How do people recall articles about disaster?

Effects of story grammar on recall of sharp end and blunt end causes.

Bachelor thesis

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Abstract

In order to gain new insights in the area of people´s ability to recall information, an experiment was conducted to study the effects of presence of a story grammar in brief descriptions of accidents. The purpose of the present study was twofold: the first objective was to find out whether participants remember more of a text that follows a certain story grammar. The second focus laid on the differences in recall of sharp end and blunt end causes. Participants were handed out two different articles with an adapted number of causes and they were asked to read them and to recall them. After reading, they were asked to answer a recognition questionnaire with regard to the content of the articles. The results showed that people recall more causes if the text contains a story grammar. A further finding was that people recall more of the sharp end than of the blunt end causes, suggesting that people tend to concentrate more on the obvious information (sharp end causes).

Table of Contents

Introduction

How do people actually read texts and process them? The current study tries to gain new insights into the area of story grammar with regard to sharp end and blunt end causes. A story grammar consists of certain elements, i.e. setting, theme, plot and resolution, that determine the structure of a text. The present paper discusses the role of providing or withholding story grammar, andto be able to make further assumptions about how story grammar influences information processing. The main parts of accident investigations are sharp end and blunt end causes, the paper also examines the differences between the two sorts of causes with regard to information processing.

According to Thorndyke (1977), a story grammar is a predetermined order of a text to create a logical and fluent transition between different paragraphs in an article. Articles that contain a story grammar include: setting, theme, plot and resolution, whereby the order of the four elements is always serial. The setting includes some general information about the location, time, situation and characters. The theme deals with the basic information of the event, reaction, goal and focus of the content. The plot describes the way to fulfil the goal in episodic actions. The resolution concerns the outcome of the content. Research results illustrate that texts with story grammar are more comprehensible than texts without story grammar (Thorndyke, 1977). Rumelhart (1980a) supports the idea of Thorndyke and concludes that information that is consistent with a story grammar can be better remembered and better recalled. Other studies show similar results, emphasizing that the structural relations in a text are necessary to gain a better understanding and structure of the text (Mandler, 1977). Garnham (1983) discusses the extensive critiques that were published after the story grammar theory was established. While he underlines the fact that there are a lot of opposing opinions against the story grammar, he also concludes that it is still the most used and applicable theory in this area. How story grammar improves memory can be explained by the schema theory.

When people try to remember information that they read in texts, they try to connect it with prior knowledge and experiences. If texts are too complicated to simply connect them to prior knowledge, people develop strategies which help them to recall the information more precisely. According to Thorndyke (1977), people tend to frequently use their long-term memory to understand and comprehend stories or events with situational context. This means that everyone could have a different understanding and recall about the same content due to the fact that everyone has various experiences and a different journey of life. Another point of view states that people usually follow the same procedure when it comes to recall from

their memory (Rumelhart, 1980b). People have the same schemata about events like a restaurant visit in their mind with small underlying differences. Therefore, memories are more uniform and build up a concept that proceeds according to consistent patterns. People remember things usually according to a certain order, like setting–event–outcome. Rumelhart (1980b) describes schemata as the „building blocks of cognition“, because we have schemata for everything, for instance for activities, events, scenes, etc. Schema theory also reveals that new information can be more easily processed if it can be related to existing schemata, and the new information also has to be compatible with prior knowledge. Overall, schemata not only guide the comprehension of events, they also guide the interpretation of written texts (Rumelhart, 1980b). Within the building of a schema, there is a difference between bottom-up and top-down processes. The bottom-up, data-driven, processes describe the environmental influences and guarantee that the reader is able to access new information. The top-down, conceptually-driven, processes include the embedding of new information in the already existing schemata. Top-down processing helps the reader to understand the text and to select possible interpretations of new incoming data (Carrell, 1983). Another literature finding shows that to be able to efficiently comprehend a text, it helps to build up a connection of the written material to the person's pre-existing knowledge (Adams & Collins, 1977). In sum, schema theory describes the interaction between background information and novel information, with in particular a story grammar improving the recall of a text by offering a structural setup.

