CLASSIFICATION OF RESEARCH METHODS OF PSYCHOLINGUISTICS

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Abstract. *In this article, the most important research methods used in modern psycholinguistic research are analyzed separately, divided into two approaches, and an attempt is made to systematize all of them based on a specific classification. The approaches are interpreted as a) observation and b) experimental methods. Then, techniques and methods used in observational and experimental settings are taken to closer analysis and divided into certain groups to reach a meaningful classification. As part of the observation-based approach, the methods of observation and introspection (self-observation) are considered. It begins with an overview of behavioural methods and then discusses neurophysiological methods. The behavioural methods are analyzed in the division of spoken and written language input/output. The neurophysiological methods involve measuring the patterns of blood flow and electrical activity in the brain while a participant is carrying out a language task. These methods are further classified as traditional and high-tech methods. The traditional methods include post-mortem examination and electrical stimulation during brain surgery, while the high-tech methods involve the use of imaging techniques. Finally, the most recent methods – computational methods are also taken to a brief analysis to establish an elaborate, if not a complete, classification.*

Keywords: *psycholinguistics, research methods, classification, observation, introspection, experiment, behavioural techniques, neurophysiological techniques, computational methods.*

INTRODUCTION

Psycholinguistics, as a branch of linguistics, aims to uncover the mental representations and processes through which people produce and understand language, and it uses a wide range of techniques to do this reasoning, which also applies to the answer to the questions of what to study (object of study) and of how to study (research methods). As psychology became an independent science, when experiment became its main method, the transition in linguistics to a new state was associated with the understanding of language as a sign system. However, language, as a sign system, cannot be seen and heard. This is because, in direct experience, we are given only speech activity - the processes of speaking and understanding, and not the sign system itself. So, precisely because scientists have always been interested in what we do both psychologically and linguistically when we speak and understand speech.

MATERIALS REVIEW AND DISCUSSION

The development of linguistic research methods emerged in connection with the consistent interpretation of language as a sign system. This breakthrough belongs to Ferdinand de Saussure's works, after which the main achievements of language science have been consistently developed over a century. However, earlier research interests into language arose within the framework of studying the nature of language in the second half of the XIX century, started by the protagonists at this time – F.Gall, J.Boulliard, E.Aubertin, P.Broca, C.Wernicke, and L.Lichtheim, to name a few. None of them would be described as 'psycholinguists,' but to the extent that their work (like

modern-day cognitive neuroscientists) informed accounts of the relationship between brain and language, they are no less a part of the history of psycholinguistics than are the linguists (1). Since then, several different techniques have been used and tried to develop approaches to classify psycholinguistic research methods to understand the matter we mentioned above.

In general, we can see four different classifications suggested by prominent scholars, which share common principles. They usually refer to their approach to differentiate in a certain setting according to what and how the subjects are taken to analysis. The classified groups can be divided into the following categories:

According to the nature of the analysis: observation, introspection (self-observation) and experiment;

According to the interaction: direct and indirect;

According to the human activity: behavioural and neurophysiological (brain)

According to the subject matter: language comprehension, language production and language acquisition.

The most influential psycholinguistic research to date has tended to use experimental methods because they are both plausible to interpret and offer certain setting requirements, which allows reproducibility and reliability, meaning that other researchers can benefit from them when used with careful consideration. This article concentrates mainly on the classification and use of experimental methods, but it will also briefly analyze the use of observation and introspection techniques.

Among the two distinct approaches used in psycholinguistic studies (observation and experiment), the preferred psycholinguistic method is to carry out a controlled experiment. This means that the researcher manipulates an independent linguistic variable to control some aspect of language processing and then measures the effect of the manipulation on a dependent variable of interest. Therefore, while there is brief information on observational and introspection-related methods, we will talk more about psycholinguistic experimental methods and try to build a classification for these techniques.

Observation. Sophisticated experimental procedures and equipment have only become available relatively recently, so it is no surprise that early discoveries in psycholinguistics were mostly based on more observational approaches. Early approaches also focused in particular on speech production, since the spoken output is most easily observed. For instance, we can note and analyse the occurrence of pauses and hesitations in speech, and assess these as indicators of the planning and sequencing of the spoken output. We can observe where speakers make errors, and relate these errors to hypotheses about the speech planning and production processes. We can also look at the correction of errors as an indication that speakers are monitoring their output. When studying speech, we record it in natural conditions. For example, when we study spontaneous oral speech, we are just interested in not influencing the subjects in any way: let them communicate with each other in the way they always do. As a result, texts are recorded on tape that make up the material for the study of colloquial speech. Another observation method can involve **observing** the language of patients who have had brain operations (2, 101-104). A person might require – because of an accident or a tumour, for example – the removal of a lobe of the brain (lobectomy) or even of an entire hemisphere (hemispherectomy). Then, too, the study of the language of living patients with severe brain damage caused by accidents or wartime injuries was and still is a useful method of investigation.

