Eric Keller

INTRODUCTION TO PSYCHOLINGUISTIC SYSTEMS

Translated into English by Eric Keller
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Eric Keller

In 1985 **Eric KELLER** was professor at the University of Quebec in Montreal and a researcher at the Côte-des-Neiges Hospital Centre Research Centre (Montreal). Originally from Switzerland, he holds a bachelor's degree in English language and literature from Utrecht University (Netherlands) as well as a master's degree (M.A.) and a doctorate (Ph.D.) in linguistics from the University of Toronto. Furthermore he pursued postdoctoral research in neurophysiology at the University of Ulm (Germany). At the time he was also undertaking doctoral studies in psychology at Concordia University (Montreal).

His professional experience and research have allowed him to explore several aspects of psycholinguistics: research methodology, speech production, communicative discourse, and second language acquisition. Based on his studies he set up a laboratory for ultrasonic measurement of articulation gestures in people with and without speech disorders.

A busy career at UQAM in Montreal and at the University of Lausanne ensued. By 2026 he had published more than 100 papers in psycholinguistics and has presented his research findings at various conferences in America, Europe, and Asia. He has also presided and organized national and international meetings on psycholinguistics, linguistics, and speech motor skills within the *European COST* and *ESPRIT* frameworks.

Introduction to Psycholinguistic Systems

This book covers all contemporary issues in psycholinguistics, including research methodology, the biological foundations of language, normal language use, language impaired by neurological damage, the psycholinguistic aspects of communication, mother tongue acquisition, and second language learning.

This volume presents the basic concepts related to language learning and speech disorders. In addition, it fits into the trends of cognitive psychology since it focuses on different psycholinguistic processes. It thus allows the reader to become familiar with a modern approach to the cognitive mechanisms underlying human linguistic functioning.

The various concepts are presented in an integrated conceptualization of the field, rather than in the form of an “encyclopedia” of research findings. This work is characterized by its clarity and scientific rigour.

Introduction to Psycholinguistic Systems is an excellent educational tool for training psychologists, linguists, speech therapists, translators, and teachers of native and second languages. It can also serve as a reference book for professionals working in these fields.

Support

The F.C.A.R. Fund (Canada) awarded a grant to the writing and publishing of this work, as part of its policy to promote the publication of textbooks and treatises in French for university students.

First English Version

The initial French version of this volume reached publication more than forty years ago.

All these years I had not found the time to consult its pages extensively; I was simply too busy. This year I decided to re-inspect this volume in detail. I read a good portion of it, thought about its orientations, and I finally decided to translate it into English. It contained sufficient novel perspectives to validate the effort of an English rendering, even 40 years after its initial publication in French. Other authors of psycholinguistics had covered several other territories of our field, while this volume favoured many theoretical and empirical considerations that others had not treated in a similar perspective.

The wording of this translation has been extensively modernized and clarified, but the content has remained the same. This text captures the same state that psycholinguistics had in 1985. Many subject areas, like the section 8 on *Language and the Brain*, would merit extensive updating now, while others could be left entirely intact. However such a challenging task is best left off to a new enterprising team of researchers.

I remember 1985 as the year that I owned my first-generation Macintosh. It was a key acquisition for this book. It permitted me to work on this manuscript at home. Also for the first time it provided a full layout of French characters for home use, which was very useful for the publication the French version of this volume.

After sending the manuscript into publication, I went to Japan and China for a month-long study of advanced methods in speech motor control. Prior in the 1970s I had learned most of my psycholinguistic tools in North America. These travels to Asia provided much wider insights into the multilingual challenges that all of us humans share. That is the rich foundation of psycholinguistics, and it is worthwhile to share these widely.

Eric Keller

Professor, hon. emeritus, Université de Lausanne

2026

Note 1

For ease of access to the *Index and bibliographical reference texts are found in the original French version.* All referenced titles are listed in CAPITAL LETTERS here.

Note 2

This volume was written in Open Office 4.1.16.

PREFACE

For nearly fifteen years now, the term "psycholinguistics" has found its place in our dictionaries. It is therefore with the approval of lexicographers that Eric Keller's students urged him to write an introduction to psycholinguistics. This linguist, on the path to becoming a psychologist after having seriously immersed himself in neurological sciences, now gives us a work that is more of a treatise than an introduction. It is the result of five years of reflection and work. Until now, the best writings on the subject have almost all been written in English. They now have a French equivalent both in terms of quality and in terms of the most generally accepted basic teachings. This is a work that not only reflects the largely original views of its author, but also his qualities as a teacher.

Most psychologists who were among the founders of modern psycholinguistics, and some linguists who joined them, emphasize that their discipline specifically concerns *the cognitive processes* that lead to the transformation of meaning into sign and vice versa. Psycholinguistics therefore have no need to establish its legitimacy, nor for any interaction with "neurolinguistics," which focuses on the mutual relations between the brain and language. It must be acknowledged that this position is scientifically acceptable, both in psychology and in language psychopathology. However, it must also be recognized that one can - following the neurological tradition and like the majority of linguists interested in language disorders following Marguerite Durand and especially Roman Jakobson - adopt another, equally legitimate but more ambitious position. Whether dealing with normality or pathology, psycholinguistics can aim either at the study of psychological processes or at the relationship between these processes and the corresponding physiological mechanisms and brain structures. It is from this second perspective that Eric Keller has unreservedly situated his book, a choice that a neurologically trained preface writer can only applaud.

After a brief introductory chapter in which the author very clearly specifies the context of his endeavour, the work begins with a long section on psycholinguistic methodology. The reader immediately learns, and will retain throughout the reading, that psycholinguistics is a discipline in full genesis and that one can only position oneself within it by accepting to become familiar with a particular form of scientific research, from hypothesis formulation to the statistical treatment of data, including their methods of data collection.

Only once this prerequisite is established, there are the classic questions concerning the nature of language, posed in new terms: the innate vs. the acquired; the biological and the social; and the characteristics specific to the species in human communication as opposed to the modes of communication among other animal species. We are at the heart of the interactions between psycholinguistics and several other disciplines.

The specific field of psycholinguistics, that is, the psychological processes underlying the production and comprehension of language, is then systematically addressed. The terms used are those of a research area in full effervescence: the reader learns what is meant by "motor theory of speech," by notions of "lexical access," by "syntactic comprehension," and so on.

Just as systematically, the discussion then shifts towards the biology of language. The major themes of contemporary neurolinguistics are then reviewed, and the reader is, so to speak, guided towards what must be known about the mutual relationships between the brain and language, from ontogeny to the stable state, from genetic

programs to their actualization in the form of a more or less absolute functional lateralization, from normal cybernetics to aphasic dysfunctions.

Everything in this volume testifies to a desire to account for the entirety of current concerns in psycholinguistics: one will not discuss the acquisition of the mother tongue without addressing problems related to the learning of a second language; one will not discuss neuroanatomical foundations without relating them to the affective and social factors with which they interact. Psycholinguistics is also presented as a field where knowledge is still so fragmentary and fragile that questioning is a daily occurrence.

With their *Introduction to Psycholinguistic Systems*, Eric Keller and his collaborators provide the francophone scientific community a book whose need has been felt for quite some time. It is to be hoped that this work will have the dissemination it deserves, especially among students; it is also to be hoped that proponents of other schools will also undertake, like Eric Keller, to submit their thoughts and hypotheses to the scrutiny of pedagogical writing.

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FOREWORD

Over the past thirty years, an unprecedented evolution has taken place in psycholinguistics. At the intersection of research in psychology and linguistics, psycholinguistics has sparked lively discussions regarding fundamental questions about our understanding of human beings. Is our faculty of language innate? What areas of the brain control the various aspects of language? How is a language acquired?

These are just a few of the questions that concern a large number of psycholinguists around the world. These researchers, working according to various theoretical and empirical methods, share the common goal of striving toward a better understanding of the acquisition, use, and pathology of language.

This state of affairs has both advantages and disadvantages. Among the advantages, it should be noted that introductory courses in psycholinguistics are now an integral part of the training of language teachers, psychologists, speech therapists, and linguists. Gradually, psycholinguistic concepts are changing the perception of language teaching and language rehabilitation. Furthermore, psycholinguistics influence new theories in psychology, education, linguistics, and phonetics.

On the other hand, the number and diversity of research in this field undoubtedly pose a considerable challenge to anyone attempting to grasp the major trends and main lines in an introductory text. How can this knowledge be summarized in a few pages? For the reader, the challenge is also significant, as they must assimilate knowledge and explore modes of thinking very different from those applied in the fields of literature, the humanities, or the exact sciences.

This volume introduces three major areas of contemporary psycholinguistics. The first area concerns the research methodology used in psycholinguistics. After a brief introduction in the first chapter, we examine in chapter 2 the different research approaches used, either the taxonomic approach or the hypothesis validity verification approach. In doing so, we focus on some fundamental concepts such as "theory," "hypothesis," and "model."

The methodological section continues in chapter 3, where the experimental method is observed in the concepts of "independent variable," "dependent variable," "confounding variable," "reliability," and "validity." We conclude this section with chapter 4, in which we briefly summarize statistical methods to enable beginners to acquire a minimum of statistical skills; we have also added a detailed didactic introduction to the most commonly used experimental procedures in modern psycholinguistic research.

The second main section of this volume addresses what today constitutes the core of psycholinguistic research: the study of psycholinguistic processes. This involves characterizing linguistic functioning in aspects as diverse as their hereditary and learned dimensions, as well as productive, receptive, neural and social strata.

In this vein, chapter 5 attempts to situate human language in relation to other cognitive, motor, and sensory faculties. We compare the hereditary and learned components of human language by establishing comparisons between human language and behaviours that are strongly hereditary or clearly learned. We also examine certain relationships that exist between human language and communication systems used by some animal species.

In chapters 6 and 7, we first seek to understand how speech is produced and then how

it is perceived and understood. The illustration and examination of slips of the tongue, hesitations, and other spontaneous speech errors allow us to postulate interesting hypotheses about the functioning of speech production. Important experimental research informs us about speech reception.

In chapter 8, we focus on the functioning of the central nervous system in regard to speech production and reception. We address key questions within current psycholinguistic research, namely those of lateralization and localization of linguistic functions in the human brain. Finally, in this section, chapter 9 is devoted to psycholinguistic strategies used in conversational situations. A quick overview will allow us to identify some of the principles governing communication processes and it will characterize certain strategies employed to improve it, whether in everyday situations or in learning or psychotherapy contexts.

The third and final main section of this volume deals with language development. We synthesize two areas of psycholinguistic research that have proven particularly fruitful: the first concerns the acquisition of the mother tongue and the second the learning of a second language. In chapter 10, we report on the major stages during mother tongue acquisition and provide a synthesis of the controversies that have prevailed in this field over the past twenty years, notably the relationships existing between language and Piagetian cognitive stages.

This volume concludes with chapter 11, which is an essential summary of contemporary research on second language acquisition. We discuss the "sensitive" period related to language acquisition and the cognitive and affective factors that seem to influence the degree of competence when using a second language. We address the various strategies employed during second language acquisition and finally discuss the concept of approximate systems (interlanguage systems) evolving between the mother tongue and the second language.

Before addressing these different sections, we wish to specify the limits we have set for this volume. We have by no means attempted to provide an exhaustive inventory of research conducted in psycholinguistics. Rather than aiming to produce an "encyclopedic" work, our choice was to present a coherent selection of some key psycholinguistic concepts and hypotheses that enjoy provisional consensus and serve as the initial theoretical foundations for contemporary psycholinguistic work.

This volume therefore reflects a personal perspective based on a series of reasoned choices which, we hope, have their own internal logic. It aims to expose the essential foundations for understanding recent writings in psycholinguistics, neurolinguistics, articulatory phonetics, and language pathology, and it explicitly leaves space for other researchers to develop work based on material we have chosen not to expand upon here. We hope that in the long term, the value of our work will be assessed not so much in comparison to previous works, whatever their content, but according to the internal structure we wished to give it.

It should be noted that this approach is not without risks for the reader. The nature of the hypotheses presented here might give the impression that all important questions in psycholinguistics are now resolved. This is certainly not the case. Many of these hypotheses are speculative; some would have deserved thorough demonstration, but unfortunately we are constrained by space and time; others will be invalidated or modified in the course of future research; this is part of the natural process of the evolution of scientific knowledge and constitutes the inherent risk of fragmenting and fixing knowledge whose major principle is its mobile evolution. We hope this volume will stimulate the gathering of information that will accelerate the scientific development

incumbent upon future researchers. It is only through continual modifications that we will all achieve a better understanding of psycholinguistics.

This work could not have been completed without the selfless support of many people. Even after thirteen years of serious study, my own knowledge in this vast field is only beginning to consolidate. Among other challenges, I undertook the bold task of writing in French, my third language after English and German. I have therefore accepted with deep gratitude all the help offered to me during the five years of preparing this manual.

Regarding the basic research and writing of this text, six people have notably contributed, in alphabetical order: Ms. F. Côté for chapter 5, Ms. R. Feltham for chapter 10, Ms. F. Gardye for chapter 9, Ms. M. Labelle for chapters 7 and 11, Ms. H. Maisonneuve for chapter 9, and Ms. A.-É. Simon for chapters 2, 3, and 4.

I also wish to express my sincere thanks to all the other people who contributed to improving this volume. I especially want to thank my friend and esteemed colleague, Professor J.-L. Nespoulous, psycholinguist at the University of Montreal, who encouraged this project at every stage and who carried out many readings of the text with extraordinary care.

I also wish to express my gratitude to Professors T. Gray (Concordia University, Montreal) and O. Stern (University of Zurich) for their valuable comments on certain chapters. I would like to thank Mrs. Frédérique Gardye, who accomplished the almost superhuman task of rewriting the entire text in four months of hard work, while respecting both the rigorous stylistic conventions of international French and the specific constraints of the original text. Finally, my gratitude goes to Mrs. Céline Laprise, from the Gaëtan Morin publishing house, for her very appreciated help in revising this text.

Eric Keller
Montreal, July 1985

Chapter 1. Introduction

A discipline is defined both by its field of research and by its methodology.

Anatomists, for example, are interested in the structure of organized beings and conduct their research through dissection, microscopy, radiology, etc. Mathematicians handle and study quantitative concepts, supporting their investigations with logical and mathematical proofs.

From this, if we now try to define the scope of psycholinguistics, we quickly realize that its domain is still relatively ill-defined; nevertheless, practitioners of this science generally agree on its methodology. While acknowledging that there is no unanimity regarding the object of psycholinguistics, we will attempt here to outline the main lines that constitute the field of research of this science.

A. THE OBJECT OF PSYCHOLINGUISTICS

1. The field of study

As its name indicates, psycholinguistics overlaps psychology, with respect to the scientific study of *mental phenomena*, thought, and the internal organization of behaviour in the individual, and *linguistics*, regarding the study of the skills that enable the acquisition and use of language.

From one perspective, psycholinguistics and modern psychology (and more specifically cognitive psychology) share the same fundamental interest and consequently pose the same question: How is it that the interaction between different mental structures is responsible for human behaviours? By studying individual functioning, a phenomenon manifested through various behaviours, the psycholinguist seeks to understand how an individual acquires a language and how they use that language. The internal events or processes that generate linguistic behaviours are thus comparable to those that determine the range of normal and pathological behaviours studied in psychology.

On the other hand, psycholinguistics constitutes an important part of the field of linguistics. Like modern linguistics, it is interested in the faculty of language. Just like the theoretically oriented linguist, the psycholinguist proposes and evaluates hypotheses concerning the mental organization specific to language.

However, psycholinguistics is much more than a conglomerate of ideas borrowed from two related sciences. For several years now, there has been growing interest in hypotheses concerning the internal functioning of the communication system, functioning that can be termed "mental," meaning that it "takes place in the mind only,

without oral or written manifestation". It is this functioning that allows us to perceive, understand, produce, use, and acquire language.

Moreover, many psycholinguists are interested in linguistic functioning as a physiological phenomenon. Scientists seek to understand what exists between language and certain brain structures such as the brain, medulla oblongata, cerebellum, cranial nerves, articulatory musculature, and the auditory system.

Furthermore, various researchers study the psychosocial aspect of communication. This specific area of psycholinguistics focuses more particularly on the systematic study of psychological factors that are either favourable or detrimental to communication from both the speaker's and the listener's perspectives.

The object of psycholinguistic research could thus be determined or defined as the set of phenomena relating, first, to the *mental functioning* of the communication system and its acquisition (psycholinguistic processes); second, to the use of certain *physiological structures* (neurolinguistic processes); and finally, to the psychological determinants of *communicating functions* (communicative processes).

2. The Psycholinguist's Approach

Another way to view the activity of psycholinguists is that they seek to understand the functioning of a complex system that they can hardly apprehend directly.

It is a difficult and challenging task which could be compared to an electronics engineer who is asked to understand the functioning of the global telephone network from a single telephone device! Even if this device could have unlimited access to the network, with precise measuring and analysis tools, it would nevertheless not be able to easily infer from its analyses all the interconnections that exist worldwide. At best, based on its technical knowledge, regional codes, and the presence of busy lines, it could infer the general network and the usage rate of interconnections and thus arrive at an approximate sketch of the network.

Similarly, the psycholinguist cannot, even with the current means at their disposal, know the precise network of neuronal interconnections governing language use. Nevertheless, they can still establish the overall pattern that emerges from the linguistic system by relying on careful observations of human linguistic behaviour. To do this, they may decide to analyze, for example, strategies for lexical retrieval in memory or the origin of errors in oral production.

These studies, as in the case of analyzing regional codes and usage rates in our example above, allow the psycholinguist to gradually build hypotheses concerning the mental processes necessary for oral communication. How is the appropriate word selected at the right moment in a sentence? How are different words combined to produce a correct sentence?

3. Psycholinguistics and related fields

Thus defined, the object of psycholinguistics is distinguished from other linguistic and psychological fields such as sociolinguistics, theoretical linguistics, and cognitive psychology.

On this subject, LABOV (1976, 258) defines the object of study of sociolinguistics as *the structure and evolution of language within the social context formed by the linguistic community* (our emphasis). This involves, for example, research related to

signs of social relations in speakers' oral expression, or surveys regarding the evolution of a pronunciation change across different social and geographical groups in the same linguistic community.

By contrast, theoretical linguistics (or general linguistics, with a structuralist, generative, transformational, or other orientation) differs from psycholinguistics by its greater interest in the internal structure of a specific language or in languages in general. In this discipline, one seeks, for example, to formulate explicit rules that define the possible sentences in a given language. Thus, the structure of a language is considered an object relatively independent of questions related to mental functioning, physiological functioning, or social dynamics.

Given the complexity of the human communication system, it is not surprising that this abstraction has been considered necessary since the Saussurian era[1] at the turn of the 20th century. It is through a delimitation of this field that psycholinguistics differentiates itself from cognitive psychology. The former is limited to the development and use of language, while the latter studies the organization and acquisition of faculties enabling thought in general. In this way, cognitive psychology can be seen both as a parent science and a sister science to psycholinguistics.

B. METHODOLOGY

1. The quantitative method

Methodologically, psycholinguistics distinguishes itself from traditional linguistics - descriptive linguistics, historical linguistics, and general linguistics - because it is more *quantitative and experimentally based* than the descriptive and logical approach. From this point of view, psycholinguistics is situated closer to experimental psychology, biology, and, more generally, the exact sciences.

Let us examine more closely the reasons that motivate and govern the use of a quantitative methodology. Suppose, for example, that a psycholinguist wishes to verify the hypothesis that access to verbal memory is more based on a *recall of their sounds* than a *recall of the meaning of those words*. To do this, they could design an experiment involving a task for each of the two types of memory access.

To recall by sounds, the researcher could possibly present words (*stimuli*[2]) to the participants (the *subjects*) in the experiment, and ask them to find terms similar from a sound perspective. E.g., “bête” [animal] would be an acceptable response to the stimulus “fête” [party]). For recall by meaning, they could ask them to find semantically similar words, e.g., the response “party” to the stimulus “fête”. Afterwards, having measured the response time for each stimulus (their *reaction time*), they would conclude if the reaction time for the phonological task (sounds) is on average significantly shorter than the time required for the semantic task (meaning). Thus access to verbal memory seems to be more *phonological than semantic* in nature. Their initial hypothesis would thus be confirmed.

We note that the result of this hypothetical experiment depends on and would be evaluated by a series of reaction time measurements. However, a problem often

1 Ferdinand de Saussure was a Swiss linguist and philosopher (1857–1913). His ideas laid a foundation for many significant developments in both linguistics and semiotics in the 20th century. He is widely considered as one of the founders of 20th-century linguistics and one of two major founders of semiotics, or *semiology*, as de Saussure called it (Wikipedia).

2 Aligning with current usage, in this volume we use the plural “stimulus” rather than “stimuli.”

arises when evaluating and interpreting reaction times: frequently, reaction times vary considerably from one trial and from one subject to another. By way of illustration, we observe that the reaction time under the phonological modality will sometimes be shorter, sometimes longer than that observed under the semantic modality. How should such results be interpreted? What conclusion can be drawn when the average reaction times are very similar? Can we conclude that the reaction time for the phonological task is indeed shorter than that for the semantic task?

Whether it is psychology, biology, or other exact sciences, such problems are solved with the help of statistical methods. Regarding the problem at hand, for example, one will seek to calculate the probability that the measured differences become *significant*[3]. If it is determined by probability calculation that the two reaction times are indeed different (*e.g.*, probability greater than 95%), one will be justified in stating that "the reaction times are significantly different."

It is by carefully examining such probabilities that the psycholinguist will rely on to retain or to reject the initial hypothesis. A descriptive or logical approach would not prove sufficiently decisive in cases where the two average times are similar. The statistical approach is, indeed, recommended whenever it is expected or desirable to express a result quantitatively. Such expectations are frequently encountered in any description related to an individual's linguistic behaviour, for example, when one wishes to calculate the number of times a speaker uses one type of utterance rather than another.

2. The generality of research results

In the vast majority of cases, the conclusions obtained by this method remain debatable, as they never constitute irrefutable proof of the initial hypothesis. It often happens that any hypothesis is refuted by subsequent results using different experimental approaches or more refined measurement methods. This is why it is important to consider data from various methods for each retained hypothesis.

Moreover, in a psycholinguistic experiment, the link between the task imposed on a subject and spontaneous linguistic behaviour is often unclear. In the example mentioned above, the relationship between reaction time in response to a verbal stimulus and the strategy for accessing verbal memory still seems obvious; but the more complex the task becomes, the greater is the risk of moving away from normal linguistic functioning in spontaneous language. The experiments and arguments presented in this volume are chosen to minimize this gap resulting from the experimental task and the spontaneous use of language.

The next three chapters will further familiarize us with *psycholinguistic methodology*. They aim to introduce us more directly to the psycholinguistic approach than if we had limited ourselves to examining only the concepts used and had listed only the research results in this field. If we are able to understand how a psycholinguist develops hypotheses and empirically tests them, it becomes possible to immediately participate in such endeavours, by evaluating the reasoning underlying the proposed conclusions, the strength or weakness of the arguments used, and the validity of the results obtained. True scientific progress is likely achieved thanks to the intervention of critical thinking applied to preconceived or established ideas. To this end, in the following chapters, we will see how to evaluate established ideas in psycholinguistics and how to

3 In this volume, the term "significant" is restricted to the domain of statistics. Also the term "proof" is limited to the specific meaning of "logical proof" or "mathematical proof."

propose and test new hypotheses.

SUMMARY

We have described psycholinguistics as a research field characterized by a set of questions related to the use, acquisition, and pathologies of human linguistic behaviour. It is distinguished both from sociolinguistics, which deals with the dynamics and structure of language within a linguistic community, and from theoretical linguistics, which attempts to define the system of signs, rules, and regularities that constitute the structure of languages. Also, psycholinguistics differs from cognitive psychology, as the latter is more concerned with general cognitive faculties, whereas psycholinguistics focuses exclusively on linguistic faculties.

In conclusion, we have explained some reasons why the acquisition of knowledge in psycholinguistics is primarily carried out with quantitative measures and statistical analyses.

APPLICATION SECTION

1. In general, what does the psycholinguist study?

2. Referring to the preceding text, briefly discuss one of the psycholinguist's areas of interest.

3. Excluding the questions already mentioned in the text, formulate one that would fall within the domain of psycholinguistics.

4. What distinguishes the fields of psycholinguistics, sociolinguistics, theoretical linguistics, and cognitive psychology?

5. How does the methodology used in psycholinguistics differ from that used in traditional linguistics?

6. Why is a quantitative methodology used in psycholinguistics?

7. What do you expect from this introduction to psycholinguistics? What are the points that interest you the most in psycholinguistics?

FOR FURTHER READING

AARONSON & RIEBER (1979). Chapter 1.

PALERMO (1978). Introduction.

For precise references, see the Bibliographic References section at the end of the volume.

Part One

Psycholinguistic Methodology

Chapter 2. The Methodology of Research in Psycholinguistics

In the introduction, we stated that psycholinguistics could be characterized by its field of application and its methodology. We could have defined it differently and said that psycholinguistics is above all a discipline that brings together persons who try to grasp and understand the human mind.

From this point of view, psycholinguistics does not represent a mass of abstract notions, but rather an investigation and a persistent effort to understand the different aspects that constitute our capacity for communication. Researchers involved in this discipline must provide and demonstrate new conceptions, or simply update traditional conceptions, by elucidating new, previously unknown aspects. In this way, they allow for the development of knowledge whose impacts can sometimes be felt, even over several decades.

This chapter outlines the method by which a psycholinguist arrives at certain conclusions and how they develop their understanding of psycholinguistic phenomena. This section mainly concerns what is called "the scientific method", as it is applied to the psycholinguistic field. We will study how new ideas are proposed, tested, and sometimes integrated into the field. In this context, we will define terms such as "hypothesis," "theory," "economy," "duplication," "theoretical construction," and "operationalization." Over the next two chapters, we will detail the experimental method by detailing the concepts and evaluations on which psycholinguistic experiments are based.

This summary of the quantitative contribution to contemporary psycholinguistic research will be simple and concise. A more comprehensive treatment of these issues can be found in many volumes specialized in the fields of philosophy of science, experimental design, and statistical analysis in social and behavioural sciences. We strongly recommend consulting the references cited at the end of each chapter.

A. THE RESEARCH APPROACH

1. From Description and Taxonomy to the Verification of Hypothesis Validity

Like most other scientific fields, psycholinguistic research has gradually evolved over the last century. Initially, it centred around description and differentiation, thus the *taxonomy* (or classification) of observed phenomena, and over the years, it moved toward verifying the validity of hypotheses.

Taxonomic research constitutes the normal starting point of any research aiming to understand a phenomenon; such a study begins with describing the state and the course of the phenomenon, the circumstances in which it can be observed, and how it can be differentiated from other similar but apparently irrelevant phenomena.

Examples of a taxonomic approach include traditional anatomical science for the use of the descriptive mode and for distinguishing different parts of the body, or in traditional medicine, for identifying different diseases and grouping them into syndromes. Following the same principle, the psycholinguist will begin their research with a careful description and classification of the behaviour of speaker-listeners, according to different situations.

An important aspect of the taxonomic approach consists in specifying certain fundamental elements whose combination produces a given phenomenon. This approach has led chemistry, for example, to the identification of elements which, through a multitude of combinations, constitute all matter known so far. In psychology, researchers and philosophers have been concerned, since ancient Greece, with the identification of the most elementary processes of the mind. Throughout this volume, we will see how psycholinguistic research developed around these two taxonomic aspects. Even today, the taxonomic approach analyzes and classifies linguistic behaviour by identifying the elements and processes that constitute our psycholinguistic functioning.

The study on slips of the tongue by the Austrian linguist Rudolf Meringer (1859-1931) clearly illustrates that psycholinguistics was originally mainly focused on a taxonomic method. In 1895 and 1908, Meringer published two collections of slips noting about 4,400 errors in spontaneous speech. These slips mostly came from lectures given by his colleagues at the University of Vienna. For the rest, he drew his data from his immediate surroundings, notably from his friend and psychiatrist Carl Mayer (MERINGER AND MAYER, 1895; MERINGER, 1908). A characteristic example of the errors collected by Meringer is as follows: "Eine **S**orte von **T**acher" instead of "Eine **T**orte von **S**acher" ("a cake from [the Sacher pastry shop]") (Note: the word Sorte actually exists in German, but not the expression Tacher). Such slips occur easily and the literature in several languages is full of them (see chapter 6).

The main contribution of Meringer's study is not measured by the systematic collection of these errors, but rather by the effort of classification. Thus, he distinguished slips involving a word, a syllable, or an individual sound (phoneme). He also distinguished between anticipation errors (saying something too early that should be uttered later), perseveration errors (repeating what was said before), and many other errors which we will not enumerate here. Even today, we use, more or less, the descriptive framework developed by Meringer more than eighty years ago (see chapter 6).

Although their considerable contribution cannot be denied, these efforts of description and differentiation are not sufficient; they will subsequently lead to validity checks of hypotheses. Researchers not only wish, at first, to delineate the nature of a phenomenon, but also the why and how of its occurrence. These are questions that

cannot be resolved by the taxonomic approach. Moreover, research shows undeniable interest in what a given phenomenon allows to infer about certain events that cannot be observed. This is a very common situation in psychology, linguistics, or psycholinguistics, because in these sciences, observable events are considered in relation to what they reveal about the mental processes that necessarily precede them, most of which are unobservable.

The usual procedure includes a first phase in which the different behaviours are examined, and from there, a second phase results which is oriented towards deducing the structure or internal functioning of the system in question. This second phase relies on the systematic use of hypothesis validity verification.

2. Illustration of hypothesis validity verification

To be clearer and more precise when verifying the validity of a hypothesis, we will say that we are primarily seeking to identify the factor or group of factors responsible for a phenomenon or group of phenomena. Explicitly, let us present this in terms of identifying the factors responsible for slips of the tongue in spontaneous language.

Suppose for a moment, like the Austrian psychologist Sigmund Freud (1856-1939), that slips of the tongue stem from certain psychological (internal) conflicts. Note that this is a hypothesis and not an established fact. To be accepted, this hypothesis must first be subjected to the empirical verification process through systematic observations. Without resorting to such methods, this hypothesis can at any time be challenged and rejected.

According to Freud's hypothesis, a slip of the tongue is the manifestation of several conflicting desires. Freud, in a famous example, cites an error whose context is situated in French-speaking Switzerland during the first world war. Switzerland, a neighbouring country to two warring nations, Germany and France, adopted a strictly neutral stance. Thus, the Swiss referred to the Germans either by the official expression "the Germans" when speaking publicly, or by the pejorative term "les boches" when in private.

Nevertheless, public opinion favoured France's position, and it was before an audience composed of students and French war refugees that "Professor M.N." made this notorious slip. This professor recounted the story of a German schoolmaster who, exhorting his pupils to till the land, asked them to encourage themselves by imagining that with every clod of earth, they crushed a French skull. Throughout the speech, the professor used the word "German," then, slipping at the crucial moment, he declared: "Imagine that with every *moche* you crush a French skull!" combining, of course, the word *"motte"* [clod] with the expression *"boche"* [offensive and dated, “kraut”], very popular at that time (FREUD, 1901/1973).

Regarding this specific error, it is easy to resort to Freud's hypothesis to explain it. The speaker indeed seemed tormented by the conflict between two desires, one of neutrality and the other urging him to express his deep feelings toward the Germans in front of an audience that shared them. The context and content of this story, as well as the transparency of the phonemic substitution, are enough to support Freud's position, at least in this particular circumstance.

However, this explanation does not fully answer our initial question. We sought to understand the origin of spontaneous errors in a general way. Yet Freud's example neither convinces nor sufficiently validates the hypothesis that most or all slips of the

tongue represent the expression of a conflict between implicit social rules (according to Freud, the "superego") and repressed collective drives (in this case, the desire for an "unhindered communion" with the audience, the "id"). A single example or even several examples chosen from the whole set of spontaneous errors cannot suffice to consolidate Freud's explanation and demonstrate it. Only a verification based on a large sample of unselected errors could remove doubt and validate his hypothesis for all errors.

In fact, modern research on a large number of unselected errors does not support Freud's main hypothesis. It turns out that only a very small subsample of errors (the most memorable errors, of course) actually reflects contradictory drives. On the other hand, a more general hypothesis is well supported, as it assumes that the majority of spontaneous errors can be explained by an interaction or conflict between two or more linguistic units similar on a phonetic or semantic level. Thus, even the slip cited by Freud can be interpreted as follows: the sound [S][4] in "moche" is phonetically close to the sound [t] in "motte" (both sounds correspond to voiceless postalveolar consonants), and the word "moche" has semantic links with this story which, in a very real sense, is indeed "ugly."

Note that, unlike the process of description and differentiation, there is no simple and direct way to verify the validity of hypotheses. A hypothesis can be supported or rejected; that is its reason for being. It follows that verifying the validity of hypotheses is an iterative (repetitive) process: an explanation is suggested and an effort is made to verify its validity. If a hypothesis is supported, it is maintained (at least for a certain period of time); if it is not, it is rejected and the search for a new hypothesis begins. In a word, any scientific result remains provisional at all times and is subject to questioning or reformulation in the form of a more satisfactory hypothesis.

B. ACCEPTANCE OF THE HYPOTHESIS BY THE SCIENTIFIC COMMUNITY

1. The principles of economy and duplication

One might reasonably expect that a hypothesis made more credible by empirical verification would be adopted by the scientific community. Nevertheless, nothing guarantees that all other researchers agree on its quality or consider it as the only possible hypothesis.

This attitude stems from the fact that renowned scholars have seen a certain number of explanatory hypotheses come and go, and that time, more than novelty, constitutes the real guarantee of their consistency. Other reasons may motivate such reluctance, either formal or informal refutations of the proposed hypotheses made by other researchers based on their own observations, or because researchers, under the influence of opposing hypotheses or theories, resist and are reluctant to accept a hypothesis that would hinder or call into question their own work.

Moreover, two scientific reasons explain the caution and notorious reluctance of the scientific community. First, alternative hypotheses are possible, and some of them may be simpler or more relevant. Given two hypotheses of equal power, science always prefers the simpler one. This principle is known as the principle of economy (*principle of economy* or *Occam's razor*). According to this principle, empirical observations should be presented in the simplest, most direct, and most economical form.

4 Capital [S] in square brackets is in phonetic script. Here it sounds like "sh" in "shoe".

In light of this principle, the clever student will reply that there is really no intrinsic reason in the biological or psychological system to justify the choice of the criterion of simplicity and efficiency; many systems related to brain function apparently show some duplication or overlap of functions. This remark applies, for example, to the auditory system, which seems to transmit essentially the same information to different points in both hemispheres. However, the scientific approach aimed at explaining the functions of the auditory system will favour simple modes of explanation over sophisticated analyses. At first glance, even if a complex analysis better accounts for a phenomenon, one should still strive to consider the simplest solutions before giving them up.

The second reason leading to the rejection of a hypothesis by the scientific community, even if it has empirical support, is that no experimenter has the capacity to consider all the factors involved in the composition of an observed phenomenon. Despite the best intentions, errors of observation or interpretation can creep in. This is why results must always be reproduced, that is, subjected to duplication (reduplication) by independent researchers.

The necessity to verify the same experiment again in another laboratory stems from these epistemological principles. Whether it is medical research on cancer or particle physics, it is quite common to count up to ten research teams reproducing the same crucial experiment. In psychology and psycholinguistics, resources rarely favour such duplication.

Most of the time, the tendency is to verify the validity of specific theoretical issues. As a professor of comparative linguistics, Meringer was particularly interested in diachronic changes related to the loss of sounds in the context of rapid speech (what is now called "allegro rules"). He proposed that the diachronic process that allowed the creation of the word "fromage" in modern French from the root "formaticum" (made in a form) of Vulgar Latin corresponds to a mental process comparable to that causing the familiar pronunciation error "Sa**r**a**h**a" for the word "Sa**h**a**r**a" (FROMKIN, 1973: 254; MERINGER AND MAYER, 1895/1978: 163).

Once again, we see that Meringer's hypothesis can be integrated into a broader theory involving human functioning and, more precisely, to the mental processes responsible for diachronic linguistic change. Taken to the extreme, this hypothesis would predict that most slips of the tongue resemble diachronic linguistic changes.

History has shown that neither Freud's nor Meringer's hypotheses were directly corroborated by current research. As we will see in chapter 6, the vast majority of errors that occur spontaneously in most individuals relate to the processing of linguistic units in real time, that is, the mental processes responsible for language production. Neither of these hypotheses can satisfactorily explain the origin of most spontaneous errors.

Therefore, we conclude from these examples that researchers generally try to verify the validity of hypotheses that account not only for real phenomena (*e.g.*, slips of the tongue) but also for more encompassing processes (*e.g.*, of a psychological or psycholinguistic nature). This implies that an explanatory hypothesis becomes exceptionally interesting if it contributes to a broader theory of human functioning. Indeed, for a given theory, the most crucial or most generalizable hypothesis is also the most important.

The importance of this principle should not be underestimated. One of the tragedies of contemporary science arises from the fact that much research is conducted and published without taking this into account, which is also why the scientific community ignores it. It seems that only half of the research published in the 2,100 most

prestigious scientific journals worldwide is cited more than once by researchers during the year of publication (COLE AND COLE, 1972: 372). Upon closer examination of the ignored articles, one finds not only that they contain a significant number of methodological problems described below but also that they are characterized by a lack of clarity and that their hypotheses are not sufficiently generalizable. On the other hand, research that makes a notable contribution to scientific progress demonstrates excellent methodological details and an exceptional contribution to a more general theory.

C. WHAT IS A THEORY?

1. Theory and Observations

Briefly, we indicated that a theory consists of a series of coherent hypotheses and that it is related to the nature of a phenomenon. In other words, there is nothing directly observable in any theory.

Consequently, a theory concerning the origin of slips of the tongue, for example, is no more tangible than a set of hypotheses about the aspects of selecting a word or sound showing some dysfunction. Even if observable components of an error in spontaneous language (*e.g.*, the speaker's lip movements or the acoustic signal of their voice) are related to a theory that explains its origin, they may serve to verify the validity of a theory, but they are not the theory itself.

Students in psycholinguistics, as in any other science, often find themselves perplexed by what may seem paradoxical. First, they learn that the main goal of research is to develop a theoretical formulation allowing the understanding of observed phenomena and the prediction of previously unobserved phenomena; that theories represent nothing more substantial than a series of ideas, meaning they are not observable; and finally, that they are always subject to scrutiny, even if they are connected to observations by appropriate demonstrations.

However, a brief overview reveals that the distinction between theory and observation is commonplace. Let us cite a familiar example: most people recognize the existence of electricity and magnetism, although no one has ever seen either. The concepts of "electricity" and "magnetism" are simply convenient theories allowing the explanation of a variety of *observable* phenomena such as sparks, electric discharges, and the operation of electric motors. From the same perspective, no one has ever seen "intelligence" or "reading ability." Yet, these are theories - theoretical constructions – that are very useful for analyzing the manifest behaviour of certain individuals and for measuring their abilities to complete, for example, in an IQ test or a reading test.

The difference between a theoretical construction and an observable manifestation leads to two important consequences. First, we must remember that theoretical constructions are only a set of valid hypotheses explaining certain phenomena. They are never "real" in the sense that they could be observed or directly measured. It is always possible, moreover, that they be replaced by a "better" theory. This latter theory would be considered "better" because it would be able to explain all the phenomena included in the previous theory as well as other phenomena that the previous theory would not account for.

Second, a researcher must never confuse observable manifestation with theoretical construction. Thus, when a cautious researcher considers that a person obtains an IQ

score of 100 points, they must be aware that this result represents only a single measurement and that it only *indirectly* assesses the true intelligence of that individual. The score of an intelligence test is not equivalent to intelligence itself, and it would be foolish to claim that "this person's intelligence is average", based on only one measurement.

"Intelligence," "reading ability," and some other concepts are theoretical constructs that we can suppose influence an individual's intellectual and linguistic functioning. If such concepts describe a certain reality - and there are good reasons to believe so - it can only be estimated. They are subjects to fluctuations caused by factors such as the individual's fatigue, familiarity with the type of test to be taken, cultural background, and language proficiency. Upon another administration of the same test, the individual may obtain a very different result from the previous one. A knowledgeable researcher might therefore report the result as follows: "During one administration of the Stanford-Binet test, the person obtained a score of 100 points."

This kind of reasoning applies to all research situations. The result of a reading test may or may not have a direct link to a person's reading ability. A single reaction time result during a lexical association test (see chapter 1) may or may not be a reliable indication of access to an individual's lexical memory. Yet regardless of the effort a researcher puts into structuring their experiment, for them, the real interest will always lie in the abstract theory. Their concrete measurements or observations would always be related to this theory. And if their theory is well designed, the researcher may be able to predict not only the occurrence of already known events but also that of events that have never been observed before.

2. The Operationalization of a Theory

Many psycholinguists apply this kind of reasoning to the experimental structuring of a study. First, they conceptualize the research problem in theoretical terms and then operationalize it in terms of feasible observations that could help them better understand the problem.

The first step consists, based on current knowledge, of a temporary definition of how a given mental process is understood; this is often referred to as developing a *process model* (*e.g.*, "a model of the origin of slips of the tongue" or "a model of access to lexical memory"). Generally, models approximate theories, but in psycholinguistics, they outline the specific sequence underlying a mental operation. For this reason, models resemble flowcharts more closely (they are often represented as such), whereas *theories* are the very essence of the functioning of a certain phenomenon. Models are generally preferred and valued according to those that permit the most specific predictions, namely those that best allow detailed verification of the validity of the theory.

The next step is to logically explore the model's predictions that have not yet been verified. Returning to the Freudian model concerning the origin of spontaneous errors, we can predict that "psychologically revealing" slips of the tongue should be particularly frequent in individuals suffering from permanent conflicts between the instances of the "id" (instinctual element), the "ego" (rational element), and the "superego" (social element). More specifically, we might expect individuals suffering from this kind of conflict to make significantly more slips of the tongue on average than those without these symptoms. The process going from a theoretical model to a specific prediction would serve as a process of *"operationalization."*

The final step is focused on the evaluation of the prediction. This involves collecting concrete observations, calculating, analyzing results, and interpreting them according to the chosen or developed model. This undoubtedly constitutes the majority of experimental work, but it does not diminish the importance of the operationalization process.

D. DIFFERENT TYPES OF OBSERVATIONS

In order to evaluate the validity of their predictions, psycholinguists use several types of observations, namely naturalistic observations, semi-induced observations, and experimental-type observations, whose most common manifestations we summarize below.

1. Naturalistic observations

This approach is traditionally used by many psycholinguists. Meringer and Freud collected errors in spontaneous speech with naturalistic observation, in the same way that Léopold, Weir, Bellugi, Brown, and others began their investigations into native language acquisition. A famous study on this subject, carried out by BELLUGI, CAZDEN AND BROWN (1969), involved home recordings of three American children, two hours per month over a period of three years. Even today, there is interest in the interpretation of quantitative data in spontaneous speech where normal subjects, second-language students, or subjects whose brain damage cause serious language problems. These data are collected under natural conditions and represent an important contribution to the understanding of psycholinguistic processes.

Two subgroups make up this type of observation: the first relates to systematic and intensive observations, notably used in studies concerning children with or without communication disorders. In this specific context, the experimenter is often out of the children's visual field (*e.g.*, behind a one-way mirror, *i.e.*, a semi-reflective mirror). Sound or video recorders are used to establish permanent recordings. Sometimes, only certain indications are noted, for example, the number of questions asked by a child or the number of answers given.

The second category of naturalistic observation corresponds to what is called *the case study*. A person is usually selected because of a particular and rare linguistic functioning. This type of observation allows for detailed hypotheses regarding the mode of communication used by a given individual in relation to their specific problem.

The naturalistic approach allows the researcher to focus all their attention on problems as they manifest in unconstrained situations. It also has its drawbacks: on the one hand, the multitude of factors (variables) involved is difficult to identify completely; on the other hand, the rarity of certain events may escape observation. It is precisely in this latter case that the researcher most often resorts to semi-induced or experimental-type observations.

2. Semi-induced observations

To avoid the problems raised by naturalistic observations, researchers often create specific situations by asking their subjects to perform a limited number of tasks. Some people, for example, make relatively few slips of the tongue in normal situations. One

of my students structured his experiment as follows: he paid a brief visit to some friends, pretending that he had very little time due to his studies. Having thus prepared them, he asked them a series of questions on different subjects to which they responded by making a large number of errors. According to his own observations, he obtained more errors per minute during this brief visit than during a later visit when he imposed no time restrictions.

Although this approach is more appropriate for certain psycholinguistic research, it nevertheless shares some drawbacks with "naturalistic" observation. The most important drawback essentially lies in unforeseen events or transient communication situations. This naturally causes variations in observation which subsequently bias the results. In a study on persuasion, for example, two participants might decide to "not play along," attempt to persuade each other, and agree without real discussion, while others would follow the given instructions (cf. the study by MAISONNEUVE, 1983, described in chapter 9). Under these conditions, special criteria would later need to be determined to eliminate meaningless results.

3. Experimental-type observations

The most complete control of a communication situation is achieved in an experiment in which the researcher determines the exact manner in which the linguistic processes is required to test its operationalization. Experimentation imposes some constraints so as to verify only the processes in question and nothing else. While the control of language use by the experimenter was limited in naturalistic and semi-induced observations, the experimental study, on the other hand, allows near-total control where manipulation of aspects of the model is possible.

To illustrate this approach, let us return to the experiment on access to lexical memory mentioned in chapter 1. As one of the appropriate means to determine whether access to the lexicon was more efficient, we suggested a reaction time test, either by phonetic or semantic association. During this fictitious experiment, normal subjects are given common words, such as "party" or "letter," recorded on tape. The subjects' task is to name as quickly as possible homonyms (like "puts" or "put") or synonyms (like "clean" or "shine").

The delay between the presentation of one of these words and the start of an appropriate response is used to assess the efficiency of access to lexical memory by these two types of association. Note that the observations collected during this experiment, that is, the reaction time measurements, are probably directly related to the theoretical construct we want to examine, *i.e.*, the efficiency of access to lexical memory.

Thus, the researcher focuses entirely on the information of interest and excludes all other data irrelevant to the study (*e.g.*, interruptions from other interlocutors, the degree of grammatical complexity of surrounding sentences, etc.). The greatest advantage of the experimental approach lies in the relevance and exclusivity of the information collected.

However, for the experimental study to be optimal, it must be structured with the greatest care, that is, in an "objective," "systematic," and "replicable" way. Under the term "objectivity," we include all factors likely to create unintentional modifications or any other kind of disturbances induced by the experimenter. For example, if a researcher used crossword champions for the lexical memory access experiment instead of selecting random subjects, he might bias (falsify) his results by favouring

synonymic access, for the simple reason that practising crosswords trains their access to synonyms. There are therefore many factors called "parasitic" variables that must be guarded against. We will mention the most important factors in the next chapter.

An optimal experiment is called "systematic" because of the relationship established between a model, its predictions, and the observations collected; it is "replicable" because it is conducted and written in such a way that any other researcher can reproduce it. Only under these conditions of clarity and accessibility to information can a researcher hope to make a valid contribution to the scientific community.

SUMMARY

In this chapter, we presented the most important principles of the psycholinguistic approach. Generally, research begins with the description and differentiation of phenomena to arrive at the iterative process of verifying the validity of hypotheses. The acceptance of a new hypothesis by the scientific community is not automatic, even if it is supported by empirical observations. To be accepted, a hypothesis must be in the simplest form while corresponding to the data collected on the subject. Furthermore, it must be replicated by independent researchers or supported by independent argumentation; finally, it must fit into a broader set of recognized hypotheses, that is, into a theory. In fact, recent studies in psycholinguistics most often stem from theoretical expectations. In other words, they represent operationalizations of theoretical models.

At the end of the chapter, we discussed the different types of observations available to verify the validity of a psycholinguistic hypothesis. Naturalistic observations constitute the most realistic verifications, but they can also limit access to information of great interest. Semi-induced observations represent an excellent way to collect the required data more quickly, but they are also subject to a large number of confounding variables. The best control of these variables is exercised through experimental study, as this mode of observation effectively excludes all irrelevant information. Nevertheless, during an experiment, the researcher runs the risk of excluding interesting data, together with irrelevant information, and thereby biasing the results with extraneous variables.

APPLICATION SECTION

1. Check your understanding of the terms explained in this chapter by briefly defining and distinguish: (a) hypothesis, theory, model, and operationalization; (b) taxonomy, replication, and economy.

2. Outline the sequence of events involved in verifying the validity of a hypothesis.

3. Conduct your own verification of the validity of a psycholinguistic hypothesis using the concrete examples suggested below (paragraphs a. to d.).

First, propose at least two different explanatory hypotheses for the psycholinguistic problem you have chosen. Write each of your hypotheses separately on a sheet of paper and rank them in descending order of probable relevance. Second, observe the way your friends, colleagues, etc., speak, or ask informal questions around you and note the answers. This collection of observations should be sufficient to allow you to

verify the validity of your various hypotheses. It is for you to see if your observations support or reject your hypotheses.

It is only at the very end, and not before, that you might consider reading (if you have the time) the chapters corresponding to the theme of your hypotheses, in order to realize whether they agree with those of some recognized psycholinguists (see chapters 6 [a], 7 [b], 9 [c], and 11 [d]).

a. Why do some people sometimes hesitate in the middle of a sentence? What happens in the process of sentence construction that causes them to produce hesitation?

b. From time to time, it happens that older people mishear what has been said to them. What is the relationship between the words they thought they understood and those that were actually spoken? For what reasons does this phenomenon particularly affect older people? Does this phenomenon also occur in younger people? If so, is there a qualitative difference between the misunderstandings that occur in older people and those in younger people?

c. Some people seem to have all the arguments; more than that, they seem able to convince others of their own way of seeing things. How do they manage this? What makes them so convincing?

d. Some individuals learn a second language much more easily than others. In your opinion, what underlies this ability? Is it an innate talent? Is it the result of a particular personality, specific influences, or another factor?

FOR FURTHER READING

KUHN (1970).

MEHLER & NOIZET (1974).

SARRASIN (1977). Introduction.

Chapter 3. Psycholinguistic Experimentation

In the previous chapter, we discussed the foundations of psycholinguistic research. We indicated that, when compared to more naturalistic observations, experimental study offers many advantages, since they primarily allow the testing of a specific hypothesis while limiting potential interference from irrelevant factors. Given that the experimental method obviously occupies a central place in the psycholinguist's research toolkit, we shall dedicate an entire chapter to it.

From the perspective of a novice, an experiment tends to have more pitfalls than naturalistic observation, since many of its aspects can seriously skew the results. Conducting an experiment without it being completely objective is probably more harmful than not undertaking it at all, because the research would be riddled with irrelevant factors that bias its results. Therefore, it remains crucial to understand the structure of experimental studies, the factors that can influence the results, and the procedures that eliminate the effect of confounding factors during the execution and analysis of the experiment.

Another reason underlying the examination of these issues is that experimental studies are very common in linguistic tests in educational settings, or in informal linguistic assessment procedures frequently used in commercial settings. Like experiments conducted for research purposes, these tests are at risk of objectivity. In this chapter, we will examine some useful principles to achieve better objectivity.

A. THE STRUCTURING OF AN EXPERIMENTAL STUDY

1. Cause-and-effect relationships

To analyze the structure of an experimental study, by analogy, we rely on the procedure of opening a locked door: if the first key does not manage to open it, another one might succeed. By eliminating inappropriate keys one after the other, one often ends up

finding the right one.

The same goes for the researcher who tests different methods; they generally succeed in finding the best one. Psycholinguists wishing to detect how we access lexical memory with a reaction time-based experiment (see chapter 1) might favour access via the semantic mode over the phonetic mode, or the pathway of synonyms over that of homonyms.

Note that this approach involves the observation of two phenomena in a *cause-and-effect relationship*. The choice of the key that opens the lock would be seen as the *cause* of the door opening; in other words, the action of choosing the right key would be causally related to the door opening. So if the researcher obtains an initial phenomenon (first variable, *e.g.*, the phonetic or semantic task) with some impact on a second phenomenon (second variable, *e.g.*, reaction time), the initial variable is then seen in a cause-and-effect relationship with the reaction time.

Nevertheless, in most cases, it is impossible to demonstrate clearly and precisely the causal impact of the first phenomenon on the second. This is the paradox that causes confusion for newcomers to research. Even though one of the most important objectives of research is identifying cause-and-effect relationships, one can never be entirely certain that a given relation to be truly causal.

Returning to our analogy, an individual might assume they have chosen the only key capable of opening the door, since the lock disengages after the introduction of five consecutive keys. But one can consider another completely different situation, that is, the true cause of the door opening would be the unlocking of the locking mechanism caused by the attempt of several succeeding keys, and not the choice of a specific key.

We can easily apply this kind of reasoning in our debate on the origin of slips of the tongue. Freud and his colleagues observed a number of spontaneous errors in accordance with their conception of psychological processes. Like the person who claims to have finally found the right key, Freud presupposed the existence of a relatively strong cause-and-effect relationship between an individual's internal psychological disposition and the occurrence of slips of the tongue. Even if the two phenomena seem to have common links in the examples cited by Freud, a direct cause-and-effect relationship was not demonstrated.

This does not mean, however, that Freud is wrong in proposing the existence of some cause-and-effect relationship. On the contrary, this indicates that anyone conducting a scientific experiment must be aware that a strong relationship between two phenomena can, but does not necessarily have to, imply a cause-and-effect relationship between the two variables.