The references discussed so far shed light on how people deal with text information, a proper example to illustrate these differences are accident reports. Complex systems can produce serious consequences for front-line personnel, managers, citizens, or regulators. Errors emerge through the cumulation of multiple factors, the error can be in the design or in the maintenance of a complex system. An error occurs through different layers of a system. Reason (1997) describes in the Swiss-Cheese Model how errors can arise and the development of a complex system from the equipment, to the human. The model has its origins in 1987 in the area of human error.

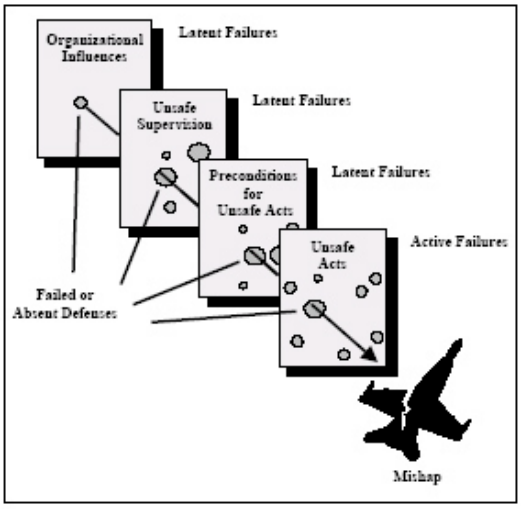


Figure 1. *The „Swiss-Cheese" model of human error causation (adapted from Reason, 1990).*

According to Reason's model, accidents occur if there is a hole in the system, followed by another one. The concentration of the holes leads to a disaster. The holes have to be closed through additional changes and improvements. The human is one layer of the system and to get an entire view of the accident, it is important to see the other layers, such as the equipment or co-workers (Reason, 1997). The model embodies the necessity to take a closer look at the accident. Reason´s latent failure model (1990) differentiates between active and latent factors that lead to failures. The active failures are immediately obvious, they result in unsafe acts and are therefore produced by the sharp end operators. The latent failures are the less obvious factors, including the institutional context, the management and organisation within a process. Front-line professionals working on the so-called 'sharp end' try to protect the system from errors. Blunt end factors such as institutions, regulations, and management procedures partially constrain the sharp end factors (Lundberg, Rollenhagen, & Hollnagel, 2009). Reason (1990, p. 173) states that latent failures are factors "whose adverse consequences may lie dormant within the system for a long time, only becoming evident when they combine with other factors to breach the system's defenses". Latent failures do not cause the concrete outcome of a failure, they can be described in a manner of leading to an outcome failure. The decisions made by people working on a complex system can result in incomplete planning, miscommunication an inadequate control. An example of blunt end causes in the disaster of Challenger was the poor safety culture and the production pressure NASA was under. It is very common that we focus our attention on the sharp end causes, but when we would concentrate more on the blunt end causes, we would get a more complete comprehension of failures made in a system.

When people are confronted with conflicting or new information, they tend to simplify this information which may lead to misconceptions and wrong understandings (Feltovich, Hoffman, Woods, & Roesler, 2004). This research emphasizes that people respond differently to complex tasks. One common form is oversimplification, meaning that people deal with complex tasks through simplifying. This is called the 'reductive tendency' by Feltovich et al. (2004). Findings from the reductive tendency phenomenon reveal that when people are trying to reconstruct events, they build up a new description, without having the complete knowledge in mind. The "reductive tendency is an inevitable consequence of how people learn" (Feltovich, Hoffman, Woods, & Roesler, 2004, p. 30). They begin to make up their incomplete knowledge with prior experiences and information. Furthermore, if they are confronted with opposing views and information about the same event, they try to change it in a way that is suitable to their prior information: these tendencies are called 'knowledge shields'. The 'demean effect' is one knowledge shield, describing that when people know that their understanding or interpretation is wrong, they reject it with a shrug. There are two other knowledge shields, such as: argument from faulty causal reasoning and extirpation. These two shields refer to the fact that when people create wrong understandings, they isolate them to create a new real context (Feltovich, Hoffman, Woods, & Roesler, 2004). The schema theory leads to simplification by applying more common concepts and prototypes for certain events. The reductive tendency describes how people deal strategically with information that is not in accordance with their knowledge, people use the knowledge shields to change the information to be suitable to existing information. This dealing is more passive and personal.

