

Landmarks in the Communication of Route Directions

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Abstract. We investigate the understanding of landmarks using a model of embedding procedures that sees affordances established on three levels. On the first level there are landmark experience and direct communication process as distinct affordance structures. On the second level the initial landmark experience has become part of the speech act thus establishing direct wayfinding communication. On the third level the communication situation of the speech act incorporating the landmark experience is changed into indirect communication thus transforming into a narrative. We apply the leveled model of narrative structure to human generated route directions. We demonstrate how the initial experience – the landmark – is incorporated into communication structures, how it turns into a narrative in order to secure understanding and how understanding is guided via narrative structures. With this approach from Literature we contribute to the problem of in-depth natural language understanding. Ultimately our interest is in automatic generation of route directions. We will show that simply referring to landmarks in route directions is not sufficient for successful communication.

Introduction

Landmarks are essential parts of wayfinding directions and any communication about space. In the research literature we find a thorough body of publications about the role of landmarks for wayfinding from a cognitive point of view. The focus is on landmark selection and on the interaction between subject (the wayfinder) and object (the landmark) in the orientation process. In contrast, this paper will investigate for the first time how landmarks are incorporated in spoken and written narratives. Route directions given by humans as well as by services have to be considered as narratives if the communication situation is lacking the direct interaction of two individuals. Hence, understanding the structure of narratives is a prerequisite of designing navigation services that include landmarks in their route instructions. Specifically we will show that it is insufficient for successful communication to simply name landmarks in route instructions. As Mark and Gould state: “Many of the properties and principles related to the understanding of fictional narrative apply to verbal wayfinding directions as well” (Mark and Gould 1995, p. 388). However, their interest is in cross-linguistic aspects, whereas our goal is a better understanding of the communication process itself. Our case study is a human generated route instruction, which will be used to exemplify a leveled model of narrative structure. A sound

theory of the communication process will enable navigation services to more effectively deliver the message.

This paper develops an analytical approach to the *structural position* of landmarks in narrative wayfinding communications. In this way, it is the first time that a structural approach to the communication of landmarks has been undertaken. We believe that our investigations will help to clarify the interlacement of physical world, oral and mediated narrative. Thus preliminary steps will be taken to understand how wayfinding texts function and how they might be improved. Further work will be necessary to formalize and apply this model to accommodate the use of landmarks in the automatic generation of wayfinding texts.

As we will show, landmarks are subject to an embedding structure in speech acts and narratives. Landmarks themselves are products of an elemental cognitive relationship. An object becomes a landmark through the directional perceiving process of a subjective mind resulting in a spontaneous action of the individual. This action can be communicated from one individual to another, thus incorporating the previous action into a direct communication process. Furthermore each communication partner may take account of this communication about the original action either via oral or other communication media, such as writing, video, photography, or digital interaction. Submitting the original subject-object relationship to a translation process, transforming it from one structural level to another, evolves a complex structure of communication. Thus three levels of structural complexity emerge: the initial relationship between the subjective mind and the object, the direct verbal communication between two subjects and the taking account of that communication process by means of other media. By studying those three levels it will be possible to investigate the requirements of preserving the wayfinding properties of the original cognitive process between individual and object – the landmark.

This paper will present previous work to introduce the terminology used, based on literature from psychology, linguistics, narratology, and natural language processing. Then it will develop a hierarchical model of increasing verbal explicitness, starting from a holistic experience situation, passing into a speech act, and finally into a written narrative. This analytical model will be applied to a human generated wayfinding narrative, which serves as a demonstration as well as a test of the proposed method. In the last section the model will be summarized and discussed in relation to navigation services and automatically generated wayfinding narratives, and an outlook to further questions is given.

Previous Work

This section introduces the terminology for this paper by collecting concepts from different disciplines, such as psychology, linguistics, narratology, and natural language processing. It also puts Location-Based Services and landmarks in context.

The concept of *landmarks* is central. In the literature relating to this paper landmarks are not formally defined. Instead, landmarks are seen as points of reference, or, more focused, as features that are relatively better known and define the

location of other points (Presson and Montello 1988). Thus, properties that can make features prominent show distinct characteristics in relation to properties of features in the neighborhood. The red color of a building lets it be perceived as distinct in a neighborhood only as long as the other buildings have a different color (Nothegger et al. 2004). Consequently it needs a perceiving subject to use (and qualify) a distinct feature as a landmark. In the context of route directions, it is the experience of relevant distinct features along a route which make these distinct features landmarks. Several authors classify landmarks in route directions according to their relation to the route (Habel 1988; Lovelace et al. 1999; Michon and Denis 2001).