A small anecdote will further illustrate this point. Some time ago, a statistician presented some data indicating that, since the beginning of the century, in a small Swiss village, the stork population had decreased proportionally to the human population. The correlation between the two variables was excellent. From a strictly statistical point of view, one was tempted to admit that there was a direct cause-and-effect relationship between the two phenomena.

However, a further approach should analyze a third phenomenon, that of industrialization, and would at the same time provide another explanation for this relationship. To meet the needs of the waterway industry, the local river had been channelled into one straight line, thus depriving the storks of their hunting grounds. Alongside this, a large number of young people from the village migrated to nearby urban centres for work. The depopulation of storks and that of humans were not in a

direct cause-and-effect relationship, despite their excellent correlation, but rather with a third variable, that of industrialization.

2. Independent and dependent variables

Despite this important warning, the search for cause-and-effect relationships represents the very essence of experimental study. Let us examine in more detail how this quest usually unfolds.

Table 1: Independent and dependent variables

Level	INDEPENDENT LEVEL		DEPENDENT LEVEL
observable	Task / imposed condition	→	observed behaviour
proposed	cause	→	effect

During the simplest psycholinguistic experiment, the researcher will modify only one condition or task and observe its effect on linguistic behaviour. For example, in the experiment on access to lexical memory, the experimenter will ask the subjects to name either synonyms or homonyms; he will thus examine one or the other condition and their effect on response time. Since the response time variable will depend primarily on the condition, the reaction time constitutes the *dependent variable* of the experiment. On the other hand, the imposed condition is called the *independent variable*, because in the proposed cause-and-effect relationship, it represents the independent element (see table 1).

At the observable level, the *independent variable* corresponds to the imposed condition or task and at the proposed cause-and-effect level, it corresponds to the cause. The *dependent variable* corresponds, respectively, to the observed behaviour and the proposed effect.

Any experimentation therefore involves a relationship between dependent and independent variables, and any experiment aims to determine the effect of certain independent variables on one or more dependent variables. By the systematic elimination of variables that have little or no effect on the dependent variable, the experimenter can, after completing a series of experiments, establish a network of relationships between independent and dependent variables. Ordinarily, the results from this approach allow the confirmation or rejection of different aspects of a theoretical model.

3. The graphical representation of independent and dependent variables

When it comes to documenting the results of experimental studies with a graph, as a general rule, experimenters follow the convention of the abscissa (x-axis) for the independent variable and the ordinate (y-axis) for the dependent variable. To remember this, it suffices to recall that the experimenter "goes from the independent variable to the dependent variable"; in the alphabet, **a** (for abscissa, which is at the bottom) precedes **o** (for ordinate, which is at the top) and x precedes y.

FIGURE 1: Fictitious results
of an experiment on lexical memory access

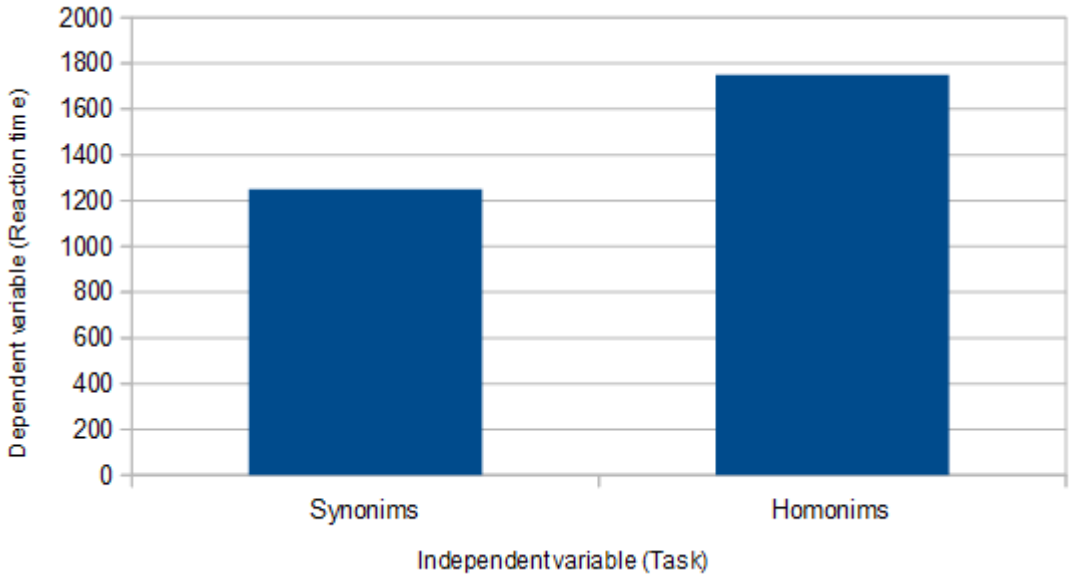


Figure 1 gives us an illustration of fictitious results concerning access to lexical memory. The abscissa represents the independent variable (synonyms and homonyms) and the ordinate, the dependent variable (reaction time in milliseconds). By the height of the two bars, we can observe that synonyms required on average less time (about 500 ms) than homonyms. Subjects take on average 1.245 ms (milliseconds) to find a synonym and 1.755 ms to find a homonym.

If Figure 1 reproduced the results of a real experiment concerning lexical memory access, we could conclude that the process of searching for a word is more efficient by means of a "semantic address" than by means of a "phonetic address." Such a result could then support the model of lexical memory access based on the mental process whose greater frequency would rely on meaning and whose less common use would depend on assonances[5] (phonological content).

4. Confounding variables

Over the years, many factors have been identified as potentially disturbing or falsifying the results of a psychological or psycholinguistic experiment, and it follows that these factors must be controlled or eliminated by the researcher. These are called *confounding* or *parasite variables*. Some of them are related to the difficulty of execution (task-related variables), others stem from actions or attitudes, either from the subject (subject-related variables) or from the experimenter (experimenter-related variables).

a. Confounding variables due to the task

One of the most laborious aspects of structuring a psycholinguistic experiment consists in the objective selection of task elements: the stimuli. Given that subjects have a certain linguistic experience, some stimuli will be more familiar to them than others. Consequently, when choosing a relatively rare word like "effete" (overly refined) for a lexical association test, it is to be expected that the average subject will take longer to select a synonym for this word than they would for a more frequent term like "pampered". Frequency or degree of familiarity with a stimulus is therefore an

5 *Assonance* is the repetition of identical or similar phonemes in words or syllables that occur close together, either in terms of their vowel phonemes or their consonant phonemes.

important variable to consider.

When measuring reaction time or error rate for a specific word, it is essential that the different stimuli have roughly the same frequency of use in the given language. Very useful lexical frequency studies for English are available on Internet. In French three of the main volumes are by BEAUCHEMIN AND MARTEL (1979), GOUGENHEIM ET AL. (1964), and VIKIS-FREIBERGS (1974).

For a large number of experimental tests, the possibility of *picturing* a stimulus also comes into play. Subjects may react faster and make fewer mistakes in the presence of words closely associated with an image than in the presence of abstract words; children are particularly sensitive to this difference. This is why the chosen stimuli must be selected according to strict criteria based on their association with mental images.

Another consideration, no less important, concerns the length and complexity of a stimulus. Longer or more complex words and sentences are obviously more difficult to understand and pronounce than their shorter or simpler counterparts. However, it is by no means easy to control the length or complexity of a stimulus and that of its response. Should length be measured in phonemes (sounds), words, open-class words (content words), or in terms of both open-class and closed-class words (function words)? Or how should syntagms[6] be counted? As for complexity, how should it be taken into account? If complexity is defined in terms of divergence from the linguistic "norm," how should the linguistic "norm" be established?

Most often, the solutions will depend on the very nature of the experiment. Phonetic tests must control, as well as possible, the length and phonological complexity indices, those related to phonemes, clusters of consonants and syllables, stress and tone in certain languages. Moreover, syntactic tasks must take into account the number of open and closed class words, and the number of phrases in the sentence serving as stimulus.

As for semantic tasks, our attention will focus on the relationship maintained by a stimulus with other words tat are related more or less directly, that is, whether or not there is a strong association with other words. Some words, such as "father," will have strong semantic links with "mother," "child," "family," and many others, while other words have more distant semantic links, as illustrated by the example of the words "clean" or "shine". When the subjects' task involves producing synonyms, this variable must be closely monitored.

Finally, experiments are sensitive to the order of stimulus presentation. Suppose that following the instruction requiring our subjects to consistently find, first, homonyms (phonetic task) and, second, synonyms (semantic task), we obtain the results shown in Figure 1. We would not know what determined better performance: the ease of execution (desired effect) or the practice acquired during the phonetic task (parasitic effect). To eliminate any impact related to presentation order, subjects perform the various tasks in different orders (referred to as counterbalanced tasks), or mixed trials from different tasks in a mixed order (interleaved tasks).

b. Subject-related confounding variables

Another source of variables affecting objectivity results, as we have already mentioned, act from a variety of the subject' actions or attitudes.

Certain attitudes towards a given task are known as *response sets*. Some subjects, for

6 *Syntax, plural syntagms:* A syntactic string of words that forms a part of some larger syntactic unit.

example, prefer to answer "yes" to all questions asked, or they tend to choose the middle position on a 1 to 7-point scale. Others strive to respond to what they perceive the experimenter expects, or to create a more favourable self-image. Many college or undergraduate students also enjoy, as a game, giving words with sexual connotations in association tests. The experimenter can counteract these factors to some extent by giving appropriate instructions, presenting a sufficient quantity of stimuli, or by selecting a large set of examples.

This question leads us to the thorny problem of the *number of subjects* and *observations* required to lessen the impact of individual variations. The solution to this problem depends on the survey envisaged. Let us return to our experiment from the first chapter: if ten randomly chosen subjects show reaction times twice as fast for synonyms as for homonyms and, moreover, if no subject exhibits the opposite behaviour, it would not be very useful to continue such an experiment. The result of the experiment would be clear, and the theoretical finding obvious.

If, on the other hand, six subjects perform better when it comes to giving homonyms and four subjects do the opposite, it would become essential to continue the experiment in order to better understand the nature of the phenomenon. This is one of the reasons why it is crucial to conduct a *pilot study* before undertaking the experimental study itself. Apart from highlighting possible pitfalls and artifacts of the experiment, the pilot study allows for estimating the final result and helps determine the number of subjects and observations necessary to solve the problem posed.

Another type of reaction attributed to subjects that hinders the objectivity of an experimental study is known as *demand characteristics*. When human subjects undergo an experimental test, they often feel compelled to meet imaginary or implicit demands of the experiment. Consequently, they modify and direct their behaviour based on the goal they set for themselves. Subjects try to figure out the objective of the study in order to confirm the hypothesis or tend to want to refute the hypothesis in reaction. As for anxious subjects, they mostly give responses intended to make themselves more interesting in the eyes of the experimenter.

Even though these effects are almost inevitable, the researcher has several means to neutralize them. The first is to remain vague about the objective of the experiment without misleading the experimental subjects in any way. In psycholinguistic research, it will rarely be necessary to adopt a strategy of diverting the study’s objective; this is a controversial approach but often used in social psychology. Generally, it will suffice that the instructions, stimuli, and experimenter's behaviour be strictly neutral regarding the responses to be provided.

The second means corresponds to the rigorous use of a control group, that is, a group of subjects possessing all the characteristics of the experimental group, except for the specific variable measured. For example, an experiment on strategies used by highly gifted second-language students could consist of observing the strategies used by the best students in this field. Although the results of such a study are surely interesting, they could only be truly interpreted by comparing them to the results of a group of students similar to the experimental students, with the number of subjects spread across different age groups and social groups. When results are levelled around the average, the effects of individual variations are minimized, allowing a better estimation of the generalization of the phenomenon.

Some researchers strictly apply the requirement of a *control group*. Take the example of a study of patients with language disorders; this usually involves a comparison between deficient language and normal language, so patients hospitalized for brain

injuries are usually compared to subjects without brain damage from a non-hospitalized environment.

However, strictly speaking, the latter are not necessarily an adequate control group, since they differ from the experimental subjects by a language disorder, brain damage, and prolonged hospitalization. This is why some researchers in aphasia prefer control groups made up of hospitalized patients who have brain damage but no language disorder. When such subjects are also matched based on age, education, and socioeconomic class, the researcher can be almost certain to have an adequate control group.

As a last resort, to counteract confounding variables induced by subjects, one can compare the results of experimental studies with observations gathered in more natural situations. This comparison between experimental and non-experimental situations helps to identify moments when the subject is influenced by their participation in the experiment.

In the case of experiments examining teaching or training methods, subjects may also be affected by the so-called *placebo effect*, that is, an improvement related to the belief that the experimental treatment in question can personally help them. Verifying learning in a natural environment allows the researcher to better counteract those placebo effects.

c. Confounding variables due to the experimenter

Effects inadvertently induced by the experimenter that harm the objectivity of the study are similar to those caused by the subjects. Thus, the researcher may provide too many details about their experiment and may thereby bias responses or give certain indications of their own reactions.

Later, when the experimenter counts up their results, while analyzing or interpreting their data, they may unconsciously make errors and promote their own hypothesis. One of the effects caused by the experimenter is known as the *Pygmalion effect* or the *Rosenthal effect*. During a study, ROSENTHAL AND JACOBSON (1968) randomly selected schoolchildren from different classes, then suggested to their teachers that these children had an unknown intellectual potential.

At the end of the school year, the authors found that the IQ scores of these children had improved significantly compared to those of the other children. They concluded that the teachers' expectations probably had an effect on the performance of these children during the school year. However, we must emphasize that authors who attempted to replicate this study encountered difficulties in duplicating the results of this experiment, and to this day, the theoretical foundations put forward are not clear.[7]

One way to guard against experimenter effects is to automate the examination process. Computers allow, for example, the automatic presentation of several types of stimuli and the recording of points associated with responses. Instructions and stimuli should be recorded on tape.

Another approach involves the double-blind procedure. In this case, neither the person administering the test nor the subject knows the specific hypothesis being tested. Sometimes, it is also useful to use "blind" judges, that is, people who evaluate responses without knowledge of either the hypothesis or the experimental conditions.

7 For a discussion of the first 345 experiments concerning the ROSENTHAL effect, see ROSENTHAL AND RUBIN, 1978.

These precautionary measures are especially recommended when the risks of contamination of the experiment are particularly high or significant.

5. Main effects and interaction effects

Once the experiment is completed, the researcher distinguishes several types of relationships that exist between dependent and independent variables. It is possible that an independent variable (*e.g.*, the task) is strongly related to the dependent variable (*e.g.*, reaction time). Such a relationship is called a *main effect*. If it is demonstrated that reaction times are much faster during semantic association than during phonetic association, one might, for example, infer that "the task has a main effect on the type of access to lexical memory."

A more complex situation is also very common. When a given independent variable strongly influences the dependent variable under certain specific conditions, that is, in the presence of a second independent variable, this is called *an interaction between the two independent variables*. For example, if it is found that female subjects show a clearer difference than male subjects regarding semantic access to lexical memory, there is "an interaction between sex and task" with respect to reaction times in lexical association. In this case, the effect of the independent variable (the task) on the dependent variable (reaction time) is attributable to a second independent variable, namely the subject's sex.

TABLE 2: Reaction time in an imaginary experiment on lexical association

	semantic task	phonetic task	task average
female subjects	1000 ms	2000 ms	1500 ms
male subjects	1490 ms	1510 ms	1500 ms
average of all tasks	1245 ms	1755 ms	1500 ms

Table 2 illustrates the two types of effects on the results of a fictitious experiment involving a sample of subjects distinguished by sex. In this table, the dependent variable relates to reaction times noted in numbers, while the two independent variables (type of task and sex of subjects) are indicated by the column and row headings.

From these results, we can deduce that the sex of the subject has no direct effect on reaction time; on average, female and male subjects exhibit the same reaction times (1500 ms) for both types of tasks. However, the type of test influences reaction times, since subjects react faster during the semantic task (average of 1245 ms) than during the phonetic task (average of 1755 ms). This is therefore the manifestation of a main effect regarding the type of task, but not for the sex of the subjects.

However, we notice an interaction between sex and task.

During the semantic task, only female subjects show a clear advantage, while male subjects obtain roughly the same average reaction time during both tasks. We observe that even if there is no main effect related to sex, there is, moreover, an interaction between task and sex which reveals that reaction times are indirectly influenced by the subject's sex.

B. THE STRUCTURING AND EVALUATION OF LINGUISTIC TESTS

The best way to understand standardized linguistic tests, or any other method of linguistic evaluation, is to consider them as a kind of experimentation. When we administer a test, we conduct an experiment assuming that the measured performance adequately estimates a broader linguistic competence. Given that it is impossible to measure all components of a person's linguistic competence, we must rely on the responses of some key elements.

Whether we base our judgments on informal exchanges, formal tests, or even standardized ones, it remains that these rely on a very limited data set. Since we will always be tempted to go beyond what our data allows, it is all the more important that the questions, as well as the answers, are representative of the measured linguistic performance.

However, due to the considerations and confounding variables we have just outlined, we are fully aware of the limitations inherent in any assessment of linguistic performance. Is our initial hypothesis about the relationship between questions and the targeted competence correct? Do our tests reveal an individual's linguistic ability, or do they only measure the student's skill in guessing what we want to hear? Do the answers to our questions correspond to what a person uses in everyday situations, or do they merely reproduce what one needs to know to succeed in school? Have we designed enough questions to reliably assess the student's performance? Is there a direct relationship between improved test results and actual linguistic ability?

Experience with linguistic tests of all kinds, experience with measurements obtained in psycholinguistic research, and certain epistemological considerations tend to make us cautious. Most researchers are aware that there is often reliance on the assumption that tests actually measure the ability to use a given language in real situations.

Nevertheless, we have a number of relatively powerful tools that allow us to examine and improve our tests. Most of these tools were developed for standardized tests, but they apply equally well to a simple classroom test or any other assessment of a person's linguistic ability. It is especially the frequently administered tests that could benefit from thorough examination. Six major requirements appear to us as decisive: a test must be practical, objective, specific and comprehensive, reliable, and valid. Let us examine each of these requirements.

1. A test must be practical

When a test is administered frequently, it must be easy to administer and evaluate. This requirement implies, among other things, that it must be of short duration, as fatigue quickly affects both subjects and graders. It is therefore necessary to find a balance between too few questions, which would not allow the competencies to emerge due to their insufficiency, and too many questions, which would hinder research because of the fatigue factor.

A test that must be administered to a large audience must be designed so that there is no difficulty in understanding the instructions regarding its use, administration, and grading. In another respect, it should depend on a minimal number of extrinsic materials such as audiovisual equipment or computers.

2. A test must be objective

As we have just seen, several variables depending on the task, the subjects, and the experimenter can cause distortion in the results of an experiment. To minimize these effects, the instructions of a test must clearly specify what kind of response is required. It is recommended to provide evaluators with criteria specifying the different levels of achievement, such as "unsatisfactory," "passable," "good," or "excellent," as well as examples to help them better gauge the responses. When serious risks of interference prevail in certain subjective evaluation situations (*e.g.*, oral exams), the evaluation should be conducted by several people, preferably from different backgrounds.

3. A test must be selective and comprehensive

Tests used to sort subjects into different groups, such as instruments for sorting classes of different levels or language proficiency tests imposed as a condition for admission to a job or university, should be selective so that students grouped based on the results actually have a similar level of competence or potential. At the same time, the test must be comprehensive, meaning it should cover a wide range of difficulties so that it can measure different levels of language proficiency. Thus, a vocabulary test should range in difficulty from easy to moderately difficult and more difficult items. Moreover, to allow every candidate to understand the requirements, the test should be presented to students with simple instructions.

4. A test must be reliable

The reliability of a test implies that the results must be repeatable. The two traditional methods used to measure reliability are, on the one hand, inter-rater agreement, that is, the degree of consensus among several evaluators regarding the same test, and on the other hand, the test-retest procedure reflecting the agreement established from results obtained during two test administrations. Naturally, relying on consensus among judges is only appropriate if the test requires some judgment at the time of grading; multiple-choice tests, for example, eliminate this measure from the outset - which is, incidentally, one of the important reasons (apart from ease of grading) why the majority of standardized tests are developed in this format.

Inter-rater agreement determines the percentage of total or partial agreement, or disagreement. To achieve an optimal degree of consensus, evaluators must first be trained regarding the criteria and their application in complex cases. As a general rule,

it is easier to agree on a linguistic performance with few variables (*e.g.*, vocabulary) than on a performance with many variables (*e.g.*, essay writing).

The test-retest procedure involves comparing the same test administered to two different groups of subjects, or to the same group of subjects. When the test is given to the same group rather than to two different groups, a time interval must be planned between the two administrations. It often happens that a test is developed and given to a first group, and its reliability is only measured later during the administration to the second group. A careful comparison is then made of the results obtained during the two sessions, in order to meet the reliability requirement of the test-retest, meaning that a question should yield a comparable percentage of correct answers in both test administrations.

It is obvious that these two groups must be as homogeneous as possible; this is why many researchers take the trouble to match the two groups based on education, gender, socio-economic status, or any other factor likely to influence the test results. Another approach is to create a second version of the same test, that is, a second "equivalent" form. In this case, the researcher must ensure that both versions have the same difficulty coefficient.

When the same test is given twice to the same group, it is necessary to eliminate learning effects. Students might remember certain elements from their first administration, or they might improve their performance by learning how a test administration is conducted. These effects can be reduced by spacing the administrations over a significant period of time and by presenting students with a pretest anticipating the main test to familiarize them with the format used.

It is interesting to note that these learning effects are probably less significant than one might initially think. A former psycholinguistics student administered exactly the same test three times to his own students. This test concerned the use of the conditional in French. The first time, it took place before any prior teaching; the second time, immediately after; and the third time, one month later. The Quebec subjects were college-level. To his great disappointment, he found that the effects of his teaching had only a minimal long-term impact (between 2% and 5% on average). Moreover, about a quarter of his students performed worse on the last test administration compared to the first or second times.

5. A test must be valid

The notion of validity is reminiscent of the relationship between observation and theory discussed in the previous chapter. On that occasion, we observed an important difference between accomplished linguistic performance and supposed linguistic competence. Similarly, an individual's linguistic performance during a test is not identical to their intrinsic linguistic competence or to their daily use of the same skills. We may wish for the existence of such a relationship, but we are never certain of it.

The methods used to evaluate the validity of a test measure the probability of such a relationship between observed performance and underlying skill. In other words, what is the probability that a test actually measures what it was designed to measure?

When a given test is supposed to measure aptitude for language learning, the evaluation of its validity should demonstrate that the test indeed measures this kind of aptitude; it does not measure a general aptitude for school learning, nor intelligence, nor preexisting linguistic competence. It is common for authors to use different terms to refer to these evaluation methods, but generally, they overlap with the following two

categories.

The first approach is *correlational*. As we mentioned earlier, there is no procedure to directly determine a person's mental capacity; consequently, there is also no direct way to know if a test is truly effective at measuring a mental capacity. Therefore, one must find a workaround, an indirect method, to confirm the so-called validity of a test. This workaround consists of comparing several tests with the same objective: if the results are similar, we can assume that the different tests reflect the functioning of the same underlying mental capacity. This is called *concurrent validity.*

This second approach is *deductive*. It involves examining the content and theoretical implications, that is, the theoretical elaborations of a test and a number of predictions regarding the performance of certain populations. The correspondence between predicted performance and measured performance is known as *construct validity*. For example, there are many tests measuring aptitude for acquiring a second language: these propose, as a trial, the learning of some grammatical structures of a little-known language (*e.g.*, Thai). By analyzing the construct validity of one of these tests, one could predict that students who perform well would experience very little difficulty learning a second language later. If these same students subsequently learn another language more quickly, one would be justified in saying that the aptitude test demonstrates "construct validity."

This kind of validity is particularly important because it allows determining the degree of transfer occurring between school learning and the pragmatic experience of daily life. Some authors have mentioned that most traditional linguistic tests pay too much attention to certain specific elements related to pronunciation, grammar, vocabulary, etc. According to these authors, these tests give us little information about the faculties involved when an individual is in a real-life situation. JOHN OLLER (1976) therefore proposed a more relevant test: the *completion test* or the *Cloze test*.

The "cloze test" consists of peppering a text with blanks at regular intervals that the student must complete using the appropriate corresponding words. According to Oller and his colleagues, this type of test involves the full range of psycholinguistic processes essential to language, which more closely resembles the daily use of a language. By applying the notion of validity of a theoretical elaboration, we should therefore find that the "cloze test" more adequately predicts linguistic performance in natural situations than a test containing specific elements.

Even though Oller's proposals are supported by other studies, it remains true that the "cloze test" represents only one of many possible assessment methods. Oller's position does not exclude that, at some point in the context of second language teaching, it may be desirable to separately assess a student's pronunciation, grammar, or vocabulary to ensure that there is some progress in those parts of learning. Language use probably depends not only on the "integrative aspects" of language but also on its "specific elements." Thus, both types of tests have their place in their own context, and each is valid according to its own objective; in the case of a test with specific elements, the desired validity would be that it correctly indicates that discrete learning has taken place, whereas in the case of a "cloze test," it would be expected to adequately predict the level of performance in real situations.

SUMMARY

In this chapter, we have addressed the main elements that must be considered when

structuring a psycholinguistic experimental study. We have seen that its objective is to establish a network of cause-and-effect type relationships between the independent and dependent variables. We have established the difference between the main effect, corresponding to the action of a single independent variable on a dependent variable, and the interaction effect, indicating that two independent variables can interact with each other concerning their effect on the dependent variable.

Structuring experimental studies means ensuring that confounding variables that can cause distortions or falsifications in the results are properly eliminated or controlled. Some of these induced by the task and stimuli have been elaborated upon: the order effects of task components and the different levels of frequency, imaginability, or length of the stimuli. Among distortions induced by the subjects or the experimenter, we cited the tendencies of subjects to respond to the characteristics of the demands of an experiment and described the experimenter's difficulty in minimizing theoretical distortions.

For each of these cases, measures were considered to counteract the parasitic effects. In summary, an experimenter has two counterweights: they can either try to maintain the same level of distortions throughout the entire experiment, or they eliminate them completely. Examples of maintaining distortions favour the comparative aspects of different stimuli in relation to their frequency, length, or susceptibility of being imaged. They must balance the tasks, so that a control group matches the experimental group. Examples of eliminating disturbing elements involve the use of devices that allow measuring and analyzing results without human intervention, as well as evaluating experimental tasks in a double-blind manner.

During this discussion, we also presented some criteria for evaluating linguistic tests used in school or commercial settings. It appears that a test must be practical, objective, specific, comprehensive, reliable, and valid. We saw that tests with the same purpose can be evaluated using the inter-rater agreement method, that results from an initial administration can be compared to those of a retest, and that the validity of the theoretical framework on which a test is based can be adequately demonstrated.

APPLICATION SECTION

1. Until the early 1960s, no animal had learned to communicate beyond about ten different elements. LENNEBERG (1967) indicated that the muscular control of the vocal tract in chimpanzees (the animals closest to humans) is too imprecise for speech production. Does this mean that inadequate control of the vocal tract is the direct cause of the lack of communication between animals and humans, or are these two element correlated variables? (See chapter 5 for additional information.)

2. An experimenter wishes to compare the effectiveness of three methods of teaching a second language. How would they proceed? Clearly specify the difference between independent and dependent variables.

3. Graphically represent a possible result of this experiment.

4. Suppose you wanted to conduct this experiment yourself. Develop a list of confounding variables that could affect such an experiment and suggest specific ways to control or eliminate the effect of these confounding variables.

5. Provide an example of a linguistic test used in school or commercial settings (from memory, if necessary). Conduct a detailed analysis of this test according to the

following criteria: "practical," "objective," "selective," and "global". Propose additional analyses to assess its reliability and validity.

6. Distinguish the concepts of reliability and validity of a test using concise definitions.

7. Here is a report recently published in a Montreal newspaper. What logical error do you see in it?

DISAPPEARANCE OF MANY DAILY NEWSPAPERS

UNITED NATIONS (Reuter) - According to the International Labour Organization, new technology, and in particular satellite communication, is causing a decrease in the number of daily newspapers published worldwide. In the United States, the number of cities with more than one daily newspaper has dropped from 239 to 45.

FOR FURTHER READING

DEMERS (1981)

Chapter 4. Statistical analyses and the experimental procedure

A. THE APPLICATION OF STATISTICAL ANALYSES

It is often said that it is possible to prove anything through statistical analysis, meaning that a particular selection of numbers can justify anything. This idea is attributable to the ignorance some people have about statistical analysis and who, in order to compensate for their ignorance, try to justify it in this way.

However, the question arises: who is impressed by biased statistical analysis? Most often, it is precisely those people who have no knowledge in the field and are unable to judge the interpretation of results, whether sensible or not. On the other hand, a person with some knowledge in the area will be better able to identify valid from invalid data. Given that statistical information is becoming increasingly important in sciences (and in the political and administrative decisions that depend on it), knowledge of statistical methods becomes as indispensable a tool as the one that allows differentiating between the good sense and bad sense of a written word.

Statistical analysis has become an integral part of contemporary psycholinguistic research; in this respect, it resembles experimental psychology. Moreover, it is certain that in the future, the empirical verification of the validity of psycholinguistic hypotheses will be even more closely dependent on statistical analysis than it is now. The majority of contemporary psycholinguistic theory consists of hypotheses that are explained rationally, but have not been empirically verified; for example, Freud's hypothesis about slips of the tongue. The advancement in understanding human psycholinguistic processes will necessarily involve statistical verification, which, consequently, will allow the distinction between valid and invalid hypotheses.

This situation places novices in a difficult position. While they are capable of understanding the hypotheses and theories of the field, even the most complex ones, as soon as it comes to participating in the empirical verification of validity and the exploration of these hypotheses, they feel ill-equipped to handle even the most basic numerical tools. Just as the information revolution caught many individuals off guard who had gaps in programming, the digital revolution in the social sciences and humanities surprises not only many students, but even accomplished practitioners in psychology and linguistics who lack some knowledge of statistical analysis.

But as with computing, a person who is convinced of the necessity of the statistical method can learn to use it without too much difficulty. This chapter offers an overview of the statistical method. Its main objective is to distinguish the types of elementary statistical description and manipulation, and to explain the most common terms and methods.

Familiarization with these concepts will facilitate the overall understanding of the statistical indices found in psycholinguistic research articles. Statistical analysis includes descriptive, inferential or deductive, as well as exploratory methods. As the name suggests, descriptive statistics are used to characterize the most important aspects of a set of numerical data. Inferential or deductive statistics are used to verify the validity of certain research hypotheses, while exploratory statistics allow for the detection of factors and relationships that are initially hidden. We therefore propose to delve deeper into each of these methods.

1. Descriptive statistical analysis

a. The mean and the mode

In statistical analysis, descriptive methods are used to determine indices such as the mean, mode, and standard deviation of a group of measurements. Their function is to describe the most important aspects of a set of observations and to reduce distortions associated with individual observations.

For example, let us suppose that a group of ten speakers recorded during a television program made an average of eight errors in one hour. Let us suppose also that this is the average frequency of the occurrence of the phenomenon studied. A statistical description like this would remain fairly arbitrary when saying that "the speaker made 20 errors in an hour, while only being observed once".

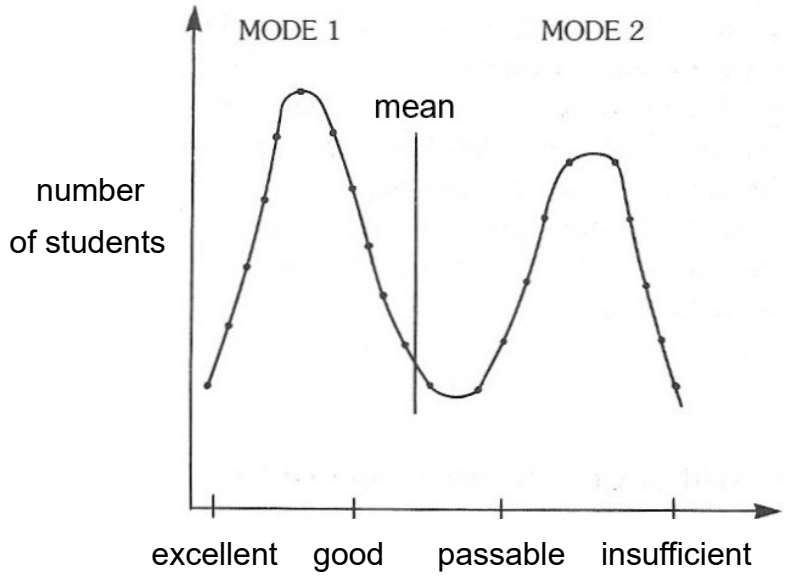
The *mean* by itself is a revealing statistical indicator, but can sometimes be inappropriate. Take the case of classes of students polarized into two groups, one characterized by great personal interest, while the other group shows the opposite tendency. This is reflected in the grades obtained during exams.

The shape of the distribution of these grades resembles the two humps of a camel,

which in statistical language is called a *bimodal distribution* (see figure 1). The first hump is around the grades "good" and "excellent," and the second, usually smaller, is near the grades "passable" and "insufficient."

In this kind of situation, it is more useful to locate the distribution of grades and the position of its "humps" than to note the absolute mean. When referring to the position of the "humps," we speak of the *mode* (the grade with the highest frequency is at the top of the hump). Observing figure 1, one could say, for example, that the grade distribution was bimodal, meaning it contains two modes: the first above the grade "good" and the second slightly below the grade "passable." This description is much more accurate and more precise than stating that the mean lies between "good" and "passable."

FIGURE 1: Prototype of a bimodal distribution illustrating the grades of a class (fictitious data)



b. The standard deviation (indicator of variation)

An important indicator used in descriptive statistical analysis is the standard deviation: an indicator of variability between different observations. It would be for example misleading to state that the average speaker makes only eight errors per hour, when this average applies both to people who made no errors and to those who made a large number - in other words, where there is great variability.

One can also consider the opposite situation where almost all speakers make a greater number of errors due to particular conditions, such as the enunciation of sentences whose pronunciation is difficult, *e.g.*: "Whose are these six sausages"?

Taking these conditions into account, the average number of errors will in all likelihood be higher, but the variability will probably be reduced. A good statistical analysis describing a data set must therefore report both the average (or modes) and the standard deviation (indicator of variability).

The calculation of the standard deviation is not as well known as that of the average, but it is quite simple and important enough to be demonstrated. The starting point is the average of a set of observations, that is, the sum of all observations divided by the

number of observations.

Next, one calculates the differences between the average and each observation, that is, subtract each observation from the average and square them.

Then, all these squared differences are added together and the result is divided by the number of observations minus one. To obtain the standard deviation, one finally takes the square root of the result.

During the second operation, squaring the differences serves to give us an *absolute difference* in a chance level condition between the mean and the results of each observation; without squaring, the positive and negative differences would cancel out.

Calculation of the standard deviation

Let us do this calculation with a real example. Usually we would do this with a computer, by just taking the columns of scores and by calculating the standard deviation with STDEVA*(number of observations in a row)* [in Open Office].

But to demonstrate the original "magic", we will do it here with real numbers.

We will take six scores for this example: 10.0, 8.0, 10.0, 8.0, 8.0, and 4.0. The symbol n = 6.

1. Calculate the mean (average): the sum of these six scores = 48.0, divided by 6 = *mean is 8.0*.

2. Subtract the mean from each score: 10.0 - 8.0 = 2.0; 8.0 - 8.0 = 0.0, 10.0 - 8.0 = 2.0, 8.0 - 8.0 = 0.0, 8.0 - 8.0 = 0.0, and 4.0 - 8.0 = *sum of differences is -4.0*.

3. Square these differences: 2.0^2, 0.0^2, 2.0^2, 0.0^2, 0.0^2, $(-4.0)^2$ = 4.0, 0.0, 4.0, 0.0, 0.0, 16.0 = *sum of the squared differences is 24.0.*

4. Calculate the *variance*: *24.0 / (n-1) = 24.0 / 5 = 4.8.*

5. Calculate the standard deviation from the variance by taking the square root of the variance: *SQRT(4.8) = 2.19.*

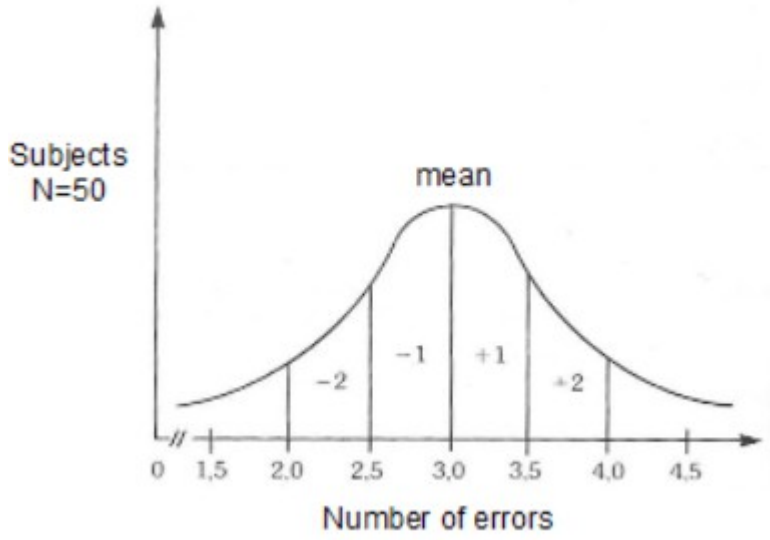
Usually, at least 68% of all the samples will fall inside one standard deviation from the mean. In our case, 5 out of 6 (83%) of our sample of scores were *not within* one standard deviation (2.19) from the mean (8.0)*. The result, therefore, was not significant from the chance level in this statistical evaluation.*

The usefulness of the standard deviation becomes clearer when considering that for a large number of observations of natural phenomena, the percentage of observations contained within one standard deviation from the mean can be predicted through mathematical operations (see Figure 2).

For example, if a sample includes about 50 speakers and the distribution, *i.e.* the number of spontaneous errors per hour is unimodal, we can expect that 68.3% of speakers will have an error rate covered by the range of *one standard deviation above and below the mean*.

Therefore, if this time an average of 3.0 errors per hour and a standard deviation of 0.5 errors were observed for 50 speakers, we can assume that about 34 of them (or 68.3% of 50) will make between 2.5 and 3.5 errors.

FIGURE 2: Normal distribution of characteristic observations, showing the mean and observations at one or two standard deviations from the mean



Expected probabilities

The area under the curve contains all observations (50). According to mathematical expectation, the greatest number of observations is expected to be around the mean (*i.e.*, 3.0 errors). The area under the curve between 2.5 and 3.5 errors (thus within one standard deviation of the mean) contains 68.3% of the total area; therefore, it can be expected that about 68.3% of the subjects (34) will make between 2.5 and 3.5 errors.

The area within two standard deviations covers 95.4% of the area under the curve, implying with high probability that 95.4% of the subjects (48) will make between 2.0 and 4.0 errors per hour.

The advantage of the concept of standard deviation is even more striking if, starting from the mean, two standard deviations are calculated. Thus, if 50 speakers make on average 3.0 errors per hour with a standard deviation of 0.5 errors. If the distribution of these errors is unimodal, the mathematical expectation would be that 95.4% of the speakers would have made between 2.0 errors (two standard deviations below the mean) and 4.0 errors (two standard deviations above the mean).

Therefore, it clearly appears that the standard deviation represents an effective method to locate the range in which the majority of observations lie.

2. Inferential or deductive statistical analysis

As we see, psycholinguistic research has moved beyond strictly descriptive and taxonomic methods. Contemporary statistical analysis developed methods that go beyond simple description to verify the validity of hypotheses. The primary hypotheses tested by statistical analysis are the difference and correlation between two variables, because in most cases, researchers want to know: (1) if two independent variables differ from each other in terms of their influence on a dependent variable; and (2) if two dependent or independent variables are correlated, that is, if they have a systematic relationship or not.

a. Differences

As an illustration, let us revisit our lexical association experiment. It would be interesting to determine if the reaction times related to the semantic task are different from those observed during the phonetic task (see figure 1 and table 2 of chapter 3). Let us rephrase this question using the appropriate statistical terminology: "What is the probability that result 1 is different from result 2, given that it was, or was not, caused by chance?"

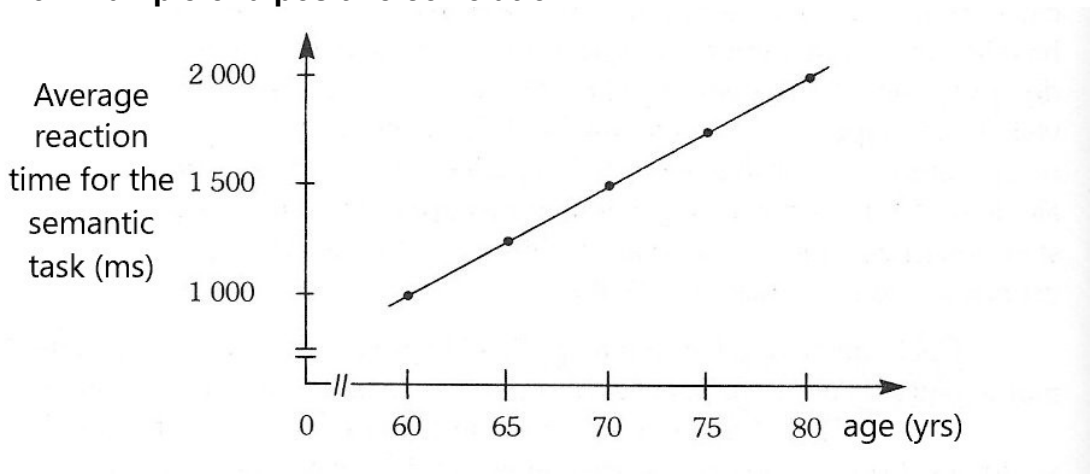
Recall that, on average, subjects took less time (1,245 ms) to respond to the semantic task than to the phonetic task (1,755 ms). To confirm or refute the hypothesis, it is necessary to see if the difference between 1,245 ms and 1,755 ms is caused by chance, meaning that we assume the presence of any accidental variations in observation, or if this difference reliably reflects a way in which we access our memory.

Statistical methods do not answer these questions categorically, but they estimate the probability that a difference is due to chance. A number of procedures (such as the t-test, analysis of variance, chi-square test) can be applied to verify the validity of hypotheses involving differences; the results of these procedures indicate the probability that the result obtained in our observation is or is not random. Such a result is generally expressed as follows: "the difference is statistically significant according to the chi-square test ($x^2 = 3.98$, d.f. = 1) at a probability level $p<0.05$."

This means that the author applied the chi-square test (a mathematical method) to analyze the observations and obtained a chi-square value of 3.98. The abbreviation "d.f." indicates the degrees of freedom of the analyzed data. When an experiment includes two categories, a semantic task and a phonetic task, there is only one degree of freedom, which means the data can vary only along one dimension. With one degree of freedom and a chi-square value of 3.98, there is less than a 5% probability that the observed differences are random.

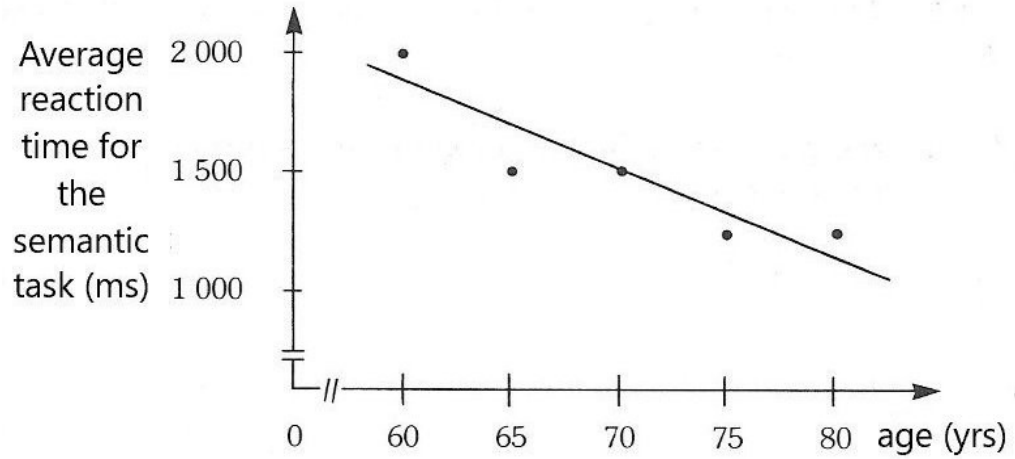
A positive correlation is shown in figure 3.

FIGURE 3: Example of a positive correlation



The reaction of older people is higher and tends to increase with age. In a case like this, we observe a negative correlation between these two variables.

FIGURE 4: Example of a negative correlation



When one of the variables decreases while the other increases, as in figure 4, this is called a negative correlation. This does not mean that there is no correlation, as the term might suggest. Indeed there is an organized relationship between the two variables, but of a different nature.

A positive correlation between two variables is perfect when all the correlation values form a straight line. If the line on the graph rises from left to right (figure 3), the numerical result of the correlation test is equal to +1. In the case of a perfect negative correlation, the correlation values form a straight line descending from left to right. Then, the result of the correlation test takes the value of -1.

When a correlation is less than perfect (*e.g.*, figure 4), the result of the positive correlation test is below 1 and that of the negative correlation test is above -1. Thus, while the result of the perfect positive correlation in figure 3 is +1, that of this imperfect negative correlation could be around -0.9.

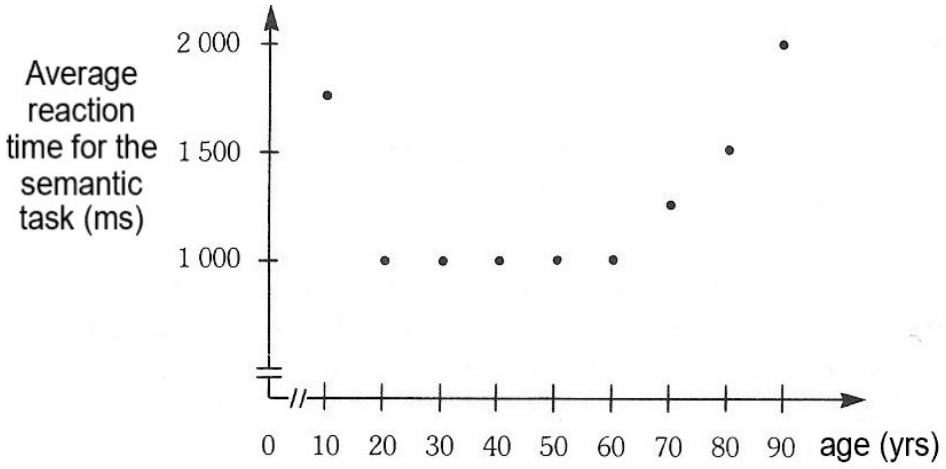
Correlation results are most often presented as follows: “the relationship between observed reaction times and the age of subjects was examined using Pearson’s correlation test. The obtained coefficient *r* is 0.75; it is significant at a level of $p<0.01$

(n=10).” This means that there was less than a one in a hundred chance that the observed correlation was random, and this value was established from ten observations.

Regarding correlations, it is not only important to obtain statistically significant correlations, but that these relationships must also be strong, that is, close to +1 or -1. This is because it is relatively easy to obtain low-value correlations, whereas it is more difficult to obtain strong correlations. This is often because many variables are indirectly related, all while leading statistically to significant correlations. Fewer directly related variables lead to stronger correlations.

As an example, if a correlation between two variables, observed in a group of 100 subjects, has a coefficient of r=0.20, it may look significant at the $p<0.05$ level. That relationship may look important at such a significance level, but it may only relate to the influence of further and remote factors. So with low r values it is important to consider further alternatives. A relationship between two variables can show some indirect level, while still maintaining its "non-random" nature. Consider test results obtained from different family members that share a number of common factors, but that are irrelevant in the tested variables.

FIGURE 5: Example of a complex but organized relationship (fictitious data)



Finally, note that simple correlations, whether positive or negative, are not the only possible organized relationships between two variables. The fictitious data in figure 5 clearly illustrate this situation. It is entirely possible to observe a complex and organized relationship that can be characterized not by a simple linear correlation, but rather by means of less common statistical methods. This is why a serious researcher generally represents the results of their observations with a graph before choosing among correlation evaluation methods.

3. Exploratory statistical analysis

The field of exploratory procedures allows us to apply numerical analysis to psycholinguistic research. These increasingly used methods enable the analysis of a large amount of observations in order to identify patterns unlikely to appear at the first examination of the data. Since they usually require considerable analysis, they are generally analyzed computationally. Even though the reasoning and mathematics

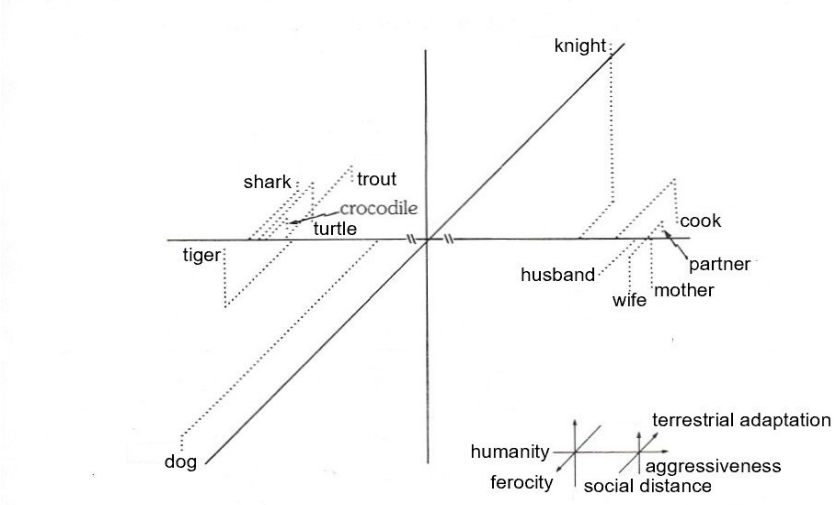
underlying these techniques are not more complex than those of deductive statistical analysis, they nevertheless go beyond the scope of this work. This is why we will limit ourselves to an outline of some possible applications here.

a. Factor Analysis

The best-known exploratory method is factor analysis. It is a group of procedures allowing the identification of common aspects, or factors, of a set of observations. Take the example of a researcher who measured several linguistic variables, such as reaction times during a semantic and phonetic lexical association test; the speed of sentence construction; the percentage of errors during a comprehension test. Additionally, the researcher took into account the age and IQ of the subjects. If strong correlations were found among some of these measures, it would be interesting to determine whether a single factor (*e.g.*, age) or a small number of factors (*e.g.*, age, IQ) were responsible for all or any of these significant correlations. Factor analysis is capable of separating factors that are more or less directly correlated by taking all the data into account.

FIGURE 6: Semantic dimensions deduced with a classification task and multidimensional scaling analysis (non-lesioned subjects)

Source: ZURIF et al., 1974, p. 183.



Another interesting application concerns the identification of factors influencing mental processes unknown to the researcher at the time of the experiment. For example, consider a study by Zurif and colleagues (1974) in which the authors studied, with normal and aphasic subjects, how to group common nouns associated with humans and animals: "cook," "partner," "wife," "dog," "tiger," "shark," etc. They presented their subjects with three cards with these words and asked them to indicate the two most related words.

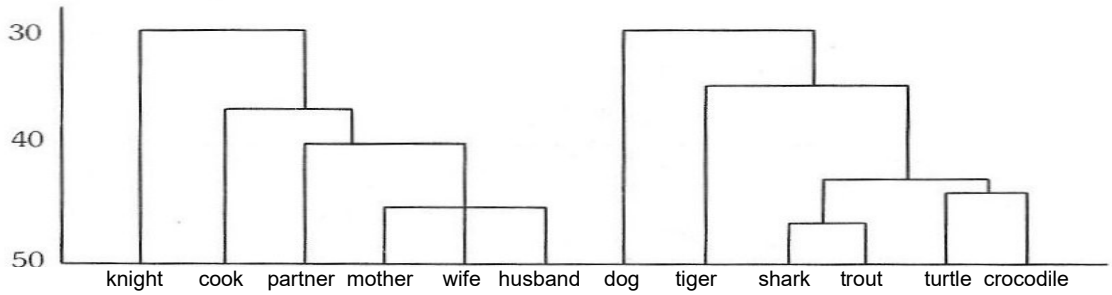
Relying on these choices, a multidimensional scaling program inferred the semantic factors (the "dimensions") that the subjects had apparently used to group the words shown to them (see figure 6). It appears that normal subjects used concepts related to human nature, aggressiveness, ferocity, and terrestrial adaptation. Compared to normal subjects, a first subgroup of aphasics (Broca's aphasics, see chapter 8) showed little deterioration in these semantic categories, whereas the results of the other subgroup of aphasics (Wernicke's aphasics) demonstrated fairly complete semantic confusion.

b. Cluster analysis

Cluster analysis is closely related to factor analysis. After identifying the factors or dimensions characterizing a set of observations, it is interesting to see which stimuli or subjects cluster into groups. Zurif and colleagues found, for example, that for normal subjects, the words "husband," "wife," "mother," "partner," and "cook" formed a first coherent group, and "tiger," "shark," "turtle," "crocodile," and "trout" formed a second (see figure 7). As for the words "dog" and "knight," they were positioned apart from these groups. This leads us to conclude that, in all likelihood, the semantic representations for "dog" are, in some way, different from those characterizing animals, and that the semantic concept of "knight" differs somewhat from those defining other human beings.

FIGURE 7: Two semantic groups identified from a cluster analysis: human beings (on the left) and animals (on the right)

The basic data for this analysis were the same as those in figure 6. **Source: Zurif et al., 1974: 176.**



c. Analysis of lived experience

The last method that deserves our attention is the analysis of lived experience *(path analysis).* Its application consists of observing a group of subjects in various personal developments in order to determine which experiences they share.

