Astrospeak in turns: Minimal sequences of conversation in institutional talk

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Interaction in many professions or institutions has led to the development of domain-specific language varieties, or registers. To distinguish these forms of language from other, everyday registers, linguistics has grouped them as Languages for Specific purposes (LSPs). The thesis focuses on the LSP used by the Apollo astronauts and mission control during the US Moon landing program in the late 1960's/early 1970's. The data used are the transcripts of the Apollo 12 air-to-ground transmissions from 1969, accessible online via a NASA website. The data is described using register analytical approaches provided by Biber & Conrad (2009). Additionally, institutional constraints and radiotelephony (R/T) are discussed as restrictive factors for talk.

The thesis concentrates on the sequence organization of the language variety, named Astrospeak by the author. More specifically, the thesis employs the methodologies of conversation analysis (CA) to explore the minimal sequence structure of Astrospeak. A minimal sequence refers to the unexpanded base form of sequence which is constructed out of turns, and whose organization is the foundation for interaction. In addition to examining the minimal sequence structure of Astrospeak, the thesis questions discuss the nature of the interaction in relation to the two research approaches for conversation: CA and Institutional CA (ICA).

The hypothesis is that Astrospeak favors a three-turn minimal sequence structure. This follows the findings of Kevoe-Feldman & Robinson (2012). Using common CA frameworks amended with institutional considerations, the analysis shows that Astrospeak does take a three-turn minimal sequence when initiated with an open question. Conversely, if no tangible information is produced in the response turn, a third turn is not triggered. The presence of the third turn is due to institutional and R/T constraints.

The thesis is the first linguistic study of Astrospeak. In addition to exploring the sequence organization of the interaction, the thesis suggests that ICA-specific frameworks could help theoretically differentiate LSPs from 'ordinary' talk. For that, the concept of procedurality is discussed as a descriptive tool for further research.

Keywords: conversation analysis, register analysis, institutional talk, sequence organization, minimal sequence, radiotelephony

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List of abbreviations

CA	conversation analysis
ICA	institutional conversation analysis
LSP	language for specific purposes
R/T	radiotelephony
NASA	National Aeronautics and Space Administration
ICAO	International Civil Aviation Organization

1 Introduction

Popular history often grazes over enormous undertakings, conflicts, and developments in the human experience with a single momentary glance. In recounting historical events, people tend to latch on to portraits of important individuals, memorable imagery, or indelible quotes. Quotations from the likes of Admiral Nelson and Martin Luther King have long defined historical events or periods because documentarians gravitate towards relatively simple soundbites. This is also true with regards to the histories of manned spaceflight. When the US landed the first humans on the Moon in the summer of 1969, the radio transmissions back to Earth were listened to by hundreds of millions, and astronaut Neil Armstrong’s famous words “*One small step for a man, one giant leap for mankind*” were embedded in the collective memory of humankind. No quote related to the Moon landing program surpasses Armstrong’s in popularity, but such poetic phrases are rare in the hours of radio transmissions between the astronauts and the flight control center in Houston, Texas. In fact, popular history fails to mention, perhaps justifiably, that the actual first words transmitted from the surface of the Moon were “*Okay engine stop. ACA out of detent. Mode control both auto. Descent engine command override off. Engine arm off. 413 is in*.” (NASA 2010: 316). For the general public, such technical jargon is probably meaningless, regardless of its factual historical importance. For linguists interested in the field of professional registers of language, however, it presents a glimpse of the actual working language used by the astronauts on a foreign celestial body.

This language, a variety of English, may be explored in numerous ways. One of the most fundamental approaches to understanding a language variety is structural analysis. Interest in the basic structure of languages has been at the forefront of linguistic research for a long time; Structuralism as a linguistic field has often been credited to have its roots in the works of Ferdinand de Saussure (Matthews 2001: 6). From its early beginnings, academic exploration of language structure has developed along many paths. One research path is concerned with human interaction and conversation structure - *Conversation Analysis* (CA). Clayman & Heritage note that successful human interaction is dependent on “structural organizations of practices to which participants are normatively oriented" (2010: 13). In other words, people who engage in conversation must be familiar with a common set of communication rules and context to be able to interact successfully. Additionally, conversation renews context, i.e. what is being said has a direct and tangible influence on the following utterances (Clayman & Heritage 2010: 14). Fundamentally, conversations are built on *turns* and *sequences.* These are the basic modules of interaction which make up whole passages of conversation; turn means the single utterance by a participant, while a series of interconnected turns constitute a sequence. The sequential organization is a crucial component of interaction; without it, participants would not be realistically able to make sense of the conversation (Hutchby & Wooffitt 2008: 42). The thesis' specific focus is on minimal sequences, the basic building blocks of conversation. Relationships between turns inside sequences are key to the analytical goals of the thesis, but relationships between sequences are beyond its scope.

Many CA studies are interested in the everyday 'ordinary talk' between people. The studies have amassed a reserve of findings on how "basic social actions are produced and recognized, and how their production and recognition are located and shaped within the institution of interaction" (Clayman & Heritage 2010: 16) However, recognition of different registers of language, particularly those which are used in professional contexts, has brought up new challenges for researchers of human interaction. Heritage (2005: 104) outlines a second type of CA, *institutional conversational analysis* (ICA)*,* which places importance on the contextual requirements and restrictions to language use by institutions. It must be noted that institutional CA builds on the foundation laid by 'ordinary' CA. Therefore, ICA studies need to have a strong and explicit relationship with the frameworks and concepts of CA, at least until new, ICA-specific, ideas are developed. The relationship between CA and ICA will be elaborated throughout the thesis. The institutional aspects of language become central and explicit when language varieties with professional use contexts are explored.

This thesis combines the sequential analysis approach of CA with the variety of English used by Apollo astronauts and flight controllers in the radio transmissions between the spacecraft and mission control on Earth. This variety of language, or *register,* can be considered a *language for specific purposes* (LSP). LSPs are varieties of language which are specifically tailored for use in certain professional contexts. The concept of institutional talk is parallel to LSP. The terms are often used interchangeably but institutional talk has specific qualities which are explored in section 3.1.2 of the thesis. Institutional talk and LSP do, however, have a similar foundation. Orna-Montesinos explains LSPs in the following way: "[T]he textual practices of specialized [languages] are linked to the communicative purposes the text needs to fulfill and to the influence the social context exerts on the [language]" (2012: 2). LSPs, by nature, are restricted registers of a natural language. They usually possess explicit or implicit restrictions which are derived from the contextual requirements placed on each register. These restrictions differ radically from register to register because the use contexts are different, as well. The specialized register examined in this thesis is called *Astrospeak*. Its name is derived by the author from *Airspeak,* a widely recognized term for the specialized English used by pilots and air traffic controllers. Having a relatively simple name for the register facilitates writing about it, but also underscores its distinct position in the field of English-based registers.

The central hypothesis of the thesis is that conversations in Astrospeak show a preference towards a three-turn minimal sequence. This is partly at odds with previous CA research which has suggested that the fundamental minimal sequence in conversation is formed from only two turns (Schegloff 2007: 22). Fundamental minimal sequence means a conversational sequence which is a) unexpanded, and b) the normative standard in the register. The analysis aims at producing meaningful examples validating such a disagreement. One reason behind this disagreement could be CA's failure to explain institutional characteristics of interaction. Therefore, CA and ICA are contrasted throughout the thesis. As additional foci, the thesis reviews turn expansion in Astrospeak sequences and suggests the application of the concept of *procedurality* into ICA and specialized register research. Imported into the thesis from the field of programming languages, procedurality can be shown to possess intriguing characteristics as a descriptive linguistic tool. The research questions of the thesis are:

1. What is the basic minimal sequence structure of Astrospeak and how the specialized context of Astrospeak influences such a structure?
2. How do the findings relate to the two research traditions of CA and ICA?
3. How can the concept of procedurality explain LSP-specific operational language use?

The thesis uses data provided by Johnson Space Center (JSC) of NASA. Available to public online, JSC provides transcriptions of all radio transmissions during the Apollo flights in the 1960's and -70's, originally made for engineering purposes. This collection of transcriptions includes over 40,000 pages of conversation between the astronauts in space and the mission control operators on Earth. This study is the first substantial linguistic venture into this data resource. Submitting to Matthiessen's (2015) goal of exploring all possible registers inside a language system, this thesis provides a sequential description of a register which has not yet been explored by linguists. The thesis is not, nor is it meant to be, a comprehensive description of Astrospeak. This is precluded by the sheer volume of data available, as well as the narrow scope of the thesis. The addition of Astrospeak knowledge into the field should support other institutional conversation analyses' findings about sequence structure in specialized languages. Finally, the concept of procedurality is presented as an idea for expanding LSP descriptions.

The body of the thesis starts with a chapter presenting the contextual information on spaceflight and communication. Exploring the context of spaceflight has two benefits: First, it briefs readers on the field of spaceflight and the human experience that is related to such an endeavor. Second, it provides the basis for the later analysis of Astrospeak data as many of the issues discussed in chapter 2 have direct consequences for conversation structure. Its inclusion in the thesis is therefore highly important. Throughout the thesis, context means solely the physical and social characteristics of spaceflight as modifying forces. Context as turn adjacency, for example, is relevant to the CA foundations of the thesis, but other terms are used in relation to it if necessary.

The key theoretical frameworks and models are presented and evaluated in chapters 3, 4, and 5. Chapter 3 explores the concept of register and outlines LSPs as distinct registers. Secondly, institutional qualities of professional registers are considered. Finally, the modal qualities of registers known as *radiotelephony languages* or *R/T* are discussed to help contextualize Astrospeak in the field of English-based LSPs. In chapter 4, the theoretical foundations of conversational and sequential structure are presented. The concept of turn is explored in detail, and two types of fundamental sequences in interaction are introduced. This chapter also discusses turn expansion which is a secondary focal point in the analysis. The analytical approach of the thesis is illustrated in chapter 5, which also presents an exposition of the data transcripts. The chosen analytical methods, such as appropriate CA frameworks and *register analysis* are introduced and evaluated in section 5.2.

The analytical section consists of chapters 6 and 7. Chapter 6 consists of three major subsections, each dedicated to one turn in the supposed three-turn minimal sequence. An additional subsection explores possible violations of this sequence structure, consequently evaluating the hypothesis. The chapter also focuses on turn expansion in all three expansion positions. Chapter 7 examines the findings of the preceding chapter and provides discussion. This chapter also presents the concept of procedurality and how it relates to the findings. Conclusions are drawn in chapter 8 and suggestions for further research using Astrospeak data are explored. Before any analysis or conclusions can be presented, however, one must gain an understanding of spaceflight as a communicative context. This is the goal of the next chapter.

2 Communication & spaceflight

Manned spaceflight started during the Cold War, as the development of intercontinental ballistic missiles presented a possibility to escape Earth’s gravity and travel to space. Soon, space became the battleground for the United States and the Soviet Union, and the two nations started racing to land the first humans on the Moon. The Apollo program was set up by the US government agency NASA (National Aeronautics and Space Administration) to land the first astronauts on the Moon by the end of 1969, and in July 1969, Apollo 11 carried two men to the surface. Upon its completion, the Apollo program had landed five additional crews on the Moon and performed a large amount of groundbreaking scientific research on Earth's celestial neighbor. The last crew departed the Moon in December 1972 and no humans have since returned. This chapter is primarily concerned with how the context of spaceflight, and the technical and social challenges it presents, modifies Astrospeak. It will allow the readers to gain an understanding about the field of human spaceflight, at least on a surface level. Such an understanding will consequently allow for an understanding of the research questions, analysis and results in detail. For contextual information, the section employs Andrew Chaikin's popular history book on the Apollo program *A Man on the Moon* (1994). This book is one of the most comprehensive works on the human aspect of the program and provides some key insights into the communicative challenges presented by the venture. No prior linguistic research has been aimed at astronaut communication outside a few studies where the multilingual and multicultural aspects of international space travel have been discussed (see e.g. Ritsher 2005, Novikova 2018). This thesis will, hopefully, serve as a starting point for further research into the triad of humans, spaceflight and communication.

As discussed earlier, this thesis relies heavily on the concept of *institutionality* in human interaction. While its background and meaning will be explored in section 3.2 in relation to linguistics, it is beneficial to briefly explain NASA and spaceflights as institutional endeavors. NASA was founded in the early 1960's by the US government as a civilian organization to oversee manned and unmanned space operations. Very early on, it was determined that all spaceflights should be controlled on Earth by a team of experts lead by a flight director. The people flying the spacecraft, astronauts, would have access to spacecraft controls, decision-making and problem-solving but fundamentally it would be mission control's responsibility to ensure crew survival and mission success. For Apollo missions, the spacecraft would carry three astronauts who each had a specific role: a commander would oversee spacecraft operations with executive powers among the crew (NASA 1969: 2), a command module pilot would oversee command module systems and navigation, and a lunar module pilot would oversee electrical and environmental systems and the lunar module. Each role required specialized training but decisions about critical systems operation were usually made by the commander. Although the crew was highly trained, the endeavor was still deemed too complex for the crew alone. Hence, mission control was given the ultimate authority to dictate mission progress.

As noted, mission control teams were led by a flight director who was given the power to determine the actions of the mission control team as well as practically commanding the spacecraft crew (NASA 1969). From the beginning of NASA, mission control operations were not allowed to be interfered with by people outside the team, i.e. administrators, politicians, journalists etc. This ensured that, from an institutional perspective, Apollo communications had a clear hierarchy. This hierarchy is central to the approach of the thesis, and it will be examined further in later chapters. In practice, the hierarchy loosened to suit certain situations that arose during the flights; the crew performed autonomous systems operations based on what they were observing, while specialized mission controllers could sometimes advise the crew without explicit consent from the flight director. Generally, however, the flight director issued commands based on data and the crew executed them. For a linguistic thesis, one important facet of the institutional backbone of Astrospeak is the use of a CAPCOM system. This means that in mission control, an astronaut acted as the Capsule Communicator, essentially as the link between the crew and the mission control team. By mission rules, only the CAPCOM could talk on the earth-to-spacecraft loop. This meant that all commands, questions etc. were transmitted to the crew by the same controller. The system was introduced so that the crew would have a peer to assist them and so that the communication loop would be kept relatively clean from overlapping talk.

The communication between astronauts and mission control via the CAPCOM happened via radio transmissions, broadly in a similar fashion as in other professional contexts where interaction participants are not in the same room. The most substantial technical restriction placed on Astrospeak is naturally the fact that the two parties communicated over a very long distance. On the simplest level, this is relatively uninteresting: Powerful radio waves reach space easily and if the telescope network is large enough, spacecraft can always remain in contact with the

Earth (except when behind the Moon). A unified S-band radio system and a worldwide network of radio antennae were built by NASA to serve the Apollo program's needs (NASA 1966). Extensive mission rules were introduced to combat problems arising from radio communications and the communication loops were closed from most of the people participating in the operation. Although numerous actions were taken to facilitate communications, the technology was rudimentary and the operating procedures were newly-invented. Naturally, many problems were observed.

The restrictions posed by the technical solutions were substantial. Radio transmitters are prone to interference which presents itself in garbled messages and loss of data. Listening to the transmissions was an arduous task because background noise and interference were quite severe throughout the mission. The physical separation of spacecraft from the Earth also had a negative influence: "It took 1.3 seconds from a message from the [Moon] to reach Earth and another 1.3 seconds for mission control's reply to reach the astronauts" (Chaikin 1994: 172). Participants had to take this into consideration, because overlapping transmissions can cause severe misunderstandings or lack of information. Furthermore, radio transmissions are a very rigid way of communicating. Because the participants do not have visual cues (eye contact, facial expressions etc.) to assist them, intonation and other prosodic features are difficult to notice. Here, basic radiotelephony procedures were applied (see section 3.3 for further discussion). In addition, the transmissions can be cut off or be garbled, possibly corrupting the messages. All these factors must be accounted for in the communication system being used.

As discussed, the participants in nearly all Astrospeak transcripts are restricted to the spacecraft crew and a capsule communicator in mission control. No other persons would be allowed to talk on the primary communication loop between the ground and the spacecraft. The communication loop of the Apollo program missions included two possible microphone settings, voice-activation and push-to-talk. These two microphone settings were introduced to cater communications for different stages of the flight. During stages which required hands-on operation of systems or were complex and important, the voice-activated or 'VOX' setting was used. In short, this meant that the microphone was turned on automatically when a person talked into it, removing the need to operate the system by hand. In non-critical phases of the flight, the crew and mission control used the push-to-talk, or PTT, mode which required pushing a button which then activated the microphone. The data annotation does not show which mode was used, but circumstantial evidence seems to suggest that PTT was the preferred mode when operative restrictions were minor enough. Such a cumbersome system is partly responsible for the concise and uncluttered nature of Astrospeak – the communicative structure, which will be discussed later in the thesis, is rigid because the mode of communication so dictates.

In addition to the technical obstacles, the subject matter of 'space talk' or Astrospeak posed challenges for NASA. Chaikin notes that for the flight controllers on Earth, the task of solving a potential problem was very complex:

> In twenty seconds a controller could look at a problem, talk to someone in his back room, think, talk to someone else, come back to the first person, and make a decision. And all the while, he would be monitoring the events around him, listening not only the conversations on the flight director's loop, but air-to-ground and perhaps one or two other loops.
>
> (Chaikin 1994: 171)

Although the people working in mission control were highly trained experts in their respective domains, this type of situation still requires an efficient way of communicating. The content of Astrospeak is therefore concentrated, coherent and dense. While LSPs that have developed in highly demanding technical contexts have numerous common characteristics (see section 3.1), one prevalent attribute is specialized lexis. In spaceflight contexts, this means high lexical density, a prevalence of abbreviations and dependence on R/T procedures. High lexical density means that in talk, a higher number of content words is detected, usually at the expense of function word density. To simplify, registers with high lexical density contain a lot of information, which is balanced by simple grammatical constructions. A detailed discussion on the common characteristics of LSPs and R/T languages, such as R/T procedures, will be offered in the next chapter. For Astrospeak specifically, the challenge of technical complexity was tackled with the cooperation between spacecraft crew and mission control. In addition, the crew and mission control possessed multiple checklists to assist in critical and non-critical operations. These were manuals which were carried aboard the spacecraft and used to assist in systems operation. The data shows numerous passages where a crewmember reads out procedures from the checklist and another crewmember operates the computer or sets switches accordingly. For communication, this means that in checklist-assisted operations, the conversation is very rigid and lexically denser than in more open-ended situations. Whether in checklist-assisted operations or not, however, Astrospeak required a simplification of utterances and a 'checks-and-balances' system between participants to combat the complexity of the subject matter. Therefore, the data excerpts show conversations which are relatively terse and repetitive.

The operational complexity of Apollo spaceflights was a central communicative challenge for NASA. Therefore, the spacecraft and other essential systems were designed to be operated by computers. In the 1960's when Apollo spacecraft were developed, computers were very rudimentary and cumbersome. Institutions such as the Massachusetts Institute of Technology (MIT) were involved in the design of Apollo computers and succeeded in developing a system which was able to control the spacecraft and calculate its complex trajectories in space. For the crews, this meant that very little actual piloting was needed on the Moon missions. The crews were almost exclusively made up of military pilots who already possessed skills relating to the operation of flying vehicles; NASA's task was to train them to become skillful computer operators. Consequently, the crewmembers were already familiar with R/T procedures and the restricted talk when they started training for spaceflights. While Astrospeak closely resembles the English used by airplane pilots, the shift in pilot role placed new constraints on talk. This is also a part of the reason that Astrospeak is regarded as a distinct register of English in this thesis. The next chapter aims to contextualize Astrospeak in the field of specialized or institutional languages. It will also discuss the modal characteristics of R/T languages in general. Together with this chapter, it will serve as the contextual backbone for the analytical goals of the thesis.

3 Register and specialized context

The influential linguist John Rupert Firth was a key proponent of the idea that language always must be examined in concurrence with its context of use. This behaviorist view "saw language as a set of events which speakers uttered, a mode of action, a way of 'doing things', and therefore linguists should focus on speech events themselves" (Chapman & Routledge: 2005: 81). Chapman & Routledge continue: "As utterances occur in real-life contexts, Firth argued that their meaning derived just as much from the particular situation in which they occurred as from the string of sounds uttered" (ibid.). For Firth and numerous other linguists, context is a vital part of the mosaic of language. These ideas form the basis for discourse analysis in general, but they are perhaps even more important to the study of *registers.*

Establishing register as it is currently known in linguistics, Halliday wrote: "Language is not realized in the abstract: it is realized as the activity of people in situations, as linguistic events which are manifested in a particular dialect and register (Halliday, McIntosh & Strevens 1964: 89)". While dialect denotes the variation in language between individuals, register refers to variation according to situation. A speaker selects an appropriate register that suits a particular situation. Register variation is very common (Biber 1995) and people often engage in it subconsciously. For example, an astronaut would choose to use different registers when talking with his family, giving interviews to journalists and reviewing instrument data with engineers. This explicit connection between the chosen register and use context is intrinsic to the concept of register. An exploration of talk-in-context can provide insights about social factors influencing professions, for example. Overall, analysis of registers may assist in determining which situational factors determine which linguistic features or understanding the semiotic space that is a language and its use in different situations (Matthiessen 2015). Register analysis will be discussed further in chapter 5.

In the Hallidayan tradition, register has been seen to contain three important variables: field, tenor and mode – "where field focuses on institutional practices, tenor on social relations and mode on channel" (Martin 1997: 4). For Yunick, the study of registers is not about distinct turn types, rather the relationships between language and its social context: “A register is not to be seen as text type but as the realization of a set of systems (field, tenor and mode) that mediate the relation between context” (1997: 328). As register is by definition context-specific, all attempts at describing a register must include a review of the contextual elements, i.e. the field, tenor and mode of a variety. It must be emphasized that these three variables refer to the context only, not on the linguistic forms taken by registers. They “are a conceptual framework for representing the social context as the semiotic environment in which people exchange meanings” (Halliday 1994: 25). If constructions of registers are considered hierarchically, the context supersedes the linguistic form; while astronauts may talk in a specific manner, they do so only because the context of spaceflight possesses characteristics which favor a certain type of language use.

