"Almost Surely" – Game Theory and the Use of Stance Markers in Academic Research Articles

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Tarkastelen pro gradu – tutkielmassani sitä, miten nk. asenteenilmaisimet esiintyvät akateemisessa kielessä peliteorian tieteenalan aikakausjulkaisuartikkeleissa.

Peliteoria on sovelletun matematiikan osa-alue, joka tutkii ihmisten (tai 'agenttien') välistä strategista vuorovaikutusta. 1940-luvulla syntyneen peliteorian ytimessä on ajatus, jonka mukaan agentit toimivat hyötynsä maksimoimisessa strategisesti, ottaen huomioon muiden agenttien strategiat. Peliteoriaa on sovellettu niin talous-, yhteiskunta-, kieli- kuin luonnontieteissäkin.

Tutkimukseni teoria pohjaa aiempaan työhön tieteenalojen asenteenilmaisimien käytöstä (Hyland 2005, McGrath & Kuteeva 2011). Aiemmassa kirjallisuudessa asenteenilmaisinten määrää eri tieteenalojen tutkimusartikkeleissa on tutkittu, ja eroavaisuuksien pohjalta tieteenalojen jakoa etenkin luonnontieteisiin ja humanistisiin tieteenaloihin.

Tutkimusmateriaalini on kerätty vertaisarvioidusta tieteellisestä aikakausjulkaisusta International Journal of Game Theory. Otos koostuu 11 tutkimusartikkelista vuosilta 1998-2013.

Tutkimusasettelussani asenteenilmaisimet ovat jaoteltu neljään luokkaan: varauksiin (hedge), vahvistajiin (booster), asenteen osoittajiin (attitude marker) ja itsen mainintoihin (self-mention). Jako on tehty Hylandin (2005) aiemman tutkimuksen mukaan, jotta tulosten tarkastelu muihin tieteenaloihin nähden on mahdollista.

Tuloksissa määrällisellä tiedolla tarkastellaan asenteenilmaisimien yleisyyttä sekä sitä mikä osuus kullakin neljällä kategorialla on asenteenilmaisimien kokonaismäärästä. Niiden asiayhteyttä ja käytön monimuotoisuutta havainnollistetaan materiaalista poimittujen esimerkkien avulla. Asenneilmaisimien käyttö on merkki akateemisen kielen retorisesta luonteesta, ja näyttää kuinka kirjoittajat argumentoivat väittämiään.

Tarkastelussani selviää, että peliteoriassa on paljon yhteistä teoreettisen matematiikan kanssa, mutta siihen verrattuna peliteoriassa on eroavaisuuksia itsen mainintojen ja asenteen osoittajien osuuksissa. Matematiikka ja peliteoria eroavat myös muista luonnontieteellisistä aineista, joten jaottelu pelkkiin luonnontieteisiin ja humanistisiin tieteisiin ei asenteenilmaisimien osalta vaikuta yksinkertaiselta. Varaukset ja vahvistajat esiintyvät peliteoriassa osassa tapauksista pareittain tai ryhmissä, ja niitä käytetään monipuolisesti sekä omien että aiemman kirjallisuuden väitteiden merkitsemisessä epävarmaksi tai varmaksi.

asiasanat: tieteellinen kieli, asenteenilmaisimet, tieteenalat, peliteoria, retoriikka

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1. Introduction

This thesis examines academic disciplinary language in a sample of research articles from the field of game theory. Earlier research has shown that all academic disciplines have their own set of features of disciplinary language use, and this thesis will focus in the use of stance markers (e. g. Hyland 2005b). A framework from previous studies on the differences of language use in academic disciplines will be used to observe how the material analyzed relates to the previous results on disciplinary features in academic writing. Special emphasis will be given to the notion of stance, and stance markers will be used as the main tool in the analysis. The initial hypothesis could suggest that, due to the multidisciplinary nature of game theory and the material, the results might not be what is expected from a mathematical model.

The primary research question can be formulated as

1) How is stance expressed in research articles on game theory?

The secondary research questions come naturally from this framework, and can be presented as following:

2) How does the use of stance in game theory relate to other academic disciplines?
3) What sort of stance markers are there in the research articles on game theory?

As any form of language use, language use in academic context also constructs and displays its own conventions and specific features which contribute to its unique linguistic culture, separating its language from that of for example a newspaper or a conversation. Academic discourses make a rich topic for research, as they are crucial to society, "a powerful cultural form in modern society, influencing and being influenced by societies which they are a part of" (Hyland 2000, 158). The linguistic differences between academic disciplines are important, as for example to those, who attempt to become a participating member of academic community, the mastery of academic

discourse and its specialist genres is vital. Previous literature has also suggested that "disciplinary identity may be structurally related to the specialist genres" (Dressen-Hammouda 2008, 233).

Becher and Trowler (2001) discuss cultures within academic communities, and define cultures as "sets of taken-for-granted values, attitudes and ways of behaving, which are articulated through and reinforced by recurrent practices among a group of people in a given context" (23). Language use can definitely be seen as a part of these special cultures, and Becher and Trowler later discuss the division between academic disciplines and how "we may appropriately conceive of disciplines as having recognizable identities and particular cultural attributes" (44). This illustrates the relevance of disciplines as a culture in which the discourse is created.

My analysis examines these differing attributes between disciplines mostly through the use of the linguistic expression of *stance*. The link between academic disciplines and disciplinary identity, as well as the overall significance of academic language, give importance to examining these differences and similarities within the academic culture. In broader terms finding and acknowledging differences as well as discovering common ground can be important in understanding and cooperation between any given cultures.

In order to answer my research questions I will present a theoretical background on researching academic writing based on previous literature. More precisely I will focus on how stance is expressed in written academic language, and how the use of stance differs in various academic disciplines. I will in addition discuss game theory and why it has been chosen as the subject matter for my material.

First my thesis will build a theoretical framework on game theory, research on academic discourse, and then I will identify and define characteristics and features of language used with different academic disciplines as well as their relevance to my analysis. I will discuss the chosen research material, which comprises academic journal articles relating to the field of game theory, and

then discuss the features of stance in the material and how game theory positions in terms of disciplinary variation in stance.

2. Theoretical Background

To build a theoretical framework for my paper I will next focus on three key issues. First I will briefly introduce the basics of game theory and then I will discuss research on academic writing. Finally I will turn my attention to the issues most essential to my analysis, the expression of stance in different academic disciplines, what differences there are in disciplines and how they appear in written academic language. In the theory sections all boldface and italics in quotations are from the original source unless otherwise indicated.

2.1. Background on Game Theory

Although I will not employ *game theory* as a theoretical tool in my study, it is essential to give some basics of game theory to illustrate the reasons as to why the research material I have chosen is from this field. Game theory is developed as a "branch of applied mathematics that models situations of strategic interaction between several agents" (Jaeger 2008 406). In other words, game theory deals with interaction between these agents, human beings. At the core of game theory there is the idea that all actions where participants, or players, make a decision, a kind of 'game' is played. Game theory has both prescriptive and descriptive applications, and can thus be used both to "tell us how we should behave in a game in order to produce optimal results, or it can be seen as a theory that describes how agents actually behave in a game" (Benz et al. 2006, 19).

In game theory use of the word 'game' can be somewhat misleading to those unfamiliar with the theory, as it does not necessarily mean a game in a conventional sense like a game of cards or a computer game (although it certainly can refer to them, too), but rather refers to any situation involving an agent, or a player, making a decision with different results, or pay-offs:

"In a very general sense we can say that we play a game together with other people whenever we have to decide between several actions such that the decision depends on the choice of actions by others and on our preferences over the ultimate results." (Benz et al. 2006, 1)

This idea of a game being played can be seen to apply to anything, from driving a car to political elections, or from auctions to a union negotiating with a company (Binmore 2007, 1). All of these games are different in their construction, but all of them have a player or players making a decision with multiple options at their disposal, and the outcomes depending on these decisions. About these options Jaeger (2008) mentions how "Each player has choices between various ways of behaving – his strategies. Also, each player has 'preferences' over possible outcomes of the interaction" (407). There is a myriad of different games in game theory, including but not limited to noncooperative games, cooperative games, games with perfect or imperfect information, repeated games and so on (e. g. Ordeshook 1986). Jaeger (2008) notes that since its inception, game theory has "developed into a standard tool in economics" (406).

Game theory uses terms like games, players or strategies, but as mentioned these apply for any situation with interaction. To give a simple constructed example of everyday game theoretical decision could be that I go to the university cafeteria with my friend, and would like to eat. However, as my friend does not have a lot of time I decide to skip lunch and enjoy a cup of coffee in good company instead. Here my decision also depends on another player's decision: I would want to have a full meal, but since I would have to eat most of it alone, I go for the cup of coffee. In game theoretical terms I have played a two-player game and have strategically reached a decision, based on not only my own preferences but also the actions of the other player, made according to their set of preferences.

Another classic example of applying game theory comes from Von Neumann and Morgenstern (1944) when they introduce a case from *The Adventures of Sherlock Holmes* by Arthur Conan Doyle. Holmes attempts to escape his nemesis, professor Moriarty, via train to Dover but after

spotting Moriarty at Victoria station anticipates that Moriarty will take a faster train to catch him in Dover, and Holmes is left with the choice of whether to stay on board until Dover or get off at the only intermediate station. Von Neumann and Morgenstern point out that this example from literature actually introduces a case of two-player game with pay-offs determined by actions of both players. (176-177)

John Von Neumann, who has a hand in the classic example above is seen as the "inventor" of game theory, when in 1928 he "derived the first prominent game theoretic result" (Gates & Humes 1997, 1-2). Game theory evolved from purely mathematical model into a tool used in political sciences and economics in the 1940s and 1950s (Gates & Humes, 2). Another example of a famous game theorist, recognized even in popular culture, is the 1994 Nobel winner John Nash (whose life was famously the inspiration for the Academy-award winning 2001 film, *A Beautiful Mind,* where Nash was played by Russel Crowe), who in 1950 introduced the concept of Nash equilibrium. Nash equilibrium is used in predicting results of games where the players know each other's strategies, and make their decision based on this.

A simplified example of Nash Equilibrium is illustrated by Binmore (2007) with the following example: "Alice and Bob are two middle-aged drivers approaching each other in a street too narrow for them to pass safely without someone slowing down (12)". In this example the solution is that if Alice knows Bob will slow down to make room on the street, Alice should speed up to access the street, or if Alice knows Bob will speed up then it is best for Alice to slow down to avoid a deadlock. Of course the strategies work vice versa for Bob, too. The situation where one slows down and the other speeds up is Nash Equilibrium, producing a best pay-off for both Alice and Bob (after all, if both speed up or slow down there is an imminent collision on the narrow street!). (Binmore 14)

Game theory, like any other theory, obviously is a theory with nuances and complexities which are impossible, and not relevant to this thesis, to cover in this brief introduction. At the heart of game theory there is however, as previously mentioned, the idea of human interaction. Game theory has real-world applications, as in for example designing auctions for government-owned radio frequencies to be used for cellular telephones in the United States and the UK (Binmore 2007, 2-3). Although game theory has its roots in mathematics, I previously mentioned its use in economics but it is also widely used in various other academic fields, including social sciences, political science (e.g. Ordeshook, 1986), psychology (Jaeger 2008 406) and even linguistics (e.g. Pietarinen 2007) or evolutionary biology (e. g. Binmore, 2007 117).

As has been pointed out, game theory has a strong origin in mathematics, and thus could initially be expected to follow the language conventions of other mathematical disciplines. However due to game theory's history of undeniably multidisciplinary applications I will argue that it can provide a seemingly opportune field to discover language features differing from mathematics, as game theory lends itself effortlessly to a variety of topics and subjects across discipline boundaries.

2.2. Researching academic writing

A part of research of academic discourse falls under the study of English for specific purposes (referred to as the common abbreviation ESP from now on, e.g. the academic journal *English for Specific Purposes*) or more accurately for this work, English for academic purposes (commonly shortened EAP, as it is here from now on), that is the use of language in academic context. Zwiers (2014) describes some main features of academic language as "the language used to describe abstract concepts, complex ideas, and critical thinking" (ix). With conventional wisdom, discourse in academic field can be seen as objective writing aimed at distributing and building knowledge, but this view has drastically changed:

"Over the past decade or so, academic writing has gradually lost its traditional tag as an objective, faceless and impersonal form of discourse and come to be seen as a persuasive endeavor involving interaction between writers and readers." (Hyland, 2005b 173).

