

A NEUROLINGUISTIC APPROACH TO LINGUISTIC REDUNDANCY

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Abstract

This paper proposes a neurolinguistic explanation for the overlap of redundancy as conceptualized by information theory and redundancy as understood in literary theory.

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1. The Concept of Redundancy

In July and October 1948, Claude Shannon, an engineer working at the Bell Telephone Laboratories, published two papers in the *Bell System Technical Journal*, in which he formulated a set of theorems concerning quick and accurate transmission of messages from one place to another. Although intended primarily for radio and telephone engineers, the generalizations Shannon made established laws that proved to govern all kinds of messages, no matter the medium. He practically established information theory, and its tenets can be used in order to investigate *any* system in which a message/information is sent from a source to a receiver.

One essential condition for any successful communication is that the message should be received and understood by the receiver. But there is a natural occurrence with communication systems in general to be exposed to interferences, which, in the jargon of this field, are called *noise*. Anything that corrupts the integrity of a message (like image distortions on a TV screen, static in a radio set, gaps or smudged lines in a written text) qualifies as noise.

During World War II, Shannon worked on secret codes, and on ways to separate information from noise. What he found was to become one of the most important concepts in communications theory: *redundancy*. In an attempt to give it a definition, Jeremy Campbell says: “In nearly all forms of communication, more messages are sent than are strictly necessary to convey the information intended by the sender. Such additional messages diminish the unexpectedness, the surprise effect, of the information itself, making it more predictable. *This extra ratio of predictability is called redundancy*” (Campbell, p.68).

2. Redundancy in Language

Communication is not restricted to man-made channels (TV, radio, and phone); it is a fact of life, taking place in all biological systems. Shannon himself applied his findings on the English language, and researchers ever since have been trying to figure out what it is that preserves the orderly structure and intelligibility of a linguistic system. Attempts have been made by linguists and non-linguists to identify and exemplify redundancy in language, starting from the information theory redundancy. I have selected a few examples:

- Swedish Docent Sharon Hunnicutt, from School of Computer Science and Communication, Stockholm: [Redundancy is] “the systematicity in one’s language (and speech). This refers to the information in a complete sentence over and above that which is essential. [...]. Accessibility to stimuli from which to make systematic inferences may depend upon environment and manner of speaking. In the presence of noise or a manner of speaking that degrades the speech, one would expect information (and redundancy) to be decreased” (Hunnicutt, pp.53-54). In other words, redundancy rescues communication in case of failure in the communication system.
- Peter Nübold and John Turner: “redundancy is a feature of the information source which insures that the communication receiver is able to reconstruct a message that has somehow suffered from transmission interference or deletion, and so interpret it satisfactorily” (Nübold and Turner, p.32).
- Canadian psycholinguist Steven Pinker: “Thanks to the redundancy of language, yxx cxn xndxrstxnd whxt x xm wrxtxng xvxn xf x rxplxcx xll thx vxwxls wxth xn ‘x’ (t gts lttl hrdr f y dn’t vn kn whr th vwls r)” (Pinker, p.181).
- American computer scientist Jeremy Campbell: “In nearly every passage of English prose there are words which could be deleted without preventing the reader from understanding what the author intends to say. And many words would still be intelligible if one or more of their letters were eliminated:
e.g. lge liv rm, 2BR, basmt” (Campbell, p.69).

3. *Information Theory Redundancy vs. Literary Theory Redundancy*

In their technical report on linguistic redundancy, given at the University of Chicago in March 15, 1999, Dr. Marie Gillette from Pennsylvania and Ernst-Jan C. Wit, now Chair of Statistics and Probability at the University of Groningen, the Netherlands, complain about the confusion in the domain. In the literature they discuss, they say that “one can observe two diverging movements. One stresses that redundancy is a form of spurious use of language, whereas the other identifies redundancy as a certain forced systematicity within the language”(Gillette, M. & Wit, E., p.4). Consequently, they set out to give their own definition of redundancy, in which, “in order to be comprehensive, these two elements have to be incorporated”. In order to do that, they distinguish between **grammatical redundancy** (“the internal systematicity and rule-governed behavior of a language in which two or more of its features serve the same function” *ibidem*), and **contextual redundancy** (“the repetition of information that is, in a grammatical sense, non-obligatory” *ibidem*). They identify grammatical redundancy in the English morpheme *-s* that marks 3rd person singular verbs in the present indicative, interrogation markers in English (**wh-** words, and subject-predicate inversion), agreement of adjectives and articles with nouns in gender and number in Romance languages, double negation in Romance languages, word-order in English, and English spelling. Contextual redundancy, on the other hand, is identified in the form of repetitions either of the same word, or by synonymy, pleonasm and the like.

Such a distinction would be a good idea, because it observes the separation existing between the two meanings of the word “redundancy”: on the one hand, there is the concept in information theory that we have seen so far, and on the other there is the concept in literary theory that means “useless superabundance of words, phrases or images in formulating ideas”

(Marcu, F. & Manea, C., p.915). But in practice, these two authors, like many other researchers, show a strong tendency to mix them, as they are inclined to see redundant features of grammar *as ones that English could do without, on grounds of intelligibility*.