It is obvious that humans possess the ability to master numerous registers and by orienting themselves to the situation, vary their linguistic output – choose a proper register – accordingly. Naturally, this means that while many varieties of language are very detailed and domain-specific, a register can also be very broad and generic (Biber 1995: 9). However, Biber notes that “[m]ost studies of a single register focus on a specialized kind of language” (1995: 11). Although register has long been a prevalent concept in discourse studies, its use has brought up some criticism. First, Lewandowski writes that researchers concerned with language variation are met with a “terminological disarray” (2010: 60). Concepts such as register, social dialect, code, and variety are used interchangeably, without theoretical distinctions between them. For the thesis, ‘register’ is used to denote a variety of use, because it has a strong theoretical foundation and professional context uses are handled under different concepts (see sections below).

A widely-quoted criticism of register comes from Crystal & Davy (1969), who argue that because every language variety imaginable can be called a register, the term loses its descriptive significance. For them, “it is inconsistent, unrealistic, and confusing to obscure these differences by grouping everything under the same heading” (1969: 61). The openness of register as a descriptive concept is not in question. That should not, however, undermine the whole concept; all interaction is somehow context-specific, and this phenomenon is named ‘register’. Overall, Lewandowski notes that “from today’s perspective, [this] criticism is totally unjustified” (2010: 69). Indeed, register is a well-defined concept which has been clearly separated from ‘style’ and ‘genre’, for example. The methodological chapter will further discuss criticisms of register, particularly in relation to genre and register analysis.

The following chapter explores registers which are explicitly tied to a certain professional field or an institution. First, registers which are restricted for professional or institutional reasons are explored. Section 3.1.1 discusses the concept of specialized language or LSP. In section 3.1.2, the concept of institution is explored in relation to specialized registers as a modifying or explanatory force. Finally, section 3.3. considers the modal restrictions placed on some restricted registers by the use radiotelephony. Overall, the key idea of the chapter is to position Astrospeak on the field of English-based registers by considering multiple facets of register distinction. Layering the concepts of LSP, institutional talk and radiotelephony will provide a thorough understanding of Astrospeak as a language variety. Institutionality in conversation analyses and the suitability of register analysis for the thesis will be discussed in later chapters.

3.1 Restricted registers: LSP and institutional talk

By nature, a register is tied to its use context. As discussed above, the variables of register – field, tenor and mode – mark the relationship of the language that is being examined and the social context in which that language is used. While all registers possess these three variables, for some the relationship of context and form is more explicit. These are registers which are used in professional or institutional contexts. Bhatia notes that registers used in professional contexts have a direct connection with the tasks associated with that context: “[D]ifferent professional discourses have their own specific characteristics that constrain their use and interpretation” (Bhatia 2008: 163). The important word here is ‘constrain’. Professional registers’ use is narrow in scope, so they do not have to be able to handle the whole spectrum of human behavior. In fact, they are more efficient if a user has only a restricted set of utterances, phrases or words to choose from. The development restricted registers is directly linked to the development of procedures in professional contexts.

Restricted language has fallen out of favor with many linguists (Léon 2007) and replaced by register in some frameworks. Léon argues, however, that this replacement overlooks the explicit contextual constraints placed on some registers (2007: 19). For this thesis, restricted language means a domain-specific register, whose form is restricted by its use in professional/institutional context.

Léon traces the concept of restricted language to Firth. She summarizes the four defining characteristics of the concept: Restricted language 1) is sourced from a natural language, such as English 2) functions in specific situations 3) contains specialized vocabulary, grammar and style and 4) is understandable to its primary users, but not necessarily to others (2007: 11). For Astrospeak, the source language is English, and it functions in the context of spaceflight. It is also reasonable to argue that Astrospeak is fully understandable only to its user-experts. This thesis then, as a preliminary exploration of Astrospeak, needs to account for the missing dimension; the specialized forms of language in the transcripts. To ensure a realistic scope, the thesis concentrates on the organization of sequence in the data, not on all realizations of the restricted language. In addition, the constraints themselves must be considered to support classifying Astrospeak as a restricted language.

While restricted language is a Firthian concept of language description, the linguistic field of exploring registers which are connected to a professional use context converged under the header *language for specific purposes (LSP).* The following two sections will explore LSP, as well as institutional talk. The terms are often used interchangeably, but there are some crucial differences. Overall, the sections are meant to contextualize Astrospeak as a restricted register.

3.1.1 Languages for specific purposes

As discussed, register in its broadest connotation can mean any variety of a source language. To combat the all-inclusive nature of register as a variety-classifying concept, subgroups of registers should be formed. It has already been determined that registers take their linguistic forms and practices because of their connection to a specific domain or context. Although this force is evident in everyday, 'ordinary' interactional situations, some professional contexts place more explicit requirements and restrictions on language. These discourses are called Languages for Specific

Purposes (LSP). Users of LSPs are often limited to professionals in a certain field; a dentist may converse with a patient in regular language but shift to an LSP once they communicate with a nurse, for example. For this thesis, the focus is on expert-to-expert talk. Considerations about possible imbalances in LSP knowledge between experts and non-experts are left for other studies.

Although establishing a subset of registers under the concept of LSP narrows the field significantly, research still must account for the high variation between different restricted varieties of talk. LSPs do seem to have some general characteristics related to the contextual requirements and restrictions placed on them, but as professional situations vary from each occupation to another, so do the registers connected to them. One attempt at presenting a list of general LSP characteristics has been made by Hoffmann (2011). He lists eleven features which he argues to contain most of the defining qualities of professional restricted registers:

> "1. exactitude, simplicity and clarity; 2. objectivity; 3. abstractness; 4. generalization; 5. density of information; 6. brevity or laconism; 7. emotional neutrality; 8. unambiguousness; 9. impersonality; 10. logical consistency; 11. use of defined technical terms, symbols and figures."
>
> (Hoffmann in Gotti 2011: 21)

The features on the list are some of the ways in which LSPs are contrasted with 'ordinary' talk. They are not characteristics which *all* LSPs share, rather a set of features which tend to define restricted registers in relation to more general language use. For example, a courtroom register of English is notoriously protracted and verbose – in direct opposition to feature 6 of Hoffmann's list. The list is not perfect for Astrospeak descriptions either: The data shows a surprising presence of personal addressing between participants, for example. Most of the list's features, however, correspond well with Astrospeak data.

Basturkmen & Elder outline the general approaches to LSP by noting that the "[t]wo central aspects of LSP are needs analysis and description of language use in target situations" (2008: 674). Needs analysis means a review of the LSP's features and application of this this knowledge to the design of language teaching materials. Indeed, much of LSP research is dedicated to how language learners can grasp professional restricted registers. It is obvious, however, that registers which are previously unknown to researchers (such as Astrospeak) must first be systematically described as a register before any practical applications may be suggested. Only then, Swales' requirement that LSP studies move from showing differences between restricted registers to explaining those differences (2000: 67) can be met. It is questionable whether a description of Astrospeak has any meaningful pedagogical application. On a theoretical level, however, Astrospeak offers an opportunity to review a unique LSP.

As discussed in the introduction, the thesis' methodological approach is to apply CA frameworks for LSP analysis. Bowles (2012: 50) notes that this approach has been oft-neglected in the field. He posits that CA has some tangible benefits for LSP research. For example, the detailed approach of CA can offer results which are considerably more specific than those of e.g. genre and register analyses (2012: 51). Furthermore, CA is, by nature, concerned with oral discourses, which Bowles argues are proportionally underrepresented in the field of LSP studies. (2012: 52). Overall, however, CA approaches must be amended by "providing a theoretical and methodological bridge between CA and LSP" (Bowles 2012: 51).

Dressen-Hammouda suggests that "[L]SP research still has not gone far enough in answering fundamental questions relative to bridging the gap between texts and contexts" (2012: 517). The reason for this may be [L]SP studies' tendency to see it as a pedagogical endeavor, with learner-driven analytic goals (Dressen-Hammouda 2012: 501). The thesis aims to amend this problem, as a conversation analytic approach is used to add to the body of research describing the nature of LSPs. It must be noted, however, that generalizations on a purely descriptive level are problematic; the connection between context and text is, by nature, specific to each LSP. While broader inferences are perhaps difficult to draw from ethnographic analyses of a single LSP, connections or similarities between different registers can still be made. Some ideas on generalizations are provided by the analysis of institutionality in Astrospeak – institutions will therefore be explored next.

3.1.2 Institutional talk

A concept closely related to, and largely overlapping with, LSP is *institutional talk.* Institutions refer to language-use contexts which are restricted by the same processes as LSPs, but also contexts in which the specialized social roles of participants modify talk. Adapting the original list by Drew & Heritage (1992: 22), Clayman & Heritage propose the three basic features of institutional talk:

> "1 the interaction normally involves the participants in specific goal orientations *which are tied to their institution-relevant identities*: President-elect and Chief Justice, doctor and patient, teacher and student, etc.;
>
> 2 the interaction involves special constraints on what will be treated as allowable contributions to the business at hand; and
>
> 3 the interaction is associated with inferential frameworks and procedures that are particular to specific institutional contexts"
>
> Clayman & Heritage (2010: 34)

Features 2 and 3 correspond well with the accepted general characteristics of LSPs discussed earlier but feature 1 places a special emphasis on the identities or roles of interaction-participants with regards to the institutional context. While these roles are often critically analyzed as examples of social power imbalance, CA approaches institutional roles as "emergent properties of talk-in-interaction" (Benwell & Stokoe (2006: 87). These roles contribute to the restricted form of institutional registers. In 'ordinary' talk, participants engage in interaction unpredictably. In institutional settings, the participant roles have qualities which place a fundamental structure on the conversation. For example, in a news interview, the interviewer is expected to ask questions but to refrain from giving lengthy personal opinions. In contrast, the interviewee is not expected to ask questions from the interviewer. Hutchby (2005) notes that institutional conversations can be placed on a continuum; some registers are very strict in their restriction of allowable input, while others are more loosely structured.

Some issues do exist regarding the concept of institutional talk. For example, the process of correctly identifying institutions affecting talk has been brought into question as an arbitrary process (McHoul & Rapley 2001). Heritage

(2005: 107) writes that almost all registers can be called institutional on sociological bases and admits that the separation of talk into institutional and ordinary registers "may not withstand […] skeptical, essentializing scrutiny" (ibid.). The starting point for an endeavor which differentiates these two must begin with defining institution as a linguistic concept. Benwell & Stokoe (2006: 88) observe that institutions are commonly associated with e.g. organizations, governments and other groups or professional settings. These are easily identifiable as institutions, but usually social sciences also consider contexts such as family and the sciences as institutions. This definition produces a very wide array of registers.

Although institutional talk seems to be problematic to differentiate from 'ordinary' talk, Clayman & Heritage note that even an incomplete distinction can be useful (2010: 35). They note that while this is challenging, participants in interaction seem to "clearly orient to the distinction" (ibid.). Such observation indicates that institutional analysis of talk is worthwhile. In Astrospeak, the boundary between 'ordinary' conversation and institutional talk is often difficult to notice but e.g. mission-critical phases of the flight do seem to orient the participants to the task and the interaction immediately reflects that. Clayman & Heritage continue by noting that many dimensions of distinctiveness can be observed between 'ordinary' talk and institutional talk (2010: 36). Concurrently, Schegloff cautions readers not to discard 'ordinary' talk as a residual category (1999: 407), or as something that is left after registers possessing domain-specific characteristics are defined. He argues that 'ordinary' talk is simply a realization of the same generic organizations which govern *all* interaction (1999: 409). Different systems of talk-in-interaction, as Schegloff calls conversation, co-exist in social situations and show significant overlap (1999: 412). Nevertheless, Schegloff recognizes that different systems of interaction can be defined by their relation to the generic aspects of interaction, such as turn-taking models and sequence organization. The thesis focuses specifically on the domain-specific influence on sequence structure. The analysis is aimed at providing evidence that in Astrospeak, it is fundamentally different from the structure of 'ordinary' talk. Such contrastive analysis is important in arguing for distinct institutional forms of language.

The decision to separate institutional and 'ordinary' talk has real benefits for research into different types of domain-specific registers. However, other issues have been raised in regard to institutional talk as a linguistic concept. Seedhouse & Richards note that research into institutional registers could be problematic as they are multi-layered with subsets of a broader LSP for different uses in the communicative context. In other words, "an institutional variety cannot realistically be treated as an undifferentiated, homogenous entity" (Seedhouse & Richards 2007: 18). While the highest-level institutional register has some general characteristics, which are present in all subsets, the subsets may have some characteristics which cannot be found in other subsets or on the highest level either. For researches drawing conclusions, and more importantly generalizations, about institutional registers, this problem must be considered. Identification of subsets may require a corpus-based approach, or at least a large body of data from which subsets could be identified. If one wishes to compare different registers without corpora, however, some common theoretical foundations should at least be used.

The basic features of institutional talk outlined by Clayman & Heritage (2010: 34) closely resemble the three variables of register in the Hallidayan model of language (e.g. Halliday 1994: 38). Field is connected to the total communicative event, or crudely to the inferential frameworks and procedures in Clayman & Heritage's list, tenor covers the institution-relevant identities of participants, while mode refers to some of the special constraints placed on interaction by the context. The matches are not perfect, but the logic stands. Using the Hallidayan register model for a foundation, institutional talk studies have a well-defined theoretical structure by which the institutional context of these registers can be described. Moreover, studies may emphasize one of the variables. For some institutional varieties the goal-orientation of participants or the domain-specific inferential networks might be especially intriguing. For Astrospeak, the study of institutional constraints on talk seem to be particularly crucial. It must be stressed, however, that all three variables of context control all institutional varieties of language; the emphasis of a single variable must not totally overrule the others.

Overall, the distinction between the concepts of specialized language and institutional language seems to arise from the explicit roles of participants embedded in the language system. The thesis returns to Institutionality in chapter 4, where its role is discussed in relation to conversation analysis. Next, a section is dedicated for examining a distinct type of LSPs, radiotelephony, or R/T, languages. Understanding radiotelephony as a key factor in Astrospeak construction is vital for the success of the thesis' analytical part. R/T's influence on Astrospeak is considerable, and the following section, along with chapter 2, will provide the contextual foundation for the whole thesis.

3.2 Radiotelephony languages

In section 3.1.1 it was discussed how professional registers can be separated from registers which do not have a fundamental connection to a professional field by classifying them as LSPs. However, LSP is still a very broad term, and under it may exist registers which share very few characteristics. For example, a list of LSPs commonly found in prior research would include medical language, legal language and the language of science, among others (Swales 2000: 62). These are obviously very different types of language, so other approaches to register classification can be taken, as well. One option is to consider the modal influences placed on a register. While conversation between people usually happens face-to-face, there are numerous instances where this is not true. For example, telephone conversations have their own unique requirements and restrictions because the participants lack visual cues normally present in conversation. An extension of phone conversations is the use of radios as a mode of communication. Some professions rely on radio waves to ensure successful operations. This type of communication is known as radiotelephony, or R/T.

This section explores registers which are influenced by R/T. These registers, or radiotelephony languages (as discussed by e.g. Elder & Kim 2009, Varantola 1989), have similar backgrounds and common characteristics. The most common examples of R/T LSPs are Airspeak, which is used in aviation contexts, and Maritime English, which is the *lingua franca* of international shipping and maritime operations. Taking the whole spectrum of English language registers into consideration, these two languages are the closest relatives of Astrospeak. Acquiring a basic understanding of both is necessary for the analytical goals of the thesis;

together with the contextual knowledge of chapter 2, knowledge about R/T languages forms the overall contextual basis for Astrospeak. Out of the three variables of register - field, tenor and mode – R/T registers emphasize the modal aspects perhaps more than other LSPs. Participants employ radio transmitters and radio waves to communicate across the vacuum of space. The use of radio transmissions places many challenges on communication and the technology, although effective, is far from perfect. Robertson describes R/T interaction in the following way:

> "The odds are heavily stacked against fail-safe R[/]T communications. Indeed, with physical impediments such as blocked frequencies and simultaneous transmissions which occasionally inhibit radio contact altogether, propagation noise, background interference, electrostatic noise, the far from ideal acoustic environment[…], (all of which contribute to the degradation of the signals received by the brain), it is astonishing that R[/]T is as effective as it is."
>
> Robertson (1987: IX)

Robertson also suggests that there is some dissatisfaction among users of Airspeak about R/T: "[T]he operational tolerances of this method of communication have been reached." (1987: VIII). She however notes that "we are nevertheless a long way from a sufficiently flexible or communicatively powerful data link for air traffic control which can replace human speech on R/T entirely" (ibid.). It is obvious that the Airspeak system is not perfect - accidents caused by human errors in communication still do occur – but currently no better system exists, and development of user skills and procedures is vital to improving it. R/T languages have developed fixed phraseologies to counter the modal constraints posed to interaction (Elder & Kim 2009). However, these phraseologies cannot reasonably cover all situations and therefore a degree of open-endedness must be allowed (Kukovec 2008: 130). The phraseologies nevertheless contribute to the rigidity of R/T languages.

The lack of non-verbal input in R/T situations has a marked influence on the interaction. A common R/T exchange adheres to a strict structure:

> "Firstly, a speaker initiates a transmission starting with [speaker] identification (call-sign) and facility identification to get the addressee's attention. Secondly, new information is presented by the speaker. Thirdly, the given new information is confirmed by the addressee by reading back the message ([i.e.] *readback*)
>
> Elder & Kim (2009: 23.3)

This is the standard procedure in most R/T languages, although register-specific variations may exist. Speaker identification has two purposes. It naturally tells the addressee who is speaking, but also alerts the addressee to the initiation of a transmission. Readbacks are used, because R/T technology cannot be fully trusted, as already discussed. It is notable that some R/T registers, like Astrospeak, do not seem to require a readback procedure at all times. The reasons for this are not entirely clear. In Airspeak, where a readback procedure is mandatory, the communicative space can be cluttered as several aircraft can be in contact with a single flight controller. In registers with closed radio loops, a readback can sometimes be excessive and may be replaced by a simple verification of reception. Overall, R/T is characterized by its inbuilt redundancy. The two most significant modal constraints for R/T languages are 1) the lack of visual contact between participants and 2) the reliance on R/T technology. To combat these constraints, R/T registers have accordingly taken forms which allow for a 'checks-and-balances' system in talk; an explicit pattern of readbacks and introductions which ensures proper participant orientation and reduces the possibility of missing transmissions inside a conversation.

Both Airspeak and Maritime English are specialized registers whose use is mandated and controlled by international organizations. Airspeak was developed by the International Civil Aviation Organization (ICAO), originally to combat the threat of incidents and accidents caused by communication errors. The need for a uniform register has been amplified by the fast grow of international air travel and consequently the presence of pilots and ground personnel with different mother tongues. ICAO mandates Airspeak use in practically all situations; even casual conversation between pilots is controlled by ICAO rules (BAA Training 2016). Maritime English has a similar background. Established as the industry standard R/T language by IMO (International Maritime Organization) in 2001 (IMO 2018), Maritime English officially takes the name Standard Marine Communication Phrases (SMCP).

As the name suggests, it is a highly controlled set of phrases for maritime operations. The name Maritime English is generally used to denote all maritime operations even beyond SMCP but still controlled by IMO regulations and common R/T procedures.

Unlike Astrospeak, Airspeak and Maritime English have been the focal points of numerous linguistic studies. A review of prior research shows that the main interest of these studies has been pedagogical. While these studies certainly have practical application value, they do not extend to a theoretical level as register analyses. The studies which have presented discussion outside pedagogical aspects (e.g. Breul 2013, which also offers a thorough review of past research into Airspeak) have suggested that the conflict between set phraseologies and required open-endedness means that R/T LSPs are inherently faulty. Even more theoretical studies into R/T languages seem to stress the importance of language training. It must be noted that this thesis will not attempt to offer a detailed analysis of Airspeak or Maritime English as distinct registers. Even a brief review of them, however, will help contextualize Astrospeak as a variety of English.

Maritime English and Airspeak are quite similar LSPs. Both use English as the source language for an internationally used lingua franca, both were created to assist transport operations, and both are coded by an international organization. It is obvious that Astrospeak contexts vary significantly from the others, but some similarities exist, nevertheless. All three LSPs must take into consideration the "inhospitable operational environment within which the language system must operate" (Robertson 1987: IX). In other words, all these registers function in a context which is in some way unnatural to humans, whether it is shipping, flying or travelling in space. While Maritime English and Airspeak exist in a multilingual environment as a lingua franca and Astrospeak does not, they all still feature a 'checks-and-balances' system in the structure of interaction to combat the hindrances of R/T use. All three LSPs are used in situations where humans operate complex machinery with high risk should that machinery fail. Additionally, these LSPs tend to have an in-built hierarchical system at least to some extent. Maritime English is often used directly between two or more ships, while Airspeak use between two airplanes is quite rare. The hierarchical system concerns operations with e.g. port authorities in Maritime

English, air traffic control in Airspeak, and mission control in Astrospeak. In all these registers, there are clear institutional roles which modify the interaction.

Many of the R/T specific constraints placed on Astrospeak were already discussed in chapter 2. A unique challenge for the participants was the distance between the spacecraft and Earth. This meant that radio transmissions, which are unreliable even in ideal situations, had a lot of garbling and drop-out. Moreover, the technology used was rather outdated by modern standards, although the basic qualities of R/T still remain the same. In comparison to Maritime English and Airspeak, however, Astrospeak had some benefits. First, the register is meant only for a closed system, whereas Maritime English and Airspeak are used in dynamic situations where participants move in and out of the conversation. For Astrospeak, the participants remain the same throughout the mission and their roles do not change. Second, participants in Astrospeak are native speakers of English who have an extensive training for their tasks. While Airspeak and Maritime English users are may have extensive training as well, they are often non-native speakers of English whose language training may be questionable. Finally, Astrospeak participants are in almost constant contact with each other, occasional antenna problems and flying behind the moon notwithstanding. In contrast, Airspeak and Maritime English users are in communication with each other for very brief periods of time. This requires the interaction to be very concise and efficient. While these qualities are certainly part of Astrospeak as well, the continued radio contact between participants allows for relative looseness in talk.

This chapter has been aimed at contextualizing Astrospeak in the field of specialized or institutional registers. The following chapter presents the theoretical foundation of the thesis by exploring CA frameworks in detail. First, the foundations of CA are detailed, and contrasted with analyses of institutional talk, i.e. ICA. The chapter then outlines the concepts of turn, turn-taking, conversational sequence and sequence organization. The most crucial sections of the chapter define two contrasting views on minimal sequence length, as well as provide some background on turn expansion. Overall, the frameworks established in chapter 4 will serve as the basis for the analysis later on in the thesis.

