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# Understanding Use Cases: Harnessing the Power of Narratives to Comprehend Application Domains

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## ABSTRACT

We investigate how stories can be used in system analysis and design to better understand the application domains. The research question we explore is: How can we employ narratives as a complement to use cases to improve our understanding of application domains? To examine this question, we study the effects—i.e., recall and problem solving—of supplementing a use case with a user story. We focus on two features of stories that can facilitate comprehension, *concrete thematic content* and *causal explanatory information*.

## Keywords

Information modeling, information representation, story comprehension, narratives, information systems development, requirements specification

## INTRODUCTION

In April 2008, the Census Bureau dropped its plans of using handhelds for collecting data for the 2010 census. The cited reason was that the project developing this system suffered from "significant miscommunication concerning technical requirements between the Census Bureau and Harris [the contractor]" [1]. This change of plans will cost tax payers additional \$3 billion dollars. Information systems (IS) project failure is often blamed on deficiencies not only in the requirements specification but also on lack of clearly specified *system intent*. Without a well defined system intent, there is little to guide us through all uncertainties of the development process, e.g., missing, ambiguous, conflicting, and incorrect requirements [2]. Without a shared understanding of the intent, the chance of miscommunications is be high [3]. The basic rule of all problem solving is that before you can solve the problem you need to understand the problem. And in order to understand the system intent one needs to understand the application domain. But what type of information representations is best suited for this task? Prior research on comprehension of IS representations has focused on comprehension of schema-based techniques such as Entity-Relationships diagrams. Such schema-based languages can not capture the full complexity of typical real-life situations that characterize application domains [4], hence, they are unsuitable for conveying the system intent. Therefore, we turn our attention to *use cases* and *stories*, which has become a de facto standard for describing demands of application domains.

During the last decade or so, scholars have become quite interested in how narratives facilitate learning and comprehension [5]. In this paper, we explore how the power of stories can be used in systems analysis. We focus on investigating how stories can enhance a person's understanding of the application domain. The research question we explore is as follows: *How can we employ narratives as a complement to use cases to improve our understanding of application domains?* Research that has examined requirements representation in systems development has either focused on developing them or on understanding them [6]. In this paper we focus on the latter.

Use cases is an information modeling technique that has gained popularity in the last few years [3, 7]. Guidelines for constructing use cases often suggest "creating user stories" as a warm-up activity [3, 7], but there has been no formal investigation on the usefulness of these stories. To explore our research question, we first investigate whether the use case is better understood if it is accompanied with a relevant story about the application domain. And if so, what specific elements should such stories include in order to be useful. Based on insights from story comprehension research, we propose two elements we believe have a particular positive impact on comprehension of stories: *concrete thematic content* and *causal explanatory information* [8]. In this paper, we focus on these two elements only.

This research has several potential implications for research and practice. First, although we know quite a lot about what drives the comprehension of schemas, not much IS research has looked the comprehension of text-based material such as use cases and stories. This research takes the first step towards exploring this area. Second, if we can identify some features that drive comprehension, we can apply what we know to offer practical advice on how to write stories about application domains.

## BACKGROUND

We first provide an overview of text comprehension and describe some properties of stories that impact comprehension. Then, we apply these insights this to formulate two features of narratives that we believe facilitate comprehension.

### Comprehension of Stories

When a person reads a story, he or she engages in an effortful “search after meaning” [9]. The reader assumes that the text has a coherent message to tell, and therefore he or she attempts to figure out why actions, events, and states are mentioned in the text. As we try to understand, we create a mental model called *situation model* of the state of affairs presented in the text; see [10] for a review. This mental model can capture all relevant aspects of the described circumstances in the text and covers at least five dimensions of a situation: protagonist, time, intentionality, causation and space.

This situation model is created by making the appropriate associations between the different elements of the story, e.g. connecting actions with subsequent outcomes. These associations are created by *making inferences*. Consequently, inference-making is one aspect of story comprehension that has received much attention in literature, e.g. [11]. An inference is a piece of information not explicitly mentioned in the text, but instead provided by the reader to “glue” different parts together. A text becomes meaningful to the readers only after they make the appropriate inferences. Consider these two examples.

If a person reads:

Example 1: *“Mary was a health nut who tightly watched her diet. She ordered a cheeseburger and fries.”*

he/she struggles to understand why a health nut like Mary would suddenly indulge herself with lots of greasy food (adapted from [12]). The story comes across as incoherent to a reader. If a person reads:

Example 2: *“Mary was a health nut who tightly watched her diet. Unfortunately, she had lost the bet with her big brother. She ordered a cheese burger and fries.”*

he/she can infer that Mary had promised her brother to eat a cheeseburger and fries if she lost the bet. As a matter of fact a most of us would prefer to make such an inference as it feels unsettling to leave Mary’s behavior unexplained.