For example, the morpheme *-s* is termed “*truly* redundant” (meaning “dispensable”, “not needed”) because the obligatory presence of the subject near the predicate in English makes it so. In a paradigm like, say, *I go, you go, he goes, we go, you go, they go*, the ending in *goes* is unnecessary “because it offers no more information than is already expressed by the subject of the sentence” (Gillette & Wit, p.5). The obvious objection to this is, of course, that, beside signaling a 3rd person singular agent (just like *he*, the subject of the sentence *he goes*), this morpheme also signals present tense *indicative*, as opposed to its *absence*, which, near a 3rd person singular noun, would mark present *subjunctive*.

In another example, English word-order is identified as a form of redundancy, which is correct from the viewpoint of information theory: in this language, due to the leveling of endings that occurred after the Norman Conquest, fixed word-order enables grammatical relationships to be established between words. But the argument goes: “Probably everyone, albeit with quite some trouble, understands that ‘Her book the he gives’ stands for the information that a male subject hands over a set of written sheets of paper to a female subject. However, when the same information is coded as follows: ‘He gives her the book’, then it is clear that the word-order in the sentence does not provide extra information. However, it does provide the same information (i.e. what is the subject, what is the direct object, etc.) in a more accessible manner, simply by conforming to the expectations that the receptor has of the sentence” (*idem*, p.8).

On the contrary, a sentence like “Her book the he gives” provides *no* information. No information (or zero redundancy) means, in communications parlance, noise. In literary jargon, it is nonsense. Only the small number of words in this sentence makes us figure out the meaning, and it is precisely the fixed word-order that makes us have expectations about English. The two authors speak of “no extra information” where there is none, and secondly, overlap again information theory redundancy with literary theory redundancy when they forget that, in communications, the extra amount of information is never supplied *in the same form*, never by repetition. For example, in the code of traffic signs, a pedestrians’ crossing is marked *redundantly*, but not *uselessly*, by parallel white lines on the road, by a white triangle against a blue square showing a pedestrian crossing the street, *and* by two intermittent yellow lights that alternatively go on and off, all at the same time. *Useless* would be to put up two or more *identical* traffic signs and nothing else. *This* would be the equivalent of literary theory redundancy.

However, I believe this tendency to overlap the two kinds of redundancy has an explanation of a subtler nature that can be detected in Gillette and Wit’s observation that words and sentences conform to receptors’ expectations. This is true, there are expectations in the minds of message receptors, but this should not be taken for a sign that we could just as easily manage without vowels in English, or without word-order. In reality, our language recognition ability is the end result of a successful process of language acquisition, be it the mother tongue or a foreign one.

4. Explanation of language recognition/reconstruction

Speaking about image storing and remembering, the American neurologist Antonio Damasio maintains, in his *Descartes' Error*, that images are not stored in the brain as exact copies of things, events, words or sentences. Whenever we try to recall something, what we get is an interpretation, a newly reconstructed version of the original, because memory is essentially reconstructive by nature. In spite of the inexistence of permanent recordings in our brains, that we all feel that we *can* summon, in our mind's eye or ear, some approximations of the images we once experienced. This suggests that such mental images are transient momentary constructions, attempts at copying models that used to be known to us. This idea has been reinforced by preliminary studies on visual remembering, based on PET (positron emission tomography) and fMRI (functional magnetic resonance imaging) techniques, which showed that visual mental imagery activates early cortical areas. The patterns of activity seen on the computer screen are topographically organized. Neuroanatomical imaging techniques show that, when a monkey sees certain shapes (a cross, a square), *the neural activity in its early cortices is topographically organized in a pattern that conforms to the shapes seen by the monkey*. In other words, an independent observer watching both the external stimuli (the shapes) and the pattern of brain activity on the computer screen will recognize structural similarities.

Taking these findings into consideration, I believe we can apply similar reasoning to word reconstruction. Concretely speaking, the manifestations of human language can be either seen (in writing), or heard (in speech). But this is doubled by the existence of a different kind of language: the psychological reality of it. The *mentalese* of psycholinguistic discourse, the silent product of the mind. In mentalese, the minimal meaningful unit is the mental word, which brings together a concept (idea of) and a *mental imprint*.

In the process of language learning, when we write, our brain stores any word in visual format, i.e. making a *visual mental imprint* of that word available to itself. Similarly, when we hear and pronounce a word, our brain stores it in audio format, i.e. making a *phonological mental imprint* of that word available to itself.

Whenever something is missing from a message, it is in the nature of our neural biological make-up to automatically start a process of reconstruction by matching the stimulus/stimuli to the imprints already stored in our memory. Failure in doing so can obviously occur in children (if they have not completed their first language acquisition process), or with adults who can either be meeting with a new word, previously unknown, or suffering from some kind of neurological disorder.

These built-in mechanisms are the ones that enable us to recognize Steven Pinker's example with the missing vowels: "Thanks to the redundancy of language, you can understand what I am writing even if I replace all the vowels with an `x` (it gets a little harder if you don't even know where the vowels are)". They are also the ones that enable us to understand Jeremy Campbell's example: "*lge liv rm, 2BR, basmt*" means "large living-room, two bedrooms, in the basement" although this one is much harder since the brain has to figure out the contexts in which we could meet with such formulation (classified ads in newspapers). In fact, thanks to this example, we can understand that redundancy is not a feature intrinsic to language: it is, above everything, a quality of the human brain; the fact that we can see it in language is only the mark that we appreciate this mental feature in one of its effects.

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