Landmarks support the building of a mental representation of an advance model of a route (Siegel and White 1975; Hirtle and Heidorn 1993; Tversky 1993). People use landmarks preferably at decision points of routes (Michon and Denis 2001), and communicate route directions by using landmarks (Daniel and Denis 1998; Denis et al. 1999; Lovelace et al. 1999). Lynch (1960) characterizes landmarks by their singularity, or contrast to the background. This is a concept from Gestalt theory (Wertheimer 1925), a reference that supports the understanding that being a landmark is a relative property. In this paper we will focus on the structures which arise through narrative communication incorporating landmarks.

Analysis of the research literature reveals a strong interest in understanding spatial perception and the related individual cognitive process (e.g., Kaplan and Kaplan 1982; Golledge 1999). Moreover linguistics investigates how spatial orientation appears in language (Jackendoff 1983). This means that either interviews are recorded of how people explain a certain way (Klein 1979; Klein 1982; Couclelis 1996; Denis et al. 1999) or concepts of location in different languages are investigated by comparing verbal expressions with spatial content (Talmy 1983; Herskovits 1986; Mark and Gould 1995). In addition there is ongoing research in modeling natural language for computerized devices, not least are navigation services (Dale et al. 2003). As communication cannot be exhaustively understood through isolated words and sentences alone, linguistic research concentrates on narrative structures (Duchan et al. 1995). In addition, the question of how to make use of accumulated data in favor of clients has led to several research initiatives employing the narrative as a device (Kim et al. 2002; Miles-Board et al. 2003; Rutledge et al. 2003).

At the same time there has been research conducted on the construction and function of narratives with a growing focus on the relation between cognitive science and narratology, and on media analysis (Ryan 1993; Herman 2003; Ryan 2003) and what it needs to model narratives (Herman 2000). Furthermore during the seventies a strong theory was developed to understand the process of understanding reading (Iser 1978). Iser builds on the speech act theory (Searle 1969; Austin 1975) and on structuralism (for a comprehensive overview see Bal 1997; Jahn 2003), on the basis of the philosophy of Roman Ingarden. Iser thus developed a theoretical approach on how reading functions, or why a reader cannot help being drawn into the experience of reading. In Linguistics an approach to narrative structures can be found in the theory of deixis outlining how coherence is established within a text (Duchan et al. 1995).

In regards to wayfinding directions the process of understanding seems to be crucial. In wayfinding communications understanding has to be non-ambiguous, otherwise wayfinding might fail. Thus there is demand for research focusing on the

seemingly passive recipient of uttered words. The ways computers understand natural language is distinct from ways how humans understand natural language. However, looking into how computers understand natural language shows us how far we have formalized what we know about human language understanding. The classical model of information communication is based on a source, a channel, and a destination, and assumes the information successfully transferred if a signal is received and decoded completely at the destination (Shannon and Weaver 1949). For explaining the understanding process of language this model comes too short. Research in natural language understanding by AI identified four levels of processing for understanding: the syntactic level (dealing with grammatical structures), the semantic level (dealing with the meaning of words and their ambiguity), the use of context (in the local and global discourse), and knowledge about the world (e.g., Winograd 1972; Allen 1987). Progress has been made on these levels in many directions, based on logical deduction and semantical networks, finally reaching story understanding to a degree that simple question about the story can be answered by the computer (e.g., Shapiro and Rapaport 1995). However, McCarthy demonstrates with an example that logical deduction is not sufficient to reach *deep* or genuine story understanding, and develops a research program for open challenges at all four levels of language understanding (McCarthy 1990). In the same direction argues Mueller in a recent literature review, stating that “the problems raised by McCarthy remain unsolved” and “it is time to return to the harder problem of [deep] story understanding” (Mueller 1998). With our approach, based on the theory of aesthetic response from Literature, we aim to contribute to the problem of in-depth natural language understanding. With this approach we start from how humans understand language, in the expectation that this will turn out to be helpful for building computer interfaces that communicate more successfully to human beings. It is open for discussion whether this contribution can also help to build computers that better understand language.