Taken together, nearly all presented reports and literature findings are based on the role of information processing and recall. The purpose of the experiment reported in the present paper was to examine some of the predictions with regard to the presence or absence of story grammar with addition to the sharp end and blunt end causes. The goal was to bring together some interesting findings about how people process articles and how they were recalled. In order to support the findings of Thorndyke´s story grammar, the first assumption of the following experiment was that people recall the information of texts better if they follow the story grammar. That led to the hypothesis that people who read articles with a story grammar (setting, theme, plot and resolution), can remember more details and facts of the article and therefore recall more causes (blunt end and sharp end causes) than people who read articles without a story grammar. The next question referred to the fact that if a text does not follow the story grammar, it becomes very complicated, therefore people try to reduce the complexity by applying different strategies (Feltovich, Hoffman, Woods, & Roesler, 2004).

If people find the article very complicated, they rely more on the obvious information presented in a text and therefore remember more sharp end causes, because including the blunt end causes leads to more complexity. That led to the second hypothesis that people that read articles without story grammar recall more of the sharp end causes. The dependent variables measured in the current study were the number of sharp end and blunt end causes recalled and the recall of story grammar elements (setting, theme, plot and resolution). Additionally, a recognition test was performed to measure the number of answers correct/wrong on the recognition questionnaire to get additional information on how people remember information.

Method

Participants

Sixty-four participants, of which 47 were females and 17 were males, volunteered to take part in the experiment. The participants were all students of the University of Twente and Saxion University of Applied Sciences, Enschede. As a reward for their participation, participants received credits on a research participation system. The age of the participants varied between 19 and 30, with a mean of 20.37. The study was approved by the ethics committee of the Faculty of Behavioral Sciences of the University of Twente.

Materials

For the purpose of the experiment, it was necessary to find suitable articles describing accidents that participants had to remember and recall. The articles were retrieved from the databases of www.google.com and www.google-scholar.com. The requirements that were needed to fulfil were to find one article with story grammar and one without story grammar. The next search query was that the articles consisted of a sufficient number of sharp end and blunt end causes. We chose two accidents in order to generalize our findings: Challenger disaster (1986) and Tenerife disaster (1977). The four basic articles of each disaster that were found on the internet were changed to suit the purposes of the experiment. It was necessary to have altogether eight different articles, one article of Challenger with story grammar that had more blunt-end causes (four blunt-end causes and two sharp-end causes) and the second one with more sharp-end causes (four sharp-end causes and two blunt-end causes). The next step was to find an article of Challenger with the same number of sharp end and blunt end causes, but without a story grammar (see Appendix D). The same was applied to Tenerife (see Appendix E). Through a previous pilot study of bachelor students, the categorization of the sharp-end and blunt-end causes was predetermined (Wurster, 2013; Geurts, 2013). A

foreknowledge test was created to measure the knowledge of the participants with regard to the content of Tenerife and Challenger (see Appendix A). A further requirement was that the articles had the same length, approximately 300 words. Every article that was used in the experiment was read by two test participants to see how much time the participants approximately needed to perform the entire experiment. They needed approximately 30 minutes. The recognition questionnaire used at the end of the experiment consisted of five multiple choice questions, containing detailed questions about the disaster (see Appendix F). All materials were written in English. Given that all students were fairly proficient in the English language, this did not pose any problems. To ensure that the articles did not differ in the length of sentences and number of words, the so-called readability score was measured (see http://www.readabilityofwikipedia.com). The Flesch-scores of all articles were between 40 and 60, which indicated that all texts had approximately the same reading-level.

Coding schemes

The previously-developed coding scheme was adjusted to be suitable for this study (see Appendix G). The final coding schemes consisted of seven parts. The first part concerned demographic information about the participant (. participation number, age and gender). The second part of the coding scheme was developed to measure the characteristics of the article, including the prior knowledge on the disaster, presence/absence of story grammar, amount of blunt end and sharp end causes and in which order the participants received the articles. The third part included questions of the setting, whether the location, date and/or characteristics of the story were mentioned by the participants. The fourth part concerned the theme, including all blunt end causes. The fifth part dealt with the plot. The plot included the sharp causes and whether they were mentioned. The sixth part was developed to measure the resolution, whether the consequence of the disaster and the number of deadly victims was mentioned. The purpose of the last part was whether the participants answered the five questions of the recognition questionnaire correctly.

