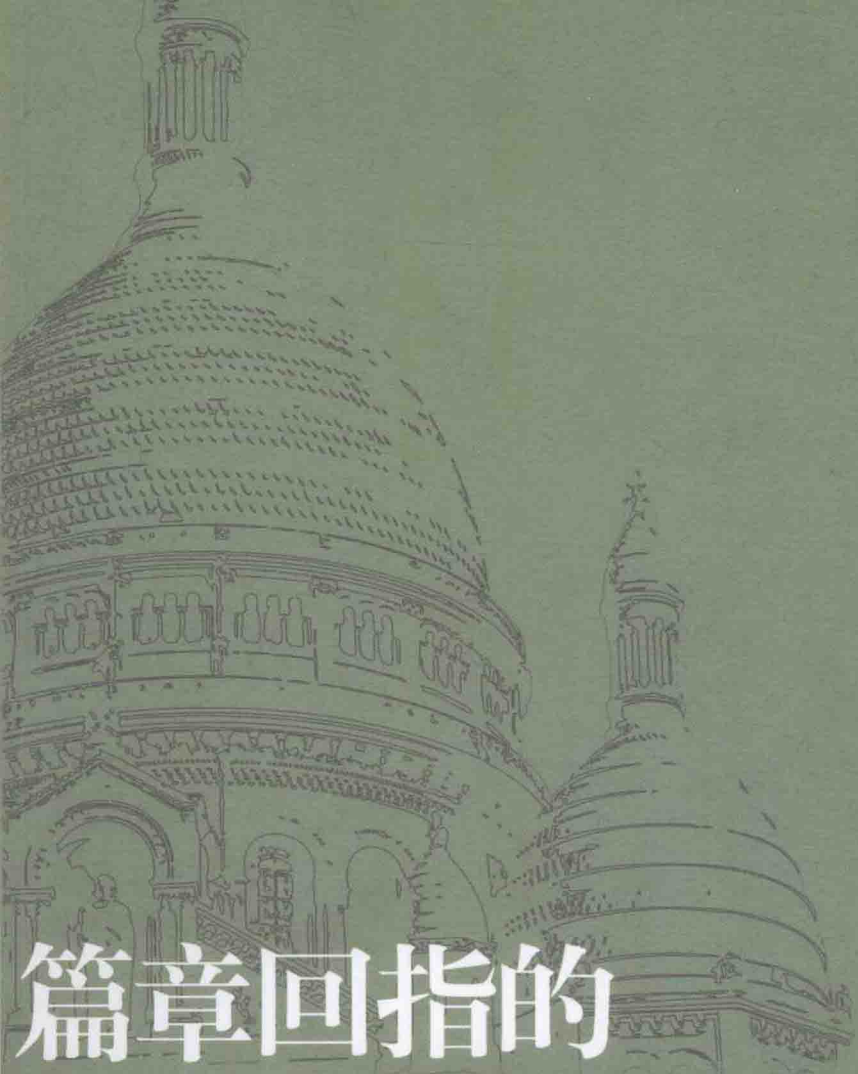

语言学论丛

篇章回指的优选解析

An Optimizing Model of Anaphora Processing:
A Theoretical Approach in the Light of Discourse Structure

基于语篇结构分析的理论探索

王大方 著

北京大学出版社
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序

王大方博士的论文要正式出版了，我很高兴，特此祝贺！

大方博士是一路应届生上来的，年龄虽小，知识面，特别是刻苦钻研的精神，却一点不差。高考那年，她是一名成绩优异的理科生，却选择了自己喜爱的英语专业。这使她的文理科知识都比较全面，为博士论文写作打下了很好的基础。

考博那年，她在紧张撰写硕士论文的同时，来到北京，听了我一学期的课。于是，她在硕士阶段没有正式学过系统功能语法的情况下，通过自学考上了这个方向的博士。（而且，她的硕士论文还获得了所在学校的优秀奖。）来到北大以后，我发现她的语用学也学得很好，劝她改方向，她又愉快地接受了。大方就是这样一位听话、用功的好学生。

大方的博士论文做的是回指研究。这是一个重要研究课题，难度也相当大，但是，她以一贯的拼搏精神知难而上，百折不挠，啃下了这块硬骨头。

她自学了 Prince 和 Smolensky 的优选论、Grosz 等人的中心理论、Beaver 的中心优选理论、Grosz 和 Sidner 的语篇结构理论、Mann 和 Thompson 的修辞结构理论等等。为了更好地理解有关理论，她还到北大计算语言所请教有关老师，跟他们交流自己的思路，听取他们的意见。