For example, BELL ET AL. (1981) conducted extensive interviews with 1,456 homosexual and heterosexual women and men from the San Francisco area to learn, first, the social influences that contributed to their sexual preference and second, those that are not directly associated with homosexuality or heterosexuality. By observing the "lived experience" of their subjects, from childhood to adulthood, and by comparing the lived experience of homosexual subjects with that of heterosexual subjects, the authors were able to find that these two groups do not differ sharply in the type of parental influence to which they were exposed. This result contradicts the traditional hypothesis that the role of parents was decisive in the sexual orientation of their children.

The analysis of experiences can therefore be valuable for identifying factors that influence human development. Since it examines phenomena that precede events for probable causes, and attempts to eliminate alternative solutions, it provides a more powerful statistical tool for examining cause-and-effect relationships than simple correlations.

This method could prove interesting for measuring normal vs. pathological acquisition of language. In this way, one could distinguish the factors that contribute to success in acquiring a second language, the development of stuttering, or of other speech

disorders. These cutting-edge methods are still not widespread but are very promising for the empirical verification of psycholinguistic hypotheses in the near future.

B. EXPERIMENTAL PROCEDURE

In this section, we present, step by step, the typical approach necessary to set up a first research project in psycholinguistics. Students who have never undertaken a research project according to the scientific method will develop, with the help of this scheme, some familiarity with these important steps. The application of this procedure will largely help them to avoid confusion in a first independent research work. More advanced students will benefit from this reminder as a work guide.

The experimental procedure is characterized by two stages: the development and execution of the research project on the one hand, and the presentation of the research on the other. These two stages differ as follows: during the first stage, the work is carried out from the researcher's point of view, that is, the collection and analysis of results, while during the second stage, the work is carried out from the point of view of the "consumer" of the experience, that is to say, the reader, *i.e.,* the one who will have to assimilate the relevant information from the project results.

1. The development and execution of the research project

In this section, we will briefly describe each step according to the usual order of execution. We will illustrate each of these steps with two examples of possible approaches to the question.

a. The selection of a phenomenon

The researcher begins their project by selecting a psycholinguistic phenomenon. For a phenomenon to be considered psycholinguistic, it must reflect linguistic functioning, in production, reception, acquisition, or in language pathology.

Example 1: The researcher chooses the phenomenon of hesitations that occur in spontaneous speech production. This phenomenon allows us to deduce certain aspects of linguistic functioning during speech production, such as the size of the linguistic units manipulated in production, or the interaction between planning and execution of speech (see chapter 6).

Example 2: The researcher chooses the phenomenon of errors made by a non-native speaker. This phenomenon informs us about the difficulties a student must face when using this language.

b. Informal observations

The researcher informally observes some aspects of the chosen phenomenon, which will allow them to assess the frequency of the phenomenon (and to some extent, its importance) and will provide a first subsample, in order to eliminate the most absurd hypotheses.

Example 1: The researcher collects about twenty hesitations at different moments during the utterances of several people and notes them as soon as they are heard.

Example 2: The researcher notes the errors of some non-native speakers, for example, on television or radio interviews.

c. Transcription and structuring of informal observations

After transcribing the informal observations collected into an analyzable form, the researcher performs an initial structuring. Try to discern a systematic structure, an internal operating rule. It may happen that several factors interact and influence the observed occurrences.

Example 1: It seems that speakers hesitate more before content words than before function words.

Example 2: It seems that non-native speakers make more mistakes in the evening than in the morning.

d. The research hypothesis

At this stage, the researcher establishes a research hypothesis. It should be very general and formulated in terms of a possible causal relationship. (Recall: *cause* independent variable, *effect* dependent variable).

Example 1: The fact that it is more difficult to search for a content word rather than a function word might explain why hesitation is greater before content words than before function words. This would apply to speakers of any natural language.

Example 2: Fatigue, greater in the evening, would be the cause of mistakes made by non-native speakers.

e. The working hypothesis

The next step is to develop a working hypothesis that allows the verification of one or more aspects of the research hypothesis. This is called an "operationalization" of the research hypothesis, meaning that it reduces the research hypothesis to a particular situation involving a limited number of subjects while predicting a precise result.

Example 1

First possible operationalization: in the spontaneous speech of 10 non-native speakers recorded on television for 60 minutes, there will be on average more hesitations lasting more than one second before content words than before function words.

Second possible operationalization: in the same spontaneous speech sample, hesitations are on average longer before content words than before function words.

Third possible operationalization: in a situation where a non-native speaker is forced to use many descriptive words, they will hesitate more per half-hour than in any other situation.

Example 2

First possible operationalization: a class of students learning English as a second language might make more pronunciation mistakes during a recording session taking place in the evening than in the morning.

Second possible operationalization: non-native subjects make more agreement errors in a written text produced in the evening than in a similar text in the morning.

f. The experimental conditions

The researcher then establishes the conditions of the experiment: they choose the sample size, the place and time of recording, the mode of observation (audio recording, video recording, computer), the mode of transcription (phonetic transcription, normal alphabetical transcription, special coding, etc.) and the classification of the expected data.

Example 1: The experimenter decides to record for one hour on an audio tape a

discussion between five friends, in the evening after work. According to their needs, they determine that it will be sufficient to transcribe in phonetic alphabet the sentence sections containing a hesitation. They transcribe hesitations according to the traditional phonetic alphabet.

Example 2: The experimenter divides their class of 30 students into two groups. To the first group, they ask simple questions abruptly, once in the morning and a second time in the evening. To the second group, they ask the same questions once in the evening and a second time in the morning. (This avoids sequence or familiarization effects with the experiment). They record each interview on an audio recording. They plan to transcribe in phonetic alphabet only the pronunciation errors. For the classification of errors, they rely on traditional phonetic analysis.

g. The execution of the experiment

Equipped with appropriate instruments, the researcher conducts their experiment. During it or immediately after, they check if they have noted the selected independent variables (age of subjects, duration of native and target language learning, social class, etc.).

h. Data analysis

The experimenter sorts their data according to clearly defined criteria. They establish and apply inclusion and exclusion criteria for data. They analyze the differences, correlations, or interactions found in the data, using statistical analyses if possible.

Example 1: The experimenter establishes the difference between content words and function words based on a definition extracted from a relevant linguistic text. Then, they identify all full or empty hesitations (see chapter 6) on the audio recording. They distinguish individually for each speaker:

(a) empty hesitations before content words;

(b) empty hesitations before function words;

(c) full hesitations before content words;

(d) full hesitations before function words. It excludes hesitations that are insufficiently audible and those longer than two seconds.

Then establish the frequency for each category. Finally, to address his hypothesis, compare empty hesitations and filled hesitations using a statistical test.

In cutting-edge research, these conditions conform to rigorously established rules. However, in beginner research, the experimenter may use their own "common sense" in choosing the intrinsic and specific conditions of the experiment they conduct.

Example 2: The experimenter analyzes the recordings of his students by calculating the percentage of errors per word used for each group, taking into account the previously mentioned conditions. He thus distinguishes:

(a) group 1 in the morning;

(b) group 1 in the evening;

(c) group 2 in the morning;

(d) group 2 in the evening.

All semantic and syntactic errors are excluded from the analysis. A t-test is applied to compare the results of the two types of recordings (morning and evening).

i. Interpretation of the results

Experimenters interpret their results in light of his working hypothesis by comparing obtained results predicted by his hypothesis. Understand their causes if unexpected results are obtained.

j. Integration of the results

Confront results with your research hypothesis and, if applicable, with a broader theory encompassing the observed phenomenon. The research hypothesis is examined, should this occur.

2. Presentation of the research

In the exact sciences, the final presentation of research (oral or written) follows strict rules (*e.g.,* the rules of the *Publication Manual* of the AMERICAN PSYCHOLOGICAL ASSOCIATION, 1983). This standard form allows other researchers to quickly locate the information they seek. Nowadays, researchers do not have enough time to undertake an exhaustive reading of all research reports published in their field; as a result, they often retain only summary information gleaned from a thorough reading of certain key passages.

When writing a research report, it is assumed that the reader is already informed, but the address is not offered to a specialized reader (for example, one would address a psycholinguist and not a psycholinguist specialized in hesitations; a psychologist oriented towards cognitive development and not a specialist in Piagetian theory; etc.).

The objectives of the presentation are as follows: (a) to situate the experiment in relation to its theoretical framework; (2) to present the research and working hypotheses; (3) to communicate just enough methodological details concerning the experience so that another experimenter can replicate the experiment; (4) provide enough results so that the reader can judge whether the research hypothesis is supported or refuted.

The standard presentation includes seven sections: the abstract (often referred to by the English term abstract), the introduction, the description of the method, the description of the results, the discussion of the results, acknowledgements, and the bibliography. Notes, tables, and graphs can be placed in different parts of the text or more often at the end of the document, after the bibliography. The importance of each of these sections may vary according to individual needs.

a. The abstract

In North American publications, this section of the report usually precedes the main text, while in European publications, it follows the discussion. The abstract summarizes, in about 100 to 500 words, the central research question, the research method, the results obtained, and the conclusion reached.

b. The introduction

The introduction provides the necessary definitions, that is, the concepts and terms that even an informed reader may not necessarily know, situates the question in relation to a theoretical framework and previous writings, explains the importance of the research, and finally presents the logic of the current approach (in this order).**c. The method**

The description of the method mentions factors likely to influence the research results

and all those important to know when replicating the experiment. This section is generally divided as follows:

(1) The subject: the type of subject (*e.g.*, age, language(s) spoken, social or dialectal affiliation if relevant).

(2) The task: the type of task (spontaneous language, reaction time, standardized test, etc.) and the conditions of the task (individual or group test, quiet or noisy environment, instructions given to the subject, etc.).

(3) The stimuli used: the description of the criteria for choosing and preparing the stimuli used (if applicable).

(4) The observation conditions, the applied measurements (type of recording: audio, video, visual observation, or both); the reliability of the observation if it is difficult to perform (*e.g.*, agreement between two or more observers regarding the same phenomenon or agreement between two analyses of the same audio recording).

(5) The criteria used in observation analysis (*e.g.*, how to classify words like "from now on," "however," etc.: function word or content word? How to evaluate errors in a situation where the student immediately corrects themselves and in one where they do not?). Provide a sufficient number of examples.

(6) The criteria for excluding subjects and observations.

d. Results

The description of the results must be detailed enough to allow the reader to form an opinion about the study's outcomes, that is, to know whether they support or refute the proposed hypothesis. Thus, the results are presented in a relatively detailed manner in graphical form or as tables. The main results are also presented in written form. The texts accompanying the tables and figures are generally detailed enough so that one does not have to refer to the main text.

e. Discussion

The discussion interprets the results in relation to the research hypothesis and the developed theoretical framework. It states the study's limitations; for example, it mentions variables that were not considered during the experiment and that could later affect the results. Often, the discussion suggests other types of analysis to better understand the issue.

f. Bibliography

The bibliography separately presents the works cited in the text and the works consulted for the development of the research. It follows the standard order by presenting the author's name, publication date, publication name, and number of pages. The components of the citation follow the order according to the type of research undertaken: for example, psycholinguistic research adheres to the rules used in a prestigious psycholinguistics journal, while a sociolinguistic document follows the order advocated in a sociolinguistics journal.

SUMMARY

In this chapter, a quick overview of statistical analysis allowed the reader to become familiar with the elements used in descriptive statistical analysis, namely the mean, mode, and standard deviation. This overview also includes the examination of the most

basic concepts in inferential or deductive statistical analysis used to verify the validity of differences or correlations in the data, then touches on the more advanced methods available in exploratory statistical analysis such as factor analysis, cluster analysis, and lived experience analysis.

The section on the experimental procedure first describes the steps of preparation, execution, and analysis during a psycholinguistic experiment and the methods of applying these to the written presentation of the experiment's results. Although there are other equally valid approaches to observing psycholinguistic data, this approach nevertheless has the advantage of fitting into the traditions of contemporary exact science.

APPLICATION SECTION

1. Suppose that in a lexical association experiment, you obtain the following ten reaction times following a verbal stimulus: 1,200 ms, 1,050 ms, 1,150 ms, 1,600 ms, 1,550 ms, 1,250 ms, 1,140 ms, 1,650 ms, 1,500 ms, 1,600 ms. Draw these results as a bar graph with bars spaced along the x-axis (one bar per 100 ms; x-axis: reaction time, y-axis: number of attempts); indicate the mean and the mode(s). What is the name of the distribution thus obtained?

2. Here are the fictitious results of a test taken in an adult education class: 78, 82, 65, 75, 86, 45, 72, 60, 93, 71. Calculate the mean and the standard deviation. According to mathematical expectation, what percentage of scores should be within one standard deviation of the mean? What percentage of scores is actually within two standard deviations of the mean?

3. Here are the ages of the students associated with the results from the previous question (fictitious data):

STUDENT	SCORE	AGE
A	71	22
B	78	38
C	45	39
D	65	64
E	75	50
F	86	32
G	45	76
H	72	54
I	60	70
M	93	23

Plot these values as points on a scatter plot; draw the age axis on the x-axis and the scores axis on the y-axis. Do you estimate that you have obtained a correlation? If yes, is it positive or negative? Closer to 1, 0, or -1? Describe your observation results in a simple sentence.

4. During a psycholinguistic experiment, suppose you found the following sentence The difference between the results of the two tasks was significant according to the t-test ($t = 1.954$, d.f. = 9, $p<0.05$). Explain the abbreviations *t, d.f.* and *p*. Simply state the

meaning of p 0.05.

5. Design a small psycholinguistic experiment following the experimental procedure described above.

FOR FURTHER READING

DEMERS (1981).

GILBERT (1978).

MULLER (1968).

Part Two

Psycholinguistic processes

Chapter 5. The Nature of Language

Human beings tend to consider themselves the masters of creation. They justify this worldview by the fact that they largely control the physical resources of the earth and attempt to understand and predict the functioning of everything around them. There is no other living being that has achieved such comprehensive control and understanding of its environment.

A question then arises: What faculties allowed humans such domination? It cannot be the sharpness of their own sensory receptors nor their motor faculties, because we know that the eagle has superior vision, that the dog's hearing and sense of smell far exceed ours, and that with some training, squirrel monkeys are capable of executing movements as precise as those of humans. It is more the cognitive and linguistic faculties of humans that distinguish us from other living beings; we seem to be more capable of solving new problems by appealing to our capacity for abstraction, and one of the important vehicles is language.

The language faculty is particularly conducive to analysis. It is potentially present in almost every individual; it manifests itself through the production and use of identifiable and measurable elements (sounds of a language, syllables, words, phrases, or utterances); and through detailed analysis, it will reveal to us a large number of characteristics common to other cognitive faculties. This explains the analogy of language as a "window into the human mind," that is, a faculty allowing us to apprehend the workings of the mind better than any other. And it is thanks to the analysis of the principles of selection, transformation, and arrangement of linguistic elements that we propose to discover the functioning of our mind.

Such an approach to human language characterizes the perspective specific to psycholinguistics and, for this very reason, the interest it commands. From this angle,

language is studied as a human faculty associated with (and yet separable from) the cognitive faculty. In later chapters, we dwell on the processes that govern the production, understanding, use, and acquisition of language. Throughout this journey, deepening certain concepts will allow us to better understand not only the linguistic faculty but also our cognitive faculties in general, relying more particularly on rational thought, on musical or artistic production and perception.

For the moment, we will focus our attention on the general characteristics of the linguistic faculty. On the one hand we will situate language in relation to heredity and learning[8]; on the other hand, conduct a comparative analysis between human language and communication systems in animals. We will note that the human language faculty is structured around a combination of hereditary and learned components, and that it differs from animal communication systems by its scope and complexity.

A. HEREDITY AND LEARNING

The most crucial and fundamental question concerns the origin of any faculty. It is a matter of determining whether this origin is hereditary or the result of learning.

The answer to this question is significant, as it defines the limits of any development or modification of the faculty in question. If a faculty is strongly rooted in heredity, it is reasonable to think that it is hardly modifiable; on the other hand, it has excellent potential for training and modification if it is acquired through learning. Moreover, if it turns out that a faculty is partially determined by hereditary components and training components, one can then expect that any subsequent modification will occur at the level of the acquired components rather than the hereditary ones. For these practical reasons, in addition to more theoretical interests, it is important for parents and language teachers to focus on this issue.

Let us clarify that we do not aim to caricature this issue into an extreme and exclusive polarization, that is, we do not consider language as a faculty that is entirely innate or entirely learned. Such an approach would prove futile, since humans probably possess no behaviour whose exclusivity belongs solely to one or the other capacity, and few reasons suggest that linguistic behaviour is an exception.[9]

Intuitively, we will grasp the relationship between heredity and learning by considering the two extremes of the behaviour spectrum: on the one hand, reflexes are primarily hereditary behaviours. On the other hand, typing with ten fingers in sequence illustrates a learned behaviour. If we learn to suppress a reflex through willpower, this results in adding learning to a spontaneous and hereditary development; *i.e.* such learning modifies a preexisting behaviour. At the same time, learning to type is constrained by preexisting resources, thus by heredity. In this sense, we emphasize that typing is partially hereditary, while a reflex is undoubtedly partly influenced by

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8 In this volume, we establish a clear distinction between "learning" and "acquisition." The term "learning" concerns the development of a faculty or a body of knowledge, either through experience or intellectual work (without necessarily any genetic predisposition for this development); whereas the notion of "acquisition" includes any development of a faculty, regardless of whether this development is spontaneous (*i.e.*, due to a genetic predisposition) or induced by experience or particular effort.

9 As an explanatory reminder, the difference between "behaviour" and "faculty" lies in the fact that behaviour is generally considered the observable manifestation of an underlying faculty, and the study of empirical questions related to any faculty is approached through a study of its observable manifestations (see chapter 2).

certain learnings.

This also applies to linguistic behaviour. The latter involves a continuous renewal of words, structures, fixed expressions, etc., and therefore cannot be purely innate. Furthermore, the fact that almost every human develops a behaviour as complex and extensive as human language immediately indicates that we must have a hereditary predisposition for learning such behaviour.

It is therefore not a question of deciding in favour of one position or the other, as many introductory authors want, but rather of seeking to identify the components of linguistic behaviour that are more strongly related to learning and those that are more directly linked to heredity. For this task, we will examine five biological criteria that will distinguish, respectively, behaviours with a strong hereditary component (*i.e.*, reflexes) and those with a strong learning component (*e.g.*, computer programming or typing). Since language is expected to lie between these two extremes, a detailed examination of these criteria is likely to reveal and differentiate which aspects of language are determined by the human genetic code and which are related to learning and subject to modification.

1. Comparison between hereditary behaviours and learned behaviours

As an example of behaviour with a strong genetic dependence, we will take the pupillary reflex, a known reflex that regulates the allowable degree of brightness for the eye according to the opening and closing of the iris. This reflex can be observed by covering, then uncovering a friend's eye with the hand; when the light diffuses again, the iris involuntarily contracts to reduce the degree of brightness projected onto the retina. To illustrate what results from the phenomenon of learning, we refer to the practice of typing. This type of behaviour has the advantage for us of being relatively recent within our experience, making it impossible for it to be genetically transmitted; it is therefore undeniably learned.

It turns out that reflexes exhibit at least five relevant traits that distinguish them from learned behaviours, which we will characterize as follows: uniformity of behaviour, exclusivity of the initial stimulus, spontaneous appearance of the behaviour, lack of receptivity to the amplifying effects of training, and the potential presence of specific biological structures for the behaviour. We will detail each of these notions.

First, the reflex is a uniform behaviour, that is, a constant behaviour within the same species. This implies that every individual of the same species demonstrates the same reflex behaviours; that in a given individual, the reflex in question presents many traits in common with that of another individual; and that the same reflex is repetitive in nature. In this regard, the pupillary reflex is essentially the same for all human beings and almost always occurs in the same way and at the same speed (except in cases of neurological pathology). On the other hand, the behaviour associated with typing differs from one person to another. Some use all ten fingers, while others use only one or two fingers or simply do not know how to type. Moreover, the speed of the behaviour differs significantly from one situation to another even among people who type regularly.

The second characteristic concerns reflexes that can initially only be triggered by a restricted group of stimuli, which we call “exclusivity of the initial stimulus” or “stimulus specificity”. This stimulus can be external, for example, light in the case of the pupillary reflex, or internal, like fear reactions resulting from a nightmare. One important consequence stemming from the specificity of the initial stimulus is that reflexes are not

intentional and therefore cannot be directly controlled by will. They can only be triggered by creating specific conditions, such as forcing oneself to cry by thinking of tragic events. In other words, the category of stimulus that causes a reflex can be broadened through training (see conditioned reflex, below), but initially, this kind of behaviour is biologically dependent on precise stimuli. The pupillary reflex illustrates this principle well, as it is initially sensitive to the degree of light, but through training that will be explained shortly, it is possible to develop the group of stimuli that trigger the same reflex.

Conversely, learned behaviours do not support this principle. Very different stimuli provoke this kind of behaviour, and it can be directly controlled by will. In typing, for example, the stimulus can be either written text, spoken dictation, or a spontaneous thought.

Thirdly, a reflex is distinguished by its spontaneous appearance, which shows that the organism does not need training for the behaviour to manifest at a given moment in development. Either it is observed from birth (*e.g.*, the sucking reflex in infants), or it develops spontaneously later in life, at predetermined times (*e.g.*, reproductive behaviour in birds). In other words, the organism is predisposed to use or develop its reflexes from birth, unlike learned behaviours which do not develop spontaneously and require a specific training process.

Fourthly, a reflex differs from a learned behaviour by the amplifying effects of training. While the extent, automation, or both of a learned behaviour increase with training, this is not the case for reflexes. Training largely determines the degree of automation in typing, for example, whereas it cannot improve, amplify, or further automate a pupillary reflex. Even if one learns to trigger it, one cannot increase or further automate it. However, it should be noted that any behaviour, reflex or learned, can be partially or totally suppressed by negative reinforcement, that is, by punishment.

Finally, there are often anatomical structures or morphological adaptations specific to a given reflex, which is not the case for learned behaviours. This may involve, on the one hand, neuronal mechanisms (stimulus receptors, neuronal pathways, particular sections of the spinal cord or brain) and, on the other hand, muscular or glandular structures that perform the reflex action. Thus, the pupillary reflex is triggered thanks to a series of small muscles located inside the iris of the eye exclusively are responsible for triggering this reflex, while typing involves structures that can, if necessary, serve other activities.

Ultimately, the difference between reflex behaviours and learned behaviours does not lie in the complexity of the behaviour. In this context, we chose the pupillary reflex as an example because it is clearly identified as involuntary and involves exclusive structures. However, we could just as well have chosen a more complex reflex that would have been more directly comparable to typing. For example, the sucking reflex characteristic of young children involves a coordinated and rhythmic action of many muscles of the lips and mouth, implying complex neural activity at the level of the medulla oblongata. The fact that it is still a reflex is easily demonstrated by the experiment of bringing a piece of lemon to the lips of a baby a few weeks old. Through grimaces, the baby clearly shows disgust for the lemon, but cannot suppress the sucking reflex and slowly draws the piece of lemon into the mouth.

2. Linguistic behaviour

Between these two poles appear a large number of behaviours that combine both

heredity and learning. We thus observe the presence of behaviours with a hereditary character, but that are also partially modified by subsequent learning.

The classic example of this type of interaction between learning and reflex is the *conditioned reflex.* In a given context, the organism learns to respond to a new stimulus by a previously associated reflex. The classic experiments demonstrated in this interaction are those of PAVLOV (1927; cited in HEBB, 1972: 24-26). In the first part of the experiment, Pavlov triggered the salivary reflex in the dog by showing it food. This is called a specific or "unconditioned" stimulus. In the second part of the experiment, before presenting the food, he regularly presented a second stimulus, most often an auditory stimulus, such as a bell, a buzzer, or a metronome beating at a precise rhythm. After fifteen or twenty auditory stimulations, the dog began to salivate at the sound of this new stimulus alone, which thus became a "conditioned" stimulus. The dog therefore learned to respond to a new stimulus by a transfer of a prior established *reflex*.

Linguistic behaviour constitutes another example, but it is part of a more complex interaction. To better understand what is involved, we will situate and describe linguistic behaviour with regard to the five fundamental principles described below.

a. Uniformity of behaviour

Linguistic behaviour is both uniform and variable. It is as uniform as a reflex can be, in the sense that all human beings (without severe neurological deficit) have an innate capacity for language acquisition: all develop it and use it fundamentally in the same way. As we will detail in later chapters of this volume, language acquisition is based on identical principles for every child; the fundamental functioning of language is the same for every individual, and language is used for the same major purposes by all human beings.

However, linguistic behaviour is subject to variation, as is any learned behaviour. Not everyone acquires the same language, and even within a linguistic community, there are considerable dialectal differences regarding certain sounds, certain words, or certain structures. Moreover, two people who have learned to speak under similar circumstances will not necessarily use language in the same way.

In other words, the *principles* governing the development and use of language are uniform, while the *precise for*m of linguistic behaviour is variable. According to contemporary linguistics, the principles of language development and use are *universal*, and the form of behaviour is specific to each linguistic community, each social group, and each individual. The linguistic faculty therefore consists, on the one hand, of *language* (its uniform aspect) and, on the other hand, of the dialect, sociolect, and idiolect of the individual in question (its variable aspect).

b. The “exclusiveness” of the initial stimulus

It is with respect to the criterion of its "exclusiveness" of the initial stimulus that linguistic behaviour most clearly demonstrates its affinity with learned behaviours. Let us prove this by contradiction by examining linguistic behaviours that seem to have affinities with reflexes.

In a group, it is likely that a person will immediately turn their head if someone in the room calls their name. This reaction is so rapid and involuntary that one might rightly assume it is a reflex. Yet, the linguistic aspect underlying this reaction is not unique, because a completely different linguistic intervention, such as clearly uttering a curse word, will probably have the same effect.

The same applies to a second form of linguistic behaviour, namely the literal imitation of words called *"echolalia."* This behaviour can be triggered by a specific stimulus in the sense that the response strongly resembles the stimulus. But in fact, this type of imitation does not imply that the behaviour has a specific stimulus or class of stimuli, as is the case for reflexes, because a person can imitate any word or any phrase.

Furthermore, young children, who represent the category of speakers most prone to this kind of behaviour, almost cease all imitation by the age of three (see below). We conclude that the linguistic behaviour is never associated with a single stimulus, that language occurs spontaneously, without an obvious stimulus, and that the stimulus is not exclusive. According to this criterion, language rather manifests as a learned behaviour.

c. The spontaneous emergence of behaviour

We observe once again that regarding the spontaneous emergence of linguistic behaviour, it is a combination of reflexive and learned behaviours. Like the reflex, language manifests spontaneously at a specific period in the child's life, but like learned behaviours, this development depends on certain conditions. We will first examine its spontaneous emergence, then the necessary conditions for its development.

(1) Spontaneous emergence

The different linguistic behaviours (production, perception, understanding of speech) develop with astonishing regularity during the first five years of the child's life. This development passes through a series of stages or "phases" ranging from babbling to the use of isolated words, to the formation of sentences lacking closed-class words (functional words), to the production of complete sentences, and finally, to continuous discourse. This sequence of events is essentially the same in all cultures studied so far and shows relevant links to those involved in cognitive behaviour (see chapter 10 for more details).

(2) The first condition: stimulation, the model, or both

Nevertheless, this sequence of events seems possible, on the one hand, only with stimulation by a linguistic model and, on the other hand, with feedback mechanisms, that is, with control of one's own speech. The importance of a model, linguistic stimulation (or both) is particularly highlighted by the example of so-called "wild" children (*e.g.*, ITARD, 1962; SINGH AND ZINGG, 1966).

The case of "Genie" is one of the most recent and best-analyzed examples. She was discovered in Los Angeles, United States, in 1970 (CURTISS ET AL., 1974; FROMKIN ET AL., 1974). This young girl appears to have been deprived of a linguistic model and stimulation for most of her childhood, from 20 months to almost 14 years. She was isolated in a room, tied to a potty chair, and deprived of almost all acoustic stimulation (her father was psychotic and hated noise).

When she was found, she was hospitalized and it was observed that she could in no way speak, even though she had normal intelligence. Given that she had been deprived of stimulation and a linguistic model, she could not acquire language. However, she managed to learn to speak adequately (but with grammatical mistakes) thanks to an accelerated linguistic learning regimen. We deduce that the presence of stimulation, a linguistic model, or both is indispensable for the normal development of linguistic behaviour.

(3) The second condition: retro-activity

The extreme difficulty, even the possible impossibility of acquiring language without retro-activity about muscular articulation has been verified in a few rare cases of children born without neural pathways related to tactile or proprioceptive sensitivity of their articulatory movements (MACNEILAGE ET AL., 1967; cited by DANILOFF, 1973: 184). These children experience enormous difficulties in acquiring their mother tongue.

On the other hand, adults experimentally deprived of their muscular retro-activity of the vocal tract show few problems (see chapter 8). Indeed, it is very likely that such effects on speech, caused by the absence of any retro-activity on the articulatory musculature, are more marked and serious during the language acquisition process than experimentally in adulthood.

We can conclude that the presence of a model or linguistic stimulation and retro-activity represent crucial conditions for language development, like other learned behaviours. At the same time, the regularity in linguistic development are in favour of behaviour that nevertheless has important hereditary roots.

d. The amplifying effects of training

Regarding training, the speaker's age is a determining factor. In a young child, the acquisition of the mother tongue does not seem to depend on training, whereas in an adolescent or adult, linguistic learning is strongly dependent on training.

With specific training, several researchers tried, but in vain, to influence the pace of mother tongue acquisition in a child. Some others tried, for example, to prematurely teach a child the structures he lacked or poorly mastered; other researchers tried to expand the inventory of structures used by completing all the child's incomplete sentences, or even rewarded the child upon success (AITCHISON, 1976: 74).

In fact, it was not so much the direct training that had the best result, but the richness of the structures and vocabulary available to the child. To this effect, we mention the experience of a Russian researcher comparing the degree of acquisition of the word doll among two groups of children. His task consisted of showing a doll to the first group saying only: "Here is a doll, take the doll, give me the doll," etc., ten times. To the second group, he repeated his oral presentation, but in phraseological tests each time different. He obtained better results with the second group when it came to extracting the doll object from a set of toys (PINES, 1969; cited in AITCHISON, 1976: 76).

However, training effects become much more evident from adolescence onward. As we will see in chapter 11 of this volume, it is precisely the lack of personal rewards that seems to hinder the perfect acquisition of a second language in adults. It seems that obtaining better results depends closely on this. This criterion therefore reinforces the notion of an interaction existing between hereditary factors and learning factors.

e. Anatomical structures and morphological adaptations specific to behaviour

At first glance, language does not seem to use specific anatomical structures. Indeed, the vocal organs are primarily intended for other vital functions such as breathing, chewing, and swallowing. The human ear, so similar to the ear of other vertebrates, does not allow us to suspect an anatomical structure exclusive to linguistic purposes.

Nevertheless, there seem to be certain physiological predispositions for language. Some researchers observed significant changes in the human vocal tract compared to that of its ancestors and that of great apes. In a series of articles, Lieberman and his colleagues (among others LIEBERMAN, 1972) demonstrated that the human larynx is anatomically lower than that observed in great apes and also lower than the probable

placement of the reconstructed larynx in Neanderthal man. This is why modern humans have a pharyngeal cavity larger than that of the chimpanzee. Recall that the pharynx is the cavity located below the oral cavity and above the larynx, that is, the vocal cords.

According to these studies, this morphological adaptation favoured the clear articulation of vowels (particularly the sounds [i], [a], and [u]) while exposing humans to a certain danger. A piece of food can lodge more easily in the human pharynx than in that of the great ape: humans are thus exposed to a greater risk of death by choking. This morphological adaptation therefore favours language at the expense of the general survival chances of the human being.

At the cerebral level, it is possible to identify even more significant adaptations by referring to studies on pathology and language localization. Some aphasics, people suffering from a linguistic disorder following a focal brain lesion (partial brain damage, cf. chapter 8), experience almost exclusively linguistic problems, although their other faculties remain intact: their reasoning is excellent, their auditory perception is good, and their motor skills are quite normal. It logically follows that there are cortical areas entirely or almost entirely devoted to language.

Another clue, related to a biological linguistic predisposition, lies in the fact that most of us will acquire language because of more or less analogous preexisting brain structures. If language had no biological basis, one would expect these anatomy-functional localizations to differ from one individual to another. Yet, this is not the case; although there is some variation in the distribution of linguistic functions at the cortical level, it remains true that certain areas, more than others, are associated with linguistic function; these are particularly the regions adjacent to the Sylvian fissure of the left hemisphere and certain regions of the basal ganglia, the cerebellum, and the brain-stem (medulla oblongata).

Perhaps the best way to summarize the morphological and anatomical aspect of the language system would be to compare it to a graft on a tree. Although the development of the receiving organism does not anticipate the insertion of a graft, it is nevertheless flexible enough to integrate and adapt to it. Over the course of evolution, language has grafted onto hearing, brain structures, respiration, mastication, and swallowing. The human organism has adapted so well that, generally, language does not interfere with the functioning of these so-called vegetative structures; most of the time, humans can accommodate both their linguistic and vegetative functions (*e.g.*, they can breathe while speaking; they can speak and eat at the same time).

3. The predisposition to language

We have just seen that language occupies an intermediate place between reflex behaviours and learned behaviours. We still need to integrate it into a global concept that can account for some major principles.

The best hypothesis that incorporates the clues already gathered is that of the *biological predisposition to language acquisition*. It assumes that genetic information does not encode a complete system (reception and production organs, lexicon, grammatical system, etc.), but rather that the organism develops physiologically and intellectually in a way that allows the acquisition of a specific language. Humans are equipped with a system that enables them to acquire a very complex communication system in a relatively limited time.

Let us briefly speculate on the reasons why human evolution resulted in a biological

predisposition for language acquisition, rather than a complete communication code that is transmitted genetically. Indeed, one must question why certain linguistic elements must be learned and relearned in each generation. At first glance, it would seem much more advantageous for humans to be endowed with a complete communication system. Everyone would speak the same language and understand each other. However, there are at least three reasons opposing this.

Firstly, it is possible that the linguistic adaptations of the biological system are too complex and still too recent for them to be part of a reflex system. If the research on Neanderthal man conducted by Liebermann and his colleagues (see above) guarantees the approximate date of the emergence of language, this then means that we have only been endowed with this faculty for a few thousand generations. This likely represents a period of time too short for a global codification of such a complex system.

The second consideration seems even more relevant. It is possible that human beings benefit more from a linguistic learning apparatus than from a pre-established communication system. It is fundamental for their survival in conditions where they continuously create and learn new words. Nowadays, they would undoubtedly be greatly disadvantaged if they could not invent or learn words such as "unionization," "colour television," and "computer": reflections of social and technological changes.

Even with regard to the acquisition of grammatical structures, it is advantageous to have flexibility in learning. Some languages frequently learned by non-native speakers have undergone historical transformations that may have made them more accessible. Languages such as French, English, or Hindi indicate the relationships between the various elements of the sentence through function words and a rather rigid syntax linked to a relatively simple morphological system (of endings, etc.). Yet these languages come from morphologically complex mother languages (Latin, Anglo-Saxon, and Sanskrit). Given that second language learners seem to have much less difficulty learning morphologically simple languages (like French, English, and Spanish) than those that are not (like Russian or German), it would be advantageous for the human species to be endowed with a system that would facilitate the learning of grammatical structures.

At first glance, a final advantage of learning certain aspects of language might seem paradoxical. A language not only constitutes a barrier for those who do not speak it but also a mark of social belonging for those who do. This is why members of a given social group feel a strong interest in establishing and maintaining distinct markers between their languages and their dialects: these distinctions allow them to identify with other members of the group to which they belong and to differentiate themselves from it, if necessary. But this is only possible if certain aspects of a language can be modified, that is, if they are learned.

Thus stated, one comes to argue that although human social structure imposes limits on the degree of genetic codification of language, it is possible that our combination of innate and learned traits represents an optimal combination for an organism living in our social context.

B. HUMAN LANGUAGE AND OTHER NATURAL COMMUNICATION SYSTEMS

The conclusion drawn from the previous discussion is that the human linguistic faculty

is comparable to other human or animal faculties. It reveals an interaction between heredity and learning on which it depends for its normal development.

However, language is also defined in relation to other faculties, not only by similarities and affinities but also by differences. It is thus interesting to investigate differences between human language and other communication systems. This is the theme of our next considerations.

For about twenty years, detailed research on the communication systems of great apes, birds, bees, and even trees has seriously challenged the exclusive appropriation of communication by humans. Recent research demonstrates, for example, that certain willows, poplars, maples, and oaks can communicate to "conspecific" trees when attacked by insects or parasites (BROWNLEE, 1983). Thus, when caterpillars invade a Sitka willow (found in the Northwestern United States), neighbouring willows respond by increasing their concentration of toxic chemical substances in their leaves. After a few days, these changes end up protecting the "alarmed" trees against caterpillar attacks, thanks to the unpleasant taste secreted by the leaves. Although the precise mechanism of transmission is not yet known, it is presumed that the affected trees produce a chemical substance carried by the air that informs neighbouring trees.

However, the mere fact that a good number of living beings are capable of communication, in one form or another, does not exclude the possibility of major differences, particularly at a quantitative level. This section focuses on highlighting both similarities and differences in comparisons between human and animal communication systems.

We will examine some research on birds by revealing fundamental similarities between their communication systems and human language. Secondly, we will discuss recent research on great apes, in studies that report significant differences between their communication abilities and those of humans. Moreover, such differences justify our use and strict distinction between the terms "language" (human) and "communication system" (animal) used throughout this volume.

1. Birdsong

Birdsong has been studied by many researchers in order to separate innate components from learned components. For this purpose, they used the method of *acoustic isolation*, that is to say, they raised young birds in an environment free from contact with adult birds of their species. The researchers then compared the adult song to that of birds that were raised normally. The results yielded a threefold typology related to song acquisition: (1) birds with a completely pre-established song; (2) birds capable of learning the song of their own species; (3) birds not only capable of learning the song of their own species, but also that of other species.

Although considered an exception, the first category consists of species that can develop a normal song when raised in isolation. This is the case, among others, of domestic poultry and certain doves (Gallus domesticus and Streptopelia risoria, NOTTEBOHM, 1970: 954), which develop species-specific calls even if they are experimentally deprived of their hearing ability during the first days after hatching. In these birds, it therefore seems that the entire system related to the species' song is genetically programmed; in other words, the entire system is innate.

The second category would include birds which, like finches (see BREMOND, 1971: 373), that need a model and feedback from their own production in order to spontaneously develop the species' song. Deprived of hearing around the age of three

months and raised in community, finches develop a song different from those raised in isolation. We thus note that the model and auditory feedback in this variety of birds have an importance comparable to what we suppose in humans.

In this perspective, another study (MARIER, 1970: 671), concerning a variety of sparrows living in California (Zonotrichia leucophrys), will draw our attention. These birds, like the finch (Fringilla coelebs), also need a model to develop a normal song. The study shows that when exposed to two songs, that of their conspecifics and that of another species, they chose the first. However, if they are exposed only to the song of a second species, they develop only the behaviour of sparrows raised in acoustic isolation. In these species, song therefore depends partially on learning, which would only be possible under certain specific circumstances.

The third category would be distinguished by the ease of learning the song of other species. This is the case of young larks, among others (Stumella magna, see BREMOND, 1971: 374), learning the song of foster parents even if the latter belong to a different species. In birds of this category, the characteristic song would therefore not be innate but subject to learning as in humans. Even in adulthood, some birds continue their learning. NOTTEBOHM (1970: 952) recounts that his 20-year-old African grey parrot (Psittacus erithacus) was able to produce more than 100 different vocalizations including imitations of other species, of the words, phrases, melodies, and noises. And even at this advanced age, this parrot continued to expand its repertoire.

In view of the principles of uniformity of behaviour, spontaneous appearance, and the presence of anatomical structures specific to behaviour, bird song, from the last two categories, compares very well to human language. The behaviour is partially uniform and partially varied; there is spontaneous appearance of the behaviour and there exist specific anatomical and physiological adaptations for it. Moreover, in certain species, learning is impossible without a model or feedback.

Despite these similarities, very few researchers would exaggerate the comparison between the human linguistic system and the communication system of birds; it is obvious that bird song is a much more limited system than a human language. However, several others have claimed the impossibility of distinguishing the communication skills of humans from those of great apes. It is therefore time to examine the extent of the communication faculties of this species considered to be the closest to humans.

2. The great apes

Several experiments have sought to demonstrate whether great apes were capable of learning, even in a rudimentary way, a communication system equivalent to that of humans.

Among the first attempts to teach a language to chimpanzees, mention should be made of the KELLOGG (1933) experiment[10]. Introduced into the Kellogg family at the age of seven months, a young female chimpanzee named Gua was raised like a human baby and as such, she was continuously exposed to human language. Although as an adult Gua was able to audibly distinguish about seventy words, she never learned to speak.

As for the HAYES (1951) experiment, supported by rigorous behavioural training

10 See also the study by FURNESS (1916), the first experiment of its kind.

rewarding imitations of human speech[11], it did not yield more encouraging results. After three years of this regimen, the chimpanzee named Viki had learned to whisper only four words: papa, mama, cup, and up, and communicated by only a few gestures. Following these experiments, it became clear that it was not due to the absence of linguistic stimuli that chimpanzees failed in their learning of oral language.

a. Gesture language

The fact that gestural signs (expressing submission, supplication, etc.) were identified in monkeys living in a natural environment (GOODALL, 1971) suggested that visual and gestural communication might yield better results. In this vein, two psychologists, the Gardners (see GARDNER AND GARDNER, 1969) hypothesized that the failures of previous experiments were probably due to the fact that the language taught relied on oral communication, and that they were not due to cognitive difficulty. Furthermore, the arguments of LENNEBERG (1967: 34) and LIEBERMAN (1972) supported the following hypothesis: according to them, great apes could not communicate using an articulated code because of their anatomical constitution, more precisely due to the musculature of their lips and the shape of their oral cavity.

The Gardners therefore attempted to teach the chimpanzee Washoe the gestural code of American deaf-mutes (ASL, or American Sign Language) (GARDNER AND GARDNER, 1969). Using this code, Washoe learned to link signs in a way that formed structures strongly resembling sentences: for example, "give me tickle," "open food drink" (in front of the refrigerator), and "give me keys" (in front of a closed door). And one day, in front of a fruit, she gestured "go drink" to a young chimpanzee undergoing the same training by pointing to the tap, probably to prevent him from taking her fruit.

Two other researchers, the Premacks (see PREMACK AND PREMACK, 1972; 1975), conducted similar research using pieces of plastic of different shapes and colours. Their first "subject," Sarah, received five hours of training per week, at a rate of one hour per day. Despite her relatively advanced age (six years at the start of her training), she learned to express herself almost as quickly as Washoe. Like Washoe, she had a few hundred signs to her credit and succeeded in correctly performing tasks such as "Sarah insert apricot red plate" (Sarah, place the apricot on the red plate!), or "Sarah give apple Mary" (Sarah, give the apple to Mary!).

b. Arbitrary signs and lexical creativity

The Premack experiment highlighted that monkeys, like humans, were capable of learning and using arbitrary signs. Let us specify that by "arbitrary signs," we mean words whose meaning is not directly related to the form of the word. The word "car," for example, is the arbitrary designation of a means of transport named differently in other languages: car, coche, etc. By contrast, the word "broom-broom" is less arbitrary, more iconic, than the word "car," because "broom broom" imitates the sound of this object.

Lexical creativity is not an exclusively human trait either, because it appears in apes.

FOUTS (1975: 156) reported that Washoe used the word "dirty" in "dirty monkey" to refer to a monkey that had threatened her, although until then this word had only been used to designate dirty things and excrement. Other examples illustrate the creative use of certain terms such as the use of the word "flower" for tobacco (probably because of the smell) and "baby" for photographs (probably the result of the real object

11 Positive behavioural training: experimental regimen in which the animal is rewarded with a pleasant stimulus (e.g., a piece or particle of food) for any action approaching a targeted goal. Negative behavioural training: regimen in which the animal is punished by an unpleasant stimulation (e.g., a mild electric shock) when it performs an action moving away from the targeted goal.

in a photograph).

c. Differences in principles and scientific criticism

Following from the above, we might assume that the code taught to chimpanzees is not essentially different from human language. However, recent studies have highlighted some important differences that exist between human language and the gestural communication systems that these great apes have learned.

The first study concerns syntactic structuring. Since human utterances are highly structured, one can distinguish two messages by changing the order of elements in a sentence (*e.g.,* "we are studying a text" has a different meaning from "are we studying a text?"). However, the possibilities for ordering are far from infinite; the sentence "*we studying text are" is an unacceptable sentence[12]. These syntactic restrictions, characteristic of human language, contrast with the syntactic variability demonstrated by great apes. Data from the WASHOE experiments (FOUTS, 1975) or the ape Lana (ref. VON GLASERSFELD, 1978) show a much less consistent and clear syntactic structuring than that observed in a child of the same age.

TERRACE (1979: 75) highlighted another major difference. While in children the amount of information increases as the length of utterances grows, the function of the long utterances produced by the chimpanzee is rather emphatic, as we observe in the example: "give orange me give eat orange me eat orange give-me eat orange give-me you."

The creative aspect of the communication system also seems to differ between humans and apes. Thus, Terrace (idem) notes that in children, the percentage of total or partial imitations decreases during the acquisition period (less than 20% at 21 months, dropping to an almost negligible proportion by age three), whereas the opposite situation predominates in chimpanzees (38% at 26 months and 54% at 44 months). The increase in this percentage of imitations suggests that in chimpanzees, it may be more a matter of conditioning or training of induced behaviours than learning a communication system (SEBEOK AND UMIKER-SEBEOK, 1979).

The empirical basis of certain studies is, moreover, highly controversial (*e.g.*, the experiments with Washoe). PETITTO AND SEIDENBERG (1979) point out the lack of rigour in the classification of signs. Furthermore, their interpretations leave us thoughtful, given that these researchers emphasize similarities rather than differences between animals and human beings, thus reflecting their theoretical bias. It is worth noting, as an example, that they focused more on successes and disregarded all uninterpretable or unacceptable gestures. On the other hand, signs belonging to the gestural code were sometimes modified, and some gestures used in the natural environment were transcribed as learned gestures. Except for the study by TERRACE ET AL. (1979) and the project on the chimpanzee Lana, no other corpus has been fully transcribed and verified.

What emerges as a dominant feature from the objective examination of the material dealing with the learning of various chimpanzees is evidently the limited nature of the words and subjects used by them. A well-trained monkey uses a few hundred different words, whereas the human vocabulary easily contains between five and twenty thousand words. This major difference reflects the lack of variety in themes. When examining the transcriptions and films on this subject, it becomes apparent that the monkeys seem to be concerned almost exclusively with descriptions ("this orange,"

12 The asterisk indicates that this utterance would not be produced by normal speakers in everyday circumstances.

"this apple"), food-related requests ("give me orange, quickly"), or requests for tickling. Over time, these topics captivate no one except another monkey.

SUMMARY

In this chapter, we have examined the place occupied by human language among the other human and animal faculties. We systematically compared linguistic behaviour to reflexive and learned behaviours based on five criteria: the uniformity of behaviour, the exclusivity of the initial stimulus, the spontaneous appearance of behaviour, the amplifying effects of training, and the existence of biological structures specific to the behaviour. We concluded that language probably integrates certain learned components on a hereditary background. We presented this interaction by analogy to a graft: its form, shared between innate and learned components, is perfectly compatible with the demands of daily communication and the social behaviour characteristic of human beings.

Next, we saw that, according to these principles, language does not differ to the extent of eliminating any comparison with birdsong or with the visual communication systems recently acquired by some great apes. However, there are qualitative, but especially quantitative, differences between human language and animal communication systems.

APPLICATION SECTION

1. Distinguish between: (a) faculty and behaviour; (b) reflex behaviour and learned behaviour; (c) human language and animal communication system.

2. Briefly explain the following concepts and support them with examples similar to those stated in the text: (a) uniform behaviour; (b) exclusivity of the initial stimulus; (c) spontaneous appearance of a behaviour; (d) amplifying effects of training on learned behaviours; (e) presence of anatomical structures and morphological adaptations specific to a behaviour.

3. How does the author of this chapter define language: (a) in relation to other human faculties; (b) in relation to the communication systems of great apes?

4. Summarize the communication ability: (a) of birds; (b) of great apes during the learning of a gestural code.

FOR FURTHER READING

AITCHISON (1976). Chapter 2.

MARLER (1973).

PREMACK & PREMACK (1975).

VON GLASERSFELD (1978).

Chapter 6. Language Production

In the previous chapters language was considered about its hereditary and learning components. We continue our inquiry with the analysis of the *internal functioning* of the linguistic system.

As with the engineer (whom we mentioned in the first chapter) who seeks to establish a sketch of the global telephone system, we intend to examine the functioning of the mental processes for thoughts and utterances. From there, we propose to outline an approximate scheme of the processes involved in linguistic functioning, as well as their most important interactions.

As we go along we will improve our understanding of the difficulties experienced during the the children's acquisition of the mother tongue or by adults learning a second language. Furthermore, a better understanding of the functioning of the linguistic system in a normal subject will provide an essential basis for understanding the various types of pathological phenomena of language.

Here we begin with its *language production.* In the following chapter we shall also

address the *perception and comprehension of language*.

A. THE EMPIRICAL BASIS OF LANGUAGE PRODUCTION

Psycholinguistic research is characterized by a rigorous empirical investigation, as it relies on a large number of verifiable observations. The study of speech production is no exception.

But here results are less often based on laboratory experiments than on detailed observations of spontaneous language. This is due to the very nature of spoken language, since in a normal situation, speakers have at their disposal a considerable range of words and structures.

This observation does not diminish the seriousness and interest aroused by experimental research in this area. On the contrary, by relying on detailed observations of spontaneous language under low-constraint conditions, many researchers have managed to highlight fundamental principles governing speech processes. Often this kind of research is developed around statistical analyses of different aspects of spontaneous language or about instrumental analyses of oral articulation.

Three main types of analysis are favoured here.

The first analysis consists of the study of errors made by normal speakers, that is, of *linguistic anomalies*. This analysis includes, among other things, slips of the tongue, hesitations, and self-corrections. Secondly, these linguistic anomalies can be studied in relation to language disorders observed in aphasic patients, dysarthric individuals, stutterers, and schizophrenics. This last type of analysis relates to laboratory experiments in articulatory phonetics.

Two comments are necessary. First, it may seem surprising that experiments in articulatory phonetics are mentioned here. But integrating such experiments into the psycholinguistic context has clearly shown that an interaction exists between phonetics and psycholinguistics. Any explanation related to the functioning of phonetic articulation must necessarily comply with the general principles governing language production. Conversely, any psycholinguistic theory of oral production must take into account the constraints of the articulatory system. Given these important interrelations, the two fields mutually feed each other through the exchange of observations and theoretical conceptualizations.

Such interactions apply to psycholinguistics and particularly to language pathology. Pathological phenomena inform us about absences in normal functioning, which serves as a guide in the research on linguistic phenomena.

The following analogy can help us explain this relationship. To better understand the functioning of a machine, we can cause disturbances in its operation by manipulating it control buttons. By observing the changes resulting from these manipulations (the "pathologies" of the machine), we can deduce, on the one hand, the different functions of the machine and, on the other hand, identify its intrinsic limits.

In the same way, to understand the functioning of a cat's eye, a biologist can artificially cut a neural access pathway, often reversibly, by cooling a specific region of the brain. By doing so, they can measure differences in visual perception and thus deduce the internal functioning of the visual system. For obvious ethical reasons, such experiments are neither desirable nor common in humans. Psycholinguists and neurolinguists rely on external observations of pathological phenomena. They measure

the differences in verbal behaviour that occur between normal speakers and speakers suffering from neurological lesions affecting language production. From these differences, they deduce criteria and principles governing normal or abnormal functioning.

B. THE BASICS OF ERROR ANALYSIS

1. Faulty and normative production

In the very notion of an *anomaly*, or "error", it is assumed that there is an ideal linguistic production that serves as a norm. To say that a statement is erroneous, or to specify the aberrations within a statement, can only be done by comparing a faulty statement with a supposedly normal statement. The comparison can be made using similar statements, in comparable circumstances, or it can be based on potential statements, considering the constraints of the language.

Since we rely on a number of arguments related to faulty statements, we must briefly examine the various criteria on which the researcher's judgment is based.

The main point is that the situation and the speakers correspond to conditions of similarity or conformity. On the one hand, this implies linguistic and sociolinguistic factors, and on the other, psycholinguistic factors. A statement is qualified as normal from linguistic and sociolinguistic points of view when it conforms to the semantic, syntactic, morphological, and phonological rules of the language, dialect, and sociolect of the speaker.

In other words, a statement is linguistically and sociolinguistically *normative* when a listener, similar to the speaker, would consider it appropriate according to grammatical, stylistic, or pronunciation requirements. It is *psycholinguistically normative* when it is produced without slips, without pauses, and without unnecessary hesitations, that is, free from language errors.

From the sociolinguistic point of view and as an example of a normative statement, let us take that of a Montreal speaker in an ordinary restaurant. This speaker uses a kind of discourse judged normal (or conventional) by a listener from the same social group when he asks for French fries by saying: "M'a prendre une patate." ("I'll have the potato dish.") However, the same statement from the same speaker would not be appropriate in a more official context. Therefore, from the sociolinguistic point of view, it must be noted that the concept of normative production is fundamentally related to the surrounding context.