Given this view it is obvious that academic writing can be examined in terms of linguistic devices, such as genre features, linguistic markers, vocabulary, or rhetoric tools. This part will further discuss the theory of research on academic writing to build a background for the analysis of language features and academic disciplines.

The concept of language in academic context in itself is a vast term which includes a variety of types of professional sub-genres to be studied, including but not limited to research articles (e.g. Gross & Chesley, 2012), academic bios (e.g. Tse, 2012), textbooks (e.g. Bondi, 2012), PhD theses (e.g. Thompson 2012) or student essays (e.g. Matsuda & Jeffrey, 2012). Academic writing has been studied with focus on different aspects, ranging from for example structural patterns (Lin & Evans, 2012) to academic vocabulary (Hyland & Tse, 2007). It should be noted that much of the aforementioned examples of varieties within academic discourse only concern academic language in its written form. Out of the aforementioned written professional sub-genres, this thesis examines the language of research articles, referred to as RA from now on.

A definition of a research article is in order to discuss it as research material for this thesis. Although Swales (1990) notes that "like all living genres, the RA is continually evolving" (110), a both thorough and brief definition of research article is given as

"a written text (although often containing non-verbal elements), usually limited to a few thousand words, that reports on some investigation carried out by its author or authors. In addition, the RA will usually relate findings within it to those of others, and may also examine issues of theory and/or methodology. It is to appear or has appeared in a research journal or, less typically, in an edited book-length collection of papers" (93)

As there are a myriad of ways to categorize and examine academic language as a research subject, one must find the appropriate viewpoint and framework for analysis. Hyland (1999) suggests that "the persuasiveness of academic discourse does not depend upon the demonstration of absolute truth, empirical evidence or flawless logic… …[texts] are persuasive only when they employ social and linguistic conventions that colleagues find convincing" (99). McGrath & Kuteeva (2012) offer a summary of some of the ways how in academic writing the author carries out the task of presenting scientific knowledge through the writing, but also has a position to leave a personal stamp on the language, as they note that a research article author in academic writing:

> [the writer] "…does indeed inform readers of the facts or processes leading to a scientific discovery, he or she also conveys an attitude towards the reliability or potential impact of the result, and its position in the existing canon. Furthermore, the author seeks to guide the reader through the material and micro-manages their interpretations, anticipating possible objections and highlighting key features" (162-163).

It is in this context of the writer's attitudes where disciplinary differences relevant to this thesis can be found. Ramanathan and Atkinson (1999) recognize "that which individuates a writer from all other writers, as evidenced in that writer's texts" (49) with the term of *voice.* Although looking at voice in academic articles is at first problematic as it has "often literary and aesthetic overtones" (Tardy 2012 34) and "for decades the study of voice has been the privileged domain of literary criticism" (Silver 2012 202), the term is not out of place with academic writing either.

Voice concerns academic disciplines, too, as "whereas 'individual voice' may be thought of as the property of a writer, 'social voice' is associated more with the disciplinary or other social groups to which the writing and the writer are linked" (2012, 37). Acknowledging the term of voice as the indicator of differentiating writers from each other, there is another term which I will employ in my analysis, *stance,* as "stance is subsumed in the broader phenomenon of voice" (Sancho

Guinda & Hyland, 2012 4) and will provide me with focus and devices needed for the theoretical background, method and analysis.

2.3. Stance and academic writing

To discover the disciplinary characteristics of RA writing in game theory my thesis will employ the term *stance*. What stance is and what it entails are discussed in this chapter. Gray and Biber (2012) describe stance as a concept about "the ways in which speakers and writers encode opinions and assessments in the language they produce," concerning personal feelings and attitudes as well as certainty and doubt in relation to knowledge (15). Stance, much the same as voice, can be applied just the same to spoken and written English as well as fiction and factual writing. There has been several definitions and descriptions of what stance entails, depending on the point of view, but in this chapter the aspects of stance most relevant to my method and analysis will be introduced: first the definition of stance and then I will discuss its composition of devices related both to the knowledge communicated as well as personal feelings and attitudes.

2.3.1. Defining stance

Hyland draws attention to academic language as a *"persuasive endeavor involving interaction between writers and readers"* (2005b, 173), highlighting the argumentative nature of it. This shows how argumentation and rhetoric are essential when discussing stance. Harking back to Aristotle the earliest definitions of rhetoric define three main components: pathos, ethos and logos, and all of them concern the speaker's (and indeed, the author's) different ways of affecting the audience.

Pathos is associated with conveying emotions and appealing to the emotions of the audience (Cockcroft& Cockcroft, 1992 9). Ethos is defined as persuasion through personality and stance (Cockcroft & Cockcroft 8), "the speaker's stance of sincere and confident authority" (Nash,

1989 207) and "ways in which the perceived attributes of a speaker, manifest through discourse, are persuasive" (Jasinski 2001 229). Logos, on the other hand is persuasion through reasoning and rational argument (Jasinski 350).

Although there are several other, more modern methods of classifying rhetorical discourse, the Aristotelian model alone illustrates that all forms of rhetoric can be expressed through stance, as stance is closely related to both knowledge and emotions in the text, and in fact these two can often be easily intertwined. More specifically knowledge and emotions in stance are expressed through evidentiality and affect, both of which will be discussed later on. Although this thesis does not discuss rhetoric per se, it is useful to point out the close relationship of these concepts.

Overall stance has been discussed by Biber et al. (1999) as the position a writer or a speaker takes on several issues in the text: "In addition to communicating propositional content, speakers and writers commonly express personal feelings, attitudes, value judgments, or assessments; that is, they express a 'stance'" (966). Biber et al. suggest that stance in a text can be "expressed in many ways, including **grammatical** devices, word choice and **paralinguistic** devices" (966), with the focus of this thesis being exclusively on the grammatical expression of stance due to paralinguistic devices relating mostly to speakers in a conversation and fictional writing (Biber et al. 967-968).

Research has been conducted on stance in academic context, for example this definition of stance as "an attitudinal dimension and includes features which refer to the ways writers present themselves and convey their judgements, opinions, and commitments. It is the ways that writers intrude to stamp their personal authority onto their arguments or step back and disguise their involvement." (Hyland 2005b, 176). Given the attitudinal dimension of stance it should be noted that a connection between stance and the definition of culture is evident, as culture concerns shared attitudes (Becher & Trowler 2001, 23). In academic writing "the writer's stance is at least partially influenced by the social practices of his or her academic discipline" (Hyland 1999. 99).

Stance has often been employed in research of academic language, as Biber (2006) points out how this seems to contradict the conventional notion of objectivity in academic language as "according to one idealized representation of university language, there would be no need for stance expressions" (87). In addition Biber notes how "in some cases speakers and writers in university registers seem more concerned with the expression of stance than with the communication of 'facts'." (87). When comparing English registers of conversational, academic, fictional and news language use Biber et al. (1999) note that stance markers are common in all the registers, and "it is more surprising that stance markers are prevalent in academic writing, especially given the general lack of first person involvement in that register" (980).The uses of stance in academic writing and their connection to academic disciplines and their own language conventions will be discussed later on, but first I will discuss components which construct stance.

2.3.2. Constructing stance: evidentiality and affect

The discussion above suggests how the perceived 'objectiveness', or at the very least the ideal of objectiveness of academic language, is perhaps more problematic than one could assume, and thus also a subject worth examining. However there is a fundamental task which academic language carries out, as for example Hyland (2000) argues that "to a large extent disciplinary discourse has evolved as a means of funding, constructing, evaluating, displaying and negotiating knowledge" (5). As stance is used to describe the writer's attitudes, using stance in analyzing academic language becomes relevant when examining these attitudes of the writer towards the knowledge being communicated. The following part discusses what the term stance entails with focus on the notions of evidentiality and affect. There are other definitions of stance, as for example the inclusion of *relation* (e.g. Hyland 1999), or the label *evaluation* (e. g. Hunston & Thompson, 2000) but for the purposes of this work I will focus on *evidentiality* and *affect*.

To further discuss stance and knowledge in academic writing Biber (2006) draws attention to the function of academic registers and their task of assessing information (87). Hyland (2000) also notes how academic texts can "work to transform research findings or armchair reflections into academic knowledge" (7) and attempt to persuade a reader "to accept a particular observation as a fact, or at least as a worthwhile contribution to disciplinary knowledge" (8). Especially as there is "always more than one plausible interpretation of a given piece of data, the reader may be persuaded to judge a claim as acceptable, or may decide to reject it" (Hyland 1999, 103). The attempt to construct or assess knowledge relates strongly to the ways the writer expresses in the text their own attitude towards knowledge, and this status of knowledge in a given proposition is known as *evidentiality* (Gray & Biber, 2012 16) or epistemic stance (Biber et al. 1999 972).

Evidentiality in a text "functions in the representation of epistemological stance - the underlying perspective on knowledge represented in a text" (Barton 1993, 746). Evidentiality in a text is expressed through evidential devices, which in many non-Indo-European languages are represented through specific grammatical constructions (Barton 746), but in English are expressed through devices such as "modal auxiliaries, adverbs, and miscellaneous idiomatic phrases" (Chafe, 1986, 261). Chafe also discusses evidentiality and academic language, giving an overview of academic written language and evidentiality in comparison with conversational English:

> "…in general, conversational English and academic writing both show a concern for the reliability of knowledge, as well as induction. Academic writing shows more concern for deduction, neither makes a big point of marking the kind of evidence per se, and hedging as well as other devices which match knowledge against expectations are more characteristic of conversation than of academic written language." (272)

Biber et al. also note the variety of ways epistemic stance can present the writer's attitudes about information: epistemic stance markers "can mark certainty (or doubt), actuality, precision, or limitation; or they can indicate the source of knowledge or the perspective from which the information is given" (972). What stance markers are and how they manifest in a text will be discussed later, but an important note on the epistemic stance and academic writing is the indication of the source of

knowledge through quotations and citations, which is essential in any given text that attempts to be considered academic.

Compared to evidentiality the notion of *affect* moves more towards the realm of emotions and attitudes: Hyland (2005b) discusses affect as part of stance, and states that affect "involves a broad range of personal and professional attitudes towards what is said, including emotions, perspectives and beliefs" (178). Affective factors refer to "overt expressions of a range of personal feelings and dispositions" (Hyland 1999 102). Biber et al. discuss attitudinal stance (974) which seems to cover the notion of affect the same way epistemic stance relates to evidentiality, as attitudinal stance markers "report personal attitudes or feelings" (974).

It should be noted that for example Biber et al. (1999) note how "the meaning of a stance marker can be ambiguous in some cases" and gives an example clause:

"I **hope** there's enough there"

Here the verb *hope* "conveys both a personal attitude and an epistemic stance (lack of certainty)" (972). This ambiguity can be dealt with by not making a separation between evidentiality and affect when discussing stance: Gray & Biber (2012) mention that evidentiality and affect are both often brought together into the model of stance, as stance actually covers both "personal attitudes and emotions as well as assessments of status of knowledge" (17). My analysis will consider this semantic difference of expressing evidentiality or affect mainly in classifying the elements of stance for the theoretical framework, but also utilize both of them in building the definition for the term stance, and illustrating the various issues which stance communicates in academic writing.

2.3.3. Marking of stance in academic writing

What stance is and how it is constructed is needed to focus on the specific ways in how stance is expressed, as there are several ways how stance is marked in writing. Biber et al. (1999) discuss the grammatical construction of stance and identify some major linguistic components which express stance in writing, including stance adverbials, stance complement clauses, modals and semi-modals, with stance adverbials and complement clause constructions recognized as the clearest cases of marking stance (969-970).

Grammatical marking of stance is a very wide topic, but there has been models of classifying and recognizing stance markers in academic language, which can offer mode focus on stance and academic disciplines, e.g. Hyland (1999). This thesis will examine stance from the standpoint of a corpus-based study on stance and engagement in RA writing by Ken Hyland (2005b). The study is based on an analysis of 240 published research articles from eight disciplines (173). Although the approach from a single corpus-based study can be considered a formidable limitation on stance, as for example Sancho Guinda & Hyland (2012) point out (4), and there obviously can be some overlap between the categories as forms can often perform more than one function at once. However for the purposes of this work this classification provides focus and offers a sufficient framework for identifying the elements of stance in a text. Hyland (2005b) recognizes four major markings of stance: hedges, boosters, attitude markers and self-mentions (178).

