PART 1

ECONOMICS OF LANGUAGE

CHAPTER 0

ECONOMICS AND LANGUAGE

The psychologist Joel Davitz once wrote: "I suspect that most research in the social sciences has roots somewhere in the personal life of the researcher, though these roots are rarely reported in published papers" (Davitz, 1976). The first part of this statement definitely applies to this book. Though I am involved in several fields of economics and game theory, all my academic research has been motivated by my childhood desire to understand the way that people argue. In high school, I wanted to study logic, which I thought would be useful in political debates or in legal battles against evil once I fulfilled my dream of becoming a solicitor. Unfortunately, I became neither a lawyer nor a politician, and I have since come to understand that logic is not a very useful tool in these areas in any case. Nonetheless, I continued to explore formal models of game theory and economic theory, though not in the hope of predicting human behavior, not in anticipation of predicting the stock market prices, and without any illusion about the ability of capturing all of reality in one simple model. I am simply interested in the reasoning behind decision making and in the arguments people bring in debates. I am still puzzled, and even fascinated, by the magic of the links between the formal language of mathematical models and natural language. This brings me to the subject of this lecture – "Economics and Language."

0.1 Economics and language

The title of these lectures may be misleading. Although the caption "Economics and Language" is a catchy title, it is too vague. It encompasses numerous subjects, most of

which will not be touched on here. This series of lectures will briefly address five issues which fall under this general heading. The issues can be presented in the form of five questions:

- Why do we tend to arrange things on a line and not in a circle?
- How is it that the utterance "be careful" is understood by the listener as a warning and not as an invitation to a dance?
- How is it that the statement "it is not raining very hard" is understood to mean "it is raining but not very hard"?
- Does the textbook utility function $\log(x_1+1)x_2$ make sense?
- Is the use of the word "strategy" in game theory rhetorical?

All the issues discussed in these lectures lie somewhere between economic theory and the study of language. Two questions spring to mind:

- *Why would economic theory be relevant to linguistic issues?* Economic theory is an attempt to explain regularities in human interaction and the most fundamental nonphysical regularity in human interaction is natural language. Economic theory carefully analyzes the design of social systems; language is, in part, a mechanism of communication. Economics attempts to explain social institutions as regularities deriving from the optimization of certain functions; this may be applicable to language as well. In these lectures I will try to demonstrate the relevance of economic thought to the study of language by presenting several "economic-like" analyses to address linguistic issues.
- *Why would economic theory be a relevant subject of research from the point of view of language?* Because economic agents are human beings for whom language is a central tool in the process of making decisions and forming judgments. And because the other important "players" in Economic Theory – namely ourselves, the economic theorists – use formal models but these are

not simply mathematical models; their significance derives from their interpretation, which is expressed using daily language.

0.2 Outline of the lectures

The book deals with five independent issues organized into two groups:

Part 1 is entitled "*Economics of Language*" and comprises the core of this book. In Part 1, methods taken from economic theory are used to address questions regarding natural language. The basic approach is that language serves certain functions from which the properties of language are derived.

In *chapter 1*, I assume that language is the product of a "fictitious optimizer" who operates behind a "veil of ignorance." The substantive issue studied in this chapter is the structure imposed on binary relations in daily language. The designer chooses properties of binary relations that will serve the users of the language. The three parts of the chapter discuss three distinct targets of binary relations:

(1) To enable the user of the relation to point out nameless elements.
(2) To improve the accuracy with which the vocabulary spanned by the relation approximates the actual terms to which the user of the language is referring.
(3) To facilitate the description of the relation by means of examples.

It will be shown that optimization with respect to these three targets explains the popularity of linear orderings in natural language.

In *chapter 2*, we discuss the evolutionary development of the meaning of words. The analytical tool used is a variant of the game-theoretic notion of evolutionary stable strategy. Complexity considerations are added to the standard notion of evolutionary stable equilibrium as an additional evolutionary factor.

In *chapter 3*, I touch on pragmatics, the topic furthest from the traditional economic issues that are discussed in

these essays. Pragmatics searches for rules that explain the difference in meaning between a statement made in a conversation and the same statement when it is stated in isolation. Grice examined such rules in the framework of a conversation in which the participants are assumed to be cooperative. Here, game-theoretical analysis will be used to explain a certain phenomenon found in debates.

Part 2 is entitled *Language of Economics* and includes two essays.

Chapter 4 deals with the *Language of Economic Agents*. The starting point of the discussion is that decision makers, when making deliberate choices, often verbalize their deliberations. This assumption is especially fitting when the "decision maker" is a collective but also has appeal when the decision maker is an individual. Tools of mathematical logic are used to formalize the assumption. The objective is to analyze the constraints on the set of preferences which arise from natural restrictions on the language used by the decision maker to verbalize his preferences. I demonstrate in two different contexts that the definability constraint severely restricts the set of admissible preferences.

Chapter 5 focuses on the rhetoric of game theory. Much has been written on the rhetoric of economics in general; little, however, has been written on the rhetoric of game theory. The starting point of the discussion is that an economic model is a combination of a formal model and its interpretation. Using the Nash bargaining solution as an illustration, I first make the obvious claim that differences in models which seem equivalent result in significant differences in the interpretation of their results. The main argument of the chapter is more controversial. I argue that the rhetoric of game theory is misleading in that it creates the impression that game theory is more "useful" than it actually is, and that a better interpretation would make game theory much less relevant than is usually claimed in the applied game theory literature.