On the other hand, the linguistic norm encompasses all the usage rules of a given language that allow distinguishing grammatically or phonologically acceptable statements from unacceptable ones. From this point of view, the statement "il *prenons* une bière" is unacceptable because it does not conform to the rules of French. It should be "il *prend* une bière" ("he takes a beer").

Finally, the psycholinguistic norm is defined in relation to *the total oral production of a statement*. It is psycholinguistically normative when it is produced without hesitations, errors, and restarts. These factors are independent of sociolinguistic and linguistic factors, because it can happen, with a bit of training, that some normal adult speakers can produce such statements without hesitations, slips, and restarts. These would be psychologically or *grammatically acceptable* and therefore *psycholinguistically normative*.

But we can also observe that the utterances of certain speakers are sociolinguistically and linguistically appropriate, although they are riddled with hesitations, self-corrections, and slips of the tongue. They are *psycholinguistically erroneous* and those are the utterances that we wish to examine here.

2. Competence and Performance

Traditionally, two major reasons are given for this kind of errors: either poor learning or a temporary malfunction of the production mechanism. Thus, the utterance "piskolinguist" instead of the word "psycholinguist" can occur due to a learning defect or as a slip of a well-known word. In the first case, it is said that the speaker's competence is incomplete, that is, a "learning fault," whereas in the second case, the error is attributed to defective performance, or a "performance error", or the production of a joke.

This distinction between the speaker's competence and performance originates in transformational linguistics (CHOMSKY, 1965). It seeks to distinguish, on the one hand, the implicit linguistic and sociolinguistic knowledge underlying the use of a given language corresponding to a speaker's *competence* and, on the other hand, the use of language at a specific moment (in "real time"), that is, their *performance*.

From this perspective, any defect in language production (whether linguistic, sociolinguistic, or psycholinguistic) can stem either from a lack in learning or from a malfunction of the production mechanism. In other words, the speaker continuously uses their knowledge of the language to produce utterances, that is, they use their *competence* to guide their performance. When they do not know how to use their language properly, they make *competence errors.* But when they stumble while speaking, they make *performance errors*.

This distinction brings us back to the concepts from the previous chapter where we distinguished innate components from learning underlying behaviour.

We suggested there that the precise form of a language is learned, and that the general principles underlying language use probably relate to deep innate components. For example, the ability to sequence elements of meaning like "this is yours and that is mine" involves a series of serial elements and important references. Those are learned very early in a normal life, probably with innate human support.

Incomplete *competence* would thus equate to a failure of this early and rapid language learning, whereas defective *performance* corresponds to the malfunctioning of certain aspects of this mechanism that can occur at any age.

C. PERFORMANCE ERRORS

In psycholinguistics, we identify primarily the different mechanisms of linguistic performance: those concerning the mechanisms of speech production or its reception, and those relating to a learning situation and/or pathology. We will begin our analysis with the most common performance errors.

Researchers generally agree on the framework to use for the analysis of performance errors. The errors of normal adult speakers can be classified into four main groups: *slips of the tongue, hesitations, repetitions,* and *false starts*.

The possibility of overlap should not be excluded; an error like "... in the blat, in the

plastic plate..." is classified both as a slip of the tongue and as a false start. Many speech errors contain multiple classifications.

Note that the transcription of errors generally follows the following pattern: the normative statement, or target statement, is first written, followed by an arrow, then the erroneous statement. Thus, the example "want... wait" probably means that they probably just meant to say "wait". Written out as a simple code, this becomes "wait → want... wait".

1. Slips of the tongue

a. Paradigmatic slips (choice slips)

- *phonological type*

Show me your gift → Show nee your gift.

(wrong phoneme: [m] → [n])]

- *lexical type*

Show me your clock, uh, your watch.

(wrong lexeme: show clock)

b. Syntagmatic slips (chain arrangement, slips in speech)

— *Spoonerism (permutation)*

Psy-chology → Pis-chology

(permutation of phonemes: [psi] → [pis]

femme folle à la messe → femme molle à la fesse

(Crazy woman at mass → soft woman at the buttock)

(Rabelais) permutation of phonemes: [f...m] → [m...f],

or permutation of two lexemes.

— *Anticipation*

pretended → predended

(anticipation of the phoneme [d])

— *Perseveration*

lived [livd] → [livi]

(perseveration of the phoneme [i])

— *Displacement*

crocodile [krɔkɔdil] → [kɔkɔdril]

(displacement of the phoneme [r])

c. Omissions

facilitate → faciter

([-li-] → 0)

d. Additions

phonology → phonolology

(addition of the syllable [lɔ])

2. Hesitations

a. Empty pauses

When that... he knew...

b. Filled pauses

Then uh... my sister, one day...

3. Repetitions

a. Repetitions of words or phrases

... he says I'm going, I'm going, I'm going to continue

b. Repetitions of initial sounds

Or sometimes I-, I-, I work-, I help to...

4. False starts

a. False starts without correction

... big yellow paw- gray...

b. False starts with correction

... who had mar-, who had put that?

It is often observed that errors can be interpreted in several ways, even within the same class of errors. The paradigmatic slip "attendre → entendre" (wait → listen) can be explained by the confusion of the two phonemes [a] and [ã] and at the lexical level by an error involving the two lexemes "attendre" and "entendre." In both cases, it is called a paradigmatic slip, but it must nevertheless be specified that according to the first analysis, it is a phonemic substitution and according to the second analysis, a lexical substitution.

In fact, this type of ambiguity is so common that it is possible to assume that the occurrences of an error increase according to the number of levels allowing a "contamination." This means that a speaker would be more likely to make a slip of the tongue when the erroneous utterance has multiple affiliations with the target utterance at the phonological, syllabic, or semantic levels. In such a case, one can expect that a speaker showing little attention or concentration might experience some difficulty in distinguishing the two utterances.

The predominance of errors of a multiple nature, highlighted by compilations of slips of the tongue, also shows the most likely source of this type of error: it would be a common linguistic behaviour based on *inattention* and *lack of concentration*. This produces a linguistic element very similar to the appropriate one. This hypothesis

differs from the kind of explanation proposed by Freud, who assumed, let us recall, an *emotional* and *unconscious drive* (see chapter 2); our hypothesis is by far the most widely supported event according to recent surveys of erroneous productions: FROMKIN (1973), GARRETT (1976), or SHATTUCK-HUFNAGEL (1983).

D. THE PSYCHOLOGICAL REALITY OF LINGUISTIC UNITS

Research on performance errors reaches two crucial hypotheses in the field of language production. First, it demonstrates that linguistic functioning probably involves identifiable linguistic elements, such as the syllable, the word, the phrase, etc. This research establish what is, if you prefer, the "currency" of the linguistic system, and that the syllable, the word, etc., are its different denominations. It is then said that these linguistic units are *psychologically real*.

On the other hand, this research has also demonstrated what the major principles of linguistic functioning are or, still in metaphorical terms, how the linguistic system produces and uses these different "coins." This research thus argues in favour of various psycholinguistic models of language production. We therefore propose to summarize some main points of each of these hypotheses.

Let us briefly define what the notion of *"psychological reality"* encompasses. For one to conclude that a linguistic element (*e.g.*, the syllable or the phrase) is psychologically real in speech production, it must be demonstrated that a speaker uses this element during language production. Thus, we require that a linguistic element be distinct from other similar elements or that it shows a particular cohesion with similar elements.

For example, the fact that one can even syllabify words of unknown words demonstrates that we mentally distinguish syllables. Also, the fact that hesitations are rarely found between the different components of a fixed expression shows a particular cohesion between these components. This type of demonstration leads us to postulate that linguistic elements such as the syllable, or its bound expression, are "psychologically real elements".

1. The psychological reality of the phonetic feature

Let us first examine the *phonetic feature*. Although various authors provide different definitions, it is agreed that it is the most basic linguistic unit, the constituent unit of the sounds of a spoken expression.

This definition is based on our understanding of the articulation of sounds: we know that the production of a particular sound results from coordinated actions of several articulatory organs. Thus, the sound [b] in "bit" involves a closure of the lips, followed by a sudden separation. At the same time, the soft palate rises and, by closing the nasal cavity, prevents air from escaping through the nose. Simultaneously, the vocal cords come together to allow the air to make them vibrate.

Each of these actions can be performed independently of any other, which allows us to define the phonetic feature as an aspect of articulation, controllable independently of other aspects of articulation (CHOMSKY AND HALLE, 1968: 298).

Anyone can realize the separability of the different aspects of speech articulation by opening or closing the lips independently of the position of the tongue, the position of the soft palate, or the vocal cords; thus, the action of the lips, or *"labiality,"* can be

considered a phonetic feature. Similarly, anyone who wishes can open the vocal cords to admit air into their lungs and close them to protect their lungs, or can let them come together so that they vibrate (voicing), independently of the movements of other articulatory organs. For these reasons, the action of the vocal cords, or *"voicing,"* is considered another phonetic feature.

Is the phonetic feature therefore psychologically real? Does the internal formulation of a sound (a phoneme), carried out by the speech production mechanism, truly involve such units? Or are these units merely a descriptive convention for linguists and phoneticians? To answer these questions, the psycholinguist must establish whether, during formulation, this unit is systematically distinguished by a speaker. Some phonological indications lead us to provide an affirmative response.

From the phonological point of view, the phonetic feature is a fundamental unit. Consider for a moment the rule of voicing assimilation in French. According to this rule, a consonant is generally voiced or unvoiced, depending on the voicing of the following consonant; thus, a consonant is unvoiced when it is followed by a voiceless consonant and becomes voiced when the consonant that follows it is itself voiced.

For example:

1. J't'envoie ça par la poste. [ftãvwa] ([ft] = unvoiced)

(I am sending you that with postal mail.)

2. J'vous envoie ça par la poste. [vuzãvwa] ([ãv] = voiced)

(I am sending you that with postal mail.)

3. "se tromper" pronounced quickly: [strõpe] ([st] unvoiced)

(to make a mistake)

4. "se détendre" pronounced quickly: [zdetãdʀ] ([zd] = voiced)

(to relax)

In rapid French production, the initial consonant of "je" in sentences 1 and 2 is voiced or voiceless depending on the consonants that follow: [v] or [t]. The same phenomenon is found in examples 3 and 4: the initial consonant of "se" is voiced or voiceless depending on the voicing of the following consonants [t] and [d].

This indicates that the feature of "voicing" is an aspect of articulation that can be differentiated without affecting other aspects of the articulation of the sound (the alveolar and constrictive position of the tongue in [f] and [t], or [s] and [z]. For example, the initial consonant of "se" remains an *alveolar fricative* whether it is pronounced [s] or [z].

Thus we observe that speakers impose systematic manipulations of phonetic features on their utterances. But are speakers capable of modifying them during spontaneous language production?

Put another way, the problem takes the following form: has the speaker learned to use two existing sounds of the language (two phonemes), one in context *x* and the other in context *y*, or have they learned a more elementary structural element, the phonetic feature, which they modify during production according to the needs of the phonetic context?

Studies on performance errors provide us with some elements of answer to this question. For example, it is observed that paradigmatic substitutions and some syntagmatic errors most often involve sounds that differ in only one phonetic feature

(*e.g.*, FROMKIN, 1973: 17 and 241; 1971: 223).

Here are some examples from a corpus collected by Montreal students:

5...dans le [bla]... dans le [pla] (plat) en plastique...

[p][b], unvoiced → voiced

(in the plastic plate)

6. attendre [atãdʀ] → entendre [ãtãdʀ]

[a] [ã], oral → nasal [ãtãdr]

(wait → listen)

7. Le ministère de la justice a [publije], excuse [pyblije]...

[y] → [u], anterior lingual closure → posterior lingual closure

(The Department of Justice has [pooblished], excuse me, published...)

Since these errors are not learned and are often immediately corrected, we can suppose that they represent only a temporary deviation from the production system. The system, so to speak, the are stumbled upon; but interestingly, these slips generally involved only one phonetic feature. This is why in the cited examples, we are faced with errors involving a modification either of the VOICING feature (vibration of the vocal cords: [p] [b]) or NASALITY (opening of the velopharyngeal passage: [a] → [ã]), or LINGUAL CLOSURE (position of the tongue relative to the palate: [u] →[y]).

In other words, it can be assumed that the speaker distinguishes the phonetic feature at a certain level during the mental operations necessary for speech production. However, the demonstration is incomplete. Several authors have noted (*e.g.*, FROMKIN, 1971: 225; SHATTUCK-HUFNAGEL, 1983) that these examples do not clearly demonstrate the separability of phonetic features, since in each of these latter examples, it is a substitution of an entire phoneme by another phoneme (each defined by several phonetic features). It can therefore also be stated that, during the faulty production of the word plat, [bla], a substitution occurred between the two segments [p] and [b], and not between two specific positions of the vocal cords.

Moreover, SHATTUCK-HUFNAGEL (1983) demonstrated that the vast majority of spoonerisms involve the displacement of a phoneme and that only a small minority of cases involve the displacement of a single phonetic feature. The latter is therefore not a linguistic element as commonly understood for the phoneme, the syllable, etc.; nevertheless, little doubt remains that the phonetic feature plays a crucial role in speech production.

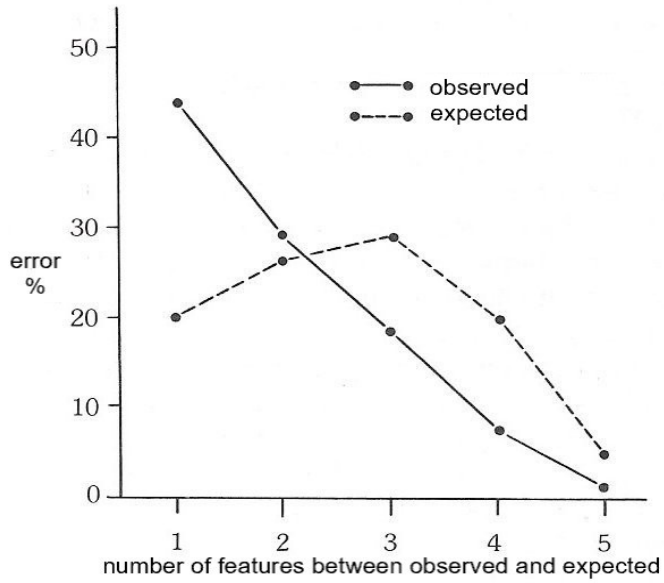
What then is its precise status?

An important clue comes from studies on phonemic substitutions in normal and aphasic subjects: several authors demonstrated that an exceptional proportion of these errors involve a single feature and that relatively few errors involve a distance of three features or more (MACKAY, 1970: 171; NOOTEBOOM, 1969/1973: 149; MARTIN AND RIDRODSKY, 1974: 336; KELLER, 1978: 280).

Notably, a study on vowel substitutions in aphasia reveals that about 43% of errors showed a phonemic substitution distance of a single feature between the uttered phoneme and the target phoneme, although the expectation was about 20% according to a random distribution of errors (KELLER, 1978) (see figure 1). In contrast, errors involving three, four, and five feature distances were much less frequent than predicted by calculations of this same random distribution.

The solution to consider regarding this controversy about the status of the phonetic feature might be only a reconceptualization of the relationship to establish between phoneme and phonetic feature. While accepting Shattuck-Hufnagel's position, according to which the production system primarily distinguishes phonemes, we wish to emphasize that the phonetic feature represents the particular cohesion existing between different phonemes.

FIGURE 1: Percentages of vowel errors in aphasia relative to the distance between the target and the error



While 43% of the errors showed a phonemic substitution distance of only one feature between the pronounced phoneme and the target phoneme (although the estimate was 20%), errors showing a greater distance from their targets were as frequent or less frequent than expected. Source: KELLER, 1978: 280.

Returning to our initial metaphor, we would say that the *phoneme constitutes the* ***common currency*** *of the production system, and the feature is its* ***denomination*** *or its "coinage"*. In this sense, both the phonetic feature and the phoneme are "psychologically real". Research on slips of the tongue suggests that the phoneme is a primary segmental unit from which articulated utterances are composed; however, their internal storage seems to follow the same organizing principles as those implemented in their articulatory realization, that is, those of the phonetic feature.

2. The psychological reality of the segment (phoneme)

We have somewhat lingered on the analysis of the psychological reality of the phonetic feature. However, there is an additional argument in favour of the psychological reality of this linguistic unit. Consider that speakers use segments (or phonemes) during the planning out of their oral production. Evidence comes from slips of the tongue, especially those whose permutation involves two very different sounds.

FROMKIN (1971: 245) gives the following examples:

8. left hemisphere → heft lemisphere, [l → h] and [h → l]

9. Lakoffs and Zimmers → Zakoffs and Limmers (two proper names),

[l → z] and [z → l]

10. Katz and Fodor → Fatz and Kodor (two proper names), [k → f] and [f → k]

Although it is always possible to analyze these permutations with phonetic features, it seems much more natural to suppose that there has been a permutation of entire segments. Example 10 shows that the features of LABIALITY, LINGUO-PALATAL CLOSURE, and FRICTION are simultaneously affected by the substitution. Rather than interpreting that the speakers made three independent phonetic substitutions, it is simpler to suppose that they substituted an entire segment in these cases.

3. Consonant clusters (consonant groups)

To continue our exploration of the psychological reality of linguistic, consider commonly used consonant groups such as [fr], [st], [pl], etc. Do these groups behave as whole units or are they grouped into more elementary units, like segments? Let us examine the following slips of the tongue:

11. J'ai été aider mon père à déchiffrer, à défricher la terre. [-fʀiʃ-] → [-ʃifʀ-]

(I went to help my father decipher, to clear the land.)

12. Oui, je suis allé voir pour jou- pour trouver le jeu de jaquet. [tr-] → [ʒ-]

(Yes, I went to see for fi-... to find the backgammon set.)

13. ...pedal steel guitar→ stedal peel guitar, [p-] → [st-]

(FROMKIN, 1973: 247)

In the first example we note a permutation involving a single segment [ʃ] and a consonant cluster [fʀ], without losing sight that there are other analytical approaches to this error.

In the second example a single segment [ʒ] replaces a consonant cluster [tr]. Finally, example 13 shows a permutation between a segment and a consonant cluster that creates the nonexistent word *"stedal". Such slips, which are far from rare, suggest that at a certain moment in speech encoding, the production mechanism treats consonant clusters as units. This phenomenon is also found in examples taken from English and German (FROMKIN, 1973: 220; CELCE-MURCIA, 1973: 197).

However, this does not mean that consonant clusters always behave as inseparable units. They are still divisible as we can see in the following examples:

14. in the plastic dish in the bla, [p-l] → [b-l]

15. La route était très grissante... glissante [g-l] → [g-ʀ]
(The road was very slippery)

We realize that some errors primarily suggest an analysis in terms of large units (*e.g.*, in consonant clusters, examples 11 to 13), while other errors can also be analyzed based on their constituent elements (examples 14 and 15). These few examples do not refute the previous demonstration that deals with phonemes, but they emphasize that the same principles of analysis apply to several levels of analysis.

Moreover, this finding shows that there is no privileged linguistic unit as the basic element of speech production, as successive waves of theorists have claimed. During the decades from 1930 to 1960, for example, American linguistics proposed the phoneme as the basic linguistic element; in the sixties and seventies it was the phonetic feature that displaced it to take its place; currently, we are witnessing the rise

of the syllable to the rank of fundamental element in speech production.

But the analysis of errors in spontaneous speech does not support the prerogative of a particular unit; rather, it suggests that each linguistic unit plays a specific role during each phase of speech production. We have already highlighted the respective importance of the phonetic feature, the phoneme, and the consonant cluster; shortly, we will report some indications concerning the psycholinguistic reality of the syllable, the lexeme, and the phrase. Each of these units indeed seems to fulfill a particular function, either as a constituent unit of larger units (*e.g.*, consonant cluster, syllable), or as the organizing principle of these units (*e.g.*, phonetic feature).

4. The psychological reality of the syllable

Two types of data lead us to consider that the syllable constitutes a unit in language production. First, deviations at the syllable level, for example, stuttering (pathological or not) often affect the first syllable of the word; also, we find errors produced by normal subjects that often involve syllables within the word.

16. Il tratraversait la rue quand c'est arrivé...
(repetition of the initial syllable [tra-])
(He was crossing the street when it happened.)

17. ça va faciter... faciliter...
(omission of the syllable [-li-])(it will faciter... facilitate...)

18. C'est pas facile, le cours de phonolologie, trouves-tu?
(addition of the syllable [-lo-])
(Phonology isn't easy, is it?)

Second, segments occupying the same intrasyllabic position are most often the object of segmental permutations. In a reanalysis of slips of the tongue in German compiled by Meringer and Mayer in 1895, it was possible to establish that consonant permutations involved initial segments of a syllable almost twice as often as if the distribution had been random (MACKAY, 1970: 178). We can therefore suppose that the following errors are characteristic:

19. Remets-moi le procès berval...procès verbal...
[vVC-bVC] → [bVC-vVC] (V=vowel, C=consonant)
(Give me the nimutes...minutes...)

20. Snow reduces visibil-... visibility
[CV-SV-bV-CV-CV] → [CV-bV-sV-CV-CV]

From these and similar examples, it appears that the size of the unit involved in a slip of the tongue is often that of a syllable, which leads us to think that this unit also has an identifiable psychological reality.

5. The psychological reality of lexemes

We continue our analysis of the linguistic units used in speech production by considering the role of "lexemes" and that of words. A lexeme is a word minus the affixes, in a simplistic definition. Thus, in the sentence:

21. She was talking about her new car.

the word "talking" consists of a lexeme "talk" to which the affix "ing" is added.

This is a theoretical analysis of this statement. From a psycholinguistic point of view, it would be interesting to determine which, the *lexeme* or the *word*, is used by the production system.

At first glance, both possibilities seem equivalent: the use of lexemes and affixes represents an economy in terms of the number of elements to be stored in long-term memory. But in speech production, it represents an additional complexity in processing, since the chosen lexemes must be combined with appropriate affixes to form words for outputting.

As for the use of whole words (*i.e.*, including affixes), this involves some ease in processing, but on the other hand, it constitutes a burden in terms of storage. Yet, given the astonishing human memory capacity (in long-term memory), the second possibility remains plausible.

Regarding these two possibilities, what indications can we draw from performance errors? We refer to the examples recorded by FROMKIN (1973: 27):

22. cow tracks → track cows

23. The tie dropped out of the bag → the drop tied out of the bag

In both cases, the error affects the lexemes and leaves the grammatical suffixes intact. In the first example, it is the permutation of the lexemes "track" and "cow", and in the second, the lexemes "drop" and "tie".

However, the suffixes "-s" and "-ed" are not altered at all. Therefore, it is very likely that when searching for a "word," the speaker initially specifies a lexeme without termination integrator, to then add it to the lexeme during real-time processing. Thus, the process of producing words containing affixes probably involves successive processing, and storage would be in terms of lexemes and not in the form of whole words.

6. The psychological reality of phrases

To conclude this section, we will address one last linguistic unit related to performance, namely the phrase. This linguistic unit emerges from the analysis of false starts (with or without repetition):

24. There will be snow / occasio... occasionally.

25. / These surplus... these surpluses will then be used to...

26. There is no reason / to sens... to think that there is no other alternative.

27. I forced him / to find... to go to bed because he was working this morning.

28. There's ham if you're hungry / in the plat... in the plastic dish.

In each of these cases, the faulty utterances are resumed from a natural break, indicated here by the slashes. These examples demonstrate that speakers in do not break the integrity of the phrase, which is an indication of the psychological reality of this linguistic unit.

This psychological reality is also supported by a study conducted by MACLAY AND OSGOOD (1959) based on a recorded and fully transcribed corpus during a psycholinguistics conference. These authors found that 89% of the repetitions began with function words (or closed-class words), such as articles positioned at the beginning of the phrase. The repetitions noted in the previous examples are therefore

very characteristic.

Moreover, they discovered that in 77% of cases where the speaker corrected a content word (or open-class word) (see examples 24 to 28), they repeated the function word or words that preceded them. Speakers thus tend to make their repetitions at the beginning of the phrase. The correction does not restart anywhere, for example, in the middle of the phrase.

Furthermore, the study by Maclay and Osgood reveals that in most cases where the correction of a function word (78%) was required, there was no repetition of the preceding words, as shown in the following example:

29. ... we each have / a mon-... some monitors there...

In these cases, the correction was made without repeating the words preceding the function word: the boundaries of the phrase were thus respected. This pattern of repetitions supports its "psychological reality". We can suppose that the psycholinguistic cohesion between the different elements of a phrase is attributable to the fact that these elements form natural syntactic and semantic units.

E. DIFFERENT PROCESSES IN LANGUAGE PRODUCTION

We have just seen that in speech production, we manipulate linguistic units of different kinds and sizes. In this section, we will consider the nature of the manipulation of these elements, that is, the manipulation or processing that is necessary for the production of the desired utterances.

The first step towards describing these manipulations is to identify the major processing stages. Later, we will add indications to clarify the nature of the processing involved at each of these stages.

1. The major processing stages

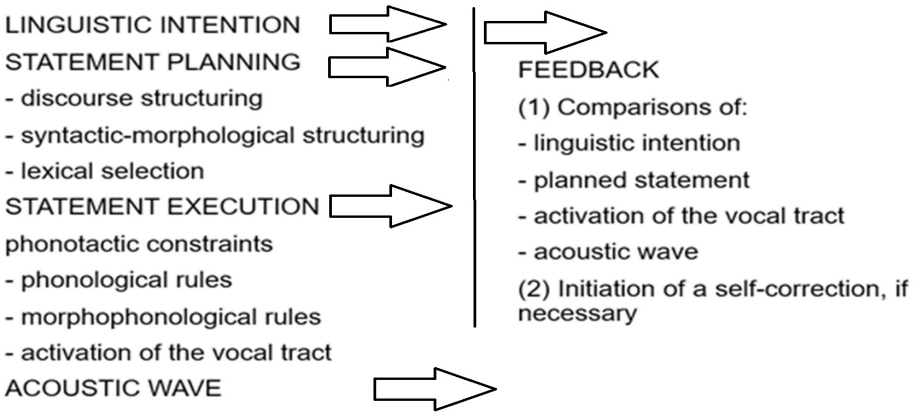
Previously, we have mentioned different levels of processing by noting that language production often involves an arrangement between lexemes and suffixes. It is clear that this arrangement can only take place after the selection of the appropriate lexemes; therefore, there must be a certain sequence of events, a series of levels or stages of processing, which constitutes speech production in real time.

It should be noted that we distinguish between *processes* and *processing stages.* A major processing stage consists of a set of processes that produce a number of mental operations. Thus, we will see that, most likely, the major stage of utterance planning consists, among other things, of two processes, one related to lexical selection and the other to the selection of syntactic and morphological structures. In other words, we assume that to plan their utterance, a speaker must first select words and then choose a grammatical structure, while taking into account their linguistic intentions (the meaning of their utterance).

As we define it, this psycholinguistic process is the very foundation of any mental operation in speech production. A process is independent of another process when observations indicate: (1) that the two processes involve very different operations; (2) that one of the processes can be affected by a difficulty independently of the others; (3) that it can be manipulated autonomously during normal language production; (4) and/or that it operates with a minimal time delay relative to the other processes. Also a major

processing stage is characterized by a coherent set of interrelated processes.

FIGURE 2: General model of language production



We can identify four main processing stages in speech production: *linguistic intention, planning, execution,* and *language feedback* (figure 2).

The speaker's discourse is planned in detail according to the speaker's linguistic intention, and is executed with a variable delay. The effect of these operations is communicated at the feedback stage which performs checks and can, if necessary, introduce a self-correction. The titles in uppercase in the figure denote the different major processing stages and the titles in lowercase indicate some independent processes in language production.

To illustrate the difference between the planning stages and the execution stages, we will refer to the following slips of the tongue:

30. Is it the handicapped... the individual who is handicapped...

31. It took me thirty-two hours to cross the so-. . . the sound barrier.

32....of the guistare... of western guitar....

The inappropriate and rejected elements contain an appropriate segment, and also an anticipation of what was supposed to be uttered later. Thus, in example 30, we have an anticipation of "handicapped". In example 31, it is what was probably combined with "so-" of "sound". The third example can be analyzed in the same way.

These productions can be explained if we assume that at the moment of the error, the speaker already had in mind an element that should be produced later. The fact that the first version of the statement is different from the second, that is, that the error is different from its correction. This supposes that there is indeed a planning stage different from the execution stage.

We can even admit that at the planning level that the lexemes were specified and that during execution, parts belonging to two of these lexemes were combined "by accident." It is only during an adjunct processing stage that the difference between the intended statement and the produced statement was noticed and corrected. This is the effect of *feedback* where the produced utterance and the planned utterance were confronted. There was then a resumption with the emission of the desired element.

2. The temporal factor during planning and execution

But why is there such a difference between planning and execution? For what reasons do we keep in mind elements that will only be executed later? Why is the speech production mechanism not such that elements are articulated as soon as they are available? For what other reasons are they retained in "short-term memory" or, in computer terms, why are they *buffered* between the moment of planning and that of execution?

The notion of buffering is important in computer science and it refers to contexts similar to those that concern us here. In the operations of computers and their peripheral devices, buffer memory is used to cope with the possible difference in speed between two mechanisms. If, for example, a computer produces a string of characters and sends it to a printer, the computer will generally have finished its action well before the printer. In order to free it for other tasks, the string will be "buffered", that is, placed in temporary memory. Thus, the computer and the printer can process their material at their respective speeds.

In the same way, it is likely that the *planning* of an utterance generally occurs at a speed greater than that of the *execution* of the articulatory apparatus. Consequently, certain sections of the utterance will be "put on hold" during language production until their turn arrives to be articulated. The availability of these planned elements in short-term memory explains occasions where some of them are articulated prematurely, thus producing anticipations.

On the other hand, if (as we sometimes encounter) at the planning level the work takes longer, that is, the previously planned material has already been emitted and execution is waiting for additional material, it is very likely that a pause (filled or empty) will occur at the articulatory periphery.

This hypothesis therefore has the advantage of accounting, by means of a single principle, for two important psycholinguistic phenomena: anticipations and pauses or hesitations (cf. MACKAY, 1970: 186); we will see that this model will also serve as a framework for our subsequent discussion.

Note that this is a hypothesis directly related to a conception of speech production in terms of real time. In this respect, this model clearly differs from other theories that does not introduce real time into its operational scheme. This characterizes almost all past and contemporary linguistic theories. Thus, what we present explicitly here is the operation of a *psycholinguistic performance model*, and not a *linguistic competence* model.

Moreover, the buffer phenomenon between planning and execution is the not only distinguishing criterion between these two production stages. On the one hand, the buffer between planning and execution is not unique, as we will soon see that this type of operation also applies to several "minor processing" levels; on the other hand, the buffer should be interpreted as indicative of an even more marked difference between planning and execution.

Specifically, a major stage is defined by the kinship that exists between the processes that constitute it. Thus, the transposition of a linguistic intention into a phonological chain involves a number of processes that together constitute the planning stage. Besides their common task, all are cognitive processes carried out within a time frame largely independent of the unfolding of articulatory events.

Conversely, speech execution consists of processes whose processing is directly linked to articulatory events, thus highly sensitive to time constraints. At this stage, the

system must not take lightly the time necessary to execute a movement by a group of muscles, as well as the delays caused by the different organs of the vocal tract in coordinated articulation. In this respect, the processes related to execution are not cognitive processes but rather motor processes.

In this sense, the production system involves a buffering operation to compensate for the speed differences between cognitive operations and motor operations. Therefore, it is the cognitive or motor aspect that best characterizes the two production stages; the buffer only highlights differences in internal operation.

Briefly summarized:
(1) linguistic intention defines the semantic aspects of the utterance to be produced;
(2) planning translates these linguistic intentions into an executable phonological chain;
(3) execution takes charge of the planned utterance at the articulatory system level;
(4) feedback compares the linguistic intention, the planned utterance, and the executed utterance to verify whether all previous operations have been correctly carried out: it is the agent of correction, if necessary and/or desired.

These operations pass through messages as desired, with the information being generated continuously. This operating system runs *in parallel* (simultaneously) while picking up elements *serially* (one after the other), in the right order. Some public speakers can do this at a fabulous rate.

3. Detailed analysis of processes in language production

a. Linguistic intention

The majority of utterances probably begin with an intention to *communicate*, to pass information back and forth between two or more persons.

Several observations lead us to suppose that the set of thoughts or ideas constituting this intention is in a *non-phonological* or even *abstract form*. The mere fact of experiencing certain difficulties in finding the right word indicates that intentional thought is more abstract than verbal manifestation, because otherwise, it is not clear why there would be a need to search for a word corresponding to the speaker's precise intention.

Moreover, we have research results that indicate that prelinguistic material is primarily stored in an abstract way. If someone is asked, for example, to repeat what they just said, it is rare that they produce it exactly in the same terms. The main meaning of the statement is preserved, but its surface structure is generally modified.

It seems that this process of modification and abstraction of meaning takes place as soon as one has perceived and understood a message. This is the result emerging from psycholinguistic experiments where subjects were able to recall a sequence of logically organized concepts, despite the fact that the presentation of these concepts was completely disorganized (cf. experiments conducted by SACHS, 1967 and WANNER, 1974, cited by FOSS AND HAKES, 1978: 110).

This abstract level of intention can be interpreted as a cognitive or prelinguistic level, relatively independent of the constraints acting on a specific language. It is at this stage, for example, that speakers can experience and represent the sensation of thirst. When they try to express this in their language again later, they will say in French, "j'ai soif," in English, "I am thirsty," and in Möré, it seems, "thirst has me" (I am possessed by thirst) (SCHLESINGER, 1981).

We suppose that the cognitive experience of thirst and the linguistic intention seeking to express it are substantially the same for a French speaker, an English speaker, and a Möré speaker, despite different linguistic realizations.

We also need to distinguish a linguistic intention from the speaker's other conscious and unconscious intentions.

When a psychotherapist says to a patient, "tell me more about this," their therapeutic intention probably lies in leading the patient toward exploring a psychological difficulty, whereas their linguistic (or apparent) intention expresses a request for additional information. As we will see in the chapter devoted to communication (see chapter 9), most exchanges simultaneously express or mask several levels of intentionality. However, for our immediate needs, we will limit ourselves to linguistic intention, that is, the intention that can be directly inferred from the speaker's statement.

b. Planning

(1) The structuring of discourse

There are several indications that demonstrate that speakers prioritize discourse structuring when transforming their linguistic intention into an oral expression.

Suppose, for example, that a speaker wants to indicate a conditional situation. During the discourse structuring stage, the speaker would identify two semantic elements: first, a state allowing the advent of another element (often introduced by "if"), then the subsequent state (often introduced by "then"). The discourse structuring stage will therefore be responsible not only for selecting the desired themes but also for implanting them at the appropriate moment in the discourse. Having selected a premise introduced by "if," they must "keep in mind the dependent condition and its linguistic introduction.

A focused study on the use of introductory discourse markers (*links* or *hinges*) allowed the identification of a number of characteristic strategies used to structure discourse (KELLER, 1979). In general, these fixed expressions inform the listener about the orientation or modularization of the discourse (*e.g.*, a condition, as in the previous example, an opinion, a generalization, etc.).

Furthermore, they foreshadow turns of speech: "what do you think about that?" signals that the speaker is ready to yield the floor, whereas "wait a minute, the...", indicates that they wish to retain it. At the level of discourse structuring, the speaker thus generally plans the *thematic progression*.

Other studies also mention this aspect of language planning by showing that speakers generally follow a regular thematic development when telling a story (ULATOWSKA ET AL., 1983: 320) and, in addition, they demonstrate the use of relatively standardized linguistic turns and patterns such as when apologizing, greeting, or parting (see articles in COULMAS, 1981). The presence of such standard structures shows the complexity and regularity of cognitive processes related to discourse structuring.

(2) Lexical, syntactic, and morphological selections

We can distinguish three other planning processes: the selection of lexical elements, of syntactic structures and of morphological structures. At this stage, the speaker is searching for linguistic material (words, grammatical structures, prosody, etc.) that best corresponds to the linguistic intention and the pre-established general plan of the discourse.

Although the operation and specific interaction of these processes will not be exactly

the same for all languages, it is nevertheless possible to distinguish the operations of these three processes.

Lexical selection is the search in long-term memory (the lexicon) for phonological representations corresponding to subjects, actions, objects, etc., specified by the linguistic intention. Thus, if the speaker intends to express thirst, lexical selection will translate the semantic representation of the concept of THIRST using an appropriate phonological representation such as "thirst" or "parched."

Syntactic selection concerns the choice of a syntactic structure (an "arrangement" of words in a sequence) that reflects both the speaker's intentions and the discourse structure. Let's take as an example the expression of a condition: the discourse will consist of at least two sections, the first of which could be represented at the level of the syntactic selection process by "if (verbal expression)" as in "if it rains...". However, there are often several expressions to essentially represent the same intention, so the first element of this condition can also be translated as "in case" (verbal expression), in "in case it rains," or "in case of" (nominal expression) in "in case of rain...".

The *morphological selection* operation closely resembles the previous ones. Some semantic information, such as the plural of a noun or the past tense of a verb, can be expressed by adding a specific affix to the lexeme (*e.g.* English: add final "-ed", French: work in plural "travaux," or in past "il faisait"). As in previous cases, speakers often have some latitude of which morpheme to choose; instead of saying "he did"/"il faisait," they could also use the structure "he was doing"/"il a fait," or even "he had done"/"il fit," depending on the context.

(3) The interdependence of planning processes

For their proper functioning, the selection processes often needs to integrate information from other processes, in addition to aligning with the speaker's intentions and prior discourse structures.

The three processes of Figure 2 are said to be *interactive processes*. We thus observe that after choosing the syntactic structure "if" (verbal expression) as the introducer of the condition, lexical selection for "if it rains..." might produce a pronoun "it", as well as a verbal lexeme "can", to which an appropriate morphological structure will be semantically linked, *e.g.* "...it could snow later").

On the other hand, after the syntactic selection of "in case of" (nominal expression), lexical selection would have been constrained to a nominal lexeme of "rain". In this context, lexical and morphological selection operations partially depend on the syntactic selection operations.

The inverse dependence between lexical and syntactic processes also proves possible, *e.g.,* "it might snow later in case it rains".

We sometimes observe syntactic restructurings caused by the lexical constraints of the language. For example, when discussing the structuring and evaluation of tests in chapter 3 of this volume, we wanted to use the terms "reliability," "validity," and "objectivity"; however, there are no adequate nouns in French to express the state of being *practical* in this context ("practicité" is used for manual tasks).

For these reasons, we were forced to circumvent the nominal form to represent our linguistic intention. So we said altogether that "a test must be *practical, objective, specific, global, reliable,* and *valid"*. In this specific case, our syntactic selection operations depended on constrains of semantic and lexical selection.

Despite these interdependencies, certain phenomena arising from normal language

and pathological language lead us to think that lexical selection remains relatively independent of the processes that serve to structure the utterance. We can observe in normal speech that speakers often hesitate when searching for a precise word. Speakers may start an utterance correctly, hesitate, find a more appropriate word, and then continue their speech.

The location of these hesitations seems to correlate with the degree of difficulty in lexical search. According to MACLAY AND OSGOOD (1959), speakers hesitate about twice as often before content words (lexical words) than before function words (grammatical words). This suggests that speakers experience greater difficulty in searching for a lexeme (lexical word) than in searching for a grammatical structure (composed of grammatical words).

This difficulty in lexical search ("word-finding difficulty") is even more pronounced in aphasic patients. It is well known that every aphasic experiences particular difficulties in this regard (GOODGLASS AND KAPLAN, 1972: 6) and that patients with amnesic aphasia are characterized almost exclusively by word-finding difficulties and lexical confusions (see chapter 8). However, in these patients neither the discourse structure nor the syntactic-morphological form of the utterances are strongly influenced by this difficulty.

(4) The final form of the planned utterance

We can suppose that from the end of the structuring of planning operations, the linguistic material is largely present in its phonological form, ready to be linked and communicated to the articulatory organs during execution. This expectation is based on the fact that a large number of anticipatory slips (about half) are phonological in nature. This implies that a large part of the material must already be available in phonological form. This does not contradict our intuitions, as we frequently become aware that we have fully planned utterances stored in memory for which we are only waiting for the right moment. In these situations, the beginnings of the utterance seem so clear and obvious that they seem to "resonate" in our head.

c. Some processes during execution

Speech execution more specifically concerns the activation, linking, and muscular realization of the utterance according to the rhythm of the momentary possibilities of the articulatory organs. Research over the past fifteen years has shown that the functioning of these processes is still far from being fully elucidated; however, we can outline some major operating principles.

(1) The motor theory of speech

In neurology, a motor system is associated with the production of movements, which is why the executive system in speech production is also called the *motor system* or *speech motor control*. Recently, some authors summarized their research related to speech production in the form of a consolidated theory called "the motor theory of speech" (see, for example, KELSO AND TULLER, 1981; forthcoming: KELLER, forthcoming). According to these authors, the central objective of the motor system is to manage temporal, force, and spatial relationships in the vocal tract (mouth, nose, pharynx, and larynx). These are relationships that exist: (1) between muscle groups acting as agonists and antagonists; (2) between different articulatory organs; (3) between the articulatory organs and the surrounding space.

Thus, the opening of the lips for the syllable [pa] indicates that the execution system must create a force relationship between the different muscle groups used to open or close the lips and the jaw (*e.g.*, orbicularis oris, digastric muscle, masseter, etc.). But at

the same time, it must take into account the temporal aspect that occurs between the initiation of lip movement and that of other organs such as the vocal cords. Finally, the system must also consider the surrounding context, such as the obstruction of saliva or food, a pipe between the teeth, or even speaking with the head turned, rather than straight forward.

Apparently, the knowledge of these relationships is identified and integrated from childhood, as they undergo standardization and stabilization in the child, whose manifestation results in an increase in the speed and efficiency of speech production.

It is also very likely that certain neurological lesions can partially or completely disrupt these learnings, as some aphasic patients (Broca's aphasia, see chapter 8) show all the symptoms of loss of control of these relationships; for example, an interference is observed between the lip opening delay and the initiation of laryngeal activity that would occur at the interface of the sounds [p] and [a] in [pa] ("voice onset time," or "VOT"). A study by BLUMSTEIN ET AL. (1980) shows that these patients were no longer able to produce a longer VOT for the sequences [pa] than for the sequences [ba], as normal speakers do. Another symptom, the fact that these patients speak much more slowly than any normal speaker, reinforces our hypothesis that this is indeed a disturbance of the spatio-temporal relationships used to automate and accelerate the functioning of the motor system.

(2) Coarticulation

Coarticulation is an important aspect of the temporal and spatial relationships that are controlled during execution. By coarticulation, one refers to the positions that different articulatory organs can assume by anticipating or persevering certain distinctive movements, simultaneously with the production of other articulatory gestures.

Let us take as an example the lip rounding in a careful pronunciation. During the production of the first syllable of the word "instrument," for example, the lips are not rounded, because if they were, the syllable "in-" [in] would be produced. However, lip rounding begins as soon as it does not interfere with the production starting from the sound [s] and after the emission of the phonemes [l] and [r] to reach the desired position of the sound in the second syllable (BENQUEREL AND COWEN, 1974). There is then an *anticipatory coarticulation* for the syllable "in-" for the production of the phonemes [str].

Perseverative coarticulation can also occur when a gesture is prolonged during one or more phonemes after the production of a sound. For example, during the pronunciation of "brusquerait" in French it is possible to observe a gradual reduction of lip rounding during the phonemic sequence [-yska-] ("-usque-").

It is likely that coarticulatory patterns represent adaptations acquired by habit (*i.e.*, they are stored in long-term memory) in the case of very frequent phoneme sequences or words (consonant clusters, diphthongs, the most frequent words).

On the other hand, the slowdowns and restarts that occur before and during the production of less known words or unusual phonetic sequences lead us to suppose that the executive mechanism must calculate during production the sequence and extent of articulatory movements. This implies that the execution stage contains processes that apply to the chaining and articulatory integration of phonetic sequences.

(3) The processes of chaining and integration

The existence of chaining and integration processes is highlighted by certain normal performance errors. Aside from their responsibility for chaining at the precise moment

of motor speech execution, these processes seem to prevent, on the one hand, the creation of unacceptable utterances - this involves the application of phonotactic constraints - and, on the other hand, they seem to be responsible for the application of phonological and morphophonological rules.

(a) Phonotactic constraints

Let us take the example of a phonotactic constraint: in French, there are certain consonant sequences that are never used. For example, the initial sequence [mb-] for a word like Mbarara (a Ugandan city) is not used. These consonants sequences do exist in the French language, but only their initial position is absent. Each language has its own constraints governing the arrangement of consonants.

Many authors, including FROMKIN (1971: 229) and HOCKETT (1967/1973: 96), indicate that in normal performance, errors or unacceptable sequences are never found in spoken language. Thus, for normal French-speaking subjects, the following slips of the tongue will never be found:

38. plombier → *ptombier

39. privilège → *ptivilège

This phenomenon can be explained if we suppose that the execution process is responsible for adapting unacceptable sequences according to the phonotactic constraints of the language, allowing exclusively the realization of acceptable sequences.

(b) Phonological rules

Indeed, errors involving phonological rules allow us to suppose that this type of standardization of articulatory chains seems to occur during the execution stage and not before. Let us reconsider the phonological rule of voicing assimilation (found in many languages) and recall that according to this rule, the voicing of the second consonant depends on the voicing of the preceding segment:

40. He hits [hits] - no voicing, [ts] = voiceless

41. He pays [pejz] - voicing, [jz] = voiced

42. He swims [zwimz] - voicing [mz] = voiced

Now, consider the case of substituting a voiced consonant with a voiceless consonant, or vice versa.

For example, in the case of "hit" → "hid" in a normal English utterance, adding a final "-s" would yield [hidz] if the rule applied *after* the slip, and [hids] if it applied *before* its occurrence. Since we hear [hits], the rule applies *before* its occurrence.

Let us now see what happens with reported errors. Thanks to the different rules and their location in the chain, as evidenced by the examples reported by FROMKIN (1973; 27), we can, therefore, deduce at what moment the error occurs:

43. tab stops [tæb staps] → [tap stæbz]

44. plant the seeds [si:dz] → [si:ts]

45. bloody students [bladi: stu:dənts] → [bladənt stu:di:z]

On tab stops [tæb staps] → [tap stæbz], we can suppose that there is first the error [tab stæps] → [tap stæbs] with an unseen s-sound, then the application of the rule [tap stæbs] → [tap stæbz]. The other examples are explained similarly. Since we suppose that the slip occurs during the speech execution stage, the subsequent application of

the dominant phonological rule of English must also take place after the production of the error.

(c) Morphophonological rules

The two phenomena discussed so far involve only phonological information that are related to the segment. We will now focus on another type of rule that requires grammatical information in addition to phonological information: morphophonological rules. Following the same reasoning, we will see that this operation applies in similar fashion to those of phonological rules.

In French, this type of morphophonological rule is found here:

46. à, les = aux [a], [l], [e] = [o]

That rule is: "in the case of *'à+les'*, say *'aux'*".

This particular rule of French applies only to the sequence of the two words *'à+les'* [ale] and must not apply to the word *allez* [ale] (which is phonologically identical); this morphological information must be taken into account during execution.

In English, there is a similar rule involving the difference between the two forms of the indefinite article, "a" and "an":

47. a new car [ə] + [nju:] = [ə**n**ju:]

48. an old car [ə] + [ould] = [ə**n**ould]

49. America is... [-kə] + [iz] = [-**kə**iz]

When [ə] represents the indefinite article (examples 47 and 48), the rule selects the segment following the article. But if the following lexeme begins with a vowel, the indefinite article is [ən] "an," whereas it remains [ə] "a" before any consonant.

Example 49 further shows that the application of this rule is limited to the indefinite article, since the phonological sequence [əı] is acceptable in the case of "America is...".

Let us now consider the following performance errors in French:

50. a system *"un système" [əsistəm] → [ənistəm]

51. an eating marathon "un marathon de bouffe"

[ən itin mæraθɔn] → [əmi:tiŋ æraθɔn]

52. There's a small restaurant on the island → there's an island on the small restaurant.

Analyzing these examples, we find that the application of the morphophonological rule *a/an* occurs *after* the faulty linking. Since we assume that these slips occur at the interface between planning and execution, this means that during execution, one must take into account not only the phonological aspects of the planned utterance but also some grammatical aspects.

These examples of the application of phonotactic constraints, phonological rules, and morphophonological rules demonstrate that the difference between planning and execution during performance does not correspond directly to that existing between syntax, morphology, and phonology as shown in competence analysis. Planning concerns the preparation of the phonological form of a word and the preparation of the syntactic structure, while execution involves the use of this information, within a very limited time frame, to carry out the phonetic chaining of the utterance.

d. Retroactivity

The last important stage in language production concerns retroactivity. These are the comparative processes between linguistic intentions, planned utterances, and executed utterances. They can correct production when it does not conform to the speaker's intentions.

It is likely that this process even integrates external information coming from the audience: self-corrections collected in spontaneous speech reveal not only corrections of errors in discourse structuring, vocabulary choice, grammatical structure, and articulation, but also include rearrangements apparently made solely to clarify an utterance for those receiving it.

Speakers show different degrees of latitude regarding their errors or imprecisions. Spontaneous speech data collected at the University of Quebec in Montreal show that a large number of errors remain uncorrected. If one stops and questions those who have just produced these errors, some were surprised. Others were aware of them, but continued to maintain the thread of their ideas. Speakers probably tend to correct themselves when they believe that the error compromises the proper understanding of their message.

SUMMARY

At the beginning of the chapter we established the empirical foundations about our language production. We then introduced the crucial distinction between linguistic competence and performance. We saw that performance represents *the functioning of the linguistic system in real time*, both in terms of speech production and reception, as well as in language learning.

This implies that the system has access to accumulated knowledge in the speaker's competence. In this sense, a *theory of performance* is more encompassing than a *theory related to competence*.

Subsequently, we examined some data supporting the real-time use of the following linguistic units in language production: the phonetic feature, the segment, the syllable, consonant clusters, lexemes, and syntagms. These units are supposed to be "psychologically real" and are manipulated in the various processes of language production.

They are ordered into major stages: planning, execution, and retroactivity. We suggested that *planning* consists of selecting appropriate lexemes with regard to the linguistic intention by the preparation of the structure of the discourse and finally, by the greater part of syntactic and morphological structuring.

As for *execution*, it seems to include processes allowing the adjustment of phonological sequences according to the use of spoken language and according to the positions habitually assumed by the various production organs.

Finally, we distinguished planning from execution by demonstrating that these are two independent mechanisms, each operating at its own pace.

APPLICATION SECTION

1. Identify five slips of the tongue, either on television, on the radio, or in your

surroundings. First, transcribe them as you heard them, like that: "... in the [bla]... in the plastic dish". Use phonetic transcription only if the word does not exist in your chosen language. Then analyze them, following the system presented in this section. Start with a rewriting of the error in its conventional form. For example, the previous mistake would be transcribed as plat → [bla]. Then analyze it. This example would be a paradigmatic slip involving a phonemic error of the type [p] → [b].

2. Here is a corpus of performance errors from normal speakers. Analyze them according to the model given above.

a. I would have loved you, I would have loved to help you...

b. I've had three children. There is one... I have a daughter who stays in Shawinigan.

c. If you're not careful with your browser, you'll erase everything... erase the floor.

d. We try, we say to ourselves, we must remember.

e. The bel-... the movements they make with their bellies.

f. Someone who is egocentric, who thinks, who doesn't put himself in charge of everything.

g. The employers' side represented, represented, sorry, by...

h. That day, I went to... to buy that shirt.

i. My work, I type it... my work, I type it.

j. Spain's entry into the European urb-... European community...

3. Classify the following statements according to whether they represent: (a) a performance error; (b) a competence error; (c) a statement appropriate to a popular context; (d) a statement appropriate to a formal context.

a. Where did you go last night?

b. Over time, people have become more uncleared, more uncluttered.

c. The supporters of the sovereign, the one...

d. Go shake him out.

e. It is often in the singular.

f. Is it when the bubbles - the notes?

g. Bus 21 is always all dirty.

h. All the children want to go in...

i. I hadn't spoken... heard about that.

j. What is this business?

4. Summarize in a few sentences the reasons why we can assume that in speech production, phoneme information can be organized according to phonetic features.

5. Summarize in a few sentences the reasons why we must assume a difference between planning, execution, and feedback.

6. What is the relevance of the concepts of psycholinguistic norm, psycholinguistic

reality, and production model for second language teaching? Answer with a few sentences for each of your responses.

7. From this chapter, attempt to make a detailed flowchart of the speech production model, more detailed than figure 2.

FOR FURTHER READING

CLARK & CLARK (1977). Chapters 6 and 7.

CUTLER (1980).

Foss & HAKES (1978).

FROMKIN (1973).

FROMKIN (1980).

SARRASIN (1977). Chapter 11.

Chapter 7. Language Reception

In this chapter we will continue our investigation of the psychological mechanisms of language by addressing its *receptive aspect*. We will attempt to establish the means by which we decode the meaning of a message that is communicated to us.

It is sometimes assumed, mistakenly, that language reception is merely the inverse phenomenon of production: instead of transforming thought into an acoustic wave, one would transpose the acoustic wave into thought. However, when we consider the two systems more closely, we note significant differences.

It is obvious, for example, that production processes involve muscular control of the vocal tract, whereas for language reception, it is a sensory structure that provides its basic information. These constitute two very different mechanisms: the execution mechanism issues independent commands to the lips, tongue, soft palate, and the larynx, while auditory analysis deals with differentiating the nerve impulses coming from the ears.