4 The foundations of conversation: turns and sequences

Conversation, in its simplest definition, is language used to interact between other humans. Liddicoat (2011: 2) describes conversation as the normal everyday activity that humans engage in and a process which enables societies to function. Schiffrin expands this to include conversation as "the method by which members of society produce a sense of social order" (Schiffrin 1994: 232). Its importance for social behavior is obviously remarkable, and thus central to numerous linguistic endeavors. Conversation analysis (CA) is a research approach interested in conversations as viewports to genuine human interaction. After being established by e.g. Harvey Sacks and Emanuel Schegloff in the late 1960's/early 1970's, CA has produced a wide array of studies which have helped to explain human behavior in interaction. Fundamentally, CA has been founded on the notion that talk-in-interaction "can be studied as an institutional entity in its own right" (Heritage 2009: 6). Heritage summarizes the aims of CA in the following way:

> "The basic orientation of conversation analytic studies may be summarized in terms of four fundamental assumptions: (1) interaction is structurally organized; (2) contributions to interaction are both context shaped and context renewing; (3) these two properties inhere in the details of interaction so that no order of detail in conversational interaction can be dismissed a priori as disorderly, accidental or interactionally irrelevant; and (4) the study of social interaction in its details is best approached through the analysis of naturally occurring data."
>
> Heritage (1989: 2)

CA research relies on these assumptions being true. Using naturally-occurring conversations, researchers aim to produce evidence about the organization of conversations. Most CA studies also concentrate on context as a modifying force – context accounting for not only the environment in which a conversation occurs, but also for the immediate local context of talk, i.e. what has been said in the conversation and how the participants orient themselves to it (Drew & Heritage 1992: 18). Schegloff (in Iedema 2003: 80-81) names these two "external" and "intra-interactional" contexts. In many CA studies, the focus is on the intra-interactional context of talk. According to Clayman & Heritage (2010: 14), the central question in CA studies is 'why that now?'; the pursuit of reasons behind people's choices when they converse with each other. Much of the research into conversations has focused on sequential organization, i.e. positioning of utterances inside conversation (Schegloff 2007: 2). The thesis adds to this body of research.

As stated above, CA has been employed in a wide array of studies. These studies have produced a set of basic concepts which make up the basic frameworks in the approach. These four concepts are summarized by Benwell & Stokoe (2006: 59-60). First, conversations are fundamentally constructed out of *turns,* utterances by people in interaction, which are arranged in interconnected sequences. Participants use turn-taking mechanisms to determine who speaks and when; a shared knowledge of these mechanisms is crucial for successful interaction. Second, *turn design* denotes processes which determine what constitutes a turn. This is directly related to the third concept, *participant orientation.* By conversing, humans try to achieve something, a "social action" (ibid.), so participants in conversation must orient themselves to what is being said. For example, if a participant asks a question, the other participant/s must orient themselves to the question and produce a meaningful utterance, in this case probably an answer. Hence, conversation is a product of its immediate conversational context which is a dynamic process, changing with each utterance. From this requirement of relevance, CA has established that conversations rely on *sequence organization*. Sequences are adjacent utterances which are interconnected for relevance; modules of conversation which propel the interaction forward. Turns form sequences, which are consequently organized systematically in talk. This thesis focuses on intrasequential organization, the relationship of single turns inside a sequence. The relationship between sequences is outside the scope of the work.

Traditionally, CA has explored 'ordinary' conversations; interaction that happens between humans who are not "confined to specialized settings or to the execution of particular tasks" (Clayman & Heritage 2010: 15). After initially focusing on phone call interaction (Arminen 2016: 184), Schegloff shifted his focus on what he calls "the primordial form of talk-in-interaction – conversation [whose] organization of talk […] is not subject to functionally specific or context-specific restrictions or specialized practices" (Schegloff 1999: 407). The studies into 'ordinary' talk have produced the basic concepts of conversation. However, research into conversations is not restricted to everyday chat. Another research tradition, Institutional Conversation Analysis (ICA), concentrates on interaction that is somehow restricted or specified because of its institutional dimensions (see section 3.1.2 for a detailed discussion and definition of institutional talk). ICA was established by Paul Drew & John Heritage in the seminal collection of texts *Talk at Work: Interaction in Institutional Settings* in 1992. Clayman & Heritage note that the aims of the two research traditions differ from each other. CA studies concentrates on generic conversational matters, such as turn-taking, while ICA focuses on the same natural interaction as a product of its connection to institutional considerations, "as something shaped by the concerns and exigencies of [the context]" (Clayman & Heritage 2010: 16).

Drew & Heritage outline "five major dimensions of institutional conduct" (1992: 28-29) which are of interest to ICA studies. The theoretical foundations for these are sourced from the generic conversational structures described by existing CA research. While other phenomena of interest may very well be identified, these five offer at least a starting point for ICA studies into restricted registers:

- Lexical choice: Specialized words and jargon that are common and suitable for a specific register
- Turn design: Selecting appropriate action and formulating its content according to domain-specific constraints
- Sequence organization: For example, how turn-taking is influenced by institutional considerations and how are sequence placed in interaction which is domain-specific
- Overall structural organization: The institutional influence of, for example, goal-orientation, procedural steps towards achieving something
- Social relations: The interactional asymmetry of participants, for example, may arise from institutional constraints on talk

This thesis' focus is placed on the sequence organization of Astrospeak. It is hypothesized to be explicitly influenced by the institutional constraints of spaceflight and spaceflight operations. The list above is not meant to be comprehensive; they are mere suggestions of possible connections of CA frameworks and institutional considerations. To be able to analyze Astrospeak, some crucial concepts of CA must be first reviewed.

As discussed, conversations are fundamentally structured in turns and sequences. The sections below discuss turns and sequences in detail. Later, two divergent views on minimal sequence length are compared. Additionally, turn expansion as a structural phenomenon is briefly discussed in section 4.3. The goal of this chapter is to explore common concepts and frameworks of CA, which are subsequently used in the analytical sections. The chapter concentrates on the theoretical foundations of interaction, not necessarily the practical differences of CA and ICA. Institutionality is so strongly associated with institutional context that these differences are considered only later in the thesis. Clayman & Heritage (2010: 16) note that this is standard in ICA studies, which is "[built] on [the] basic findings about the institution *of* talk". The comparison of minimal sequence lengths presented in sections 4.2.1 and 4.2.2 is central to the hypothesis of the work. In relation to the fundamental CA works on sequence organization, the chapter's exploration of turns, turn-taking, sequences and minimal sequences is undoubtedly limited. However, the frameworks discussed here are sufficient for satisfactorily achieving the analytic goals of the thesis. The chapter also provides a wide array of prior research for further reading.

4.1 The conversational turn

Although the main focus of this thesis is sequence organization of conversation, Heritage & Clayman note that "[s]equences are made up of turns and cannot, therefore, be completely analyzed without a major consideration of turn design" (2010: 45). Turns in conversation are utterances by a single participant, which, according to Schegloff, form "coherent, orderly, meaningful succession or 'sequences' of actions or 'moves'" (2007: 2). He adds that turns drive the conversation forward, creating sequences which then perform some role on getting activities completed. Turns are the key building block of conversation; they are the everyday utterances such as answers, greetings and interjections that humans use without any significant thought in all interaction.

Before moving on to the sequences, i.e. coherent series of turns which in turn drive a conversation forward, some key concepts concerning turns must be defined. This section explores two of these; turn design and turn-taking. First, the basic questions of turn design are concerned with turn content. A speaker must select the action they wish to take by uttering a turn in the conversation – to orient themselves to what has been said before and decide where they want to direct the conversation. After deciding on the preferred action, it must be put into words, i.e. the "verbal shape" (Drew & Heritage 1992: 34) of the turn must be decided upon. Second, the processes behind turn-taking must be adequately understood. Humans seem to be very capable in discerning when they are supposed to talk in conversation and how they signal to others that their turn is over. Schegloff (2007: xiv) posits that the fundamental questions regarding "the turn-taking problem" must uncover "who should talk next and when should they do so" (ibid.). Turn-taking processes have direct influence on the turn content itself, as they do not occur only in non-verbal terms.

Studies concentrating on turn design are aimed at uncovering the processes how humans decide on what they say in a turn. These processes may be lexical, grammatical or prosodic, or a combination of any of these (Gardner 2004: 264). The language choice depends on the local meanings of words or phrases, not necessarily on the literal interpretations of these constructions (Gardner 2004: 275). As conversations are a collaborative effort, it is sufficient that the participants agree on allowable input to a turn. Turn design is therefore functional. This functionality allows for a broad variety of inputs into turns. Schegloff (1996: 55) refers to the turn as the organizational unit of talk which 'houses' the grammatical structures which in turn form interaction. Schegloff's use of 'grammar' is purely descriptive; "the progressive grammatical realization of a spate of talk on a particular occasion can shape the exigencies of the turn as a unit of interactional participation on that occasion" (1996: 56). This is not to say that grammar, as it is commonly understood, does not exist in talk. The basic foundations of grammar still apply to participants as language users but for CA, the relevant grammar is formed in the interaction as a shared knowledge of allowable input.

As the variety of inputs is not restricted to lexical items (words or phrases), parts of turns are often called *turn-constructional units*, or TCUs (Schegloff 2007: 3). Schegloff writes that, in conversation, "TCU […] constitutes a recognizable action in context (2007: 4), meaning that a turn in conversation must have at least one TCU which serves some kind of purpose in the conversational context. A turn may contain multiple TCUs, but Schegloff notes that after the first TCU of the turn, the "transition to the next speaker can become relevant" (ibid.). This does not mean that a turn is finished or that a transition will happen, but that other participants are 'granted' a permission to orient themselves to a possible change in speaker. Schegloff (1996: 58) observes that for all participants in interaction, the "[m]anagement of the production of the turn or TCU […] is in substantial measure conducted by reference to the action(s) analyzable out of the turn-so-far". The speaker and other participants are able to infer TCU boundaries from what has already been said. This knowledge propels the conversation naturally forward as the contextual shaping of the interaction is often subconscious to humans. When a completion of a TCU offers a potential for a turn change, the mechanisms of turn-taking become relevant.

It is well-understood that interaction is a collaborative process. Participants share an understanding on the structures of talk in a way that speaker changes are handled naturally. As turns are constructed out of TCUs, it is obvious that they include a quality which informs non-speakers when it is allowable to take a turn. These processes are known as turn-taking. While conversations often 'break the rules' of turn-taking by having multiple simultaneous speakers or lapses in talk (i.e. silences), the implicit turn-taking mechanisms are so capable that, in most cases, satisfactory progress of interaction is achieved (Schegloff 2000: 3). Turn-taking was brought to the forefront in CA by Sacks, Schegloff & Jefferson in their seminal paper *A simplest systematics for the organization of turn-taking for conversation* in 1974. The mechanisms presented in the paper have been proven in numerous subsequent studies, although they have also been criticized on, e.g., critical and cultural grounds (Gardner 2004: 271). According to the paper, the findings are context-free, i.e. they are applicable to any conversations and are not bound by contextual considerations

(Sacks, Schegloff & Jefferson 1974: 699). First, some common characteristics of conversation are outlined. The paper notes, for example, that conversations can have multiple participants. There is no prior specified interaction length, turn content or distribution of turns. Finally, turn order and size also varies (Sacks, Schegloff & Jefferson 1974: 700-701). Many of these characteristics, in addition to the freedom-from-context, are challenged by institutional restrictions. The are discussed throughout the thesis.

After establishing some general characteristics of conversations, Sacks, Schegloff & Jefferson shift to outlining the mechanisms of turn-taking, i.e. how turns are organized in interaction. After uttering the initial TCU, a speaker may either continue speaking or a transfer to a new speaker may occur. Such boundaries are known as transition-relevance places or TRPs (Sacks, Schegloff & Jefferson 1974: 704). If no transfer occurs in the TRP after the initial TCU, and the current speaker continues, then the same decision about possible transfer occurs at the following TRP until a transfer has occurred or the conversation has ended altogether. If a transfer happens, then the rules reapply to the new speaker; the original speaker must refrain from interfering with the process. Overall, the rules governing turn-taking (ibid.) function in all conversations, although the nature of human behavior will obviously sometimes contradict them. Overwhelmingly, however, the basic structure of turn-taking exists as Sacks, Schegloff & Jefferson outlined.

TCUs alert participants that a possible turn transition is becoming relevant. They also have a role in determining who will speak next in the conversation. Schegloff briefly outlines two possible turn-taking processes regarding turn allocation (2007: 4). First, a speaker may produce a TCU that selects the next speaker by, for example, directing a question to a participant. This process shifts the focus on the addressee who is expected to provide an answer. Often, turns do not conclude with a clear speaker selection TCU, however. “If no one has been selected by a/the prior speaker, then anyone can self-select to take the next turn”, writes Schegloff (ibid.) A common process of turn-taking is that “the participants assume and assign speaker and recipient identities contingently as their talk unfolds” (Kasper & Wagner 2014: 191). The process is open-ended and negotiated implicitly by the participants. For institutional registers, turn-taking can be relatively fixed, for example in moderated discussions such as political debates (Sacks, Schegloff & Jefferson 1974: 701). Turns are not taken freely by participants because they are filtered by a moderator who decides who is allowed to speak and when a speaker must end their turn.

While it has been established that a single turn is the basic element of conversation, it is also clear that turns are not utterances separate from each other. In fact, turns need to have a connection to the conversational context to have any meaningful outcomes. Heritage reiterates the common foundational concept of CA which states that conversations, and single utterances inside conversations i.e. turns are both context-shaped and context-renewing/-maintaining (2005: 105). This means that a turn is influenced by the preceding turns as it orients itself. It must have this relationship, because arbitrary utterances with no connection to preceding talk usually do not make for a successful conversation. Conversely, the turn also renews or maintains context by somehow re-orienting the conversation for the following turn. Overall, a turn can be seen as a link in a chain; it must be connected to the preceding turn, but it also serves as the basis for the turn that follows it.

Turn design and turn-taking are conversational concepts which have been widely discussed in CA research. The discussion here is admittedly limited. While turn-taking mechanisms, for example, have an influence on sequence structure, the scope of the thesis will not allow for a lengthy analysis of this influence. Rather, the next sections are dedicated to the exploration of sequences as a conversational concept and a discussion on minimal sequences in talk.

4.2 Organization of turns: sequences

CA methodology is based on the idea that utterances are tied to the conversational context i.e. "CA examines what the action does in relation to the preceding action(s), and what it projects about the succeeding action(s)" (Heritage & Clayman 2010: 14). This fundamental relationship leads to the conclusion that turns are not purely separate entities but rather they are sequentially organized. In its simplest form, a sequence is a series of turns which has an identifiable start and an identifiable ending. They are brief but coherent packages of information-exchange between conversing humans. Schegloff differentiates between *sequence organization* and *sequential* *organization* (2007: 2). Sequential organization is a general term referring to "any kind of organization which concerns the relative positioning or utterances or actions". All conversations are sequentially organized as their components (TCUs, turns, sequences etc.) are placed in the conversation in a relative order (ibid.). Sequence organization is a subtype of sequential organization. It refers to the way turns, or actions, are placed in a relative order into "coherent, orderly, meaningful successions" (ibid.). For this thesis, the focus is on the sequence organization of Astrospeak; how astronauts and flight controllers put together turns to achieve institutional goals of flying to the moon.

If sequences are viewed as 'closed' packages of talk, they must consequently have a start and a finish. Opening of a sequence occurs when the prior turn indicates that the turn is finished and that no others are selected to address that turn. A new sequence starts when a participant self-selects to start speaking. This is a very simplified picture of sequence opening; indeed, the detection of sequence boundaries is arbitrary, related possibly to thematic construction. Schegloff (2007) notes, sequences are actions placed in an orderly succession. Therefore, it is not unreasonable to suggest that a sequence performs some action, and when this action is finished, so is the sequence. For R/T languages, sequence openings are easier to detect because R/T procedures often mandate a callsign procedure at the start of each transmission sequence.

One of the problems for recognizing clear sequence separation has to do with closing the sequences. Schegloff (2007) discusses types of constructions which mark that a sequence has ended. First, he explores unilateral and foreshortened sequence endings, which are characterized by abruptness (2007: 182) and ambiguity (2007: 183). Schegloff concludes "that unilateral and foreshortened endings are not a viable way of ending sequences" (2007: 186). For the purposes of this thesis, the notion of "dedicated sequence-closing sequences" (ibid.) is much more interesting. In short, these are types of sequences which contain a collaborative device directing the sequence towards closure; the initial turn "serves in effect to propose the possible closing of the sequence" (Schegloff 2007: 186), and in the responsive turn, "[c]ollaboration is implemented by producing whatever response to the prior turn would achieve agreement or alignment with the action/stance displayed in it; that is, a preferred response" (2007: 187). This means that if an agreement/alignment to the initial turn by the responsive participant is satisfactory to the initiating participant, the sequence is closed. As in sequence opening, closing of sequences is also easier to identify in R/T registers. As the communicative structure is rigidly set, it must also contain procedures to end a sequence. For this thesis, the ending of R/T sequences is crucial; it is suggested that each Astrospeak sequence closes with a verification turn, i.e. a confirmation of reception of the preceding transmission.

The view that turn-taking causes conversations to be sequentially organized is not universally accepted. Cowley (1998) criticizes structuralist views of conversation, especially the widely referenced turn-taking paradigms presented by Harvey Sacks et al (1974). He sees the structuralist paradigm rejecting important facets of communication such as prosodic and visual elements, concentrating only on the surface level of audible utterances (1998: 544). Cowley argues that the structuralist stance does not possess meaningful evidence and therefore "[s]ince there is no turn-taking mechanism, it is mistaken to theorize conversations as sequences of specifiable types of unit" (ibid.). This argument results from a fundamental objection to turn-taking as a linguistic concept altogether. For example, Cowley argues that "conceptualizing talk as turn-taking […] detaches conversations from relationships, motives, reasons, and concurrent events." (1998: 546). These arguments seem to suggest that traditional structuralist approaches to conversation do not account for participant hierarchy or context. While CA studies have often concentrated in tracing generic conversational practices, ways of conversing which are not contextually bound, it would be dishonest to state that contexts are irrelevant for structuralists. Even so, the ICA approach explicitly takes the contexts and hierarchies of conversation into consideration, an alteration accounting for a perceived lack of such consideration. Cowley's criticism seems to gravitate towards objection to turn-taking as a universal constant because he does accept that meaningful conversations are constructed of sequential unit types (1998: 599), partly contradicting himself.

Some of the criticism towards traditional CA approaches points to the failure of taking the complexity of human interaction into consideration. The data used for this thesis have some beneficial qualities relating to those criticisms. First, turn-taking mechanisms are often explicit because the data shows multiple turn-concluding and -initiating constructions, effectively telling the other participant that the turn is finished. Second, the R/T restrictions and requirements discussed in the previous chapter call for unambiguous messages which do not allow for meanings to be negotiated in talk. The turns must be concise and clear, to combat the challenges presented by R/T. Finally, Astrospeak lacks some of the natural extralinguistic features of interaction such as visual cues, so they do not have to be considered when analyzing the sequential nature of radio transmissions. These are all discussed further in chapter 6. Accepting that conversations *can* be analyzed as a flow of sequences, the following sections discuss the fundamental construction of them, concentrating on two conflicting approaches to minimal forms: Minimal two-turn adjacency pairs and minimal three-turn sequences.

4.2.1 Minimal two-turn adjacency pair

Although sequences can be quite long, with several layers of expansion (see section 4.3), many researchers believe that the unexpanded basic structure in sequence organization is the adjacency pair. The structure of an adjacency pair is quite simple. It consists of two turns by different speakers which are placed adjacent to one another. The turns have a relative order in which the first turn initiates the exchange and the second turn is a response to the first turn. Finally, these two turns have a *pair-type relationship* which means that for successful interaction, the second turn type must have a direct relationship with the first turn type (Schegloff 2007: 13). While expansions and interferences may cause adjacency pairs to take flexible forms, the key structure of two parts in direct hierarchical relationship still remains.

An adjacency pair starts with the first turn, or an "F" (2007: 13). These turns initiate the sequence and thematically position it in relation to the wider conversational context. Second turns, or "Ss" (2007:13), are by nature "responsive" (*ibid*.) to the preceding turn which initiates the minimal pair construction. The content types of these turns vary in accordance with the initial turn contents in a logical pair-type relation. These utterances form natural pairings "such as greeting-greeting, question-answer, offer-accept/decline" (*ibid.*), and thus the response turn is partly dictated by the type of the initial turn. The relationship of these turns is not always uncomplicated. For example, the turns can be expanded, seemingly breaking the pair, if certain situations arise (see section 4.3). The immediate adjacency may be broken but the pair-type relationship dictates that the sequence is not satisfactorily closed until the response turn is produced. Pair-type relationship is a vital element of interaction on the structural level; without such a relationship, turns in conversation would not construct a larger block of successful communication.

Although it is very common for an adjacency pair to expand into a longer sequence than two pair-type related turns, many adjacency pairs do exist as a clean two-turn form that forms the entire sequence. Schegloff presents the strictly formulaic opening and closing sequences of conversations as an example (2007: 22). He continues by observing that evidence, although inconclusive, suggests that unexpanded minimal pairs are prevalent in conversational contexts in which "the participants are committed to co-presence by an event structure not shaped by the interaction itself" (2007: 26). These are situations which are characterized by long pauses in conversation and intermittent brief exchanges. The minimal pair can be referred to as the "base pair", indicating that it is the unexpanded sequence form. In reality, the base pair is often expanded by pre-, insert, and post-expansions (see section 4.3). The relationship between F and S is ultimately the most crucial aspect of a sequence, whether a minimal pair or an expanded sequence. The initial utterances direct the response turn towards a pair-type related answer; it has to be, then, that the initial speaker expects a certain kind of answer.

Most Fs allow for a variety of responsive turns, requiring only that they are relative to the initial turn (Schegloff 2007: 58). For example, an acceptable response to a request to do something can be a refusal, an acceptance, or a question requesting reasons for the request. Schegloff moves on to argue that because sequences are made to accomplish something, performing an action, the speaker of the initial turn has a preferred response (2007: 59). Under this preference organization, all possible responses are not equal. As an example, Robinson & Stivers (2006) explore the preferred responses to questions:

> "The evidence that an answer is the alternative preferred over a non-answer response takes several forms. First, answers are the most common category of response to information questions. Second, the turn shapes of answers and non-answer responses reflect their ranking as preferred and dispreferred categories of response. Third, interactants typically treat non-response as indicating disalignment rather than indicating that no response will be forthcoming. Fourth, speakers do interactional [work] to provide answers, despite non-answers being a readily available alternative category of response."
>
> Robinson & Stivers (2006: 371)

The example above summarizes well the central idea of preference organization. This process affects all conversations and most adjacency pair types. Schegloff also notes that some Fs place a restrictive effect on the S. Greetings, for example, are assumed to be responded to by a return greeting (2007: 58). This rigidity has some intriguing characteristics when the sequence structure of Astrospeak is explored. Details will be provided in chapter 6, but the initial turns in Astrospeak structure seem to place clear restrictions to the responsive and the verification turns.