A Model of Narrative Understanding

Not always do we try to comprehend route descriptions through direct conversation. Probably we try more often to acquire understanding from written words, pictures or other devices. This means the same expectation of understanding applies even though there is no partner to be questioned. On one hand we have to make sense of what we read, hear, or see in order to find our way. On the other hand we cannot refrain from making sense when we perceive a narrative. But what we understand intuitively and what we should understand to find the right way does not necessarily coincide. Hence there must be structures generating, guiding and shaping the process of understanding. Therefore the question of landmarks in texts involves both the initial cognitive process and the way in which landmarks are incorporated in the bipolar and multilayered structure of language use.

Three questions should be asked:

- What is the initial cognitive process like?
- How is it transferred into a speech act?
- How is a speech act incorporating landmarks transferred into a narrative?

To deal with these questions the mentioned disciplines offer important approaches. Cognitive science will help to clarify the first question. The latter questions need speech act theory and narratology to provide the tools of understanding how spoken and mediated communication are related. Furthermore a theory of the process of making sense is needed to understand why we do not understand when understanding seems to be taken for granted. The approach of this paper is to point out that it is vital to analyze the *receiving part* of a communication process in order to generate comprehensibility of mediated communication of whatever kind in the future.

Landmarks can only function in the very sense of the word through the cognitive act of a subject. To mark an object out among others has to be done by an individual. It cannot be the quality of the object itself. It needs a perceiving and reflecting mind. Although its quality to stand out from its surroundings is partly due to its physical qualities complex procedures of perceiving and understanding are needed to make use of it. Therefore a landmark is an object within a relation to a subject.

The special connection between the subject and the object was identified and analyzed by Gibson. He called it affordance (Gibson 1979). Affordance is neither the quality of the object alone nor the mere perceiving action on the subject's side. The term captures the connection. There have to be structures of the object which afford the subject to do something in regard to it. Doing means both the physical and /or mental activity of the subject. Gibson concentrates on affordance of objects within a defined and stable perceiving situation. But he also states that affordance can be found in more complex situations like events and communication. Therefore the term affordance will help to understand more about the relationship of objects and subjects within communication.

It is not only the subject engaged in various affordances. The subject may talk about her experiences to another subject. Then the above outlined relationships between subject and object are embedded in a *speech act* (Wittgenstein 1963; Searle 1969; Austin 1975). According to Austin the speech act consists of three parts which have to be in place simultaneously. There has to be a physical utterance which can be understood as an encoded message. This is the *locutionary act*. The second part ensures that the recipient of the message knows what he is supposed to understand. This part is called the *illocutionary act*. And the third part tries to make the recipient do something. This is the *perlocutionary act*. All three parts happen at the same time and are not necessarily verbal. The illocutionary act needs agreement between the communicating partners, of *accepted procedures*. The perlocutionary act constructs the verbal material according to the accepted procedures in order to initiate an action on the recipient's side. The action may be both physical and mental.

Finally the speech act referring to the event of a certain wayfinding process can be accounted for without a direct conversation partner using other media. This means an additional encoding process. Thus narrative procedures come into place. The narrative can be understood as the encoded structure of a speech act. According to Iser (1978), the accepted procedures of the illocutionary act have to be made explicit to produce a narrative as there is no externally defined speech act situation. Instead there is an agent accounting for what has happened.

The elements of a narrative have to be arranged consecutively. Hence understanding develops through a step-by-step process. As there are distinct elements positioned beside each other *gaps* appear which function as initiators of the text's

reception (Iser 1978). The reader will try to fill those gaps according to the basic logic of cognitive models (Lakoff 1987). Spontaneous interrelation through the reading process is ensured; the text executes affordance.

Thus both speech acts and narratives offer structures to spontaneously involve the recipient. Therefore it can be said that they exact affordance: they make people do something meaningful.

Hence communicating landmarks means a translating process from the basic relation between a subject and an object resulting in a completed orientation procedure into a narrative making the recipient experience the initial affordance of the object and perform a similar orientation procedure without having previous knowledge of the landmarks. This can be performed in two steps of increasing complexity according to our understanding of the embedding structure of communication.

A leveled model of narrative structure

When we talk of landmarks we think of an object and a perceiving subject. Apparently a basic relationship has to be formed between the two in order to become a landmark. This relationship can be understood in the terms of Gibson's affordance. There is something on the object that fits into the physical and mental structure of the subject, into his or her subjective cognition, which triggers an action on the subject's side.