2.3.3.1. Hedges and boosters

Hedges mentioned by Hyland (2005b) are "devices like *possible*, *might* and *perhaps*, that indicate the writer's decision to withhold complete commitment to a proposition, allowing information to be presented as an opinion rather than accredited fact" [italics from original] (178). *Boosters* on the other hand are defined by Hyland as "words like *clearly*, *obviously* and *demonstrate*, which allow writers

to express their certainty in what they say and to mark involvement with the topic and solidarity with their audience" (179). Hedges and boosters can also be defined as "communicative strategies for increasing or reducing the force of a statement" (Hyland 2000, 87). In terms of semantic distinction both hedges and boosters are regarded as part of epistemic stance as epistemic stance, according to Biber et al. (1999) can mark both certainty or doubt (972).

There are certain strategic tasks which both hedges and boosters can be seen to have in writing. Hyland (2009) notes that with hedges and boosters "both strategies emphasize that statements don't just communicate ideas, but also the writer's attitude to them and to readers" (75). Their rhetoric nature and strategic usage should also be noted, as both of these stance markers "work to balance objective information, subjective evaluation and interpersonal negotiation, and this can be a powerfully persuasive factor in gaining acceptance for claims" (Hyland 2000, 101).

Hyland states that hedges in academic writing are used to reduce the force of statement to distinguish certainty from opinion and allow reader to dispute their interpretations and leave "agreement open to readers' judgements" (94): after all, in academic writing the knowledge is presented in statements which are "evaluated and interpreted through the prism of disciplinary assumptions" (92). Boosters on the other hand are used to enforce the statement of the writer: this is acknowledged by Hyland as a bit contradictory to hedges and their cautious nature, but note that boosters serve the purpose of balancing this caution "by a degree of assertion and self-involvement" (97). Both hedges and boosters in writing are of course not independent of individual factors such as self-confidence and experience, but as Hyland also points out, "all acts of communication carry the imprint of their contexts" (91) and thus there are discourse conventions which are followed in RA writing by the use of stance markers such as hedges and boosters.

2.3.3.2. Attitude markers

The difference between the epistemic and attitudinal stance is, as mentioned before, mostly semantic rather than grammatical. For the marking of an affective attitude in a text Hyland (2005b) uses the term *attitude marker* "conveying surprise, agreement, importance, frustration, and so on, rather than commitment", and that these are mostly "signaled by attitude verbs (e.g. *agree, prefer*), sentence adverbs (*unfortunately, hopefully*), and adjectives (*appropriate, logical, remarkable*)" (180). Biber et al. (1999) categorize these devices as signaling attitudinal stance, which marks attitudes, evaluations and personal feelings or emotions in the text (974). Hyland (2009) notes academic disciplines in relation to attitude markers as "this marking of attitude in academic writing allows writers both take a stand and align themselves with disciplinary-oriented value positions" (76).

2.3.3.3. Self-mentions

The fourth element marking stance used in Hyland's (2005b) study, *self-mentions*, relates to "the use of first person pronouns and possessive adjectives" to present information (181). Hyland (2009) states that with self-mentions "the presence or absence of explicit author reference is therefore a conscious choice by writers to adopt a particular stance and disciplinary-situated authorial identity" (76). As academic register favors the more objective and non-personal use of language, self-mentions can actually bring an explicit self of the writer into the text, and these instances position the writer directly with the information presented.

Although stance, along with voice, can often be connected with studying individual writers, for my study I will look at some general features characteristic to various academic disciplines. Given how stance is strongly associated with the individual and their attitudes I will next introduce theoretical background on how stance markers have been used to analyze entire academic disciplines and more importantly how I will differentiate between disciplines and use this in my

analysis of the RA material and what I will attempt to find. The four elements of stance introduced in Hyland's study provide a sound framework for mapping stance markers in academic writing and associating them with different academic disciplines.

3. Differences in disciplinary discourses

Variation in academic discourse can be approached from several angles, for example using different academic genres of writing, focusing on differences between language use of students and seasoned academics (e.g. Barton 1993) or examining the structures of research articles (e.g. Lin & Evans 2011). This chapter will address the previously discussed theoretical framework on academic language, mostly the concept of stance, and will use this background in relation to different academic disciplines. Main focus will be on these disciplines and how they differ from each other in terms of language features, especially stance.

To study academic writing in RA literature with focus on academic disciplinary discourse it is essential to define and identify the differences in language use among various disciplines. Finding a framework of disciplinary academic writing is challenging, as disciplinary conventions in academic writing are "both subtle and complex, offering a guiding framework for writers" and do not consist of explicit rules (Hyland 2000, 145). It should be noted that making assumptions about very strict discipline boundaries should be discouraged, as Becher & Trowler (2001) note how a branch of a discipline can separate from the "parent discipline", e.g. in the case of statistics and mathematics, (41) and also how organizational structures of universities and international community "with its own professional associations and specialist journals" (41) play a role in defining various academic disciplines. With these issues acknowledged it is still possible to find differences between the language uses of different academic disciplines and show their relevance to my analysis.

Approach, subject matter and methodology can obviously differ in academic disciplines, but there are other methods of differentiating between them. Hyland & Tse (2007) have employed a corpus study for differences in academic vocabulary, and notice that their results "reveals uneven word frequencies, restricted item range, disciplinary preferences for particular items over semantic equivalents, and additional meanings lent to items by disciplinary convention and

associations in lexical bundles" (248). Becher & Trowler (2001) draw a distinction between 'hard' sciences and 'soft' fields in terms of knowledge construction, where in the first knowledge is built on the previous work of others, and in the latter the views of others are presented for the writer to take a positon in relation to them (36).

3.1. Disciplines and stance

The corpus-based study by Ken Hyland on stance and engagement in academic research articles (2005b) is the main basis for differentiating academic disciplines in terms of stance. As Hyland's study included eight disciplines: "mechanical engineering (ME), electrical engineering (EE), marketing (Mk), philosophy (Phil), sociology (Soc), applied linguistics (AL), physics (Phy) and microbiology (Bio)" (178). McGrath & Kuteeva (2011) later followed similar approach and method on 25 published articles from the field of pure mathematics (P Mth) (163). The inclusion of pure mathematics is to McGrath & Kuteeva important, as although they state that "pure mathematics does share common ground with the hard sciences" it also has a notable differences and uniqueness in that the process of knowledge verification differs since in mathematics "the results are substantiated by logical, mathematical reasoning" and the outcome is "essentially limited to a binary true or false (162). With McGrath & Kuteeva's and Hyland's studies there are a total of nine different disciplines with various stance markers mapped.

Hyland's results suggest that overall, stance items occurred 30.9 times per 1,000 words, with hedges being the most common one with 14.5 per 1,000 words compared to attitude markers (6.4), boosters (5.8) and self-mentions (4.2) (86). Hyland points out that the overall frequency of stance markers is greater per 1,000 words than that of for example passive voice constructions or past tense verbs, illustrating the prevalence of stance in academic RA writing (186). It should be noted

that the previous numbers about the overall frequency does not include the McGrath & Kuteeva findings of pure mathematics, as it used different corpus material.

Table 1. Stance features by discipline (per 1,000 words)

Feature	P Mth	Phy	Bio	ME	EE	Phil	Soc	AL	Mk
Stance	**10,7**	**25.0**	**23.8**	**19.8**	**21.6**	**42.8**	**31.1**	**37.2**	**39.5**
Hedges	1.8	9.6	13.6	8.2	9.6	18.5	14.7	18.0	20.0
Boosters	5.4	6.0	3.9	5.0	3.2	9.7	5.1	6.2	7.1
Attitude markers	2.7	3.9	2.9	5.6	5.5	8.9	7.0	8.6	6.9
Self-mentions	0.8	5.5	3.4	1.0	3.3	5.7	4.3	4.4	5.5

Table 1 illustrates the number of stance markers per thousand words. The author has combined results from both Hyland and McGrath & Kuteeva studies in the same table. As can be seen, there is clearly variation in the frequency of the stance markers by discipline. Overall pure mathematics (P Mth), mechanical engineering (ME) and electrical engineering (EE) display the smallest number of stance marker occurrences, while philosophy (Phil), marketing (Mk) and applied linguistics (AL) have the most stance marker occurrences. In fact the difference between pure mathematics and philosophy is a formidable one, 10.7 to 42.8. With 10.7 P Mth displayed clearly the least stance markers, as even ME and EE had 19.8 and 21.6, respectively. Hyland attributes the variation on the nature of the 'hard' and 'soft' disciplines, as "those in the humanities and social sciences taking far more explicitly involved and personal positions than those in the science and engineering fields" (187). This would explain the higher number of stance markers, as they communicate the writer's attitudes towards the information, and also the 'softer' fields allow more communication of personal positions.

3.1.1. Hedges and disciplines

In Hyland's study hedges (e.g. *could, might, suggests*) were by far the most common stance marker in all of the disciplines, as illustrated by Table 1. The frequency of hedges in comparison between disciplines also followed the pattern of sciences and engineering displaying less hedges than the 'softer' fields. McGrath & Kuteeva's results with P Mth however considerably deviated from this, as hedges were in fact not even the second most common stance marker, with only 1.8 occurrences. In comparison, even the engineering data showed a frequency of 8.2 (ME) and 9.6 (EE). McGrath & Kuteeva note that the small number of hedges in P Mth "was expected" (170) and attribute it to "the high level of conviction demanded of a truth-based discipline and the complexity of the subject matter" (171). Hyland (2005b) discusses hedges and disciplinary differences in building knowledge, and notes that "while writers in all disciplines used hedges in the evaluation of their statements, they were considerably more frequent in the soft disciplines, perhaps indicating less assurance about what colleagues could be safely assumed to accept" (188).

3.1.2. Boosters and disciplines

Table 1 indicates that boosters (e.g. *clearly, obviously*) were with most disciplines the second most common stance marker, with P Mth being the notable exception with boosters: in P Mth boosters were the most common stance marker, and actually more common than all the other stance markers combined (5.4 for boosters compared to the total of 5.3 with the three other stance markers). For EE, boosters were the least common stance marker, which is somewhat interesting as it was the only discipline where this is the case. The other engineering discipline, ME also had a relatively small number of boosters as they were less common than both hedges and attitude markers.

With boosters it can be seen that the division of hard vs soft disciplines might not be clear-cut with all the individual stance items. Although general occurrence of stance markers can be seen to illustrate the 'hard-soft' division, each discipline still have their own individual profile of stance markers.

3.1.3. Attitude markers and disciplines

Attitude markers (e.g. *agree, unfortunately, remarkable*) in the data also support the hard/ soft division of disciplines, as they were most common in philosophy and applied linguistics at 8.9 and 8.6 respectively. Physics, biology and pure mathematics all showed a relatively low number of attitude markers, ranging from 2.7 to 3.9, less than half of philosophy or applied linguistics. Both engineering disciplines positioned somewhere in between with 5.6 (ME) and 5.5 (EE).

3.1.4. Self-mentions and disciplines

Self-mentions (e.g. *in my opinion, we think that*) generally appear to be the least common stance item across disciplines, which is understandable as academic language generally can be seen to encourage more passive voice in writing. There seems to be some variation in the frequency of the most versus least self-mentions from 0.8 (P Mth) to 5.7 (Phil). Perhaps surprisingly physics (Phy), philosophy (Phi) and marketing (Mk) have the most self-mentions. The fact that physics might be considered a 'hard' discipline and philosophy on the softer side makes it interesting, especially as other hard sciences, P Mth, EE and ME have very little occurrences of self-mention.

The difference in the use of self-mentions and disciplines is explained by Hyland (2005b) to possibly be due to strategic differences. Hyland suggests that "in the sciences it is common for writers to downplay their personal role to highlight the phenomena under study, the replicability of research activities, and the generality of the findings" and in the softer disciplines the use of first

person relates to "the desire to both strongly identify oneself with a particular argument and to gain credit for an individual perspective" (181).

Overall Hyland and McGarth & Kuteeva's results support the 'hard' and 'soft' division of disciplines. Other studies too have shown "a clear correlation of with the traditional distinction between hard and soft disciplines, broadly corresponding to the sciences and humanities/ social sciences" suggesting that "the sciences tend to produce more impersonal texts" (Hyland 1999, 109).

In a previous study Hyland (1999) sees a possible explanation to this in both the purpose of the sciences and the code of communication. Whereas natural scientists "often convey meaning in a highly compressed code impenetrable to the uninitiated" and "see their goal as producing public knowledge able to withstand the rigours of falsifiability" (109), with the humanities and social sciences the 'code' of communication is more simple as knowledge-making "despite the use of technical terminology, is often accomplished in apparently everyday terms" and they produce "interpretative discourses which often recast knowledge as sympathetic understanding" (109).

