The Enhanced Literate Mind (ELM) Hypothesis

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Abstract

In the present paper we describe the *Enhanced Literate Mind (ELM)* hypothesis. As individuals learn to read and write, they are, from then on, exposed to extensive written-language input and become literate. We propose that acquisition and proficient processing of written language ('literacy') leads to, *both*, increased language *knowledge* as well as enhanced language and non-language (perceptual and cognitive) *skills*. We also suggest that all neurotypical native language users, including illiterate, low literate, and high literate individuals, share a Basic Language Cognition (BLC) in the domain of oral informal language. Finally, we discuss the possibility that the acquisition of ELM leads to *some degree* of 'knowledge parallelism' between BLC and ELM in literate language users, which has implications for empirical research on individual and situational differences in spoken language processing.

Keywords: enhancement, literacy, reading, oral informal language, shared language repertoire, written language

1. The Enhanced Literate Mind (ELM)

The ELM hypothesis is the claim that written language experience results in increased language *knowledge* and enhanced language and non-language perceptual and cognitive *skills*. For space reasons, and in order to minimize maturational confounds, we will highlight here a selection of key effects with adult participants only.

1.1 Literacy Effects

Note that the term literacy is often used in (slightly) different ways. Here we define literacy as in the (first part) of the UNESCO definition as: "the ability to identify, understand, interpret, create, communicate, and compute, using printed and written materials associated with varying contexts" (UNESCO Institute for Statistics, 2024). It is also important to point out here that literacy is a continuum: Most literate individuals can be 'classified' as belonging to one of a range of proficiency levels (similar to the levels of the PISA reading assessments, OECD, 2019).

First, we point out that most of the non-shared linguistic elements and patterns among people are a straightforward consequence of literacy. Written language effects of increased *knowledge* include additional vocabulary, grammatical constructions, and knowledge of conventions of spelling and written discourse. These effects of literacy-related increased knowledge are well-established and uncontroversial (for instance Favier & Huettig, 2021a; Seidenberg, 2017, Ch. 4, and many others).

Research over the last decades however has revealed that learning to read and write has also extensive effects on *language-related skills* that are perhaps not so immediately obvious. Now already classic findings are the effects of learning to read on phonological awareness (Morais et al., 1979). Early forms of awareness of phonological segments (e.g., syllable, onset, and rhyme awareness) develop without teaching but reading instruction is necessary to become aware of smaller units of speech such as phonemes (Lukatela, et al., 1995; Morais et al., 1986). A more recent demonstration of the power of literacy during online language processing are the results of robust enhancement of language prediction skills, not only when reading but also during speech processing (Favier et al., 2021; Huettig & Pickering, 2019; Mishra et al., 2012). Another example are the literacy-related increases in verbal memory (Demoulin & Kolinsky, 2016). Smalle et al. (2019) observed better short-term serial-recall performance in literate compared to illiterate individuals.

Recent research has also revealed that literacy has extensive effects on *non-language skills*. Learning to read, for example, is associated with an increase in object recognition abilities including the recognition of human faces (Van Paridon et al., 2021) and faster detection of targets in visual search tasks (Bramao et al., 2007), especially in central and right-of-center spatial regions in left-to-right readers (Olivers et al., 2014). More generally, learning to read leads to an extension of the functional visual field from the fovea to parafoveal areas (Olivers et al., 2014). Literacy also results in faster rapid automatized naming (RAN) of visual objects and color patches (Araujo et al., 2023).

1.2 Effects on skills reflect enhancement

All of the effects mentioned above are effects in tasks in which literate compared to illiterate people showed (statistically robust) *enhanced* performance. In contrast, there are two tasks for which it has been argued that illiterate people perform better than literate people. First, the destructive competition hypothesis in cognitive neuroscience predicts that the neuronal 'recycling' of face recognition networks, as a function of reading acquisition, has detrimental behavioral effects on the cognitive functions for which the cortical network was originally evolved. This predicts that illiterates should be better in recognizing faces than literates (Dehaene & Cohen, 2007). There is no evidence for this, in fact some evidence for the opposite has been observed in behavioral (Van Paridon et al., 2021) and neuroimaging work (Hervais-Adelman et al., 2019). The second effect is mirror-invariance, which is the evolutionary-old perceptual tendency to process mirror images as equivalent. Illiterate people retain mirror-invariance and perform very poorly in mirror-image discrimination tasks. Learning a script with mirrored graphs (for example d≠b) requires breaking mirror-invariance. As a result, literate people perform much better than illiterate people in mirror-discrimination (Fernandes et al., 2021; Kolinsky et al., 2011). Illiterate people, it could thus be argued, are better in sustaining mirror-invariance. This reasoning however seems questionable. *Retaining* the skill of mirror-invariance and mirror-discrimination failures by illiterate people hardly constitute an advantage in modern literate society. In short, we conclude that literacy does not just change performance, it truly *enhances* many linguistic, perceptual, and cognitive skills[1].