在吃透前人理论的基础上，大方从界定基本语篇单位（Elementary Discourse Unit）入手，对现有理论进行了一系列改进，如，利用修辞结构理论和中心理论中的核心内容对意图结构和注意力状态进行了更具体的阐释，将中心理论融入层级性的修辞结构分析之中，利用信息状态、指称形式和视角效果这三个核心因素对不同语篇实体的突显性进行评估，以便有效识别当前的注意力中心，等等。这些细节我不在此重复，有兴趣的读者可以自行参阅。

为了验证自己的方案，大方还自己建立了一个小型语料库，实现

了理论和实际分析的有机结合。

王大方博士的论文要正式出版了，她的研究成果将有机会得到世人的评价。这对她本人是一件喜事，对回指研究也是一件喜事。我们期待王大方博士的语言学研究能取得更大的成果，也期待着回指研究的进一步发展。

姜望琪

北京大学燕北园

2012 年 1 月

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前　言

回指现象一直是语言研究中最为基本和重要的问题之一，同时也是哲学、人工智能、认知科学等很多相关领域内的热门话题。受中心优选理论(Beaver,2004)的启发，本书借助语篇结构分析提出了一个侧重于篇章回指处理的优选理论模型，并借助小型英文语料库验证了它在回指解析中的出色表现。

中心优选理论将优选论(Prince & Smolensky，1993)和中心理论(Grosz et al.，1983，1995)有机地结合在一起，在很大程度上简化并优化了以往的回指解析方案，一经提出就受到了语言学界的广泛关注。遗憾的是这一理论没能摆脱中心理论的羁绊，仅从语篇的线性发展入手将语篇的局部连贯作为回指解析的主要依据，因而在回指解析的过程中遭遇瓶颈。例如，它只凭借句法成分来衡量不同语篇实体的突显程度，这一略显粗糙的做法在一定程度上降低了回指解析的准确性。又如，它总是到回指语所在语句的前一句去寻找它的先行语，但先行语的实际位置显然要自由得多。针对中心优选理论的缺陷，本研究尝试以语篇的整体结构为基础，利用源自不同结构层面的回指制约因素构建一个更为理想的优选解析模型。

以 Grosz 和 Sidner(1986)的结构理论为基本框架，本书在第三章对语篇结构进行了较为系统和深入的阐释。Grosz 和 Sidner 将语篇结构划分为语言结构、意图结构和注意力状态三个有机联系的部分，为语篇信息处理构筑了一个较为完整的理论体系。但是如果要将它应用于回指研究，有必要对其进一步充实和完善。在界定和明晰了基本语篇单位(Elementary Discourse Unit，简写为 EDU)之后，本研究分别利用修辞结构理论(Mann & Thompson，1986，1987，1988)和中心理论中的核心内容对意图结构和注意力状态进行了更具体的阐释。

修辞结构理论从功能的角度解读语篇的整体性和连贯性，利用多种修辞关系将传递完整命题意义的语篇片段有机地组织在一起。它

与意图结构理论最重要的契合点在于，它们都认为语篇结构能够反映出作者具有层级性的交际意图和目标，而且某些语篇片段因传递相对重要的交际意图而具有核心性和主导性。修辞结构理论在结构分析方面的主要优势在于它提供了一个开放性的修辞关系集，从而为细致描述语篇的宏观结构创造了便利条件。根据回指研究的需要，书中建立了一个包含八种广义修辞关系的集合并从多个角度对它们进行了详细分类，为进一步探究语篇宏观结构与回指现象之间的关系奠定了理论基础。

中心理论所关注的是注意力状态、指称方式的选择在实现语篇的局部连贯中所发挥的效应。这一理论在对注意力状态进行描述的同时，揭示了语篇实体的突显性和篇章主题的连贯性在代词使用中的主导作用，从而为回指解析提供了一定的理论依据。但是它涉及多种中心变量（前瞻中心、回望中心、优先中心）和注意力切换方式（持续、保持、转换），使分析过程略显繁复。更重要的是，这一理论以解读语篇的局部连贯作为最根本的出发点，因而应用于语篇回指解析时暴露出一定的局限性。

为此，本书在第四章将中心理论融入层级性的修辞结构分析之中，从四个方面对其加以补充和完善，力求在局部和宏观这两个密切相关的结构层面上提升这一理论在回指解析中的表现。首先，利用基本语篇单位（EDU）和最小修辞单位（Atomic Rhetorical Unit，简写为ARU）对注意力中心的更新单位进行了明确的界定。其次，探讨了如何利用信息状态、指称形式和视角效果这三个核心因素对不同语篇实体的突显性进行评估，以保证有效识别当前的注意力中心。再次，详细阐述了三种不同类型的主题修辞关系在注意力中心的切换过程中所发挥的作用，并将它们概括为三大效应：校直效应、并联效应和花园路径效应。最后，为了适度地扩大解析过程中先行语的搜寻范围，本研究利用 Fox(1987) 在修辞结构的框架下定义的两种回指分布基本模式，即积极模式和控制模式，来解读聚焦空间的推进和跃迁。