Self-observation (Introspection). When learning a language, linguists constantly use their linguistic intuition - in other words, they turn to their "inner screen". The researcher turns to his/her language experience and asks questions about his/her intuition. Such self-observation, when it is realized precisely as a consistently applied method, is called **introspection**. At times language is not given to us in direct observation, our psyche becomes an unconditional and immediate given to us. Only we can "look into ourselves" - even if we are inclined to use either pink or black glasses. The method is when our psyche acts as a given, which we judge as if contemplating ourselves on the "inner screen". Introspection, is, by its definition, inaccessible to either correct reproduction or control from the outside. In this sense, the results of introspection cannot be considered verifiable. This does not mean, of course, that introspection is meaningless or unscientific. We just need to remember that by observing our psyche, we always change it.

The famous German scholar G.Ebbinghaus (1850–1909) was himself his subject in one of the most famous experiments (3). Of course, he did not do it out of negligence and not out of indifference - it was a conscious step. So, Ebbinghaus used introspection to try on the experiment for himself, realizing the specifics of this "fitting". In other words, he accompanied his introspection with reflection, or feedback, on the essence of this procedure. Incidentally, it took a hundred years to realize the true place of introspective and reflective procedures in science. After all, with rare exceptions in the human sciences, the researcher always begins by fitting the planned experiment to himself, combining the experimenter and the subject in one person. We emphasize once again that: by observing our psyche in the role of its researcher, we inevitably change it. The fundamental shift in science occurred precisely when this circumstance was first clearly recognized. When it became clear that, in the general case, the researcher and the object of research should not be combined in one person (4, 336). This also applies to psycholinguistics, to a full extent.

Experimental methods. The experimental method became dominant in psychology with W.Wundt, one of the founders of scientific psychology, that is, at the end of the 19th century. In a certain sense, psychology took shape as an independent science precisely when experiments became the main method of cognition. The field of psycholinguistics has gained valuable insights through hypothesis testing, experimentation, and observation of everyday language use.

Recent advancements in technology have allowed for even more precise observation, such as the measurement of brain activity during language tasks. By combining theoretical and descriptive insights from linguistics with the rigorous experimental methods of psychology, psycholinguistics has gained a comprehensive understanding of language acquisition and processing. In the 1870s, Russian science experienced a significant shift in its understanding of speech and language research, as scholars began to recognize the value of experimental methods. This paradigm shift was heavily influenced by the pioneering works of J.A.Baudouin de Courtenay (1879-1918), who founded the Kazan School of Linguistics (5). The contributions of his students and followers, particularly L.V.Shcherba, further propelled this field of study forward (6). J.A.Baudouin de Courtenay was the first to emphasize the importance of observing living speech and experimenting with it. He was also the first to propose the use of instruments for this purpose. The concepts developed by the Kazan school were further expanded by L.V.Shcherba, who founded a phonetic laboratory in Saint Petersburg that is still operational today. Both Baudouin de Courtenay and L.V.Shcherba were engaged in the study and functioning of living languages and dialects. Scientists began to draw their knowledge from observations of live-sounding speech and

were no longer limited to the study of texts and previously compiled dictionaries. Considering that this happened about 120 years ago, we confirm how bold Baudouin's ideas were. Both Baudouin de Courtenay and Shcherba sought to analyze language as a phenomenon that exists primarily in the psyche of individuals and provides social connections and communication. It is also important that both of them emphasize the commonality between the research procedures that it is desirable to apply in the analysis of speech, and experimental methods in other sciences. Therefore, we can safely consider these two scientists as the founders of psycholinguistics as a science based on observation and experiment.

Stages of generating formulation rules. The process of acquiring knowledge through experiment can be represented as links of the following chain:

1. Formulation of the general research problem.

2. Putting forward a set of hypotheses

3. The formulation of a working hypothesis and the derivation of experimentally verifiable consequences from it;

4. Formulating conclusions and making changes to initial ideas. Eventually, either the initial hypothesis is confirmed, or not through the experiments.