Although P Math displays the smallest number of stance marker occurrences, McGrath & Kuteeva consider surprising especially "the presence of attitude markers and boosting devices, further debunking the myth that mathematical discourse is purely objective, and conveyed by standardized code" (170). This is somewhat in contrast to Hyland's notion of the rigorous 'code' of natural sciences, but both are not mutually exclusive, as it is reasonable to assume that the disciplinary cultures of hard and soft sciences contribute to disciplinary differences in stance markers, but also even the most theoretical discipline such as pure mathematics are not exempt from stance markers.

3.2. Issues and Problems

Stance is a wide and complex topic, and the fact that there are various ways to define it poses the problem of selecting which definition to use. I discussed the definition of stance relevant to this paper,

but since there are more than one term involved (e. g. evidentiality, affect, evaluation), it is problematic to compare the different definitions. This ambiguity alone can cause some dissonance in understanding and interpreting stance.

The framework for the methodology will be used as in Hyland (2005b) and McGrath & Kuteeva (2012). This poses some problems, as the division of stance markers in Hyland has a semantic rather than a clear grammatical basis, but as for example Biber et al. mention that "the meaning of a stance marker can be ambiguous in some cases" (972) and it is not uncommon for them to have more than one role. For these reasons assigning stance markers in their proper category is done on an individual basis, depending on the context of use rather than the actual structure.

There are other methods of categorizing stance, as for example Gray, Biber & Hiltunen (2011) use a more lexico-grammatical method, constructing stance by "modal and semi-modal verbs, adverbials and *that*-complement clauses controlled by stance nouns, verbs and adjectives" (222-223). They categorize stance markers according to for example attitudinal, certainty and likelihood. (256). A method such as which Gray, Biber & Hiltunen use offers a detailed basis to identify stance markers, that differs from the division to hedges, boosters, attitude markers and self-mentions. I have addressed this by introducing the grammatical features of stance in my discussion on theory, but this issue cannot be fully resolved since my analysis will use the categorization introduced by Hyland. This will however offer the benefit of having a background of the previous results and utilizing these results in the analysis of Game Theory in relation to other disciplines.

Gray, Biber & Hiltunen utilize an extensive list of forms used in their analysis of stance, and this list was used as a starting point, alongside a list of hedges, boosters, self-mentions and attitude markers used by Hyland in the Appendix for Metadiscourse (2005a, 220-224). The forms in the list by Gray, Biber & Hiltunen are however classified in accordance to division of hedges, boosters, attitude markers and self-mentions which Hyland uses. All of their stance markers were not counted,

as their analysis is are gathered from material from late 1700s to early 1800s, and are somewhat archaic and irrelevant to modern day academic English i.e. *frighten'd, odde*. The complete list of forms used and their division is presented in Appendix 1.

4. The material

For the material for my thesis, RA literature from the field of game theory has been selected from the peer-reviewed academic journal *International Journal of Game Theory*. Total of 11 articles published between 1998 and 2013 have been selected based on the subject keywords associated to them. In order to discover material suited to finding various disciplinary discourse features, the most common keywords found in the journal's archive such as *mathematical, mathematical analysis, mathematics, game theory,* or game theoretical concepts such as *Nash equilibrium, rational choice theory* etc. were intentionally avoided to a degree when selecting the material for the analysis. Instead subject words relating to various other disciplines such as *robotics, friendship, semantics (philosophy)* or *lexicography* were favored to ensure material with at least superficially more varied subject matter, and thus perhaps more likely possibilities for providing instances of different disciplinary language features in the material.

It should be noted that the selection process has not, however, strictly disregarded conventional game theoretical topics to enable more variety in the material. Ultimately the selection of the material was done through the author's consideration and judgment. As the sample collected is quite small, the bulk of the analysis will consider the context of the stance markers and not only the quantitative data. Some quantitative results are discussed to place the results obtained to the framework of results from Hyland (2005b) and McGrath & Kuteeva (2011) on stance markers in different academic discourse.

I utilize the theoretical framework for the stance markers with the classification of hedges, boosters, attitude markers and self-mentions used by Hyland (2005b). To come up with specific stance markers, I have used as a starting point the extensive list of stance markers used by Hyland (2005a) and added to the list those used in Gray, Biber & Hiltunen (2011, p. 255), and divided the stance markers into the four categories used by Hyland. For the complete list of stance markers

used, see Appendix A. The data sample of 11 RAs contain 99 990 words, varying between 3,786 and

13,418 words per article.

5. Results and Discussion

The results are discussed and compared in the context of the previous results of stance markers in different academic fields from Hyland (2005b) and McGrath & Kuteeva (2011). The author has calculated the mean values for the number of stance markers per 1,000 words, and the share of the four categories out of the total number of stance markers as percentages. The results have been added to the overall results to include these means to discussion. First the overall number of stance markers and the share of different stance markers of this total are discussed, and then selected instances of the stance markers from the material are examined further, using examples from the material. This helps to highlight not only the individual markers but also the context of the stance markers in the RAs.

The results in Table 2 illustrate the number of stance markers found in the material alongside the results of previous studies (Hyland 2005b, McGrath & Kuteeva 2011). The results are listed as instances per 1,000 words, rounded out to match the results from previous studies; the average (AVG) for all the disciplines is also counted and rounded out to .1 decimal. The total number of stance markers in game theory is 4.7 per 1,000 words. The largest number of stance markers is found in the category of boosters with 2.2, and lowest in attitude markers with 0.6.

Table 2. Stance features by discipline (per 1,000 words)

Feature	G Th	P Mth	Phy	Bio	ME	EE	Phil	Soc	AL	Mk	AVG
Stance	4.7	10.7	25.0	23.8	19.8	21.6	42.8	31.1	37.2	39.5	25.6
Hedges	1.1	1.8	9.6	13.6	8.2	9.6	18.5	14.7	18.0	20.0	11.5
Boosters	2.2	5.4	6.0	3.9	5.0	3.2	9.7	5.1	6.2	7.1	5.4
Attitude markers	0.6	2.7	3.9	2.9	5.6	5.5	8.9	7.0	8.6	6.9	5.3
Self-mentions	0.8	0.8	5.5	3.4	1.0	3.3	5.7	4.3	4.4	5.5	3.5

As previously pointed out, when making conclusions on the results the small sample size must be considered, and discussion on absolute numbers is fundamentally problematic as the data is different in every case. It is however feasible to look at some tendencies from the results. The overall low number of stance markers in game theory can be seen to resemble the natural sciences and mathematics more than the social sciences and humanities, as in social sciences and humanities the number of stance markers is invariably over 30 per 1,000 words. The overall number of stance markers in game theory is considerably lower than the previous low of 10.7 in pure mathematics. In fact, game theory has the lowest number in every category except for self-mentions where it is tied with pure mathematics.

Although the number of stance markers in game theory is in every category well below the average, this is expected as the total numbers are much lower than in other disciplines. This can well be the result of the small sample size used in the analysis, so one should be very cautious in making any conclusions about this. It should be noted that game theory resembles pure mathematics in this regard as pure mathematics also has numbers below the total averages, with the exception of boosters. There are also other individual instances in disciplines where the number of stance markers is below total average, so the results on game theory are not a complete anomaly in this sense (e.g. boosters and sociology, hedges and mechanical engineering).

Pure mathematics and game theory have in common the fact that the number of boosters is substantially larger than number of hedges, when with the other disciplines hedges are more common. The number of hedges and self-mentions in game theory are also close to the values from pure mathematics, even in absolute numbers (i.e. in G Th 1.1 and 0.8; and P Mth 1.8 and 0.8). Given that game theory is essentially a mathematical model this result is not surprising. Out of all the stance markers in game theory attitude markers have the lowest share. This is not unique as attitude markers also have the lowest share of stance markers in biology and physics, although the absolute numbers are lower in game theory. To enable some discussion on the distribution of the stance markers, in

Table 3 the share of every stance marker from the total number is shown as percentages, alongside with the mean, or average, of all the disciplines included (AVG). The percentages are rounded out to .1 decimal.

Table 3. The share of stance features from the total number, in percentages (%)

Feature	G Th	P Mth	Phy	Bio	ME	EE	Phil	Soc	AL	Mk	AVG
Hedges	**23.4**	16.8	38.4	57.1	41.41	44.4	43.2	47.3	48.4	50.6	**41.1**
Boosters	**46.8**	50.5	24.0	16.4	25.3	14.8	22.7	16.4	16.7	18.0	**25.2**
Attitude markers	**12.8**	25.2	15.6	12.2	28.3	25.5	20.8	22.5	23.1	17.5	**20.4**
Self-mentions	**17.0**	7.5	22.0	14.3	5.1	15.3	13.3	13.8	11.8	13.9	**13.4**

In game theory the absolute number of attitude markers is considerably lower than in other disciplines, but their share of the total number is not exceptional, with 12.8 %. It is still a second lowest share, with only biology having a marginally smaller share (12.2%). Game theory, biology, physics and marketing all have their share of attitude markers below the average of all the disciplines (20.4%). The share of hedges in stance markers found in game theory is also considerably lower than the total average of all the disciplines (23.4% compared to 41.1%), but with self-mentions and boosters game theory has percentages actually above the average.

In terms of hedges and boosters the similarity between game theory and pure mathematics is again noticeable. As with other disciplines hedges form almost half of all the stance markers and the share of boosters vary from less than 15% to a little over a quarter, in pure mathematics and game theory it is the other way around. This suggests that mathematics differ not only from humanities and social sciences, but also from natural sciences in terms of the distribution of the found stance markers in RAs.

With attitude markers and self-mentions game theory resembles physics and biology, as they also have a larger share of self-mentions than attitude markers, and both are around the 15% share of the total number of stance markers. This can be seen to suggest that although game theory is a mathematical model, it has similarities with natural sciences instead of only pure mathematics, as pure mathematics has larger share of attitude markers, and very small that of self-mentions.

Based on the selected RA material, in game theory the total number of stance markers is lower than in other disciplines. Out of the previous results on different disciplines game theory has similarities to pure mathematics (low overall number of stance markers, share of hedges versus the share of boosters), but in some respect game theory also has similarities with the natural sciences more than pure mathematics (low share of attitude markers and high share of self-mentions in the found stance markers). Overall the results seem to suggest that there are not only differences between the 'hard' and 'soft' sciences, but that mathematics differ from the natural sciences as well, as game theory and pure mathematics differ from for example biology and physics especially with the total number of stance markers. The share of hedges and boosters of the total is also different from natural sciences, whereas social sciences and humanities do not differ from the natural sciences in this regard.

As quantitative analysis is not the main component of this thesis, next section will highlight the stance markers found in the material, discussing hedges, boosters, attitude markers and self-mentions. Some patterns are discussed but only in qualitative manner to show the context of their use. Previous studies do not discuss these so in regard to the patterns comparison between disciplines is not possible in the same way as with the number of stance markers. It should be noted that examples of several authors are often used to show that the cases might not be merely stylistic choices of individual authors, but were found in the works of different writers, published in different years or decades. It should be noted that in the following sections, all italics in the numbered examples are added to highlight the word item expressing stance, unless stated otherwise.

5.1. Hedges in Game Theory

When analyzing any of the stance markers in the RA material, one must note that as stance markers can depend on the context not all cases of the found word items are used as hedges/stance markers, as for example:

> (1) "We constructed an experimental design *around* these hypotheses…" (Bolton et al. 1998 271)
>
> (2) "We will now come *around* to collect the consent forms…" (Bolton et al. 297)

In (1) and (2) the word *around* is not used to mark stance of approximation, but as a preposition. In Bolton et al. alone there were 10 instances of the word *around*, but none of them were used as hedges. Despite this, the context can easily tell when a word item is used as a hedge, such as in (3), as in this case *about* is used to present approximation rather than a preposition.

> (3) "The proportion in 1Game-6Card is *about* 15% (4 out of 27)" (Bolton et al. 281).

An analysis on the context is thus of importance in discussion on stance. Previous studies did not specify the tools used to differentiate these cases of the same word item either marking stance or something else, but it is not essential in the discussion on the results obtained, as the background is used mainly as a reference point but the closer analysis on the stance markers does not require comparison of individual instances in other disciplines.

The total number of hedges varied from 24 to 224 per article, and in total 1,070 instances of hedges were found in the RA material. This gives the number of found hedges per 1,000 words as 1.07 or 1.1 when rounded up the same as in Hyland (2005b) and McGrath & Kuteeva (2011). This would place game theory in the same numbers of hedges as pure mathematics (1.8), which comes as no surprise considering game theory as a mathematical model. Table 4 shows hedges found in the game theory (GTh) data, in relation to other disciplines.

