

Technologies of the Intellect: Firming up the Concept

Earlier I characterized cognitive artefacts as external aids that help to solve internal cognitive problems. By introducing language as a technology of the intellect I may seem to have muddied the waters, but language is also a public externalized 'tool', whether spoken or written. Are there general laws or principles governing cognitive artefacts? We need a clearer understanding of what cognitive artefacts are and how they work. Here is an attempt at a more precise characterization.

A cognitive artefact has the following properties:

1. It is designed to provide solutions to a particular type of cognitive problem (e.g. the problem of obtaining a memorizable and precise dimension)
2. The artefact is externalized in a publicly accessible medium (e.g. a tape measure)
3. The artefact has been honed by cultural selection over alternative designs (e.g. the tape measure has standardized units, and is made of durable flexible material)

4. There's a specific procedure for using the artefact (e.g. one end of the measure is placed at one end of the measured object, and the value read off the other end)
5. The process is effective and economical (the cognitive and practical advantages outweigh the costs of obtaining and using the artefact)
6. The output of the procedure must be easily assimilated and re-internalizable (e.g. the output is the dimensional length in an easily memorable set of units, like centimetres)

More abstractly we could think of a cognitive artefact as designed to solve a cognitive problem, like finding the value of the function, f(x) = ?. The tool should yield the value, e.g. f(x) = y, and y should provide a useful solution to the cognitive problem and the practical problem that sparked it. Thus, a clock can tell us where we are in the working day, a calculating machine like an abacus can tell us the sum of two large numbers, a map may tell us where we are in space, and so on.

This characterization helps us distinguish what is and is not a cognitive artefact. A measuring stick is a cognitive artefact, but a crow bar is not; a compass is a cognitive artefact, but the boat it helps to direct is not; a dictionary is a cognitive artefact, but a blank notebook is not. Some cases are less clear. Consider guide-dogs for the blind: they supply an auxiliary sense to their users, they have been bred and trained for the job, and help solve problems such as when to cross the road. If they are putative cognitive artefacts, sheep dogs are probably not – they are merely auxiliary legs, as it were, efficient tools but not solutions to cognitive problems. More far-reaching is the question of whether a human team can be a kind of cognitive artefact. Ed Hutchins (1995) has argued that a (pre-GPS) naval navigation team, each using different instruments and reporting values up the chain, is a kind of personified computer (see also Enfield and Kockelman 2017). If so, it would contrast with a soccer team, or an assembly line, which are teams that solve non-cognitive tasks.

So far, I have circumvented the fact that some cognitive artefacts, and some uses of many others, involve not a new solution for a new problem, but the retrieval of an old solution. This is Goody's 'storage' use of literacy. We also noted the two uses of lists: the forward looking (as in a shopping list) and the backward looking (as in a record of what was bought).[16] For the storage use we need a slightly different definition, now of a mnemonic cognitive artefact. Some of the examples I have given have mnemonic usage, that is, the ability to recall information from storage. Tallies would be an example: you can use a series of notches to count the mounting incremental cost, or refer back to a tally to see how much total debt has been accrued. Similarly, you can refresh your memory with a map ('what was that road number?'), or check the mark you put on the tape measure. But there are also objects, like the knot in the handkerchief, that have no other function. The knot in the handkerchief performs a private function, but if I leave an arrow formed of sticks on the path to show you which route I took, that serves the purpose of retrieval by another. As a simple ethnographic example, Rossel Islanders have coconut plantations where people can freely forage for fallen coconuts unless there is a *cha vyi* or taboo sign put up. This consists of a partially husked coconut on a stick, and signals that the owner intends to collect the coconuts for exporting as dried copra.