优选论最早创立于音系学领域，它所提供的选择机制在回指解析领域有着广阔的应用空间。受中心优选理论的启发，本书在第五章将不同结构层面的回指制约因素转化为生成器（GEN）和评估器（EVAL）的具体工作机制，建构了一个更为完善的回指优选解析模型。在这一优选框架中，生成器有两大任务：一是识别具有名词性先行语的代词，二是确定先行语的搜寻范围并采集所有潜在先行语。评

估器的主要工作是凭借如下六个有序排列的制约条件，从候选集合中挑选出最适合的先行语：AGREE ≫ DISJOINT ≫ RECENCY ≫ PARALLELISM≫SALINECY≫ALIGN。简单地说，AGREE 要求回指语与其先行词在性、数上达成一致，DISJOINT 规定同一谓语的论元彼此不同指，RECENCY 限定了不同的回指距离在回指解析中的制约作用，PARALLELISM 强调了并联效应对回指解析的影响，SALIENCY 反映了各种对语篇实体的突显性产生影响的因素在回指解析中的作用，而 ALIGN 从语篇宏观连贯的角度体现了校直效应所产生的解析倾向。

最后，本研究借助一个包含三种语篇类型、共计 17,311 词的英文语料库对这一优选模型的工作效度进行了检验。在人工标注的基础上，它在处理远距离回指、模糊回指和反向回指（预指）这三种相对特殊和复杂的回指现象时表现十分出色。总体而言，它对语料库中第三人称代词的解析成功率达到了 95.24%，这是一个相当不错的成绩。对于解析过程中没能顺利找到相应先行语的 29 个代词，书中也对它们进行了较为详细的描述和分析，希望有助于这一优选解析模型的进一步发展和完善。

本书是在我的博士论文基础上修改而成的，凝聚了近年来的学习和思考，希望可以为相关领域的研究者提供一些灵感和助力。本书的出版得到了中国人民大学外国语学院“985 工程”青年学者项目的资金支持，在此深表感谢！

Abbreviations

ARU: Atomic Rhetorical Unit

BFP: a pronoun resolution algorithm proposed by Brennan, Friedman and Pollard

C_b: backward-looking center

C_f: forward-looking center

C_p: preferred center

COT: Centering Optimality Theory

CT: Centering Theory

DP: Discourse Purpose

DRA: Domain of Referential Accessibility

DSP: Discourse Segment Purpose

EDU: Elementary Discourse Unit

EVAL: Evaluator, a component of OT working mechanism

GEN: Generator, a component of OT working mechanism

G&S: Grosz and Sidner's theory of discourse structure

GT: Global Topic

LT: Local Topic

NLP: Natural Language Processing

OT: Optimality Theory

RST: Rhetorical Structure Theory

TP: Theme Progression

VT: Veins Theory

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Chapter 1

Introduction

Under the heading "anaphora" we encounter one of the most fundamental and vital aspects of language and language use. Regarded as one of the few "extremely good probe" (Chomsky, 1982: 23) in furthering our understanding of the nature of the human mind, anaphora has provided a testing ground for a number of competing hypotheses concerning the relationship between syntax, semantics, and pragmatics in linguistic theory. What's more, it has attracted a growing amount of attention from philosophers, psychologists, cognitive scientists and artificial intelligence workers.

Due to the discourse-ensitive nature of anaphora, its processing at the discourse level has become one of the most popular and productive research areas in recent years. Making full use of Optimality Theory, I attempt to elaborate anaphora resolution as a selection procedure grounded on a multi-level exploration of discourse structure. It is hoped that such an optimizing model will turn out to be of certain theoretical value towards the large scale empirical work that remains to be done in this challenging area.

1.1 Anaphora: The Central Notion

In order to specify the nature and function of anaphora in discourse, we must first have a clear idea of the range of anaphoric processing available in English. This section depicts a general picture of the central notion "anaphora" and the concepts associated with it. The primary purpose here is not to provide an all-encompassing linguistic account of the pervasive phenomenon of anaphora. Instead,

I seek to present a preliminary classification of various types of anaphora so as to set the stage for a more detailed analysis of "strict" nominal anaphora in this study.

1.1.1 Defining Anaphora in Its Narrow Sense

The term "**anaphora**"[①] is derived from the Ancient Greek word *αναφορα*, which is a compound word consisting of the separate words *ana* (*ανα*), i. e., back in an upward direction, and *phora* (*φορα*), i. e., the act of carrying. Hence, anaphora denotes the act of carrying back upstream. In the construction of discourse universe, anaphora essentially serves as a signpost in indicating, for instance, the maintenance of reference to an earlier-established discourse referent, or the inference of a latent discourse referent via an existing one, or the degree of saliency which a discourse referent is assigned within the current utterance segment.