It turns out that everything that could be said about each link in this chain is true not only for psycholinguistics but also for any science where the experimental approach prevails: the same general rules for experimenting, the same requirements for ensuring the reproducibility and reliability of the results.

CLASSIFICATION OF EXPERIMENTAL METHODS. Experimental methods have become much more advanced and sophisticated, especially with the help of software that allows precise control over the presentation of stimuli and data collection since the 1950s. Experimental approaches have several benefits over observational approaches, including reduced observer bias and greater control over what participants are required to do. This means that researchers can more easily isolate specific aspects of production or comprehension processes that interest them. However, the downside of experimental approaches is that they often lack natural validity. In other words, it is usually only in experimental settings that participants are asked to explicitly judge whether a stimulus they hear is a word in their language or makes sense in their language.

Experimental techniques often involve measuring response time, where the time taken by participants to complete a language-related task is recorded along with their accuracy. Some response time tasks involve competing attention, meaning that the time taken by the participant to complete the task depends on how much spare mental capacity they have. This capacity will, in turn, depend on the nature of the linguistic processing taking place at the same time.

Other response time tasks use reaction times as a measure of the processing speed for the item being attended to. In its simplest form, perhaps, the response time task requires participants to press a button as quickly as possible when they see or hear a word. There may be a choice of buttons, one for a positive response when the word is an actual word of the language and the other for a negative response when the word is not an actual word. These methods deal with how the speed and accuracy of participants' responses depend on factors such as familiarity – well-known words result in faster and more accurate responses than less well-known words.

One of the prominent scholars in the field of Russian psycholinguistics, A.A. Leontiev, has provided several definitions of this science. One definition summarizes the understanding of psycholinguistics by other scientists: "Psycholinguistics is the science that studies the relationship

between the system of language … and language ability (7)." Another definition states that "the subject of psycholinguistics is speech activity as a whole and the patterns of its complex modelling." Besides, he also believed that "The subject of psycholinguistics is the structure of the processes of speech production and speech perception in their relationship with the structure of the language (8)." According to him, psycholinguistic research should analyze a person's language ability based on both speech activity and the language system. Based on this definition, we can offer the following classifications (Table 1):

Table 1

Direct Approach	Methods of semantic scaling
	Associative techniques
Indirect Approach	Linguistic experiments Positive Linguistic Experiments Negative Linguistic Experiments Alternative Linguistic Experiments
	Formative experiments

Direct Approaches are the most common in psycholinguistics, and can also be subdivided into the following sub-groups.

1. Methods of semantic scaling. The experimentee must place the test object (for example, a word) on a graded scale given by antonymous adjectives such as "hot-cold", etc., by his subjective assessment of the meaning of this word. The classical technique of this kind is Ch.Osgood's "semantic differential" (9). Another option is the "semantic integral" by V.I.Batov and Y.A.Sorokin, where the test material is whole texts, and the task is to attribute them to one or another author (10, 122-126).

2. Associative techniques. Statistically processed results of a mass experiment on free verbal associations, conducted on a certain contingent of subjects, are called associative norms. For example, associative dictionaries can be used during experiments if they are available in the native language of the experimenter.

For **Indirect Approaches**, the most commonly used parameter is the latent time (the duration of the processes). Other parameters may be the number and nature of errors. These methods can be the following:

A linguistic experiment, if we give its most general definition, is an experiment that explicates the language sense of the subject (native speaker) to verify language models (local standard models) or functional speech models, which are a special case of language models. There are three types of linguistic experiments:

A) A positive linguistic experiment - having made some assumption about the meaning of a particular word, a particular form, etc., one should try to see if several different phrases can be said using this rule. An affirmative result will confirm the correctness of the postulate.

B) Negative linguistic experiment - an incorrect statement is constructed, and the subject (informant) must find the incorrectness and make the necessary corrections.

C). Alternative experiment - the subject determines the identity or non-identity of the proposed segments.

Formative experiment. What is being investigated is not the functioning of the language ability in speech activity, but the formation of this ability, and the experiment consists of the fact

that we organize the methods of formation in different ways and compare the effectiveness of the results obtained.

BEHAVIORAL AND NEUROPHYSIOLOGICAL METHODS.