Schegloff argues that "in its minimal, basic unexpanded form an adjacency pair" consists of two turns (2007: 13). While this has been proved to hold true in many studies, the argument is actually meant to refer to a general scope. He continues to note that some prior studies have suggested that the unexpanded basic sequence consists of three turns. That is also the hypothesis of this thesis. Schegloff argues that these studies "represent but one configuration of sequence organization" (ibid.) and that these registers show a three-turn minimal sequence because of domain-specific interactional considerations. As the thesis is focused on a restricted register whose modal dimensions are shown to favor redundancy and repetition, studies arguing for a three-turn minimal sequence become intriguing. This longer minimal sequence structure is reviewed next.

4.2.2 Minimal three-turn sequences

The discussion above concentrated on the well-established arguments that basic conversational sequences, without expansions, consist of a pair of turns. However, a competing view championed by some scholars is that some types of adjacency pairs must be fundamentally amended with a third turn. Schegloff writes about this:

“Some students of talk-in-interaction take the basic minimal size of a sequence to be *three* turns […]. From this point of view, two-turn sequences are elliptical; they are missing something, ordinarily their third turn.” (2007: 22). He continues to note that, analytically, such stance requires the explanation of a lack of the third turn in minimal pair sequences. Schegloff himself takes the stance which considers the third turns in minimal sequences to be minimal expansions. To recap, a minimal sequence is a sequence which is the unexpanded minimal form in the register. All expansions and breakdowns of adjacency must refer back to the minimal sequence. This thesis takes the alternate position to Schegloff's; the hypothesis is that Astrospeak's preferred minimal sequence is formed of three turns. The exploration of this claim will be provided in chapter 6.

Researchers have uncovered several registers which show a preference toward a minimal three-turn sequence. One such pattern can be detected in classroom talk. The QAE (question-answer-evaluation) sequence (Mehan 1979 in Kevoe-Feldman & Robinson 2012: 235) consists of three turns, with the third turn being an essential part of the sequence. They note that “regardless of whether students' second-part answers are correct or incorrect, teachers are strongly accountable for somehow claiming acceptance/rejection of such answers” (ibid.). The institutional dimension of talk has a strong influence on such sequences because the role of teacher does require some evaluation of the answer utterance. In fact, most studies calling for a three-turn minimal sequence seem to have an institutional dimension.

Another study presenting evidence of a three-turn minimal sequence was done by Heidi Kevoe-Feldman and Jeffrey D. Robinson (2012). In it, they found that in certain instances, interaction between customers and an electronics repair shop showed a fundamental three-turn sequence structure. Besides having similarities to the thesis at hand by presenting institutional interaction as a key reason for three-turn sequences, the data was also influenced by modal requirements as the study explored phone calls. The scope of Kevoe-Feldman & Robinson's study was very limited; the interaction between the participants in their data occurs in a rigid form of a status solicitation, a response and finally an acceptance/rejection of said status (2012: 222). Furthermore, they note that “[t]urn

3 is *not* a feature of *all* courses of action in the present […] context, but rather particular to that of status solicitation" (2012: 223), meaning that the argument for an elemental third turn cannot be extended to other types of sequences between the participants. Although Kevoe-Feldman & Robinson's analysis is restricted to single course of action, it does serve as evidence that institutional registers have contexts which seem to require a three-turn minimal sequence.

The elemental third turns argued by some researchers seem to be often placed following the initial and responsive turns. Therefore, the first two turns in the three-turn sequence are in accordance with the minimal adjacency pair types. The fundamental nature of the final turn is of closing. Closing the sequence is naturally discussed at length by advocates of adjacency pair structure. If a closing turn would be elemental in every register, people would exhaust time with mundane turns specifically closing the sequence, when it was embedded in the responsive turn all along. However, pair-type relation obligations can be seen extending to an essential third turn in some cases. Some initial turns might launch a minimal sequence where a third turn is consequential. It is worthwhile, therefore, to aim at recognizing the turn types which require a third turn. Schegloff, who proposes that the general minimal sequence is the adjacency pair, observes the prevalence of three-turn sequences, but places the final turn under the header "minimal expansion". For him, simple third turns which complete the sequence are "sequence-closing thirds" (Schegloff 2007: 118); turns which are used to drive the interaction towards sequence closure. The simplest examples Schegloff discusses are tokens such as 'oh' and 'okay', utterances which contain very little information but emphasize sequence closure (ibid.). Some linguists, however, have taken a competing position by noting that certain third turn utterances are not purely simple tools for managing conversation, but rather contain some important information or input regarding the contiguous sequence. Research by these linguists argues that Schegloff's rejection of third turns as a simple post-expansion fails to recognize their importance for the interaction.

Before the thesis moves towards an exploration of Astrospeak data to see whether its sequence structure shows a preference for a three-turn minimal sequence, a brief note about turn expansions needs to be given. While pre- and insert expansions are not central to the CA approach of the thesis, they offer important contextual information for Astrospeak description. The findings related to them emphasize the R/T restrictions placed on Astrospeak. Expansion in the post-position, however, provides the key discussion points for minimal sequence length: If the analysis can show that a third turn in the sequence serves an important communicative purpose and it is prevalent in the data, then it must be accepted that a sequence containing only a minimal pair is somehow incomplete.

4.3 Turn expansion

It is obvious that turns and sequences do not exist in normal talk in a formal, strict structure as human interaction tends to be quite fluid. The definitions of expansion types follow the outlines presented by Schegloff (2007), with special emphasis and discussion on the nature of expansions in the post-position. The three types of expansions discussed by Schegloff are pre-expansions, insert expansions and post-expansions. In Schegloff's text, these expansions are related to the minimal adjacency pair paradigm; possible third turns are considered post-expansions by him. Expansions will be discussed separately, in relation to the data excerpts, in the analytical section.

Pre-expansion refers to utterances which precede the F in a sequence. Schegloff notes that "[v]irtually all pre-expansions are themselves constructed of adjacency pairs" (2007: 28). By nature, pre-expansions serve a preliminary purpose, by for example alerting the addressee to the initial turn utterance. One such instance might be calling for a friend in a crowded room, waiting them to acknowledge you and only then initiating the sequence proper. Schegloff lists pre-expansion types such as pre-invitation, pre-offer and pre-announcement in his work (2007: 29-37). All these expansions serve a particular role in relation to the base sequence; a pre-invitation may, for example, query whether the addressee is occupied, which in turn is followed by an invitation to join the speaker somewhere. Like pre-expansions, insert expansions are often in a sequential organization, as well. They are placed between the F and S in the base sequence to, for example, gain some additional information related to the first turn. Schegloff (2007: 97) notes that insert expansions are usually initiated by the addressees of the base pair first turn. The addressee may clarify some information in the first turn by asking an expanding question, which is consequently responded to by the initial speaker. These expansions help participants to orient themselves accordingly to the ongoing sequence, without having to initiate a totally new sequence after the original sequence has been completed.

While pre- and insert expansions serve different roles in Astrospeak, the major considerations should be placed on post-expansions. As discussed earlier, the conflict between two- and three-turn minimal sequences seem to be analytically placed on the nature of the third turn. While several studies have shown that a third turn may serve crucial communicative purposes, making it an elemental part of the minimal sequence, some dispute the universal applicability of this. Schegloff argues that proposing this requires analytic accounting (2007: 22). He proceeds to suggest that turns which follow the base pair by closing the sequence are “sequence-closing thirds” or SCTs (2007: 118). For Schegloff, these are always redundant; a sequence can, and often does, conclude at the end of the response turn. Indeed, many sequences which consist of a set minimal pair (e.g. greeting-greeting, question-answer) do not require anything additional after the second turn. If an SCT is applied, this is “minimal post-expansion”; a simple addition which “is designed not to project any further within-sequence talk itself”. Rather, they are devices which move towards closing the sequence in various ways. A minimal post-expansion can, for example, be an evaluation of the response turn utterance by the initial speaker. Schegloff notes that post-expansions can be found after both preferred and dispreferred Ss; their interactional input shifting according to context.

The thesis applies the idea of SCT for the analysis. However, it argues that SCTs in Astrospeak are not post-expansions, but rather elemental parts of the sequence. Third turns in Astrospeak seem to move the sequence towards closure, but they also seem to carry important contextual weight. Therefore, the thesis is aligned with studies such as Kevoe-Feldman & Robinson (2012) in hypothesizing that the elemental sequence structure of Astrospeak consists of three turns. To satisfy Schegloffians who call for analytic accounting of the third turn, the thesis must shift to the analytical section of the thesis. First, however, the data and methodological approaches of the analysis will be reviewed in chapter 5.

5 Data & methodology

This chapter of the thesis presents the data source and the methods which will be used in the analysis in chapter 6. First, section 5.1 outlines the background of the data source and provides some discussion on how the data is selected for the analysis. This section also explains the technical features in the data and presents how the data is treated in the analytical chapter. Section 5.2 presents some key methodological aspects of the study. First, the lessons from chapter 4 are used to discuss institutional conversation analysis in relation to the data. The discussion argues that ICA studies must be grounded in the exploration of generic conversational phenomena, as in 'ordinary' CA, but that the understanding of the institutional context has to be considered concurrently with the language data. Second, the concept of register analysis is discussed and critiqued, but it is also shown to have beneficial qualities for the analysis, especially in relation to handling the data in text excerpts.

5.1 Data

The transcripts are lifted from one of the full transcript documents provided by NASA. The chosen document is the *Apollo 12 Technical Air-to-Ground Voice Transcription, November 1969,* referred to under the excerpts as *AS12_TEC.* There are other types of transcripts provided by NASA, as well, but the air-to-ground transcripts are the best for this thesis because they contain all the radio communications between mission control and the spacecraft crew. Other types of transcript documents provided either introduce a public affairs officer's commentary among the transcripts or contain only the recorded communications inside the spacecraft, potentially omitting some of the interaction on the communication loop. The technical aspect of the document means that the transcript was originally made for the purposes of reviewing technical facets of the mission by engineers. This also explains the relatively minimalistic annotation, which in transcripts made for linguistic purposes would be much more precise and elaborate. The website contains technical air-to-ground transcripts from every lunar flight in the Apollo program, but because they are all over 1000 pages long, only one of them can be reasonably explored in the framework of the thesis. The Apollo 12 transcript was chosen at random because all the transcripts are very similar and thus the randomness is not a restrictive factor in the successful completion of the study. The study could be replicated with similar excerpts from all the other flights' communication transcripts.

The data consist of three columns of information: The series of numbers marks the time of transmission in MET (mission elapsed time, i.e. time from launch) in days/hours/minutes/seconds, the middle column identifies the speaker (CC for mission control, CDR for commander, CMP for command module pilot, LMP for lunar module pilot and MS for multiple speakers), and the last column contains the actual transmission. Here is an example of how the transcripts are presented later in the analytical chapter:

01 09 17 47	CDR	Hello, Houston, 12.
01 09 17 50	CC	12, Houston. Go.

Excerpt 1 (AS12_TEC p. 137)

The primary focus of the chapter is naturally on the third column; the transcribed utterances themselves. The MET timecode is occasionally used to denote a specific utterance. The speaker column is occasionally used to underscore institutional role influences on the interaction (see chapter 2 for details). The document also includes a few additional annotation markings in the transcript column:

> A series of three dots (...) is used to designate those portions of the text that could not be transcribed because of garbling. A series of three asterisks (***) is used to designate those portions of the text that could not be transcribed because of clipping caused by the VOX mode. One dash (-) is used to indicate a speaker's pause or a self-interruption, and subsequent completion of a thought. Two dashes (- -) are used to indicate an interruption by another speaker or the point at which a recording was abruptly terminated.
>
> NASA (2010: 2)

Using excerpts which include a lot of garbling or clipping annotations is generally avoided to ensure that the conversational sequence is understood correctly as it happened in the transmissions. Additionally, interruptions may hinder the sequential analysis by effectively blurring the turn boundary, so transcripts which contain these are avoided, as well. The text excerpts are incorporated in to the thesis as images of the PDF document to preserve the original form of the transcript and assuring that no clerical errors are made in typing the transcripts by hand. The thesis relies on the transcriptions accepting that they might contain inaccuracies or errors. Errors in transcription are not very significant to the aims of the thesis because turn type distinction can be observed with the help of contextual clues. A detailed understanding of turn content is irrelevant for the thesis.

The analysis is conducted using relatively simple data excerpts from the entire transcript document. It must be noted that most Astrospeak discussions are intertwined; a new sequence is initiated often by the person uttering the third-turn verification. The data excerpts perhaps indicate unnaturally clear sequence boundaries. While the transcript format does seem to favor this, many examples can be found in which the boundaries are less clear. This boundary clarity was pursued to assist in the analysis. It does not inhibit analysis in any way – similar patterns are found in excerpts where turns blend into each other inside a single transmission. Rather, this decision was taken to make the arguments of the thesis as clear as possible for the reader. The excerpts are not altered in any way, and while the observation of sequence boundaries is undoubtedly subjective, the excerpts are represented as they are in the transcript. Each faulty representation of data must be attributed to a clerical error by the author.

The scope of the thesis does not allow for a review of every utterance transcribed and certain actions must be taken to limit the amount of data examined in the following chapter. In practice, this means discarding parts of the transcription for various reasons. The first sections to be discarded consider the initial stage of the flights, from achieving Earth orbit to early phases of translunar flight. This is done because the radio transmissions are intermittent at this stage of the flight; the spacecraft's proximity to Earth means that a continuous signal cannot be supported (due to the revolution of Earth among other reasons). Only when the spacecraft gets further away, telescope antennae can support a continuous signal. The thesis also rejects passages of the transcripts where the astronauts are in two separate spacecrafts and communicating simultaneously. The transcripts are not flexible enough to reasonably separate conversational patterns in such a multi-faceted communicative context. The restrictions and possibilities of drawing inferences from a relatively small sample size of text excerpts is discussed, among other issues, in the next section.

5.2 Analytical methods

Selecting a viable analytical approach for the thesis is a challenge. While ICA studies are rooted in established CA frameworks, it has been determined that recognizing the institutional aspects of a register requires careful institutional context analysis. This may be amended with the methodologies of register analysis to underscore the importance of talk-in-context and especially the modal restrictions placed on Astrospeak. A combination of three separate methodological approaches – CA, ICA and register analysis – will provide a solid foundation for the thesis. The theoretical frameworks are primarily supplied by the sequential analysis tradition inside CA. These were reviewed in detail in chapter 4. Institutional influence and specialized registers were discussed in chapter 3. This section will first briefly review how conversation analysis can be adequately used for institutional registers. Then, the focus is placed on exploring register analysis as a methodological tool. This section offers a discussion about the suitability of register analysis for studies such as this one.

As mentioned earlier, the data used in the analysis has not been subjected to prior linguistic research. By furthering understanding about a certain register of English, the thesis is intended to provide a starting point for future research into Astrospeak. The thesis is *not* intended to provide a comprehensive description about the nature of Astrospeak as it is primarily concerned about the sequential structure of interaction in it. Matthiessen argues that, in addition to the theoretical approaches to register, it is important to "develop many more extensive accounts of registers" (2015: 1). For his "registerial cartography" (ibid.) project, this thesis opens a new variety to map further. Moreover, Herke et al. suggest that relatively few studies have performed "descriptive work genuinely based in the notion of register as elaborated by Halliday" (2008: 188). This seems to indicate a gap in research, which the thesis aims to fill.

The primary focus of ICA is placed on the institutional context modifying talk, or “the operation of […] social institutions *in* talk” (Clayman & Heritage 2010: 16). While context is an important dimension of all registers, its role is emphasized in conversations whose form is restricted or otherwise modified by the specialized environment in which it functions. Context and linguistic evidence must, however, be viewed in direct relation to each other. Arbitrarily explaining linguistic phenomena as results of contextual influence is in complete. Arminen calls for understanding the context and hence its consequences for language form:

> “[Researchers] need to examine the context's procedural relevance. In terms of methodology, this focus on procedural relevance provides criteria and a toolkit to avoid arbitrarily invoking a countless number of extrinsic, potential aspects of context. However, in order for the analyst to use procedural consequentiality as an analytical criterion, s/he must have sufficient knowledge of the context in question.”
>
> Arminen (2016: 31)

This requisite is satisfied in the thesis by chapter 2, in which the spaceflight context of Astrospeak was explored in detail. Therefore, a satisfactory understanding of the Astrospeak endeavor is gained and the analysis can be directed at relevant phenomena. In practice, research into institutional register has two concurrent paths: First, regular conversation analytic goals of identifying structural organization have to be met. This means identification of conversational practices, i.e. features of talk which are recurrent, specifically positioned in a sequence, and tied to a specific interpretation/consequence (Clayman & Heritage 2010: 16). This will be the basic approach of the analytical chapter. Secondly, the analysis must present the participants’ institutional orientations or, at minimum, “[the] constraints which are institutional in character or origin” (Drew & Heritage 1992: 20). Identification of institutionally relevant structures can be challenging but again, understanding the institutional context and, for example, the modal restrictions placed on talk will assist in this. Overall, the data excerpts are chosen following Léon’s guidelines: “From a methodological point of view, the language under description should be a text, the transcription of the raw empirical material. In addition, the language under description should be contextually determined so that each restricted language has a discursive definition" (2007: 14). In this thesis, the definition is extended only to sequential organization, not all facets of the register.

While Astrospeak's institutional qualities are relatively easy to identify based on contextual knowledge, their influence on the linguistic form is still unclear. Some phenomena are rooted in the institutional roles of spaceflight, whereas some are connected to the modal restrictions of R/T. Overall, however, these forms make up the register features of Astrospeak. In chapter 3, register was explained as a variety of language used according to contextual requirements. To form a description of Astrospeak as a register then, and not an arbitrary collection of linguistic phenomena, the thesis employs *register analysis,* the analysis of context-specific varieties of language. Biber & Conrad (2009) offer a good methodological basis for this. This approach necessitates the "identification of the pervasive linguistic features in the variety" (ibid.) to draw conclusions about the nature of the register. These pervasive linguistic features are not limited to any one of the facets of language, i.e. grammar, lexis, phonology etc. The pervasive features can exist on all levels of language. For this thesis, the focus is on conversational practices – reoccurring sequential organizations which have a context-specific dimension. Another possible pervasive feature in Astrospeak could be, for example, the use of abbreviated lexis.

Register analysis allows for a variety of language to be examined through a collection of text excerpts (Biber & Conrad 2009: 6), not only complete texts. This has obvious advantages for the thesis, as the data resource is very large and difficult to grasp in its entirety. The approach relies on finding the linguistic features which occur in the register relatively often. For example, the analysis will show that while Astrospeak does not always use a three-turn minimal sequence, that feature is still very prevalent. Full texts are not needed to detect this; a group of transcript excerpts will offer a sufficient resource for evidence. Fundamentally, Biber & Conrad argue, register analysis works on three levels: The linguistic level, the contextual level and the functional level (2009: 6). On the linguistic level, the language forms of registers are described, whereas the contextual level refers to the situation in which the register is used. The final level of register analysis combines the first two; a register possesses certain linguistic features because they are well-suited for the register's context. This relationship is central to the approach and thus, for

Biber & Conrad, “the third component of any register description is the functional analysis” (ibid.). One might notice the similarity of this approach to the approaches outlined in relation to ICA. As the emphasis of the analysis will equally be on the linguistic evidence and the contextual constraints, the foundations of register analysis seem to be directly applicable to the overall goals of the thesis.

In prior research, register analysis has been contrasted with genre analysis. As Flowerdew (2011: 139) notes, genre analysis has a strong connection to the study of LSPs. While the concepts of register and genre overlap in many ways, the two research traditions serve different roles. According to Yunick, genre analyses have a more detailed approach to communicative events and their social context, whereas register analyses are more general and descriptive works (1997: 324). Bhatia (1993) criticizes endeavors in register analysis for failing to explain the reasons behind the use of the linguistic features that have been uncovered (1993: 6). He commends studies which aim to produce some evidence about a linguistic feature in a register but proceeds to note that “they tell us nothing whatsoever about the aspects of the variety these syntactic elements textualize or to what purpose such features are markedly present or absent in a particular variety” (ibid.). For proponents of genre analysis, register analyses lack important observations of the contextual restrictions placed on talk.

The selection of register analysis as the methodological basis for the thesis is grounded in the research questions. While the thesis is primarily concerned with Astrospeak as a distinct variety of English, another dimension of the study is to contribute to field of ICA. Prior ICA research has shown that the sequence structure of conversation is fundamentally different in institutional talk and ‘ordinary’ talk. The hypothesis is that Astrospeak shows similar institutional structures regarding the three-turn minimal sequence. While genre analysis would allow for a detailed variety-analysis based on context, register analysis can offer results which are more applicable to generalizations. In contrast, genre analysis can only focus “on the conventional structures used to construct a complete text within the variety” (Biber & Conrad 2009: 2) in addition to observing features which might not be common in the text at all. Yunick notes that genre analysis is limited in its ability to differentiate distinctly context-specific constructions from more general ones:

> "The study of genres *qua* language events gains much in the explanation of human teleologically organized linguistic behavior - but still other types of analysis are needed to explain general patterns which determine the set of choices within which particular purposes are expressed."
>
> Yunick (1997: 325)

The choice of register analysis seems, therefore, valid. The analysis attempts to uncover a structural sequence which has been already detected in other institutional registers. If the analysis was to be limited to a genre analysis, such connections could not be reasonably made. In addition, Biber & Conrad's position on register analysis (2009) allows for the data to be examined in text excerpts, not as a complete text. Finally, Yunick posits that while register is a well-defined concept in the Hallidayan model of discourse (see chapter 3), genre seems to lack a proper theoretical status (1997: 327). The criticisms of register analysis, however, offer a good source for amending the register analysis approach with detailed and concurrent review of communicative context. It must be noted that the concurrent analysis of linguistic form and context is central to all ICA studies (Drew & Heritage 1992: 20).