Design

Story grammar presence/absence was a between-subjects factor. The number of sharp end and blunt end causes was a within-subjects factor. In order to prevent order effects of which text they started with, one half of the participants started with the Tenerife article, whereas the other half started with the Challenger article.

The articles were manipulated in two ways (independent variables): (1) Presence/absence of a story grammar: does the article clearly contain the sequence of setting,

theme, plot and resolution? and (2) Number of sharp end and blunt end causes mentioned. Each article contained either four or two sharp end or blunt end causes. The following measures were recorded (dependent variables): (1) Number of sharp end and blunt end causes recalled, (2) Recall of story grammar elements (setting, theme, plot and resolution) and (3) Number of answers correct/wrong on the recognition questionnaire.

Procedure

Before the experiment was conducted, the participants were asked to fill in a questionnaire to test their foreknowledge about the content of the disasters of Challenger and Tenerife. It was important that the participants did not have much foreknowledge, because that could have an influence on the findings of the experiment. If the foreknowledge test indicated that participants already possessed too much knowledge about the accidents, they were not eligible for participation in the experiment.

After inviting the participants to the study room, they were handed out an instruction and an informed consent form and were asked to read and sign it (see Appendices B and C). If necessary, questions about the experiment were answered. The assignment of the participants to each group was completely random. After the assignment, the participants were asked to read the first article. After reading the first article, they were handed out a crossword puzzle and were asked to solve it for five minutes. The crossword puzzle was intended to distract the participants for a while. By this, it is possible to find out what participants keep in long-term memory, without relying on their working memory. After completing the crossword puzzle, the participants received a blank paper and were asked to write everything down that they remembered of the article. After their recall, they were asked to complete a multiple choice questionnaire with five questions. Hereafter, the participants were asked to begin with the second article and to follow the same process as with the first article. The duration of the complete experiment was approximately thirty minutes. Every participant had the opportunity to get a debriefing after the experiment was conducted.

Results

Foreknowledge test

All 64 participants were allowed to take part in the experiment, because there were only three participants that did answer one out of ten questions correctly with regard to their foreknowledge. We may therefore safely assume that none of the participants possessed foreknowledge of the accidents.

Order effects of the articles

Independent samples t-tests were performed to investigate whether story order had an influence on the amount of recalled sharp end or blunt end causes. The participants received the articles in either Tenerife and Challenger or reversed order. No effect of story order was detected (see table 1).

Table 1

T-tests to control for story order.

Story Grammar	Story order	Levene's Test		T-Test		
		F	p	t	df	p
present	T_h-C_l/ C_l- T_h	1.42	.52	.41	14	.69
present	T_l- C_h/ C_h- T_l	.08	.78	.15	14	.88
absent	T_h-C_l/ C_l- T_h	3.71	.08	1.52	14	.23
absent	T_l-C_h/ C_h- T_l	.27	.61	.28	14	.78

Note. $_h$ = high: including more sharp end than blunt end causes, $_l$ = low: including more blunt end than sharp end causes.

Effect of story grammar

The independent samples t-test showed whether the participants that received the articles with story grammar recalled more causes than the group which received the articles without story grammar (see table 2). The results showed that there was a significant effect, indicating that participants who received the articles with story grammar recalled significantly more causes than participants who received articles without story grammar, $t_{(62)} = -5.67$, $p < .001$.

Table 2

Independent samples t-test to show differences in the recall of causes.

		Recalled number of causes	M	SD
Story Grammar	present (n=32)	181	5.66	1.68
	absent (n=32)	108	3.38	1.54

Effect of story grammar elements

Chi^2-tests were carried to investigate whether the participants who received articles with story grammar recalled more story grammar elements than the participants who received articles without story grammar. Only the theme element showed a significant effect, with participants reading articles with story grammar recalling significantly more than participants who were recalling articles without story grammar. It is important to mention that naming just one blunt end cause already constituted evidence of remembering the theme of the text. As can be seen in table 3, setting, plot and resolution did not show an effect.

Table 3

Chi^2-tests to detect differences in recall with regard to presence/absence story grammar.