Within the field of psycholinguistics, various techniques are employed to gauge dependent variables. Such techniques may include measuring **behavioural** dependent variables, such as eye movements during reading, or **neurophysiological** variables, such as monitoring electrical brain activity while listening to sentences. This article delves into the two primary categories of techniques, beginning with behavioural methods for examining comprehension of both spoken and written language, followed by neurophysiological methods for analyzing language production and dialogue.

Behavioral methods. A prominent scholar in this field, S.Garrod offered several techniques within the behavioural context (11). Besides this classification he puts a clear distinction according to the object of the study: language production and language comprehension. This division can further be grouped into spoken and written analyses. (Table 2)

Table 2

BEHAVIORAL METHODS	
Spoken Language Production	Analysis of Speech Errors
	Speed Accuracy Trade-Off (SAT)
	Picture Naming
	Priming Techniques (Implicit priming technique)
	Dialogue analysis (Referential communication task)
Spoken Language Comprehension	Cross-Modal Priming
	The Gating Technique
	The Visual World Paradigm (eye-tracking)
Written Language Comprehension	Self-paced Reading
	Rapid Serial Visual Presentation (RSVP)
	Eye-tracking during reading
	Moving window technique

NEUROPHYSIOLOGICAL METHODS. It has increasingly become common to conduct studies that involve monitoring blood flow patterns or electrical activity in the brain during language production or comprehension tasks.

These measures provide a more direct measure of psycholinguistic processing than behavioural methods such as response button pressing. As a result, they have a clear advantage over traditional methods. According to D.Steinberg, these methods can be classified as **traditional** and **high-tech methods**. (12, 306)

Traditional methods: post-mortem, electrical stimulation. Our knowledge of how language works in the brain is not very extensive, and this is because we have only used a few methods to study it. The oldest method is the **post-mortem examination** of the brains of patients who had displayed language disorders while they were alive.

The abnormalities found by P.Broca, who used the method for the first time, in certain areas of their brains in post-mortems correlated with the language symptoms they displayed in life

(13). During brain surgery, a method pioneered by Penfield in the 1950s involves **the electrical stimulation of the cerebral cortex** in conscious patients (14). When stimulated, patients report memories such as childhood events or old songs. However, verifying the accuracy of these memories is difficult. This method is limited to open brain areas of patients undergoing surgery without anaesthesia, so its use is restricted.

High-tech methods. In recent years, revolutionary new methods have been developed within the study of language and the brain, involving powerful new techniques in imaging**: CT or CAT** (Computerized Axial Tomography), **PET** (Positron Emission Tomography), **Magnetic Resonance Imaging (MRI)** and Event-Related Potentials (**ERPs**) (15, 165-181). These techniques allow us to study the brain without performing surgery or any other invasive procedures. They give us a real-time view of how the brain is functioning and can be used to explore the brain activity of both normal individuals and those with brain problems.

CAT scans use a series of X-rays taken from different angles, while PET scans measure emissions from radioactive substances that are injected into the bloodstream. MRI is another imaging technique that measures blood flow in the brain. In his article, psycholinguist S.Garrod classified the neurophysiological methods as three particular measurement technique groups, that have been used to address a wide range of questions about the early stages of lexical processing and more general syntactic and semantic processes in language comprehension and language production (11):

1) The first measures electrical activity at the scalp using electroencephalography (EEG**)** to produce what is called event-related brain potentials (ERPs).

2) The second measures changes in brain blood flow associated with neural activity using functional magnetic resonance imaging techniques (fMRI).

3) The third measures changes in magnetic fields associated with the electrical activity in the brain using magneto-encephalography (MEG) (16, 171-216).

Each technique has its advantages and disadvantages as a psycholinguistic tool. While ERPs are an effective tool for measuring the timing of neural activity, identifying the source of the activity can be challenging due to various extraneous factors, such as skull thickness and interaction between signals from different brain areas. In contrast, fMRI provides precise information about the specific brain area linked to the activity.

As a result, fMRI is particularly useful in neurolinguistic research, which tracks changes in blood flow.

However, fMRI is not suitable for psycholinguistics research, as it cannot accurately establish the timing of neural activity. This is due to the time lag between the neural activity and the resulting changes in blood flow.

 Finally, the most recently developed technique, MEG, offers good localization with a similar temporal resolution to ERP.

An advantage of the MEG technique is that the magnetic fields it measures are not distorted by surrounding tissues, which can affect the electrical activity measured by EEG.