In its broad sense, "anaphora" can be defined as a linguistic phenomenon in which the interpretation of a linguistic expression (called an **anaphor**[②], often attenuated) depends on the entity denoted by another expression (called an **antecedent**) in the same text or discourse. The complexity of anaphora investigation partially roots in the variety of anaphoric relations. In terms of the morph-syntactic features of antecedents, anaphora can be generally classified as follows:

① The term "anaphora" has two senses according to the direction of the pointing. Narrowly it may be used in contrast to "cataphora", which arises when a reference is made to denote an entity mentioned subsequently in the text. Broadly, the term may also be found subsuming both forward and backward reference. It is in the latter sense that anaphora is used in this dissertation, unless mentioned otherwise.

② The term "anaphor"is used in Chomsky's Binding Theory to indicate reflexives (such as *himself*, *themselves*, etc) exclusively. In this study, the term is used as a cover term for various forms of referring expressions in discourse.

Table 1.1 Categorization of anaphora in its broad sense

Nominal Anaphora	**Noun anaphora**[①] I don't think I'll have a sweet *pretzel*, just a plain *one*.
	Noun-phrase anaphora *The Queen* is not here yet but *she* is expected to arrive in the next half an hour. *Amy* had made a special effort that night but ø was disappointed with the results.
Verbal Anaphora	**Verb anaphora** Stephanie *balked*, as *did* Mike.
	Verb-phrase anaphora Bill will only *present his apologies* if Fred does ø too. John says he wants to *leave his present job*. He has been talking of *it* for quite some time.
Adverbial Anaphora	We shall go to *McDonalds* and meet you *there*. Come and pick me up *at noon*; I'll be ready *then*.
Adjective Anaphora	Gerald Middleton was a man *of persistently depressive temperament*. *Such* men are not at their best at breakfast.
Clausal Anaphora	*Max speaks excellent French* and Professor Hill knows *it*. *They will probably win the match*. *That* will please my mother.

In the field of Natural Language Processing (NLP), however, the term "anaphora" is often used to denote "**nominal anaphora**" in particular. The definition provided by *The MIT Encyclopedia of the Cognitive Sciences* clearly presents the nature of anaphora in this narrow sense:

"The term anaphora is used most commonly in theoretical linguistics to denote any case where **two nominal expressions** are assigned the **same referential value or range.**" (2000: 20)

This type of anaphora is admittedly viewed as the most important and frequently occurring type of anaphoric relation because discourses are always scattered with references to objects which were

① Noun anaphora refers to the anaphoric relation between a non-lexical referring expression and the head noun or nominal group of a noun phrase. So the antecedent here is "pretzel" rather than "a sweet pretzel". Noun anaphora represents a particular case of identity of sense anaphora, which will be introduced in the later part of this section.

either already known to the involved participants, or were introduced into the discourse and then discussed further. As illustrated in the above table, nominal anaphora arises when a referring expression (pronoun, definite noun phrase or proper name) is used to denote an entity and/or sense embodied by a non-pronominal NP in the same discourse.

Nominal anaphora can be further classified according to (i) the inference needed to detect the antecedent (*direct* as opposed to *indirect* anaphora), (ii) the morphological status of the anaphor (*Pronominal*, *Noun Phrase*, *Noun*, *Zero* anaphora, etc.), (iii) whether the anaphor and the antecedent have the same referent in the real world (*identity-of-reference* or *identity-of-sense* anaphora), (iv) the location of the anaphor and the antecedent (*intrasentential* as opposed to *intersentential* anaphora). In light of these parameters, the following sections will be devoted to drawing division lines within this area. As a result, the scope of this study will be narrowed down step by step. Some basic notions and terminology adopted in this study will also be introduced in this process.

1.1.2 Direct Anaphora vs. Indirect Anaphora

In terms of the inference needed to detect the antecedent, nominal anaphora can be grouped into two broad types: Direct anaphora and Indirect anaphora.

Direct anaphora links anaphors and antecedents by such semantic relations as identity (John... he), synonymy (a shop... the store), generalization/hyponymy (John... the man), or specialization/hyponymy (a shop... the boutique). In contrast, **Indirect anaphora** (also known as **associative**, **bridging** or **inferable anaphora**) arises when anaphors and antecedents are linked through semantic relations such as part-whole/meronymy (a glass bottle... the stopper), set membership (a football team... the forward) and so on. These links may be either stereotypic (a restaurant... the waitress) or text-specific (a village... the church).

Using "anaphora" to denote direct anaphora solely, this study will not cover the resolution of indirect anaphora, which is a complicated process normally requiring the use of domain or world

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