There are two main questions that have been examined in this area. First, what leads people to make the appropriate inferences? Second, what effect does inference-making have on understanding? In summary, prior research has identified two main factors that impact inference-making and thereby comprehension: *the reader* and *the text itself*. With respect to the reader, issues such as reading proficiency, verbal proficiency, prior knowledge about topic, motivation, goals, and reading instructions has been investigated. With respect to the text itself, prior research has focused on properties of the text, e.g., text type (narrative vs. expository), structure, content, language, syntactic and linguistic features. This study focuses on the latter, that is, the properties of the text itself. The next subsection will explore this issue further.

### The Power of Stories

Overall, stories are perceived as “easy to understand” due to a number of properties of stories; see [5] for a thorough review. We highlight four of these properties and provide examples of how they can be used to enhance task performance.

#### *Stories Provide a Context for New Knowledge*

It is not a coincidence that some of our first life lessons are handed down us as stories, for example like Aesop’s fable about the tortoise and the hare. Stories are effective learning tools for children because they lack personal experience. In order to understand new material, people need context to help them relate the new information to what they already know [5]. If a rule is presented to us without any context, we will not be able to decide the validity of the rule, and we will have a hard time storing it in our memory. Grownups are usually equipped with a large set of personal experiences to draw from. So, if we are presented with an abstract rule like “overconfidence can lead you into trouble” we might remember a few personal episodes for which this was held true. If we can associate concrete episodes with an abstract rule, we can use those episodes as a

context for verifying or refusing it. Children have of course less life experience to draw from. That is why stories for children also come with a suitable context that can help them to understand and verify the rules for themselves.

#### *Stories Permit Application of Real-World Knowledge*

Many studies on reasoning and problem solving have found that people perform better if the problem is presented in a realistic context. For example, Venet, Markovits and Vachon [13, 14] applied this to conditional reasoning tasks. What they discovered was that subjects who were provided with a realistic context for the conditional reasoning problem performed better than subjects who were not provided the realistic context. The explanation for this is that the realistic context permitted the subjects to access empirical world knowledge that helped them solve the problem.

To illustrate this phenomenon, consider this abstract reasoning problem:

*If P then Q. Q. What can you say about P?*

Contrast the abstract version with this one:

*France and Brigitte are talking about trees. France is certain that if one cuts down a tree, the tree will fall down. Last week, Brigitte saw a tree that had fallen down. Can Brigitte conclude that the tree must have been cut down?* [14], page 944.

Even children with limited ability to reason with formal logic can utilize their *general world knowledge* to arrive at a correct answer. If the child happens to remember strong winds can knock down trees too, he or she can conclude that it is not certain that this particular tree has been cut down; it might as well have fallen over during a storm.

#### *Familiar Theme in Stories Improve Long-Term Memory*

An additional strength of narratives is how they utilize familiarity to explain something to us. Narratives are usually abundant with descriptions of everyday activities and familiar references function as “hooks” into our memory making it easier for us to remember the information. To remember is to create an association between the new information and something we already have stored in our memory. Familiar concepts are more memorable than unfamiliar concepts because we already have plenty of existing associations for familiar concepts in memory [15]. Just consider the following scenarios.

**Scenario 1:** *You meet three people at a party. They present themselves as Ragnhild, Ashakiran and Viacheslav.*

**Scenario 2:** *You meet three people at a party. They present themselves as Johannes, Elisabeth and Christopher.*

Although the three names are more or less equal in length, we struggle to remember the first group of names because they are unfamiliar to us.

#### *Narratives Extend Our Working Memory Capacity*

Contrary to the capacity of our long-term memory, our short-term memory is severely limited. The rote capacity of our working memory is fixed at seven “chunks” plus/minus two [16, 17]. Fortunately, we can circumvent this severe limitation by chunking information together by applying *familiar patterns*. Consider these two alternative situation descriptions:

**Description 1:** *Person A shares fact number 2 with person D. Person C shares fact number 1 with person B. Person B shares fact number 3 with person A.*

**Description 2:** *Ann and Curt are married. One day bump into some friends of theirs, Bob and Diana, who also are married to each other. Ann and Diana always have a lot to talk about, and Ann immediately starts telling Diana about their plans for the holiday. Bob and Curt are golf buddies, and Curt therefore proudly announces to Bob how he improved his all-time-record on the golf course the day before. Bob laughs and says to Ann “Oh, so your husband has been practicing behind my back, eh?”*