There are even more significant differences that affect the overall functioning of the two processes: challenges and situations faced by the speaker are entirely distinct from those encountered by the listener. In *language production*, the speaker seeks to find and chain linguistic sequences that best reflect a given thought or emotion. By social convention, the speaker thus feels compelled to produce more or less well-formed and complete linguistic chains in response. Also in language reception, the listener generally has some information about the topic of discussion. Their main goal is to

extract new elements from the received message.

Often, a single word or phrase is sufficient for the proper understanding of the entire statement, and it can be assumed that the rest of the statement primarily serves to provide cues about where the key elements are located. The multitude of strategies employed to search for such key elements is the central focus of the study of the receptive language system.

A. THE EMPIRICAL BASIS OF LANGUAGE RECEPTION

In this chapter we will refer to empirical research selected from a large number of systematic experiments. The receptive language system is probably the most thoroughly explored aspect of psycholinguistics, given its particular suitability for experimental study. This is not surprising, as a researcher in this discipline has excellent experimental control; it is easy to select the stimuli introduced into the ear and, subsequently, to measure the auditory perception of subjects. By privileged control of the two ends of the system, "input" and "output," the differences resulting from the relationship between stimulus and responses become more evident.

Language expression contrasts with speech production in a central aspect. Since there is no direct access to thought, *i.e.* no reliable information to the “input”, the researcher has no choice but to analyze spontaneous productions (slips of the tongue, hesitations, etc.). As we have seen, this procedure infers the operating principles of the production system via various logical arguments.

But the analysis of the receptive aspect of language also poses certain problems. For example, in following the acoustic wave to the interpretation of the message, it is difficult to determine whether those processes operate simultaneously or in succeeding stages. Although the stimulus and the response are known, the identification and interpretation of the mode of operation of the intermediate processes are far from reliable or indisputable. This subjects us to a multitude of trials and it raises difficult questions to resolve.

Despite these uncertainties, we still observe a certain consensus in many works dealing with the receptive aspect of language. We subdivide these issues into two parts: those dealing with *auditory perception* and those relating to *auditory comprehension*.

These two stages of speech reception are relatively easy to distinguish experimentally. If speakers are asked to repeat nonexistent words constructed according to their own language (so-called "logatoms"[13]), they are able to repeat them, although they obviously cannot understand them. The act of repetition includes some decoding of the perceived message and a rudimentary phonological analysis of the auditory signals before the message can be re-emitted using the production system. This decoding corresponds to what we call "auditory perception," as distinct from "comprehension".

In the first part of this chapter, we will therefore focus on *auditory perception*: we will seek to determine how we perceive and distinguish the sounds of a given language. In the second part, we will examine the issues faced by the *auditory comprehension system*. These issues will be presented in relation to strategies used to facilitate the *decoding of a message*.

13 *Logatoms* are used in experiments to analyze how sounds are processed without the influence of an existing vocabulary. They allow to focus on phonetic properties such as syllable structure, phonetic variation, and prosody.

B. AUDITORY PERCEPTION

1. The basis of auditory perception: distinction

Fundamentally, auditory, visual, or tactile perception is based on the *recognition of differences*. The colour red appears as such to our eyes because of the contrast compared to other colours. The high-pitched sound of a whistle is clearly distinguished because of other sounds that are less high-pitched or different. Although it is characterized by a particular set of sound frequencies, the most important function of the perception system is not to identify the precise frequencies of the whistle sound. Rather we wish to establish the identity of the instrument, or its *meaning to us*.

We start from some perceived differences between this sound and other surrounding or possible sounds. Precise frequencies can help distinguish the whistle from surrounding noises, but they are only clues among others (such as volume, melody, and the length of the whistle blow) that allow the perception system to classify the sound it perceives.

Another argument leads us to the same conclusion. Even if we wanted to, we could not distinguish all the sounds heard around us. Given that we are capable, in absolute terms, of discriminating several hundred thousand sounds, if we had the task of identifying them all, we would have to restrict ourselves exclusively to analyzing our auditory environment. Moreover, it turns out that we do not really need such detailed information. To function well in our daily environment, only a limited number of auditory distinctions are sufficient. Among these, the most relevant are those that we use around us.

Some acoustic differences are particularly relevant because they serve to distinguish words in our language. The word [b] "bay," for example, is acoustically characterized by a slight burst of noise, opening in a particular way toward the characteristic sound waves of the sounds [ɛj]. These acoustic events differ very little from that which characterizes the word "pay and yet, the difference in the initial sound allows distinguishing two words. The auditory system must detect the difference between the two acoustic events in order to make a phonological distinction.

On the other hand, other acoustic differences are not relevant to the proper understanding of a message, despite the fact that some of them are, in absolute terms, at least as important as the difference between "bay" and "pay." For example, we know that the consonant [k] tends to be produced in the posterior part of the oral cavity when combined with back vowels (in "cuckoo") and can be realized in a more anterior part when combined with front vowels for the name (in "keen"). These two realizations of the sound [k] give rise to different acoustic waves. But the distinction between the two variants of [k] does not serve to distinguish two words, so the typical listener generally does not notice this difference. It is not considered "*phonological*."

The same phenomenon applies to the difference between the rolled [r] used in many parts of the world, and the guttural [ʁ], used in the North of France and most of Quebec. Although the rolled [r] is articulated by a flap of the tongue tip and the guttural [ʁ] is produced by air friction between the velum and the tongue, few people pay attention to the difference between the two sounds. This is not surprising since both are used interchangeably within a word; regardless of the sound quality of the "r," the meaning of the word will be well understood. In other words, the difference between these sounds is not *phonologically relevant* and the perception system is not required to distinguish them.

2. The phonematic hypothesis

The immediate goal of a speech listener is therefore to establish distinctions that are relevant from a linguistic point of view. But are these phonemic, syllabic, monemic (words), or even syntagmatic distinctions?

According to a traditional hypothesis, it is assumed that the acoustic information is distributed in phonemes. For a given word, "beat," for example, the listener would compare the frequencies, amplitudes, and durations of each segment -b-, -i:-, and -t- with other similar segments. Being sure that it is a (b), an (i:), and a (t), they would reconstruct the chain [bi:t]. This chain would then be linked to a meaning ("beat") found in a "mental dictionary."

Although simple and rational, this conception of perception does not correspond to the results of empirical research. Problems arise as early as the phonemic identification stage: detailed experiments have established that there are significant acoustic differences depending on the different realizations of the same phoneme, whether these are realizations of the "same" phoneme in different phonological contexts or according to different speakers.

Thus, it is observed that the frequencies and amplitudes of the [b] segment in "beat" are not quite identical to those of the [b] segment in "bells." Similarly, a first utterance of "beat" does not involve an acoustic wave totally identical to that produced during a second utterance of the same word, whether by the same speaker or by someone else.

In fact, the acoustic information contained in the consonant [b] is primarily encoded in its vocalic environment. If listeners are presented with a magnetic recording of the word "but", cut in such a way that the acoustic information of the segments [a] and [t] disappears, leaving only that part of the segment [b], these listeners do not perceive a [b], but a sound resembling a bird's chirping (cf. COOPER ET AL., 1952). On the other hand, if the experimenter *replaces* the chirping of the initial consonant of the word [dat] with that of the sound **b** from "but," the listener perceives [bat]. This indicates that the acoustic information of the consonants [d] and [b] are encoded in the acoustic wave of the neighbouring vowel. This phenomenon is known as *coarticulatory encoding*.

3. The reasons for coarticulatory encoding

This surprising phenomenon at first glance is quite well explained when situated in the context of speech production. Some reflections on the principles of speech articulation will help us better to understand it.

We know that humans can produce between fifteen and thirty phonemes per second (LIBERMAN ET AL., 1967: 432). Such a rapid rate is made possible because the articulatory organs prepare the articulation of sounds in advance. In French we can observe a lip projection in anticipation of the sound “u” (sound [y]) in the word "instrument." According to measurements made by BENGUEREL AND COWAN (1974), the lip projection begins as early as the articulation of the phoneme [s] and intensifies during the emission of the sounds [t] and [ʀ]. We know that the lip projection precedes the sound [y] for “u”, because it is not inherent to the sounds [s], [t], and [R].

The production system can only use these anticipatory movements when they do not interfere with the distinction of sounds being produced. Thus, the sounds [s], [t], and [R] are not distinguished from other French sounds by the presence or absence of lip projection. If the initial nasal sound “in” of "instrument" were articulated with lip

projection, it would be perceived as an “un” [nasalized œ], as in the sequence “un” “deux” “trois”. The presence or absence of lip projection would entail a phonological distinction between these two French phonemes.

Taking these principles into account, let us analyze the articulatory production of the two words "bark" [baʀk] and "dark" [daʀk] in a Canadian speaker of English. In the articulation of the [b] in the word "bark," the tongue most likely adopts a low position in anticipation of the following [a]. This position of the place of articulation does not disturb the perception of the [b], since the precise position of the tongue is not decisive for this consonant; it is only afterwards that the lips open to allow the emission of the sound [a]. Note that at the moment the lips separate, the vocal tract is already positioned to produce the [a], and the position of the tongue remains essentially the same when moving from the sound [b] to the sound [a].

On the other hand, the production of the initial consonant [d] in the word "dark" requires the tip of the tongue to contact the alveoli. However, at the moment of separation occurring between the tongue and the alveoli, the tongue must quickly change shape and position to assume the position for the sound [a]. This implies a rapid transformation of the vocal tract caused by the occlusion, as the tongue descends from the alveo-dental position to a low position in the oral cavity.

The acoustic consequences of these two examples are as follows. Since the occlusion of the vocal tract for the initial consonants [b] and [d] permits only a weak sound emission, the listener is unable to distinguish the two consonants during the initial period of the word. However, after the separation of the phonatory organs, the acoustic consequences of the relatively stable shape of the vocal tract in [ba] are clearly different from the acoustic consequences of the transformation of the vocal tract occurring in [da]. The listener can then distinguish or identify the two occlusive consonants. Paradoxically, the information distinguishing the occlusive consonants [b] and [d] is therefore not found in the occlusive segment of the consonant, but rather in the segment operating the transition between the consonant and the neighbouring vowel.

4. The perception of vowels

The phonematic hypothesis proves no more adequate for the perception of vowels than for the perception of consonants. This is surprising, because during the production of vowels, the vocal tract transmits relatively significant sound pressures to the environment, and it would be logical for the auditory system to use the central part of a vowel to distinguish it from another vowel.

Yet, as demonstrated by an experiment on vowel perception, the identification of vowels is not simpler than that of stop consonants. As reported by STUDDERT-KENNEDY, 1979, Strange and Jenkins recorded stimuli in the form [b]-V-[b] (such as [bob], [bib], etc.) which they played to subjects under four experimental conditions:

a. A control group heard the normal tape.

b. A second group heard the same tape from which the part of the vowels containing the transition to the consonants had been removed. The subjects only heard the centre of the vowels and the consonants.

c. A third group heard the transitions between the vowels and the consonants, but the centre of the vowels was removed.

d. For the fourth group, the duration of the consonants and vowels was modified

in order to study the importance of the duration factor in segment identification.

The subjects' task was to identify the vowels that they heard. The results showed that subjects had great difficulty identifying vowels when the duration of the segments was modified, and had almost as much difficulty when the transitions were removed. On the other hand, identification was hardly affected by the disappearance of the centre of the vowels. For vowel identification, the authors concluded the primacy of dynamic factors (such as duration and transitions) over factors related to those frequencies and amplitudes that are relatively stable in their central sections.

These results, along with a considerable number of similar indications, suggest that if the auditory system "focuses its interest" mainly on the transitions between phonemes, it is because the chances of finding information related to phonemic distinction are greatest there. At the junctions occurring between two sounds, the system can detect acoustic information concerning at least the two adjacent sounds; even better, these are precisely the places that inform it about the identity of the stops.

In a context of rapid speech, a system under pressure and seeking to quickly detect the phonological distinctions of the utterance would optimize, through this kind of strategy, the acquisition of the sought information. Whatever the precise reason, these experiments obviously do not support a simple phonematic hypothesis. It seems that in auditory perception, attention is more directly focused on the transitions between phonemes than on their intrinsic acoustic information.

5. Categorical perception

These results reveal an important paradox: even though the auditory system primarily relies on acoustic information coming from transitions between sounds, one of the major responsibilities of the perception phase remains to distinguish and identify the sounds themselves. At certain points in the perceived chain, it is crucial to be able to distinguish between “pain” and “bane”, or between “bark” and “dark”.

This paradox is explained by the presence of *integrative processes* in language reception, which ensure the translation of primary information (*e.g.*, the evolution of sound frequencies in transitions or the duration of syllables) into secondary information (*e.g.*, sound categories), useful for the identification and understanding of the message. These processes accomplish the task of *discrimination* [distinction and identification as previously emphasized]; more precisely, they involve phonological distinctions made between sounds, words, or fixed expressions and, at the level of *comprehension*, semantic distinctions concerning the meaning of words, statements, or the perceived discourse.

The fundamental principle is that of *classification* or *categorization.* This allows the creation and maintenance of mental representations that capture the *categorical aspect of surrounding events*.

For example, a listener capable of distinguishing the words “bark” and “dark”, uttered by person X, can probably distinguish them as well when uttered by person Y, despite significant acoustic differences existing between the pronunciations of different speakers. This implies that the listener has *abstracted* certain information about the surrounding sounds and mentally categorized them in terms of sound classes.

This principle of categorical perception can be elegantly demonstrated by a type of experiment that has become a classic in the field. It involves creating artificial acoustic stimuli closely resembling syllables of a natural language. For example, LIBERMAN ET

AL. (1957) presented fourteen artificial stimuli to their subjects whose main acoustic characteristics (the "formants") *varied continuously from [ba] to [ga].* Between these two extremes, there were also stimuli resembling [da]. The subjects' task was to say whether they heard [ba], [da], or [ga].

As a surprising choice, no artificial stimulus evoked a more or less intermediate response between two of the three alternatives (see figure 1). Although one would have expected some stimuli to produce a roughly equal distribution of responses between [ba] and [da] or between [da] and [ga], nine out of fourteen stimuli were always clearly identified as [ba], [da], or [ga], and the responses to the five other stimuli tended to favour a particular classification. Clearly, the subjects were not aware of the continuous nature of the variations between stimuli and tended to classify them according to their similarities with the phonemes of their language.

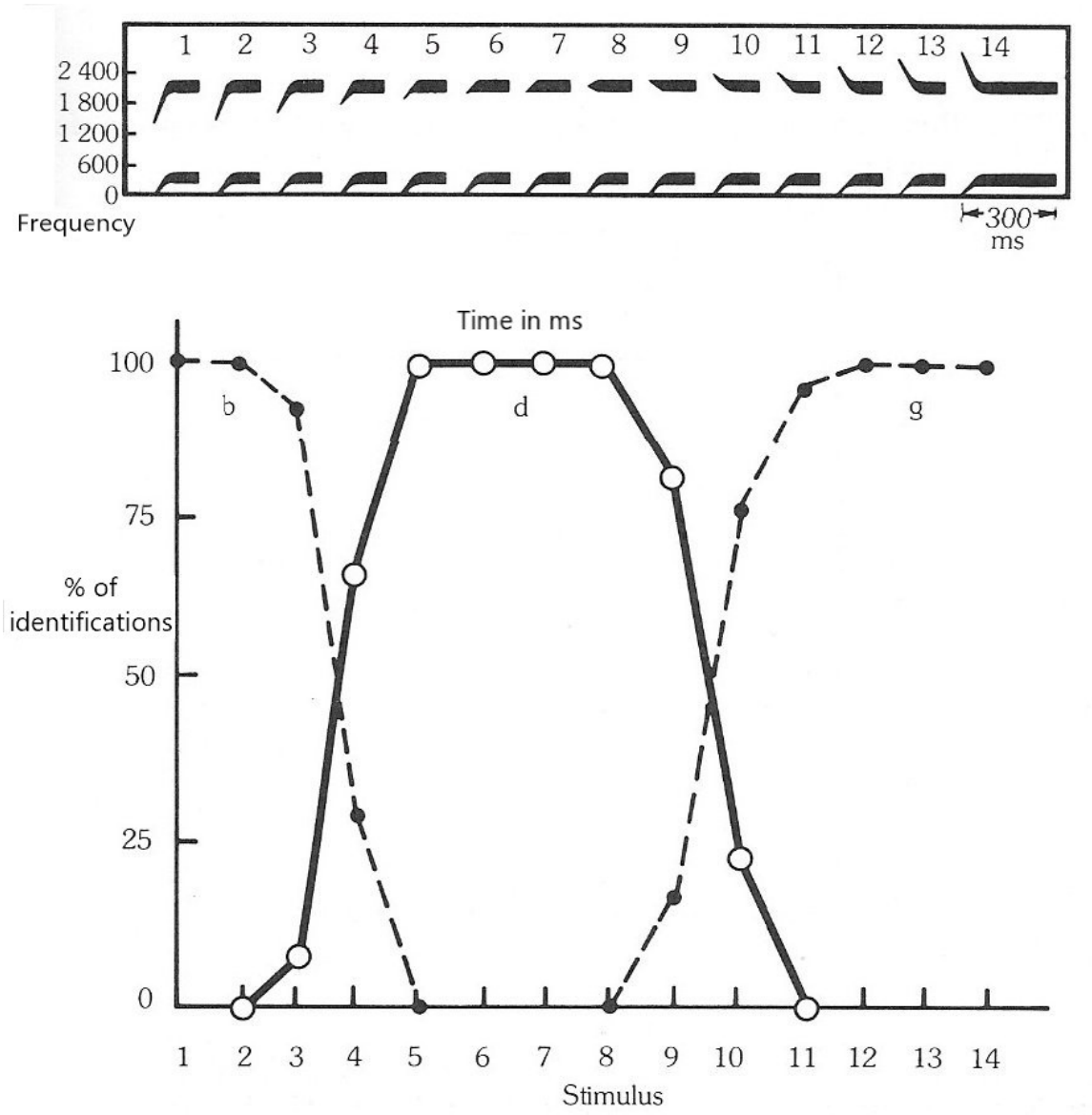
The principle of categorical perception also seems to apply to vowels, although less clearly than in the case of consonants. Golusina and then Walker (reported by VAN VALIN, 1976) developed artificial vowel stimuli varying continuously between [i] and [a]. Russian and American listeners perceived the distance between these vowels and the sound [i] roughly in the same way as if it were their native language. They tended to group firstly, the sounds resembling the segment [i]; secondly, the sounds resembling the segment [e]; and thirdly, the sounds resembling [a], with members of each group classified at roughly the same distance from [i] (see figure 2). However, VAN VALIN's (1976) results were not as clear. The classification trends from his results showed that the distinction of vowels appeared more gradual than that of occlusive consonants.

Several authors demonstrated that the mechanisms of categorical perception were not exclusive to human language. KUHL AND MILLER (1974), for example, trained chinchillas to respond differently to artificial stimuli resembling either [da] or [ta]. Afterwards, intermediate stimuli were presented, and the chinchillas responded as categorically as if they were human listeners.

Even more, SINNOTT (1974) was able to show that, compared to another measure of categorical perception, monkeys even gave more categorical results than human subjects. He asked his subjects to react as quickly as possible when the artificial stimulus (*e.g.*, a [ba]) was different from the previous stimulus. Human subjects responded faster to a measurable difference involving a boundary between two phonemes ([ba]-[da]) rather than to one between two syllables considered representative of the same phonemic category ([bal]-[ba]). However, intracategorical reaction times were even faster for monkeys than for human subjects.

Categorical perception is therefore not a human peculiarity. Moreover, it is interesting to note that categorical perception also applies to visual stimuli (PASTORE ET AL., 1977, reported by STUDDERT-KENNEDY, 1979). It is truly a characteristic and inherent mode of operation of the perception mechanism, whose validity here applies specifically to the perception of spoken language.

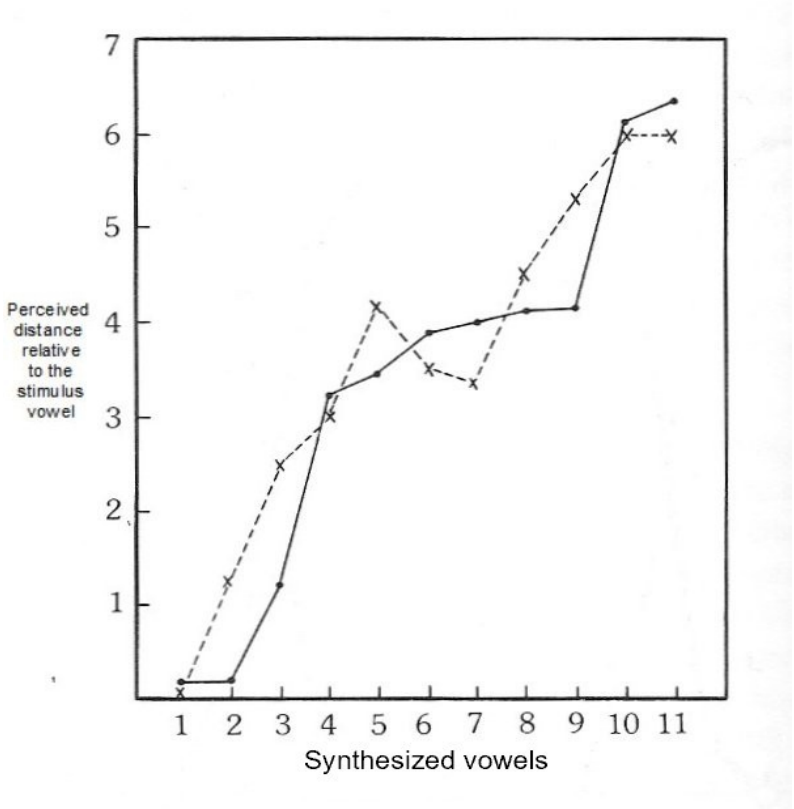
FIGURE 1: Experiment illustrating the principle of categorical perception



The experimenter presents fourteen artificial stimuli (above) to listeners, some of which (1-3) resemble a [b], some others (5-8) a [d], and still others (12-14) a [g]. The listeners tend strongly to group the stimuli into categories during an identification task (below), even though the artificial stimuli were designed to represent a continuous modification between [b], [d], and [g].

Source: LIBERMAN ET AL., 1957.

FIGURE 2: Results of two experiments on vowel perception



The experimenters presented their subjects with pairs of vowels where the first was always an artificial stimulus resembling [i] and the second, an artificial stimulus varying between [i] and [a] (stimulus 1-11). Despite the continuous variation, the two groups of subjects tended to group the results into three categories of stimuli: 1 and 2 (resemblance to [i]); 5 to 7 (resemblance to [e]); 10 and 11 (resemblance to [a]). Russian subjects: continuous lines, American subjects: dashed lines.

Source: VAN VALIN, 1976: 52.

6. Other strategies of auditory perception

a. The complexities of categorical perception

We have just seen, thanks to the categorization process, that the auditory system can solve the problem of individual pronunciation differences. But there are everyday situations that require, in addition to categorization, a realignment of the primary information playing the role of categorical markers. Take, for example, the acoustic information that serves as a distinguishing mark for the phonological difference existing between French "pain" and "bain" (“bread” and “bath”). A Parisian or Montreal listener who has learned to distinguish the phonemes [p] and [b] relies on a set of acoustic cues, one of the most important being the presence of voicing (vocal cord sound activity) during the production of [b] and its absence during the production of [p].

However, some French speakers from Alsace seem to distinguish between [p] and [b] not by the voicing of the consonant, but by the degree of lip pressure and the duration of the consonant. For Parisian or Montreal speakers, the [p] and [b] of these Alsatian speakers will initially resemble (p) more closely for both cases, although Alsatian speakers perceive a real phonological distinction. After a brief training period (ranging from a few days to a few weeks), these same Parisian or Montreal speakers will be able to distinguish the [p] and [b] of the Alsatian speaker despite any contextual ambiguity.

This is of course assumed that they have acquired and integrated other acoustic cues allowing phonemic distinction, or, if you prefer, that they have made an adjustment to their categorical perception. It is then said that these listeners have acquired rules of equivalence, or *transcoding*, between different dialects. These problems and strategies are more common than one might initially suppose. D.H. Klatt listed a number of crucial problems that a perceptual system must overcome (KLATT, 1979):

(1) A phoneme is not always pronounced the same way: the pronunciation varies depending on the position and phonetic environment within the same speaker.

(2) The acoustic signal is continuous. How is segmentation into phonemes possible? Where does the phoneme begin and where does it end?

(3) The duration of a segment varies depending on its position in the sentence and according to the words. It also varies from one speaker to another depending on intonation and stress. Some phonemes are differentiated only by duration (this is sometimes the case for [ʤ] and [w] in English). What matters is the relative duration of the segments and intonational factors.

(4) Each speaker has their own way of speaking.

(5) Each region has its own accent.

(6) Phonological rules do not apply to each individual word, but they cross word boundaries. How to recognize if we have the same pronoun in "**yr** off now" as in "no! **You** are kidding"?

(7) Hearing often occurs in noisy contexts, sometimes even with overlapping messages. Pronunciation is sometimes incorrect. How then to recognize those individual words? How can one decode a single message when several people are speaking at the same time?

(8) What is the mechanism for using prosodic cues (rhythm, intonation, stress)?

We observe that the categorization of auditory stimuli is very complex. In addition to the few relatively simple mechanisms we examined earlier, there must also be more elaborate auditory analysis mechanisms, allowing distinctions and inferences in cases where a simple passive categorization of primary acoustic information would not provide the required information. In the next section, we will outline some of these strategies.

b. Active strategies: visual cues

Receptive processes are not entirely passive. Obviously, the listener uses certain active strategies to organize the sound fabric; in other words, they "search for the appropriate information enabling them to decode an utterance or to clarify a passage incorrectly perceived at first hearing."

Sometimes, this search becomes conscious; for example, when we go to a projection of a film viewing, it sometimes happens that we encounter a passage in the dialogue that we cannot decode. We then try then to understand what we missed, it will be at the expense of the subsequent sentences on which we cannot focus all our attention.

We have already mentioned one of these active strategies by demonstrating that attention was focused on transitions between consonants and vowels; these are particularly some revealing areas in the phonetic chain. Another strategy seems to involve visual cues; we can be convinced of this by thinking about how easily we confuse [f] and [s], or [m] and [n] during a telephone conversation.

SUMMERFIELD (1978, cited by STUDDERT-KENNEDY, 1979) moreover conducted a

systematic study on this question. He asked subjects to transcribe a series of sentences scrambled by background noise. The text to be transcribed and the masking text were read by the same person and presented simultaneously on a video tape. There were three experimental tasks:

a. The subjects listened to the recorded tape without visual support.

b. They listened to the tape while being able to see the entire figure of the person speaking.

c. They listened to the tape while being able to see the lips of the person speaking.

The comprehension percentages were as follows: 23% for **a.**, 65% for **b.**, and 54% for **c.** It is observed that, as a general rule, visual cues have the effect of doubling the comprehension rate of the sentences heard, showing the importance of such cues for linguistic perception.

An analogy can help us better understand this result. Several authors suggested that the listener follows the linguistic message somewhat like perceiving a repetitive movement. By watching a bouncing ball, for example, one can predict the place and time where it will touch the ground: we integrate past states at the present moment and project the ball's trajectory into the future. In the same way, a listener integrates at all times the variations of the linguistic message by using all the cues at their disposal, such as consonant-vowel transitions or visual cues, in order to be able to conceive the probable continuation of events.

c. Active strategies: adjustments

The hypothesis of active linguistic perception is also supported by certain experiments showing that speakers of two different native languages perceive an identical sound continuum differently, and that bilingual individuals can switch from one categorical system to another (somewhat like our typical Parisian or Montrealer acquiring the distinctive system of a native Alsatian speaker).

As an example, let us consider some acoustic differences between the occlusives of French and English. English speakers pronounce the voiced sounds [b], [d], and [g] with lip opening or during a linguo-palatal contact, coinciding more or less with the onset of laryngeal voicing. It is then said that the *Voice Onset Time (VOT)* is more or less equal to zero.

In French, however, the onset of voicing precedes the opening of the vocal tract by 40 to 60 ms (which explains the greater sonority of these sounds in French than in English). Furthermore, the timing of voicing for the voiceless sounds [p], [t], and [k] in French is relatively similar to the VOT of the voiced sounds in English, that is, it is close to zero. This is why monolingual French speakers often perceive English [b], [d], and [g] as a French [p], [t], and [k].

However, bilingual speakers manage to adjust their perceptual expectations according to the linguistic context and to distinguish the categories well depending on the linguistic context. The fact that such learning exists was demonstrated by an experiment by CARNEY ET AL. (1977). These researchers trained subjects to clearly perceive different degrees of VOT and thus succeeded in expanding the inventory of VOT categories that subjects were actually able to distinguish.

C. AUDITORY COMPREHENSION

The problem posed by verbal comprehension corresponds to a situation we have all experienced: how is it that at certain moments, especially when we feel exhausted with fatigue, we do not understand what has just been said, even though the perception is sufficiently correct to repeat the message?

Please recall the distinction of comprehension and perception that was based on an experiment involving the repetition of nonexistent words (logatoms). A speaker is generally able to repeat such phonemic sequences. We deduced that the role of auditory *perception* is to identify *distinctive sound cues*, without abstracting any meaning. We also concluded that *comprehension* is responsible for abstracting the meaning of the utterance. This was based on distinctive sound and visual cues provided by the auditory and visual perception networks.

In this second part of this chapter we propose to examine and explore in more detail the mechanisms that allow such semantic extraction from an utterance. We will begin the discussion with some comments about the different forms that can be accessible to comprehension.

It is possible to understand an utterance from a strictly literal and sequential point of view. The deep and underlying motivation behind the choice of the theme and the specific expression of a speaker can be obtained mechanically from a given sequence of words.

The following examples can attest to this. From the statement "close the door, please," one could simply retain the literal or objective meaning, that is to say, the proposition of the sentence: a desired action (that of closing), an object on which this action should be carried out (the door), and a polite formula (please). Combined with the absence of the subject, this seems to convey a request or a mark of politeness, mingled with the imperative of the wished-for action.

Let us then introduce the second aspect of comprehension by attempting to obtain the underlying intention of the sentence, which may diverge from the proposition. Thus, a phrase like "I am cold" differs from the previous statement "close the door, please" in terms of *the proposition*, but not necessarily in *intention*. Saying "I am cold" may literally mean, for the one who perceives it, a description of a particular state (cold). But such a proposition can have a precise intention, that of requesting that an action be taken to remedy the sensation of cold.

Moreover, the statement "close the door, please" can also conceal an even deeper or veiled motivation. Although the emphasis is on a request, the underlying reason may be hidden, possibly relating to discomfort or a wish to be private.

Generally, it is only by resorting to an unambiguous context that a perception takes on a precise meaning. Sensory data are then accumulated, which combined with verbal data allow us to exclude unlikely meanings and intentions. Thus, we are able to carry out a relatively rigorous analysis of the situation, through which, by ruling out unlikely occurrences, we arrive at a realistic hypothesis of the underlying intentionality or deep motivation of the speaker.

To conduct scientific research on intentions or deep motivations underlying a given statement, we would theoretically need a valid method for their identification. Since this is not the case, psycholinguistics has traditionally focused its research on the propositional level. The fact that the literal meaning of a statement can be understood by all members of the linguistic community constitutes a sufficiently solid foundation for

systematic research to be undertaken in this area. This is why research on the understanding of the *propositional aspect* constitutes the substance of the following section.

1. The comprehension processes

A linguistic analysis of utterances teaches us that the literal meaning of an utterance can be encoded in three ways, reflecting respectively information derived: *first*, from the form of lexemes and fixed expressions, primarily conveying the particular meanings of the message; *second*, from a syntactic and morphological structure tending to signify the relationships existing between the lexemes; and *third*, from prosody (intonation, rhythm, accentuation, etc.), chosen to transmit emphases and the mode (declarative, interrogative, etc.) of communication.

Viewed from this angle, the sentence "could you close the door, please?" contains among other things the lexemes “close", "door” and the fixed expression “please”. It also contains an interrogative structure linking the action between the speaker and the listener, and it is usually uttered with a slight interrogative or imperative intonation and an emphasis placed on one or more elements of the sentence, according to the needs of the situation.

We observe that the final meaning conveyed by this utterance will be based on these three types of information: here we will speak of *lexical comprehension processes, grammatical (or syntactic) comprehension,* and *prosodic comprehension*.

It is interesting to note that certain units of meaning identified by these processes mutually reinforce each other, while others complement each other. For example, in the expression "please," the interrogative syntactic structure "could you," followed by the verb, and the intonational curve of the utterance indicate that it is a request. These three units of meaning reinforce each other, although they are encoded separately from lexical, grammatical, and prosodic points of view.

By contrast, the lexeme "door" syntactically takes the position of the direct object, but its precise meaning ("an opening in a wall") is not communicated by any other linguistic element of the sentence and, without being redundant, it complements the other elements of the sentence.

Although these three processes only enrich a given meaning, it is highly probable that during the initial phase of the comprehension process, the three decodings involve distinct operations.

We will examine two types of decoding that have been the subject of numerous psycholinguistic investigations: *lexical comprehension* and *syntactic comprehension*. We will approach these processes from the perspective of an active search strategy shown by comprehension processes, just as we did in perception processes.

2. Active strategy in comprehension

An active information search strategy is most likely necessary due to the speed of speech. Given articulatory speech rates, we are suggesting that the comprehension system probably uses active searching for the information contained in the message: it cannot linger on each constituent unit. Listeners construct, in parallel with the speaker, their own version of a given statement.

We can verify the validity of the statement by referring to a situation where someone

suddenly leaves their sentence in suspension. We are generally able to finish the sentence for them; in other words, our interpretation of their statement proves sufficiently developed to complete the idea without the addition of extra words.

This reasoning leads us to a central hypothesis concerning the comprehension of continuous speech. It assumes that two receptive processes occur in parallel: the first is responsible for formulating hypotheses about the linguistic elements to expect; and the second is responsible for verifying these hypotheses by continuous comparisons between expected elements and perceived elements. In the case of a sufficient divergence between expected and perceived elements, a reformulation of the hypothesis would be required. It would be verified against the initially misunderstood elements or against subsequent elements in the continued flow of speech.

3. Lexical comprehension

As we listen to others speak, the basic information most likely comes from an initial interpretation of the sounds we hear.

However, uncertainties remain regarding the different units of this message, since perception does not separate words from each other, nor does it "spell" them out as on a written page. Thus, "Anne and Mary" probably do not present themselves to the comprehension system as [æ:n ənd mæri], but rather as something like [æ:n:nmæri].

Similarly, auditory perception does not discriminate between homophones (*e.g.*, *night* and *knight*, pronounced the same but differing in meaning) and does not necessarily link different dialectal pronunciations of the same word. Untangling such ambiguities is done with certain strategies: it is possible that initially a listener searches for the most frequent words, or that they have phonological, syntactic, and pragmatic expectations regarding the heard words. Both of these strategies will capture our attention.

a. The frequency effect

Among the 5,000 to 20,000 words in our active vocabulary, only a few hundred are truly frequent. For the most part, speech contains mostly articles, prepositions, some commonly used verbs, and some common nouns. The vast majority of words rarely appear in our speech, except in specific contexts.

It is therefore likely that while listening, we make preselections of the approximate frequency rate. Several studies conducted with tachistoscopic presentation (rapid visual presentation, generally at a speed of about one-tenth of a second) demonstrated a greater sensitivity to frequent stimuli. But these visual experiments do not allow for rigorous deduction concerning auditory comprehension, as they relate to visual understanding during isolated word presentations.

But there are a number of experiments that satisfy, to some extent, these two objections and they seem to confirm the frequency effect.

FASS (1969) presented his subjects with sentences like these:

1. The travelling bassoon player found himself without funds in a strange town.
2. The itinerant bassoon player found himself without funds in a strange town.

Both sentences say the same thing, except that the word "travelling" is probably more frequent than the word "itinerant." The experimenter asked his subjects to press a button as soon as they heard a /b/ sound and recorded their response times. Subjects generally responded faster to sentences of type 1 than to those of type 2.

Such a result can be explained if one assumes that during the lexical search process

for the word "travelling," the listener is less concerned and less occupied than during that for the word "itinerant": they can more easily identify the /b/ that follows the word "travelling" and press the button more quickly.

b. Lexical expectations

We previously suggested that an important strategy in speech comprehension would rely on constructing a parallel statement, that is, on developing hypotheses about upcoming elements in the statement. For example, we spoke about the perceptual adjustment characteristic of bilinguals, and our ability to "mentally finish incomplete sentences."

The experiments of W. Marlsen Wilson [1978, cited by STUDDERT-KENNEDY, 1979] are very revealing about lexical expectations. This researcher asked subjects to detect an inserted word, either in a sentence or in a sequence of random words. It turns out that the reaction time required to detect the word *decreased* if the word was inserted in a sentence rather than in a random sequence of words. If the sentence was inserted in a wider context, the reaction was even faster.

We can interpret these results as follows: in a sequence of random words, it is impossible to predict when the target word will appear. Therefore, each word must be compared with the one being searched for before making a decision. However, the clearer the context, the more we expect the word to appear in certain specific places. When it appears, we are already ready to react, since its presence confirms our expectations. The reaction time is therefore shorter.

This argument also allows us to detect how lexical expectation makes the task of comprehension easier. We know, from numerous studies in auditory and visual perception, that it is easier to distinguish two stimuli than to identify (name) each of them.

The tachistoscopic presentation of a visual stimulus can, for example, be shorter to correctly distinguish the colour of two circles than to identify their colour individually. Similarly, when listening to two scrambled words, we find it easier to distinguish their identity or difference than to grasp which words they are. It is possible that having prepared a lexeme will facilitate message comprehension, since it will only be necessary to decide whether the prepared lexeme actually corresponds to the heard lexeme. No other action will be required in this case. The additional effort to identify what was truly said will only be needed in a limited subset of all the heard lexemes.

4. Syntactic comprehension

Syntactic comprehension constitutes a second process of verbal comprehension, complementary to lexical comprehension. Any linguistic utterance of more than one word can carry a syntactic structure, in the sense that the words can be ordered in a certain way. In many languages (*e.g.*, French), this structuring is the primary source of information about the relationships that exist between the different elements of the utterance in a declarative sentence, for example, a noun in the initial position acts as the subject, whereas it would have the role of object in the post-verbal position. Syntactic comprehension is the process of decoding this type of information. The psychological reality of this process is demonstrated by numerous psycholinguistic experiments.

a. The psychological reality of syntactic comprehension

One of the best ways to demonstrate the psychological reality of a syntactic

comprehension process involves a tricky experiment where only the information load is manipulated. This is the kind of test that Flores d'Arcais (1978, cited by LEVELT, 1978) applied during the exploration of syntactic comprehension.

Specifically, embedded phrases would be more difficult to process and therefore would occupy the receptive functions of the subject more than the other parts of a sentence. Consequently, reaction times to an incidental event should be longer for the analysis of embedded phrases, but only for the decoding of that part of the sentence.

In order to verify this hypothesis, he presented sentences with embeddings to subjects using headphones. He played with the auditory signal, occasionally switching it from one ear to the other, sometimes at the exact moment of the presentation of an embedding, and sometimes at the moment of the transmission of a main part. He then measured the reaction time to detect the moment when the switch between ears occurred.

As expected, the response times were on average longer when the switch took place during the presentation of the embedded part of the sentence than during that of the main part. These results reveal, in all likelihood, that the comprehension system is probably more occupied during the decoding of the embedded (subordinate) part and, consequently, cannot react as quickly.

The second result of this experiment further supported this hypothesis. D'Arcais compared the response times for the main part under two conditions: the first, when the subordinate clause was presented before the main part of the sentence; and the second, when the order of presentation was reversed. He recorded the best reaction times when the main part preceded the subordinate part.

The interpretation of these results is more convincing when one conceives the syntactic comprehension system as a mode of parallel processing. One could conceive it as being forced to slow down the flow of other parallel processes (such as the reaction task) when it is occupied by multiple tasks simultaneously.

In our illustration, the comprehension system must "keep in memory" an utterance that is not entirely interpretable during the decoding of the embedded phrase: it then operates less efficiently than if it only had to deal with the main part of the sentence. Consequently, it performs the reaction task less quickly.

b. Subdivision according to intuitive judgments

Having established the psychological reality of the syntactic comprehension process, we must explore the strategies to which this process resorts to.

One of these likely concerns the segmentation of the utterance into parts, somewhat as a "divide and conquer" strategy. It has the advantage of not making the listener wait until the end of the sentence to begin their syntactic analysis; they can trigger the process of abstracting the syntactic meaning of a sentence as soon as they have received the first coherent part, in other words, the first phrase. Once the analysis allowed by the phrase is completed, they can move on to the next phrase, retaining only the elements not yet decoded until they have decoded (or guessed) all the syntactic structures of the sentence or utterance.

To verify this hypothesis, it would be necessary to know whether listeners of a language agree on the places where they segment between two parts of a statement. One could, for example, consider verifying the subdivision process by resorting to intuition, a method often used in linguistic analysis. Thus, it would be sufficient to ask subjects (non-linguists) to formulate their intuitive judgments regarding the subdivision

of a statement.

This was the approach chosen by E. MARTIN (1970), who presented his subjects with sentences like this one:

Politicians were spending the year's tax money.

Martin imposed no limit on the number of syntactic groups that subjects could identify. Generally, he found, supported by statistics, that subjects considered "politicians were spending" and "the year's tax money" as the two dominant syntagmatic groups. In other words, the intuitive analysis of these subjects was as follows:

[(Politicians were spending) (the year's tax money)].

In French: *[(Les politiciens dépensaient) (les impôts de l'année)].*

This is quite surprising because, traditionally, formal syntactic analysis associates the verb more closely with the object than with the subject (in both English and French). A typical example of this analysis would be:

[(Dogs) (chase (cats))].

French: *[(Les chiens) (chassent (les chats))].*

Building on this result, it was observed that intuitive judgments were influenced by the length of the sentence during evaluation. J. MARTIN and colleagues (1971) obtained results comparable to those of E. MARTIN for sentences where the subject was short and the object was long. However, they obtained results comparable to the traditional analysis when the subject was long and the object short - as if the subjects wished to create a balance between the two groups.

We are therefore led to deduce that intuitive judgments do not directly reflect the processes of syntactic comprehension. This may be partly caused by the fact that subjects made their judgments somewhat after their understanding and not during the entire process of syntactic comprehension. Thus, it can be concluded that this intuitive structural analysis is not truly a reliable test regarding the formal strategy of subdividing syntactic structures.

c. The subdivision of the statement according to experiments using the click method

A methodology seemingly resolving these criticisms was popularized in the 1960s by the classic study of FODOR AND BEVER (1965). In this type of experiment, subjects hear sentences with clicks superimposed at precise points. The task is to write down the sentences and to graphically indicate where the click occurred. Subsequently, the distance between the subjective judgment and the objective position of the clicks is measured.

This study showed that the subjects made a certain category of systematic error regarding the precise boundary where they placed the clicks. Generally, they placed them closer to the major phrase boundaries. Thus, in the following sentence

That he was happy was evident from the way he smiled.

the major boundary is located between *was happy* and *was evident*, and the subjects tended to locate the click closer to this boundary than it actually was. Moreover, noises placed exactly on this boundary were perceived more accurately than noises placed elsewhere in the sentence.

We conclude that the hypothesis of the "divide and conquer" strategy is supported by these data. If listeners tended to place the marks closer to the subdivisions of the

statement than they actually were, it is probably due to their concern with phrase analysis. On the other hand, when syntactic decoding is at its minimal activity, that is, near syntactic divisions, the perception of clicks is better.

Nevertheless, a methodological criticism remains regarding this study. It can be assumed that the judgment and placement of clicks do not reflect the syntactic structure, but rather the intonation curve of the sentence, or other acoustic factors. For this reason, GARRETT ET AL. (1965) produced two sentences comprising two different syntactic structures but possessing the same acoustic information. In these two sentences:

((In her hope of marrying) (Anna was surely impractical)).

(Your hope of marrying Anna) (was surely impractical)).

The major boundaries were located in different places (before or after *Anna*), while having been made from the same magnetic tape, which contained the entire sentence except for the part *In her* and *Your*.

The results supported the original hypothesis. The subjects tended to move the clicks superimposed on "Anna" towards "marrying" in the first sentence and towards "was" in the second sentence. This type of experiment allows us to suppose that during sentence analysis, listeners use a syntactic subdivision strategy of the statement. Nevertheless, it is not certain that this structure always corresponds to the structure inferred by a formal analysis of these same utterances.

d. The effects of syntactic-semantic complexity

As we have seen previously in the example of embedded sentences, subjects seem more absorbed by syntactic decoding of complex structures than by simple structures. This principle has been used for a large number of psycholinguistic experiments to highlight the relative difficulty posed by certain syntactic structures.

One can thus attempt to verify whether the structures that appear more complex to us, according to our theoretical syntactic analyses, also pose a more marked problem to the listener who tries to decode them. In this way, one can expect that structures like the passive or negation are more difficult to decode than an affirmative active structure. Also a complex or ambiguous semantic structure would require more delay in internal processing than a less complex and less unambiguous structure. Let us consider some psycholinguistic experiments that put these hypotheses to the test.

FORSTER AND OLBREI (1973) conducted a series of experiments in which they measured the speed of subjects' judgments regarding the grammaticality of statements. Among other things, subjects were successively presented with ungrammatical statements, statements in the active form and others in the passive form.

The hypothesis proved to be correct that the passive is a more complex structure than the active voice. On average, subjects took one-third of a second longer to judge sentences in the passive form than those in active form. Similar experiments on negation presented comparable results, that is, a longer reaction time for negative sentences than for affirmative sentences.

In this type of research, a problem remains, namely that one can almost never control all variables. Although the complexity of the passive structure truly imposes a greater challenge to the comprehension process than the active structure, let us remember that in almost all contexts, the active is nevertheless a much *more frequent* structure than the passive. Moreover, these experiments generally do not take *contextual*

information into account. In fact, fundamentally different results are obtained if the contexts of the stimulus presentation are modified.

On this subject, we will mention some additional experiments. During another verification task, Olson and Filby (1972, cited by LEVELT, 1978) showed that subjects reacted faster to the passive sentence if the subject of the sentence corresponded to an object highlighted in the *visual field*. Hupet and Lebouedec (cited by LEVELT, 1978) also showed that listeners prefer the subject of the sentence to be definite. Thus, "The man was bitten by a dog" will be preferred to "A dog bit the man," even if the latter sentence is syntactically simpler. Regarding negative sentences, Johnson-Laird (1972, cited by LEVELT, 1978) presented subjects with one of the following two sentences in response to the stimulus: Either *John is intelligent* or *he is rich*:

1. John is not rich.

2. John is poor.

The subjects clearly preferred the first sentence when it came to implying that Jean was intelligent. We can therefore say that in a given context, the negative sentence will be easier to understand than the affirmative sentence. However, the large number of experiments conducted on complex syntactic structures seem to indicate that their comprehension is indeed more delicate. If a very specific context favours, in some cases, the choice of a more complex structure, it remains true that in a neutral context, the simple (active, affirmative) sentence is probably decoded more quickly than in the complex sentence.

e. The moment of syntactic decoding

In the previous pages, we presented arguments in favour of the hypothesis that the understanding of syntactic elements occurs in segments. We suggested that the listener initiates a syntactic analysis as soon as they detect the first syntactic element: they extract its syntactic meaning (as well as possible or necessary) and retain in short-term memory only the elements that remain unclear. They then attempt to resolve these remaining elements either by decoding later segments or by making conjectures about the speaker's linguistic intention.

This hypothesis is supported, among other things, by certain experiments using the click method. Let us recall that FODOR AND BEVER (1965) demonstrated the subdivision into phrases using this method. Furthermore, when ABRAMS AND BEVER (1969) asked subjects to press a button as soon as they heard the click signal, they noticed that the reaction time was longer when the click was located at the end of the sentence rather than at the beginning.

This seems to indicate that the comprehension system is more engaged in syntactic decoding at the end than at the beginning of the sentence: a result that appears consistent with the hypothesis that continuous decoding is only just beginning at the initiation of the stimulus sentence, but is in full activity by the time the sentence reaches its end.

Another experiment confirms this hypothesis even more directly. By asking people to repeat a text as they heard it (*i.e.*, "shadowing" a text), Marsen-Wilson (1973, cited by LEVELT, 1978) was able to show that phonological, syntactic, and semantic decoding occurs from the very beginning of the sentence. Similarly, in another experiment, J.M. Carrol et al. (1978, cited by LEVELT, 1978) demonstrated that during the presentation of a sentence, context influenced comprehension.

From the above, we retain the following principle: the listener's position is by no means

passive; on the contrary, as we realize that the listener seeks information that is relevant to them in the statements they hear, that they proceed to decoding as soon as they can and continuously. They develop hypotheses regarding what they think they have heard or what they will hear shortly. It is only by virtue of such a strategy that we can explain the considerable speed of the "processing" of statements in comprehension.

Moreover, the listener's conjectural activity also informs us about the reasons why we so often misperceive or misunderstand a statement. Too often, in our haste, we do not sufficiently compare our conjecture of the heard statement with the statements actually produced: as a result, we "perceive what we hope to hear."

SUMMARY

In this chapter, we have examined the two major processes of speech reception: *auditory perception* and *auditory comprehension* (see figure 3). We have shown that perception is fundamentally a process of *categorical distinction of sounds (discrimination)* based particularly on the acoustic information contained in the transitions between sounds.

This perception is divided into two parts, one of which performs a relatively *passive filtering* of surrounding sounds to extract linguistically distinctive cues (features), while the other actively seeks to *categorize this information* in the form of phonological representations.

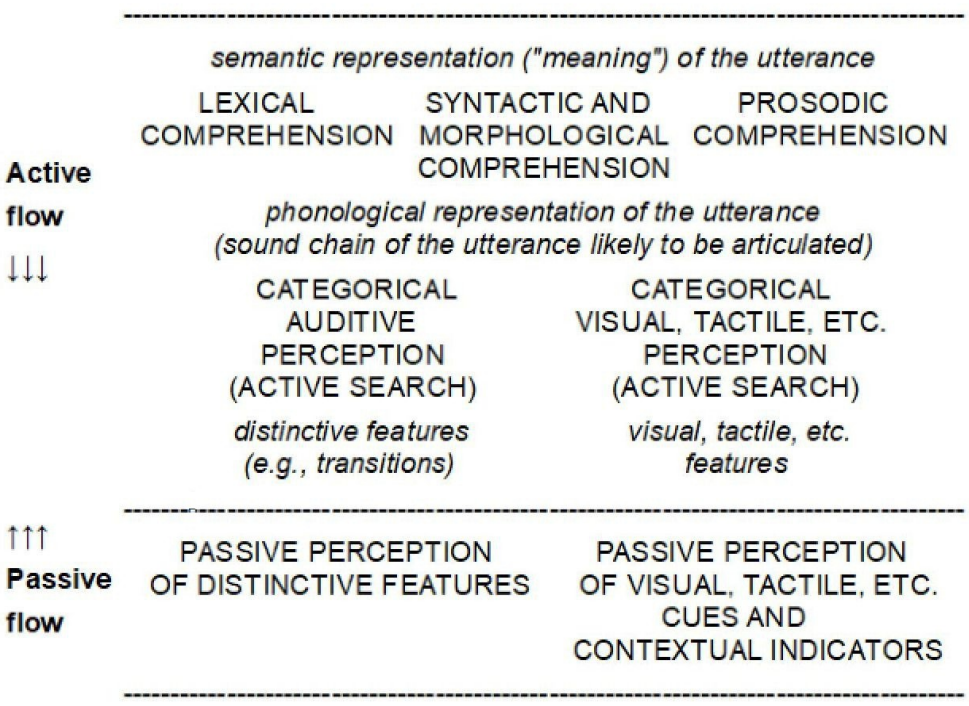
The *passive filtering* can be echoed (in the form of repetition), even if the listener does not understand their meaning. *Categorical processes* on the other hand receive support from other modalities of perception, visual, tactile, etc., which in turn provide additional information about the speaker's facial expressions and gestures, and about circumstances potentially relevant to an understanding of the statement in question.

Finally, a successful transmission provides an *understanding* of a statement. This resides primarily in the decoding of its lexical, syntactic, and prosodic elements.

All these receptive processes seem to *operate simultaneously (in parallel)*. Among the strategies used by these systems of comprehension, we have illustrated the identification of frequent elements and the subdivision of the statement into phrases. We have also repeatedly highlighted, in relation to both stages, the development of expectations concerning lexical or syntactic elements that will probably complete a statement. These active processes of speech reception allow communication to sustain their demand for considerable listening speed.

Taken all together, the following auditory perceptual schema emerges:

FIGURE 3: General model of language reception



The perception stage consists, for each modality (auditory, visual, etc.), of two forms of perception: a **relatively passive perception (or filtering)**, allowing the abstraction of distinctive features, and an **active and categorical perception**, allowing the reconstruction from these features of a phonological representation of the perceived utterance.

The perception processes, conceptually inherent to the different modalities, operate simultaneously (in parallel). The comprehension stage consists of at least three sets of processes. They operate in parallel: **lexical comprehension**, responsible for identifying the meaning associated with the different words constituting the utterance; **syntactic and morphological comprehension**, responsible for abstracting the grammatical relations linking the different elements of the utterance; and finally, **prosodic comprehension**, responsible for identifying elements of emphasis and modes of communication underlying the utterance.