Table 4. Hedges by discipline

Feature	GTh	P Mth	Phy	Bio	ME	EE	Phil	Soc	AL	Mk	AVG
Hedges (per 1,000 words)	1.1	1.8	9.6	13.6	8.2	9.6	18.5	14.7	18.0	20.0	11.5
% of stance markers	23.4	16.8	38.4	57.1	41.41	44.4	43.2	47.3	48.4	50.6	41.1

Overall, there are some patterns to be found in the hedges in the RA material. The mathematical context has a clear effect on the hedges used. There was also a tendency to separate the hedges from the actual text, clustering of the hedges, and hedging previous work of other academic work instead of the writers' own claims. The following examples are not meant to list every occurrence of the hedges in the data, but to present a sample of the patterns in their original context.

5.1.1. Hedges and patterns: mathematics

Many of the hedges seem to indeed be connected to the context of mathematics, as they work together with mathematical elements in the text, e.g. theorem as the agent in (4) or p-value as the agent in example (5):

(4) "Theorem 12 *implies* the following generalization of Theorem 10." (2008 Biro et al. 352)

(5) "as the p-value *indicates*" (Bolton et al. 282)

(6) "Since for both the Prisoners' Dilemma and Chicken a ÿ d > 0 and since we *assumed* that 2a ÿ b ÿ c > 0; it follows that…" (Eshel et al. 1999 463)

The example (6) shows a very common instance of the use of hedges in the material; when introducing any equations or mathematical framework in the text, the phrase *assume* or *suppose,* is often used. Whichever of these phrases the writer tends to use leads to several cases of that hedge in the text. As can be seen in examples (7) to (10), these hedges appear to be a part of a fixed expression in the text,

and using a certain hedge can be seen as a stylistic choice from the author(s). In (7) and (8) *assume* is used, and thus was common in the article, and in articles like (9) and (10) *suppose* was used in the same way.

(7) "First, *assume* that $\gamma > \left(\frac{1-b-}{1-bc} \right.$." (Buenrostro et al. 2007 359)

(8) "…since continuity is not imposed, ^{ti} is *assumed* to satisfy completeness" (Asheim 2001 457)

(9) "*Suppose* f(0) = ∞ and f" (Martinelli 2007 330)

(10) "**Proposition 5** *Suppose* that $m\tilde{} > m_j$" (Buenrostro et al. 368)

As game theory is originally a mathematical model and resembles pure mathematics in the number of stance markers, the fact that mathematics can be seen in the context of stance marker use is expected. As is the case in for example *assume* and *suppose*, if a stance marker is part of a fixed expression in mathematics, that marker appears more often in the article.

5.1.2. Hedges and patterns: separation

One pattern in the use of hedges was that they were often somehow separated from the actual text. This is done in the material by embedding the hedges with the use of commas into a separate clause, as in examples (11) and (12), or through the use of parentheses like in (13).

(11) "Such an idea is, *in our view*, misguided." (Mayo & Wilson 2013 710)

(12) "We show that, under *certain* circumstances, policy-makers have the incentives to not give in to a protest group" (Buenrostro 2007 p. 374)

(13) "…if one or two countries give in to protestors (*maybe* because of asymmetries— protest groups are much more important as voters in some countries than others)" 1(Buenrostro 373)

It should be noted that cases (14) and (15) are somewhat more unique, as the hedging word item alone is included in parentheses instead of having an entire clause separated. This seems to be a completely

stylistic choice, and its purpose can be seen to be attempt to detach the hedge from the claim, softening it even further. These cases were rare, but as can be seen in (14) and (15) they were not used in only a single article.

(14) "In this paper we suggest that (*seemingly*) altruistic behavior may have also originated…" (Eshel et al. 448)

(15) "…since any extensive game of (*almost*) perfect information…" (Asheim 478)

In several cases the hedges are separated from the main text in other ways than just embedding them within the text. There are multiple instances when hedges are used in a footnote instead of the actual text. (16), (17), and (18) are all examples of hedges in separate footnotes on the bottom of the page, not included in the main the article.

(16) "*Assume* that the project is always worth carrying out from the point of view of the regulator." (Sun 2011 648)

(17) "Again, we *assume* that it is worthwhile to implement the project in both periods." (Sun 649).

(18) "Many of the SA algorithms for learning in noisy environments *assume* that one can draw finite samples of any size at successive stages of inquiry." (Mayo & Wilson 704)

Separating hedges from the text might serve to add even more caution to the claims made by the writer, as Hyland notes that hedges "indicate the writer's decision to withhold complete commitment to a proposition, allowing information to be presented as an opinion rather than accredited fact" (2005b 178). Separating the hedging from the actual statement seems to work as a hedging strategy of its own, softening the writers' claim even more. This could suggest that the function of a hedge can be amplified in a manner with other linguistic tools than only word items or a grammatical feature.

As the overall number of hedges in game theory was low compared to other disciplines, and the share of them out of all the stance markers was lower too, this can be seen to suggest that

game theory is very careful in using hedges, and even in instances that they are used the hedges can be separated from the main text of the article through punctuation or footnotes, as seen in the selected examples.

5.1.3. Hedges and patterns: clustered hedges

In the material it was not uncommon for the hedges to appear very close together. Often several hedges appear within the same claim. Often this clustering is understandable due to the grammatical properties of the hedges, such as auxiliaries (could, would) and modal verbs (seem). Examples (19) to (23) show hedges paired in this manner in several texts, using *appear, seems, could* and *would*.

> (19) "However, the following, seemingly intuitive, inductive procedure *appears* to *indicate* that…" (Asheim 2001 p. 465)

> (20) "The argument *seems* to *imply*…" (Asheim 2001 p. 465)

> (21) "The fuel tax protests in Europe *seem* to *suggest* that there is a "domino" effect which our simple model with linear demand does not capture." (Buenrostro et al 2007 p. 373)

> (22) "Similarly, one *could assume* that players have fixed locations in a lattice and, hence, each player is more likely to meet her neighbors than any other player" (Rivas 2009 538)

> (23) "…the resulting interval *would* be *rather* wide…" Mayo & Wilson 2013 706)

Other times the clustering of the hedges happens without the grammatical element. This works to possibly soften the effect of hedges even more, much the same as separating hedges does. In academic writing, taking strong stances can be problematic but this use of several hedges supports the notion of academic text as "a persuasive endeavor" (Hyland 2005b 173). In examples (24) to (26) instances of clustered paired hedges are presented, and in (27) can be seen a case where the same hedge is repeated several times, as repetition can work as a persuasive strategy of its own.

(24) "The divergence of trajectories from the equilibrium line *seems a bit* counterintuitive…" (Berger 2001 p. 538)

(25) Nevertheless, the scope of the result remains *somewhat* narrow on the demand side, in that *relatively* few commonly used demand functions satisfy both conditions. (Amir & De Feo 2013 640))

(26) "In this regard, *perhaps* we *can* eschew the difficulty of fully characterizing the set of equilibria…" (2011 Sun 654)

(27) "The individuals in a player's learning neighborhood are *likely* to play the same strategy that he does, since he is *likely* to imitate them and they him. However, an individual interacts with players in his interaction neighborhood, who may or may not have imitated him. A strategy is *likely* to be unbeatable if it earns a higher payoff than others in these changing environment (else a player of this strategy is *likely* to switch to another that does better)." (Esher 449)

Hedges can appear together with another hedge, and especially with modal verbs and auxiliaries, but there are instances of other paired hedges. Sometimes a same hedge can be repeated consecutively. All of these add to soften the hedges even more, and this can be seen to add to the function of the hedges as a persuasive strategy.

5.1.4. Hedges and patterns: hedging previous work

Previous literature mentions how hedges are utilized to "indicate the writer's decision to withhold complete commitment to a proposition, allowing information to be presented as an opinion rather than accredited fact" (Hyland 2005b 178), and so they are used as a rhetorical tool for the writer to make claims while reducing the force of these claims as absolute. Moreover, hedges "work to balance objective information, subjective evaluation and interpersonal negotiation, and this can be a powerfully persuasive factor in gaining acceptance for claims" (Hyland 2000, 101). In the RA material there are many cases however when the writer chooses to use hedges in relation to previous academic claims instead of their own writing.

Sometimes hedging previous work is done in the same way as hedging the writer's own work, to not make a too bold of a statement, and to leave room for interpretation. In these cases like (28)-(30) previous work can be seen to support the writer's own claims, yet the hedge is still used. In one case, the writer hedges their own previous work in the same way (31).

(28) "The game frame argument also *suggests* an alternative explanation to the anonymity effect claimed by Hoffman et al." (Bolton et al. 1998 290)

(29) "Ever since *proposed* by Schumpeter (1950) and Downs (1957), the "rational ignorance hypothesis" has been part of the received wisdom in social sciences." (Martinelli 2007 315)

(30) "Kinship has been *suggested* as a *plausible* explanation of altruism and cooperative behavior between blood relations." (Esher 447)

(31) "…the firm's reaction curve cannot be globally increasing, as *argued* in some detail in Amir (1996a)." (Amir & De Feo 2013 664)

In other cases, such as (32-37), hedging previous work seems to function more as to question that work rather than using it to support one's own statements. These cases show that hedges can be used in more than one way. More commonly they are used to leave room for interpretation and to soften the statements made by the writer, adding a level of politeness to the text. Although it is not as common as hedging one's own claims, hedges can also be used to cast doubt on previous work, presenting them as uncertain or questionable. Using hedges in this manner can be seen to strengthen the statements of the authors themselves if their aim is to question some previously made assumptions on the topic.

In (32) to (34) the previous position is questioned on a more general level, as they refer to a hypothesis (32), previous literature (33) or an "originally proposed algorithm" (34)

(32) If the hypothesis is correct, then the percentage of dictators offering $5.00 *should* be the same across the two cells… …If this hypothesis is correct, then dictators *should* tend to give more… (Bolton et al. 278)

(33) "Importantly, in much of the previous literature on public firms, it is tacitly *assumed* that the public firm can freely choose the type of the game…" (Amir & De Feo 630)

(34) "Originally this learning process was *proposed* as an algorithm for calculating the value of a two-person zero-sum game." (Berger 2001 532)

In (35) to (37) the hedging is more specific, directed at a specific piece of literature (35), a specific writer (36), or certain cases (37).

(35) *"*Even more tenuous is the *claim* that the public follower can unilaterally implement the Stackelberg equilibrium because of its dominant position, as in Beato and Mas-Colell (1984)." (Amir & De Feo 629)

(36) "He gave intuitive arguments *suggesting* that altruism should evolve…" (Esher 464)

(37) "In those cases, beliefs *should* be updated according to Bayes' rule" (Buenrostro et al 2007 376)

Although hedges have the function of balancing information and opinion, and softening a claim made by the author, the material shows that hedges can also be used with previous literature instead of only the author's own claims, or utilized to question opposing views. There are also cases when hedges can be found separated from the main text in different ways, or clustered together when making a claim.

5.2. Boosters in Game Theory

The same way as with hedges, the context of the booster is important when discussing if the word item is used as a booster or not. For example in (38) the word *certain* is not used as a booster communicating certainty, and has no rhetoric purpose in that way; in (39) the same word item is a booster.

(38) Together, these studies create a *certain* dissonance. (Bolton et al. 275)

(39) For any such event E, mutual *certain* belief of E implies that E is true: (Asheim, 469)

The number of boosters ranges from 43 to 193 per article, with a total count of 2234 boosters. This gives the number of boosters per 1,000 words as 2.23 or 2.2 if rounded up according to previous results. As seen in Table 3, here game theory shows the lowest frequency of boosters out of any disciplines, with even lower result than previous lowest number 3.2, from electrical engineering (EE). However, as previously discussed the share of boosters out of all the stance markers in game theory is quite large, 46.8% of all stance markers found are in the booster category.

Table 4. Boosters by discipline

Feature	*GTh*	*P Mth*	*Phy*	*Bio*	*ME*	*EE*	*Phil*	*Soc*	*AL*	*Mk*	*AVG*
Boosters (per 1,000 words)	**2.2**	5.4	6.0	3.9	5.0	3.2	9.7	5.1	6.2	7.1	*5.4*
% of stance markers	**46.8**	50.5	24.0	16.4	25.3	14.8	22.7	16.4	16.7	18.0	*25.2*

As hedges are used to make the claims presented softer, boosters do the opposite and are used to add certainty to claims: "words like *clearly*, *obviously* and *demonstrate*, which allow writers to express their certainty in what they say and to mark involvement with the topic and solidarity with their audience" (Hyland 2005b, 179). Hedges and boosters have some common ground in their functions.