The reason why it is easier for us to keep track of what is said by who to whom in the second description is due to “chunking”. We chunk information together by applying familiar patterns already stored in long-term memory thereby reducing the overall number of chunks that must be processed by our short-term memory [17]. The profound effect of chunking can be demonstrated as follows. Think about the effort required to memorize this list of letters: B B C C N N E S P N H B O M T V T N T. Now look at the same sequence as BBC CNN ESPN HBO MTV TNT. We have now circumvented the capacity of the working memory by chunking the incoming information. Instead of a list of random letters we perceive six TV channels listed in alphabetical order. In the same way, we draw on stereotypical patterns to chunk the information given in the narrative about Ann, Curt, Bob, and Diana, e.g., wives chatting with wives and husbands chatting with husbands.

## Composing Comprehensible Stories

Let's say that you have some information you would like to convey as a story, but you are wondering how to write it and what elements to include. This section will apply what we know about *inference-making* and *properties of stories* to suggest two features that can facilitate comprehension of stories.

### *Causal Explanatory Content and Comprehension*

There are two elements that are particularly critical for the comprehension of narratives: temporality and causality [18]. While the two are interwoven (see for example [19]), in this paper, we focus on the latter, causality.

Like most other aspects of a story, understanding about causality is acquired by making an inference, as described in the earlier subsection. Causality expressed or implied in the story material is not grasped by the reader before he or she makes a *causal inference* connecting related ideas in his or her mind. If the causal connection is made very explicit, it is easy for the reader to make the connection, and the text is perceived as *causally coherent*. Causality that is less explicitly expressed requires the reader to work harder in order to establish a connection. These are called *breaks* in causal coherence. Sometimes, breaks in coherence are not detrimental to understanding as the reader is, in fact, able to connect the ideas by making an inference. But there are also situations where the reader is not able to make the appropriate connection. In those cases ideas remain isolated and comprehension suffers.

Research that aims at improving text, in particular instructional text, has looked at how to foster the reader's inferential activity by repairing such breaks in coherence [8, 20]. The goal is to get the reader to actively think about the antecedents and consequences of what is described in the text. These studies have found that a reader develops a deeper understanding of the material if the text is supplemented with information that stimulates the reader's causal inference making, see [20] for an overview. Gilabert, Martínez and Vidal-Abarca [8] tested this approach by applying it to a text about the Russian revolution. Subjects who read the passage that had been supplemented with causal explanatory information scored higher on the inference test (43%), and included more inferences and less erroneous information in their free recall protocols compared with the subjects that read the original passage.

### *Concrete Thematic Content and Comprehension*

An idea is concrete to the degree that it triggers an "Ah, this reminds me of..." response. Likewise, an idea is abstract to us if we possess no knowledge which can be related to its content [22]. A story provides a concrete, *worked-out example* of an abstract idea. The positive effect of worked-out examples on learning is a well-documented [23]. As the previous section pointed out, concrete examples are beneficial because they a) serve as a context for evaluating new knowledge, b) permit us to use real-world knowledge, c) improve our long-term memory, and c) extend our working memory capacity. In short, concrete examples save us from a lot of cognitive work by allowing us to reuse what we already know.

Another feature of stories or worked-out examples is that they are *thematic* in nature. When used in problem solving, the story arranges the elements of the problem around a common theme with a logical progression. A thematic presentation can be a short and highly contrived story as found in mathematical word-problems. Or, it can be as elaborate and wide-spanning as composing all the lectures of an introductory course in accounting around a single business case. The thematic content has a positive effect on understanding as it provides both a memorable association among the different building blocks of the problem and brings up associations to other real-world experiences.

## RESEARCH QUESTIONS

This section first provides an overview use cases and user narratives and then presents the research question. We also provide some examples of how to operationalize thematic content and causal information.

### Use Cases and User Narratives

Use cases is a technique that mainly targets early phases of systems development, usually employed for developing and documenting the functional requirements. Cockburn [7] distinguishes between three types of use cases with decreasing degree of formality: "*fully dressed*" use case (or simply a use case), "*relaxed*"<sup>1</sup> use case, and *usage/user narrative*. A fully dressed use case describes in plain English the interactions between the user and the system as a numbered set of steps; Figure 1 presents steps that are required for online filing of delayed luggage claim.