APPLICATION SECTION

1. Explain how and why the acoustic information of stop consonants is encoded during transitions to adjacent vowels.

2. What leads us to think that we hear sounds categorically?

3. Indicate some experimental results supporting an active conception of the categorical perception process.

4. Explain the contribution of the following strategies to comprehension: the effect of the frequency of linguistic elements, lexical and grammatical expectations.

5. How has the mental subdivision of syntactic structures been demonstrated?

6. Why do we claim that comprehension is an active process?

7. What are the effects of syntactic and semantic complexity on comprehension?

FOR FURTHER READING

CLARK & CLARK (1977). Chapter 2.

FOSS & HAKES (1978). Chapter 2.

SARRASIN (1977). Chapters 9 and 12.

Chapter 8. Language and the Brain

In recent years, we have witnessed a true blossoming of interest in the relationship between linguistic faculties and the human brain.

This was made partly possible by the development of new methods allowing the compilation and analysis of neurophysiological and neuropsychological data. The expansion of the field of *neurolinguistics*, in line with these trends, has led us to a more nuanced understanding of neural functioning in language and of our biological limits in psycholinguistic functioning and language acquisition. We can also formulate interesting hypotheses about the involvement of certain brain structures in psycholinguistic functioning. These hypotheses have direct repercussions on the understanding and treatment of language disorders.

The major themes of neurolinguistics will be addressed in three stages.

First, we will examine the distribution of psycholinguistic functions in the two hemispheres of the brain. This distribution is called the *lateralization of brain functions*. Secondly, we will focus on the different aspects of psycholinguistic functioning of the various brain areas, that is, the *localization of brain functions*. Summarizing this approach, we will attempt to associate neurolinguistic perspectives with the concepts already presented in the two previous chapters. Finally, we will study the means of control that can be exerted over linguistic production through the *feedback system*. This remains very little explored despite its crucial importance in psycholinguistic functioning and language learning.

A. LATERALIZATION (HEMISPHERIC SPECIALIZATION)

Since the brain is among the bilateral structures of our body, psychological and linguistic faculties can be established either in the left hemisphere, the right hemisphere, or simultaneously in both hemispheres. Judging by several indications (discussed below), the left hemisphere would be responsible for the majority of linguistic functions exercised in most of us.

What factors favour linguistic development in the left hemisphere rather than the right hemisphere? Are these factors purely biological, or is there a functional compatibility between new and pre-established faculties in various cephalic regions? Some reflections on human evolution will enlighten us on this point.

1. The evolution of bilateral and unilateral structures

Let us note from the outset that biological evolution does not necessarily lead to the duplication of anatomical structures; although we have two hands, two eyes, and two cerebral hemispheres, we nevertheless have only one liver and one heart. As a rule, an organism develops a bilateral structure only when it is useful or indispensable for its survival. This is why the evolution of many aquatic animals, more or less sedentary, did not result in bilateral structures - for example, oysters, mussels, or scallops. The bodies of these latter are rounded, a shape that does not prevent them from feeding and reproducing.

In more mobile animals, particularly vertebrates, the external structure proves to be the most clearly bilateral. We can suppose, as KINSBOURNE (1978) does, that to respond to the challenges posed by the external environment (likely presenting oneself as much to the left as to the right), the skeleton and musculature developed in such a way as to react on both sides of the body.

Take as an example a fish that perceives food on its left. Its left eye receives the information and transmits it to a neural centre located on the same side, near the eye. But to propel itself toward this food, the fish must activate the fins on the other side of its body, that is, the right fins. So it is the left visual centre that registers the motor actions and it is the visual centre on the right side that controls the motor actions.

The situation unfolds similarly in terrestrial vertebrates. To turn to the left, they must activate the right limbs more energetically than those on the left, and conversely, to make a right turn. This is probably why the control of limb movements in vertebrates is fundamentally *'contra-lateral.*'[14]

2. The evolution of manual specialization and language lateralization

These functional interactions motivate quite well the evolution of bilateral structures in vertebrates. However, in humans, they do not explain the predominance of the left hemisphere for linguistic functions, nor their link to the frequent right-hand prevalence.

A favoured hypothesis would suggest that the predominance of the left hemisphere for linguistic functions would be *secondary and subordinate to our right-hand preference*. Having previously developed a dominance of the right hemisphere for manual functions (regardless of the reasons), humans would at a later stage have developed linguistic

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141. Contra-lateral means to be directed from one side to the other by crossing the mid-line.

functions in the opposite and "less occupied" hemisphere.

To support this hypothesis, one can invoke that elements of speech, like manual functions, are produced *sequentially as in any motor task*, and second, that humans are those who, among vertebrates, most clearly manifest a preference for a particular laterality and for linguistic functions on the opposite side.

To verify the validity of this hypothesis, let us examine the evolution of manual functions and linguistic functions.

Over the few million years that humans have lived on earth, and since they learned upright walking, their manual activity has gradually imposed itself, leading to a parallel development of specialized functions of both hands. The ambulatory function, that is, the use of hands for climbing, jumping, and walking, was originally bilateral in view of the required coordination. This led to manual specialization, because when working on an object, one hand holds it while the other acts on the object. Manual specialization is easily observed in humans, but it also seems widespread among monkeys (MACNEILAGE ET AL., IN PRESS). Another factor favouring manual specialization comes from the fact that humans, endowed with considerable learning abilities, can benefit from concentrating their training time on a single hand.

Now, returning to language, it turns out that the demands of linguistic function are quite different from those required for manual lateralization. The musculature of the vocal tract is simultaneously activated on both sides: no linguistic articulation depends on independent control of one side of the vocal tract. In contrast to manual functions, speech production does not *per se* require lateral specialization.

If linguistic controls preferably develop in the left hemisphere, it is possibly because blood circulation is generally stronger on the left side than on the right, particularly in the motor region of the brain (SABAN, 1981). Indeed, for several years now, we have known that any mental activity involves greater oxygenation in the brain region concerned. Since the left hemisphere is slightly better supplied with oxygen than the right hemisphere, it is possible that the tendency toward slightly lateralized control in the left hemisphere may ultimately be related to blood circulation.

According to this hypothesis, a motor activity involving a high degree of coordination of rapid movements (such as speech articulation which is very rapid) would tend to be located in the hemisphere that can most easily and quickly meet the current oxygenation needs of the neuronal tissue involved in these functions. They thus need not be directly related to handedness.

3. The lateralization of linguistic functions in right-handers and left-handers

This is also contra-indicated by research from cortical research. Paul Pierre Broca, a French surgeon of the last century, was the first to hypothesize that language control operates in the left hemisphere for right-handers and in the right hemisphere for left-handers. From his observations, combined with those of his colleagues, it followed that in right-handers, a lesion in the left hemisphere of the brain generally caused aphasia, whereas he observed only one case of aphasia in a left-handler with a lesion in the right hemisphere.

This simple hypothesis was later nuanced. Penfield and Roberts, two neurologists from Montreal, collected a large number of data providing us with precise information on this question (PENFIELD AND ROBERTS, 1959). First of all, many exceptions to this rule are noted. In publications dating from 1868 to 1956, the authors report 119 cases

contradicting this hypothesis: 66 cases of aphasia with left hemisphere lesions in left-handers and 53 cases of aphasia with right hemisphere lesions in right-handers. Moreover, among the cases of aphasia with right hemisphere lesions, 39% were right-handers and 48% were left-handers (hand preference was unknown in 13% of cases).

Subsequently, these same authors recorded hand preference and lesion location in 130 of their patients suffering from severe localized epilepsy who had undergone brain surgery. Among the aphasic patients, some left-handed and others right-handed, the majority presented aphasia with left hemisphere lesions: 115 of the 116 cases were right-handed, and 13 of the 14 cases were left-handed. Penfield and Roberts concluded that regarding the linguistic aspect, the probability of *left lateralization was very high and independent of hand preference*. Left hemisphere dominance for language was verified for most right-handers, left-handers, and ambidextrous individuals.

Since then, the results of numerous experimental studies have supported this position. According to recent evidence gathered from aphasic patients and experiments involving dichotic listening, tachistoscopic presentation of visual stimuli, and EEG potential recording, the majority of right-handers do favour a language representation strongly lateralized to the left hemisphere. Furthermore, left-handers exhibit less pronounced lateralization than right-handers, as they are more capable than right-handers of solving linguistic problems using the right hemisphere.

To summarize, this evidence does not favour a simple notion of a direct dependency between hand preference and linguistic dominance, but it rather supports a model in which both functions depend on a third factor, either genetic influences or possibly blood supply.

4. Recent indications on the lateralization of linguistic functions

Moreover, recent research tends to demonstrate that left hemisphere dominance for language does not equate to "exclusive responsibility for all linguistic functions." Indeed, during the period when researchers such as Penfield and Roberts attested to left cerebral predominance for language, a series of new experimental methods began to nuance the concept of "dominance" by categorizing parts of the brain responsible for different linguistic functions.

a. The contribution of the study of the sectioning of the corpus callosum

One of the most operational methods related to the lateralization of human psychological faculties concerns the sectioning of the corpus callosum[15]. During the 1960s, this type of intervention was performed to prevent epileptic seizures in patients with serious lateral focal epilepsy; nowadays, it is mainly used in antitumor surgical procedures. The possibilities of communication between the two hemispheres are greatly reduced during a *sectioning of the corpus callosum*, without the patient usually realizing it or their general behaviour being visibly affected. However, these patients exhibit subtle deficits that allow us to better understand the lateralization of different brain functions.

The first psycholinguistic experiments conducted on these patients involved tachistoscopic presentation of visual stimuli (numbers, letters, words, and images) and obtaining a verbal response (GAZZANIGA AND SPERRY, 1967) (see figure 1). Since the right visual field is exclusively linked to the left hemisphere and vice versa, it

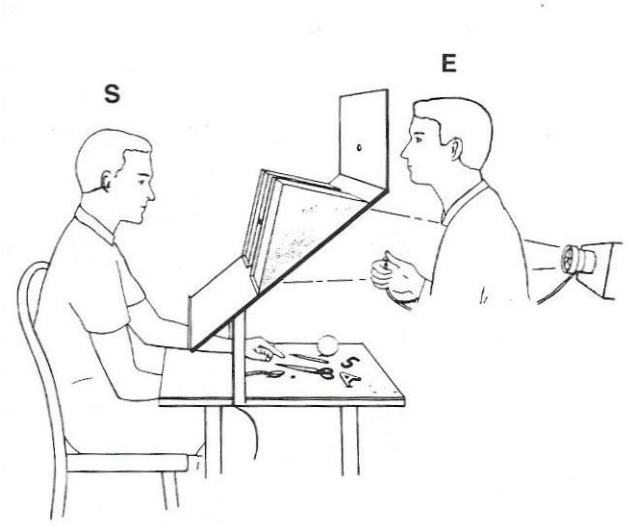
15 The corpus callosum is a relatively thick band of neuronal fibres that connects the two hemispheres.

became possible to test the two hemispheres separately for different functions. The results showed that regarding oral production, there are significant differences between the two hemispheres. Only the left hemisphere could adequately name stimuli presented to the right, as the right hemisphere was incapable of controlling the articulatory musculature.

However, the right hemisphere was not entirely devoid of linguistic abilities. Although clearly less skilled than the left hemisphere in almost all examined linguistic faculties, it nevertheless possessed a limited competence for recognizing lexemes. For example, following the tachistoscopic presentation of the written representation of an object to the left visual field, a patient correctly chose the target object among other objects using her left hand (*e.g.*, a spoon among a knife, a comb, a toothbrush, plastic letters, etc.). Since the image perceived in the left visual field was sent to the right hemisphere and control of the left hand is carried out by this hemisphere, it was concluded that the perception and understanding of the stimulus did occur in the right hemisphere.

To measure more precisely the linguistic capacities of the two hemispheres, Eran Zaidel, a Californian psychologist, had the idea of using a contact lens linked to a mechanism that excluded any stimulation to one of the two visual fields (ZAIDEL, 1975). Zaidel presented to two patients with sectioned corpus callosum four standardized tests for auditory comprehension (Peabody, Ammons, Goodglass and Kaplan, and Token Test). The results indicated that the right hemisphere had at its disposal a relatively extensive vocabulary.

FIGURE 1: Experimental setup used with patients who have undergone a sectioning of the corpus callosum



The subject (S) looks at a two-section screen on which the experimenter (E) presents images of simple objects. The subject fixes their gaze on a point between the two sections of the screen: consequently, the images projected on the right screen are perceived by the left part of both retinas and analyzed by the right hemisphere (and vice versa). The subject selects an object corresponding to the perceived object using the hand controlled by the contra-lateral hemisphere. When the subject analyzes the image using the same hemisphere that controls the hand, they have no difficulty performing the task, but when the analysis and manual control are done by different hemispheres, the task proves impossible to execute.

Source: GAZZANIGA and SPERRY, 1967.

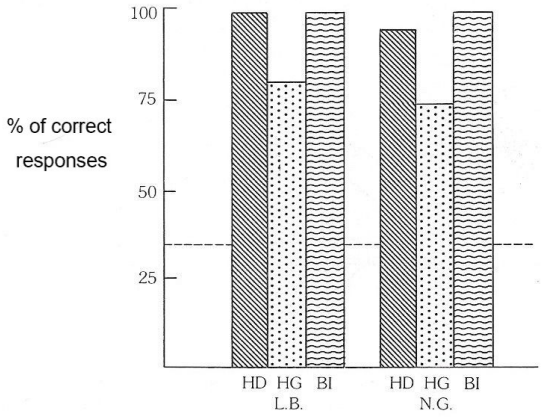
This knowledge was comparable to that of a fourteen-year-old adolescent in one case and to that of a ten-year-old child in the other case (ZAIDEL, 1977). Of course, the results obtained from the left hemisphere were still superior to those of the right hemisphere, comparable to those of a sixteen- or fifteen-year-old person, respectively (see figure 2).

We deduce from all these studies that the left hemisphere is linguistically more active than the right hemisphere; however, the fact that the latter is involved in certain linguistic functions leads us to think that normal linguistic operations involve cooperation between the two hemispheres, and that the left hemisphere contributes to this dominant role.

b. The contribution of the study on dichotic listening

The study of patients whose corpus callosum is sectioned provides us with important indications. However, let us express some reservation regarding all information coming from language pathology. Indeed, these results reflect the activity of an affected brain and, consequently, do not necessarily compare in all respects to the activity of a normal brain. The same applies to a patient who, having lost a leg and developed new walking habits, does not necessarily inform us about all aspects of normal walking. So a patient affected by a language pathology does not necessarily inform us about all aspects of the linguistic behaviour of a normal subject. In addition to having lost certain linguistic faculties, such a patient has probably developed compensation and avoidance strategies that obscure the true nature of their linguistic deficits.

FIGURE 2: Results of the Token Test. Test taken by two patients who underwent a sectioning of the corpus callosum (L.B. and N.G.)



The results of the test with presentation to the right visual field (HD) were higher than those with presentation to the left visual field (HG), reflecting the superior linguistic abilities of the left hemisphere. However, the results reflecting the abilities of the right hemisphere demonstrated significant linguistic capacities, with success rates of about 75%. Both patients achieved almost perfect success rates with presentation of stimuli to both visual fields (BI).

Source: ZAIDEL, 1977: 5.

This is why the contribution of a new method measuring the lateralization of linguistic functions in the normal subject proved particularly useful. This method, called *dichotic listening*, developed in the 1950s in England (BROADBENT, 1956) it has since been

used by many researchers. In these experiments, the subject wears stereo headphones and is simultaneously presented with two different stimuli to both ears. It is generally observed that the stimulus reported by the subject is the one to which they paid the most attention. If the subject hears more stimuli in the right ear than in the left ear, it is assumed that these are easier to analyze in the left hemisphere than in the right hemisphere.[16]

This method demonstrates that the vast majority of linguistic information is more easily analyzed by the left hemisphere. For example, if the two French words "bavard" and "bazar" are presented simultaneously to both ears, it is more likely that the subject will repeat the word heard by the right ear rather than the one heard by the left ear. On the other hand, a subject without specific musical training listening to two melodies at the same time will more easily identify the one coming from the left ear. Verbal analysis therefore seems to be preferably carried out in the left hemisphere and melodic analysis in the right hemisphere.

Since the first publications by BROADBENT (1956) and KIMURA (1961), several hundred experiments have been conducted using this method (see *e.g*. RAMIER, 1972). However, the results obtained inform us much more about phonological perception than about other linguistic aspects since it is easier to find dichotic pairs highlighting phonological relationships than to find pairs of stimuli of semantic or syntactic order.

The contribution of this methodology is nevertheless considerable. It has been possible to demonstrate the superiority of the left hemisphere over the right hemisphere regarding the perception of consonants, although the analysis of non-linguistic sounds does not involve hemispheric preference (*e.g.* TSUNODA, 1975). On the other hand, analyses relating to the perception of intonation show that the observation of the melodic curve of language is preferably carried out by the right hemisphere (ZURI, 1974, BLUMSTEIN & COOPER, 1976).

An extension of this methodology sheds light on the motor control of language. Two psychologists from the University of Texas, Harvey Sussman and Peter Macneilage (*e.g.* SUSSMAN, 1971), developed a complex mechanism measuring the coordination between articulatory organs and auditory stimuli. In their experiments a sound whose pitch (frequency) is randomly varied by computer is presented to one ear. The subject must follow this sound with a lever to the other ear, controlled the tongue or the chin.

These researchers found that the accuracy of the "tracking" was better when the subject heard the second sound (the one under their own control) *in the right ear* than when the dichotic arrangement was reversed. Given that auditory feedback on one's own speech seems to play an important role during unusual activities, it is not surprising that accuracy increases if this feedback is located in the right ear, more directly connected to the control of articulation in the left hemisphere.

All together, these analyses conducted on aphasics, patients with corpus callosum sectioning, as well as those involving dichotic listening suggest several constants.

We observe that the left hemisphere almost entirely assumes responsibility for *controlling the articulatory organs*, and this is true for the majority of speakers. However, *linguistic comprehension* is less exclusively in the domain of the left hemisphere. When competitive stimuli are presented to both ears, the left hemisphere appears more capable of linguistic analysis than the right hemisphere. But it can also analyze linguistic material in language reception and, moreover, appears more closely

16 The majority of neural pathways connecting the ear to the brain cross from one side to the other.

involved in the analysis of intonation.

B. THE LOCALIZATION OF LINGUISTIC FUNCTIONS

1. Aphasias

Data related to corpus callosum sectioning and dichotic listening allow us to characterize the hemisphere that is the centre of various linguistic functions. To more precisely delineate the regions involved, several language pathologies, particularly aphasia, are traditionally examined.[17]

By differentiating certain types of linguistic problems resulting from lesions adjacent to specific brain areas, the researcher deduces the relationships established between linguistic elements and anatomophysiological elements. For example, excessive slowness is most often associated with lesions located in the frontal regions of the cortex rather than in the posterior regions. Therefore, we are justified in supposing that the anterior regions are more directly involved in the motor action of speech production (execution) than the posterior regions.

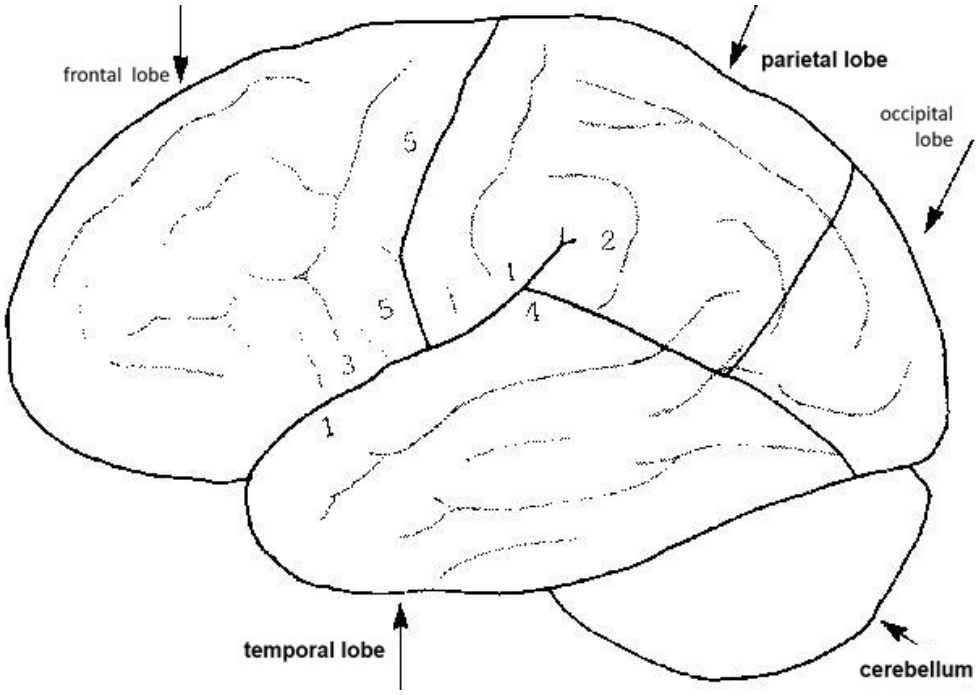
However, it is necessary to carefully distinguish the effects of pathology from the patient's attempts at compensation and avoidance. For example, Broca's aphasics tend to simplify clusters of consonants and diphthongs in speech production (KELLER, 1984). This linguistic behaviour, clearly distinct from that of a normal subject, can be interpreted either as a direct consequence of the lesion or as a compensatory strategy of the patient in relation to their difficulties with oral production.

First, let us briefly summarize the various forms of aphasia and then outline a neurolinguistic model of language production and reception.[18]

17 An aphasia is a difficulty or loss of an aspect of language resulting from a brain lesion. A lesion is the damage to some tissue.

18 The description of the syndromes is based on two recognized reference sources in the field, HÉCAEN AND (1965) and GOODGLASS AND KAPLAN (1972).

FIGURE 3: Neuroanatomical landmarks on the cortex of the left hemisphere of the brain. (To the left, the anterior pole; to the right, the posterior pole.)



1. lateral fissure 2. curved gyrus (angular gyrus) 3. Broca's area
4. Wernicke's area) 5. primary motor area

a. Broca's aphasia (motor aphasia)

This disorder is characterized by a particular difficulty in expression, but comprehension is generally sufficient. The patient seems to know what statement they want to express, but the articulatory act itself poses a problem. This type of patient therefore speaks slowly, with great effort, and often experiences some difficulty in linking certain syllables. On the syntactic level, their production can take the form of a telegraphic style; lexemes (function words) are often omitted, although content words are generally preserved. This type of oral expression is also known as *agrammatism*.

Here is an example (translated):

- How old are you?

- Sixty-three, sixty-three (63).

- Were you born in Montreal?

- Ah, no, in Saint, in Saint-Baneubi, in Saint-Bt... in Bd... Saint-Bat-

Bi. (Saint-Barthélemy)... anyway.

A Broca's aphasia often presents a lesion in the Broca's area, in cortical tissues adjacent to the posterior and inferior part of the frontal lobe, or in both.

b. Conduction aphasia

Conduction aphasia is characterized by particular difficulties regarding the selection of words and phonemes corresponding to the intended utterance. This type of patient often selects the wrong word or phoneme, then tries to correct themselves. That is why we find many interruptions and self-corrections in these utterances. This patient also

experiences major difficulty with repetition tasks. Here is an example of their spontaneous production (translated):

"It's a morning at nine o'clock in my garden I was planting beans... then I made two-z-rows... two rows... and then the third I... lost the... because I... the beans were there... but I was making... I was putting them, I was picking them... I was taking all that... I was... but I didn't faint... so..."

(HECAEN AND ANGELERGUES, 1965: 69)

Conduction aphasia frequently involves a lesion in the posterior brain region located in the part of the curved gyrus (angular gyrus) and the sulcus closing the lateral fissure near the boundaries of the temporal and parietal lobes.

c. Wernicke aphasia (sensory aphasia)

Although the speech rate of Wernicke aphasics is normal, and these patients rarely self-correct, their linguistic production is not normal. Their speech includes words that are either misplaced or more or less invented. Frequently, their speech does not clearly indicate whether they know what they want to say. Syntactically, their production is described as paragrammatic, meaning that well-formed phrases are found but are syntactically poorly embedded within larger units. Their oral comprehension is generally very impaired. Here is an example (translated):

I was a teacher in Remiremont at that time... so I had all the students to make work, to take care of the vokdisk and also to take care of all the tak they were doing at the same time as me to increase cha... at each note what was needed. And then my daughter was uh because my daughter is very well I don't know if you?

(HECAEN AND ANGELERGUES, 1965:71)

This form of aphasia is caused by lesions generally located in the temporal and parietal lobes, and they often include Wernicke's area.

d. Amnesic aphasia[19]

This type of patient often presents characteristics of a Wernicke aphasic in the rehabilitation phase. They experience particular difficulties in word selection or *"word-finding."* In spontaneous conversation, they often replace desired words with "placeholder words" like "thingy" or "stuff" and produce elaborate circumlocutions to compensate for the unavailability of words. Moreover, they frequently produce antonyms of the sought words ("poor" for "rich," "fair" for "unfair"). The lesions causing this type of aphasia are generally located in the same brain regions that are responsible for Wernicke's aphasia.

e. Global and mixed aphasias

The previously described syndromes are rarely present in their pure forms. It is much more common to encounter patients with a mixed (mild) aphasia showing signs of several syndromes, and patients with a global (severe) aphasia involving profound disorders both in speech expression and reception. These patients suffer the effects of lesions located in several cortical and subcortical regions associated with language.

f. Dysarthrias

To conclude, it should be noted that there are articulatory disorders resulting in imprecise articulation, or monotone oral expressions, or even spasmodic articulation. Such disorders stem from certain conditions of the neuronal system, primarily ensuring

19 Not to be confused with "amnesia," which consists of a total or partial loss of memory.

the connection between the cortex and the articulation organs involving the pyramidal pathways between the primary motor area, the brain-stem, the cerebellum, and certain cranial nerves (nerves V, VII, VIII, IX, and XII) as well as the basal ganglia. These articulatory disorders are referred to as *"dysarthrias."*

2. A model for the localization of linguistic functions

Given the statistical relationship that exists between the localization of lesions and syndromes, it follows that certain linguistic functions related to the expression and reception of language can be assigned to different regions of the brain. However, it must be noted from the outset that the general trends outlined here are subject to a large number of exceptions.

a. Language production

The confusion in discourse structuring, commonly observed in Wernicke's aphasics, most often coincides with lesions in Wernicke's area located in the temporal lobe. The difficulty in selecting the phonological form of words, characteristic of conduction aphasia, is particularly associated with lesions in regions adjacent to the angular gyrus located at the posterior boundary of the lateral fissure and the posterior and superior parts of the temporal lobe. Furthermore, agrammatical disorders, observed in Broca's aphasia, affect more anterior areas, for example, Broca's area in the frontal lobe.

In summary, speech planning (discourse structuring, lexical selection) probably involves all the linguistic areas of the brain: discourse planning (the temporal lobe), selection of the phonological form of words (the posterior boundary of the lateral fissure), and formulation of grammatical structures (anterior regions, particularly Broca's area).

On the other hand, the processes of speech execution - syntactic sequencing of sentence elements, phonological and coarticulatory sequencing, activation of the muscles of the phonatory tract - seem particularly affected by Broca's aphasia and dysarthrias. This suggests that the anterior regions of the brain (Broca's area, the primary motor area) and the nervous system leading to the articulatory organs (pyramidal tracts, brain-stem nuclei, cerebellum, cranial nerves) are responsible for the execution stage.

As we have previously indicated, some nuances must be added to such a generalization. On the one hand, it should be noted that there is considerable variation regarding the precise localization of lesions, and a significant subset of lesion locations contradicts the stated generalization (*e.g.*, anterior lesion affecting planning processes and posterior lesion affecting execution processes).

On the other hand, some processes seem to involve structures distributed throughout an entire hemisphere or even the entire cortex. According to recent research, for example, it is increasingly evident that the processing of vowel production and reception differs from that of consonants in terms of localization. Thus, it is possible to demonstrate relatively clear differences between the consonant productions of Broca's aphasics and those of conduction aphasics (NESPOULOUS ET AL. 1983; in press), without forgetting that measurements of vowel formants and vowel substitutions produced by these different groups of aphasics show no differences between them (KELLER, 1975; KELLER ET AL., 1982; RYALLS, 1984).

b. Language reception

Although it is possible to develop a sequential scheme for the language production

processes associated with brain localizations, the same is not true for reception, as it is less well localized. Several studies (*e.g.,* BLUMSTEIN ET AL., 1977; KELLER ET AL., 1982) highlighted the important role of the posterior language areas (Wernicke's area, the angular gyrus), as well as the secondary role of Broca's area, in the task of auditory perception. Regarding comprehension disorders, it seems that all the brain's language zones (Wernicke's area, Broca's area, the areas surrounding the posterior boundary of the lateral fissure) are almost uniformly involved during this phase (*cf.* GAINOTTI ET AL., 1975; GOODGLASS ET AL., 1979).

Therefore, let us note that language production seems to successively engage different psycholinguistic processes operating from relatively distinct regions at the cortical level, whereas speech reception rather appears to involve a quasi-simultaneous cooperation of all language areas.

Such a difference between *sequential organization in production* and *parallel organization in language reception* can probably be attributable to organizational imperatives. One can conceive of language production in terms of steps accomplished from the speaker's intention and the articulation of utterances corresponding to that intention (*cf*. chapter 6). It is quite different for the reception of the utterance: the only clearly sequential events are the transmission of the auditory signal from the cochlea to the brain-stem and its initial analysis at the brain-stem level. Subsequently, the system seems to apply, simultaneously, a set of phonological, syntactic, semantic, and pragmatic strategies to determine, actively and passively, the meaning of the message.

According to this hypothesis, there is little functional reason to support a sequential processing of the auditory signal, once the signal reaches the cortex from the brain-stem. From there, it is rather a *simultaneous* and *interactive* interpretation of the signal that accomplishes the task of the comprehension phase.

C. RETROACTIVITY

It has long been known that language is continuously controlled by a *feedback system*. The fact that normal speakers regularly correct themselves when they realize they have just made a mistake (see the examples in chapter 6) justifies the presence of such a mechanism in a speech production model. However, until now, relatively little research has been conducted on the precise functioning of this feedback system.

An important problem encountered during this research stems from the fact that the feedback system encompasses several complementary pathways linking the periphery to the central nervous system: the auditory pathway, the tactile pathway (sensation, touch), and the proprioceptive pathway (sensations that inform us about the degree of muscle contraction in the body). If one of these components is impaired, the others compensate for the deficiency, as evidenced by people who become deaf in adulthood. Despite difficulties experienced when articulating sibilant sounds ("hissing": [s, f, z] and [ʒ]), they can nevertheless speak almost normally.

In contrast, a child born deaf (absence of a single feedback channel) will have serious problems during the language learning phase. Without special training, they will probably be unable to speak with hearing people. Obviously, their difficulties are related to the auditory problem, more precisely to the absence of an auditory model as well as the absence of feedback on their own speech (see chapter 5). But to what extent does real-time language production require feedback? Does language production become independent of feedback as language is acquired?

1. Feedback in the experienced speaker

The first of these questions has long been addressed by psycholinguistics. More specifically, it is asked whether speech production is directly influenced by its previous actions or if it would remain unchanged without feedback. In engineering terminology, is language an *open-loop* or *closed-loop* system?

A system is said to be "closed-loop" if its action depends on two factors: first, the action itself, and second, the effect of its previous action. For example, a heating system is generally closed-loop, since the "decision to continue heating depends: a) on the action of the heating mechanism (there is no heat if the mechanism is not working) and b) on the previous action (an automatic setting interrupts the mechanism's action when there is enough heat)." On the other hand, a system is "open-loop" when its action is predetermined and does not depend on the previous action (it is "programmed" in advance).

It is difficult to know whether language strictly falls into the category of "open loop" or "closed loop," as there is currently evidence indicating that its functioning lies somewhere between the two categories. Results supporting a pre-established program come from research on the effects of interrupting one or more feedback pathways. It has already been mentioned that deaf adults who have lost the auditory pathway experience little difficulty communicating. Furthermore, normal subjects who have a blockage at the level of tactile and proprioceptive nerves through an injection of lidocaine (as at the dentist) in the region of the trigeminal nerve (cranial nerve V, which innervates the facial region and thus the lips) continue to speak almost as if nothing had happened (BORDEN, 1979).

On the other hand, results demonstrating the involvement of feedback in real-time production (supporting the "closed loop" hypothesis) come from research conducted by Abbs and colleagues (*e.g.*, FOLKINS AND ABBS, 1975). These researchers observed rapid compensations to movement disturbances imposed on an articulatory organ. For example, they asked their subjects to quickly repeat the logatome [hæpæ]. From time to time, they blocked the action of the lower jaw to observe the action of the lips during the production of (p). As shown in Figure 4, the lips quickly compensated for the inaction of the jaw, and the lip closure required for [p] was accomplished without problems. This type of result suggests that speech production is continuously controlled by the feedback system, which can, if necessary, induce compensation. This position is further supported by examples of self-corrections made after slips of the tongue (see Chapter 2).

BORDEN (1979) and KELLER (forthcoming) propose a resolution to this dilemma through a synthesis of these two positions. According to these authors, experience in the native language leads adults to know "pre-established variants" for all articulations (in common situations), allowing them to create "pre-established articulatory programs" as needed. At the same time, the feedback process constantly monitors articulatory actions and remains ready to calculate compensations to make for any unforeseen disturbance in the vocal tract.

This hypothesis is supported by a study by LINKE (1976) on a patient who underwent bilateral ablation of the trigeminal nerve, resulting in a blockage of lip feedback (Figure 4). This patient was still able to contract the muscles of his face (the motor and facial nerves were not affected) and to move his lips normally for speech production, even though his hearing was interrupted by the introduction of white noise (a continuous rustling) through headphones. In other words, this patient was able to produce labial

articulations without feedback.

However, he was unable to *compensate for a disturbance* caused by a slight electrical discharge on the lips, unlike normal subjects.

The study. As predicted by the hypothesis, the "pre-established" components of speech production (open loop) were not affected, whereas the compensatory components (closed loop) were disrupted.

2. Retroactivity in Learning

Although in adulthood the various retroactive pathways seem to play a secondary role, each of them is nevertheless necessary for language acquisition.

This is evident from studies conducted on children born with deficiencies in the pathways necessary for retroactivity. The example of the deaf and hard-of-hearing strongly supports this, although it is difficult to establish a precise distinction between common problems of auditory perception and specifically those of retroactivity. However some cases of children brought to our attention, born without tactile or proprioceptive ability, were unable to learn to speak (MACNEILAGE ET AL., 1967).

The results of previous studies have implications for learning a second language. It can be briefly stated that the student must, in order to learn a second language well, not only listen to the language but especially hear and "feel" themselves speaking. In other words, they need retroactivity on their own linguistic production. This notion is also found in a study conducted in France by Guy PLASTRE (1972), who compared the learning of the Italian language by beginner-level students, who were forbidden to practice the language during the first two months of their training (to get them used to Italian sounds), with that of students who were able to practice from the beginning. The latter achieved much better results in oral expression.

FIGURE 4: Result of an experiment demonstrating the contribution of feedback in speech production

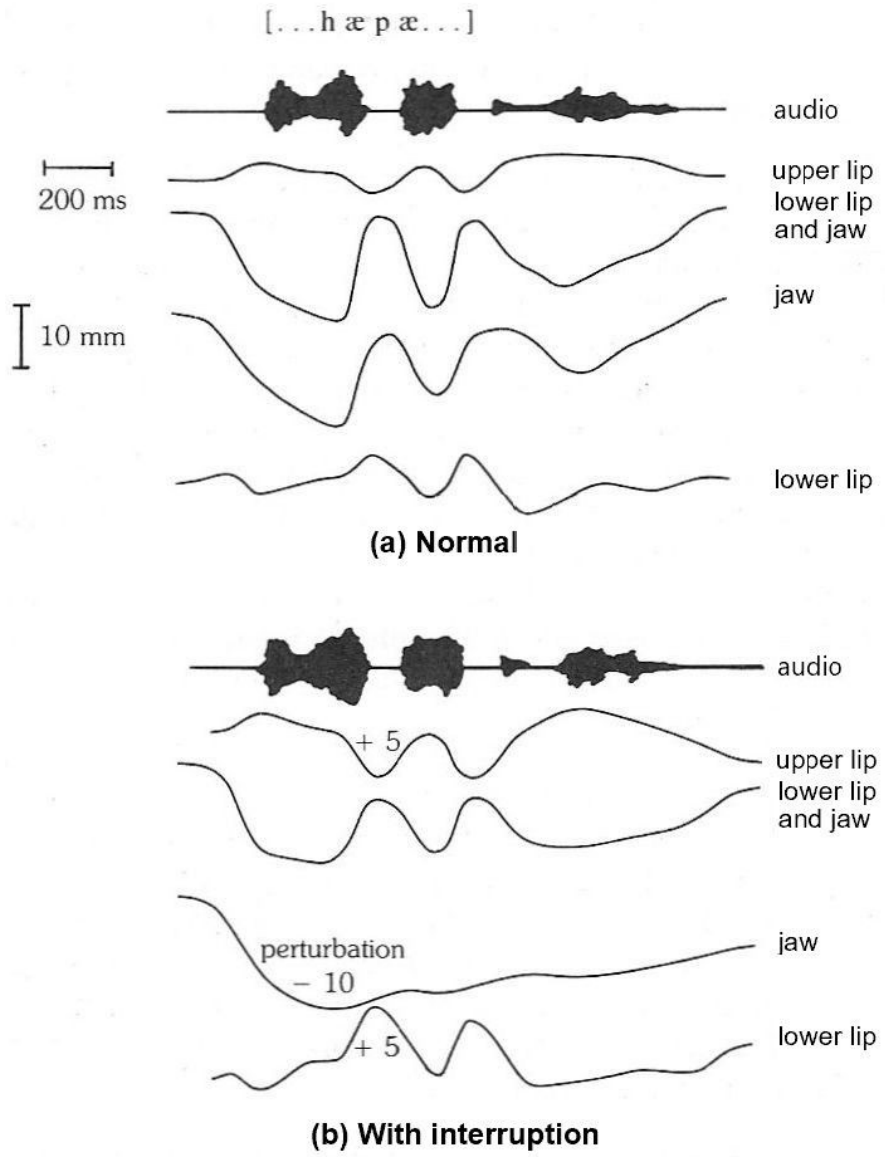


Diagram (a): Oscillographic tracings of the movements of the upper lip, the lower lip (combined with those of the jaw), movements of the jaw, of the lower lip (independent of those of the jaw), while pronouncing the logatome [hæpæ]. The initial tracing (audio) shows the corresponding sound energy: the silent period between the first two sound bursts corresponds to the closure of the lips for [p]. Diagram (b): Tracings of the articulatory movements during the pronunciation of the same utterance, but with sudden blocking of the inner jaw. Despite this disturbance, the lips manage to achieve a complete closure by rapidly modifying their path; each makes a 5 mm compensation to counteract the effects of the block (10 mm).

Source: FOLKINS AND ABBS, 1974.

SUMMARY

In this chapter, we examined the evolutionary factors that probably determine the lateralization of linguistic functions in the brain. It turned out that the lateralization of the language specific to the left hemisphere is not directly related to manual preference

and that it involves different linguistic functions unevenly. Thus, the control of articulation (language execution) is more distinctly lateralized in the left hemisphere than the various speech planning processes and, in particular, in lexical selection.

Different types of aphasia then allowed us to propose a *basic model of the neuronal pathway* of linguistic information in the reception and production of speech. Planning processes probably originate from the posterior regions of the linguistically dominant hemisphere to subsequently involve all the linguistic areas of that hemisphere. Execution processes most often operate at the level of the anterior linguistic areas of the left hemisphere and bridge to the articulatory organs through the subcortical structures of both hemispheres, including the pyramidal and extra-pyramidal pathways, the cerebellum, and the cerebral brain-stem. As for the processes of speech reception, they evidently involve the entire linguistic areas of the brain.

To conclude, an examination of retroactivity revealed that for the experienced speaker in a given language, it probably operates as a control element, whereas it seems crucial for language learning.

APPLICATION SECTION

1. What is the relationship between manual preference and hemispheric lateralization at the language level? Formulate reasons supporting your position.

2. Is the seat of language in the left hemisphere? Answer by supporting your arguments with concrete examples.

3. Outline in a few sentences the pathway of linguistic information in the brain during reception and production.

4. Explain the concepts of *open loop* and *closed loop*, and their application to language.

5. Identify the type of aphasia in the two following transcripts and justify your choices (translated):

PATIENT 1:

Interviewer: Can you tell me about your illness?

Patient: It's [dipisil]

Int.: M... m...

Pat: The, I at is [iszi...si] (here) and [is-]...he... if I have a...how...the, the s-sun...

Int.: M... m...

Pat.: ... sun

Int: The sun?

Pat.: I have to [i-] hit the [ol mɛ-] the m- [lɛt] [l] (the) head, the head (headache).

PATIENT 2:

Int.: And is this the first time you have come to this hospital?

Pat.: e... for the moment... well it's yesterday that I came... t... m... three times in in three or four times. It was yesterday that by (for) some... doing tests of... to see how one behaves... the reaction that concerns me, you know.

Int: M... m...

Pat.: That’s what they do, in principle I don’t know, I’m not a doctor, huh?

6. The following data represent successive approximation attempts to pronounce a word (the target word) in a repetition task. It concerns a patient with conduction aphasia. For each of examples, say if the production approaches the target word. What are your evaluation criteria? Give the different steps of your analysis.

Target word	***Attempts***
[pɔrtɛ] "portait"	[a-c], [pa], [pɔm], [prɔmɛ], [prɔ], [avɛ], [pɔr], [pɔrn]
[ipopotam] "hippopotame"	[a], [ipis], [ipo-to], [opo], [api], [pc], [ipopopa], [ata], [tɔmto], [tɔm], [tom], [m-tam], [tam]
[sɛptãbR] "septembre"	[sɛtpart], [sɛt-pa:R], [setpa]
[ʃod] "chaude"	[ʃ-s], [ʃwo], [ʃobR], [s]

FOR FURTHER READING

Lateralization

KINSBOURNE (1978).

Localization

KERTESZ (1983).

SEGALOWITZ (1983).

Aphasia

HÉCAEN & ANGELERGUES (1965).

LECOURS, LHERMITTE et al. (1979).

Retroactivity

BORDEN (1979).

Chapter 9. The Psycholinguistic Aspects of Communication

In the previous sections, we analyzed the processes of language production and reception. Many current studies address this aspect of psycholinguistics. However, it seems to us that they neglect another aspect that we consider equally important, namely the way in which an individual uses these linguistic functions in *active communication between speaker-listeners*. We thus seek to understand not only the detailed functioning of our linguistic system, but also the way in which the individual employs this system in real communication situations.

Given the glaring lack of psycholinguistic research in this area, we will have fewer opportunities to refer to detailed observations, unlike in most other chapters. We will thus resort to various fictional examples and logical argumentations. Nevertheless, this will hardly hinder our highlighting of certain major principles.

An individual, when engaging in communication, is strongly influenced by the physical, psychological, and social context, as well as by the sociolinguistic conventions of their culture. We will address the choice of communicative strategies in relation to these contextual factors, personal and social goals. We will examine pursued goals in manifested as well as non-verbal aspects of acts of communication.

A. THE PRESUPPOSITIONS OF ORAL COMMUNICATION

Let us approach the question while clarifying certain assumptions related to the act of communication.

We can define oral communication in terms of the agents involved, the actions performed, the purpose of these acts, their effects, and their context. We can observe that the essential aspects of ideal communication involve at least two participants who are engaged in a social situation, where the goal lies in the transfer of information by means of a common code and a given context. This transfer leads to a change in the understanding of the discussed topic in at least one interlocutor.

We use the term "oral communication" in its broadest sense to include any conversational situation, provided that there is a transfer of information involving at least two people. The case of an individual conversing with themselves is only a particular case of this rule, since it artificially posits the presence of an interlocutor who is none other than a part of themselves. By focusing on the expression "change in the understanding of the topic," we wish to emphasize that this includes any deepening, enrichment, or broadening of the understanding of a given topic.

Several aspects of this definition invite a more in-depth investigation. Since the psycholinguistic perspective targets linguistic actions, we will first focus on the actions of various speakers, and then on the communication difficulties that speakers must face. From this, we will be led to discuss the strategies a speaker uses in pursuit of successful communication, thereby trying to any overcome obstacles. Finally, we will address the question of the listener and their contribution to communication.

Let us briefly note that the conception of communicative acts presented here is integrated into a broader conception of voluntary actions (see chapter 5). It assumes that the act of oral communication represents only one of the various means available to an individual to achieve their goals. Indeed, there are other means, such as gestures, facial expressions, and a wide range of other means. We will have the opportunity to address some aspects of non-verbal communication in our explanations.

B. POTENTIAL DIFFICULTIES IN COMMUNICATION

The act of communication must face a large number of potential obstacles that we can summarize as physical, social, and psychological difficulties. In fact, these difficulties are so significant that it is surprising that interpersonal communication is possible at all.

1. Physical difficulties

Physical difficulties constitute all the disruptions in oral communication that occur during the transmission of the message from the speaker to the listener. This transmission channel begins physiologically at the neurological and articulatory system of the speaker, passes through the air and potential instrumentation, and reaches the auditory and neurological system of the listener.

Telephone communication provides a good example of a physical obstacle for two main reasons. On the one hand, the telephone does not allow visualization of the speaker. As we mentioned in chapter 7, visual signs assist and complement the

understanding of an oral message, especially when it is disturbed. Thus, the mere fact that the telephone reduces communication acoustically constitutes a considerable limitation to verbal communication.

The telephone removes certain frequencies from the signal for transmission economic reasons, because a single channel can then transmit multiple conversations simultaneously.

In the past, filtering mostly affected high acoustic frequencies (for example, frequencies above 3300 hertz) and these frequencies particularly characterized fricatives ([s], [θ], [f], etc.). So some words distinguished exclusively by such sounds were sometimes confused (for example, "think" and “sink” or "fun" and "sun"). With the advent of cell phones, this issue has radically changed; however some channel limitations have remained. It is still possible to lose distinctiveness when a phone signal is degraded, or when speech frequencies touch frequencies outside the channel's designated bandwidth.

On the anatomo-physiological level of the communication pathway, we also observe a large number of potential sources of interference. Anyone trying to eat a sandwich while speaking reduces their chances of being understood, since it prevents the free movement of their articulatory organs. The comprehension abilities of a person who has suffered damage to the neurological or muscular systems corresponding to the anatomical regions of language (various lesions of the brain or relevant neural pathways) are also diminished.

These illustrations of potential difficulties obviously do not exhaust the list of physical obstacles to any communication. Consider only the partially deaf person or the mother speaking to her child from an adjacent room, or two mountaineers communicating from one summit to another. Each person faces a physical constraint that will necessarily suggest particular communication strategies.

2. Social difficulties

Since the act of communication is fundamentally a social act, oral communication can also be disrupted at this level, concerning three different aspects of human interaction.

First, the success of communication depends on cooperative action between participants, and this cooperation can be defective. Second, good communication assumes the application of certain social rules among participants, and a failure to observe these rules reduces the chances of successful communication. Finally, it depends on shared learning with other members of the community: communications referring to shared learning are easier to understand than those referring to singular learning.

a. The cooperative action of communication

(1) Communicative reinforcement

The example of telephone communication illustrates well the cooperative aspect of communication. Receiving information from the other does not mean listening silently or passively. It is essential to reinforce the absence of the other's visual information by oral manifestations of one's presence and attention. This is why certain expressions, such as "yes," "uh," serve to establish and maintain the communication link. Indeed, as a general rule, the cessation of such signs causes concern in the speaker, which may

manifests as follows: "Hello, are you still on...?" Typical reaction of this cooperative aspect show that the communicative link is being tested.

(2) The contribution of non-verbal communication

When communication takes place face to face, the manifestations of the exchange are more flexible and more complex. We then observe not only the acoustic signs, but also body language including all the gestures, body position, and facial expressions. The impact of gestures in communication deserves particular attention.

A look back at history shows that it was not until the 1950s that researchers attempted to integrate gestures into the study of interpersonal communication. This is the case of American anthropologists Ray Birdwhistell and Edward Hall (cf. WINKIN, 1981), who most often tried to formulate an analytical framework for gestures and their relationship to language. For them, work begins with this question: among all possible gestural behaviours, which are culturally selected to form meaningful sets for communication? This approach fundamentally resembles that of the linguist who, faced with the wide range of possible sounds, tries to identify, analyze, and characterize the few dozen sounds used by a given culture to form a particular language.

The various studies conducted by these researchers, to whom should be added the names Bateson, Jackson, and their intellectual successors of the second and third generations whom we will not cite here (cf. WINKIN, 1981), showed that these gestural and expressive codes varied from one culture to another and from one social group to another. Taking these signs into account, we direct our communication in a specific way, assess the reaction of our interlocutors, and enter into or refuse the act of communication. It is easy for us to trace the gestural origin of expressions such as "I read it in his eyes," "you just have to look at him," "he looks honest," or even "I have no trust in that kind of smile," reflecting our perception about the "other person."

Other observations focused on the analysis of spatial behaviour (ARGYLE, 1975) revealed how individuals signal certain attitudes through their spatial position. Some experiments recorded by Argyle demonstrated that moral intimacy was proportional to the physical distance between people. The stronger this intimacy, the smaller the bodily distance.

As an example, one only has to refer to the social rules governing our behaviour. Let us take the various situations corresponding to different positions around a table. Two people in a conflict period or adopting a competitive attitude may place themselves face to face: this is the signal of a confrontation, a tense situation. Some other behaviour will be expressed more by physical distance, where individuals avoid any contact. As for people who have cooperative or conducive relationships, they might position themselves at an angle around a corner of a table. The cooperative or non-cooperative aspect, as we can see, is expressed in many ways. There is often no need to speak to signal either an offensive or a relaxed attitude.

(3) The cooperative aspect

Communication strongly depends on the willingness and the desire to receive a message. The actions of a speaker might be in vain in the face of the listener's firm disposition not to receive a message. Therefore, cooperative action must follow the evolution of communication. Indeed, it is possible that a listener stops understanding, during a conversation, what is being said or transmitted to them. In a normal situation, the listener can intervene so that communication is reestablished. However, there are circumstances where this is difficult, even impossible (for example, with a large audience); from then on, significant parts of the communication may be lost.

Another lack of cooperation is possible: that of the speaker. Some speakers excel in their verbal skill by they talking incessantly. They give no glance to the participants, and expect no questions. They do not react to signs of boredom manifested by yawns, furtive glances at the watch, tidying papers, etc. Like a train speeding along, they flee the context, their environment, and continue their inexhaustible verbal flow, despite the audience's exhausted tolerance. The audience that no longer receives any sign of consideration, may send back similar sins of their disinterest, objectively, verbally or subconsciously.

b. The social rules of communication (Grice's rules)

Communication can be interrupted by a transgression of the social conventions governing it. SCHEGLOFF (1968: 1079) relates the anecdote of a woman who, having received a number of impertinent phone calls, took to answering the receiver without identifying herself, which eventually annoyed those around her. By acting thus, she broke a necessary social convention of the time which meant that the person who picks up the phone invites a verbal exchange.

This convention has changed in the meanwhile. Given the frequent inopportune phone calls that are now displayed on the phone, many persons do not identify themselves any more, or they do not answer the phone at all.

Within such social conventions, some of these rules govern the interpretation of a message; these are called conventions of semantic implication or maxims (implicatures). The philosopher GRICE 1967 (cited in SPENCE, 1979) categorizes them into four fundamental types: quantity, quality, relation, and manner.

(1) The quantity rule

The quantity rule states that any contribution to a conversation must be as elaborate or as limited as appropriate to the evolution of the meaning of the conversation. Thus, the question: "Do you have the time?" generally prompts a response such as: "Yes, it is eight fifteen." The affirmation "yes" is not sufficiently complete as an answer to satisfy the meaning implied in the question.

Similarly, the response: "Yes, it is eight hours, fourteen minutes, and thirty-seven seconds" in the context of an everyday conversation would violate this same rule, but for the opposite reason to that of the first response. In such a situation, this answer would be considered too detailed compared to the idealized pattern for this type of conversation.

However, note that irony, teasing, and sarcasm are violations of this rule. These are then conscious, chosen, and controlled transgressions. It is no longer a matter of a poor internalization of the quantity rule. On the contrary, it is a play on the listener's expectation that this rule be respected. The transgression then becomes another rule paired with the first, and the relationship of the second rule to the first constitutes the link and articulation of the intentional linguistic game.

(2) The quality rule

The second rule of Grice, the quality rule, relates to the truthfulness of the message. In Western thought, the basic assumption is that what is said should conform to the truth, a conception found in the philosophical statement of the pre-Socratic philosopher Parmenides: "Being is, non-being is not." It is obvious that the use of metaphor or storytelling would violate this rule if, implicitly and deeply rooted in us, it were not true that such devices are consciously used to distinguish what is fictional from what is conceived and accepted as true.

A violation of this rule in everyday life makes communication extremely difficult. BROWN (1973a) reports several observations made in a psychiatric hospital. One of the patients in this hospital, a young man who seemed particularly happy, told him: "When I get out of here, I will take a plane to Scotland, where they are filming the movie *Fiddler on the Roof*, because I strongly wish to get the lead role."

This statement contains three violations of the quality or truth rule. First, the movie *Fiddler on the Roof* was already finished at the time the young man was speaking; second, Scotland was not a likely location for the filming of this movie at that time; and third, the young man in question was far too young and inexperienced to be entrusted with the lead role in the film. Brown suggests that in normal speech, anything that is not plausible or true is continuously censored, and that schizophrenic speech is precisely characterized by such violations of the quality rule.