Though the book covers several distinct issues under the heading of "economics and language," it by no means covers all the issues that might be subsumed under this

rubric. For example, I do not discuss the (largely ignored) literature labeled the "economics of language" which was surveyed in a special issue of the *International Journal of the Sociology of Language* (see Grin, 1996). Grin (1996) defines the "economics of language" as "a paradigm of theoretical economics and uses the concepts and tools of economics in the study of relationships featuring linguistic variables; it focuses principally, but not exclusively, on those relationships in which economic variables play a part." This body of research does indeed revolve around traditional "economic variables" and related issues such as "the economic costs and benefits of multi-language society," "language-based inequality," and "language and nationalism." However, despite the similar headings, those issues are very far from my interests as expressed in this book.

0.3 One more personal comment

While browsing through the literature in preparation for these lectures, I came across a short article written by Jacob Marschack entitled the "The Economics of Language" (Marschak, 1965). The article begins with a discussion between engineers and psychologists regarding the design of the communications system of a small fighter plane. Following the discussion Marschak states: "The present writer … apologizes to those of his fellow economists who might prefer to define their field more narrowly, and who would object to … identification of economics with the search of optimality in fields extending beyond, though including, the production and distribution of marketable goods." He then continues: "Being ignorant of linguistics, he apologizes even more humbly to those linguists who would scorn the designation of a simple dial-and-buttons systems a language." I don't feel that any apology is due to economists … but I do feel a sincere apology is owed to linguists and philosophers of language. Although I am quite ignorant in those areas, I hope that these essays present some interesting ideas for the study of language.

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CHAPTER 1

CHOOSING THE SEMANTIC PROPERTIES OF LANGUAGE

1.1 Introduction

This chapter will present a research agenda whose prime objective is to explain how features of natural language are consistent with the optimization of certain "reasonable" target functions. Rather than discuss the research agenda in abstract, I will begin with the specific argument and return to the general discussion at the end of the chapter.

This chapter discusses binary relations. A binary relation on a set Ω specifies a connection between elements within the set. Such binary relations are common in natural language. For example, "person x knows person y," "tree x is to the right of tree y," "picture x is similar to picture y," "chair x and chair y are the same color," and so on. I will avoid binary relations such as "Professor x works for university y" or "the Social Security number of x is y," which specify "relationships" between elements which naturally belong to two distinct sets. I will further restrict the term "binary relation" to be irreflexive: No element relates to itself. The reason for this is that the term "x relates to y" when $x=y$ is fundamentally different from "x relates to y" when $x\neq y$. For example, the statement "a loves b" is different from the statement "a loves himself."

Certain binary relations, by their nature, must satisfy certain properties. For example, the relation "x is a neighbor of y" must, in any acceptable use of this relation, satisfy the symmetry property (if x is a neighbor of y, then y is a neighbor of x). The relation "x is to the right of y"

This chapter is based on Rubinstein (1996).

must be a *linear ordering*, thus satisfying the properties of completeness (for every $x \neq y$, either x relates to y or y to x), asymmetry (for every x and y, if x relates to y, y does not relate to x), and transitivity (for every x, y, and z, if x relates to y and y to z, then x relates to z). In contrast, the nature of many other binary relations, such as the relation "x loves y," does not imply any specific properties that the relation must satisfy *a priori*. It may be true that among a particular group of people, "x loves y" implies "y loves x." However, there is nothing in our understanding of the relation "x loves y" which necessitates this symmetry.

The subject of this chapter is in fact the *properties* of those binary relations which appear in natural language. Formally, a property of the relation R is defined to be a sentence in the language of the calculus of predicates which uses a name for the binary relation R, variable names, connectives, and qualifiers, but does not include any individual names from the set of objects Ω. I will refer to the combination of properties of a term as its *structure*.

I am curious as to the structures of binary relations in natural language. I search for explanations as to why, out of an infinite number of potential properties, we find that only a few are common in natural languages. For example, it is difficult to find natural properties of binary relations such as the following:

A1: If xRy and xRz ($y \neq z$), and both yRa and zRa, then also xRa.

A2: For every x there are *three* elements y for which xRy. (In contrast, the relation "x is the child of y" on the set of human beings does satisfy the property that for every x there are *two* elements y which x relates to.)

Alternatively, it is difficult to find examples of natural structures of binary relations which are required to be tournaments (satisfying completeness and asymmetry) but which are not required to satisfy transitivity. One exception is the structure of the relation "x is located clockwise from y (on the shortest arc connecting x and y)." Is it simply a coincidence that only a few structures exist in natural language?

The starting point for the following discussion is that binary relations fulfill certain functions in everyday life. There are many possible criteria for examining the functionality of binary relations. In this discussion, I examine only three. I will argue that certain properties, shared by linear orderings, perform better according to each of these criteria. Of course, other criteria are also likely to provide alternative explanations for the frequent use of various common structures such as equivalence and similarity relations.

1.2 Indication-friendliness

Consider the case in which two parties observe a group of trees and the speaker wishes to refer to a certain tree. If the tree is the only olive tree in the grove, the speaker should simply use the term "the olive tree." If there is no mutually recognized name for the tree and the two parties have a certain binary relation defined on the set of trees in their mutual vocabulary, the user can use this relation to define the element. For example, the phrase "the third tree on the right" indicates one tree out of many by using the linear ordering "x stands to the left of y" when the group of trees is well defined and the relation "being to the left of" is a linear ordering. Similarly, the phrase "the seventh floor" indicates a location in a building given the linear ordering "floor x is above floor y." There would be no need to use the phrase if it was known to be "the presidential floor." On the other hand, the relation "line x on the clock is clockwise to line y (with the smallest angle possible)" does not enable the user to indicate a certain line on a number-less clock; any formula which is satisfied by three o'clock is satisfied by four o'clock as well. In fact, the existence of even one designated line such as "twelve o'clock", would enable the use of the relation to specify all lines on the clock. The effect of using such a designated element is equivalent to transforming the circle into a line.

Thus, binary relations are viewed here as tools for indicating elements in a set whose objects do not have names.