The discussion on the suitable analytical methods for the thesis must be grounded in the data. The nature of LSPs has brought up questions regarding the nature of analytical tools applied to them. Gotti and Giannoni argue that researching restricted languages requires specialized linguistic tools because the data itself is so different from other varieties of language:

> When applied linguists deal with vocational discourses, they are faced with a double challenge: on the one hand, the need to account for textualisations which are often alien to the general language; on the other hand, the need for analytical tools designed specifically for their investigation. The analysis of specialized discourse calls therefore for a specialized discourse analysis.
>
> Giannoni & Gotti (2006: 9)

Giannoni and Gotti argue that because LSPs are explicitly tied to their contexts of use, generalized analytical tools may fail to provide adequate descriptions about them. A contrarian view argues that this is backwards logic: LSPs are a continuation of natural languages and therefore subject to the same patterns as 'ordinary talk'. Specialized analytic tools will probably produce specialized patterns in language – heuristically applying general analytic tools could be more beneficial in emphasizing the differences between restricted and unrestricted registers. The development of specialized tools for specialized language analysis could lead to insufficient recognition of the direct relationship of an LSP and its source language. LSPs are named as such for a reason; using specialized approaches might undermine the special characteristics because they are not contrasted with the 'ordinary'. In other words, specialized tools for specialized tasks produce unusual results.

This thesis follows the general CA frameworks discussed in chapter 4. ICA builds on these frameworks as generic structural phenomena, only to amend the approach with the analysis of institutional context (Clayman & Heritage 2010: 16, Drew & Heritage 1992). This does not mean that it is the only possible approach, and the chapter 7 will discuss the need for a formation of new ICA frameworks and tools to understand LSPs better. The formation process, however, is far beyond the limitations of this thesis, and thus a standard CA approach is used. By using a traditional sequential approach, the analysis can also provide a good basis for contrasting LSPs with 'ordinary' talk. Register analysis offers a perspective to understanding a register based on lexico-grammatical evidence (here, minimal sequences). As a register analysis, the structural approach is amended with concurrent exploration of the conversational context. This amalgamation of approaches allows for a detailed analysis of the register's sequential structure, the reasons for the structure's existence and, later on, the relationship of specialized languages and CA frameworks.

The rest of the thesis is dedicated to the analysis of Astrospeak transcript excerpts. In chapter 6, the excerpts are presented and discussed in three main sections, each devoted to a single turn inside a presumed three-turn minimal sequence. Additionally, related expansion types are reviewed. So that the arguments are reinforced, the chapter will also discuss violations of this hypothesized minimal sequence structure. The chapter relies on the concepts of CA, which are amended with institutional and contextual considerations. Thus, the goals of register analysis and ICA can be satisfactorily attained. Chapter 7 is dedicated to a discussion of the findings of chapter 6. In it, the relationship between CA and ICA are discussed in relation to Astrospeak evidence. Finally, the thesis is brought to a conclusion in chapter 8 by summarizing the thesis and providing some suggestions on future research. Next, the thesis moves to the analysis of Astrospeak transcripts.

6 Analysis

So far, it has been established that 1) human spaceflight poses unique challenges to interaction, 2) Astrospeak use has institutional characteristics which influence the register form, 3) R/T procedures are necessary for communication, but they severely restrict communication, 4) CA presents a thoroughly reviewed theoretical background for institutional register analysis, and 5) commonly accepted CA theories may not fully adhere to the practical findings in LSPs such as Astrospeak. The analytical sections will be built on these foundations. This chapter offers a detailed analysis of minimal structures in Astrospeak transcripts, using the Apollo 12 Technical Air-to-Ground Mission Transcript (NASA 2010) as the primary source for evidence.

The main hypothesis of this thesis is that Astrospeak transcripts show a preference towards a three-turn minimal sequence. This is explained by the institutional and modal restrictions placed on interaction. The theoretical background for this construct was reviewed in section 4.2.2. Sections 6.1, 6.2 and 6.3 are consequently dedicated for examining the first, second and final turns of a minimal sequence respectively. The hypothesis is contrasted throughout the analytical sections with the minimal pair argument discussed extensively in chapter 4. The last section of the chapter, 6.4, explores possible violations of the three-turn minimal sequence and their relationship with the original hypothesis. To satisfactorily address the hypothesis, it is vital to consider the conflict between arguing for elemental three-turn sequences and for minimally expanded adjacency pairs. It can be difficult to satisfactorily differentiate between the two sequence types. This chapter, however, builds on the three-turn minimal sequence argument because it’s prevalence in Astrospeak can be explained by contextual and procedural evidence.

Minimal expansion and adjacency pair evidence are discussed in chapter 6.4 as well as throughout the preceding sections in cases where necessary.

Secondary matters discussed throughout these sections are turn expansions in all three positions (pre-, insert and post-positions), as well as the restrictions placed on interaction by R/T and spaceflight context and how they manifest themselves in the sequential structure of Astrospeak. Expansions are highlighted to provide support for the three-turn minimal sequence, especially in the post-position, where data is examined in detail to show that in certain cases, the third turn of a sequence is not an expansion but an important and elemental part of the sequence structure. This phenomenon is intertwined with the contextual and modal influences of Astrospeak as a R/T language and therefore those influences must be addressed, as well.

The main research questions this chapter hopes to answer are: **1) What is the fundamental sequence structure of Astrospeak interaction?** and **2) How does the specialized context of Astrospeak influence such structure?** By concurrently working on the structural and contextual levels, the thesis aims to offer a deeper understanding of the structure of Astrospeak. Purely concentrating on the linguistic evidence provided would produce only surface-level observations, but keeping the contextual aspect attached to the analysis, the analysis can combat the criticisms placed on register analysis by Bhatia (1993). As noted earlier, specialized languages show a preference for specialized linguistic forms. These forms are based on specialized use context. The remaining research questions are handled in chapter 7, where the findings of chapter 6 are discussed in detail.

6.1 First turn

CA studies are grounded in the assumption that each turn effects the conversation via context-renewal (Heritage 1989: 2). Thus, each turn argued to contribute to the conversational effort. As mentioned, the following three sections analyze turns of Astrospeak conversation separately, and for clarity, the analysis moves chronologically inside the sequence. Schegloff (2007) provides a good starting point for differentiating turns. In his terminology, the first turn of the minimal sequence is initiating something, thus it can be called the initial turn (2007: 13); a type of utterance which starts the conversational sequence. This section explores the initial turns of Astrospeak minimal sequences. While context-renewing capabilities are possessed by every turn in a conversation, the initial turn is the guiding force behind the sequence it initiates. As discussed, pair-type relationship means that the response turn must have a direct connection to the contents of the first turn. Without such a relationship, human interaction would be unorganized and erratic. Because the focus of the thesis is on sequence structure, and the initial turn guides that structure, focusing first on the first turn is key to the rest of the analysis. This section will introduce a rough turn type classification for Astrospeak initial turns and explore how they affect the remaining sequence. The exploration of the initial turn is central in determining whether the analysis supports the hypothesis or not. The section will also discuss pre-expansions and R/T procedures affecting Astrospeak.

Before exploring initial turn types, a brief note about the beginnings of utterances in the data. The modal restrictions bring up R/T procedures which are highly prevalent throughout the transcripts. When the sequence is initiated, the usual practice is to first call for the addressee by callsign and then to introduce themselves. If the conversation is then continuous, this introduction pattern is not repeated. However, even short pauses in the transmissions seem to often bring up that pattern when transmissions are resumed.

00 13 07 12	CC	Apollo 12, Houston. We have a - some P37 PADS for lift-off, 25, 35, 45, and 60, when you're ready to copy.
00 13 07 23	CDR	Okay. Mr. Bean is busying himself finding the PAD at this time, and he'll be ready to copy in just a minute.
00 13 07 31	CC	Roger.

Excerpt 2. (AS12_TEC p. 82)

Excerpt 2 is a simple example of the introductory procedure described above. Mission control contacts the spacecraft by stating its callsign and introducing themselves. The conversation then proceeds without further callsign use. Although there is an 11-second gap between the initial and responsive turn transmissions, the flow of communication is reasonably continuous (mission control even gives time for the crew to respond in “when you’re ready to copy.”) and does not require additional callsigns. In many instances the use of a callsign introduction is a good indicator of a new sequence. In the following excerpt the boundary between two sequences is clear in part because of the use of a callsign introduction in the first turn:

01 05 58 04	LMP	Houston. Apollo 12. The lithium hydroxide canister change out has been done on time.
01 05 58 10	CC	Roger 12. Thank you, and your platform looks real good. No updates.
01 05 58 16	LMP	Okay.
01 06 02 16	CC	Hello, Apollo 12, Houston. A hot flash on the Phoenix 200. Al Unser and Mario Andretti collided with each other and Bobby Unser is now in the lead.
01 06 02 28	CDR	Okay. Very good.

Excerpt 3 (AS12_TEC p. 103)

In this excerpt, callsign introduction is given in the transmission at 01 05 58 04 MET, followed by two turns. Another sequence is initiated by mission control at 01 06 02 16, exactly four minutes after the previous transmission "Okay.". At first glance, this seems redundant. The communication loops are closed, and no new participants can take part in the conversation. This pattern is based purely on the context of interaction: Because no visual or clear prosodic cues are available, a type of fail-safe pattern is installed in the conversation to clarify who is addressing who. It can also alert the listener to the transmission. This pattern is also prevalent in other R/T languages.

Callsign use is perhaps the clearest and most common feature of initial turns in Astrospeak sequences. However, their presence does not directly lead to the fundamental sequence construction of three turns. Section 6.3 discusses the third/final turn in detail, but it is clear that because of the adjacency rules of conversation, the preceding turns dictate the presence and content of the final turn. The most prevalent initial turn type which produces a three-turn sequence is inquisitive:

02 11 10 11	CC	Would you give us H_2 tank heater number 2 to AUTO?
02 11 10 19	CDR	H_2 heater number 2 to AUTO.
02 11 10 23	CC	Roger. Thank you.

Excerpt 4. (AS12_TEC p. 175)

01 16 01 33	CDR	And what do you want us to dump the waste water to - 25 percent or 15 percent?
01 16 01 44	CC	Let's take it down to 10 percent this time. That'll give you a pretty good margin.
01 16 01 55	CDR	Roger. Ten percent.

Excerpt 5. (AS12_TEC p. 150)

00 11 08 52	CC	12, a while back you read to us some service module RCS propellant quantities, and they showed OFF-SCALE HIGH. Also the TM from that gage is still reading OFF-SCALE HIGH, and we suspect a problem with the gage. We'd like to do some troubleshooting on that and have ycu look at those four propellant quantity readings again and also look at the service module indicator to put that at HELIUM TANK TEMPERATURE and read the four quantities. For your information - For your information, our calculations down here show your RCS total is 86; A is 84; B, 88; C, 84; and D is 89.
00 11 09 42	CDR	Okay. I just checked all A, B, C, and D, and they're all still reading OFF-SCALE HIGH. And then the - in the tank in the service module RCS indicator He tank temp is reading 70 on A; it's reading 85 on B, 85 on C, and 65 on D.
00 11 10 19	CC	Roger, Pete. Copy 70, 85, 85, 65.

Excerpt 6. (AS12_TEC p. 76)

All three excerpts above contain an initial turn which asks the respondent something, eliciting an answer which is then confirmed/verified in the final third turn. The triggering of the third turn seems to be contingent on the content of the initial turn; direct or indirect questions prompt a third turn, as do turns which otherwise request some tangible information in the response turn. Based on the data, the three-turn sequence of 1) inquiry 2) response and 3) verification seems to be quite rigid in that sequences where a question is in the initial position and there is no verification turn are rare (and possible violations of the fundamental sequence structure, see section 6.4). Inquisitive turn types seem to support the hypothesis of the study. Other initial turn types, however, have a different effect on the sequence structure.

Another common initial turn type in the data is a command or request for systems operation, usually from mission control to the spacecraft. As was briefly discussed earlier in the thesis, the institutional roles of Astrospeak are usually quite clear, mission control directing the flow of the mission and the crew executing orders and operating the spacecraft. These roles are explicit and do not change during the mission. Thus, many conversational sequences look like the following:

00 08 56 58	CC	Pete, we'd like you to take the S-band antenna to the OMNI and go to the Bravo position.
00 08 57 05	CDR	Okay. S-band OMNI to Bravo.

Excerpt 7. (AS12_TEC p. 69)

00 04 27 37	CC	12, Houston. When you get a chance, turn off your O_2 fans.
00 04 27 43	CMP	Roger. They're coming off.

Excerpt 8. (AS12_TEC p. 41)

As the excerpts show, command turn types do not seem to lead to a third turn. A possible reason for this is the explicit institutional roles of the participants. Sequences which are initiated by a turn giving a command do not require any input other than the verification of understanding in the responsive turn. To simplify, mission control gives a command, which the crew then executes. This means that command turns tend to initiate minimal-pair sequences. Command turn types seem to be uttered exclusively by the CAPCOM, or "CC", as is expected based on the institutional roles mission control possesses in the interaction. A similar construct occurs when either mission control or the spacecraft transmits an observation or some other fragment of information:

03 15 12 10	CC	12, Houston. Five minutes to LOS.
03 15 12 16	LMP	12. Roger.

Excerpt 9. (AS12_TEC p. 262)

03 15 14 11	CC	Hello, Apollo 12; Houston. You're GO for LOI 2, and your PIPA's look real good.
03 15 14 19	CDR	Roger, Houston. GO for LI - LOI 2.

Excerpt 10. (AS12_TEC p. 262)

The information value of these sequences is relatively low, and no real interactive input is needed. Thus, no additional turns need to be added to form a three-turn sequence. Initial turn types such as commands and observations show a tendency for initiating minimal-pair sequences, so they are not the primary focus of the thesis. Chapter 6.2 on responsive turns will however examine their content a bit further. While other turn types could perhaps be identified in the initial turn, the thesis only concentrates on the inquisitive, command and observation turn types. Out of these three, the inquisitive turns seem to initiate a three-turn minimal sequence. The reasons for this will be discussed later in the thesis.

6.1.1 Pre-expansion

Of course, the transcripts are not always sorted into clear minimal sequences. The data shows some occurrences of initial turn expansion, usually in a reoccurring form. The R/T requirements seem to influence sequence initiation by hedging the first turn in the following way:

00 00 17 38	CC	Apollo 12, Houston. Over.
00 00 17 39	CDR	Go ahead.
00 00 17 41	CC	Roger. We've looked at your REFSMMAT; it's looking good, Pete. You can press with P51 and 2.
00 00 17 47	CDR	Okay.

Excerpt 11. (AS12_TEC p. 7)

00 05 21 48	CC	Apollo 12, Houston.
00 05 21 51	CMP	Go ahead, Houston.
00 05 21 53	CC	Roger. If you'll give us POO and ACCEPT, we'll fire up some - a new REFSMMAT, a zero trunnion bias, and a CMC clock update. Over.
00 05 22 02	CMP	Roger. It's all yours.
00 05 22 05	CC	Roger.

Excerpt 12. (AS12_TEC p. 49)

Mission control (CC) calls up to the spacecraft with proper callsign procedures but halts the transmission in excerpt 11 with a procedural "Over" and in excerpt 12 with simply pausing. The spacecraft crew (CDR or CMP in these excerpts) then responds to the initial transmission by acknowledging mission control and giving permission for proceeding with the transmission. The third transmission in the excerpts then contains the actual information which was the impetus for the sequence all along. This type of pattern is highly prevalent in the data and serve as good examples of pre-expansion. The information conveyed is in the third transmission, but the sequence is initiated with a standard R/T procedure. This expansion process also occurs when the spacecraft crew initiates the sequence:

00 05 25 34	CMP	Hey, Houston, 12.
00 05 25 35	CC	Go ahead, 12.
00 05 25 38	CMP	Roger. Doing the P23 at 6 hours. You gave me this attitude after we left that S-IVB, but the flight plan has star 15 for the optics CAL, 204 262 0. Are you going to change that?
00 05 26 01	CC	Dick, you'll have a new REFSMMAT at that time, and your inertial attitude ought to be that now. Once you put in your new REFSMMAT, you ought to be in good shape.

Excerpt 13. (AS12_TEC p. 49)

This type of initial turn pre-expansion seems to occur mostly when there has been a longer gap between transmissions between mission control and the spacecraft. Again, the lack of visual cues and confirmation, as well as technical restrictions, between the two require special attention in communication. By first successfully contacting the spacecraft and gaining the crew’s attention, mission control can subsequently follow with the actual information, with an assurance that the important transmission has been heard and understood. The same logic is behind the crew’s initial turn expansions. Similar pre-expansions of the initial turn can be found in the data with the addition of some information on the mode of communication:

00 03 51 06	CMP	Houston, this is 12 on VOX.
00 03 51 11	CC	Roger, 12. We're reading you loud and clear on VOX.
00 03 51 14	CMP	Okay. I've got Pete working up in the tunnel. We've got the hatch - hatch is coming down between us.

Excerpt 14. (AS12_TEC p. 28)

Here the crew contacts mission control and informs them of the microphone setting on the communication equipment on the spacecraft, which is followed by the evaluation of transmission quality by mission control. Only after this procedure the actual information can is transmitted. This is a very similar to the pre-expansion in excerpt 13, but some additional content on the mode of communication is provided. Pre-expansions related to R/T restrictions are very common in the data.

The transcript excerpts in this section have suggested that inquisitive turn types, those which elicit a substantial answer from the addressee, seem to bring up a third turn after to the second turn. While the evidence so far is limited, the emergence of the three-turn pattern in the data hints that institutional/contextual requirements placed on interaction are modifying the conversational structure. It must be noted that only inquisitive turns have been shown to trigger a third turn, while other turn types have not. This preliminary conclusion that three-turn sequence emerges after an initial inquisitive turn is drawn according to the pair-type relation rules that suggest that the initial turn type is the guiding force behind the sequence (Schegloff 2007: 13). Additionally, the pre-expansions detected in the data place even more stress on the R/T procedures affecting conversation. Overall, the examination of first turns underscores the contextual dimensions of Astrospeak and suggests that its uniqueness has direct consequences for the register itself. While the main hypothesis seems to be fulfilled by inquisitive turn types in the initial position, it would be perilous to draw definite conclusions just yet. For that, supporting evidence is searched in the remaining turns of the minimal sequence.

6.2 Second turn

As in the previous section, Schegloff's terminology on differentiating turns can be used here. In his description of sequence structure, the second turn is a response turn (Schegloff 2007: 13). This means that according to pair-type relationship rules, the second turn in the minimal sequence needs to be directly related to the initial turn. From this, it can be construed that the initial utterance types explored in the previous section, such as commands and questions, dictate the responsive utterance types in the second turn of the sequence. This section looks at the response turns in Astrospeak sequences. While the second turn is perhaps the least interesting to the overall analytic aims of the thesis, their content is still crucial at determining the existence of a third turn. In this section the three main initial turn types' effect on the response turn will be examined first, followed by some notes on e.g. insert expansions. As inquisitive initial turns show a tendency to trigger a three-turn sequence, the first excerpts show how the response turns in such sequences contribute to the sequential organization:

01 16 01 33	CDR	And what do you want us to dump the waste water to - 25 percent or 15 percent?
01 16 01 44	CC	Let's take it down to 10 percent this time. That'll give you a pretty good margin.
01 16 01 55	CDR	Roger. Ten percent.

Excerpt 15. (AS12_TEC p. 150)

03 07 36 33	CDR	Houston, 12.
03 07 36 36	CC	Go, 12.
03 07 36 41	CDR	Roger. You want to watch this rendezvous radar transponder self-test? We're about ready to do that any time you are.
03 07 36 51	CC	Okay, stand by.
03 07 36 58	CC	12, Houston. There's nothing meaningful we can monitor on that, Pete. Just go ahead with it.
03 07 37 03	CDR	Okay. It's in work.

Excerpt 16. (AS12_TEC p. 223)

03 08 27 21	CC	Roger. You guys must really be closing in on it, huh?
03 08 27 31	LMP	This is the first time we have been able to look at it, and in the mare area - up to now - it looked very, very smooth; but now when you look at the mare area, you can see there's a quite a number of long ridges, and what have you, that mar the maria a little bit.
03 08 27 50	CC	Roger. Understand.

Excerpt 17. (AS12_TEC p. 227)

There is nothing special about the three excerpts above. They show the basic tendency of Astrospeak to be organized in three turns in a minimal sequence if the initial turn is inquisitive. The response turns naturally follow pair-type relationship rules and address the question. For the sequence to take a third turn, it seems that the response turn must contain some tangible information. The way closed yes/no questions influence the sequence structure is more irregular – this will be discussed later. The excerpts also showcase some of the institutional aspects of Astrospeak. The data suggests a tendency that questions regarding systems operation are mostly uttered by the crew (excerpts 15 and 16). In contrast, questions regarding the situation onboard during the mission are naturally uttered by mission control (excerpt 17). This underscores the institutional roles associated with Astrospeak. The crew is tasked with operating the spacecraft systems with the assistance and guidance of mission control, whereas mission control relies on the crew to perform tasks and to provide them with critical observations on the spacecraft or the environment.

Following the pattern that was established in the previous section, notification turn types show a preference towards a minimal pair sequence. Either the crew or mission control will inform the other participant of something – a maneuver, a procedure or an action – and the addressee will only acknowledge that notification. The response does not contain anything more than a verification, so a third verification turn is unnecessary and not present in the data. The following excerpt shows two minimal pair sequences where the initial turn is a notification, triggering a verification already in the second turn:

00 08 00 02	LMP	Okay, Houston, we're powering her back down now.
00 08 00 06	CC	Roger. We copy. You're powering down.
00 08 04 01	LMP	Houston, we're getting ready to transfer to CSM power right now.
00 08 04 06	CC	Roger, Al.

Excerpt 18. (AS12_TEC p. 64)

The sequences starting at 00 08 00 02 and 00 08 04 01 are identical regarding their turn types. The initial turns are notifications of actions by the crew and the response turns are simple verifications of a successful transmission. The repetition of "You're powering down" does not change the turn type, it is only a redundant addition to the verification.

Command turn types in the initial position seem to trigger a minimal pair sequence, as well. In Astrospeak, there are numerous instances where systems operation relies on one participant reading procedures off a checklist with another participant performing task according to the checklist readouts. This process manifests itself in the following way:

01 06 53 03	CDR	Okay. YAW 2 is OFF.
01 06 53 04	CMP	It's OFF.
01 06 53 05	CDR	PITCH 2, OFF.
01 06 53 06	CMP	It's OFF.
01 06 53 07	CDR	YAW 1, OFF.
01 06 53 09	CMP	It's OFF.
01 06 53 10	CDR	PITCH 1, OFF.
01 06 53 11	CMP	It's OFF. Okay?
01 06 53 13	CDR	Okay. Let me run the checklist, now.