These techniques measure event-related potentials (ERP), the electrical currents passing through the fluid that surrounds neurons as they respond to an event, or event-related magnetic fields (ERF) which measure currents over larger neuronal structures.

Considering the techniques discussed above, all of them can be grouped into the following categories (Table 3):

Table 3

NEUROPHYSIOLOGICAL METHODS	
TRADITIONAL	Post-mortem examination
	Electrical stimulation of the cerebral cortex
HIGH-TECH	CT or CAT (Computerized Axial Tomography)
	PET (Positron Emission Tomography)
	Magnetic Resonance Imaging (MRI)
	Functional Magnetic Resonance Imaging (fMRI)
	Magneto-Encephalography (MEG)
	Electro-encephalography (EEG)

COMPUTATIONAL METHODS. Computational methods of psycholinguistics are techniques that use mathematical or computer models to simulate and explain aspects of human language processing and acquisition. Some examples of computational methods of psycholinguistics are:

•   **Artificial neural networks:** These are systems that consist of interconnected units that can learn from data and perform tasks such as speech recognition, natural language understanding, and machine translation (17).

•   **Connectionist models:** These are models that use artificial neural networks to account for various psycholinguistic phenomena, such as word recognition, sentence processing, and language development (18, 607–626).

•   **Probabilistic models:** These are models that use statistical methods to represent and manipulate uncertainty and variability in language data. They can be used to perform tasks such as parsing, word segmentation, and language modelling.

•   **Corpus linguistics:** This is a method that uses large collections of natural language texts to analyze linguistic patterns and phenomena. It can be used to study various aspects of language use, such as frequency, collocation, and variation[1].

RESULTS

As we have seen, psycholinguistic research methods are ways of studying how people learn, use, and process language. There are different types of psycholinguistic research methods, depending on the research question, the data source, and the data analysis. the main classifications of psycholinguistic research methods that we have discussed in this article are:

Observational and behavioural methods: These methods involve observing and measuring how people perform language-related tasks, such as reading, speaking, listening, or writing. Examples of these methods are response time, accuracy, eye-tracking, and speech error analysis.

Neurophysiological methods: These methods involve recording the brain activity of people while they engage in language-related tasks. Examples of these methods are electroencephalography (EEG), event-related potentials (ERP), functional magnetic resonance imaging (fMRI), and magnetoencephalography (MEG).

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[1] https://opentextbc.ca/psyclanguage/chapter/research-methods-in-psycholinguistics/

Computational methods: These methods involve creating and testing mathematical or computer models that simulate aspects of language processing or acquisition. Examples of these methods are artificial neural networks, connectionist models, and corpus linguistics.

Experimental methods: These methods involve manipulating one or more variables that affect language processing or acquisition and measuring the outcome. Examples of these methods are priming, artificial linguistic systems, and virtual reality. Based on the research methods and techniques that we have discussed so far, there is an attempt to **classify** the research methods into the following groups (Table 4):

Table 4

PSYCHOLINGUISTIC RESEARCH METHODS		
OBSERVATIONAL METHODS	**INTROSPECTION**	
	Behavioural methods	**Spoken Language Comprehension** The Gating Technique The Visual World Paradigm (eye-tracking)
		Written Language Comprehension Self-paced Reading Rapid Serial Visual Presentation (RSVP) Eye-tracking During Reading Moving window technique
		Spoken Language Production Picture Naming Referential Communication Task (based on dialogue) Speed Accuracy Trade-Off (SAT)
EXPERIMENTAL METHODS	**Behavioural methods**	**Spoken Language Comprehension** Cross-Modal Priming
		Spoken Language Production Implicit Priming
	Neurophysiological methods	**Traditional** Post-mortem examination Electrical stimulation of the cerebral cortex
		High-Tech CT or CAT (Computerized Axial Tomography) PET (Positron Emission Tomography) Magnetic Resonance Imaging (MRI) Functional Magnetic Resonance Imaging (fMRI) Magneto-Encephalography (MEG) Electro-encephalography (EEG)
	Linguistic methods	**Direct** Methods of semantic scaling Associative techniques

		Indirect Analysis of Speech Errors Positive Linguistic Experiments Negative Linguistic Experiments Alternative Linguistic Experiments
	Computational methods	**Artificial neural networks** speech recognition natural language understanding machine translation **Connectionist models** word recognition sentence processing language development **Probabilistic models** parsing word segmentation language modeling **Corpus linguistics** frequency collocation variation
FORMATIVE METHODS		All of the techniques above can be formative once they are established under a certain formulation to reach expected outcomes