		Setting recalled	χ^2	df	p
Story Grammar	present (n=32)/ absent (n=32)	32/ 31	1.02	1	.31
		Theme recalled	χ^2	df	p
Story Grammar	present (n=32)/ absent (n=32)	32/ 17	19.59	1	.001
		Plot recalled	χ^2	df	p
Story Grammar	present (n=32)/ absent (n=32)	32/ 31	1.02	1	.31
		Resolution recalled	χ^2	df	p
Story Grammar	present (n=32)/ absent (n=32)	32/ 30	2.07	1	.151

Number of recalled sharp end versus blunt end causes

Paired samples t-tests were performed to show the differences in recall of the sharp end and blunt end causes with regard to the presence/absence of story grammar. As can be seen in table 4 and figure 2, in both groups (presence/absence of story grammar), sharp end causes were recalled to a greater extent than blunt end causes. The results also showed that the sharp end causes were in total more recalled than the blunt end causes.

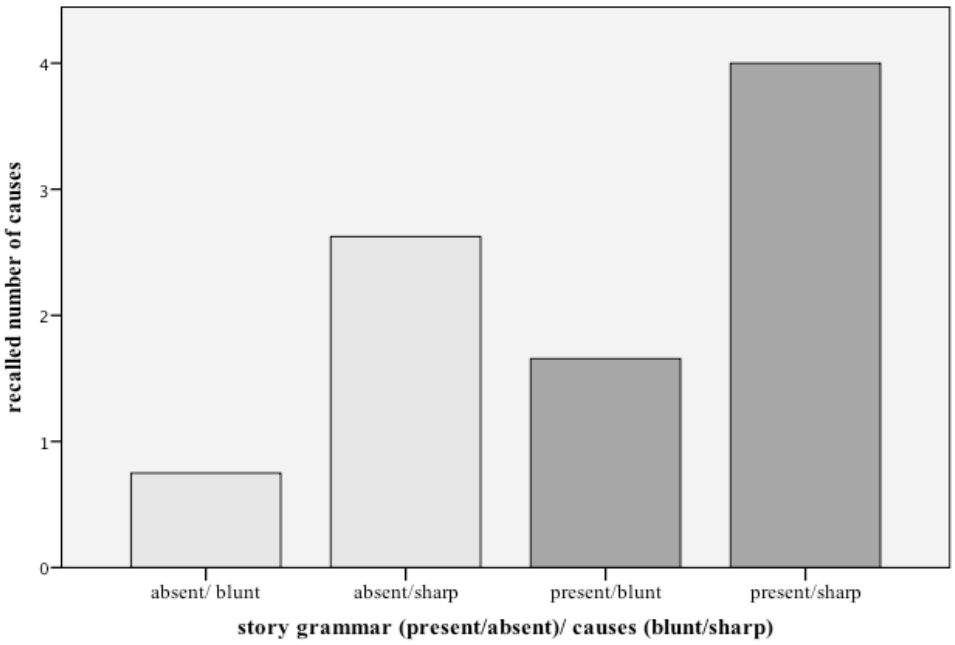
Table 4

Paired samples t-test to show differences in recall of blunt end and sharp end causes with regard to story grammar.

		Blunt end causes			Sharp end causes					
		Total	M	SD	Total	M	SD	t	df	p
Story grammar	present	53	1.66	1.00	128	4.00	1.24	-8.75	31	.001
	absent	24	.75	.95	84	2.63	1.29	-6.39	31	.001
	Sum	77	1.20	1.07	212	3.21	1.44	-10.58	63	.001

Figure 2

Recalled number of causes (sharp/blunt) with regard to presence and absence of story grammar.



An independent samples t-test was performed to show whether the blunt end and/or the sharp end causes were more recalled with regard to presence/absence of story grammar. The results showed that the sharp end ($t_{(62)}$ = -3.71, p < .001) and the blunt end causes ($t_{(62)}$ = -4.34, p < .001) were significantly more recalled by the participants that read articles whereby the story grammar was present.

Percentage of correctly answered questions

Mann-Whitney U tests were performed to show the percentages of correctly answered questions on the recognition questionnaires. As can be seen in table 5, there were no significant differences found in the percentages between the two story grammar groups, indicating that the presence and/or absence of story grammar did not have an influence on the questionnaire answers.

Table 5

Mann-Whitney U-Test to find out how many people answered the questions correctly.