This means three constitutive structural elements can be discerned: an object, a subject and the action triggered by their interplay. It means furthermore that the term landmark apparently conveys an experience, and not a single reference to an object in the world.

Hence, when we want to communicate landmarks we have to communicate experiences. When we want to comprehend an experience of somebody else we usually try to "put ourselves into his situation". This metaphor says clearly that we try to have the same feelings, thoughts, and physical perceptions: we are ready to do something.

As stated above, communication may happen on different levels of complexity (see Figure 1). At the beginning there is the initial encounter of Ego and an object. According to the wayfinding properties of this relationship the object can be called landmark, thus depicting the affordance. This is a nonverbal process containing only the perceiving subjective person and the object with its physical properties. We will call this an experience.

Then, this initial experience may be incorporated into a speech act with two or more partners who are physically present sharing the same (not verbalized) situation. This means that the whole experience has to be put into signs and organized sequentially. The speech act being partly organized nonverbally, based on accepted procedures, provides the affordance to have a corporeal experience.

Finally the initial experience can be accounted for without a shared situation and even by means of other media. Now the situational specificities have to be accounted for by an agent. The accepted procedures have to be built-in and the agent

orchestrates them. Thus the orchestration of the accepted procedures together with the initial experience produces the needed affordance to activate the recipient’s mind.

In all three stages experiences are negotiated. At the beginning there is the initial encounter of person and object. Then the initial experience becomes part of another experience – the speech act. Thereafter the experience of a speech act merges with the initial experience and becomes an experience itself – a narrative. Thus a basic experience can apparently only be communicated by translating it into another experience either in one (speech act) or two stages (narrative). Note that this understanding of the narrative is distinct from the widespread understanding of the narrative as written speech acts. Our approach to define narrative is structural, and acknowledges the higher complexity of the communication process.

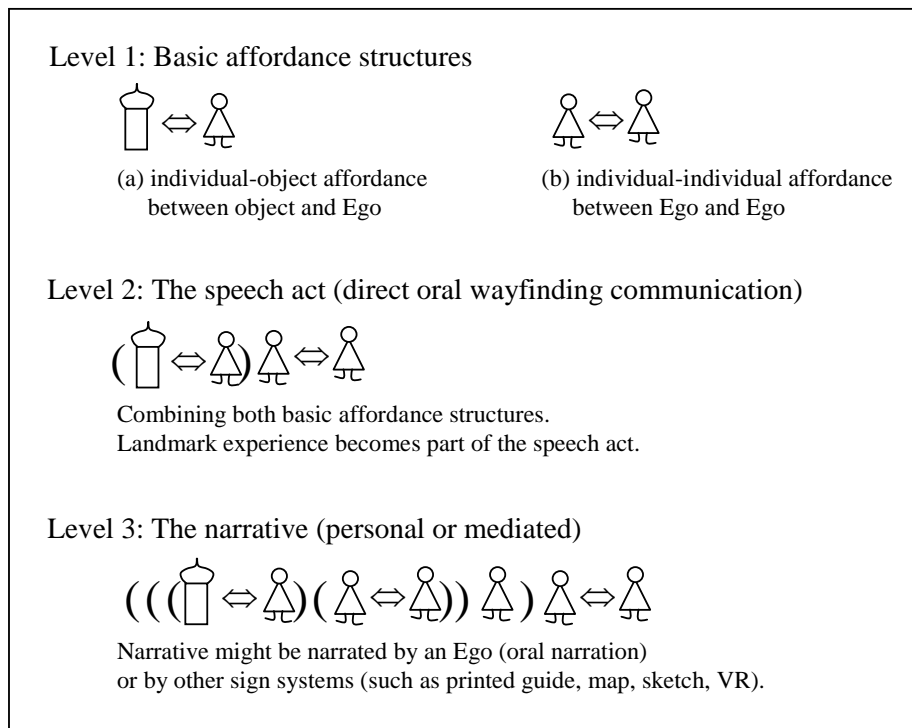


Fig. 1. The three levels of the presented model (see text).