(3) The rule of semantic relation

The third rule of Grice stipulates that in normal communication, there is a semantic relation between the preceding elements and the subsequent frequent elements of the discourse. In other words, that there is a natural and logical progression regarding the subject discussed. Thus, a statement like "I'm hungry" is not a relevant response to the question: "When are you going to buy yourself a new umbrella?" since it is not semantically consistent with the question; one would deduce that the person who answered is avoiding the subject or did not hear the question.

(4) The rule of manner

Finally, the rule of manner specifies how communication should proceed. For example, in clinical psychology, the therapist generally maintains some distance in their statements, whereas a more active participation is expected from a union representative. A violation of the communication expectations established by the rule of manner will often weaken the effect of the communication. A talkative psychotherapist would transgress the rule of manner established by their intervention and role. Similarly, a union representative who is too silent at times when they should not be judged ineffective, according to the rules prescribed by their role.

The form and importance of these rules are subject to cultural variations. In parts of Asia, for example, the rule of quality is often secondary compared to the rule of manner, meaning the way (polite and non-abrupt) a message should be delivered takes greater importance than the literal adequacy between the message and the facts. In the West, the opposite tendency prevails.

On the other hand, considering the example of the therapist, it is clear that certain forms of psychotherapy require more or less intensive interventions from the therapist. Nonetheless, it remains evident that, faced with a given social rule in a culture or profession, the transfer of information always takes into account, more or less explicitly, the social expectation of the listener.

c. Sharing learned knowledge

The last social aspect of communication draws on the sharing of learned knowledge. First of all, it involves the use of the same linguistic code, both orally and referentially. To appreciate the importance of this sharing, one must cite as examples some of the differences that exist between the French used in France and as it is used in of Quebec. Although close, both nevertheless refer to sometimes distinct references.

Thus, a Quebecois woman visiting France who asks for "une brassière" in a department store will be directed to baby items, because in France, a "brassière" is not

a women's undergarment but rather a baby garment that fastens at the back. This kind of misunderstanding is not unique. In the field of clothing, "les bas" can represent another source of confusion. The item "bas" in Quebec corresponds, in France, to a "sock," and for some French, the word "bas" refers to the object that Quebecers call "collant" (tights). Moreover, a French person in Quebec wishing to obtain socks will be given what are called slippers.

Less obviously, and certainly more seriously as well, the sharing of learned knowledge poses the problem of cultural references. These differences are often so subtle that it is sometimes difficult for us to realize that we do not share the same concepts as those of our interlocutors.

The concepts "democracy," "freedom," "neutrality," "honesty," and "fidelity," qualified as abstract, will generally create as much discrepancy in definitions or representations as if they originated from different cultures.

Therefore, we could say that learned knowledge rests on the sphere of referents, both real and symbolic or imaginary. The universe of comic strip characters, expressing one of the possible manifestations of the imaginary, allows us to observe that an individual who grew up in a Francophone society would not have the same experience of the imaginary world as that of an individual from North American society.

Further, any reference to the striking resemblance of *Dupond* and *Dupont* will generally be in vain for a Americans, even if they speak impeccable French. Likewise, any reference to a telephone booth serving as a place of supernatural transformation (a place where *Superman* changes from an ordinary character to a super-powered character) will often need to be explained to Francophones.

Finally, there are considerable differences regarding the rhetorical approach chosen by each speaker. For example, a mathematician, a philosopher, or a lawyer will preferably choose a logical approach in their discourse, while an artist, a literary person, or a musician will rely more on the intuitive reaction of the listener. These preferential approaches can be so different that explanations presented in terms of the rhetorical approach of one group will not even be acceptable to members of another group. A speaker concerned with being understood more widely will probably take such differences into account.

3. Psychological difficulties

The psychological level constitutes another source of difficulties. It is possible that an interlocutor does not feel motivated for an exchange, or that a partner has interrupted all communication with the other partner, or that during a labour conflict, a negotiator withholds information. These are all delicate psychological situations that will disrupt the transfer of communication.

On the psychological level, as well as on that of social interactions, the personal objectives of the speaker, as well as those of the listener, can be ambivalent, ambiguous, subtle, or even difficult to identify. Thus, communications with a commercial purpose provide us with an illustration of well-hidden motivations in their messages.

The following case offers us a good example of what a modern theory of communication called *crossed messages* (the concepts presented by Bateson, see WINKIN, 1981: 38): a salesperson can formulate an apparently rational message (“this car can reach 200 km/h”), while carrying another suggestive message that appeals to the speaker's power of transgression (“it will make you look good”).

These "crossed messages" are common in everyday life, and they can disrupt communication to the point of becoming contradictory. This is called *“double bind”* which weighs on the receiver who, in decoding it, is placed in a truly untenable situation, that is, at an impasse. The most famous example of a double bind given by Bateson is none other than that of the mother who says to her child: "Aren't you going to come kiss your mommy?" while adopting a posture (arms crossed) and an intonation of voice that contradicts it. One could multiply such examples. Thus, the injunction "be spontaneous" seems to promise better communication by invoking an order that in this way contradicts the message.

By such a glimpse at disruptions of communication, it is evident that the obstacles that can interfere with the course of the act of communication are numerous. The physical, social and psychological conditions should be good for an act of communication to truly succeed, that is, for it to produce a change in understanding of the topic in the listener. We have thus illustrated the importance of an intact physical channel, of adequate communication reinforcement, of concordant nonverbal gestures, of observing rules of communication, of sharing linguistic and cultural knowledge, and of motivation and non-ambiguity toward the act of communication. A deficiency with respect to any of these factors, separately or jointly, can harm good communication.

However, good communication is not impossible. A perpetual flow of information continues to be transmitted every day. Some speakers, more gifted no doubt, know how, despite difficult situations, to overcome obstacles and create favourable grounds. They use strategies with skill, whereas others less gifted struggle painfully.

C. STRATEGIES SPECIFIC TO COMMUNICATION

1. Speaker strategies

We all know good communicators. Who has not been astonished by the communicative force of General De Gaulle? Who has not experienced the penetrating voice or personal conviction of Gilles Vigneault? These first-rate communicators do not seem to know the many obstacles related to communication that we have just described. They radiate an energy that surprises and fascinates us, even going so far as to influence some of our opinions or our attitudes.

The explanation of such a dynamic is a subject on which thinkers have been reflecting since ancient times. The art of rhetoric was addressed by philosophers such as Plato and Aristotle, and by politicians like Cicero. These individuals, based on their own experience in politics, law, or sciences, attempted to isolate some factors determining the success of communication. Much later, during the last three centuries, a significant number of philosophers and educators have reevaluated this question. However, it was only during the last half-century that empirical research, inspired by coherent theories referring to psycho-sociological interactions between interlocutors was been conducted.

Even today, it would be presumptuous to believe in the existence of a general and relevant theory that would account for all the psychological, sociological, and linguistic factors of communication. Nevertheless, we can review a number of them and propose them as influencing factors, relative to the objectives and actions of the speaker and the listener.

a. The objectives and challenges of the speaker

We have only vague information concerning the objectives pursued by a speaker. Manifestly, the host of a television news program seems to want to inform us, just as a clown wants to entertain us, and a politician on an electoral campaign wants to convince us and instill their point of view. What other goals could intervene for each of them? Would it be impossible that the host acts only because of the good remuneration of their work, or to satisfy a certain need to showcase themselves? Does the clown not indirectly desire to establish a disguised report of their perception of the human condition? As for the politician, do they not have some financial interests to promote via a general assembly?

It is certainly not the psycholinguist's role to try to answer all these questions. Let us only remember that among other things, the speaker's objective consists of circumventing, overcoming, or combating the many obstacles of communication, being sensitive to feedback information coming from their interlocutors, respecting the social rules of communication, and building their message in familiar and accessible terms. Moreover, they will seek to face a possible lack of interest or a certain mistrust and, in doing so, they will be encouraged to seek an engaging formulation and to carefully select their mode of argumentation.

b. The actions performed in communication

The actions performed in view of a good conversation closely follow the difficulties described above, as they are best summarized in terms of adaptations, that is, of various palliative actions undertaken to circumvent or avoid these obstacles.

(1) Adaptations to Physical Difficulties

Palliative actions, in response to any physical defect, have been the subject of intensive research in the field of telecommunications. These studies led, during the twenty years after the Second World War, to the formulation and application of *information theory*, a theory concerning the transfer of information between interlocutors (SHANNON AND WEAVER, 1949).

Although the mathematical formulation of various aspects of this theory is rather technical, certain constituent concepts are accessible and relevant to decisions made by speakers facing physical obstacles. These particularly involve two conceptual relationships: one concerns the relationship between channel capacity and the encoding cost required (the *principle of sequencing*); the other specifically addresses the relationship between channel noise and the volume of signal needed to combat this noise.

We will discuss these principles with a few non-technical examples.

(a) The Principle of Sequencing

Suppose a group of experienced mountaineers is climbing one of the peaks of the Himalayan range and they want to stay in contact with the base camp. Imagine, moreover, that for unfortunate reasons, these people can no longer use radio transmitters and are forced to resort to a large yellow flag as a means of communication. The appearance of the signal twice a day at a fixed time would mean that everything is going well, and the absence of a signal would imply serious problems.

Such a communication system involves the use of a single distinctive sign. This sign is either present or absent. In terms of communication theory, this is the simplest transmission of information possible, based on the presence or absence of a specific

signal. This is called "one bit of information," a *bit* having only two possible values (“bit” corresponds to “binary unit”).

If this team of mountaineers had two signals of different colours (two bits of information), they would be able to considerably improve the level of communication. They could distinguish four distinct messages. For example, using a yellow signal and a red signal, they could agree on the following code:

(a) yellow and red flags = everything is going well

(b) yellow flag = some problems, but the ascent continues

(c) red flag = serious problems, we are returning

(d) no signal = call for help.

We observe that with each addition of a distinctive sign, or each time a bit of information is introduced, the possible number of messages doubles. Three signals would provide eight possible messages: four signals would provide sixteen; five signals would bring the number to 32 possibilities; etc. By analogy, if one wished to distinguish 26 key letters of the alphabet, the use of five bits would suffice (2 x 2 x 2 x 2 x 2 = 32). Similarly, if one wanted to differentiate and represent all the words of French, twenty distinct bits would probably suffice, since they would allow 1,048,576 codings.

However, there are practical limits to simply adding bits, since the simultaneous transmission of a large number of bits poses a considerable problem. In long-distance telecommunications, it would be very costly to use twenty separate lines to carry the twenty bits of information distinguishing various words (regardless of the difficulty of encoding and decoding). Similarly, during articulation, it is simply impossible to produce twenty different sounds at the same time. The vocal tract can produce only one sound (phoneme) at a time, except for coarticulatory effects described in chapter 7.

For these reasons, the information should be restructured so that it can be transmitted through a single channel. This implies a transformation of the given number of bits from a simultaneous form to a sequential form. In telecommunications, the international standard (*e.g.*, ASCII code in serial mode) provides sequences of eight electrical signals to represent all the letters of the alphabet, plus a certain number of control codes. It is then said that the transmission involves "bytes" of eight bits, where each distinctive byte can represent a different letter.

(b) Sequencing in oral communication

Articulatory communication involves the same sequencing of information, but it is even slightly more advantageous than the transmission of alphabet letters in telecommunications. The latter is based on the transfer of only two types of signals (*i.e.*, the presence or absence of a voltage), whereas oral communication involves up to 80 different signals (*i.e.*, phonemes). Thus, French words do not need to be encoded in terms of sequences (in bytes) of *twenty* signals with distinctive values, but with an average length of only about *six* phonemes.

The approximate calculation is as follows: French distinguishes about 38 phonemes; each phoneme therefore corresponds to a little more than five bits of information (recall that five bits distinguish 32 values). To be able to distinguish one million words[20], it would require four phonemes per word (four times five bits allowing 1,048,576 possibilities). However, this would assume that each phoneme could take any position

20 One million words is a very approximate and probably generous estimate of the contemporary French vocabulary, including recently acquired technical terms.

in a word, which is obviously not the case (*e.g.,* in French no word is made up of four consonants).

Given these sequential restrictions, we arrive at an average of about six phonemes per word. As a general rule, we observe that languages have a certain number of very short and frequent words, and a large number of other words that are very long but appear less frequently in speech. To summarize the principle of sequencing, we can assert that the various elements of a message are transmitted according to the inherent capacities of the channel used. Trying to exceed the channel's own capacities requires a restructuring of the message so that it conforms to the specific conditions of the system.

This leads to the following rule: the more limited the channel's capacities, the longer the message becomes. Furthermore, it is observed that speakers apply this principle in cases of physical difficulties. Thus, when a speaker slows down their rate, or spells out a known word on the phone, they reduce the bits of information per second and thereby facilitate listening.

Nevertheless, our linguistic system also seems to present a threshold limit to the understanding of slowed messages. Information presented very slowly is indeed more difficult to understand than information offered at a moderate rate. Transmitting a message by spelling often requires the aid of a pencil and paper. The principle of sequencing also applies to the reorganization of discourse structure (see chapter 6) to overcome comprehension difficulties.

Often, we facilitate the understanding of a long sentence by splitting it into at least two parts. As an illustration, consider the following sentence: "Last night, after work, when we were at the restaurant, where I think I saw the cool guy with the black glasses and the big nose that you described to me the last time we went to get vegetables at Ginette’s." Although grammatically acceptable, we rarely hear such sentences. On the other hand, we frequently observe a segmentation such as: "Do you remember the last time we went to get vegetables at Ginette’s? You described a cool guy with black glasses and a big nose. Well, last night, we were at the restaurant after work and I think I saw him." Thus, segmentation makes all information accessible by avoiding too many embeddings that would discourage a listener.

(c) The relationship between signal and noise

The second major principle borrowed from information theory concerns the relationship between signal and noise. In brief, this principle states that every channel contains sources of noise that can obstruct the transmitted signal. The more significant the noise, the less of the signal will be received. The mathematical formulation of this principle in information theory has made it possible to precisely calculate several aspects of the communication channel, the transmission capacities of telephone lines, the limits of human hearing, and the capacities of tactile perception.

In terms of human communication, this principle predicts two additional ways to counterbalance physical difficulties in speech transmission: one is to reduce the noise level, and the other is to increase the volume of the emitted signal. In the presence of noise, it is often enough to speak louder to be well understood. However, it should be noted that voice distortion generally becomes noticeable when speaking very loud, and beyond a certain point, the effects of distortion will cancel out the effectiveness of the voice amplification strategy.

It should also be noted that this strategy serves to strengthen a signal that is adequate from the perspective of the transmission channel and to reinforce a signal that is inadequate in terms of its energy: by contrast, the sequencing strategy serves to adapt

a signal whose energy is adequate to the capabilities of a limited channel.

(2) Adaptations to social difficulties

If one of the major social difficulties results from divergence, and the best way to counterbalance this difficulty would be to seek to establish *congruence*.

Indeed, a number of studies have shown that congruence between interlocutors amplifies communication. FRANK (1979), in a specialized review on the variables governing the benefits of psychotherapy, emphasized that the success of a therapy strongly depends on the degree of congruence that exists between patient and psychotherapist regarding the *mode of interaction* used.

Paradoxically, the degree of agreement between patient and therapist, in relation to possible *outcomes in psychotherapy*, does not seem to be linked to the success of the therapy. We can speculate that communication between patient and therapist bears fruit when they agree on their mode of social interaction, but that agreements based on questions of the substance of the therapy is less decisive. Adaptation to social difficulties (as defined above) seems to occupy a very important place in human communication.

It is still difficult to specify the salient variables of congruence that influence the transmission of information between interlocutors. It would certainly be interesting to define in more detail what constitutes a *winning mode of communication*. Huguette Maisonneuve, a contributor to this volume and former master's student at the University of Quebec in Montreal, performed an interesting experimental study in this regard (MAISONNEUVE, 1983). She tried to identify the elements that, at the discourse level, would have a persuasive effect on the interlocutor by comparing the modes of argumentation of subjects who had a persuasive effect with those who did not.

The analysis was made from a corpus of conversations between two individuals (about 60 sentences per conversation) who had to form an opinion on three thorny questions (*e.g.*, “What would be your acceptable degree of risk of receiving a fine, when parking your car in a prohibited zone when you're in a hurry?”). After each had previously established the acceptable degree of risk, the two individuals were placed in a conversational situation. They then had to try to convince each other mutually of their criteria and reasoning. Moreover, the subjects had only thirty minutes of discussion for the three questions, with the objective of reaching a consensus for each question.

At the end of the experiment, the two individuals had to separate again and to secretly write down their positions resulting from the exchange. During the final evaluation of the experiment, the "winner" was considered to be the one who succeeded in influencing the position of the other participant the most. During the tabulation and analysis, conversational sequences indicating no change were not taken into account, with the focus being more on the argumentative articulation that could lead to a tipping effect regarding the modification of the stance.

The research results showed that the "winning" subjects in the discussion tended to be less ambivalent, to make more interventions, and to deliver more varied and original interventions.

The predictive values of these variables distributed the roles of winners and losers from the first quarter of the discussion. Although each of these variables taken individually was not found to be reliable and sufficient on its own, the combination of these three variables, on the other hand, did predict 75% to 77% of the winners from the first quarter of the discussion.

We therefore perceive linguistic actions serving sociological and psychological objectives: the speaker who engages an audience with a varied, well-supported, and non-ambivalent presentation probably succeeds better, because they establish congruence with their interlocutors (a social factor), as much as they engage their interest and counterbalance their mistrust (psychological factors).

These conclusions are supported by some additional research indicating that these two aspects of oral presentation are particularly important, namely the mode of argumentation and the mode of presentation. Thus, ZILLMAN (1972) concludes that "rhetorical questions in negative forms ("isn't it?", "no?", etc.) would be more persuasive than those in affirmative forms. Questions dissipate the persuasive intentionality and thus circumvent the listener's mistrust.

On the other hand, Zillman finds it likely that the mode of presentation also influences the degree of acceptance during communication. An elegant presentation, delivered at an acceptable pace, sprinkled with a minimum of hesitations and slips, will have a better impact than a difficult presentation, presented too fast or too slowly. These conclusions, although still very little tested experimentally, seem to align with the same social and psychological factors we have already highlighted.

(3) Adaptations to psychological difficulties

In the context of psychotherapy (which can be perceived at certain levels as the development of multidimensional strategies aimed at convincing an interlocutor), several strategies were developed, specifically with the intention of counterbalancing the harmful effects of mistrust or lack of attention. This type of strategy is an integral part of the approach in psychotherapy developed by the eminent American hypnotherapist Milton Erickson. This approach is systematically taught in contemporary clinical psychology (*e.g.*, ERICKSON, ROSSI AND ROSSI, 1976; ERICKSON AND ROSSI, 1976). We will look at it more systematically.

Although it is obvious that we are not yet at the end of the discussion about what precisely a *hypnotic state* is, it should be noted that a hypnotist can induce a subject to make surprising internal changes through hypnosis. For example, many people can be made to keep their arm submerged in ice-cold water for long periods without feeling any pain, whereas other non-hypnotized people would find the experience unbearable after half a minute. It follows that the procedure of hypnotic induction represents a particularly effective communication strategy that manages to bypass difficulties related to the listener's mistrust or lack of attention.

Certain aspects of this approach will therefore be retained and will be the subject of our discussion regarding strategies that can be used to increase the persuasion of a communicative act.

Let us note that certain parts of a hypnotic induction are, above all, designed to establish congruence between the hypnotized subject and the hypnotist: thus, the familiar "you" and the collegial "we" (*e.g.*, "we are going to try a little experiment together...") are linguistic signs used to enhance the shared commitment to the therapeutic process. But what interests us primarily relates to the linguistic formulation of the induction. We will see that the formulations chosen by Erickson are such that they allow the hypnotized subject a certain latitude of interpretation; this clearly bypasses the subject’s mental oppositions and makes it difficult for them to adopt a systematic disagreement strategy.

On the other hand, Erickson uses interpretative ambiguities and unusual semantic sequences in order to create, at specific moments, a slight confusion in the subject.

The subject will then feel disoriented and unable to systematically oppose the induced message or requests.

To illustrate these principles, let us consider in detail a passage from a hypnotic induction by M. Erickson (E = Erickson, J = John):

“- E: You can uncross your legs.

- J: Am I going to do it?

- E: Could you? Elbows to the body. Now you let your hand rest on your thigh. Now look at this horse. Do you see it?

- J: (Nods affirmatively.)

- E: There is no reason to move. No reason to speak. All you need to do is look in the direction of this horse. And by staying like this...silent and quiet...

(a little later...)

- You will remember something that happened a long time ago. When you went to school for the first time, you were faced with the task of learning to write the letters of the alphabet. It seemed like an extremely difficult job. All those straight, curved, angular lines. And what made this task even harder was that there were printed letters, handwritten letters, uppercase, lowercase. Gradually you formed a mental, visual image that is located somewhere in your brain.

At the time, you didn’t even know what a mental image was. And you located it there permanently. You really don’t need to move. You don’t need to speak. You had to learn the letters of the alphabet in the same way. And what made this work even harder was that there was a certain order in learning the numbers.

Isn’t 6 just an inverted 9? Isn’t 9 just an upside-down 6? Isn’t 5 just a 2 turned upside down? And which comes first, a 3 or a 4? You don’t need to move. You really don’t need to speak. Just look in this direction. During the time I have been talking to you, there has been a change in your breathing. The rhythmic beating of your heart has changed. Your motor reflexes are no longer the same. And when I say the word 'now', you will close your eyes.

NOW and you feel very comfortable, the more comfortable you feel, the more deeply you will enter trance...”

Source: Associate Trainers in Clinical Hypnosis, Syosset, N.Y.

This induction is relatively easy to analyze. We observe that Erickson often uses formulations that leave a great deal of freedom of action to the hypnotic subject: “you can uncross your legs,” “elbows to your body,” or “you don’t need to...”. It is also possible that the induction produces the opposite effect: “look at this horse, you went to school,” “you were faced with.” The objective is to confuse the subject: can he think what he wants, or is he obliged to let his attention be directed?

Erickson induces confusion even more overtly when he quickly jumps from a hypnotic instruction to suggestion, and when the suggestions themselves are chosen in a way to disconcert the subject. From a quarter to half of the text, he reminds the subject of previous learning.

Then suddenly, he moves from a hypnotic instruction to returning to the story. He resumes the instructions, only to completely change the subject again. All these changes of course are proposed without preamble, at the same pace and with the same tone of voice. Simply by imagining that a five could be an inverted two, we can

quite easily understand the confusion experienced by a hypnotic subject and that they are indeed ready to be absorbed by the considerations or requests coming from the hypnotist.

Erickson integrated these techniques into his hypnotic approach because his clinical experience revealed to him that there was a set of strategies that allowed bypassing the mental resistance of some of his patients. In Erickson's hands, this approach seems to have been successful. However, let us remember that this is not an infallible method. Existing research agrees to conclude that a free and adult individual is capable of resisting any clear method of persuasion if they wish, which is quite reassuring (*cf.* BOWERS, 1976: 61).

Summarizing the communication strategies available to the speaker, we have found that they can circumvent physical difficulties by systematically sequencing the elements of their discourse and by improving the signal-to-noise ratio of their message; they can increase social congruence with their audience through unambiguous and engaging communications; and they can dissipate the audience's resistance by making systematic disagreement difficult. However, information transfer is only possible when a cooperative action is established between interlocutors. It is therefore appropriate to examine the contribution of the listener's communication.

2. The communication process from the listener's point of view

a. The salient traits of the listener's personality

The most advanced research in this field has mainly focused on the influence of the listener's personality. It should be noted that the term "personality" in psychology constitutes the set of characteristics specific to an individual, which do not undergo significant variations over a short period of time. These studies thus highlighted certain psychological and physical traits that intervene in the communication process.

The first factor relates to the degree of *authoritarianism*. Some authors showed that the degree of authoritarianism of an individual was proportional to their susceptibility to influence others (CRONKHITE, 1969: 130). This is a surprising fact at first glance, and it seems contradictory. Cronkhite explains these results as follows: since authoritarian people are recognized more for their emotionality than for their reasoning ability, they tend, by that very fact, to represent a favourable ground for the influence of others.

The other trend, which seems relatively stable, concerns women and their supposed more impressionable nature (CRONKHITE, 1969: 136). Although the majority of studies were conducted in the American context of the fifties and sixties, the indicated differences between men and women is so marked that it is difficult to deny their importance.

However, some explanations are necessary. These results take on a completely different direction if we accept the hypothesis that the crucial variable in the persuasion process is represented by a *degree of aggressiveness*. Since it emerges from observations in comparative biology that the behaviour of males of a species, compared to females, is generally characterized by greater aggressiveness, we can speculate that men may use this trait more advantageously to resist persuasion. It should also be mentioned that according to some sociologists, aggressiveness, because of its socially privileged character, still favours this behavioural aspect more in men than in women today. A man's aggressiveness is even now less severely censured by surroundings than that of a woman; simultaneously, stereotypical communicative and persuasive patterns are found to be reinforced by social

influences.

b. The listener's resistance strategies

Nevertheless, it follows that every listener has resistance strategies against persuasion. CRONKHITE (1969: 156) enumerates four of them, with solid empirical support. First, a person may *misperceive or poorly retain* any information that differs from their own prejudices. Second, a listener may *select the arguments they approve* of and underestimate those with which they disagree. This selection is properly based on subjectivity. If an argument seems to support our reasoning, we prefer it to one that opposes our interests.

The third possibility concerns the following alternative: either we *devalue any disapproved argument* or *we devalue its importance*. This strategy aligns well with the results of a good number of socio-psychological studies tending to show that subjects solidify their opinions after making a choice. For example, car buyers generally tend to look at advertisements concerning the car they have chosen *after* their purchase and not before.

Finally, the fourth strategy lies in *differentiating the various aspects of an argument*. An example often used in persuasion research concerns the negative attitude of Southern Whites in the United States toward Blacks in general. If they are presented with arguments such as some Blacks are indeed intelligent, hardworking, and neat individuals, they will probably modify their stereotyped reaction; but instead of radically transforming their negative attitude into a positive one, they will concede that some individuals are exceptions to the rule. According to Cronkhite, these strategies possibly represent key mechanisms in the attitude change process and thus represent a fundamental aspect of communication according to the criterion that communication leads to the modification of the understanding of the discussed topic.

SUMMARY

In this chapter, we proposed some psycholinguistic aspects of the communication process occurring between speaker and listener. After defining certain salient features, we addressed the various difficulties (physical, social, psychological) that hinder effective communication. We saw the importance of certain social rules and considered some strategies to circumvent or overcome these difficulties. Then we focused on certain strategies establishing the persuasion process, more specifically by discussing the role of the listeners and their resistance strategies.

APPLICATION SECTION

1. Give examples of communication difficulties. Differentiate between physical, social, and psychological difficulties.

2. Explain in the context of communication: "cooperative action in communication," "semantic implicature convention," "quantity," "quality," "relation," "manner," and "sharing of learned knowledge." Provide a relevant example for each term.

3. Explain the difference between a manifest communicative goal and a less obvious communicative goal. Give an example.

4. Explain the sequencing strategy (a) in terms of bits of information and (b) in terms of

an everyday communication example.

5. Create another hypnotic induction integrating the principles of latitude and confusion by M. Erickson.

6. Summarize the four ways to resist communication according to Cronkhite.

FOR FURTHER READING

AARONSON & RIEBER (1979). Chapters 12 and 15.

CRONKHITE (1969).

WINKIN (1981).

Part Three

The development of language

Chapter 10. The Acquisition of the Mother Tongue

A. MAJOR STAGES

1. The prelinguistic stage
    a. The production of vocalizations
    b. The receptive aspect of the prelinguistic stage
2. The holophrastic stage
3. The syntactic stage (approximately 2 to 5 years old)
4. The advanced stages (5 years and older)
    a. Syntactic structures
    b. Pragmatic functions
    c. Metalinguistic abilities

B. SOME KEY QUESTIONS

1. The relationship between comprehension and production
    a. Auditory perception and linguistic and paralinguistic comprehension
    b. Comprehension, repetition, and production
2. The interpretation of holophrases and telegraphic sentences
    a. Holophrases
    b. Telegraphic sentences
3. Is language learned or acquired?
    a. The behaviourist and Chomskyan positions
    b. Creativity, the spontaneous emergence of language, and rule extraction
4. Cognitive development and linguistic development
    a. Prerequisite cognitive conditions
        (1) The sensorimotor period
        (2) The semiotic function
        (3) Parallels between linguistic structures and cognitive structures
    b. The acquisition of meaning
        (1) The relationship between signified, signifier, and internalized category
        (2) The interaction between meaning and linguistic competence

SUMMARY
APPLICATION SECTION
FOR FURTHER READING

Language involves complex activities that occur in adulthood.

In speech production, the speaker must select and articulate statements, while maintaining control over the processes that organize articulation, whereas in speech reception, constituent sounds and their meaning must extracted from received utterances.

How are these abilities developed in the child? What are the stages in language acquisition? What is acquired by children during their development? And finally, do children from the same linguistic community develop these abilities in similar fashion and in the same sequence?

These are the questions and themes that will be addressed in the first part of this chapter. In the second part, we will focus on the linguistic part of the child's cognitive development. We finally discuss strategies that are used during the acquisition of their mother tongue.

A. THE MAJOR STAGES

A child often seems to suddenly proceed through the different stages of language acquisition.

This is the case when they begin to use identifiable names like "mama" or "papa," and later, when they are able to produce entire sentences with an intonational contour strongly resembling that of their parents. But as CLARK AND CLARK (1977: 298) point out, the notion of *stage*, used according to theories of biological and psychological development, does not necessarily imply a sudden transition from one type of behaviour to another. Most of the time, it rather involves the gradual addition of a new type of behaviour to already established behaviours, or the progressive modification of an established form of behaviour.

The phase of first identifiable words, in other words the beginning of the *holophrastic stage* (McNEILL, 1970), should most often be conceived as a gradual process. Also regarding babbling, it is generally observed that it is only gradually abandoned to make way for a stage where words become increasingly identifiable, precisely due to a decontamination from babbling.

This transition from one stage to another *may not* involve a qualitative change in expression or comprehension in a child. It is rather an arbitrary choice by the researcher who subdivides into analyzable periods a gradual development of linguistic ability which is, moreover, difficult to segment qualitatively. Thus, BELLUGI ET AL. (1970), for example, define stages of syntax acquisition in terms of the child's *mean length of utterance (MLU*). It is estimated that a child moves from stage I to stage II as soon as the mean length of their utterances exceeds 2.25 words, and reaches stage III when the MLU exceeds 2.75 words.

Different stages are generally associated with the age at which these characteristics appear. However, it is important to emphasize that research in psycholinguistic studies cannot specify the precise age at which a given faculty is acquired, because the rate of acquisition varies, sometimes considerably, from one child to another, and it increases as the child grows. On the other hand, the order in which the different stages succeed one another generally does not vary, regardless of the structure of the language being learned. Children acquire the various linguistic faculties in a similar order. Let us now address these stages of acquisition in more detail.

1. The prelinguistic stage

a. The production of vocalizations

During the first months of life, the child emits sounds that are described as cries, cooing, squeals, lallation, babbling, etc. Several analyses suggest dividing this period into two stages: the first ranging from birth to about four or six months; the second extending until the age of a year and a half, an age at which most children begin to express their first words in a clearly identifiable way.

The first stage of the prelinguistic phase is characterized by the spontaneous emission of a great diversity of "vocal noises." Among these, some may be indicators of various emotional states, such as contentment, discontent, or fear. The production of these "noises" does not appear to be subject to auditory control of speech production, since it has been observed that deaf children also produce normal cooing during this period (LAUNAY AND BOREL-MAISONNY, 1975: 24). These noises, as well as the general behaviour of a child of this age, seem to be distinguished by their non-intentional and

reactive character from the vocal and linguistic noises of later stages: the child does not choose his vocal expression, it is emitted spontaneously or in response to a stimulus. It probably represents in the child a biologically pre-programmed reaction to external and internal events.

However, the second stage shows the development of voluntary control and the social aspect of language. Children practice their babbling by emitting sounds that gradually shape themselves to the sounds of the mother tongue, by successive reproduction or imitation of the intonational contour of their surroundings. Children are, from then on, capable of establishing a certain control over their own production, since they are able to modify their vocalizations through interactions with the environment.

Differences in vocal emission depend noticeably on where the child is located, *e.g.*, in the cradle or on the lap of one of their parents (DELACK, 1976), as well as on the timbre voice of the person with whom they are communicating. LIEBERMAN (1967) observes that two children, aged respectively 10 and 13 months, babbled at a higher pitch in the company of their mother than in the presence of their father. Furthermore, WEIR (1966) mentions that the intonation of babbling is sensitive to intonational differences inherent in the language that surrounds it, so that the babbling intonation of a Chinese child possesses a richness, a variation of expression far more important than that of an American child, which is attributable to the intonational richness of the adult Chinese model.

An additional indication of the voluntary and social aspect of language, specific to the prelinguistic phase, is demonstrated by the fact that deaf children tend to gradually cease their vocal emissions during this period.

These developments can be explained as follows: in evolving from cooing to babbling, a normal or deaf child moves from more spontaneous or reflexive acts to acts that depend more on social interaction. In this way, a deaf child, hindered in communication by a lack of social exchange, may after some time to stop attempting it. Observations made with children raised in orphanages, who receive less attention and fewer stimuli than children raised in a typical family setting, point in the same direction: although these children babble more than deaf children, it remains true that they babble less than children raised in families (DE VILLIERS AND DE VILLIERS, 1978: 37).

As we mentioned, when a child between nine and eighteen months begins to use identifiable words, they do not stop babbling (MENN, 1976). Some indications suggest that the first words mark the phonetic evolution and semantic realization of babbling elements used previously. Indeed, babbling seems to contain the same phonetic sequences as those of the first words (OLLER ET AL., 1976).

Moreover, babbling at the holophrastic stage has some resemblance to that of the prelinguistic stage in that the child modifies the intonation contour of babbling according to different desires; for example, to express a request or regret (MENN, 1976, HALLIDAY, 1975). Finally, the child often gives the impression, when babbling or talking to themselves, of putting their own production system into operation and testing it (DE VILLIERS AND DE VILLIERS, 1978: 37; WEIR, 1962: 102). These utterances are not addressed to anyone and often have a repetitive character, suggesting a natural continuity, extending from babbling to language at this holophrastic stage.

b. The receptive aspect of the prelinguistic stage

During the so-called prelinguistic period, the child shows a surprising ability in terms of linguistic reception. Long before they can truly speak, the child is able to distinguish certain important features of language sounds. From the age of one month, they can

distinguish the human voice from other sounds, and before reaching two months, they respond differently depending on whether it is their mother's voice or that of a stranger (MEHLER, 1978).

Even more surprisingly, babies only a few days old can be trained to respond differently to the presentation of one of two artificial stimuli such as [ba] and [ga]. Their conditioning consists of offering them milk via a pacifier when one of the two stimuli is presented. It is then observed that they continue to suck the pacifier more in response to this stimulus, even after they stop the milk for themselves (EIMAS ET AL., 1971: TREHUB, 1973; EIMAS, 1974 and 1975). This suggests that the child is born with knowledge of the acoustic determinants that distinguish the phonemes of their human language.

2. The holophrastic stage

From the age of 10 to 13 months, and during the following few months, the child learns the lexicon one word at a time. Their utterances consist almost exclusively of isolated words. This is why this stage is called *holophrastic* (from the Greek *holos* meaning "whole").

Generally, the first words are nouns. Children name people and objects with which they are most often in contact - objects and people who are part of their universe; family members, animals, food, drinks, and toys [NELSON, 1973]. Their vocabulary also includes some words designating past and present actions, or requests. However, the child rarely uses verbs and more often adverbial words like "again," "hello," or "outside" (FOSS AND HAKES, 1978: 237).

As for the use and frequency of words, they vary greatly among children. Thus, one child's vocabulary may be composed almost entirely of nouns, while another child's may include many words carrying a social connotation, such as hello, greetings, etc. These differences may reflect living conditions determined by the particular environment of each child.

But what do the first words used by the child mean? When the child clearly says "cat" upon seeing the cat enter, parents tend to believe and over-interpret their child's linguistic intent, thinking the child meant "here is the cat" or "look at the cat," if only they could express themselves without hindrance. However, for now, let us note that several studies indicate that the meaning evoked by an utterance like "cat" is closer to an emotional reaction than to a complete meaning derived from a precise sentence. Below, we will discuss this issue in more detail.

3. The syntactic stage (from about 2 to 5 years)

When the child begins to produce expressions of two or more words, it is said that they enter the *syntactic stage*. This stage will last from two to five years. From then on, the child will have largely mastered the syntax of their mother tongue.

Many researchers (BRAINE, 1963a and 1963b; MILLER AND ERWIN, 1964; BROWN ET AL., 1964) have observed that at the beginning of the syntactic stage, certain traits seem to distinguish the child's language from adult language. First of all, a child aged 2 to 3 years seems to have a certain tendency to omit words and endings of certain words (suffixes). Nevertheless, these omissions do not occur randomly: they concern words such as "on" "the" or "they," that is, terms of little significance within sentences (*e.g.*, “old truck” for “the old truck”). On the other hand, the words retained and

produced are likely to be the most significant in terms of meaning. These are the words that refer to people, objects and actions. A language containing such omissions is often called *telegraphic language*. It is an economical or minimal structure from which a message can be clearly understood.

A fundamental feature of language during this stage concerns the order of sentence elements. This order affects comprehension, production, and repetition alike. One of the first rules used by the child is to place the subject before the verb and the direct object complement in a sentence. This rule is observed both in English (BRAINE, 1976) and in several other languages where this phenomenon has been studied (SLOBIN, 1973).

Moreover, for the interpretation of a sentence, this rule is used in the same way by the child. This is why, at the beginning of the syntactic stage, a child will interpret a passive sentence as if it were actually an active sentence. In the sentence: "The cat is chased by the dogs," the child will understand that it is the cat who is chasing the dog and not the other way around, given that “the cat” appears first. The grammatical subject is perceived as the agent of the action and not as its object (FRASER ET AL., 1963).

Another specificity during this period concerns certain grammatical errors. These errors, like omissions, are by no means the product of chance, but reflect the child's linguistic organizational system. Having learned the use of the suffix “-ed” to indicate the past, a child will tend to apply this rule by generalizing it to verbs from other groups. In English they tend to omit the past ending, and in French they will produce structures like "*il a metté" for "il a mis," "*il a rié" for "il a ri," and "*il a répondé" for "il a répondu" (GRÉGOIRE, 1937-1947/1968: 129-130).

In these cases, therefore, the child extends a rule to inappropriate linguistic elements, or in other words, *over-generalizes* the rule. Although the child has obviously not yet fully internalized the functioning of the rules of their mother tongue, they nevertheless demonstrate by such errors that they are gradually grasping them, but at their own pace.

Conversely, it happens that a child applies an exceptional rule to simple and stable linguistic structures. It will therefore be possible to hear them say in French: "*il a envoit" instead of "il a envoyé," (“he sent”), a mistake probably formed by analogy to irregular structures like "il a écrit" (“he wrote”) or "il a conduit," (“he drove”), or they may say "*il dormra" instead of "il dormira," again perhaps by analogy to "il sera" (“he will be”) (GRÉGOIRE, 1937-1947/1968: 124).

The principle of over-generalization can extend to the lexical domain. At this stage, when children create new words, they tend to conceive them based on already existing structures. GRÉGOIRE (1937-1947/1968: 37), for example, mentions a child who, knowing the words "le diner" (“the diner”) and "le déjeuner" (“the breakfast eater”) created "*le jardiner" and "*le courir." In the same vein, the expression "le mal" (damage in general) led to the creation of the expression for "*le ça" (p. 38).

HETHERINGTON AND PARKE (1979: 282) also mention the creation of words by "reinventing the singular from a form that exists only in the plural: the child can create the new English word “clo” (a piece of clothing in the singular) from the existing word “clothes” (pieces of clothing in plural). These principles are probably universal, as SLOBIN (1966) observed that in Russia and other countries. Young children often use the general rules of their language to create new words from exceptions.

These psycholinguistic manipulations are very revealing; they show that the child does not learn solely by simple repetition or imitation. Their learning occurs much more

through the deduction of the operational principles of their language and their application to new situations.

4. Advanced stages (5 years and older)

Before the age of five, the child already manages to master the fundamental structure of their mother tongue and is capable of speaking intelligibly, practically without too many syntactic and morphological errors. However, the learning process is far from complete. Children improve and refine their language in several ways. First, they develop their vocabulary and deepen their understanding of word meanings, a process that seems to continue throughout life. Moreover, despite their great mastery of syntactic structures, they must yet complete their understanding by accessing certain complex grammatical structures.

a. Syntactic structures

Carol CHOMSKY (1969) conducted several studies on grammatical structures acquired late in childhood. In one of these studies, she analyzed the understanding of sentence structures such as "John is anxious to please" and "John is easy to please." On the surface, the two structures of these sentences are very similar, although, in fact, they represent very different underlying syntactic structures. In the first sentence, "John" is the subject of the complement "is anxious to please" (typical case), whereas in the second sentence, "John" is the object (atypical case).

To find out which structure would be more accessible, Carol Chomsky presented children of different age groups a doll with covered eyes and asked them if it was easy to see (atypical structure, as the doll is the object of the complement). Only 20% of five-year-olds answered correctly with "yes." Most of them interpreted that the doll was the subject of "to see" and answered "no," given that it had covered eyes. These results differ from children over seven years old, who generally answered correctly, arguing that the the doll was easy to see since it was in front of them. This demonstrates that a strategy allowing the understanding of exceptional cases often develops well after the acquisition of a basic system, governed by the fundamental rules of the language.

b. Pragmatic functions

During this period, another aspect of development concerns the improvement of communication abilities called *pragmatic functions*. These functions refer to the rules that determine what kind of language is appropriate for a given situation. Knowledge of such rules allows effective communication by choosing appropriate expressions depending on the place and the interlocutor. For example, a child's expression will be shaped according to whether they are at school or in a street environment.

The first research on the development about these communication abilities was conducted by PIAGET (1926). Based on his observations from children's conversations, he concluded that children's manipulation of pragmatic functions was inferior to that of adults. According to him, the child has difficulty distancing themselves and situating the interlocutor's position. The resulting language therefore does not contain all the information necessary for the listener's proper understanding. Piaget labels this stage as *egocentric language*. It is only between the ages of six and seven that the child develops the ability to distinguish between their own perceptions and those of others.

This interpretation motivated other researchers to conduct numerous studies. Contrary

to Piaget, GLEASON (1973), SHATZ AND GELMAN (1973) found that four-year-old children were able to adapt their language according to the listener, as they noticed that children expressed themselves differently, depending on whether they were speaking to adults or younger children. Furthermore, WELLMAN AND LEMPERS (1977) realized that children as young as two years old seemed sensitive to the social determinants of communication. For they noted, before communicating any message, that the child often checked whether the interlocutor was attentive and in a state that allowed proper understanding of the message. It would therefore appear that the ability to take into account the interlocutor and the surrounding situation develops very early in the child.

Nevertheless, one should not assume that in their communication a five-year-old child is as effective as an adult. Other studies conducted by PETERSON, DANNER, AND FLAVELL (1972) showed that four-year-old children were not as sensitive to certain factors as seven-year-old children. They did not perceive as well the signs betraying the interlocutor's lack of understanding, with signs of confused or perplexed looks, or by an attitude suggesting "I do not understand." However if the interlocutor openly expressed their need to know more, then the four-year-olds were able to go back, in order to be more explicit just like seven-year-old children.

KRAUSS AND GLICKSBERG (1977) also observed a progression in descriptive abilities, which they assessed using figures. This experiment and other comparable experiments (see FOSS AND HAKES, 1978: 296-302) suggest that during this stage, children systematically improve their communication skills.

c. Metalinguistic abilities

Finally, the child acquires *meta-linguistic abilities*, the ultimate phase allowing them to discern ambiguities, differentiate grammatical from ungrammatical sentences, and control their language to the point of making rhymes, poetry, and wordplay.

Again, existing research indicates that the development of meta-linguistic function occurs progressively. HAKES, EVANS, AND TUNMER (1976) (cited in FOSS AND HAKES, 1978) asked children aged four to eight to judge the acceptability of certain sentences. The study revealed that older children rejected more sentences deliberately than younger children, a phenomenon probably caused by a better internalization of grammatical rules.

Moreover, the reasons given by each age group differed: eight-year-olds generally gave reasons similar to those of adults, while four- and five-year-olds relied more on semantic reasoning or on moral judgments that were implicitly contained in the meaning of the sentence. For example, the sentence "the boy hit" was judged unacceptable by younger children because they had been taught that hitting others was forbidden, whereas older children judged this sentence as *incomplete*.

From this research emerges the idea that the phase measuring the evolution of the child's meta-linguistic judgments is divided into three main stages. During the first stage, the child judges the acceptability of the sentence based on their understanding of the sentence. In the second stage, the acceptability of the described events determines that of the meaning of the sentence, leading finally to the child being capable of evaluating statements based on strictly grammatical criteria.

B. SOME CRUCIAL QUESTIONS

1. The relationship between comprehension and production

Observations by parents and researchers have generally left the impression that children are able to respond correctly to sentences that are far more complex than those they can produce. This leads us to suppose that the development of comprehension precedes that of the production of speech. Thus, McNEILL (1970: 102) wrote that it was likely that children were only able to expand their linguistic competence thanks to their highly developed comprehension.

However, the relationship between comprehension and linguistic production is far from obvious. On the one hand one should distinguish between *auditory perception* and *linguistic comprehension*, and on the other hand, to *linguistic comprehension* and the understanding of *extra-linguistic contextual signs.* It is also necessary to specify whether the message concerns linguistic production in repetition or in spontaneous language.

a. Auditory perception and linguistic and paralinguistic comprehension

We have already mentioned that during the prelinguistic period, children could distinguish syllables of the type [ba] from those of the type [ga], as they were also able to differentiate between his mother's voice and that of a stranger. Nevertheless, can we say that these abilities pertain to proper linguistic comprehension? It would probably be more accurate to say that they highlight abilities related to *general auditory perception*, and that this competence only serves to prepare the child for true *linguistic comprehension*.

Let us present a similar problem. A child begins to respond correctly towards the end of his first year. Does he or she turn the head towards the speaker, point to an object, or follow an instruction? Can we therefore deduce that they understand what is being said? LEWIS (1951) supposes that at this stage, the child responds not to the phonetic form of the word, but rather to the intonation, the variation in emphasis of the message, and the context in which it is produced. According to him, it is only when the child responds adequately to the entire phonetic form, independently of extra-linguistic signs, that one can assume that they have truly understood the message.

In the same vein, BLOOM (1973b) notes that the instructions to which the child responds most often refer to the immediate environment. These instructions, which seem to be received and understood, tend to have a redundant character relative to the context. They will often be made up of short and simple sentences, to be strongly emphasized, and to be repeated and accompanied by exaggerated gestures.

For example, while walking in the park, a parent waves towards the swings to their child and says: "Look at the swings. We are going to play on the swings. The swings." To which, most likely, the child will respond appropriately by running towards the swings. By this action, we cannot conclude that he has fully understood the meaning of the given linguistic chain. Most likely, the child will have grasped the context and the possible intentions of the parent in the situation, and not the precise meaning of the adult's message.

b. Comprehension, repetition, and production

Given these uncertainties, it would be desirable to focus on more rigorously controlled experiments that could give us with more information about the true underlying skills in

comprehension and production. For illustration, consider FRASER, BELLUGI AND BROWN (1963), who studied the period of emergence of grammatical competence during comprehension, repetition, and production. They tested ten grammatical contrasts (singular-plural, present-future, etc.) in twelve three-year-old children. In comprehension tasks, the child was to select the image that best matched the presented sentence. Thus, the contrast between singular and plural, for example, was tested with sentences like "the sheep is jumping" (singular) and "the sheep are jumping" (plural). The child chose among images, one of which showed a sheep jumping over a fence and a sheep waiting (for singular), or two sheep jumping over the fence (for plural).

In repetition, the child had to demonstrate competence by accurately imitating the target sentence, whereas in production, competence was shown by the appropriate use of relevant grammatical features (*e.g.*, is/are) in spontaneous descriptions of the target images. The results of this study showed that spontaneous production of the correct grammatical marker was generally the most difficult of the three tasks. This was followed in descending order by comprehension, then by repetition of the target sentences. Children thus seem capable of producing sentences without understanding them, through pure imitation. However, they do not appear able to provide the correct grammatical markers in spontaneous production without understanding their meaning.

Although, in general, language production tends to follow the acquisition of comprehension. BLOOM (1974: 294) summarized research showing that children use certain syntactic structures even before they fully understand their meaning. We can also cite the conclusions of KEENEY AND WOLFE (1972), who reported from their experience that three- and four-year-old children did not necessarily understand the relationship between the use and meaning of verb inflection regarding singular and plural, even though they correctly matched subject and verb number in spontaneous production.

BLOOM (1974: 295) suggests in this regard that the attempt to use a grammatical structure might very well be the means by which the child acquires the structure itself. As we have seen, the child creates and uses their own grammatical rules during the search for the appropriate rule for adult language structures. We are thus led to conclude that, on the one hand, that the child does indeed understand certain words and structures before being able to produce them and, on the other hand, that children acquire certain other words and certain other structures during their attempts at production and comprehension.

2. The interpretation of holophrases and telegraphic sentences

We have discussed the holophrastic stage of language acquisition, situating it mainly in the second year. This stage is primarily characterized by the production of expressions containing only one word. The question we now raise concerns the precise interpretation of these utterances, which we will refer to here as *holophrases*.

a. Holophrases

In 1970, David McNeill proposed that the young child possessed significant knowledge concerning morphological and syntactic relations, well before the emergence of spontaneous language. Children, lacking the ability to produce complete sentences, express only one word at a time. Thus adults' interpretations of these holophrases may be that children are trying to express themselves in inadequate fashion, when in fact these words may have the same syntactic functions as those used by adults.

Suppose that the child has more extensive knowledge of the grammatical structure of language, given the limited possibilities of the child's language production. Thus GREENFIELD AND SMITH (1976) proposed a modification of McNeill's hypothesis. They suggested that the holophrase could be interpreted according to the *extra-linguistic context* in which it was produced, so that the meaning of a word was varied, depending on the situations with which it was associated.

Greenfield and Smith argued that even though syntactic and morphological knowledge was still limited in holophrastic children, but that their semantic and conceptual knowledge was quite different. According to them, they possess a sufficiently developed range of words as well as a considerable number of types of relations maintained by these words among themselves. So much so that in a given context, the children's production of simple words can be considered a manifestation of the semantic relations they have already discovered. They demonstrate their understanding of meanings and networks of sense not in relation to syntactic support, but precisely in their current context.

This hypothesis met with some reluctance from certain researchers. According to BROWN (1973b) and BLOOM (1973), Greenfield and Smith's argument rests on two unjustified presuppositions. The first presupposition is that it seems difficult to take for granted that the meaning of a child's word is similar to that of an adult; the second is that one cannot be sure that the interpretation made by the adult is necessarily the correct one. If the child says "hot" while looking at the stove, one cannot be certain that it expresses the same thing as an adult who states: "The stove is hot." For all these reasons, Brown and Bloom adopted a more conservative interpretation of holophrases than that of McNeill and that of Greenfield and Smith.

They merely suggested that the first words had only a weak connection with the situations in which they were found and, on the other hand, that they did not convey either syntactic relations or precise semantic links.

b. Telegraphic sentences

The interpretation of telegraphic sentences appears less difficult to us than that of holophrases. Since telegraphic sentences contain more words, the risk of misinterpreting them is reduced. It seems that these two- or three-word expressions justify more the application of the interpretation we have just discussed, that is, an interpretation relying on the production context of these elementary sentences. At this stage, there is more certainty regarding the interpretation of semantic relations despite the limited syntactic competence at this age.

The precise interpretation of these sentences remains approximate nonetheless. BLOOM (1970) reported an example that well illustrates the problems posed by a "rich" interpretation of telegraphic sentences. Kathryn, one of the subjects under study, produced the utterance "mommy sock" in two different situations. The first context occurred when Kathryn's mother put on her socks and shoes. This situation lent itself to the interpretation "mommy (is putting on my) sock," the relation between "mommy" and "sock" being of the agent-object type.

The second context was established when Kathryn's mother was washing laundry and the child took one of her mother's socks and said "mommy sock." We are tempted to believe that what was uttered this time corresponded to the interpretation "(here is) mommy's sock," implying a noun-complement relation. Although these interpretations are just as plausible as probable, we nevertheless have no assurance that they accurately reflect the child's intentions.

3. Is language learned or acquired?

In the fifth chapter of this volume, we adopted the position that the human being is biologically predisposed to language acquisition and that there is a critical period during which its acquisition is facilitated. We also mentioned that certain conditions, such as the presence of a model and opportunities for use and feedback on speech, must be added in order for this predisposition to be realized.

The demonstration was established thanks to the cases of feral children; we think in particular of the case of Genie (CURTS ET AL., 1974; FROMKIN ET AL., 1974) and perhaps also the case of the feral child of Aveyron (ITARD, 1962) who learned language structures only with great difficulty after childhood.

The question that interests us from then on will focus on the factors that promote language acquisition during childhood. Is it through training based on imitation, reinforcement, or correction that the child develops linguistic skills? Or does the child acquire language because they discover the linguistic structures and rules themselves and spontaneously?

a. The behaviourist and Chomskyan positions

In 1957, the American psychologist B.F. Skinner published a volume entitled “Verbal Behavior” in which he analyzed human language from the perspective of behaviourist theory. He suggested that language should be considered a behaviour whose evaluation would fall under the same conditioning principles as any learned behaviour.