Story Grammar	present	absent		
	correct answer (in %)	correct answer (in %)	Mann-Whitney	p
Q1	87.7	96.9	464.00	.16
Q2	100	100	512.00	1.00
Q3	93.8	100	480.00	.15
Q4	43.8	62.5	416.00	.14
Q5	68.8	84.4	432.00	.14

Post hoc analysis

Given that the participants received one article of Tenerife and one of Challenger, a post hoc test was performed to explore differences between descriptions and recall of both disasters.

A paired samples t-test showed that the average number of blunt end causes recalled differed between the Challenger article (M = 0.78, SD = 0.85) and the Tenerife article (M = 0.42, SD = 0.69) without regard to the presence or absence of story grammar. There was a significant effect ($t_{(63)} = 2.61$, $p < .05$), with blunt end causes being more often recalled by the participants who read the article on Challenger. The test showed the same results for the sharp end causes. There was also a significant effect $t_{(63)} = 3.192$, $p < .002$, indicating that the amount of sharp end causes recalled was higher in the Challenger article (M = 1.89, SD = 1.03) than in the Tenerife article (M = 1.43, SD = 0.75).

Discussion

The purpose of the current study was to investigate whether people remember and are able to recall more information if a story grammar is present in a text. The experiment extended the findings of other studies on the area of information processing and recall.

The first hypothesis of the present paper that people who read articles where a story grammar is present recall more details, facts and causes than people who read articles where the story grammar is absent, can be partially confirmed. First, with regard to the recalled causes, it is important to note that the major part of accident investigations usually consists of a description of causes. The results show that people recall more causes when a story grammar is present (cf. Thorndyke,1977; Rumelhart, 1980a). Texts were more comprehensible when they contain a story grammar and can therefore be recalled easier. The structural relations and a logical and fluent transition between different paragraphs in a text help the reader to a more accurate understanding and subsequently better ability to recall (Mandler, 1977). The results also show that aside from the fact whether a story grammar is present or absent, people recall at least one item of the setting, plot and resolution. An explanation for this finding could be that it is possible that the order in which the text elements were presented activate schemata (cf. Rumelhart, 1980b). Therefore the text can be better stored in memory and can be recalled easier afterwards. There is no difference in the presence/absence of story grammar, it therefore seems to imply that people can remember the same amount of background information (i.e. setting, plot and resolution). It is therefore not important in which order the information in a text is presented, e.g. it does not matter whether the setting will be mentioned at the beginning or at the end of a text. Information may be automatically categorized and stored in a certain order to be better available during recall. One exception is theme, containing all the blunt end causes presented in a text. People tend to recall more of the theme when a story grammar is present. This could be due to the presence of story grammar which may lower the complexity of the text which enables people to focus besides the sharp end causes also on the blunt end causes. The results suggest that in order to be able to make the text more comprehensible and simpler, a story grammar can be integrated.

The second hypothesis claiming that people recall more of the sharp end causes when a story grammar is absent cannot be confirmed. Results reveal that people recall more of the blunt end and sharp end causes when a story grammar is present. Given the finding that the causes were more frequently recalled when a story grammar is present, it remains to note that the recall of sharp end causes predominates. The finding of the dominating sharp end causes does not support the idea of Mandler (1977), who states that people recall and remember more of the facts that lie in the background instead of the most obvious facts when a story grammar is present. These results are not entirely consistent with the reductive tendency of Feltovic, Hoffman, Woods and Roesler (2004), who posit that if a text becomes too

complicated, people try to reduce the complexity by oversimplification. This would mean that people who read complicated texts (story grammar absent) will recall more of the sharp end causes than people who read articles where a story grammar is present, but the results show the opposite. That raises the question why people usually tend to recall more of the sharp end causes. Even when a text contains a story grammar, it can remain complex and therefore cause people to oversimplify (Feltovich, Hoffman, Woods, & Roesler, 2004). According to Reason´s active and latent failure model (1990), the sharp end causes were the most obvious failures, produced by the operators that are directly associated with a progression of failure. The present results are in agreement with the findings of Reason and therefore support the conclusion that people largely focus on sharp end causes. Marton and Sääljö (1976) stated that on the one hand people can use a deep approach, which means their focus lies on the meaning and understanding, the deep approach can be compared with the blunt end failures of Reason´s latent failures model. On the other hand people can focus more on the surface characteristics that are equal to Reason´s sharp end failures, including the ability for the recall and reproduction of new facts, without regarding them as critical and store them unconnected from previous knowledge in their memory.