What does this mean for the landmark? The three constituents, consisting of object, subjectivity and action, have to appear in the speech act as well as in the narrative. They have to appear in their interrelation. Neither the object nor the subject, not even both of them, is sufficient. It is not sufficient to mention three entities. It has to be the affordance which constitutes the experience and therefore has to be incorporated in verbal structures.

The subjectivity of the landmark experience will be found in strategies to make sure that the partner who makes the utterances has really had this very experience with the landmark. He will do everything (with words) to assure that he is the one to

have had that experience and to know it. This has to be understood as a mere strategic measure to express subjectivity, not as a question of personal reliability. The subjectivity of the landmark experience and the subjectivity of the uttering partner of the conversation merge into one, even if the person giving directions has not himself experienced the landmark but merely knows about it. He usually will make it explicit if he has not experienced it himself, which is a strategy in itself to transfer reliability. At the same time the subjectivity of the real person making statements about directions and objects within a speech act gives rise to doubts about whether his references to reality will be reliable. Therefore the direction giving person will additionally try to assure his personal integrity.

Two opposed goals have to be pursued to accomplish the task of transferring affordance of an initial landmark experience into a speech act: the subjectivity of the direction giving person has to be pointed out positively in order to transfer affordance, and at the same time the subjectivity has to be shown under control in order to ensure confidence of the recipient. The accepted procedures will control the sender's subjectivity by ensuring the most possible compliance between the communication partners. On this basis the perlocutionary act can be realized by pointing out the involvement of the sender and therefore being justified to expect the same experiences from the recipient. Insofar Grice's famous maxims of quality and relevance for verbal communication are also satisfied (Grice 1975).

In the written narrative affordance of the initial landmark experience will appear as the event which will be told about. As the narrative has to incorporate both illocutionary act and perlocutionary act the problem of the different subjectivities becomes even more complicated. Now the identification of the initial subjectivity with the sender subjectivity has to be brought together with measures to control the sender's subjectivity in order to be reliable. All three will appear in the same medium in consecutive units. There are no nonverbal elements any more. The recipient will read the units one after the other and try to build a continuous meaning. She will actively build *gestalts* by filling the gaps to produce connectedness. Therefore it will be very important to secure the connectability of the elements. It must be easy for the recipient to introduce his own mental images. Nevertheless it has to be a controlled production. Otherwise she will make herself a picture which does not coincide with reality elements (landmarks). This means controlling subjective activity. Now in order to rely on the transferred experiences, the subjectivity on the reader's side has to be guided. The subjectivity of the sender thus moves into the gap structure of the text. The text strategy has to provide possibilities for the reader to activate her own repertoire but at the same time limit those possibilities in order to have the desired experience.

The assuring subjectivity which transfers the initial affordance into the speech act – the identification of sender subjectivity with landmark subjectivity – will now be the focalized depiction of the initial object, subject and action. The sender of the speech act who has identified his subjectivity with the original landmark experience will now appear as the perspective on the event. The text will have a *focalizing agent* who decides in what way the object and the action will be depicted.

As a narrative always has a narrator, even though he will not always function as a focalizer (Bal 1997), the question of reliability arises again. Per se a narrative has subjectivity being an utterance whose origin cannot be identified. There are no

accepted procedures to support the communicative process outside the written text. The narrative has to produce this situation by itself. The elements which have secured the compliance of the speech act partners now appear as the repertoire to deal with. *Narrative strategies* will be employed to organize the *repertoire* in such a way that the reader may believe what she understands as meaning.

A wayfinding narrative

This section will show how the above developed analysis model can be applied to a route instruction. On the one hand the abstract model can be explained with a specific example; on the other hand the model is tested for applicability.

The following route instruction is human generated, and was given to one of the authors in a real-world wayfinding situation.

I am looking forward to your visit to my home, at Abcstrasse 33 in Münster. Here is how you will get there by bus from the train station.

*After you leave the Münster **train station** (take the main exit, “Westausgang”, not “Ostausgang”), continue across the **square** leaving the **big glass house** (containing the bike parking) on your left, and cross the **main road** at the **traffic lights**.*

*On the other side of the road, turn left in front of the first row of houses, and walk toward the last of the **bus stations** on that side (approximately 150 meters). The sign should list bus number 10, which you take (direction Mecklenbeck).*

*Enter in front of the bus (it runs every 20 minutes) and buy a ticket from the driver for 0.65 Euro (try to have small change ready!). Stay on this bus for approximately 15 minutes. It takes you through the **center of town** (watch the **Dom** on your right after 5 minutes) and along **Aasee** (the lake) to the bus station Abcstrasse (the second after a sharp turn left, away from the lake).*

*Exit and walk in the direction back to where the bus came from for 200 meters. Just across the **small intersection** with Bischofstrasse, find Abcstrasse Nr. 33, the second entrance in a **row of red brick buildings** on your right.*

Have a safe trip!