The most elaborate of the non-linguistic mnemonic systems appear to be the *quipu* knotted records of ancient Peru. Although all the functions of these records are disputed, as is the degree to which they relied on verbal exegesis, it is uncontroversial that they record large numbers, their sums and other calculations, probably largely amounts of tribute in goods or *corvée* labour (they were used as recently as the last century as tallies by Peruvian shepherds to keep track of their flock). Using a positional system, and strings attached to strings, knots of different types could record massive numbers (Urton 2003; Ifrah 1998: 68ff.; https://khipukamayuq.fas.harvard.edu/).

Here is an attempt to characterize the storage function of cognitive artefacts:

Mnemonic cognitive artefacts have the following properties:

1. They perform the function of encoding a thought A at time t, in such a way that A can easily be retrieved at a later point t_{+n} – the solution to the problem of recalling A

[16] Searle (1979: 3) describes this as 'direction of fit', world to words, or words to world. Following Anscombe, he notes that a man with a shopping list followed by a detective noting down his shopping would have the same list but with different functions.

2. There must be some external marker of A, call it ά, which can be encountered and bring the thought A to mind at t_{+n}
3. For ά to be recoverable by random others, there must be a public convention that ά stands for A
4. The procedure for encoding ά is effective and simple enough to be economical
5. The encoded thought A must be recoverable, easily assimilated and useful at $t_{+n.}$

Obviously, writing performs this storage function *par excellence* (as well as being a computational mode for working out our thoughts). What is less obvious, perhaps, is that writing is in some respects more like a knot in a handkerchief than a tape recording of speech, in that it requires imaginative reconstruction of prosody, intonation, seriousness or jokiness, surprise or politeness. Moreover, speech itself is only a cloudy sketch of the underlying thought and intent (Levinson 2000).

Again, there may be grey areas about what should count. My mementos may be meaningless to you, and only some of the public may correctly 'read' the reminder (e.g. only church goers may know that the bell is a warning of an imminent church service). Can reminders hold indefinitely into the future?[17] Tzeltal peasants plant a *tim* tree at the borders of their land, which should last for generations. This is intended to be understood as a reminder of a boundary claim, unlike the planting of, say, a mango tree. But what about the little metal Eiffel tower I brought back from Paris: is this souvenir a mnemonic artefact, intended to remind whoever sees it of Paris, or a mere association we cannot easily avoid? The anthropology of power, prestige, empire and exchange abounds with fabled objects and talismans like the Koh-i-Noor diamond in the British crown, the Benin bronzes or the top Trobriand *mwali*. Take the apical Rossel Island shell 'coin', named Anêw:ee. Like the Koh-i-Noor it is too valuable to exchange, rarely displayed and attached to a lineage. It carries with it the myth of its origin – it has only a prestige function coupled to its mythic mnemonic power. It is unclear whether we would want to call these cognitive artefacts; but I don't think that boundary problems like these should disconcert us.

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[17] Dutch speed limit road signs other than the initial one carry the inscription *herhaling* 'reminder', although legally they are re-commands, not reminders.

Now it's well known that memory feats are possible without external prompts. But that is because the things to be remembered have been associated with imagined *external* objects. The classical art of memory worked in this way. In order to deliver your speech without missing any points or departing from the correct order, you may associate the sequence of points to things in a familiar room – then you can travel through the imagined room recovering every point faultlessly (Yates 1966). The technique trades on the primacy and robustness of the two systems of spatial cognition: the 'what' system dedicated to things (indexing your talking points), and the 'where' system dedicated to their location (organizing the order; see Ungerleider and Mishkin 1982).

These, then, are the two functions of cognitive artefacts, forward-looking computation and backward-looking recall. One and the same artefact, like a tally, an agenda or a list, can have both functions, but some such artefacts are specialized to one function or the other, the computational (like the compass, the clock or the abacus) or the mnemonic (like the egg timer, the receipt or the souvenir).