Excerpt 19. (AS12_TEC p. 121)

This exchange shows that in performing checklist-assisted operations, the response turn concludes the sequence. In the excerpt above, the CDR reads out commands from a checklist, which are then performed by the CMP. In the response turns the CMP only repeats the command while performing the action. No verification turns are triggered in such a sequence. It must be noted that the conversation above is between two crewmembers, so the usual R/T constraints do not apply here. The data does not seem to include passages where mission control gives commands in a similar fashion. This is because many of the procedures are laid out in physical checklists that the crew has onboard. The procedures requiring checklist-assistance are the most crucial to spacecraft operation and thus a fail-safe system was conceived where the effect of failure in the communication systems between the crew and mission control was eliminated. There are, however, many instances where mission control gives commands to the crew in less critical operations:

09 20 52 39	CC	Apollo 12, Houston. Let's go ahead and roll it on the PTC.
09 20 52 54	CMP	Roger. We're starting PTC.

Excerpt 20. (AS12_TEC p. 1038)

10 02 26 40	CC	12, Houston. You're GO for PYRO ARM.
10 02 26 43	CDR	Roger.

Excerpt 21. (AS12_TEC p. 1060)

In the two excerpts above, the command turns by mission control direct to crew to perform certain operations on the spacecraft systems. The command is acknowledged in the response turns and the actions are taken (in these cases, starting the temperature-controlling maneuver and arming the pyrotechnic parachute systems). The exchange again concludes in the response turn because no tangible information is transmitted back to mission control outside the verification of the initial turn message.

While the discussion above strongly suggests that most of the three-turn minimal sequences seem to be initiated by inquisitive turns, and command/notification turns are restricted to minimal pairs, an additional initial/response type pair can be found in the data that tends to bring up a third turn:

03 08 54 14	CC	TEI 1, SPS/G&N: 38641, minus 0.59, plus 0.64, 085:32:39.16, plus 3207.1, plus 0813.0, minus 0310.9; NA for roll; pitch is 093; the rest of the pad is NA. Your ullage is four jets for 11 seconds; burn undocked. Over.
03 08 55 26	LMP	Okay, Houston. TEI 1 SPS/G&N: 38641, minus 0.59, plus 0.64, 085:32:39.16, plus 3207.1, plus 0813.0, minus 0310.9, NA, 093. The rest is NA. Ullage is four jets for 11 seconds; burn undocked.
03 08 55 59	CC	That's affirmative, and you are ready for TEI 4?

Excerpt 22. (AS12_TEC p. 229)

Prolonged passages of information in the initial turn seem to direct the responding participant to read back the same information. This readback is then either confirmed as correct or corrected in the final turn. In the excerpt above, the LMP first copies the information on a writing pad, and then reads back the initial message. The readback is confirmed and the CC initiates a new sequence after "That's affirmative,". Although this seems similar to the checklist-assisted operations discussed earlier (where the response turns also closed the sequence), the amount of information contained in the response turn is such that a verification is triggered. In some cases, the readback is requested in the initial turn, but here it is done without such an explicit request. It is unknown whether mission rules dictate when readbacks are necessary, but they seem to occur in situations where a great amount of numeral data is transmitted in one turn.

6.2.1 Insert expansion

The previous section explored pre-expansion in the Astrospeak minimal sequences. One prevalent pattern was hedging the first turn to ensure successful R/T communications. R/T exerts influence on other types of expansion, as well. Below is an example of insert expansion, brought up by R/T procedures. When a recipient of an inquisitive initial turn is not able to respond immediately, an insert expansion is often triggered. Usually the show up in the following way:

01 04 06 38	LMP	Houston, Apollo 12. How far out are we now?
01 04 06 41	CC	Stand by and I'll find out for you, Al.
01 04 06 55	CC	12, Houston. Not quite halfway at a 110 000 miles.
01 04 07 02	LMP	Roger.

Excerpt 23. (AS12_TEC p. 98)

Here the crew requests a piece of information from mission control, but they are unable to return with an answer right away. Instead, mission control commands the crew to "Stand by" until an answer can be given. In this excerpt 14 seconds pass between the call to stand by and the actual answer to the initial turn question. While pre-expansions happen before any tangible information is transmitted, insert expansions occur in the middle of a sequence. The "stand by" call is fundamentally a part of the responsive turn, because it effectively pauses the sequence until an answer to the initial turn question can be produced. The call is consistent throughout the transcript and it is not used interchangeably with e.g. "wait". The call can therefore be viewed as a standardized procedure in the R/T mode. A similar procedure is present in other R/T registers, such as Airspeak (Robertson 1987: xix).

There is another type of insert expansion in the data, as well. As discussed in earlier in the thesis, the context of spaceflight and the mode of R/T have serious limiting effects on communication. In the case of the responsive turn, one of the most common hindrances is garbling and/or dropout of the initial turn. If the dropout is serious enough, the addressee participant may not be able to hear the transmission or even know that the transmission has been uttered in the first place. These dropouts are not represented well in the data because the transcripts were made based on the recordings of the air-to-ground loop. The dropouts were possibly deemed irrelevant for the engineering purposes the transcripts served. However, less severe obstacle for transmission reception may cause the addressee to request a repetition of the initial turn in the following insert expansion construct:

01 07 06 37	CDR	And, Houston, we're planning to make a dump now. Is that okay?
01 07 06 49	CC	Say again, 12.
01 07 06 53	CDR	We're planning a urine dump now, if that's okay.
01 07 07 11	CC	Yes. No problem, 12. Go ahead.
01 07 07 15	CDR	Okay.

Excerpt 24. (AS12_TEC p. 127)

Based on the contextual information provided by the turn at 01 07 06 49, it can be determined that the initial turn at 01 07 06 37 is somehow obstructed and thus incomplete. The recipient, here mission control, therefore requests a repetition of the initial turn by the crew. This is an insert expansion because the initial turn is followed by a hedging of the response turn. The initial turn is repeated, and the sequence moves towards closure with the response and verification turns. This hedging resembles the pre-expansion hedging discussed in relation to the initial turn. However, the determining factor between the two types of expansion is the turn being expanded. Here, the responding participant hedges the turn because they cannot hear the initial turn properly. Thus, it is an expansion turn, not a pre-expansion even though the tangible information is completely transferred only after the expansion.

The exploration of the response turn in an Astrospeak sequence suggests that inquisitive turn types which trigger a substantial response (i.e. some tangible or new information, not a simple yes/no answer) also lead to the presence of the third, verification turn. The content of the response turn is dictated by the initial question, but the response turn also renews context by containing information whose successful transmission needs to be verified in the third turn. Again, R/T and context determine this need; if the response turn contains tangible information, it needs to be acknowledged by the addressee. A failure to verify a response might indicate a garbled transmission or other problems with the radio connection. In addition, the content of the response turn often repeats the initial turn content, adding to the 'checks-and-balances' nature of Astrospeak. Overall, the relationship between first and second turns in the minimal sequence underscore the rigidity of Astrospeak communication where almost everything is somehow verified or repeated to ensure communicative success. This rigidity is obvious in the insert expansions, as well. Constructs which are meant to combat modal challenges and problems are necessary, and common, expansions of Astrospeak sequences.

Through the first two turns of the minimal sequence, the evidence is well-aligned with prior research that suggests a minimal-pair sequence structure for interaction. However, the relationship between the initial and responsive turns, although substantial for the overall sequence structure, is not at the core of the thesis. Like Kevoe-Feldman & Robinson (2012), the thesis emphasizes that the first two turns require a final turn for a completion of a minimal sequence, at least if the initial turn is inquisitive. Astrospeak's context and mode place certain obligations for its communicative structure. In determining the number of turns constituting a minimal sequence, this means the presence of a final, third turn. The third turn, as well as turn expansion in the post-position, will be explored in the next section.

6.3 Final turn

So far, the analysis has explored the first two turns of the minimal sequences in Astrospeak. As discussed, many CA studies argue that a minimal pair with two turns form the basic, unexpanded base block for interaction. This has provided the thesis a consistent terminological basis for the examination of Astrospeak structure. Indeed, the analysis here has shown that in many cases, interaction in Astrospeak consists of minimal pair sequences. The analysis has also suggested, however, that inquisitive turns in the initial position seem to add an additional turn to unexpanded sequence structure. This section explores the contents of the third turn and reiterates the logic that triggers its addition to the sequence structure. The contextual aspect of Astrospeak is vital to the discussion, so it is considered concurrently with the linguistic evidence in the excerpts. Because the existence of an elemental third turn in the sequence structure of the register is central to the hypothesis of the work, this section is crucial – minimal pair sequences are not discussed here, but in the following section.

In the three-turn minimal sequences observed in the data, the final, or third turn is the simplest with regards to its form and content. Although it seems to be simple, the third turn serves an important purpose in Astrospeak. Because R/T cannot be trusted to function perfectly (see section 3.3), the interaction has evolved to contain patterns to combat this. The third turn acts as a verification of a received message in the response turn. For this reason, it is called the verification turn throughout the thesis. The following excerpts give examples of the usual final turn in the three-turn minimal sequence:

00 01 35 56	CC	Apollo 12, Apollo 12, Houston. Roger. We saw your manifold pressures change a little bit, so it does look like they fired. Also, Neil's here, and he says he didn't hear his go on MIN IMPULSE either.
00 01 36 07	CDR	Okay. But we can see them firing. We're getting some flashes now.
00 01 36 12	CC	Roger.

Excerpt 25. (AS12_TEC p. 14)

00 08 41 11	CC	And, 12, would you go ahead and verify that the O_2 heaters are in AUTO?
00 08 41 17	LMP	Both O_2 heaters are in AUTO.
00 08 41 21	CC	Roger, Al.

Excerpt 26. (AS12_TEC p. 68)

00 10 44 12	CC	Pete, would you go ahead and verify the position of the floodlight switch? Verify that it's off?
00 10 44 19	CDR	Floodlights are off and exterior lighting in OFF. We also punched the little button on the hatch and the floodlights went off.
00 10 44 32	CC	Roger. We copy.

Excerpt 27. (AS12_TEC p. 74)

These are the most common turns in the data. Words such as "roger", "affirmative", "okay" and "copy" end most of the three-turn sequences as they are all synonyms denoting understanding and acceptance of the responsive turn utterance. Under

Schegloff's view on sequence closing expansions, the short third turns here are minimal expansions of the sequence – tokens to note the completion of a transmission sequence. At first, the verification turns seem to carry very little information as closing tokens normally do. However, they do seem to have a clear and important role regarding the communication mode and context. The R/T requirements placed on the communication are so severe that skipping the closing turn could have undesirable consequences for the successful completion of tasks. Spaceflight is such a complicated endeavor that careful and procedural (i.e. a step-by-step process) attention is paid to the operation of systems. This importance placed on a procedural approach is one of the keys to understanding Astrospeak as a specialized register.

The preceding analysis has suggested that in the rough turn type classification proposed in this thesis (i.e. inquisitive, command and observation turns), only inquisitive turns in the initial position trigger a three-turn sequence. Command and observation turns seem to fit into a minimal pair sequence so the analytic focus of this chapter is not on them. To emphasize the patterns brought up by an inquisitive initial turn, here are a few excerpts where this clearly happens:

03 14 59 26	CC	Roger. Understand. And do you say that the LM is illuminated by earthshine?
03 14 59 35	CDR	Yes. Real well. It's very reflective itself, and so it looks almost like the soft sunlight if there is such a thing. But you can, for example, look out and read the marks on the Commander's overhead window; you can see all the quads, the struts. And real pretty up here in earthshine. Kind of gives it sort of a gray-green cast, though.
03 15 00 03	CC	Roger. Understand.

Excerpt 28. (AS12_TEC p. 261)

04 16 38 32	CC	Help us get a better visual pindown of where you are. Do you - Are you able to locate a 50-foot block, approximately 100 foot, right in front of you, or an 8- to 10-foot block about 50 feet in front of you? And that will be at R5, 13.1.
04 16 39 23	CDR-LM	Well, I can't say that there is anything like that. There is one great big block that looks to me like it's 1500 or 2000 feet in front of us that meets that description. It's a really big fellow, sitting out there.
04 16 39 44	CC	Roger, Intrepid.

Excerpt 29. (AS12_TEC p. 368)

The analytic focus on the initial turn is crucial for determining the basic structure of Astrospeak. The content and role of the third turn seems quite one-dimensional, but its mere existence is linguistically relevant. The connection between turns in a sequence is well-understood as pair-type relationship, so the effect of the initial turn is not necessarily surprising. The excerpts above show a tendency for Astrospeak to take a three-turn sequence structure when the first turn is an open question. This directly influences the response turn content, but also is effectively responsible for the third turn, as well. As discussed, the verification turn can be understood as either an elemental part of the sequence or a minimal expansion of the sequence. The excerpts above arguably support the former position. As sequence closing turns, they take the R/T vocabulary "roger" with the addition of either a callsign or a verification of understanding. These would arguably be quite awkward and bulky minimal expansions. Additionally, because the third turns seem to be triggered by most inquisitive turns in the data, it would seem that the verification indeed is an elemental part of the interaction structure in Astrospeak. A quantitative analysis on this phenomenon is beyond the scope of the thesis, but it would provide an interesting path for future research into Astrospeak structure.

In most sequences, the third turn seems to exist almost solely as a verification turn. An acknowledgement of a completed piece of exchanged talk between the spacecraft and mission control is relatively thin in information content, but valuable because of the conversational context. The data, however, shows some occurrences which emphasize the importance of the third turn, and indeed the whole verification process in Astrospeak talk. The following excerpt exhibits this need:

00 00 01 12	CDR	I got three fuel cell lights, an ac bus light; a fuel cell disconnect, ac bus overload 1 and 2, main bus A and B out.
00 00 01 36	CC	Apollo 12, Houston. Try SCE to auxiliary. Over.
00 00 01 41	CDR	NCE to auxiliary - -
00 00 01 43	CC	SCE, SCE to auxiliary.

Excerpt 30. (AS12_TEC p. 1)

The excerpt above shows a correction procedure initiated because a command, a response to an issue by mission control, is read back wrong by the astronauts: "NCE to auxiliary - -". As has been already determined, verification turns are common in Astrospeak, so the command gets corrected without problems: "SCE, SCE to auxiliary" – without it the consequences could be severe as the flight is in a precarious phase (ie. a mission-critical problem). If the crew does not read back the original command "Apollo 12, Houston. Try SCE to auxiliary. Over.", the misheard transmission cannot be identified and corrected.

The verification also ensures that a failure in receiving a transmission can be corrected immediately. Because mission operations rely on the cooperation between the crew and mission control, it is vital that a recipient of a transmission reacts to the initial utterance. In the following example a response is initially not given:

00 01 43 09	CC	Apollo 12, Houston. You can run that TVC check.
00 01 43 39	CC	Apollo 12, Houston. Did you read my last?
00 01 43 43	CDR	No. What was that?
00 01 43 48	CC	You're GO on the MTVC check.
00 01 43 51	MS	...
00 01 43 52	CDR	We're in process right now.
00 01 43 53	CC	Okay.

Excerpt 31. (AS12_TEC p. 16)

The failure to give a response leads mission control to check whether the initial turn was received at 00 01 43 39. Problems with the communication loop would be the most probable causes behind situations where a transmission is not received at all. Because there is an explicit need for a verification of reception, the lack of response to "run that TVC check" is interpreted to mean that there has been a gap in the radio link. Mission control then proceeds to check whether the command has been received.

Above, it has been determined that the majority of third turns are simple verifications, uttered because of R/T requirement and restrictions. However, the third turn seems to have some other roles in the data as well. For example, below is an excerpt in which the third turn introduces a new procedure after a piece of information is requested by the initial turn:

00 05 53 07	CDR	Houston, you are looking at the torquing angles?
00 05 53 12	CC	We have them, 12.
00 05 53 14	CDR	Roger. Torquing at this time.
00 05 53 16	CDR	MARK.

Excerpt 32. (AS12_TEC p. 51)

In this excerpt, the CDR concludes the sequence of again acknowledging the responsive turn of mission control. Additionally, he announces starting the torquing process on his own MARK. MARK is a technical term in the transcripts which gives the engineers a precise point in mission elapsed time in which a certain action has been taken by the crew. Although the last two transmissions in the excerpt above are separate, they belong to the same turn – they are only separated so that the engineers have a clear timestamp on the torquing action being executed. Additionally, the third turn is directly adjacent to the initial and responsive turns and it is not part of a new, separate sequence. A similar third turn containing additional information is found here:

02 21 16 14	CMP	Houston, 12. How does the rate look?
02 21 16 32	CC	12, Houston. The rates are looking good.
02 21 16 37	CMP	Okay, here we go.

Excerpt 33. (AS12_TEC p. 214)

This excerpt shows a three-turn sequence whose final turn primarily announces the successful reception of the second turn but also contains an announcement of starting a maneuver relating to the “rates”. While there are other examples in which the third turn is shown to include more than a simple verification, they still follow the same turn type pattern that the more common verification-only turns do. For the purposes of the sequential analysis of the thesis, this is the key factor. The initial turns in these sequences are similarly triggering a responding turn which does contain some substantial information which needs to be verified. Therefore, a distinction between simple verifications and third turns containing additional information is not necessary for the aims of the thesis.

6.3.1 Post-expansion vs. elemental third turn

Here, the contrasting views on SCTs (sequence-closing thirds) must be considered. It was determined earlier that while Astrospeak does seem to use the third turn for concluding a sequence, it does carry some other contextual importance. The hypothesis is that Astrospeak minimal sequence has three turns. The institutional requirement for verification renders the third (verification) turn an elemental part of the minimal sequence. Support for this claim must be found in the data. This can be problematic, however. There is no way to discover the speakers' motivations to use a verification turn in interaction. In addition, there are no known explicit rules for astronaut communication which mandates such constructs. The support must come, therefore, from contextual knowledge and the prevalence of the three-turn pattern in the data, especially in reoccurring conversational contexts. Here is a simple example of a three-turn sequence:

04 08 05 30	LMP	Houston, Intrepid. On the LM S-band - How do you hear?
04 08 05 34	CC	Intrepid, this is Houston. Reading you slightly weaker than normal and fairly clear.
04 08 05 45	LMP	Roger.

Excerpt 34. (AS12_TEC p. 298)

This is a nominal conversational sequence of Astrospeak which fits into all the norms that have been established in the analysis. In the initial turn, the LMP asks mission control something. The responsive turn reacts to the question accordingly, providing a tangible answer to an open question. The initial speaker then verifies the answer and closes the sequence in the third turn. Contextual evidence suggests that the third turn is elementally part of the sequence. While the thought process of participants is impossible to ascertain, the fact that an overwhelming majority of sequences beginning with an open question also contains a third, verification turn strongly indicates that the third turn serves an important role in interaction. This must consequently mean that if the verification is seen as an elemental part, it cannot be an expansion. In contrast, other initial turn types have been shown to trigger only a minimal pair. The transcript does, however, contain some passages seemingly contradicting this logic. In closer examination, they can be shown to be examples of minimal expansion:

02 14 10 56	CC	Just want to remind you to charge battery B, please.
02 14 11 07	CMP	Roger. Battery B charge.
02 14 11 09	CC	Roger. Thank you.

Excerpt 35. (AS12_TEC p. 181)

Here, the initial turn is a command by mission control. Following standard Astrospeak procedures, the CMP acknowledges the command and performs an action based on it. Mission controls then moves on to verify the response turn even though prior analysis has shown that commands in the initial position do not usually trigger a third-turn verification. This seems to suggest that, in excerpt 35, the third turn is an expansion. The response turn does not contain such tangible evidence which would necessitate verifying as it is simply an acknowledgement and repetition of the initial turn command. The conversational tone of excerpt 35 is quite relaxed, hinting that the command does not involve any mission-critical operations. Rather, it seems like a non-critical reminder delivered with unnatural politeness (at least in relation to other Astrospeak conversations). The third turn expansion might be a continuation of this politeness. Overall, the analysis does not suggest that this is an elemental part of the sequence.

Making absolute claims about a register of language is analytically perilous. Although the past three sections have uncovered definite patterns of sequence structure in Astrospeak, it is beneficial to explore potential contradicting evidence, as well. The next section, therefore, provides discussion on possible violations of the structure outlined in the analysis so far. Examples of sequence structure which do not adhere to the supposed rules of interaction will be provided and evaluated in relation to other findings and contextual aspects of Astrospeak. The section will also further explore sequences which contradict the hypothesis of the study. Considering violations is not aimed at undermining the findings so far. The evidence of the past three sections strongly suggests that the hypothesis is correct regarding inquisitive sequences. The next section is offered only to provide balance and to reinforce what has already been discovered.

6.4 Violations of the three-turn minimal sequence

The sections above have shown that Astrospeak does possess constructions whose minimal form consists of three turns. Generalizing these findings to state that Astrospeak data shows only three-turn minimal sequences, however, would be dishonest. This section is dedicated to finding examples of sequences where the interactional rules established earlier are somehow broken. In practice, this means uncovering sequences which depart from the argued three-turn minimal sequence structure. It has already been determined that command and observation turn types will not bring up a third turn. While considering them violations is problematic, they will be discussed here because they contradict the original hypothesis. In addition to presenting excerpts where supposed violations occur, their context must be considered, because it may offer explanations for said violations. A detailed analysis of structure violations is beyond the scope of the thesis, but even a limited exploration of the matter offers balance and expands the contextual knowledge about Astrospeak.

03 12 12 20	CC	Understand that you can see larger boulders in the bottom of the crater?
03 12 12 26	CDR	Yes, and also along the sides of it.

Excerpt 36. (AS12_TEC p. 245).

In this excerpt, the response turn seems to include tangible information that usually brings up a verification in a third turn. However, the sequence ends with the response turn. A closer examination of the turns finds that the inquisitive turn by mission control in the initial position is, in fact, a yes/no question. Earlier it was discussed that closed yes/no questions pose a challenge for the argument that inquisitive turn types always trigger a third turn. Thus, the argument was amended so that the response turn must contain tangible information which would then be verified in the third turn. In the excerpt above, this happens. However, the initial turn is a closed question and thus the sequence is positioned as a minimal pair. The information in the response turn is not totally inconsequential, but it is also a redundant addition which does not seem to require a verification. If the three-turn minimal sequence is the norm for inquisitive sequences, this is a clear violation.