The emphasized nouns are landmarks, some of them prototypical ones (such as *train station, Dom*), others marginal ones (such as *small intersection, row of red brick buildings*). For centrality in categories see Rosch (1978) or Lakoff (1987). (Without having (or trying to give) a formal definition of landmarks, we do not claim that the identified landmarks in the text above are complete.) The landmarks can be identified because they are objects and they trigger some kind of bodily awareness in the recipient. As mentioned above the landmark consists of an object, a subject and the affordance enacted between the two. That means qualities of the object and qualities of the subject fit together in a way that perceiving process and physical action cannot be separated. Both perceiving process and physical action are part of the spatial learning process of the individual. Whenever these basic experiences are addressed the individual will produce them in her mind (Gibson 1979; Lakoff 1987). The individual will produce the sensation, not an intellectual reference.

At the same time other expressions refer to special characteristics which have had to be agreed upon before. That a train station is a building with exits, that one may travel by train at all, that a house can be made of glass, what kind of material glass is, that a square consists of intersecting streets, what traffic lights are, that buses have stations which can be found by signs, what a cathedral might look like and what is meant by a lake – by mentioning those nouns the text assumes, and thus makes explicit, the compliance between the sender of the information and his recipient. These nouns function as gaps and are elements of the repertoire at the same time. As gaps they invite the recipient to make a picture herself, as elements of the repertoire they make sure that what is said is possible. They evoke mental models, presumably prototypes, thus engaging the recipient spontaneously. Nevertheless the produced pictures will be unspecific.

In order to convert the initial affordance – the landmark and the individual experience connected to it – into a written language without an actual speech act situation, the “I – you” structure of the underlying speech act is transferred into the focalizing agent thus turning the initial experience into the event of a narrative.

The “you” provides the perspective of the narrative units. The performed actions belong to the realm of basic logic of the recipient (such as *leave*, *follow*, *cross*, *watch*). The “you” in the speech act justifies the invitational quality of the utterance by referring to the corresponding “I”. “You” cannot be understood without an “I”. That means that even when there is no actual dialog situation the recipient has to infer one spontaneously thus getting assurance that the sender knows the experiences he is telling about. The “you” as the focalizing agent of the narrative has to recall the “I” in the sense of a foreground - background relationship to substitute the lack of an actual “I”. This means furthermore that this focalizing process (and with it the transference of the speech act into a narrative) produces gaps. The recipient being a real person furnishes the gap with her personal experiences of wayfinding. Thus subjectivity on the reader’s side comes into play. To ensure the reliability of the communication the filling of the gaps is controlled by mentioning location qualities. These indicate special knowledge of the area (such as *exit “Westausgang”*, *exit “Ostausgang”*, *the bike parking*, and location names such as *Aasee*, *Bischofstrasse*). This narrative structure coincides with the actual speech act situation of a wayfinding dialog: there the subjectivity of the speech act has to be controlled in order to ensure the reliability of the communication. The recipient of wayfinding directions wants permission to believe what she is hearing.

As the narrative consists of the events (in our case – landmarks) and the focalizing agent (in direct communication: the sender making an utterance) there has to be an entity which arranges all these elements. The narrator sets the stage. He has to be understood as an agent, as a strategy of the narrative how to make the recipient experience and understand. Although the narrator may not be identifiable as a personality of any kind he/she is one of the basic elements of a narration.

In our case the narrator adopts personality by saying “I” and thus connecting to the basic “I – you” structure of the wayfinding speech act and thus ensuring the reliability of the following story (*I am looking forward to your visit...*, *Have a safe trip*). If there is no specification of the narrator the recipient will fill specifications in. This means the narrator can act as a gap, and the “I” can be understood as a controlling strategy. The recipient is required to fill in a communication experience when addressed with

“you”. To have the desired effect she has to produce the desired experiences in order to be able to identify the landmarks correctly and further to find the right way. The narrator does not necessarily have to identify himself. The narrator can be less personal and even withdraw into other strategies of assuring as in computerized wayfinding directions or may take on all kinds of strategies as the history of fiction tells us (Jahn 2003).

