Chapter 14

GAMES, QUANTIFIERS AND PRONOUNS

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In this paper, I will outline a game-based approach to reference tracking. Reference tracking is the ability to successfully assign referents to discourse anaphors. My central claim is that reference tracking is an example of how linguistic agents can strategically manage a resource; as such, it is amenable to a game-theoretic analysis. The technique I will develop relies on the management of a data structure, which I will call a game board; since all participants of the discourse are aware of how the game board is managed, speakers can strategically use this resource during the course of a conversation.

We turn, in Section 1, to a brief presentation of some data about how quantifiers introduce discourse entities and how these entities can be accessed by discourse anaphors. I do not intend to cover all of the possibilities here, but to treat a few interesting basic cases. In Section 2, we will turn to a brief discussion of Game-Theoretic Semantics (GTS) and a few rules for interpreting a small selection of quantifiers. The quantifier rules of GTS allow for a straightforward introduction of discourse entities. I will not specifically address the problem of scope ambiguities here, fixing my attention instead on the elementary case of how a single quantified expression establishes a discourse entity. I will briefly address the problem of scope in the conclusion of the paper.

In Section 3 we turn to a game-based discussion of discourse anaphora. The basic idea is that once discourse entities have been introduced, they can be treated as a resource available as public knowledge to the participants of the discourse. The participants can then treat the problem of associating referents with discourse anaphors as a game that can be solved rationally. I will argue that the referents for discourse anaphors can be found by solving for the Pareto-Nash Equilibrium of the game. The idea is that both the speaker and the hearer are involved in a strategic interaction and that the basic structure of the problem is a matter of public knowledge. Because of this mutual knowledge, the participants in the conversation are able to formulate coherent strategies dealing with reference tracking, the ability to correctly assign discourse referents to pronouns. In short, in Section 2 we approach the problem of establishing discourse entities using quantifiers and in Section 3 we solve the problem of choosing ways to refer to them.
1 OVERVIEW

My interest here will be twofold. There have been extensive discussions in the literature about how names, singular indefinites and some definite noun phrases introduce new discourse entities. Concrete proposals have been made about how these discourse entities are managing over the course of a conversation, particularly in the literature on Dynamic Semantics, Discourse Representation Theory (DRT) and Centering Theory.\(^1\) Furthermore, while Dynamic Semantics and DRT have had a great deal to say about how some noun phrases introduce discourse entities (and others do not), they have had less to say about how these resources are managed. Centering Theory has had a great deal to say about how resources are managed, particularly with respect to topic-hood, but it has not been particularly concerned with how quantified noun phrases introduce these resources. I would like to consider here, first, how a broader range of expressions introduce discourse entities and, second, how these entities are then managed in the course of a conversation.

I will consider relatively simple texts like those exemplified in (1):

\begin{enumerate}
\item a. No dean reads Proust. They prefer Stephen King.
\item b. At least 5 deans dropped acid. One jumped out the window.
\item c. At most 5 faculty members considered resorting to cannibalism. They changed their minds when they realized how much work it would be to hunt undergraduates.
\item d. Most deans are druids. They march about waving mistletoe.
\item e. More deans than faculty eat three square meals a day. They need to keep up their blood sugar.
\item (They being the deans)
\item f. More deans than faculty eat three squares a day. They want to keep their weight down.
\item (They being the faculty)
\end{enumerate}

In each of the above cases, a quantifier introduces a discourse entity—for the moment, we will make no commitments as to the character of this entity—which is then the target of a pronoun in the next sentence. We should compare the small texts in (1) which involve inter-sentential anaphora with the example in (2) which involves anaphora within a single sentence:

\begin{enumerate}
\item The doctor told John his pants were on fire.
\end{enumerate}

Assuming that the doctor in (2) is male, then the sentence is perfectly ambiguous given no further information about the context; the pronoun his can refer either to John or the doctor. The pronouns in (1) behave quite differently from the one in (2). All else being equal, the pronouns in the second sentences of the texts in (1) are unambiguously dependent on an element in the preceding sentence.

Consider, first, the small text in (1)c. The pronoun they in the second sentence must refer to those faculty members, five or fewer in number, who considered resorting cannibalism. A similar judgment holds for (1)d; they must refer to those deans who are druids. The pronoun they in (1)a must refer to deans—note, though, that this pronoun has no plural antecedent in the preceding sentence. The indefinite pronoun one in (1)b must refer to an individual selected