06 18 10 38	LMP	Houston, Apollo 12. Did you want us to put that switch in FORWARD, where it is now, or put it back to OFF?
06 18 10 46	CC	Stand by.
06 18 11 07	CC	Al, what we want is the tape record switch to FORWARD if it's not there already.
06 18 11 16	LMP	That's where she is and that's where she'll stay. Okay?
06 18 12 26	CC	Apollo 12, 1 minute to LOS.
06 18 12 34	LMP	Roger.

Excerpt 37. (AS12_TEC p. 837)

Here the sequence between 06 18 10 38 and 06 18 11 16 does have three turns, which are triggered by an inquisitive initial turn. After an insert expansion, mission control provides an answer to the initial turn question in a nominal manner. The LMP's verification in the third turn, however, is irregular. He does accept that the switch is in the correct position, but not by a standard verification utterance, instead using a colloquial phrase. Structurally interesting is the tagged question "Okay?". This might be an addition to the colloquial tone of the turn in general. The tagged question is not answered to, nor is it acknowledged in any way. At 06 18 12 26 mission control initiates a new sequence and the tagged question at the end of the previous sequence is effectively forgotten. While the turn content strongly suggests that this is not a situation where an utterance has significant conversational value, the discarded question is still an anomaly in the data. Usually questions, even quite mundane ones, are reacted to in the rigid structure of Astrospeak. For a sequence structure which tends to favor clear sequence starts and endings, the excerpt above is an anomalous violation.

The excerpts above present direct violations of Astrospeak sequence structure and R/T procedures. As discussed, however, many types of sequences do not fit into this normative approach at all. The data contains numerous examples of sequences which contain only two turns, the most common of which are relatively simple commands, notifications or yes/no questions in the initial turn:

03 06 21 57	CC	12, a reminder, it would help if you turned the uplink squelch off.
03 06 22 06	CDR	Okay. Uplink squelch going off.

Excerpt 38. (AS12_TEC p. 219)

04 08 49 55	CDR	Okay, Houston. We are bringing the AGS up at this time.
04 08 49 59	CC	Roger, 12.

Excerpt 39. (AS12_TEC p. 303)

00 04 19 59	CMP	Houston. 12. Let us know when that maneuver is over, please.
00 04 20 03	CC	Wilco.

Excerpt 40. (AS12_TEC p. 39)

00 07 40 20	CDR	Houston, do you now want us to put ourselves in the COMM configuration you requested?
00 07 40 31	CC	Pete, that's affirmative.

Excerpt 41. (AS12_TEC p. 39)

Discussing these sequence types as "violations" of the sequence structure is slightly misleading. It has already been determined that many initial turn types will not trigger a three-turn sequence, and only the inquisitive turn type will. The minimal pair sequences are handled as violations here solely because they contradict the thesis' original hypothesis that all Astrospeak conversations would fundamentally be arranged in three-turn minimal sequences. Command and notification sequences seem to be arranged in a minimal pair; this is not a violation *per se,* but evidence of a partly failed hypothesis. The yes/no questions, on the other hand, do possess some interesting qualities relating to minimal sequence structure.

Out of the three initial turn types mentioned above, the yes/no question (here, excerpts 40 and 41) is the most difficult to categorize based on its tendency to trigger a third turn. While there are several examples of a yes/no question lacking a third, verification turn, there are also many examples, like the following, in which verification does occur after a simple response turn utterance:

06 16 14 01	CC	12, Houston. One and one-half minutes to LOS, and a reminder on that power on the high gain. And, also, were you able to pick up anything on the target of opportunity?
06 16 14 15	CDR	No, we weren't.
06 16 14 20	CC	Roger.

Excerpt 42. (AS12_TEC p. 826)

06 23 18 41	CC	Clipper, Houston. We assume then that you did not do a P52, at about 165:50. Over.
06 23 18 57	CMP	No.
06 23 18 59	CC	Roger.

Excerpt 43. (AS12_TEC p. 848)

These are cases where the third turn being elemental and it being a minimal expansion are at clear odds with each other. 'Ordinary' CA tradition suggests that the third turns in the examples above are mere minimal expansions of a pair. Without having explicit rules on verification transmissions for Astrospeak, it is difficult to assess whether a verification turn is simply a token closing, or indicative of an elemental pattern in the register's sequence structure. This issue is at the heart of the thesis. While the uncertainty regarding the closing turns here needs to be acknowledged, R/T requirements, modal restrictions and the prevalence of the verification turn (at times in 'unconventional' situations) in the data suggest that rejecting the third turn as a simple expansion is analytically problematic. The circumstantial and contextual evidence contradicting this determination is strong. Based on this, it can be argued that inquisitive turn type utterances (even the simplest ones) need to trigger a third turn in Astrospeak. Hence, examples where questions do not do so seem to show a violation of the sequence structure.

This chapter has shown that Astrospeak is a highly structured and rigid LSP. It tends to favor a three-turn minimal sequence structure when the utterance in the initial position is a question, and the answer in the response turn contains some tangible information. The third turn is mostly dedicated to verification – acknowledgements of received transmissions. Their presence is explained by R/T procedures and a systematic approach to verify each transmission in ensuring successful systems operations. The three-turn sequence is not normally present when the initial utterance is something other than an open question. The analysis has also extensively discussed R/T restrictions to Astrospeak use, and how they are clearly visible in turn expansion inside Astrospeak sequences. Finally, the chapter has considered violations of the established sequence structure and how closed questions are problematic for the analysis. The next chapter will elaborate on these findings by contrasting them with other institutional conversation analyses and conversations in general. In addition, some new ideas, such as procedurality as a descriptive concept for LSP research, are discussed and evaluated. The chapter will rely on the evidence provided in the prior chapter, so some repetition of the key ideas cannot be avoided.

7 Discussion

This chapter is dedicated for a discussion on the findings presented in the previous chapter. For the sake of clarity to the reader (and the author), the chapter has a clear organizational structure. First, the findings related to the register analysis of Astrospeak are presented. They begin with a review of the institutional context of Astrospeak, using Halliday's three register variables. This is followed by the discussion on the pervasive linguistic feature in focus; the three-turn minimal sequence structure. The combination for these two factors is functional, as Biber & Conrad (2009) note. The findings are then contrasted with other varieties of talk to suggest possible theoretical divisions between institutional and 'ordinary' talk. Some ideas on ICA-specific frameworks, or at least a need for them, are suggested. Finally, the concept of procedurality is applied here as a descriptive tool for restricted register analyses, after which the conclusions about the findings are drawn.

First, Astrospeak's social context must be summarized. Halliday's register variables offer a good, concise tool for this:

- Field: Spaceflight; crew in the spacecraft, mission control on Earth; operation of highly complex machinery, computers and trajectories

- Tenor: Hierarchical roles; mission control holding authority over operations, generally dictates mission progress; crew operates systems accordingly and may act independently if needed
- Mode: R/T; modally constrained spoken dialogue between crew and mission control; R/T procedures

The conclusion is that Astrospeak form cannot be explained arbitrarily by the context of spaceflight. That context needs to be analytically detailed; the combination of field, tenor and mode presents an efficient categorization for context dimensions and it has been widely used in register analyses before. The major findings about the contextual dimensions of Astrospeak relate to institutional roles and the modal restrictions of R/T. First, command turn types seem to be primarily uttered by mission control, mirroring the institutional role of mission control having authority over spacecraft operations. The crew does not have such authority, so command turns uttered by a crewmember seem non-existent. In contrast, observation and inquisitive turns seem to be uttered equally by mission control and the crew. An embedded institutional feature is that of respondent selection; most of the time, the CDR would be in charge of communications with mission control. However, all three crewmembers had distinct areas of expertise regarding the spacecraft. If the initial turn would refer to a specific system, the crewmember with corresponding expertise would take the responsive turn.

As for R/T, the influence on Astrospeak structure is quite clear. First, all expansions seem to be triggered by R/T considerations, whether it is hedging of the first turn or pausing to come up with an answer. R/T procedures are found throughout the transcripts; callsign use, readbacks and repetitions are all widely-recognized features of R/T talk. Most crucially, R/T seems to influence Astrospeak's minimal sequence structure. The analysis found that sequences which begin with an inquisitive turn type and followed by a response turn containing some tangible information beyond a simple yes/no answer do seem to trigger a third, verification turn. The process of verifying is directly influenced by R/T. It was determined earlier that R/T languages incorporate a 'checks-and-balances' system to combat the problematic nature of communicating via radio. Transmission cannot be fully trusted, so a linguistic process of verification must be applied; a verification in the third turn ensures that the tangible response given in the second turn was received satisfactorily by the addressee. For contextual reasons, this third turn is considered an elemental part of the minimal sequence. This is in direct contrast with Schegloff's position on minimal sequence length. As there are no visual cues and other processes normally associated with human interaction in R/T, the usual rules do not apply. In Schegloff's work, a sequence closing sequence is like a knot in the end of a fishing line to stop it from falling off the reel. In Astrospeak, each three-turn sequence is essentially a closed loop which then forms a chain with other adjacent sequences. This rather cumbersome and cyclical structure is the essential nature of Astrospeak.

Like Kevoe-Feldman & Robinson's study (2012), the thesis is not arguing that a three-turn minimal sequence is the basic construction underlying all conversations. Rather, it seems to exist in certain institutional contexts, being heavily dictated by the initial turn type in accordance to pair-type relation rules. To reiterate, the distinction between an elemental third turn and a sequence-closing third is quite vague, but institutional requirements place a heavy emphasis on the need for the third turn. If its role is institutionally important, it would seem logically faulted to discard it as a mere expansion. The analysis has shown plenty of evidence for patterns of three-turn sequences in situations where the initial turn is a question triggering a tangible answer. The thesis therefore argues that in these situations, a three-turn sequence is the minimal sequence form, as opposed to the minimal pair.

While the thesis argues that a third verification turn is elemental to the minimal sequence in Astrospeak, it must be noted that this does not imply that all utterances in the data are arranged in a three-turn minimal sequence. As section 6.3/6.4 showed, there are numerous cases where conversation between mission control and the spacecraft follow a basic adjacency pair structure. This does not, however, mean that the main argument of the thesis is faulty. The third turn does exist in the conversations as a contiguous part of the sequence and its existence must therefore have a reason. The trigger for the verification turn seems to arise from the content of the response turn. Response turns which only verify transmission reception or provide a yes/no answer seem to be so simple that a third turn is not triggered. In contrast, if the response turn contains some tangible information, more than “roger” or “That’s affirmative”, there seems to be a need for verification by the initial turn speaker. Such tangible information in the second turn seems to exist only in sequences which are initiated by an open question.

The combination of situational context and linguistic form brings up the functional register description of Astrospeak, following the pattern established by Biber & Conrad (2009: 6). While they call for the identification of many “pervasive linguistic features” (ibid.), this thesis has only focused on one feature; the elemental third turn in the minimal sequence. Analysis has shown that its prevalence in the data is notable, and indeed pervasive. The three-turn minimal sequence is not restricted to any particular operation or phase of the flight. Rather, it seems to be resulting from the severe modal restrictions placed on Astrospeak by R/T. In addition, the complex subject matter of Astrospeak may have a role in its inclusion, as well. It can be rightly argued, therefore, that the three-turn minimal sequence serves a functional role in the Astrospeak register. This answers the first thesis question: The minimal sequence structure of Astrospeak seems to be three turns when the first turn is a question and the second turn contains some tangible information. Otherwise, the minimal structure seems to be an adjacency pair.

Studies in Institutional CA still rely heavily on the foundations of ‘ordinary’ CA. However, the evidence seems to suggest that institutional restricted registers tend to have structural characteristics which differ from the paradigms laid out by research into everyday talk. If CA and Institutional CA studies produce highly different findings about the fundamental nature of interaction, as they seem to, the logical determination would be to form new paradigms specifically for institutional talk. Currently, many institutional CA studies clash with some of the basic elements of social interaction suggested by ‘ordinary’ CA. The solution could be separating the two research traditions further by implementing new methodologies and identifying distinct basic elements of institutional registers or LSPs. Such undertakings are far beyond the scope of this thesis but growing the body of research on institutional register structures and contrasting them with CA paradigms could produce fascinating future studies in the field. This seems to answer the second thesis question regarding the relationship of findings to CA and ICA – the findings were achieved using conventional CA frameworks but seem to contradict the commonly accepted results of ‘ordinary’ CA studies. In contrast, the findings are similar as in other studies (Kevoe-Feldman 2012), which have also combined an institutional register with a common CA approach.

The data seems to validate some of the discussion on the institutional roles of Astrospeak in chapter 2. Although a throughout and definite analysis of the institutional roles of Astrospeak cannot be performed here, there is still enough evidence of them in the data to warrant a debate between CA and ICA. The failure to fully explore the institutional roles of participants in Astrospeak transcripts could hinder the strength of the thesis’ comparison between them. However, the analysis has a strong connection to other institutional talk characteristics given by Clayman & Heritage (2010: 34), namely the context-specific constraints for talk and the procedural inferences for systems operation and mission success. The contextual constraints have been already extensively discussed. An exploration of context-specific inferences of interaction, however, provides an additional perspective to Astrospeak as an institutional register. By establishing the concept of *procedurality,* these inferences and the connection of interaction and action can be perhaps understood better.

The term *procedural* has been used in prior research to describe registers which procedurally follow set steps, such as recipes or installation manuals. These registers are highly rigid and do not offer much evidence about the interactive nature of language. In Astrospeak data, checklist-assisted operations closely resemble such rigid procedures. Because of their rigidity, they are not central to the aims of the thesis. However, the concept of procedurality can be expanded to explain interactional structure, at least in some LSPs. It has been already determined that LSPs are domain-specific and thus heavily influenced in form by their use contexts. These contexts are unique for every LSP and cannot be used to form generalizations about the nature of restricted registers. The introduction of procedurality as a descriptive concept may provide a basis for forming some generalizations, however. Such generalizations would offer intriguing possibilities for expanding ICA frameworks or analytic tools for LSP research. The conceptual background for procedurality is derived from the field of programming languages and has not been used in this sense in discourse studies.

Procedurality can be seen to an extent in all human communication but restricted languages, and especially restricted radiotelephony languages, are dependent on it for successful practice of communication. For ICA aims, procedurality allows the identification of embedded inferences in talk, i.e. the goal-orientation of R/T languages as institutional registers is evident in the procedural nature of communication structure. Procedurality, as defined here, is meant for descriptive purposes. The thesis argues that procedurality is an important attribute of LSPs, but it is not meant as an all-encompassing explanation for the nature of such registers. The following paragraphs will define procedurality in languages, emphasize its importance in LSPs and subsequently validate the need for it in ICA.

As mentioned above, the term 'procedurality' is lifted from the field of programming languages. The scope and limits of the thesis do not allow for a lengthy review of its meaning in computer sciences, but its main principles are easily transferable to human-to-human communication. Programming languages are the tools for software developers to construct new software and computer programs, as well as essentially working with computers. Procedural languages are a subset of programming languages; a varied group which shares the main basic ideas. In brief, The Institute for Information Systems and Computer Media of the University of Graz (IICM) defines the wide array of procedural programming languages "essentially [being] based on concept of so-called "Modules" also known as "Functions", "Procedures" or "Subroutines"." (IICM 2002: 14). In other words, the procedural languages consist of an archive of existing pieces of commands which can be combined to form new software with little new code necessary. This means that building new software is a streamlined process because the programmer does not have to start writing the code from the beginning, but rather they may call up existing procedures. This process can be compared to assembling a puzzle depicting a flower arrangement compared to painting the flowers from scratch.

Such concept of procedurality can be understood in human interaction context, as well. Although the contents do not vary in procedures of programming languages, they do in human communication. However, Mudraya notes that generally "language consists of 'chunks' which, when combined, produce continuous coherent text, and that only a minority of spoken sentences are entirely novel creations" (2006: 236). When the restricted nature of LSPs is considered, this phenomenon is emphasized and arbitrary inputs into conversation are discouraged. The analysis has shown that aside from some content variation, Astrospeak seems to be constructed of a relatively rigid set of accepted phrases and structures. These utterances and sequences can be viewed as similar 'procedures' or 'modules' as the ones in programming languages discussed above. Such rigidity in conversation is nothing new, of course; pair-type relation rules dictate that utterances in conversation must adhere to the adjacent utterances (Schegloff 2007: 13), thus essentially restricting interaction. This restriction is obvious in LSPs or institutional registers, but special emphasis must be placed on the "inferential frameworks and procedures that are particular to specific institutional contexts" (Clayman & Heritage 2010: 34). As discussed, sequences of talk are used to perform an action. Sequences of *institutional* talk are used to perform an action that is very domain-specific. In addition, the sequence design is restricted by the institutional context in which the action is to be performed. Such rigidity means that operations can be performed if participants adhere to a procedural, i.e. step-by-step approach without divergence from the accepted structure.

For this thesis, procedurality refers to the rigid performance of operations by means of LSP use. It must be noted that all conversations contain a degree of procedurality; most discourse-related studies are based on the notion that utterances are arranged in a predictable pattern to attain a certain goal. However, studies concentrating on 'ordinary' conversations must contain clear provisions for open-endedness. For LSPs on the other hand, a violation of procedural structures presents severe hindrances for successful communication. R/T languages such as Astrospeak are especially vulnerable to such violations. The analytical sections of this thesis delve into these communicative problems and restrictions in depth with the support of data, but even before looking at the evidence, the need for a rigid communication system, mainly consisting of procedural components or modules is clear. Because of the complexities of spaceflight (see chapter 2), there is a need for a set group of acceptable utterances in reaction to the sequence initiation. These rules may not be flouted or violated, or else successful completion of communicative sequences cannot be attained. To some extent, the contextual requirements move LSPs closer to the rigid systems of programming languages (computers cannot think and thus the form of communication between machine and operator are set), even though they still are natural languages with a certain degree of open-endedness. This connection validates the application of procedurality to LSP studies. Such an approach also answers to the third thesis question on how 'procedurality' can explain LSP-specific language use.

Here, the discussion returns to the institutional talk characteristics posited by Clayman & Heritage (2010). Procedurality in R/T languages has been shown to ensure successful interaction in a challenging communicative environment. A step-by-step approach to language use means that communicative options are limited to a set of accepted utterances in certain situations. This is tied to the institutional roles of the participants. As discussed, Astrospeak seems to be placed between the open-endedness of 'ordinary talk' and the strict closed nature of programming languages. The roles of participants reflect this continuum, as well. The institutional roles seem to be tied to the institutional imbalance between participants. In everyday conversation, the balance is quite even (possible imbalances being implicit). In programming languages, all the power to steer the interaction is on the human operating the computer. Astrospeak can be placed in between the two on a power imbalance continuum:

Figure 1. The continuum of increased imbalance in participant influence on interaction in ordinary talk, Astrospeak and programming languages

'Ordinary talk'

Participant A: Initiates conversational sequences freely, no explicit dominance over other participant

Participant B: Responds to initial turn according to pair-type relationship, renews conversational context freely

Astrospeak

Participant A, mission control: leading role, issues commands and dictates most crew actions, explicit dominance over crew according to mission rules, reacts to crew observations

Participant B, spacecraft crew: operates spacecraft systems under the guidance of mission control, observes environment and systems, reports observations to mission control, may operate systems independently if needed

⬇

Programming languages

Participant A, operator: Total control of interactive situation, explicit dominance

Participant B, machine: Works according to operator input, no independent role in interaction

This continuum correlates well with prior research into LSPs. Danet (in Gotti 2011: 12) calls restricted spoken languages spoken-composed languages. As the figure above shows, restricted languages such as Astrospeak are 'intermediate' forms of talk; not as open as everyday registers, but not totally closed as programming languages. The conversational imbalances reflect this position.

8 Conclusion

The hypothesis of this work was that the sequential structure of Astrospeak shows a preference for a three-turn minimal sequence. Based on the analysis, this is partly true. Initial turns which inquire something and thus trigger a response which answers to the inquiry, also trigger a third, verifying turn after the response. Initial turns which do not call for a response with any tangible information content, do not seem to trigger that verification turn. It is therefore impossible to argue that all Astrospeak conversations prefer a three-turn minimal sequence as the base building block of interaction. However, recognizing that a certain turn type does trigger a three-turn sequence is a meaningful result. As a register analysis, the thesis has shown that the three-turn minimal sequence is a pervasive feature of Astrospeak, which arises from the functional needs of the use context, such as R/T constraints and institutional inferences.

This thesis is not refuting the evidence that supports the presence of a minimal two-turn adjacency pair as the basic structural element of conversation. However, it calls into question the universal applicability of such a claim. Prior research has shown that in some situations, the lack of a third turn in a basic sequence causes the interaction to lose something elemental. This is supported by the findings of the analysis of Astrospeak data in this thesis. The requirements for a three-turn minimal sequence seem to be context-related. For Astrospeak, the third turn exists almost always as a verification turn – a natural part of R/T communication procedures. The analysis shows that when a conversational sequence is triggered by an initial turn requesting some information from the responding participant, a third turn is used by the initiating participant to verify the completion of the interaction. At first this seems inconsequential, but requirements and restrictions to language use in spaceflight contexts help explain the need for this final elemental turn. A similar pattern is attributed to institutional influences by Kevoe-Feldman & Robinson (2012).

The specialized English register of spaceflight, Astrospeak, has not before been explored by linguists. Therefore, future research has numerous paths towards better understanding this historically significant but still very much alive variety. This thesis has established that inquisitive turns seem to trigger a three-turn minimal conversational sequence, but a more detailed analysis of turn types might be necessary to offer support for this finding. As a register analysis, the thesis lacks an exploration of pervasive features outside the minimal sequence structure. A review of abbreviated lexis or repair mechanisms could amend the register description provided by this thesis. In addition, the thesis has offered a discussion about the institutional qualities of Astrospeak. While the general institutional aspects are explained and understood in this thesis, future research could perhaps combine mission rules analysis with institutional talk evidence to strengthen these findings. In general, Astrospeak offers and intriguing data source for a variety of linguistic studies. NASA's archives offer over 40,000 pages of transcripts, most of them unused in prior research. They present an opportunity to e.g. understand R/T lexis better or to explore grammatical density in specialized talk. To poetically interpret Matthiessen's pursuit of mapping registers (2015), Astrospeak is a newly-discovered island in the ocean of English-based registers.

In a broader sense, the thesis argues that institutional registers may require specialized ICA tools in future research. Many studies, including this one, have established that institutional effects on language seem to cause the register in question to take forms which conflict 'ordinary' talk rules. A logical reaction to this finding would be to begin forming new frameworks dedicated to institutional conversation analysis. This endeavor, however, requires more studies which expose the supposed rift between CA methodologies and institutional register evidence. The concept of procedurality was discussed briefly in chapter 7, to establish it as a viable descriptive concept in LSP studies, much more work is needed.