CONCLUSION

Thanks to these methods, our scientific understanding of the brain and its functions has grown immensely, but we still have much to learn. This is because it has only been in the past 40 years that brain exploration has been furthered by the development of technologically advanced methods. While these methods enable us to delve into the neurophysiological aspects of language production and comprehension in great detail, there remain certain areas of psycholinguistics where informal observation and relatively simple experimental techniques prove useful for gaining deeper insights into the production, comprehension, and representation of language. Additionally, these techniques offer an advantage to many researchers, particularly those in linguistics departments within humanities faculties, due to their lower cost when compared to the expensive imaging techniques mentioned earlier. The coming decades of this millennium are sure to be exciting as we develop new technological methods for uncovering the connections between the brain and language. We look forward to refining our current classification model with the aid of future high-tech advancements.

REFERENCES

1. Altmann, G. (2006) Psycholinguistics: History. Encyclopedia of Language & Linguistics. http://dx.doi.org/10.1016/B0-08-044854-2/04157-2

2. Heim, S., Opitz, B. & Friederici, A.D. (2002). Broca's area in the human brain is involved in the selection of grammatical gender for language production: evidence from event-related functional magnetic resonance imaging. Neuroscience Letters, 328, 101–104.

3. Ebbinghaus, H. (1885). Memory: A contribution to experimental psychology. New York: Dover.

4. Frumkina R.M. (2014) Psycholinguistics: a textbook for students. institutions of higher professional education. - 5th ed., Rev. - Moscow. Publishing Center "Academy".

5. Adamska-Sałaciak, A. (1998) Jan Baudouin de Courtenay's contribution to linguistic theory", Historiographia Linguistica.

6. Shcherba L.V. (1957) "O chastyakh rechi v russkom yazyke" (On the parts of speech in the Russian language). Originally published in a journal. Reprinted in the collection, Izbrannye raboty po jazykoznaniju i fonetike.

7. Leontiev, A.A. (2003) Osnovy psikholingvistiki (Basic Problems of Psycholinguistics). Moscow: Smysl. SPb.: Lan'.

8. Leontiev, A.A. (1969) Psikholingvisticheskie edinitsy i porozhdenie rechevogo vyskazivaniia (Psycholinguistic Units and Speech Generation). Moscow: Nauka.

9. Osgood, Ch.E. (1952) The nature and measurement of meaning. Psychological Bulletin.

10. Sorokin, Yu.A. (1974) Ocenka tekstov metodom semanticheskogo integral (Evaluation of texts by the method of semantic integral). In: Psixolingvisticheskie problemy` massovoj kommunikacii (Psycholinguistic problems of mass communication). Moscow, Nauka publ., pp. 122–126

11. Garrod S. (2006) Psycholinguistic Research Methods. Elsevier Ltd. University of Glasgow, Glasgow, UK.

12. Steinberg, D.D. and Sciarini, N.V. (2006) An introduction to psycholinguistcs. 2nd ed. Pearson Education Ltd, Great Britain. 306p

13. Costandi, M. (2007) Old brains, new ideas. History of Neuroscience, Neuroscience. https://neurophilosophy.wordpress.com/2007/04/26/old-brains-new-ideas/

14. Nitsch, R. & Stahnisch, F.W. (2018) Neuronal Mechanisms Recording the Stream of Consciousness – A Reappraisal of Wilder Penfield's (1891–1976) Concept of Experiential Phenomena Elicited by Electrical Stimulation of the Human Cortex. Cerebral Cortex 28(9). DOI: 10.1093/cercor/bhy085

15. Frackowiak, R.S.J. (2000) Imaging neuroscience: system-level studies of physiology and anatomy of human cognition. Cambridge, MA: MIT Press, pp. 165–81.

16. Osterhout, L. & Holcomb, P.J. (1995). 'Event-related potentials and language comprehension.' In Rugg, M.D. & Coles, M.G.H (eds.) Electrophysiology of mind: event-related brain potentials and cognition. Oxford: Oxford University Press. 171–216.

17. Nick Chater and Morten H. Christiansen (2012) Computational Models of Psycholinguistics. The Cambridge Handbook of Computational Psychology. Cambridge University Press.

18. Ronald M. Kaplan (2019) Computational Psycholinguistics. Computational Linguistics 45 (4): 607–626.