In the RA material there are some noteworthy patterns and examples on the use of the boosters. The effect of mathematics is seen in the use of boosters, and, like hedges, boosters can be found paired or clustered in the text, and separated from the main text in separate clauses. Boosters also often occur in the initial position of a sentence. Boosters can also be found in cases where the author is giving in or acknowledging their own shortcomings, but also in the more common manner to enforce the claims of the author, or to enforce previous work that supports the article.

5.2.1. Boosters and patterns: mathematics

As was the case with hedges, given that game theory is a mathematical model the effect of mathematics in the use of boosters is expected. Although this can be seen as a feature of academic text in general, the agent in boosters is rarely the writer or the author, but some other factors, e.g. *hypothesis, case study, lemma* etc. Examples (40) to (44) show some of these instances. Mathematics effects the semantic domain which these agents present.

(40) Since the anonymity *hypothesis asserts* that… (Bolton et al. 282)

(41) *Our case study* here *shows* that it is not impossible to collect such evidence! (Buenrostro et al. 375)

(42) The following *lemma establishes* the first connection between unbeatability and winning in a simple frontier state. (Esher et al 1999, 452)

(43) …*Theorem 7 proves* that m gets his best stable partner again. (Biro et al 355)

(44) Here we provide *the theorems* which *demonstrate* which strategies meet the various definitions… (Mayo-Wilson et al 2013, 697)

The boosters are also used in close proximity of probabilities, mathematical equations and terms, like in examples (45) to (47). In (45) the word *strictly* refers to numbers representing the payoffs, and in (46) to values of F. In (47) the theory on the strategies of x are described with the word *obvious*.

(45) We assume that all payoffs in W are *strictly* positive. (Esher et al 449)

(46) *F* is *strictly* increasing and continuously differentiable over some interval (c,c) such that $0 \leq c < c$, with F(c) = 0 and F(c) = 1. (Martinelli 317)

(47) It is *obvious* now that x gets a worse partner under any stable half-matching for G than at any stable half-matching for G – v (Biro et al. 351)

In some cases it can be argued that special knowledge on the academic language of mathematics is required for the reader to fully grasp the content of the claims, such as in (48), (49), and (50). Here the boosters are used with mathematical equations.

(48) For any such event E, mutual *certain* belief of E implies that E is *true*: KE ¼ K1E X K2E JK1E1X K2E2 ¼ E1X E2 ¼ E since, for each i, KiEi ¼ Ei. (Ashmein, 469)

(49) It has thereby been *established* that si0 A SiðhÞnCiti ðhÞ if si0 differs from backward induction only by the action taken at h. (Asheim, 480)

(50) The only difference is that G is not bipartite, so instead of a matching, we *maintain* a half-matching hMv for G − v. (Biro et al 342)

As the agent in the use of boosters in something else than the writer, this can be seen to have an argumentative strategy of its own, as the validation for a claim comes from an outside source instead of an opinion. As examples (48) to (50) show, even the most theoretical and abstract parts of discussion in game theory can use stance markers.

5.2.2. Boosters and patterns: separation

As was the case with hedges, boosters also were found separated from the main text in embedded clauses, such as in (51). Sometimes only the boosting element is used with commas like *of course* in (52).

(51) …the set N has a largest Cournot equilibrium in the new order, which is *clearly* q0,q1. (Amir & De Feo, 651 in the Appendix)

(52) This probability is, *of course*, independent of the precise location of the frontier on the line. (Esher et al 452)

There are cases when parentheses are used to separate the clause with the booster, as in cases (53) to (55). Parentheses instead of commas can be seen to separate the boosters even more from the text. In (55) there is a pair of boosters in the parentheses, *actually* and *proved*.

(53) Thus, Schuhmacher's Thm. 2 (which *shows* that the backward induction outcome obtains with ''high'' probability for any given ''small'' e) is strengthened… (Asheim, 455)

(54) Let M be any finite sequence of RL methods, and let S , N be any M-network (*in fact*, one need not assume G is connected). (Mayo-Wilson et al, 726)

(55) …in view of the payoff externalities at hand (this is *actually* formally *proved* in Lemma 4 in Appendix). (Amir & De Feo 2013, 641)

Notably in example (56) the entire independent clause is placed in parentheses from start to finish, although it is not even an embedded clause. These cases were rare, and can be seen to be perhaps a stylistic choice, although it does separate the booster from the claim, softening its impact.

(56) For example Andy would like to play mostly with Bill, then with Cliff and finally he prefers Daniel the least. (*In fact*, everybody tries to avoid Daniel.) There is no stable solution. (Biro et al 337)

There are also instances in which boosters are placed in the footnotes of the text. Cases (57) to (60) are examples of this. Previously with hedges separating the hedges from the text can be suggested to soften the impact of the hedge even more, functioning almost as an additional hedging strategy. With boosters there is a similar effect; all ways of separating the boosters work as a strategy that softens the claim without losing the element of affirmation granted by the booster itself.

(57) In particular, the explanatory power of the I'm-no-saint hypothesis *must* be interpreted in the context of all the data (Bolton et al. 285)

(58) Aharoni and Fleiner (2003) *showed*, that the existence of the stable half-matching is a consequence of the famous theorem of Scarf (1967). (Biro et al 333)

(59) Assume that the project is *always* worth carrying out from the point of view of the regulator. (2011 Sun, 648)

(60) What the literature on endogenous timing refers to as "basic game" *actually* consists of three distinct games… (Amir & De Feo, 636)

Boosters that are adverbials (*obviously, clearly, evidently* etc.) and other discourse markers like *in fact* and *of course* are found in the initial position of a sentence. Due to their grammatical nature this is hardly surprising, but initial position can be seen to have also another effect. A boosting element

in the initial position allows the booster to enforce the entire following clause, which would not work the same as placing the booster in the middle position or in the end of a sentence. Examples (61) to (68) are a few examples of boosters in initial position, all displaying a different booster.

>(61) *Of course* accepting a null hypothesis raises concern about the power of the test. (Bolton et al. 281)
>
>(62) *In fact*, x_ is not uniquely determined for such a point in time. (Berger 534)
>
>(63) *Clearly*, by our assumptions on payoffs, a tough policy-maker always chooses the status quo. (Buenrostro et al. 375)
>
>(64) *Obviously*, there are at least two equilibria without information acquisition (Martinelli 318)
>
>(65) *Evidently*, the characterization of the pairwise equilibria in the long-run presented in the previous section is still valid here. (Rivas 2009 535)
>
>(66) *Undoubtedly* this result relies a good deal on the quadratic structure of the social welfare function… (Sun 2011 654)
>
>(67) *Indeed*, the private firm's profit is strictly decreasing in the public firm's output (Amir & De Feo 639)
>
>(68) *Clearly*, $E_n \subseteq F_{n,\epsilon}$. (Mayo-Wilson et al 2013, 718)

The above boosters show how common the booster in an initial position can be. This was also different from hedges where hedges in initial position were not a common pattern. Overall, as was the case with hedges, boosters are also detached from the main clauses through the use of punctuation or footnotes. Although this separation can be seen to soften the effect of the booster, especially in the initial position the boosters can be seen to function as boosters for the entire following clause.

5.2.3. Boosters and patterns: clustered boosters

Boosters, like hedges, are found in pairs or close proximity in some instances. In these cases the use of multiple boosters increases affirmation and power, and works as a clear rhetoric strategy when the

author is making a claim. In examples (69) to (36) boosters are found in pairs. (69) and (70) have

some distance in the pair of boosters although they are in the same sentence.

> (69) The experiments by Sonsino et al. [25] and Søvik [26] *show* that some subjects
> do *in fact* accept the bet in a slightly more complicated version of this game.
> (Asheim, 467)

> (70) Theorem 1 below *shows* that equilibria with information acquisition for arbitrarily
> large electorates *must* be characterized by a cutoff cn such that voters acquire
> information (Martinelli 319)

(71), (72) and (73) have closer proximity with the boosters, and in (71) especially the pair *decisively*

demonstrate creates strong affirmation to the claim, especially compared to if only one of them would

be present.

> (71) Both 10Game6Card and 10Game-2Card data *decisively demonstrate* that…
> (Bolton et al. 285)

> (72) It can nevertheless be seen as a learning process for boundedly rational agents,
> and *indeed* it is *established* as the standard such learning process. (Berger, 532)

> (73) Players do not know this fact and believe that once a friendship relation is broken,
> it *will never* be set up again. (Rivas 2009, 525)

Example (74) is slightly different as there are three boosters in a single sentence.

> (74) In the next sections we provide conditions for existence of equilibria in the two
> cases of domestic and foreign private firms, and *show* that the leader's payoffs are
> *indeed always* larger than the corresponding Nash payoffs under our assumptions.
> (Amir & De Feo 636-637)

Sometimes in order to explain a model the same term is used multiple times, and this affects the

occurrence of some boosters. In (75) *certainly believing* is clearly a fixed phrase used to explain a

model, so these two boosters occur together multiple times. This repetition itself is a rhetoric tool of

its own, and the fact that the term is made of boosters can be seen to make the repetition even more

persuasive.

(75) Likewise, since 2 respects the preferences of 1 and, in addition, *certainly believes* that 1 is cautious, it follows that 2 prefers R to L. As a consequence, since 1 respects the preferences of 2, *certainly believes* that 2 respects the preferences of 1, and *certainly believes* that 2 *certainly believes* that 1 is cautious, it follows that 1 deems R infinitely more likely than L. (Asheim 2001, 455)

Repetition through the use of same booster can be also seen in (76) and (77) with *always* and *must* respectively. In these cases also a model is explained, and the repetition works as a persuasive strategy. This use illustrates how expressing stance relates closely to argumentation and rhetoric.

(76) In equilibrium, a tough policy-maker *always* maintains the status quo and a weak policy-maker faced with only one protest group will *always* give in. Protest groups will *always* believe that a policy-maker who changes the policy is weak with probability 1. (Buenrostro et al. 357)

(77) …we get that kn = qF(cn)n1/2 and hn = wnn1/2 *must* satisfy Eqs. 12 and 13. Thus, kn *must* converge to zero as n grows arbitrarily large (Martinelli 338)

In boosters pairing or repetition can be seen to add to the affirming function of boosters, strengthening the rhetoric power of the article. This shows that when examining stance in the material, the context of boosters also plays a part instead of simply the number of boosters.

5.2.4. Booster and patterns: boosters and writers

Although boosting is used to enforce one's own claims and theory, boosters were also found in cases where they are used to give in to criticism or acknowledging shortcomings of the author's own work. As making an argument instead of only declaring conclusions is an important part of academic discourse, it is not surprising, but this showcases how boosters can be used in very different ways than just to enforce or affirm one's own point. The way the boosters are used in (78) to (82) can be argued to actually accomplishing something similar to hedging claims. These kinds of boosters are often found in the results or discussion at the end of the articles.

(78) Identifying such a purpose will *no doubt* require much further empirical and theoretical study. (Bolton et al. 295)

(79) It is, however, not yet *clear*, how these paths converge to L. (Berger 2001, 537)

(80) *Clearly*, there are several issues that this model has not addressed. (Buenrostro et al. 374)

(81) *Obviously*, as with any stylized model, we have left out many important factors in protest movements (Buenrostro et al. 374)

(82) The assumptions validating this conclusion are *obviously* very general. (Amir & De Feo 647)

In one case the booster itself is hedged, with *almost surely* in (83). This case is only found in one of the articles, so it could be argued that it is a stylistic choice. The term is repeated and once again seems to be a fixed term or phrase, but is unique as it is constructed with a hedge and a booster.

(83) By Lemma 3, it follows that, *almost surely*, every learner in NG(g) has an estimate of the EU of a that approaches the actual EU of a in ω. Because $a \in A_\omega$, by the definition of the strategies $\{m^{\delta\epsilon}\} \cap {}_a$ a plays actions in$\in$A and Lemma$A4_\omega$, it then follows that, *almost surely*, every with probability approaching one. learner in $N_G(g)$ G [sic]
Continuing, by Lemma 5, it follows that, *almost surely*, every learner in $N_G(g) \cap G$ plays plays actions in A_ω infinitely often. (Mayo-Wilson et al, 725)

Boosting can also occur in relation to previous work and background literature. As seen in previous discussion, there are cases where the agent in relation to the booster is something different than the author (e.g. *lemma establishes, Theorem 7 proves*), but there are cases where the agent is a writer, although not the author of the article itself. Examples (84) to (89) show these cases, where the claims made in previous literature are presented more as undisputed facts than for example opinions to be interpreted or contested.