1.3 How does literacy enhance linguistic, perceptual, and cognitive skills?

The reason that reading experience has such wide-ranging effects on ELM skills is that it involves a large number of complex, multifaceted, and overlearned behaviors (Huettig, Kolinsky et al., 2018). The many subroutines involved in reading require the fine-tuning of many perceptual and cognitive functions, including basic visual skills, phonological and semantic processes, attentional mechanisms including oculomotor control, executive control

[1] Note in this regard that reading-induced directional biases are a special case. Experience with the direction of written scripts (for example left-to-right as in English or Devanagari vs. right-to-left as in Arabic and Hebrew) influences habitual scanning directions of images, the direction of ordering of objects, and judgments of facial affect (e.g., Eviatar, 1997; Heath et al., 2005). It does make little sense to label such directional biases as enhancement.

mechanisms, long-term memory, working memory, and so on. It is important to note that none of these particular functions are specific to literacy but reading trains and *fine-tunes* all of these subroutines.

The huge amount of practice involved in the optimization of the specific complex subroutines makes proficient reading an effortless behavior and amazing accomplishment. This is because sophisticated perceptual and cognitive procedures are overlearned and become automatized with the typical reader’s vast amount of practice (Huettig, Lachmann et al., 2018). ELM hence is a straightforward consequence of the recruitment, modification, and coordination of preexisting perceptual and cognitive skills in the service of practicing the evolutionarily new cultural activity of reading (cf. Lachmann & van Leeuwen, 2014).

An enhanced mind can in principle also be acquired through other activities than reading. Activities like painting, weaving, and cooking may also enhance some perceptual and cognitive subroutines, for example overt and covert visual attention, working memory, fine motor control, mirror-image discrimination skills, etc. (Kolinsky & Verhaeghe, 2017) as well as processing efficiency and speed. It is not central for the arguments made in this paper whether these overlearned abilities involve as many interacting complex subroutines as the skill of reading (though we believe they may not), our point is simply that reading acquisition is not special in its ‘mind-enhancing potential’.

2. Basic Language Cognition (BLC) in the domain of informal oral communication

All neurotypical adult native speakers (including illiterates, low literates, and high literates) share a Basic Language Cognition (BLC) in the domain of oral informal language (Hulstijn, 2015).

2.1 What is BLC?

Our suggestion about the existence of BLC rests on a simple reasoning, dictated by common sense. There must be some repertoire shared by (nearly) all language users because otherwise they would not be able to communicate with one another in many everyday situations. Let us assume that we computed the raw frequencies of lexical and grammatical elements in a huge corpus of spoken language, truly representative of language, produced - in a wide variety of communicative situations - by people of different ages and different levels of education and profession. The idea then is that BLC pertains to knowledge and use of the elements in the steep part of the heavily skewed distribution of raw frequencies, i.e., to the elements that occur frequently in such a corpus (Hulstijn, 2015, 2019).