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<sup>1</sup> Cockburn actually calls it "casual" instead of "relaxed".

|                      |             |                                                                                                                                   |
|----------------------|-------------|-----------------------------------------------------------------------------------------------------------------------------------|
| <b>Use Case:</b>     |             | <b>FILING A DELAY LUGGAGE CLAIM ONLINE</b>                                                                                        |
| <b>Precondition:</b> |             | The user has accessed the web site with the online claims system.                                                                 |
| <b>Description:</b>  | <b>Step</b> | <b>Action</b>                                                                                                                     |
|                      | 1           | The user provides an insurance policy number.                                                                                     |
|                      | 2           | The system verifies the existence of the policy, and display a blank form for registering a claim.                                |
|                      | 3           | The user provides personal information like name and address. The user also provides the personal information for any co-insured. |
|                      | 4           | ...                                                                                                                               |

**Figure 1:** Example of a (fully dressed) use case.

Relaxed use cases and user stories describe the same situation using a narrative style. In this study we will refer to these as narratives with a *low* versus *high* degree of concrete thematic content, see Figure 2. The two stories in the first column have a high degree of concrete thematic content, while the two in the next column have low.

The narrative high on concrete thematic content are specific about the person, the time, the place, the actions, etc. For example, the excerpt about “Lisa” below is part of a longer story about the problems Lisa and her husband Paul had with their luggage on their trip to Paris over the Valentine’s weekend. It uses proper names like “Lisa” instead of generic role names like “the user”, and it refer to “her husband” rather than “a family member”. The descriptions of actions are concrete, like “she types in her policy number” rather than tentative, like “a user has to type in his/her policy number”.

|                                   |             | <b>Concrete Thematic Content</b>                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------------------------------|-------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                   |             | <i>High</i>                                                                                                                                                                                                                                                                                                                                                                                                            | <i>Low</i>                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Causal Explanatory Content</b> | <i>High</i> | First Lisa sits down by the computer and accesses the web site for filing claims. Since all policies are identified by its unique policy number, she types in her policy number in order to start a new claim. The claims system displays a blank electronic form. Lisa states her personal information and the personal information of her husband as well, since her policy also covers accompanying family members. | A user must first access the web site for filing claims. Since all policies are identified by its unique policy number, a user has to type in his/her policy number in order to start a new claim. The claims system will display a blank electronic form. The user has to state his/her personal information and the personal information of others who are covered by the policy as well. |
|                                   | <i>Low</i>  | Lisa accesses the web site for filing claims. She types in her policy number. The claims system displays a blank electronic form. Lisa states her and her husband’s personal information.                                                                                                                                                                                                                              | A user must access the web site for filing claims. He/she has to type in his/her policy number. The claims system will display a blank electronic form. The user has to state personal information of all who are insured.                                                                                                                                                                  |

**Figure 2:** Examples of user narratives with high and low concrete thematic content, and with high and low causal explanatory content.

We will also consider user stories with a high versus low amount of causal explanatory content, see Figure 2. The stories in the first row have a high amount of causal explanatory content, the stories in the second row has low. The narratives that are high on concrete causal explanatory content contain more justifications for why actions are performed. For example, Lisa needs her policy number to start a new claim, *because all policies are uniquely identified by it*. Or, Lisa includes her husband’s personal information, *because he is covered by the policy as well*.

**Research Question and Investigations**

Advocates of use cases have argued that requirements descriptions in the form of stories or narratives are easier to comprehend [24] although we have not been able to find any study that has empirically evaluated this claim. The purpose of

this study is therefore to empirically assess how a (*user*) narrative can help a person to comprehend a situation described in a *use case*. We are interested how well the person understands the explicit material in the use case as well as how he/she grasps the broader circumstances implied by the use case. The research question we explore is: *How can we employ narratives as a complement to use cases to improve our understanding of application domains?*

To examine our research question, we focus on the following aspects:

1. Does a user narrative impact use case comprehension?
2. How do a) concrete thematic content and b) causal explanatory content facilitate comprehension?

Requirements representation studies usually consider three types of comprehension: syntactic comprehension (e.g. understanding of the modeling language constructs), surface, and deep semantic comprehension [6]. Surface understanding is built from the information given in the case while deep understanding goes beyond what is explicitly described. Since use cases employ plain English, we will not consider syntactic comprehension; instead we examine both surface level and deep comprehension.

**Investigation 1:** First, we are interested in exploring the positive effects a user narrative has on the comprehension of a corresponding use case. In short, we are interested in finding out if user narrative along with the use case is better than the use case alone. At first glance, one might argue more information should lead to better understanding. But it is far from evident that more equals to better when it comes to comprehension; the detrimental effect of *information overload* is well documented [25]. Too much information can be confusing, e.g., prevent one from being able to give priority to what is important, thereby hampering performance; see [25] for an overview. It is therefore plausible that adding a narrative to a use case could either be irrelevant to comprehension, or be confusing since one now has to integrate two different descriptions of the same situation.