Overall, the thesis has been the first serious linguistic endeavor into the language of spaceflight, Astrospeak. This is valuable in its own right; each register of language that can be brought to the sphere of discourse studies can further the understanding of human behavior and language use. The aims of the thesis have been fairly limited as is necessary for a realistic scope in an MA thesis. As a linguistic first, however, the effort has been rather more meaningful. For this reason, it is fitting to conclude with a quote from the Apollo 12 mission transcripts, uttered when CDR Pete Conrad stepped on the surface of the Moon.

```
04 19 22 16        CDR-EVA  Whoopie!  Man, that may have been a small one for
                            Neil, but that's a long one for me.  I'm going
                            to step off the PAD.
```

Excerpt 44. (AS12_TEC p. 406)

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Appendix 1: Finnish summary

Keskustelusekvenssit astronauttien ammattikielessä

Kun Neil Armstrong ja Edwin Aldrin laskeutuivat Kuun pinnalle heinäkuussa 1969, media kertoi heidän ensimmäisiksi sanoikseen: ”Kotka on laskeutunut”. Tosiasiassa astronautit viestivät ensitöikseen lennonjohtoon kuumoduulin järjestelmien ja moottorin statuksen hyvin teknisellä erikoisenglannilla. Tämä tutkielma keskittyy astronauttien käyttämään erikoiskieleen, jota kutsutaan nimellä *Astrospeak.* Tutkielmassa käytetään transkriptioita Apollo 12-lennon radioliikenteestä aluksen miehistön ja lennonjohdon välillä. Aiempi kielitieteellinen tutkimus ei ole soveltanut kyseistä lähdettä, joten tutkielma on lähdemateriaalinsa osalta pilottiluonteinen. Transkriptiot ovat alun perin tehty USA:n avaruusjärjestö NASA:n toimesta lentoteknisiin tarkoituksiin, mutta ne julkaistiin vuonna 2010 NASA:n verkkosivustolla yleiseen käyttöön.

Tämän tutkielman tarkoituksena on tarkastella Astrospeakin sekvenssirakennetta keskusteluntutkimuksen metodologiaa käyttäen. Aiempi tutkimus on suurilta osin perustunut ajatukselle, jonka mukaan kielen laajentamaton perussekvenssi koostuu kahdesta puheenvuorosta (*adjacency pair).* Erityisesti institutionaalisiin kieliin kohdistuneet tutkimukset ovat kuitenkin haastaneet tätä käsitystä (esim. Kevoe-Feldman & Robinson 2012). Myös tämän tutkielman hypoteesina on, että Astrospeakin perussekvenssi koostuu kahden sijaan kolmesta puheenvuorosta. Tutkimuksen teoreettisena perustana käytetään yleisen keskusteluntutkimuksen tuottamia viitekehyksiä ja teorioita. Niiden avulla pyritään selvittämään mikä on Astrospeakin sekvenssirakenne. Lisäksi tutkielman keskiössä on institutionaalinen keskusteluntutkimus (*ICA),* jonka avulla voidaan selittää erikoiskielten ominaispiirteitä. Tutkielmassa vertaillaan yleistä ja institutionaalista keskusteluntutkimusta ja pohditaan niiden soveltuvuutta Astrospeakin analysointiin. Tärkeässä osassa on myös kyseisen varieteetin määrittely ja asemointi muihin erikoiskieliin nähden.

Tutkielma etsii vastauksia seuraaviin tutkimuskysymyksiin: 1) Mikä on Astrospeakin perussekvenssirakenne ja miten sen käyttökontekstin rajoitteet vaikuttavat rakenteen syntyyn, 2) Miten löydökset voidaan asemoida keskusteluntutkimuksen kahden pääasiallisen tutkimussuunnan suhteen ja 3) Miten *proseduraliteetin* käsitettä voidaan käyttää parantamaan erikoiskielten kuvauksia tulevissa tutkimuksissa. Keskustelun- ja erikoiskielten tutkimuksen viitekehykset korostavat kontekstin merkitystä kielen muotojen kehittymiselle. Siitä syystä tutkielmalle on oleellista selvittää Astrospeakin kontekstuaalinen pohja. Astrospeakin pääasiallisena kontekstina toimii avaruuslento. Se vaikuttaa kielen ilmenemismuotoihin monin tavoin. Esimerkiksi lennonjohdon ja avaruusaluksen etäisyys rajoittaa monia luonnollisia keskustelun aspekteja, kuten sanatonta viestintää. Kontekstuaalisiin rajoitteisiin voidaan laskea myös avaruuslentojen institutionaaliset ulottuvuudet. Ensisijaisesti tällä tarkoitetaan sitä, että jokaisella miehistön ja lennonjohdon jäsenellä on lennon aikana oma tehtävänsä, joka heijastuu myös kielenkäyttöön. Kuulentojen tekniset ja teoreettiset haasteet näkyvät Astrospeakin informaatiotiiviissä rakenteessa.

Astrospeak on englannin kielen varieteetti, joka on muotoutunut sen käyttäjien tarpeiden, sekä käyttökontekstinsa vaatimusten ja rajoitteiden mukaisesti. Yleisesti kielen varieteetit jaetaan murteisiin ja rekistereihin. Murre viittaa yksilölliseen kielen variaatioon, mutta rekisterillä tarkoitetaan kielen muotoa, joka on yhteydessä tiettyyn kontekstiin tai sosiaaliseen tilanteeseen. Rekisterin konseptin toi diskurssintutkimukseen M.A.K. Halliday, joka määritteli myös kielen muotoa muokkaavat kolme kontekstin ulottuvuutta: alan, osallistujaroolit ja muodon. Alalla tarkoitetaan rekisterin yleistä kontekstia, eli sitä missä sosiaalisessa ympäristössä kieli esiintyy. Osallistujarooleilla viitataan osallistujien vaikutukseen kielenkäytössä. Muoto tarkoittaa kielen ilmenemistä kontekstissa, eli esimerkiksi onko se puhuttua vai kirjoitettua tai muodollista vai epämuodollista.

Rekisterin käsite voidaan laajentaa koskemaan kaikkia kielen varieteetteja. Crystal ja Davy (1969) kritisoivatkin käsitettä sen avoimuuden ja abstraktiuden vuoksi. On selvää, että kaikissa sosiaalisissa tilanteissa kontekstin merkitys on huomattava. Sen merkitys kuitenkin korostuu ammatti- ja erikoiskieliä tutkittaessa. Erikoiskielen määritelmä pohjautuu J.R. Firthin näkemyksiin rajallisista rekistereistä; kielen varieteeteista, jotka ovat eksplisiittisesti rajattuja käyttökontekstinsa vuoksi. Myöhemmin nämä varieteetit nimettiin erikoiskieliksi (*languages for specific purposes).* Erikoiskielet ovat rekisterejä, jotka eriävät muodoltaan 'tavanomaisista' kielen varieteeteista. Bhatian (2008) mukaan esimerkiksi ammatillisilla konteksteilla on erityisiä piirteitä, jotka heijastuvat myös kieleen, jota kyseisessä kontekstissa käytetään. Erikoiskielen sijaan keskusteluntutkimus on usein käyttänyt termiä 'institutionaalinen kieli'. Sen määritelmät ovat yhteneväiset erikoiskielen kanssa, mutta sen yhteydessä korostetaan usein käyttäjien institutionaalisia rooleja, jotka vaikuttavat kielen muotoon. Institutionaalinen keskusteluntutkimus pohjautuukin yleisen keskusteluntutkimuksen periaatteiden lisäksi institutionaalisten kielten kontekstuaalisiin rajoitteisiin ja vaatimuksiin.

Astrospeakin kannalta merkittävin kontekstuaalinen rajoite on sen käyttömuoto. Astronautit ja lennonjohto käyttävät viestinnässään radioliikennettä (*R/T),* joka asettaa kommunikoinnille monia haasteita. Radioliikennekielet, kuten Astrospeak, ovat kehittäneet rakenteeseensa muotoja torjumaan esimerkiksi radioliikenteelle tyypillistä prosodisten elementtien puutetta. Myös keskustelun sekvessirakenne kokee radioliikennekielissä muutoksia: Radioaaltojen epäluotettavuuden vuoksi keskusteluihin on lisätty redundantteja puheenvuoroja, jotka toistavat edellisen puhujan viestin. Näin voidaan taata, että alkuperäinen puheenvuoro on kuultu ja ymmärretty oikein. Yleisesti radioliikennekieliä leimaavat tiiviys, radioliikennefraasien kuten kutsumerkkien käyttö sekä sisäänrakennettu redundanssi. Tutkielman kontekstuaalinen osuus selvittää Astrospeakin ja radioliikenteen suhdetta yksityiskohtaisesti.

Tutkielman kielitieteellinen pohja koostuu keskusteluntutkimuksen teorioista ja viitekehyksistä. Keskusteluntutkimus perustuu ajatukselle, jonka mukaan kaikki ihmisten välinen kielellinen interaktio perustuu tietyille normeille ja rakenteille, jotka voidaan analyyttisesti selvittää. Claymanin ja Heritagen mukaan keskusteluntutkimuksen pääasiallinen tavoite on selvittää syitä ihmisten valinnoille heidän keskustellessaan toisten ihmisten kanssa (2010: 14). Keskusteluntutkimusten spektri on laaja ja varioi vahvasti tutkimuskohteena olevien ilmiöiden osalta. Tämä tutkielma keskittyy perussekvensseihin; puhejaksoihin, jotka koostuvat kahdesta tai useammasta puheenvuorosta, ja joilla on selkeä alku ja loppu. Perusajatuksena on keskustelun rakentuminen kerroksellisesti. Yleisesti ottaen puheenvuoro on sekventiaalisesti pienin keskustelun elementti, joskin sen sisältä on mahdollista löytää vieläkin pienempiä merkityksellisiä elementtejä. Puheenvuorot muodostavat sekvenssejä, jotka vuorostaan voivat muodostaa pidempiä jaksoja, esimerkiksi kokonaisia keskusteluja. Perussekvenssit ovat laajentamattomia, eli niihin ei ole liitetty ylimääräisiä puheenvuoroja. Laajennukset saattavat esiintyä ennen sekvenssin puheenvuoroja, niiden välissä tai niiden jälkeen. Laajennuksien sisältö muokkaa keskustelun etenemistä, mutta välitetyn informaation osalta ne ovat eksplisiittisesti ylimääräisiä puheenvuoroja.

Laajentamattomien perussekvenssien mitasta on käyty keskusteluntutkimuksen kentällä debattia. Yleisesti mittana pidetään kahta puheenvuoroa, eli minimiparia. Esimerkiksi Schegloff (2007: 13) näkee minimiparin keskustelun perussekvenssinä. Useat erikoiskieliä ja institutionaalisia rekisterejä tutkineet kielitieteilijät ovat kuitenkin osoittaneet, että keskustelun perussekvenssi koostuu heidän aineistoissaan kolmesta puheenvuorosta, jolloin minimipari olisi jollakin tavalla puutteellinen sekvenssi. Esimerkiksi Kevoe-Feldmanin & Robinsonin (2012) mukaan elektroniikkaliikkeen asiakaspalvelussa tiettyjen keskustelutilanteiden perussekvenssi on kolmen puheenvuoron mittainen. Tutkielman hypoteesi on, että myös Astrospeakin perussekvenssi noudattaa kolmen puheenvuoron rakennetta kontekstuaalisista syistä johtuen. Institutionaalisten rekisterien analyysi on suosittua keskusteluntutkimuksen saralla, mutta instituutiospesifien teorioiden muodostus on jäänyt vajavaiseksi. Kolmen puheenvuoron perussekvenssi erikoiskielissä saattaa tarjota hyvän mahdollisuuden siihen.

Tutkielman analyyttinen osuus sitoo yhteen Astrospeakin kontekstuaalisen taustan, institutionaalisten rekisterien ja radioliikenteen rajoitteet kielenkäytölle sekä keskusteluntutkimuksen oleelliset teoriat ja viitekehykset. Analyysi kulkee samanaikaisesti kahta rinnakkaista väylää: Primäärifokuksena on Astrospeakin sekvenssirakenne. Tähän sovelletaan mm. Schegloffin käsitteistöä. Tarkoituksena on selvittää löytyykö kolmen puheenvuoron perusrakenteen hypoteesille todisteita aineistosta. Rakenteellisen analyysin ohella tutkielma keskittyy Astrospeakin rekisterianalyysiin, eli käytännössä sen käyttökontekstin ja rakenteen välisen suhteen analysointiin. Lopputuloksena on siten Astrospeakin minimirakenteen kuvaus, mutta myös Astrospeakin funktionaalinen rekisterikuvaus, eli vastaus siihen, miksi Astrospeak on kehittänyt sekvenssirakenteensa. Rekisterianalyysi pohjautuu Biberin ja Conradin (2009) malliin. Kaksitasoisella analyysillä pyritään vastaamaan mm. Bhatian (1993) esittämään kritiikkiin, jonka mukaan rekisterien analyysit ovat yleisesti epäonnistuneet rakenteiden funktioiden selittämisessä.

Analyysissä käytetään Apollo 12-kuulennon radioliikenteen transkriptioita. Biberin & Conradin rekisterianalyysimallin (2009) mukaisesti transkriptioita tarkastellaan lyhyissä jaksoissa, joista havaitut toistuvat rakenteet voidaan heijastaa koskemaan koko rekisteriä. Analyysi rajoittuu otteisiin vain yhden lennon transkriptioista, sillä tutkielman rajoitukset eivät salli yhteensä n. 40 000 sivun aineiston käsittelemistä. Transkriptio-otteet ovat integroitu analyysiin kuvina, jotta mahdolliset kirjausvirheet saadaan minimoitua. Aineiston rajallinen käsittely on pyritty pitämään mielessä johtopäätöksiä esiteltäessä. Rekisterianalyysin periaatteiden mukaisesti se ei kuitenkaan estä merkityksellisten rakenteiden havaitsemista. Tutkimus voidaan toistaa samoin loppupäätelmin myös muiden Apollo-lentojen transkriptioita käyttäen.

Analyysikappaleet perustuvat rakenteellisesti kolmen puheenvuoron perussekvenssi -hypoteesille. Sen mukaisesti transkriptio-otteita käsitellään vuoro kerrallaan; aloittava vuoro, vastaava vuoro ja viimeinen vuoro analysoidaan erikseen kronologisessa järjestyksessä. Vuorojen ohella analyysiin liitetään keskustelua vuorojen laajentamisesta jokaisessa kolmessa positiossaan. Ensimmäiset vuorot aloittavat sekvenssin ja määrittävät vahvasti sen sisältöä. Aloittavien vuorojen jälkeisten vuorojen on liityttävä aloittavaan vuoroon keskustelun parirelevanssin periaatteiden mukaisesti. Tämä relevanssi on oleellinen myös Astrospeakin sekvenssirakennetta tarkastellessa. Kolmen puheenvuoron sekvenssejä analysoitaessa aloittavan puheenvuoron sisältö nousi määrittäväksi tekijäksi: Jos aloittava puheenvuoro oli avoin kysymys, sekvenssi otti kolmivuoroisen rakenteen.

Muunlaiset havaitut vuorot, kuten esimerkiksi käskyt ja havainnot eivät tuoneet esille kolmatta vuoroa vaan sekvenssit näyttivät järjestyvän minimiparimallin mukaisesti.

Aloittavat puheenvuorot määrittävät vastauspuheenvuoroa parirelevanssin mukaisesti. Astrospeakin perussekvenssien analysointi osoitti, että avoimet kysymykset näyttävät johtavan kolmen vuoron sekvenssiin. Täten vastauspuheenvuorojen on myös pidettävä sisällään jotakin, joka johtaa kolmannen vuoron esiintymiseen. Vastauspuheenvuorojen analyysi osoitti, että kolmivuoroinen sekvenssi esiintyy silloin, kun vastauspuheenvuoro sisältää merkityksellistä tietoa kyllä/ei -vastausta monimutkaisemmassa muodossa. Suljettu kysymys ei näytä edellyttävän kolmen vuoron sekvenssiä, sillä vastaus siihen on yksinkertainen. Monimutkaisempi vastaus sen sijaan näytti johtavan kolmanteen vuoroon hyvin usein.

Kolmannet vuorot esiintyvät aineistossa kontekstuaalisten vaatimusten vuoksi. Avoin kysymys tuottaa vastauspuheenvuorossa avoimen vastauksen, jota ei pystytä ennakoimaan samalla tavalla kuin esimerkiksi suljetun kysymyksen kohdalla. Radioliikenteen haasteiden ja institutionaalisten rajoitteiden vuoksi Astrospeak vaatii redundanssia ja radioliikennekonventioiden noudattamista. Kolmas vuoro esiintyykin aineistossa lähes yksinomaan verifikaatiovuorona. Sen sisältö ei oleellisesti muutu kolmen vuoron sekvensseissä, vaan sen puhuu yleensä sekvenssin aloittaja reaktiona vastauspuheenvuoroon. Yleisimmät kolmannen puheenvuoron muodot ovat ”okay” ja ”roger”. Ilman verifikaatiota vastaaja ei voi olla varma välittyikö hänen vastauksensa vastaanottajalle kommunikaatiokanavan epäluotettavuuden vuoksi. Kolmannen puheenvuoron esiintyminen kyseisessä kontekstissa on aineistossa laajaa, vastaten siten Biberin & Conradin (2009) määritelmää toistuvasta kielellisestä ominaisuudesta.

Tutkielman loppupäätelmien osalta oleellisessa osassa ovat kaksi eriävää suhtautumista kolmansiin puheenvuoroihin. Schegloff (2007) näkee kolmannet vuorot minimaalisina laajennuksina. Hänen mukaansa verifikaatiomalliset kolmannet vuorot eivät sisällä tietoa, joka olisi oleellista sekvenssin perusrakenteelle. Kolmannet vuorot ovat siten ylimääräisiä sekvenssin osia. Analyysin perusteella voidaan kuitenkin esittää eriävä näkemys. Astrospeakissa avoimien kysymyksien kohdalla esiintyvät kolmannet puheenvuorot eivät muodoltaan eroa minimilaajennuksista, mutta niiden rooli on kontekstuaalisten rajoitteiden vuoksi oleellinen. Kolmivuoroinen sekvenssirakenne on samankaltaisissa keskustelukonteksteissa toistuva, joten sitä ei voida hylätä satunnaisena kielenkäytön muotona. Rakenteen toistuvuus yhdistettynä sen rooliin keskustelun kontekstissa määrittävät sen fundamentaalisen luonteen Astrospeakissa – avoimella kysymyksellä alkava sekvenssi tarvitsee kyseisessä englannin varieteetissa kolme puheenvuoroa.

Astrospeakin sekvenssirakenne voidaan selittää funktionaalisesti rekisterianalyysin periaatteita noudattaen. Radioliikenteeseen nojaava kommunikointi on luonteeltaan epäluotettavaa, joten keskustelun rakenteeseen on sisällytettävä mekanismeja, jotka vähentävät esimerkiksi kommunikaatiokatkosten uhkaa. Kolmen vuoron sekvenssi on toistuva rakenne, jonka olemassaolo pohjautuu rekisterin kontekstuaalisiin rajoituksiin. On kuitenkin todettava, että tutkielman hypoteesi ei pitänyt täysin paikkaansa. Sekvenssit, jotka eivät alkaneet avoimella kysymyksellä johtivat lähes poikkeuksetta minimiparirakenteeseen, kolmivuoroisen sekvenssin esiintyessä ainoastaan tarkasti rajatussa kontekstissa. Tästä huolimatta löydökset muistuttivat läheisesti esimerkiksi Kevoe-Feldmanin & Robinsonin löydöksiä institutionaalisen rekisterin osalta.

Astrospeakin kolmen sekvenssin rakenne tarjoaa lisätodisteita institutionaalisen keskusteluntutkimuksen erityislaatuisuuden argumentin puolesta. Löydösten pohjalta voidaan perustellusti pohtia vaatiiko erikoiskielten keskusteluntutkimus erityisiä teoreettisia viitekehyksiä. Uusien viitekehysten luominen on tutkielman rajoitukset huomioon ottaen liian suuri haaste. Tutkielmassa kuitenkin esitellään proseduraliteetin käsite, jolla viitataan erikoiskielten vahvasti strukturoituun keskustelun etenemiseen. Proseduraliteetti on toistaiseksi puhtaasti deskriptiivinen termi, joka on otettu diskurssintutkimuksen käyttöön ohjelmointikielten analyysistä. Proseduraliteetilla voidaan korostaa erikoiskielten ja institutionaalisten rekisterien keskustelurakenteiden jäykkyyttä ja niiden sisäänrakennettuja redundansseja.

Loppupäätelminä voidaan todeta, että Astrospeakin kolmivuoroinen sekvenssirakenne esiintyy sekvensseissä, jotka alkavat avoimella kysymyksellä. Syynä tähän voidaan perustellusti pitää rekisterin kontekstuaalisia rajoitteita; Astrospeakin asiasisältö ja kommunikaation kanava määrittävät tarpeen keskustelurakenteen toistoa ja redundanssia korostavalle luonteelle. Muissa sekvensseissä vastauspuheenvuoro ei sisällä tarpeeksi informaatiota, jotta verifikaatiopuheenvuoroa esiintyisi. Tutkielman luonne on ollut pilottiluonteinen, joten esimerkiksi puheenvuorotyyppien luokittelua voidaan jatkaa ja täsmentää tulevissa tutkimuksissa. Muita potentiaalisia lähestymistapoja tuleville tutkimuksille tarjoaa esimerkiksi Astrospeakin erikoistuneen sanaston tutkimus. Rekisterianalyysinä tutkielma on keskittynyt ainoastaan sekvenssirakenteeseen, joten moni toistuva Astrospeakin kielellinen ominaisuus on jäänyt tunnistamatta. Suuremmassa mittakaavassa tutkielma on pyrkinyt korostamaan tarvetta erikoistuneille teoreettisille viitekehyksille institutionaalisen keskusteluntutkimuksen alalla. Tutkielma on ollut ensimmäinen kielitieteellinen tutkimus käyttäen Apollo-lentojen radioliikennetranskriptioita ja astronauttien ammattikieltä tutkimusaineistona. Pelkästään se riittää syyksi tarkastella Astrospeakia lisää tulevaisuudessa.