The goal of the whole procedure of conveying landmarks (and furthermore of complete wayfinding directions) is that the recipient may develop a picture of the intended way and eventually find and use this way. This means that the recipient has to be enabled to produce a gestalt which coincides with the intended way. She has to connect the pictures she has been triggered to produce to a gestalt as complete as possible with regard to the goal of the narrative. Relating to landmarks, this means that landmarks have to be selected and placed in an order where the affordance of one landmark can be closely related to the affordance of the next (see examples such as *after you leave...continue across...leaving on your left side...on the other side of the road...it takes you through...exit and walk...across...*). Thus those gaps which appear through arranging the landmark stories consecutively can be controlled. The recipient will provide images to connect them. To prevent her from losing the right way in the very sense of the word, connecting the different narrative units has to be made easy thus reproducing the basic logic of *source-path-goal* (Lakoff 1987) of the initial landmark experience in the narrative structure.

To summarize we can state that two main goals have to be performed in order to translate the basic landmark experience: subjectivity has to be made explicit to make the affordance traceable and at the same time subjectivity has to be controlled to ensure reliability. This happens on two different levels according to the structures of communication, either of the speech act or the narrative. Wayfinding with the help of landmarks via narrative has to provide gaps for the recipient to fill in her personal experiences. This ensures the translation of affordance and at the same time has to control these gaps to make sure that the intended picture may be produced.

Conclusions

In this paper we investigated the structure of understanding landmarks in verbal wayfinding directions. The initial landmark experience can be understood as a semantic structure which can be explained in cognitive terms. After the transformation into speech acts, the initial experience transfers into a syntactic structure which produces what we call an event worth telling about. The speech act partners provide for the semantics. In the narrative the speech act transfers into an event as well, and a new syntactic structure evolves. Now the narrative structures establish the new semantics. The embedding procedures always function through establishing affordances (Figure 1).

For a human generated wayfinding narrative we could demonstrate how the initial experience – the landmark – is incorporated into communication structures, how it then turns into a narrative in order to secure understanding, and how understanding is guided via narrative structures. However our final interest is in computer generated

route instructions, as provided by navigation services. Is the presented and discussed model of narrative structure applicable to the communication of navigation services to their clients? And if so, what are the issues to be learned from the model in this context? Finally, if deficiencies can be identified, can we develop computable models filling these gaps, such as narrative agents? Investigating these questions is part of our ongoing work, and beyond the scope of this paper. However, some preliminary observations give evidence of the relevance of these questions.

Location-Based Services, especially navigation services, are direct competitors to people generating route instructions: they produce and communicate route instructions on demand, either in advance (offline route planners) or sequentially, adapting to the location of the client (online navigation services). Their means of communication may vary, for instance using visual means, like maps or symbols, or verbal means, like written or spoken text. However, their communication has to be of the complexity of the third level of Figure 1. This is because the immediate personal communication situation is lacking, and the non-verbal part of spoken communication, responding to a specific client and a specific situation, cannot be produced automatically and has to be explicated. In this sense, an oral instruction by, e.g., a car navigation system is structurally a narrative put through speech synthesis.

Compared to the complex communication task, current navigation services deliver relatively plain narratives. These are based only on the geometry of routes (Winter 2004), and lack landmarks. The major obstacle for not including landmarks is the lack of landmark information in spatial databases, or, in cases where services confuse landmarks with pre-selected points of interest, a lack of understanding what properties make a good landmark in a specific wayfinding situation. This situation will change since recent research addresses the automatic selection of landmarks from databases to enrich route instructions (Elias 2003; Nothegger et al. 2004). As soon as landmark information becomes available the problem of integration in text arises. In this regard our research is timely.

The above discussion has made clear that it is not sufficient just to name landmarks in a computer generated narrative. Landmarks should generate an experience, and this process should be controlled by the service. Hence, a narrating agent is required, equipped with formal models of communication experience, or narrative structure of landmarks. A formalization of our findings is needed and left for future work.

Landmarks are just one element of orientation in the complex interplay of mind and object within the discussed narrative structure. Other elements of the narrative can be studied in the same way, which forms another line of concurrent and future work.

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