2.2 Shared (language) repertories

The existence of shared lexical repertoires (including the knowledge of single words, or word families (e.g., *develop*, *development*, *developer*, *developmental*, and *semi-developed* belong to a word family), for example is uncontroversial (Hulstijn (2015; Nation & Coxhead, 2021). BLC also includes some shared grammatical repertoires. Shared grammatical knowledge extends to highly abstract grammatical patterns. Evidence for this proposition comes from two recent studies. In a study assessing adult native speakers' (including low and high literates) receptive knowledge of grammatical structures of Dutch, Favier and Huettig (2021) selected 180 grammatical structures from an authoritative grammar. For each structure, two instantiating sentences were constructed. Twenty-three linguists rated 95 structures as (a) core, i.e., “virtually known by all adult native speakers” (p. 3) or peripheral. Of these, a set of 25 core structures, along with 25 peripheral structures (each structure represented by two sentence instantiations) and 15 ungrammatical foil sentences were selected for an acceptability test. The test was administered to 38 native speakers with either high or low literacy experience. Acceptance of core, peripheral, and foil trials was 90%, 57% and 13% respectively. Thus, consistent with the intuitions of the linguists, there was a large discrepancy in overall performance of both low and high literates between core and peripheral structures. In another study, Hulstijn (2017) investigated shared syntactic repertoires in a sample of 98 adult native speakers of Dutch, differing in age, level of education, and profession, who performed the same four speech production tasks. Speech output of all participants showed a Zipfian (i.e., an extremely unequal) frequency distribution of word tokens and part-of speech sequences. As expected, some structures, typical of formal written discourse (e.g., center embedded clauses, pre-nominal participle phrases) were only produced by few participants. But 20 grammatical function words (e.g., conjunctions) were produced by all speakers. All speakers produced instances of several purely formal syntactic schemas, unconstrained by lexis, semantics, or pragmatics (subject-verb inversion in main clauses, separation of auxiliary and main verb in main clauses, and verb final in subclauses).

These findings support the ‘common sense arguments’ for BLC: Although neurotypical people differ enormously in cognitive skills, they are all capable of acquiring the complex system of a language, including some highly abstract syntactic patterns (albeit not with the same pace).

3. ‘Knowledge parallelism’ between BLC and ELM in literate language users

Finally, we raise the possibility that the acquisition of ELM results into *some degree* of 'knowledge parallelism' between BLC and ELM in literate language users and discuss the potential consequences of this state of affairs for psycholinguistic research of spoken language processing.

3.1 What does 'parallelism' mean?

The word "parallelism" unfortunately is ambiguous (and sometimes used in a metaphorical sense) in the academic literature. "Parallelism" for instance is often used to mean processes that run simultaneously: When two processes run in parallel, it is not the case that one process must be completed before the other process can start. Parallel processing in this sense stands in contrast to strictly sequential processing. Another notion of parallelism (in linguistics) refers to the absence of a hierarchy between phonology, syntax, and semantics: the idea that language is represented and processed in multiple and parallel streams involving phonological, semantic, syntactic, (and perhaps other types of) information (Baggio, 2018; Hickock & Poeppel, 2016; Huettig et al., 2021; Jackendoff, 2003, 2007). This stands in contrast to the Chomskyan tradition in linguistics, which assigns a central (or 'higher') role to syntactic processes. Jackendoff's parallel architecture however is not only concerned with a non-hierarchical parallelism between phonology, syntax, and semantics, but it comprises also the claim that some forms of knowledge exist independently from one another (even though they are linked in various ways).

Similar to such a 'meaning' of parallelism, here we raise the possibility of what we term 'knowledge parallelism' between BLC and ELM and the consequences this may have for empirical research of situational and individual differences in processing spoken language (Hintz et al., 2020; for written language see Huettig & Ferreira, 2023). In our brief discussion, we shall highlight some internal (mental) effects (the minds of individuals) rather than external effects (for instance in a language community).

3.2 Increased knowledge vs. enhanced skills

We note again that we draw the distinction between knowledge and skills[2]. Enhanced skills are the consequence of an ELM optimization process that cannot be straightforwardly undone. Individuals with ELM benefits cannot simply switch back to a skill level of BLC (for example they cannot voluntarily switch back to illiterate face recognition, visual search, or verbal memory skills). BLC knowledge and ELM knowledge however may co-exist even when high literacy levels have been acquired. With the exception of very few people (e.g., scholars reading text written in a language they do not speak, e.g., ancient Greek), or with the exception of situations of high diglossia (e.g., classical versus local-spoken Arabic), the typical literate person has knowledge of both the written language and the corresponding spoken language (or of a regional dialect or of a sociolect of the corresponding oral language). Our subsequent discussion relates to the knowledge effects of ELM in spoken language processing only.