(84) Robinson (1951) *proved* that under fictitious play the set of Nash equilibria is globally attractive… (Berger 533)

(85) Hofbauer and Sigmund (1998) *show* that all cyclic 2 2 bimatrix games are strategically equivalent to a zero-sum game. (Berger 536)

(86) They *proved* that one can *always* reach a stable matching, if one exists, from an arbitrary matching by successively satisfying blocking pairs. (Biro et al 2008 334)

(87) Irving (1985) constructed the first polynomial algorithm that *finds* a stable matching if one exists at all (Biro et al 334)

(88) Blum and Rothblum (2002) *realized* that an agent can only benefit by arriving later to the market in the Roth–Vande Vate algorithm. (Biro et al 352)

(89) For example, Marmaros and Sacerdote (2004), using the number of emails exchanged between students from Dartmouth College, *found* that similarity in age…" (Rivas 2009, 523)

The cases above are different from instances where the active agents are the writers themselves, like in examples (90) and (91). Although these cases seem to explicitly present the writers' work as facts, and thus are very strong claims, they are not unheard of in academic writing. This shows that boosters are indeed used very directly to affirm one's own work. In example (91) the work of previous literature is actually questioned by using a booster.

(90) We *find* that some friendships emerge in the first periods only because the parties involved do not have other alternatives (Rivas 523)

(91) We *demonstrate* that, whether the uncertainty is small or not, Laffont and Tirole's menu of contracts, giving rise to a non-partitional continuation equilibrium, is not optimal. (2011 Sun 646)

As boosters are tools which "allow writers to express their certainty in what they say" (Hyland 2005b, 179), they also can be used to give certainty to previous literature. Still, there are cases where the authors themselves affirm the certainty of their own statement.

5.3. Attitude markers in Game Theory

The number of attitude markers found in the material was lower than either hedges or boosters. In fact, attitude markers were the least common stance marker category found in the RA material. In total 643 instances were found in the material, ranging from 14 instances to 154 per article. This gives the number of attitude markers per 1,000 as 0.643, or 0.6 if rounded out.

Table 5. Attitude markers by discipline

Feature	GTh	P Mth	Phy	Bio	ME	EE	Phil	Soc	AL	Mk	AVG
Att.mark (per 1,000 words)	**0.6**	3.9	2.9	5.6	5.5	8.9	7.0	8.6	6.9	3.9	*5.3*
% of stance markers	**12.8**	25.2	15.6	12.2	28.3	25.5	20.8	22.5	23.1	17.5	*20.4*

Table 5 shows the number of attitude markers and the share of attitude markers out of all the stance markers. Although the total number in game theory is low, the share of stance markers is in line with natural sciences. The share of boosters and hedges in game theory was similar to pure mathematics so attitude markers are different in this manner.

As was the case with hedges and boosters, the context is necessary to see if a word item is truly an attitude marker. Comparing examples (92) and (93) we can see that in (92) the word *even* is an attitude marker with a rhetoric function, but in (93) it is merely referring to the number in question.

> (92) …and *even* dictator 8 appears to be giving in a capricious way… (Bolton et al. 1998, 283)

> (93) When all are seated (an *even* number) (Bolton et al. 295)

As with hedges and boosters, mathematical context is seen to play a part in game theory and the attitude markers found. Also some theoretical terms employ attitude markers, so certain attitude markers occur often when those terms are used. As with hedges and boosters, attitude markers are found separated from the main text by punctuation, or in footnotes. Attitude markers also occur with passive form, or an agent different than the writer, creating some distance between the attitude marker

and the author. Finally out of the attitude markers those relating to surprise and uncertainty, as well as importance, necessity or emphasis were found.

5.3.1. Attitude markers and patterns: mathematics

Mathematics has an effect on some of the attitude markers used. In (94) and (95) the mathematical context accounts for the use of the attitude markers *necessary* and *natural*.

> (94) …so x, y do not satisfy (16) for or which is a *necessary* condition for x to be an unbeatable strategy in hWr;0i and in hW; ri. (Eshel 1999 et al. 462)

> (95) …where i is the maximum *natural* number i ≤ m + 1 (Rivas 2009 528)

In some cases a specific term or theoretical concept is formed with an attitude marker, and this often lead to that specific attitude marker being common in the articles. The attitude marker *perfect* is used in some of the instances, e.g. when discussing *perfect information*, *perfect equilibrium* or *perfect matching*. In (96) the term is defined after the first use. In Bolton et al. the attitude marker *typical* is used twice, both times with the term *typical dictator* (97), and in Asheim article the attitude marker *perfect* occurs 24 times, always with either equilibrium or information, as seen in (98) and (99).

> (96) "a *perfect* stable matching (i.e. a stable matching where no agent is single)" (Biro 348)

> (97) In this section, we describe a hypothetical decision procedure for a *typical* dictator (292)

> (98) …reflecting that also the pure strategy vector ðM; CÞ is a *perfect* equilibrium." (Asheim 456)

> (99) A finite extensive game is of *perfect* information (Asheim 463)

This occurred with other terms too, for example with expected utility or expected cost. In Martinelli article, expected occurred 12 times, never without either cost or utility as seen in (100).

(100) Moreover, the *expected* utility of voters in this equilibrium will be larger than the *expected* utility of voters in any equilibria without information acquisition. (Martinelli 316)

Mathematics and specific theoretic terms affected the use of attitude markers in the material. As was discussed in the theory section, academic language constantly takes a stance and assumes an attitude which it attempts to communicate through argumentation and stance markers. As the terms themselves include an attitude marker it is clear how objective academic language is not straightforward even in purely theoretical discussion as in a way the specialized language itself includes taking a stance.

Attitude markers also occur with and an agent that is something different than the author. This was found in boosters also, and can be seen to work in much the same way, distancing the attitude marker from the author or author's own opinion. In (101) to (106) this is done with passive form, or using structures like *some may feel* (105) or *one usually considers* (106)

(101) As the assessment increases, it seems *reasonable* to assume that the measure of benefits that accrue from leaving a fixed amount, such as $0.30, will decrease. (Bolton et al. 277

(102) In such a setting it is *natural* to expect reputational externalities (Buenrostro et al. 2007, 360)

(103) For the first part of the proposition it *suffices* to notice that… (Rivas 525)

(104) Hence, some pooling is *required* in equilibrium. (Sun 2011 650)

(105) Some may *feel* that strategic advantage can be fairly used only if it was in some sense fairly gained (Bolton et al. 292)

(106) When dealing with (evolutionary) game dynamics, one *usually* considers either intragroup interactions between individuals of the same type… (Berger 528)

In (105) and (106) whether the writer agrees with the stance taken is open to interpretation. Using noun phrases like *the mixed duopoly* (107), *this randomization* (108), or *requirement* (109) also disassociates the author's own stance on the matter.

(107) …the mixed duopoly *admits* a Cournot equilibrium. (2013 Amir & De Feo 645)

(108) This randomization *requires* that… (Buenrostro et al. 376)

(109) Proper consistency will be based on three requirements: The first of these *ensures* that each player plays the game G, the second requirement *ensures* that each player takes all opponent strategies into account (is cautious), while the third requirement *ensures*… (Asheim 460)

Although the examples above show how the attitude marker can be separated from the author's own attitude, there are cases in which the author is actively the one taking the stance. Examples (110) to (112) show that stance taking can sometimes be clear, and the authors position themselves with the attitude they express.

(110) This paper provides a pivotal voter model with costly information that predicts that only a small fraction of voters acquires information in large elections–a prediction we find entirely *acceptable*. (2007 Martinelli 332)

(111) Throughout the paper, *we allow* the basic game to have multiple pure-strategy Nash equilibria (Amir & De Feo 640)

(112) We believe that the most *important* part of our results is… (Mayo-Wilson 714)

Some of the same issues were found as with previous stance markers, such as the effect of mathematics or specific theoretical terms in the text. The authors also can disassociate themselves from the attitude marker, but as seen from the examples this was not always the case

5.3.2. Attitude markers and patterns: separation

Compared to hedges and boosters, the attitude markers were not found as often separated through punctuation. There were some cases, for example in (113) in initial position, and (114) separated with commas. In (115) there is separation through placing the attitude marker inside apostrophes.

(113) As *usual*, let F (preferred to) and @F (indifferent to) denote the asymmetric and symmetric parts of F. (Asheim 467)

(114) As to the intuition behind the emergence of private leadership here, *as usual*, the private firm expands output (Amir & De Feo 644)

(115) …depending on this neighbor's strength to project his seed to the vacant location and with no reference to the dead individual or his `*wishes*'. (Eshel et al. 465)

Attitude markers were found in footnotes, like boosters and hedges. Footnotes seem to offer the writer possibilities to take stance or make an argument while keeping it separate from the main text. Footnotes appear to be a widely used stylistic feature of game theory, as examples (116) to (119) are all from different writers yet include an attitude marker in the footnote. In (118) there are several attitude markers in one sentence, and in (119) the use of the attitude marker *good* seems to be an explicit value judgment in academic writing, which is perhaps often seen as neutral or objective.

(116) *Even* more tenuous is the claim that… (Amir & De Feo 629)

(117) …*a* [italics in text] obtained from conditioning on a third common measure; they are *essentially* unrelated. (Mayo-Wilson et al 2013 698)

(118) It is *reasonable* to apply such a method, since *even to approximate* the minimal number of the blocking pairs for general graphs is theoretically hard (Biro 333)

(119) The literature warns, however, that if there are many ties in the rankings ± as is the case in our data ± then the normal approximation may not be very *good* (Bolton et al. 282)

Some attitude markers were found in acknowledgements at the end of the text, and here the stance taking does not seem to be connected to the theory or argument, but is used to show appreciation or gratitude to others involved in the writing process of the article. Examples (120) and (121) show two of these cases, with (120) from a footnote and (121) from acknowledgement at the end of the text.

(120) The first author *wishes* to thank the help of the GNFM (Eshel et al. 448)

(121) We thank also the anonymous referee for his *careful* reading and constructive suggestions. (Biro 2008 356)

The attitude markers show same strategies of separating the stance taking from the main text or main clause as hedges and boosters previously. It should be noted that there were more varied examples from both hedges and boosters, and although this thesis does not list the number of cases in different contexts, a closer analysis on this might be a topic for future research.

5.3.3 Attitude markers and patterns: the attitudes

Although there are several attitude markers in the text which communicate different attitudes and listing all of them is not the purpose of this study, this section will illustrate some of these cases. Hyland mentions that attitude markers are used in "conveying surprise, agreement, importance, frustration, and so on, rather than commitment" (2005b, 180). As there were several instances of attitude markers in the text not relating to commitment, the attitude markers highlighting *importance* or *necessity* of a certain matter were found in several articles, as well as attitudes of *surprise* or *uncertainty*.

With importance or necessity the writer seems to argue for the validity of their claim or theory. Like boosters, the attitude markers such as *important*, n*ecessary* or *noteworthy* all seem to defend or emphasize what is presented. Examples (122) to (125) show some of these attitude markers.

> (122) The generalization of the concept of the Wright manifold to extensive form games also plays an *important* role in the analysis (Berger 532)

> (123) To do so, although they may be of *great importance*, we abstract away from collective action problems (Buenrostro 354)

> (124) "heterogeneity in the voters' costs of acquiring and processing information seems to be a *necessary* ingredient for *satisfactory* models" (Martinelli 338) (in the appendix part)

> (125) On the other hand, it is *noteworthy* that the the the [sic] scope of the result is totally unrestricted on the cost side. (Amir & De Feo 641)

With uncertainty or surprise the effect of the attitude marker can be seen to in a way hedge the proposed claim or clause: the writer displays some element of uncertainty or surprise as if to show that they are open to criticism themselves. There is a difference with the attitude markers and hedging, as can be seen when comparing for example (126) and (127): in the first the attitude to the unexpected is more positive and in the latter somewhat more neutral.

> (126) *Fortunately* this happens to be the case for 2 2 bimatrix games. (Berger 535)

> (127) …that is, we can check whether the two hypothesized effects tend to reinforce one another or cancel one another out or possible have some *unexpected* effects. (Bolton et al. 278)

In other cases also an attitude marker is used to show that there is something surprising in the claim that is made, such as in (128) and (129). In (128) the surprise hedges the claim, while in (129) the use of *striking* is not as neutral of an attitude to the surprising element.