How Cognitive Artefacts Work

Why exactly does externalization of a cognitive problem have the cognitive efficacy it evidently has? One can think of various answers, some specific to particular types and uses of cognitive artefacts and some general in nature. Most generally, the thoughts in question get two representations: the internal one, and the external one. The duality already offers substantial benefits, as shown for example by the gestures accompanying speech. If you give directions of the sort "First go left, then take the next right", you hand will most likely precede the affiliated words by around 200 milliseconds (McNeill 1992). You literally feel out the correct response. Children can also be shown to gesture correctly in response to a novel problem, even though they can only correctly describe it later in development (Goldin-Meadow 2015).

Another general feature of cognitive artefacts is that the mental representation is *transduced* to another medium, e.g. from thought to speech, or speech to writing, or music to notation. The transducer operation changes the representation. Take mental arithmetic in decimal systems: this can be represented on an abacus, but now in terms of 5s and 1s. So the matched representations, internal and external, are never exactly isomorphic (true, of course, even for speech and writing). The transformation, yielding two ‘handles’ as it were, appears to give one a better ‘grasp’ of the concept or the problem. Sometimes the external medium offers advantageous properties lacking in the internal (or other external) representation. Thus while speech and music are transient ephemeral signals, writing and musical notation are time-independent and static, and can be repeatedly examined. Here written notation contrasts with e.g. tape-recording, which also allows retrospection, but not the freezing of time. Hence the special value of lists, that so intrigued Goody. Moreover, what was linear in character now becomes two dimensional, as when a partitur offers visual representation of the different parts of a musical score and their alignment. Indeed, additional dimensionality is often a feature of the ‘added value’ of the external representation, as when time is represented on a sundial or a clockface. Likewise, the two dimensionality of tables and matrices endows them with their special computational possibilities. Transduction is most often from an abstract medium to a concrete one (e.g. number to tactile abacus), as if the concrete is easier than the abstract. This is consistent with Piaget’s analysis of conceptual development in children, which proceeds from the concrete to abstract thought and reasoning. Transduction to a visual medium seems to be particularly helpful, like using Venn diagrams to solve logical puzzles, perhaps because (as I noted already in connection with the art of mnemonics) our visual and spatial cognition is so strong. But tactile media also have a special role and it is worth bearing in mind the special role that the hand has played in human evolution. The opposable thumb and the extra innervation of the human hand have made us uniquely capable tool users, both of physical and cognitive tools. Practitioners of the art of mental abacus often gesture as if using the physical apparatus. Finally, there is the added benefit that derives from cultural routines for the use of cognitive artefacts (like rules for using the abacus), giving us ready-made procedures for yielding desired and precise results.

Another important feature of cognitive artefacts is the recursive system of externalization and re-internalization. Since the result of the external computation or assessment must be re-internalizable, it must be in a format we can readily digest (we don’t design computers to talk to us in machine code). Constant use of the external device means that our own thoughts will be increasingly constituted by whatever formats the device delivers. This is Goody's story about literacy – oral performance in a literate society won't be the same thing as oral performance in an oral society. Much of the folklore and epic literature that we celebrate as fundamentally oral, such as that of Homer, in fact bears the imprint of literate minds (Goody 1987: 98). We can compose written works in our heads, or write music without sound as when the deaf Beethoven wrote the Ninth Symphony. When the external device is itself re-internalized or ingested we observe some of the most powerful effects of cognitive artefacts: mental arithmetic by mental abacus, directional estimates by mental compass, memory feats by imagined spatial mnemonics.

Externalization into a public medium has made it possible for cultural selection to work its magic on the design of our cognitive tools. Like writing, with its 5000 years of cultural development and enhancements, most other cognitive artefacts have long histories. The abacus likely goes back 4000 years to ancient Sumer. Sundials and astronomical alignments are prehistoric in origin. Babylonians were making maps of the world nearly 3000 years ago (qv. the Imago Mundi tablet in the British Museum), while compasses have been used for navigation for at least a thousand years. Standardized weights and measures can be traced to ancient Sumer and Egypt. The long prehistory has allowed cognitive technologies to be constantly improved by cultural evolution, each step providing the basis for further more rapid steps. Cognitive technology has increased exponentially. As Ray Kurzweil (2001) put it, "We won't experience 100 years of progress in the 21st century – it will be more like 20,000 years of progress (at today's rate)." The early stages of accelerating growth may not appear to be exponential, (as we learnt in this pandemic year) but in the case of technology (as with the pandemic) they were.