3.2 Research implications of some degree of 'knowledge parallelism'

Spoken language in many situations becomes more complex after ELM acquisition (an enhancement effect of exposure to written language) but informal spoken language often retains many of its BLC characteristics in the daily interactions of people. In terms of mental

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[2] We suggest that the literacy-contingent additional knowledge is best characterized as an 'increase' (as it refers for instance to a greater *amount* of knowledge about a particular topic), whereas we prefer the term 'enhancement' for literacy-contingent refined skills such as mirror-image discrimination, face recognition, and visual search (as the term more directly refers to an *improvement in quality*).

representation everything that can be said in BLC (at least in alphabetic scripts) can be rendered in orthography. But note that expressions in BLC ('informal spoken') and ELM language often diverge on several levels of representation such as phonology (which one can also render as a deviation from the standard spelling of English, for example 'watcha' instead of 'what are you'), morphology (some North American, Irish and British dialects allow 'yous' as the plural of 'you'), and semantics ('that's ace' occurs more in informal spoken, 'that's wonderful' more in ELM language; or 'cash' instead of 'money' and 'kids' instead of 'children' or 'postgraduate students'). This raises the possibility that not all parts of BLC knowledge match ELM knowledge[3].

One important issue concerns the materials used: The spoken stimuli in psycholinguistic research tend to be not representative of typical oral communication, they are closer to 'ELM language'. The spoken stimuli in experiments often consist of grammatically complete sentences which rarely anyone would use in typical conversation (e.g., 'weird', 'unnatural' subject or object relative clauses) rather than short utterances consisting of word sequences truly representative of daily spoken language (Tucker & Ernestus, 2016). The linguistic content of the spoken stimuli is rarely selected on the basis of frequency counts of either a corpus of everyday oral communication or a corpus of formal oral communication (e.g., in a court of justice, in a hearing in parliament, in a business meeting, etc.).

[3] Note in this regard that the interplay of BLC and ELM is not always one-directional towards greater use of ELM language. The adoption of social media across the world, for instance, has resulted in a quite sudden change and evolution of online writing towards language that resembles often informal speech rather than written language (Baron, 1998, 2013; Khatteb Abu-Liel, Eviatar, & Nir, 2021).

Another problematic issue are individual differences. For example, in empirical studies little or no information is often given about participants' home languages and the distance of participants' spoken vernacular to the standard ELM language. Across individuals, ELM acquisition can result in vastly different vocabulary and syntactic knowledge (Nation et al., 2022) as well as metalinguistic knowledge, that is linguistic knowledge that people can 'declare': say that they know what, for instance, a vowel, a noun, a verb, or a subclause is. Metalinguistic knowledge is parasitic on ELM knowledge. For control of certain situations in which spoken language is used (e.g., formal or legal discourse), some metalinguistic knowledge seems to be indispensable.

This brings us to the third point: the diverse situational contexts in which spoken language is used. Psycholinguistic research must take into account the differences between shared (BLC) vs non-shared (ELM) knowledge representations of spoken language in different conversational contexts (for example monologue vs dialogue, Pickering & Garrod, 2021). Individuals produce and comprehend spoken language in enormously different situations, the extent to which individuals are able to draw on BLC and ELM knowledge in a context-dependent manner, deserves, we conjecture, more exploration.

In short, further research is required to explore the effects of 'knowledge parallelism' systematically, including the possibility that the somewhat distinct BLC and ELM knowledge representations require a type of code-switching that is 'impoverished' but somewhat similar to the switching of languages in bilinguals (Biber, 1988; Heredia & Altarriba, 2001).

4. Conclusion

In the present paper we have argued that all neurotypical native language users share a Basic Language Cognition (BLC) in the domain of oral informal language. We have provided a (very) brief description of the ELM hypothesis: Literacy acquisition results in individual differences in language knowledge but also enhanced linguistic and non-linguistic skills. This leads to certain implications for any general theory of language and cognition. First, a general theory must be able to describe the conditions that lead to enhanced linguistic and non-linguistic skills beyond BLC (as in the case of the literacy-contingent acquisition of ELM). Second, a general theory must be capable of explaining why some elements of a language are acquired by all speakers while others are not. We have pointed out several implications of the BLC-ELM distinction for the design of psycholinguistic experiments. We conjecture that the 'knowledge parallelism' between BLC and ELM has the potential of explaining a considerable part of performance variance that could not be accounted for in earlier psycholinguistic studies.

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