> (128) More *surprisingly*, Beggs' reinforcement learner might not converge if placed in the wrong social circumstance. (Mayo-Wilson et al 696)

> (129) Note the *striking* difference between our stability result and the one of Gaunersdorfer, Hofbauer, and Sigmund (1991)… (Berger 538)

The attitude markers sometimes seem to complete the same function as hedges or boosters, but they enable different degrees of neutrality towards the claims or results discussed. Emphasizing the importance, necessity or surprise are only some of the cases found, but illustrate some of the cases where the writer takes a stance to what is claimed through the use of attitude markers.

5.4. Self-mentions in Game Theory

Self-mentions seem to be the most simple to list, as they are specific word items and not dependent on the context to the extent as previous stance markers. However, an analysis on the context is necessary, especially with the first person singular pronoun I, as the letter is often used in

mathematical context: "Individual i will switch to the strategy1 used by individual j" (Eshel et al 1999, 450).

The total number of self-mentions in the sample was 846, ranging from 22 to 187 per article. The number of self-mentions per 1,000 words is then 0.846, or 0.8 when rounded. A majority of these came from the pronouns *we* or *us,* a total of 694 instances, or 82% of all the self-mentions. Table 6 shows the number and share of self-mentions, and as discussed previously show in game theory the share of self-mentions exceeds the average.

Table 6. Self-mentions by discipline

Feature	GTh	P Mth	Phy	Bio	ME	EE	Phil	Soc	AL	Mk	AVG
Self-mnt. (per 1,000 words)	0.8	0.8	5.5	3.4	1.0	3.3	5.7	4.3	4.4	5.5	3.5
% of stance markers	17.0	7.5	22.0	14.3	5.1	15.3	13.3	13.8	11.8	13.9	13.4

Self-mentions are an explicit way for the writer to insert themselves in the text, as Hyland (2009) notes that "the presence or absence of explicit author reference is therefore a conscious choice by writers to adopt a particular stance and disciplinary-situated authorial identity" (76). As Hyland mentions the authorial identity associated in the explicit presence of the author, self-mentions can be seen as instances of assuming a form of this authorial identity. In this section the cases of self-mentions from the material are highlighted. As the use of first person plural was the most common way to use self-mentions, in this section these will be discussed alongside other cases of different self-mentions.

The most noteworthy pattern in self-mentions in the material is the difference between the uses of singular or plural form. When a self-mention is used as a stance markers, the use of the pronoun *we* is extremely common in the RA material. Cases like (130) and (131) are examples of this

use of the plural form. In (131) it should be noted that the pronoun *us* occurred 10 times in the article, always in the construction *let us x.*

> (130) In particular, even though the experiment completely shatters one of *our* initial hypotheses… (Bolton et al 1998, 270)

> (131) Let *us* consider the above sequence with an extra stopping rule (Biró et al 351)

In some instances the plural form *we* was used even when there is only one author. Cases like this can be seen as either conforming to a convention of using we in academic writing, or a strategy to include the reader to the narration. Examples (132) and (133) are examples of single author using the plural form.

> (132) By a role game *we* mean a symmetric two player game based on a bimatrix game" (Berger 528)

> (133) *We* first construct a sequence, indexed by n, of -belief systems. By Def. 3 this involves, for each n and for each player i, a finite set of types – which *we* below denote by Ti00… (Asheim 472)

There are also cases when the single author uses a singular form in the text. Sometimes there is still some level of distance, like in example (134) through the use of *the author* instead of *I.* As (135) shows, the first person singular was used in some cases although as mentioned, *us* and *we* are much more common. It could be argued that the use of I displays a stronger authorial stance taking, and authors are likely to avoid this in order to keep a more objective or diplomatic position in their writing.

> (134) *The author* performs simulations and finds that groups of players of the same type tend to form friendships. (Rivas 523)

> (135) In *my* characterization of proper rationalizability in two-player games *I* drop property 1., which is an equilibrium assumption; instead *I* assume that there is common certain belief of property 2., which *I* call proper consistency. (Asheim 2001 454)

Footnotes and acknowledgements at the end of the text seem to allow much more explicit stance taking, as was the case in some of the attitude markers expressing gratitude or appreciation. It could

be argued that acknowledgements can be examined as a separate form of academic writing than research article, but as these acknowledgements were included at the end of the text or in a footnote the same way as other footnotes in the article they are included here. Examples (136) and (137) show self-mentions in this use. Although in other parts of the texts the plural form was used here the authors use the explicit *I*.

(136) *I* am indebted to Josef Hofbauer for many helpful discussions. (Berger 2001 527)

(137) *I* would like to acknowledge Nejat Anbarci, Howard P. Marvel, James Peck, Huanxing Yang, Lixin Ye and two anonymous referees for their valuable comments. All remaining errors are *my* own. (Sun 655)

In example (138) both the plural and the singular form are used to distinguish each author's own stance. However the singular first person pronoun is avoided in this part also.

(138) *We* wish to thank Vijay Krishna, the Associate Editor and two anonymous referees for very helpful suggestions, as well as audiences at CORE, University of Strathclyde, Università degli studi di Pavia, 2007 EARIE Conference in Valencia, 2008 ESEM Conference in Milano, and 2009 PET conference in Galway. The second *author* gratefully acknowledges financial support from Fondazione Alma Mater Ticinensis - Pavia, project 'The governance of markets and firms after the global crisis'. The scientific responsibility is assumed by the *authors*. (Amir & DeFeo 649)

Compared to other stance markers, self-mentions did not show the same kind of patterns but as they express the presence of the author and not any particular stance this is somewhat expected. The use of plural form even with single authors can be seen as either a convention or a rhetoric strategy to persuade the reader by including the reader. However, the explicit singular form was not absent, and is used especially in footnotes acknowledging or thanking others.

6. Conclusions and Further Research

Stance is a vast topic that has been classified and discussed through different approaches. This thesis has used the four categories of hedges, boosters, attitude markers and self-mentions to enable comparison and framework from other studies on stance markers and academic disciplines. Results were discussed mostly through examples from the RA material but some discussion on overall results was included

In this thesis the number of stance markers in RA material relating to game theory has been presented. The low number of stance markers might suggest that game theory is more hesitant than other disciplines in taking a stance, but as the sample size was small and the material in every discipline different, the data do not support this strong of a statement. In pure mathematics "the presence of attitude markers and boosting devices" was found to be somewhat surprising, "further debunking the myth that mathematical discourse is purely objective, and conveyed by standardized code" (McGrath & Kuteeva 2011, 170). The same can apply to game theory as it is a mathematical model, but still shows occurrences of stance markers, further emphasizing objectivity in even mathematics as a myth.

The total number of stance markers in the RA material is noticeably lower than in any other discipline, but the share of the four categories shows a unique structure in their use, which is comparable with the way stance markers in other disciplines are formed. Game theory resembles pure mathematics in terms of low overall number of stance markers and the share of boosters and hedges, but the share of attitude markers and self-mentions was more similar to some natural sciences and different from pure mathematics. Although there are similarities with pure mathematics and natural sciences in some regards, the results suggest that the clear division to natural sciences versus social sciences and humanities might be a simplistic one.

Some patterns on the context of the stance markers were discussed. As this was not discussed in the background literature, comparisons could not be made between disciplines, but this is not essential to the purpose of discussing context of use. Especially boosters and hedges can strategically be used to support or soften either the writers' own statements, background literature supporting their claims, or statements the writer wishes to contradict. For further research, to focus on the context of use might yield more results in differences of stance between different academic disciplines.

The use of footnotes seems to be a convention in RA relating to game theory, and they are used to employ stance makers while separating them from the main text. In hedges and boosters the tendency to separate the markers from the main text was found in several instances. Looking at the use of footnotes and disciplines could be a topic in further research on disciplinary differences to see whether disciplines which do not use footnotes as much have different strategies to separate stance markers from the text.

The semantic field of mathematics affected the use of agents in stance markers in hedges, boosters and attitude markers. The stance markers in game theory show how academic language makes claims and arguments through softening or enforcing them, or through attitudes like necessity, importance or surprise. In self-mentions the use of plural form *we* is very commonly used even when there is a single author, and can be seen to be an academic convention.

The single biggest issue in drawing conclusions from the results is that for a more statistically viable result a much larger set of analyzable data should be used, for example in the form of a corpus. Since this study concerns itself with illustrating the presence of rhetorical language use in academic research articles in the particular field of game theory, the purpose is not to come to a quantitative, definitive result. Rather, by identifying and classifying the instances of stance markers

the study discusses how game theory, a field developed from a mathematical model, utilizes stance markers.

In further studies it could also be fruitful to examine for example differences in the use of stance markers by seasoned academics and writers with little published work. The overall frequency of the stance markers, as well as their distribution could be of interest. For example, is it more likely for a newly published writer to make stronger claims, or having to use more hedging to argue their research? The use of different attitude markers and what stance they represent might also be a topic for further research. With self-mentions the use of singular forms might also prove to be worthwhile issue.

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Appendix: Stance Markers used

Hedges:

about

almost

allege

allegedly

apparent

apparently

appear(s/ed)

approximately

argue(s/ed)

around

assume(s/ed)

broadly

can,

certain amount

certain extent

certain level

claim(s/ed)

could(n't)

doubt

doubtful/ly

essentially

estimate(s/d)

fairly

feels

felt

frequently

from my perspective

from our perspective

from this perspective

generally

guess

hint

indicate(s/ed)

in general

in most cases

in most instances

in my opinion

in my view

in this view

in our opinion

in our view

imply,

improbable

improbably

indicate

insinuate

kind of

largely

likely

mainly

may

maybe

might

mostly

often

on the whole

ought

perhaps

plausible

plausibly

possible

possibly

postulate(s/ed)

presumable

presumably

probable

probably

propose

quite

rather x

relatively

roughly

seems

should

sometimes

somewhat

suggest(s/ed)

suppose(s/ed)

suspect(s/ed)

sort of

tend to

tended to

tends to

to my knowledge

typical

typically

think

uncertain

uncertainly

unclear

unclearly

unlikely

usually

would

wouldn't

Boosters:

absolutely

actually

always

apparently

assert

believe(s/ed)

beyond doubt

certain

certainly

clear

clearly

command

conclusively

decidedly

decisively

definite

definitely

demonstrate(s/ed)

doubtless

emphasize

establish

established

evident

evidently

find

finds

for certain

found

guarantee

have to

in fact

incontestable

incontestably

incontrovertible

incontrovertibly

indeed

indisputable

indisputably

inevitably

insist

know

known

mainly

maintain,

must

never

no doubt

obvious

obviously

of course

probably

prove(s/d)

realize(s/ed)

really,

shall,

show

showed

shown

shows

strictly

sure

surely

think

thinks

thought

true

truly

undeniable

undeniably

undisputedly

undoubtedly

universally

usually

will

without doubt

won't

Attitude markers

absurd	confusedly
accept	correctly
acceptable	curious
adamant	curiously
admirable	deny
admirably	deserving
admire	desirable
admit	desirably
admittedly	desire
afraid	desperately
agree	disagree
agreeably	disagreed
agreed	disagrees
agrees	disappointed
allow	disappointing
amazed	disappointingly
amazing	disturbingly
amazingly	dramatic
anticipate	dramatically
appropriate	dream
appropriately	ensure
approve	essential
astonished	essentially
astonishing	even x
astonishingly	excellent
bad	excessive
blame	exciting
careful	expect
complain	expected
	expectedly

extraordinary	interestingly
fair	intolerably
faithfully	ironically
fear	marvel
feasible	natural
feel	necessary
fitting	noteworthy
forget	noticeable
fortunate	obligatory
fortunately	odd
frankly speaking	peculiar
fundamental	perfect
glad	prefer
gladly	preferable
good	preferably
gratifying	preferred
great	pretend
happily	proper
hope	reasonable
hopeful	reflect
hopefully	regrettably
humbly	remarkable
ideal	remarkably
important	require
importantly	resolve
inappropriate	rightly
inappropriately	sadly
incredible	satisfactory
indifferently	sensible
interesting	shocked

shocking

shockingly

speculative

strange

striking

strikingly

suffice

sufficient

surprised

surprising

surprisingly

trust

typical

unbelievable

unbelievably

understandable

understandably

unexpected

unexpectedly

unfortunate

unfortunately

unhappily

unusual

unusually

usual

willingly

wisely

wish

wonder

worry

Self-mentions

I

me

mine

my

our

the author

the author's

the writer

the writer's

us

we