**Investigation 2:** For the second question, we are interested in finding out what features of narratives that facilitate comprehension. If we are able to identify what makes an effective narrative as opposed to a not-so-effective narrative, we will be able to provide some practical guidelines for composing user narratives. Here, we focus on the effect of *concrete thematic content* and *causal explanatory content*. The first attribute represents the “storylikeness” of a narrative, while the second attribute represents the causal descriptions found in the material.

**RESEARCH METHOD**

This section will briefly outline the experimental design of our study, including operationalization of independent variables (IVs) and measurement of dependent variables (DVs).

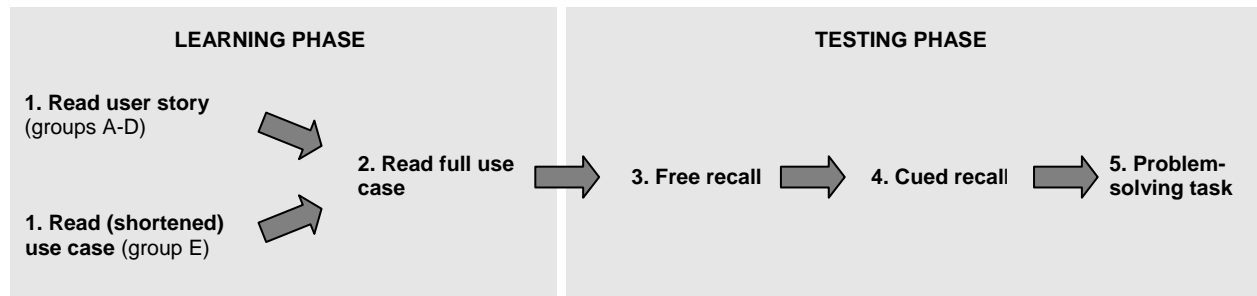
This study has five experimental groups employing a (2 x 2) + 1 lab experiment design, see Figure 3.

|                            |      | Concrete Thematic Content |     |             |
|----------------------------|------|---------------------------|-----|-------------|
|                            |      | High                      | Low |             |
| Causal Explanatory Content | High | A                         | B   |             |
|                            | Low  | C                         | D   |             |
|                            |      |                           |     | E (Control) |

**Figure 3:** Experimental design and IVs.

Figure 2 shows examples of how concrete thematic content and causal explanatory content are operationalized. The stories with high concrete thematic content is centered around a main character called Lisa who, together with her husband Paul experienced problems with their luggage during their Valentine’s trip to Paris. In contrast, the non-thematic version refers to an abstract “user” and abstract “trips”. The causal explanatory version includes the rationale for many user actions, such as “Lisa will be asked to provide copies of various travel documents *so that the incident can be verified.*” The non-causal version just states the action.

Figure 4 illustrates the main steps of the planned experimental procedure. Groups A-D will receive a user story with high/low concrete thematic content and high/low causal explanatory content before reading the use case; see Figure 2 for example of such stories. The control group will not receive any user story. Last, all groups will be tested for understanding through free recall, cued recall, and problem solving task. The recall tests measure surface level and intermediate level comprehension [8] while the problem solving task measure deeper comprehension by asking the subject to reason beyond the information provided [26].



**Figure 4:** Experimental procedure (not including training phase).

The recall tests only ask for the information *given in the full use case* and gauge a subject's understanding of the overall situation as well as probing for particular inferences. The additional material, the user story, will therefore only aid the subjects in answering these questions if it helped them understand the use case itself better. The problem-solving task asks the students to reason about what happens in a situation *neither described by the stories nor in the use case itself*. E.g. the story and use case describe what happens *before* and during the filing of an insurance claim. The problem-solving centers on what might happen *after* the claim is filed. Correspondingly, the extra material will only be beneficial if it helped the subject to grasp the broader circumstances implied but not directly outlined in any of the material.

## CONCLUSION

This paper explored how stories can complement use cases for application domain comprehension. First, we highlighted some important cognitive operations involved in understanding stories, such as inference-making, and then we considered certain properties (*concrete thematic content* and *causal explanatory content*) of stories that make them understandable. While concrete thematic content gauges the "storylikeness" of the description, the causal explanatory content explicates the explanation and justification of actions and events. We also briefly outlined how this research will be conducted using a lab experiment.

We present a first step towards developing a theoretical foundation for how to evaluate and improve non-schematic representation techniques used in information systems development. There have been many anecdotal claims for the efficacy of textual use cases and stories. Here, we aim at providing some empirical support for these claims. The practical outcome of this research would be a set of recommendations that would guide practitioners in composing narratives that enable application domain understanding.

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