All this raises interesting questions about the ontology of cognition. Is it my belief or the calculator's that the square root of 2 is 1.41421356237? Is it my belief or my diary's that I have a meeting on November 23rd? Do I or my GPS machine know how to get from here to Gretna Green? Some philosophers bite the bullet and accept a theory of 'extended mind' (Clark and Chalmers 1998). Humans and things in their environment, namely cognitive artefacts, can form coupled computational systems, just like we form coupled ecological systems with the environment. There's no mind in the machine, but mind plus machine can form a radically enhanced mind.

Conclusions

In this lecture I have enlarged upon a theme that Goody held dear, the idea of technologies of the intellect, but that other anthropologists with less interest in language have let languish. I have suggested that literacy is part of a much larger field of 'technologies of the intellect' which would surely repay much deeper scrutiny. Goody's emphasis on the mental amplification afforded by writing helps anthropology connect to the cognitive sciences. As he himself put it, writing "(…) encourages special forms of linguistic activity associated with developments in particular kinds of problem-raising and problem-solving, in which the list, the formula and the table played a special part" (1977: 162). He was what we now would call a 'situated-cognition' or 'extended mind' theorist *avant la lettre*: "When a map or a book intervene between the object and the subject, we are dealing with 'mind' out there as well as with mind inside" (1987: 255).

One consequence of this view is that languages and cultures afford different cognitive tools. Goody was content to allow a large gap between the pre-literate and the literate mind, but he viewed literacy as potentially a universal leveler, a domesticator of the savage mind. He resisted the relativism implied by his key idea. However, once we consider the much broader field of technologies of the intellect it becomes obvious that numerous cognitive artefacts and technological traditions undermine the idea of a single divide: instead of a single ravine, we are looking at the surface of a glacier. The developed lexica of the world's 7000 or more languages constitute tool chests with quite different inventories. Add to that all the different technologies of the intellect, the calculating traditions, the navigational and measurement traditions, and we have a very varied landscape of post-savage minds. Even in a globalizing world, it may take generations for imported mental traditions to take root.[18] Goody strongly resisted relativism because he was committed to a broad historical comparative sociology; he

[18] Consider, for example, why semi-conductor manufacturing plants are only to be found in Asia and the developed West (https://en.wikipedia.org/wiki/List_of_semiconductor_fabrication_plants) where there have been generations of highly disciplined and skilled factory workers.

was no friend of Geertz or the American cultural anthropology of the time.[19] But I think it is clear that 'technologies of the intellect' are inconsistent with the strong strand of thinking in sociology and anthropology encapsulated in Bastian's phrase 'the psychic unity of mankind'.[20]

Goody's idea has tremendous resonance in a world given over to computational devices, where economies are transformed by artificial intelligence, where we hold powerful cognitive artefacts in our hands every day and rely on them for finding our way, maintaining our social networks and transacting business. Wars will be won and lost, nations will succumb to or survive pandemics, political and economic systems will thrive or perish, according to the power of rival cognitive artefacts and their artful use. It may seem perverse in this age of information technology to have spent most of this lecture tonight considering very simple technologies of the intellect, but my hope is that by focusing on the simple cases we can come to understand better the processes, both social and cognitive, that underlie the remarkable way in which the species has perfected the use of cognitive prostheses. It is time anthropology put such artefacts center stage and investigated their cultural evolution.

[19] See Hann 2017:477

[20] This does not mean there is no shared cognitive bedrock as it were – see also Levinson 2019.

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Printed by IMPRESS Druckerei, Halle/Saale