Language conditioning would thus be comparable to conditioning performed on rats, which, through manipulation of reinforcements and punishments, would lead to a specific behaviour. He therefore viewed conditioning as a set of learned habits, developed over a certain period, without any support from innate or mental mechanisms (mediation mechanisms). His theory suggests that the child learns language by observation and imitation, and that language is shaped and fixed by reinforcement and correction from adults.

In 1959, the American linguist Noam Chomsky strongly criticized this hypothesis. He pointed out that the learned behaviour of rats differs greatly from linguistic behaviour. His first argument was based on the following element: it is indeed possible to predict that after a certain training, a rat will press a lever as soon as it hears the sound of a bell, whereas it is impossible to predict what an individual would say at a given moment.

Moreover, if the behaviour of rats is easily controlled by reinforcement, linguistic behaviour, on the other hand, does not seem to be particularly influenced by any reinforcement or non-reinforcement. The validity of this argument was demonstrated more systematically by BELLUGI ET AL. (1970). These researchers identified a phenomenon that Skinner’s hypothesis struggles to account for. While parents tend to approve more of sentences expressing a truth rather than grammatically correct sentences (see above), how is it that the child learns to form correct grammatical structures?

Not only is language development in the child incomparable to the conditioned behaviour of the rat, but it also has some characteristics that are distinctive of imitation and reinforcement. CHOMSKY (1972a, 1972b) suggests, for example, that the child uses operations that can only be well executed when they have a good understanding of the internal structure of the sentence concerned.

Thus, to be able to produce the interrogative form of the sentence "Are you hungry?" by the rule of inversion of the verb and the subject, the child is forced to understand an aspect of the internal structure (the fact that "you" is a pronoun), so as not to overgeneralize this rule to cases where it does not apply.

According to CHOMSKY (1972a: 30), the understanding of the internal structure of language that allows such distinctions is part of the child's innate language capacity. This means that the child would be equipped with a genetic code allowing, at a certain level of maturation, to properly differentiate such cases.

b. Creativity. The spontaneous emergence of language and the extraction of rules

Another salient fact about language, not predicted by Skinner's behaviourist hypothesis, is creativity. Adults have at their disposal a very large number of utterances[21]. Moreover, a speaker can create a new word (often by analogy to existing words) in order to account for or describe new phenomena. This implies that the child cannot learn language by storing a set of ready-made sentences to be used at the appropriate moment. It is more an exercise of control and considerable creativity in the selection and combination of elements to be uttered.

Other factors that inform us about the phenomenon of acquisition in children are based on observations related to linguistic development itself. We know, for example, that any child whose linguistic development proceeds normally begins to speak between 18 and 28 months, unlike the behaviour of the rat which is carefully taught. In children, language appears as an unexpected phenomenon; the acquisition process seems to start by itself.

Other observations also lead us to the same conclusion. The speed or slowness of language acquisition does not depend on particular instruction, that is, specific efforts to correct it (BRAINE, 1971: 161; CAZDEN, 1972: 92). Efforts to improve the child's language by expanding each of their utterances have also been unsuccessful (CAZDEN, 1972). According to one of Pines' experiments (1969: 165), the best way to advance a child's language is simply to offer them a rich variety of utterances and to speak normally. Children seem to be able to disambiguate themselves in extracting the structures and grammatical rules of their surrounding language.

In conclusion, we recall that language development in the child seems to be more a process of acquisition that occurs spontaneously, rather than training received from outside. The regularity of this development supports the hypothesis in favour of a biological predisposition to language acquisition.

4. Cognitive Development and Linguistic Development

Until the late 1960s, research in the field of native language acquisition mainly focused on the acquisition and use of grammar in the child. Only in the last fifteen years has interest seemed to shift and is now focused on the link between cognitive development and language acquisition (*e.g.,* BLOOM, 1970, 1973; BOWERMAN, 1974; SLOBIN, 1973).

From earlier discussions, it emerges that the roots of human linguistic developments are situated on the their *cognitive* level. The faculties of perceptual discrimination,

21 Linguists tend to say an "infinity of utterances," which is obviously impossible given that at any moment, humans only have a limited vocabulary and inventory of syntactic structures from which they can construct only a limited number of utterances

linguistic discovery, and analysis described above are probably linked to more general cognitive discrimination faculties. It is even possible that these cognitive faculties fundamentally contribute to the acquisition of analogous linguistic faculties (PIAGET, 1963; SLOBIN, 1973; SCHLESINGER, 1971).

a. The Prerequisite Cognitive Conditions

(1) The Sensorimotor Period

It is the Swiss psychologist Jean Piaget who proposed the most comprehensive theory of cognitive development, a stage underlying linguistic development. According to his theory, language development is associated with the emergence of the symbolic function in the child during the *sensorimotor period* of cognitive development (from birth to 24 months).

The *symbolic function* is defined as the ability to represent an object and an event in the form of a mental image or a symbol. It is characterized not only by the use of words but also by other behaviours that manifest at the same age. This is illustrated by the stage of *deferred imitation*, that is, the ability to *depict an object in its absence*, symbolic play, a stage of internalizing an object and its meaning through play. The child demonstrates their ability to internalize, transform, and produce the field of external objects or facts.

According to Piaget, this symbolic function does not appear suddenly, but unfolds gradually by accumulating the achievements of the sensorimotor period little by little. The most important activity leading to symbolic activity is manifested through direct imitation, because it allows the child a first attempt to establish a correspondence between their own actions and the objects in their environment. Piaget thus recounts the imitation performed by his daughter.

Lucienne, with the help of her own body, imitated the movements of her father's bicycle (GINSBURG AND OPPER, 1979: 73). From the emergence of such symbolic functions, there was an appropriation that extended the representations of objects or events to the formulation of *internal mental images* or *symbols*.

Piaget thus admitted the existence of an innate element in cognitive development and proposed the *construction of novelty* as a *distinctive sign*. This is characterized by two fundamental traits. First, it is unprecedented for each subject and lends itself to additional constructions. It is a play articulated around internal and external structures. The external structure transforms this concept by assimilation into a corresponding *internal structure*, an assimilated concept for every new construction by the child. And it is from this scheme that a program of increasingly complex operations develops.

(2) The semiotic function

Based on this conception of language linked to acquisitions made at the sensorimotor intelligence level, Piaget developed a second hypothesis, that of the *semiotic function*, where language is only a particular case.

He characterizes this semiotic function as being integrated into assimilation schemas specific to the sensorimotor level. Imitation, as perceived as an intentional and adequate repetition of the behaviour of objects through bodily movements, would proceed via internalized imitation (generating internal images and mental representations), to evocative play, and to *deferred imitation* (repetition in the absence of the corresponding object).

This thus constitutes the context in which language is inscribed and develops. According to Piaget's theory, it is therefore these general cognitive capacities that

condition the appearance and development of language.

This semiotic function is a necessary condition for language development, but alone, it does not fully explain it. To be able to talk about an absent object or a past event, *object permanence* is required, that is, being able to retain in memory an object or event outside immediate vision. On this subject, BROWN (1973b) suggests that the capacity to recognize objects is a cognitive faculty necessary for the correct use of demonstrative statements such as "this dog here" and "that dog there." We can claim that a child has developed this faculty when we observe behaviours such as sucking movements in the presence of a bottle of milk. This demonstrates that the child has retained in memory the action associated with the bottle; in other words, they are capable of establishing *object permanence*.

(3) Parallels between linguistic structures and cognitive structures

Besides the fact that these cognitive faculties are prerequisites for language acquisition, there seems to be a systematic resemblance between the accomplishments of the sensorimotor period and certain aspects of language that Chomsky's linguistic theory characterizes in terms of *deep structure* or *base structure*. This hypothetical linguistic structure attempts to capture the most fundamental relationships among the typical elements of a sentence. According to this hypothesis, every observable utterance would be merely a systematic transformation of the deep structure.

SINCLAIR (1971) establishes a number of correspondences between the general cognitive faculties of the child during the sensorimotor period and the salient features of the deep structure. First, at the time when the child is able to *order objects and events* in time and space, they are simultaneously capable of linguistically ordering elements (syntagmatic words) in time. Otherwise, it would not be possible for them to abstract the order of elements, a fact we discussed at the beginning of the syntactic stage. This faculty corresponds to the chaining of linguistic elements in the base structure of a sentence.

Second, a child of this age is able to use a whole set of objects during the same action; for example, if a spoon is taken away to prevent them from hitting the plate, they are likely to try to grasp another utensil to continue their action. Linguistically, they are capable of using a series of words in a given position in the sentence: *e.g.*, the second position in the phrases "baby book" (*i.e.* “my baby book”) *vs.* "baby car" (“baby in the car”) (MILLER AND ERWIN, 1964). This corresponds to the notion of category in the base structure (*e.g.,* the categories of noun phrase or verb phrase).

Third, when the child can grasp the relationships between objects and actions, implying that they understand the effect of the interaction between the utensil and the effect in the aforementioned example, they can linguistically apprehend the stable relationship that exists between an initial noun phrase (the subject) and a verb phrase (the complement).

Finally, as soon as the child reaches the stage of object permanence (*i.e.*, they recognize an object despite its visual variation, seen from afar, up close, or from another angle), this means linguistically that they will be capable of preserving an element despite the various transformations acting upon it (*e.g.*, the same noun phrase in declarative and interrogative forms: "*you are* hungry," "*are you* hungry?").

It should be emphasized that this is only a brief collection of the correspondences identified by researchers of the Piagetian school. Other research indicates that the sequential development of cognitive faculties unfolds more or less in parallel with the

gradual development of linguistic faculties. Such parallels prove important for two reasons. First, they suggest that linguistic faculties represent extensions of the general cognitive faculties of the human being. In other words, the major principles of *psychological functioning* that govern nonverbal human behaviour also seem to apply to *linguistic functioning*. Following this analysis, there would therefore be no reason to perceive and maintain a dichotomous functioning between linguistic faculties and psychological faculties.

The second consequence lies in the fact that certain key aspects, both of the Piagetian school and the Chomskyan school, are strongly supported by this type of congruence. Order, categorization, permanence, as well as the understanding of relationships between concrete objects or linguistic elements belong to these key aspects. The fact that these faculties are already cognitively and linguistically evident in the child at the end of their sensorimotor period (around the end of the second year) supports their status within the two theories.

We can therefore legitimately assume that these principles will be difficult to refute by future research and that they will be an integral part of any theory concerning the acquisition of the mother tongue.

b. The acquisition of meaning

Despite similarities that exist in language and other symbolic activities of the child, such as drawing or dramatic play, language occupies a specific place among all these activities. In order to use language well, the child must use highly conventional symbols, a complex system of relations between these symbols (grammar), and a large number of social norms governing their use. Even if other symbolic activities may involve considerable motor skills or a specialized vocabulary (like drawing), it remains true that only language uses such an extensive conventional vocabulary.

Similarly, a non-linguistic symbolic activity may involve common rules (*e.g.*, dramatic play), but none involves a system as complex as that established by the grammatical relations governing the structure of utterances. The extent and complexity of linguistic structures themselves suggest that the child uses strategies aimed at obtaining this vast network of relations between linguistic symbols and objects or events to be represented.

(1) The relationship between signified-signifier and internalized category

As soon as children acquire stable mental representations of objects and events during the sensorimotor period, they begin investigating the links between these representations and conventional symbols. Thus, a child that has acquired stable representations of a swing (the object) and the act of swinging (the event) acquires systematic links that exist between these representations and the associated words. At first, they will discover the signified-signifier relationship (between the object, the swing, and the name of the object, "swing"), then their attention will focus on the grammatical relationship allowing differentiation between "swing" and "swinging."

MACNAMARA (1972) indicates that the links a child establishes between the signified and its internalized category (the mental representation of the signified element) allow them to discover certain relationships between mental representations and linguistic symbols. Having previously segmented and classified the surrounding world into categories, the child will seek to establish links with associated linguistic symbols. Thus, once the child has learned to mentally distinguish the stove from other objects, they will establish in their internal lexicon the word associated with this mental

representation as "stove".

This connection between the object and the word will be made gradually through experience. Subsequently, their representations will need to disentangle from certain conceptual overlaps. For example, if repeatedly, when shown a stove, the child is told "hot," they will first have to differentiate this new word from the existing linguistic representation of the object ("stove") and understand that it is not the word representing the object, but a characteristic associated with this object and shared with other concepts, such as fire or a radiator.

This hypothesis of learning of meaning is supported by some salient observations. MACNAMARA (1972) notes in this regard that children acquire words for colours, shapes, and different sizes of objects only after having learned to distinguish and name a certain number of objects. Given that attributes like heat, colour, shape, and size are elements shared by many objects or concepts, it is logical that the link between attribute and symbol is learned later than the one existing between object and attribute.

As soon as the child knows a few simple words, they will discover the relationships between these words, again relying on their knowledge of the real world. This is how they will develop and identify the difference between "the dog chases the cat" and "the cat chases the dog" by observing the action unfolding before their eyes. After identifying the two animals involved in the action, they will detect the concepts of agent and object in this type of action. Then they will notice that the agent is more often associated with the initial position in the sentence and the object with the final position (MACNAMARA , 1972).

(2) The interaction between meaning and linguistic competence

Along the same lines, SCHLESINGER (1971) proposed that the fundamental relational concepts of child language must be semantic and must reflect the way the world is perceived by the child. According to this conception, a child first observes what the adult is talking about in terms of semantic classes (*e.g.*, agent, action, object, owner, possession, etc.), then associates these semantic classes with what they hear in order to establish the link between a situation and the sentence referring to it. Only afterwards will they generalize the semantic classes to grammatical classes, so that having learned the structure "dad's hat," they will be able to generalize it to a larger utterance like "the beginning or the end."

HALLIDAY (1975) highlighted a complementary aspect to these hypotheses concerning the learning of meaning. From his point of view, language learning takes place in the form of constant interaction between the child and others. It is in this way that the child learns a set of interpersonal communicative functions, for example, the instrumental function ("give me"), the regulatory function ("do as I tell you"), or the interactional function ("me and you, we play together"). According to Halliday, children only respond to the needs of existing functions, so they are driven to learn new words, and they are motivated by the desire to know and interact with his environment. The new words allow them to classify their new experiences.

Throughout this discussion, we have emphasized that linguistic development depends on cognitive development. However, one should not hastily conclude that the relationship between cognitive abilities and linguistic abilities is unidirectional, that is, going exclusively from cognitive to linguistic. We lean more towards SCHLESINGER (1974: 45), as he proposes more of an interactional approach between the cognitive aspect and the linguistic aspect: language operates on an already established cognitive basis, which in turn will be influenced by the use of language.

In this way, children will categorize the world around him into different classes to which they assign different names. But by learning new words, they will be led to develop new categories. Thus, more generally, the acquisition of linguistic elements or structures will gradually lead them to new ways of classifying their experiences.

SUMMARY

Throughout this chapter, we have referenced important studies in the field of first language acquisition. We began with a description of the major stages including the prelinguistic stage (indications of linguistic competence before the emission of the first understandable word), the holophrastic stage (the use of single words), the syntactic stage (the arrangement of several words), and the stages of advanced linguistic development.

We then discussed some problems in interpreting certain observations concerning child language. We addressed the question of the development of comprehension in the child and attempted to determine to what extent oral expression reflects the child's linguistic competence. We further explored the relationships between the acquisition of cognitive and linguistic faculties, exposed some important parallels between cognitive and linguistic structures, and examined how the acquisition of cognitive structures must precede that of linguistic structures.

APPLICATION SECTION

1. Summarize the key events of the following stages: (a) the prelinguistic stage; (b) the holophrastic stage; (c) the syntactic stage; (d) the post-syntactic stage.

2. Does comprehension precede speech production or vice versa?

3. What does a child mean when they say "hot" in front of a stove?

4. What observations lead us to say that a young child's language acquisition is spontaneous?

5. Summarize some parallels between cognitive and linguistic types of development.

6. Briefly describe how a child learns to designate objects and events around them.

7. Comment on the examples of child language provided below, using the terminology presented in this chapter. (*N.B.* We are indebted to Mr. J.-L. Nespoulous, professor of psycholinguistics at the University of Montreal, for providing these examples.)

a. Production and comprehension

(Olivier, 3 years and eight months old, is looking at a children's comic strip. In one of the images, there is a rabbit.)

- Adult: *Do you know this?*

- Child: *Yes.*

- Adult: *What is it?*

- Child: *?*

- Adult: *Aren't you happy, Oliver?*

- Child: *No.*
- Adult: *Why?*
- Child: *hmm!*
- Adult: *Are you happy?*
- Child: *Yes.*

b. The process of lexical acquisition

(The same child, still with images.)
- Child: *Oh, a waf-waf.*
- Adult: *No, that's not a dog, it's a fox.*
- Child: *A fox?*
- Adult: *Yes*

(Another picture.)
Child: *There's a fish there.*
Adult: *And yes, and there, what is it? (a crocodile)*
Child: *A big fish.*
- Adult: *No, it's a crocodile.*
- Child: *A croc...?*
- Adult: *A crocodile.*
- Child: *A cocodile.*
- Adult: *Almost: a crocodile*.
- Child: *A corocodile. (mimicry of dissatisfaction)*

c. Some childlike pronunciations

(The same child, target form: pronunciation for a French speaker.)
cochon (pig) - coson
lapin (rabbit) - palin
boxeur (boxer) - boskeur
bougie (candle) - bouzie
bibliothèque (library) - bilitothéque
Jean-Luc (name Jean-Luc) - [ã-yk]
Camembert - Cambébert

d. The child's syntax, morphology, and discourse

(The same child.)
Ya un loup méchant. (for «Ya un méchant loup»). (There's a mean wolf.)

Je te l’aide (for «je t'aide»). (I'll help you, for "I'll help you").
Ya quelqu'un...pas (for «ya personne»). (There's someone... no, for "there's no one").
Je veux jus de pomme. (for «Je veux du jus de pomme.») (I want some apple juice.)
Papa viens (for «papa, viens voir.») (Daddy come, for "Daddy, come and see").
J'ai peindu toi (for «je t'ai dessiné»). (I painted you, for "I drew you").
Le paté de le chat (for «Le paté du chat»). (The cat's pâté.)
Un autre épompier (for «Un autre pompier»). (Another fireman.)
Laurent, en a un navion (for «Laurent, il a un avion»). (Laurent, he has a plane).
À la garderie, nous ont joué (for «nous avons joué»). (At daycare, we played).
L’auto, il est cassé. (The car, it is broken.)
Le chien-chien, il est mortu (for «mort). (The doggy, he is dead).

FOR FURTHER READING

AITCHISON (1976). Chapters 6 and 7.
CLARK & CLARK (1977). Chapters 8, 9, 10 and 13.
Foss & HAKES (1978). Chapters 8, 9 and 10.

Chapter 11. The Acquisition of a Second Language

At first glance, it may seem surprising that the largest portion of the world's population uses two or more languages, at least to some extent. One only has to look at the Indian subcontinent, where inter-provincial trade is conducted either in English (even since decolonization) or in Hindi, the most widely spoken Indian language. Another equally vast country can be taken as another example, where the official language, Mandarin, coexists freely with the dialects of each region of China.

The phenomenon (and necessity) of acquiring a second language is therefore widespread. Among the billions of bilingual or multilingual people, some individuals show special aptitudes or talents for acquiring a second language. How can their success be explained? Could it be a particular talent? Could it be a favourable context that explains this linguistic ability? We must consider each of these factors and explore them.

We will examine a series of related issues. First, the differences and similarities between the acquisition of a mother tongue and of a second language; then, we will specify the main acquisition strategies in the specific context of acquiring a second language; and finally, we will examine the various factors likely to account for individual differences in second language acquisition.

A. THE MOTHER TONGUE AND THE SECOND LANGUAGE

Within our school-based societies, the experience of acquiring a second language is clearly distinct from that of the mother tongue. As a general rule, this acquisition only takes place after sufficient mastery of the mother tongue, during a period covering late

childhood to late adolescence. Another characteristic lies in the fact that the process of acquiring a second language occurs in a more "artificial" way, so that the "exposure time" to a foreign language is very limited. Still students can optimize their learning with specific methods and effective strategies.

Also a student receives on average less than a thousand hours of instruction for learning the second language throughout their schooling. To better understand what this corresponds to, a thousand hours compares to less than three months spent acquiring the mother tongue, counting only daytime hours.

This limited exposure to a second language, compared to the time devoted to acquiring the mother tongue, suggests why children living in bilingual environments achieve a higher mastery of the second language than those who grow up in a unilingual school environment. Nevertheless, even assuming that all could benefit from a bilingual context, some observers doubt that the majority of them would reach perfect competence in their second language, even if they had at their disposal a time proportional to that which they had to acquire their mother tongue. According to them, this seems to be caused by *biological differences* imposing a limit on the acquisition of a second language. This suggestion deserves further exploration.

1. Biological factors

In the fifth section of this volume, we mentioned that in certain bird species, the development of song occurs only during a specific period of their lives (a *"critical period"*). By contrast, in the human species, language acquisition can take place in a less restrictive manner.

Although childhood represents the optimal period for this acquisition, some reported cases (*e.g.*, feral children like *Gen*) confirm that it is nevertheless possible to bypass this critical period to some degree, although among all reported cases, no language acquired under these conditions was ever perfectly mastered. Therefore, adapting our terminology to the human context, we use the term *sensitive period* for the optimal period for language learning. That said, it seems that a biological factor limiting the ability to acquire a first language is indeed involved during this sensitive period; it remains however to be explored whether these limits also apply to the acquisition of a second language.

According to E. LENNEBERG (1967: 125), a process of gradual fixation of linguistic functions linked to the biological maturation of the brain would explain the difference between the acquisition abilities of children and those of adolescents. During this period, from 15 months until puberty, the brain would be capable of acquiring language, after which it becomes more laborious and qualitatively different.

Lenneberg supports his hypothesis of a gradual fixation with two main arguments. First, children with aphasia can have a faster and more complete recovery capacity than that observed in adolescents or adults. This suggests that the transfer of functions localized in the damaged regions of the brain to other intact regions is much easier for children than for adults. The second argument concerns hemidecortication, that is, the removal of the cortical layer of one hemisphere. It appears that a young child is generally able to transfer all linguistic functions to their right hemisphere with little trace resulting from this transfer (DENNIS AND WHITAKER, 1976). Neither adolescents nor adults show the same recovery capacity or “plasticity”, which tends to support the validity of the gradual fixation process, at least concerning language acquisition.

Following Lenneberg, SCOVEL (1969) suggested that the plasticity of brain functions in

children facilitates the acquisition not only of the mother tongue but also of a second language. This would explain the difficulties adults experience when learning a second language.

The publication of Lenneberg's volume sparked a fruitful discussion regarding the sensitive period for language acquisition. During this discussion, it became evident that it was no longer a question of giving predominant importance to the biological criterion. On the one hand, the limits of the sensitive periods as indicated by Lenneberg were contested, and, on the other hand, cognitive changes occurring at puberty were considered to be the influencing factors.

It is interesting to note that authors in this field often do not distinguish between the acquisition of productive and receptive language skills. However, we saw in the previous section that children show an indication, from the first weeks of life, of notable receptive competencies. It is only around the beginning of their second year that they develop oral expression. It would therefore be misleading not to take this fact into account, and thus not to consider the phenomenon of the sensitive period with some flexibility, more precisely concerning the lower bound of this period.

The upper limit of this sensitive period can also be questioned. KRASHEN (1973) notes that according to some indications concerning cortical maturation, the sensitive period probably ends around the age of five. For example, the lateralization of oral expression in the left hemisphere seems complete, or almost complete, in children over five years old: this is demonstrated by the high percentage of persistent language disorders accompanying of left hemisphere lesions in children over five years old. Moreover, it is children under five who, after left hemispherectomy, recover their linguistic functions best through transfer to the other hemisphere.

Furthermore, some other authors have demonstrated with dichotic listening tests (see chapter 7) that there are little or no differences in lateralization between children aged 5 to 11 and adults (ROTHENBERGER, HEESCHEN, AND ROOB, 1981). According to them, the biological maturation of the brain is already well advanced by the age of five.

Despite this, it is evident that a large number of children over five years old are capable of perfectly learning a second language, whether in a bilingual context or thanks to a certain type of teaching (*e.g.*, immersion programs, see below). Moreover, about 5% of adults also succeed in perfectly acquiring a second language (HILL, 1970).

It therefore seems more than likely that factors other than biological ones intervene in the process of acquiring a second language and determine the degree of obtainable competence. These are probably cognitive, affective, and motivational factors.

2. Cognitive and affective factors

According to Piaget, the puberty period corresponds to the transition to a stage of formal operational thought, that is, the use of formal logical reasoning. From a linguistic point of view, the child can now learn to recognize the rules of a language and consciously apply them, like mathematical formulas. It is important to examine whether the conscious formulation of linguistic rules could in some way interfere during the acquisition of a second language.

To our surprise, research indicates that awareness of the rules of a language is not necessarily detrimental to its acquisition. On the contrary, some results of SNOW AND HOEFNAGEL-HÖHLE, 1977 (cited in CHUN, 1980) tend to show that the cognitive structure of adults could even be an initial advantage over that of children. Based on

tests administered at intervals spaced over 4.5 months during one year, among a population of English speakers aged 3 to 67 years learning Dutch in the Netherlands, these researchers demonstrated that adults initially performed much better than children on pronunciation tests. But they were later caught up by these children. For all aspects related to morphology, syntax, and lexicon, the different age groups were equivalent.

Along the same lines, research conducted on the results of immersion programs in Ontario revealed that older students made progress more quickly than younger ones. To do this, a comparison was made between the French level of students in immersion classes since grade 8 (about 1,400 hours of French up to grade 10) and the French level of students in immersion since kindergarten (about 4,000 hours up to grade 8). While the younger students demonstrated better aptitude in oral comprehension, the older ones caught up in reading comprehension and achieved results equivalent to those of the younger students in their overall tests.

This means that the older students were able to catch up in 1,400 hours with the younger ones who had undergone 4,000 hours of instruction. These same older students also outperformed students of the same age (1,400 hours) in non-immersion classes (SWAIN, 1981).

NEUFELD (1979) also reports several experiments that tend to discredit the idea that it is practically impossible for an adult to learn a second language without an accent. In one of these experiments, twenty adult English-speaking subjects listened to 18-hour video recordings in Chinese and Japanese. After a learning period focused on recognizing intonation and subtle articulatory differences, the subjects were asked to imitate as best as possible ten utterances in these languages. The results were judged by native speakers of each language. Eleven out of twenty subjects were classified as native speakers of Japanese, and nine out of twenty for Chinese. These indications seem to show that under favourable circumstances, adults can deploy learning abilities comparable to those obtained by children.

This kind of result therefore allows us to modify the initial formulation of one of our questions. Why, despite similar competence between adults and children, do we still find that adults do not actualize their second language learning abilities as well as younger learners?

This phenomenon is further supported by the research of PATKOWSKI (1980), who studied 67 immigrants arriving in the United States at various times. They belonged to different age groups. He subjected them to linguistic tests and had them fill out a questionnaire. Of the four variables measured (age at arrival in the United States, number of years spent in the United States, degree of exposure to the language, and degree of formal study of this language), it emerged that the age of arrival in the United States was the best predictor of the degree of syntactic competence. Regarding phonetic abilities, Douglas BROWN (1980) indicates that it is rarer for a person to master the pronunciation of a second language than the syntax of that language.

Several relatively unexplored factors can probably explain the difference between adults' acquisition potential and the level of competence they achieve. It is possible, for example, that socio-affective changes occurring at puberty influence the daily learning circumstances in class. Indeed, at this age, an adolescent begins to become aware of their social self. Often, they feel uncomfortable and embarrassed in front of their peers and fear making mistakes more. This disposition tends to harden in adulthood.

Another difference relates to the mode of learning. While a child perceives the second language in a playful way, adults take the underlying social game more seriously

(STENGAL, 1939, cited in SCHUMANN, 1975). This reasoning would account for many results. Thus, the particular social environment created in immersion or laboratory situations would reduce participants' inhibition by allowing them to evolve as normal speakers of the acquired language. Furthermore, it is possible that adults who have retained the playful aspects succeed better than others.

It is also likely that for adolescents and adults capable of operational thought, learning a second language is partly inhibited by their incorrect or incomplete linguistic abstractions (ROSANSKY, 1975). In this regard, an experiment by BIALYSTOK (1979) shows that English-speaking subjects asked to judge the validity of French sentences, then to specify or locate the error, were better at identifying correct sentences when no reflection time was given. This indicates that subjects relying more on their implicit (or unconscious) knowledge of French achieved better results.

It is therefore highly probable that the child, incapable of consciously formulating the rules of the target language, relies on their unconscious strategies for discovering and developing linguistic structure, while the adolescent and adult, to an even greater degree, are more often guided, and often mistakenly, by consciously learned rules.

B. LEARNING STRATEGIES

The next question concerns the learning strategies used by adults. By identifying erroneous strategies we can detect certain traps in order to apply remedial strategies.

Let us clarify the differences between acquiring a mother tongue and a second language. The acquisition of a second language is considered in terms of learned knowledge, as opposed to a spontaneous acquisition of the mother tongue. Within our school-based societies, this learning is undertaken consciously and deliberately, but only after the acquisition of the mother tongue. Ultimately, any learning can be conceived as a form of *action strategy*, comparable to those used in conversation (see section 8).

What is meant by *strategic structure* here? In very general terms, we can compare learning a second language to *problem-solving*. This is defined and characterized by the implementation of various actions that combine or exclude or the integration of compatible data and to elements of one or more solutions.

According to DEWEY (1910, cited by BROWN, 1980: 83), problem-solving involves five stages: (1) becoming aware of the problem, a phase that may include perplexity or frustration due to the problem's significance; (2) attempting to identify the problem; (3) formulating a hypothetical solution based on known data; (4) testing the hypotheses: if these prove erroneous, reformulate the problem (*i.e.*, return to step 2); (5) and incorporating the solutions found into one's own cognitive structure.

Following this model, a French-speaking learner of English will first be confronted with the awareness that formulating an idea is laborious because it is not spontaneous, and they will recognize that they lack elements to express it adequately (step 1); then, they will identify (consciously or unconsciously) the part(s) of the code they do not sufficiently master (step 2); they will draw from their linguistic "baggage" the data that will allow them, more or less successfully, to formulate their own solution (step 3) to produce the sentence that is most compatible with the target code. When faced with any misunderstanding may they seek a new, conforming formulation (step 4), by which they will hopefully enrich their linguistic performance (step 5).

The strategies (more or less successful) that we will discuss concern this third stage, that is, the manipulation of linguistic resources used to achieve satisfactory results. Is this a *transfer strategy, i.e.*, a person relies on the linguistic knowledge of their mother tongue to develop a representation or a formulation in the target language? Or is it a *generalization strategy* where knowledge is drawn directly from the target language? Or finally, is it possible to circumvent the problem by an *avoidance strategy*?

Let us now address each of these strategies.

1. The Transfer Strategy

Linguistic transfer is the use of linguistic data already known in another language. This is favourable when the linguistic structure is similar for both languages. If this condition is not met, it goes without saying that this strategy can lead to failure.

Thus, we speak of *positive transfer* if the use of structures from the initial language produces a correct statement in the second language. For illustration, consider the following case. Both French and German use the *present tense* with French "depuis" and German “seit” to describe an event that has been happening for some time, whereas English uses “since” with *a past tense*:

In French: “*J'attends* ici depuis onze heures”. Present tense.

In German: “*Ich warte* hier seit 11 Uhr”. Present tense.

In English: “*I've been waiting* here since eleven o'clock.” Past tense.

It is therefore expected, and rightly so, that German speakers generally do not make mistakes with the French structure. On the other hand English speakers quite frequently produce faulty French sentences like "*j'ai attendu* ici depuis onze heures".

*Positive transfer i*s little studied because a statement can be the result of either a correct acquisition of the language rules or a transfer strategy. On the other hand, *negative transfer* from the mother tongue to the second language helps explain many mistakes made by students of that language. For example, French speakers frequently produce English sentences such as:

English: “I'm waiting here since eleven o'clock.”

(instead of: “I have been waiting here since eleven o'clock.”

French, correctly: "J'attends ici depuis onze heures."

The sentences are ungrammatical in English, but they do reflect the French structure.

This study of linguistic transfer in second language students led, after World War II, to the *comparative analysis* of languages. The underlying idea was that it would be possible to predict the most frequent mistakes through *taxonomies of differences or similarities* between natural languages. However, this type of comparative analysis faced two crucial obstacles that condemn it and have led, since 1965, to favour *systematic error analysis* instead.

In detailed comparisons of two languages, an extremely long and complex task, students do not make all the mistakes predicted by comparative analysis and, conversely, some mistakes that they do make are not predicted by this analysis.

Thus, according to comparative analysis, Spanish speakers should not encounter any difficulty in distinguishing he/she in English, just as English speakers should not in Spanish, given that the use of these pronouns is similar in the two languages.

However, this distinction regularly poses a problem for Spanish speakers and not for English speakers (SELINKER, 1972: 42). An equally paradoxical phenomenon is found among French speakers, which is all the more strange, since the English structure corresponds to the French structure (example from DULAY AND BURT, 1974: 1051).

Furthermore, GEORGE (1972, cited by DULAY AND BURT, 1974: 105) mentions that only one-third of the errors found in his students' corpora can be attributed to interference from the mother tongue. In this regard, TAYLOR (1974: 30) cites several important studies that tend to show that not all errors are caused by transfers. Some of them are even systematic occurrences, regardless of the mother tongue. DULAY AND BURT (1974) interpret these phenomena as incidences caused by generalization or simplification of rules (see below).

Comparative analysis should not, however, be entirely rejected since it allows for evaluating the distance between the linguistic structures of different languages while predicting a certain number of difficulties. Still the definite importance of the transfer principle (about one-third of the errors) means that current research focuses more on determining other factors. Thus, ZOBL (1980) proposed considering transfer no longer from the mother tongue, but rather from *any* second language.

The usefulness of this latter approach is demonstrated by the fact that the theme "je les vois" (“I see them”) is not commonly produced by French speakers, whereas "je vois elle" (“I see her”), can be found, made according to the English order.

According to Zobl, this can be explained as follows: French, like English, observes the SVO order (subject, verb, object). However, English respects this order more strictly than French. In English, the object always follows the verb, whereas in French, clitic pronouns (me, te, le, la, etc.) can come between the subject and the verb (*e.g.*, “Je te le donne”). Furthermore, the order of pre-verbal clitic pronouns in French remains more complex than in English. On this subject, we have also noted that acquiring the SVO order seems to be a longer process for French-speaking children than for English-speaking ones.

The general use of the SVO structure by French speakers can then be explained by the fact that the placement of pronouns in French expresses an exception to the SVO structure, whereas it follows a more conventional form in English. Zobl's explanation seems to adequately account for the errors and explains them appropriately. She highlights that a large number of mistakes made in difficult structures, from the perspective of transfer between two languages and reflect the speaker's *generalization strategy*, or *ad hoc solutions* adopted due to uncertainty induced by the grammatical difficulty.

2. The generalization strategy

By discovery and elaboration strategies, the systematic study of errors highlighted active procedures in second language learning. In this sense, these strategies are a cross-check of the original language process. This learning strategy could therefore strongly align with the generalization strategy (and the effects of over-generalization) discussed in the previous chapter.

Recall that generalization is the process by which a student applies an already existing structure in the target language to a new element. Similar to what happens in such cases with the mother tongue, we find *false generalizations* in the second language student such as: “I goed”, I runned”, or in French, "vous faisez," "j'ai allé," etc.

TAYLOR (1975), in comparing the use of transfer and generalization strategies among English language students, noted that errors attributable to *transfer* mainly concerned beginners, while those due to *generalization* were more typical of the intermediate level. This phenomenon is explained if one considers second language acquisition as a process of discovering linguistic rules. Indeed, every beginner, possessing only a minimal linguistic knowledge, may try to expand their knowledge based on their mother tongue. In doing so, they therefore may resort to a transfer strategy. On the other hand, a more advanced student can progress more with their new linguistic support and, emboldened, may be more prone to overgeneralize.

This generalization strategy seems linked to a more global strategy of grammatical simplification, also present in children learning their mother tongue. Like the child, the adult tends to simplify the target language system as much as possible by omitting redundancies, generalizing grammar rules, and regularizing exceptions. In this regard, TAYLOR (1974: 26) cites JAIN (1969) and BUTEAU (1970), who propose that errors stem from the internal complexity of the target language rather than from interference from the mother tongue. From this, it follows that it is more of a *simplification strategy*. On this subject, it is interesting to note that ZOBL (1980) reached the same conclusion by studying transfer, and according to him, transfer generally occurs when the target structure is inconvenient to use.

3. The Avoidance Strategy

The third and final learning strategy we consider here relates to an avoidance strategy. This has been little studied but seems to play an undeniable role in second language learning. We speak of an avoidance strategy when a person refrains from using a linguistic element they feel uncertain about. This linguistic element can be a lexical item, a morpheme, a syntactic structure, a word containing a specific phoneme, or a sequence of phonemes that are difficult to pronounce. It is clear that we cannot speak of avoidance for every unmastered linguistic element; this behaviour primarily refers to the attitude of a person who, although knowing the element in question, chooses not to use it. It is therefore, among other things, an indicator of difficulty.

KLEINMANN (1977) studied the avoidance strategy on 39 students studying English, including 24 Spanish and Portuguese as well as 15 Arabic speakers. The structures that were evaluated included the passive voice, the present progressive, the infinitive complement, and the direct object complement. According to the results of the comparative analysis, the Arabic students were expected to have more difficulty with the passive and the present progressive than the Spanish and Portuguese students, while the latter were expected to encounter more obstacles with the infinitive complements and the direct object complement. As for the avoidance hypothesis, it predicts that the group experiencing more difficulty with a certain structure would tend to avoid it and, consequently, would use these structures significantly less often than any other group.

The results supported the avoidance hypothesis. A significant difference marked the two groups in their use of the passive, infinitive complements and direct object complements. As predicted by the comparative analysis, Arab speakers used the passive less, but used the infinitive complements and direct object complements more than the Spanish and Portuguese speakers. Given that both groups showed similar behaviour in comprehension tests, the differences in usage observed here are probably attributable to an avoidance strategy, rather than a misunderstanding of the structures.

On the present progressive, the Latin speakers seemed to avoid it more than the Arab speakers, a phenomenon not expected by a comparative analysis. Kleinmann comments on these results that two structures have a similar form but different functions. The present progressive in Spanish, Portuguese, and English, present a specific interference difficulty. However for Arab speakers, the present progressive seemed easier to learn because it is nonexistent in their native language, and so it was not subject to interference from the avoidance strategy.

4. Approximate Systems

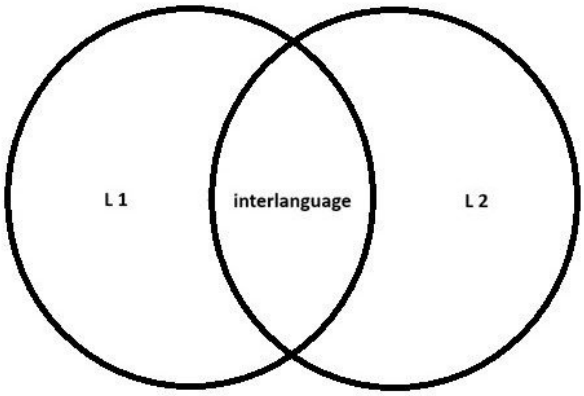
From the early seventies, awareness arose that second language learning largely involved an *active process of discovery*. This sparked the idea that the successive stages of learning constituted phases of a coherent system. Such systems initially possess all the characteristics of native languages and, secondly, a structure that conforms to that of the acquired language.

The term *interlanguage*, proposed by SELINKER (1972), was adopted to describe these approximate systems. This interlanguage (“IL”) is described as a coherent language distinct from the original language (“L1”) as well as the target language (“L2”), but it overlaps with both in some of its characteristics, as shown in Figure 1.

This concept of interlanguage is particularly interesting because it stipulates that some errors cannot be interpreted either from the first language or entirely from the second language, although some characteristics seem to emerge from both parts. DULAY AND BURT (1974: 115) cite the incorrect English sentence "he name is Victor" (for “the name is Victor”) spoken by Spanish children. This sentence reflects neither the Spanish structure, nor the English structure, nor even a stage of acquisition of English as a native language. It is possible that in their attempts, learners overgeneralize or reinforce a different structure, due to a general awareness of the difference between English and Spanish. Following this path, they produce a structure foreign to both languages.

According to SELINKER (1972), there are several sources of error in interlanguage. For those arising from generalization and transfer, Selinker adds them as errors attributable to the learning method. As evidence, Selinker indicates that Serbo-Croats regularly use "he" in English, both to define masculine and feminine references.

FIGURE 1: The concept of interlanguage



At the same time, gender distinction for subject pronouns do exist in Serbo-Croatian.

Selinker explains the systematic use of "he" by the contextual contamination of their classroom exercises, composed almost exclusively from the form "he." The gender difference is known; it is an integral part of the same categorical division, but it can only become automatic with systematic practice.

Another specific characteristic of interlanguage lies in its possibility to become fixed. But this only occurs once the speaker has enough opportunities to express themselves, when they sense either a learning threshold or their insufficient improvement. It is a fossilization defined and determined by the persistence of a certain formal structure over the years. The typical example, in terms of pronunciation, is offered by the common occurrence of a retroflex "r" among English speakers speaking French. Moreover, a fossilized element tends to reappear, even if one believes it is corrected. According to Selinker, all this demonstrates the psychological reality of interlanguage events.

C. TYPICAL DIFFICULTIES IN SECOND LANGUAGE ACQUISITION

Each aspect of learning has its own difficulties. For example, the perceptual distinction of sounds, pronunciation, syntactic structure, vocabulary, and various oral and written styles highlight challenges and characteristics that are specific to each individual.

1. Pronunciation problems

Unlike other aspects of second language learning (morphology, syntax, etc., which only concern mental operations), correct pronunciation is directly related to neuromuscular control. Now, as with any physical activity performed regularly, neuromuscular control of the articulatory organs becomes automatic with practice (KELLER, forthcoming), and the deep rooting established in first language acquisition hinders our process of linguistic adjustment. The adult then faces three levels of obstacles: they must learn new sounds; they must modify their habitual pronunciation; and they must learn certain combinations of phonemes that were previously unknown. This difficulty is all the more pronounced because adults generally persist in a transfer attitude. They tend to rely on a known support through which they feel comfortable and diminish their perception of the phonemic differences of the target language.

FLEGE (1980) analyzed the pronunciation of English stops (p, t, k, b, d, g) made by Arab speakers in the United States. The results obtained reinforced the *interlanguage hypothesis*, namely, that these sounds were expected to be phonetically intermediate between the two languages concerned and that they were pronounced in a slightly variable manner.

Flege also found that phonetic indicators that were closest to English concerned persons who had been established in the United States for the longest time. Some traits were exaggerated due to the awareness of the difference between the produced phoneme and the target phoneme; phonetic overshooting focused either on an aspect of the already acquired phoneme or on the target traits. From these results, it emerged that the student may proceed by exaggerating certain vocal aspects of the target language, at the risk of producing sounds that are foreign to both languages.

2. Problems in the acquisition of morphemes

When learning a second language, the acquisition of morphemes is one of the most

representative examples of these difficulties. What is at stake is the order of acquisition, which should differentiate morphemes that are difficult or easy to learn.

BROWN (cited in CHUN, 1980), as well as several researchers who followed him, attested that the order of acquisition of morphemes in a mother tongue remained roughly immutable from one child to another, and depended more on its complexity than on its frequency or salience. Following these results, KRASHEN ET AL. (1976) examined this phenomenon in the acquisition of a second language. The task of producing twenty morphemes showed that the order of morphological difficulty was roughly the same, regardless of the subjects' age, mother tongue, or linguistic learning. The order of difficulty of the order of acquisition of these morphemes does not correspond to the morphological development of the mother tongue.

If morphemes were acquired according in a privileged order, this would indicate that there exists a natural order, inherent to cognitive structure, governing the learning of morphemes and probably syntactic structures. The results of these studies suggest that several factors determine this order of acquisition. It is unlikely that this order is entirely caused by the degree of difficulty of a given morpheme, since some difficult but frequently used structures are mastered relatively early by the majority of learners (consider, for example, the interrogative-negative conditional form of “couldn't you...?”, in French "ne pourriez-vous pas...?").

On the other hand, for those learning a second language, some morphemes stand out more than others. In this regard, Krashen et al. observed that in English the morphological marker of the third person singular (the final [s] in “she walk**s”**, compared to “I walk”) is neither syntactically nor semantically complex and is by no means one of the very first morphemes taught. However, it ranks 20th in the spontaneous production test. The reason for this late acquisition may be explained by the redundant nature of this morpheme. Since the subject has already been designated by a noun or a pronoun, the "-ed" marker in the final position appears subsidiary to the student, especially since it does not constitute a primary phonetic feature.

It follows that the order of appearance depends on the probable interaction of at least four factors: its degree of difficulty, its degree of usage, its redundant nature, and its salient nature. It is also appropriate to distinguish three types of difficulty. First, a morpheme appearing only late could imply a syntactic difficulty in the utterance (*e.g.*, “ he had not returned them to him”, French “il ne le lui avait pas rendus”).

The second difficulty could be conceptual (*e.g.*, for French learners, the numbers 70-79 and 90-99, *e.g.*, ninety-five "quatre-vingt-quinze"). As for morphemes that are particularly difficult to pronounce, it could be a difficulty in arranging relatively short morphemes resulting from a phonetic difficulty (*e.g.*, “we would be cleaning” / "nous nettoierions" or “we would be boiling” / "nous boullirions").

D. INDIVIDUAL DIFFERENCES IN SECOND LANGUAGE LEARNING

In light of what we have noted so far, we are able to summarize and deepen the discussion based on potential individual factors that determine the degree of success in learning a second language by a given individual.

1. Age

Whatever the individual or combined causes are (biological, cognitive, affective, or

social), it is evident that younger children generally manage to master a second language more easily. On the other hand, major learning problems arise for the majority of the population starting from adolescence and in adulthood. Age-related problems could largely be limited to the factors discussed below, given that we established in a previous section that biological factors do not seem to impose an absolute limit on second language learning.

2. Duration of Learning

We have mentioned several studies throughout this chapter that suggest the duration of second language learning is generally correlated with the level of linguistic competence achieved (*e.g.*, PATKOWSKI, 1980). However, it is recalled that Ontario studies related to immersion (SWAIN, 1981) demonstrated that older students, in total immersion for a duration of 1,400 hours, were able to catch up with and surpass younger students in total immersion for a duration of 4,000 hours. We deduce from this that this factor alone, just like age, is not a sufficient cause and must be combined with other factors, such as social sensitivity and motivation.

3. Intellectual faculties

It is obvious that we do not all possess the same talents. Second language learning is no exception to the rule. The importance of this factor is highlighted by the study of GARDNER AND LAMBERT (1959), described below. However, systematic research seeking to demonstrate the contribution of intellectual faculties to such differences is still in its infancy.

4. Motivation

Motivation seems to be one of the most decisive factors in second language learning. The theoretical reasoning supporting this position states that any motivated student will increase on their own the number of hours of learning and practice, and will engage more intensively and systematically in their learning.

There are only a few studies that have established the importance of this factor, including that by GARDNER AND LAMBERT (1959). This is perhaps still the most serious effort undertaken so far on this subject. These authors measured among English-speaking subjects learning French in Montreal that a large number of factors that could affect second language acquisition. The factors evaluated include: the success rate in oral and auditory learning (measured by imitation and comprehension of French sentences); verbal intelligence (measured by verbal analogy tests) and student motivation (assessed based on the number of French homework assignments completed in class, preference for the French course, frequency of French use in favourable situations, intended future use, and the importance attributed to knowledge of the language).

Furthermore, the authors took into account the students' general linguistic aptitude, their perception of the relevance of French, their attitude towards French Canadians, and their level of anxiety in experimental situations.

The factors most strongly correlated with the success rate were motivation (r = .40) and verbal intelligence (r = .42), while measures of social attitude towards French Canadians, general linguistic aptitude, and anxiety showed little or no correlation with the success rate.

5. Social sensitivity (embarrassment)

Dulay and Burt (cited in KARSHEN ET AL., 1976) mentioned the existence of an affective filter capable of blocking the acquisition of linguistic data. Nevertheless, adopting a positive and motivated attitude would be sufficient, according to them, to reduce the inhibitory effect and facilitate the acquisition of the target language.

The following experiment seems to support this position. During an experiment Guiora et al. (cited by SCHUMANN, 1975) offered a "cocktail" to 87 subjects. These were divided according to the amount of alcohol received, into five groups, distributed as follows: (1) the cocktail was alcohol-free; (2) the cocktail contained 9 dl of 90% alcohol; (3) the cocktail contained 6 dl of alcohol; (4) 4.5 dl; (5) 3 dl. Ten minutes after consuming the cocktail, the subjects were given a test of imitation of words and phrases in the Thai language. The best results were obtained by the subjects who drank the preparations containing 3 and 4.5 dl of alcohol; a dose believed sufficient to suppress social sensitivity, but insufficient to create debilitating intellectual effects.

However, more systematic studies should be conducted focusing on the importance of social sensitivity, given the relatively ambiguous results of this study. Indeed, it is well known that alcohol acts more rapidly on the motor system than on intellectual capacities (due to the pathways of alcohol distribution in the brain which affect the cerebellum before the cortex). It can then be assumed that subjects who consumed a slight amount of alcohol would have experienced, ten minutes after ingestion, a decrease of native motor patterns, without yet suffering negative side effects on their intellectual functioning. This would allow them to improve their ability to imitate a new motor pattern, without necessarily involving the concept of social sensitivity.

6. The socio-psychological aspects of using a second language

Current social psychology emphasizes the notion of the individual as a component of a social group (TAYLOR AND BELLEROSE, 1981: 275). In this perspective, the social group constitutes and refers the individual to himself, by a mirror effect, and provides him a certain security in exchange for his belonging and solidarity.

Thus, speaking a foreign language may represent a potential threat to the individual, and speaking it too well would mean belonging to another linguistic group, thereby risking being deprived of the support of one's own social group. For fear of questioning his social belonging, the individual might develop a certain resistance (conscious or unconscious) to an advanced learning of a second language.

This hypothesis is supported by a number of informal observations. It is well known that some ethnic groups seem more predisposed to learning foreign languages (*e.g.*, the Dutch, the Swiss and the Scandinavians) than others (*e.g.*, the Americans, the English and the French). There is nothing surprising about this, as this predisposition generally belongs to cultures whose history traditionally has brought them into various contacts with foreign languages. Because of this, the descendants of such cultures do not feel that their identity is threatened. One could almost say that speaking foreign languages well would be an asset in asserting their cultural identity.

This kind of argument also applies to Quebec. For a long time already, Franco-Quebecers have often been required to use English in their workplace and with the majority of the English-speaking population in the rest of North America. Since the rise of the Quebec nationalist movement in the 1960s, the majority of French-speaking

environments in Quebec have distanced themselves, somewhat, from English, although statistically, the rates of English use in the workplace have not indicated any substantial change between 1971 and 1981.

In the minds of many of these individuals, a highly advanced knowledge of English would be contradictory to their cultural identity within the French-speaking community of North America. Other individuals, however, play the card of exploiting their English skills while maintaining an image of a Francophone loyal to the cultural and political cause of French Quebec nationalism (one thinks of many political, cultural, and commercial figures in contemporary Quebec). The choice between the two models obviously depends on personal freedom as well as the individual's social context; in situations of social conflict, pressures for social grouping are perceived more directly, and in less conflictual situations, knowledge of second languages constitutes an undeniable asset and a prestigious mark.

SUMMARY

In this chapter, we have examined the major principles governing second language learning. We addressed the biological factors involved in the critical phase of acquisition, noting that this phase cannot be held solely responsible for the slow or incomplete learning of a second language that is generally observed among adults. This learning model seems rather linked to socio-affective factors.

We then examined the strategies employed in learning situations. Research dealing with the transfer of linguistic knowledge from the mother tongue to the second language has shown that similarities between two languages can only predict about one-third of the mistakes made. The majority of errors are explained in terms of the student's generalization abilities, avoidance strategies, teaching methods, and fossilization.

In fact, most adult learners seem to create their own interlanguage, that is, a set of linguistic structures integrating elements from both their mother tongue and their second language. Furthermore, it seems that their interlanguage tends to evolve in a similar and predictable way among the majority of learners, reflecting the degrees of difficulty, usage, and redundancy of the different linguistic structures being acquired.

Finally, we focused on some factors that could be held responsible for differences in individual success. Although this area is still very little studied, motivation factors and socio-psychological perception seem to play an important role in achieving success in acquiring a second language.

APPLICATION SECTION

1. Explain the reasons that suggest the "critical period" ends around the age of five.

2. What studies have shown that children aged 5 to 11 are not necessarily more capable of acquiring a second language than adolescents and adults?

3. Explain some socio-affective factors that could intervene in the often poorer acquisition of second languages among adolescents and adults.

4. Explain the limitations of comparative language analysis and that of the study of transfer strategy.

5. Summarize studies that have shown the relevance of generalization and avoidance strategies.

6. Give examples that support the concept of *interlanguage*.

7. Summarize the study by GARDNER AND LAMBERT (1959).

8. Explain the socio-psychological notion according to which the concept of cultural identity within the linguistic community would be linked to the degree of success in acquiring a second language.

FOR FURTHER READING

BROWN (1980).

CHUN (1980).

KRASHEN (1981).

KRASHEN (1982).

PARADIS (1978).