The experiment also shows that the participants adapt their way of learning, depending on their motivation. In the present experiment, the people volunteered and had no obvious reason to be highly motivated to understand and learn all the facts of the texts. It could be assumed that the people did not have enough motivation to remember more information of the texts. The literature clearly states that what people remember and understand from reading texts depends to a great extent on their motivation. These intentions, in turn, drive and direct their reading strategies (Tiwari, 1999).

The results of the recognition questionnaire show no significant effect of story grammar presence on recognition. This indicates that the presence or absence of story grammar of the text did not have any influence on the number of correctly answered questions. This seems to imply that when it comes to recognition, the information remembered of an article where a story grammar is present or absent will be stored in a similar way and can be retrieved equally well. This also agrees with schema theory that people automatically store the information in a similar way.

An interesting difference was found between the results of the texts about Tenerife and Challenger. Both blunt end and sharp end causes of the Tenerife text were more frequently recalled than those of the Challenger text. Since there was no difference in the readability score, readability can be excluded as a possible explanation. The reason for the

difference in number of causes recalled between both texts could be that the text of Challenger was very technical and arguably more difficult to comprehend in comparison to the text of Tenerife (over and beyond a simple readability score that merely measures sentence length).

Limitations

All participants were students. Therefore generalization beyond this sample has to be taken cautiously. The questionnaire included no opt-out possibility. If participants were unsure of what to answer they had to guess the right answer. There were also differences between the two texts of Challenger and Tenerife, the differences indicated that one text could be more complex that the other. A more consistent picture would be given if the texts would have shown the same research results.

Future research

The present research gave rise to assumptions about how people deal with complex articles, future research can investigate texts that will be not as complicated or as different in complexity as the texts on Tenerife and Challenger. A further recommendation is to increase the motivation of the participants. This can be done by letting the participants believe that they have to present the previously read information or reward a few participants that recall the most information. To get the chance to receive more accurate results, the manipulation of the articles could be enlarged, e.g. by presenting more sharp end and blunt end causes. A more thorough check of previous knowledge could be done by interviewing the participants. Interviews could collect more information with regard to the knowledge and motivation to read of the participants. This additional opportunity could have added some important qualitative data and could have allowed deeper insight into the participants' motivation and knowledge. Due to the high level of technical information, it is possible that people may tend to only concentrate on the most obvious information, i.e. the sharp end causes. In order to have a general view on how the participants recall information, texts of lower complexity could be considered as well.

Conclusion

The main goal of this research was to gain new insights in the area of recall and recognition. It seems that people can remember and recall more information of a text when it follows a story grammar. Even when people tend to rely more on the most obvious information, they are still able to recall the important information. The research at hand provides useful insights when it comes to situations where it is necessary that people remember as much as possible.

This study investigated the connection between the way people deal with texts and accident investigations. The relative recall of information can be altered by providing or withholding story grammar.

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Appendices

Appendix A: Questionnaire- Foreknowledge

Experiment – Questionnaire

1. Are you female ___ or male___?
2. How old are you? ____
3. Questions related to Challenger:

3.1. When did the disaster of Challenger take place?_____

3.2. Where did it occur? _____

3.3. How many people died? _____

3.4. What was the trigger of the catastrophe?

_____

3.5. Do you have any additional information about this topic?

_____

4. Questions related to Tenerife:

4.1. When did the disaster of Tenerife take place?_____

4.2. Where did it occur? _____

4.3. How many people died? _____

4.4. What was the trigger of the catastrophe?

_____

4.5. Do you have any additional information about this topic?

_____

All questions were filled in with right data.

_____

(Place, Date and Signature)

Thank you for participating at this experiment.

Appendix B: Instruction

Dear participant,

Welcome to the experiment!

Before the experiment started, I would like to ask you if you complete the questionnaire about your knowledge, regarding the accidents.

The duration about the experiment is approximately 45 minutes.

After completing the questionnaire, you will receive the first article and were asked to read it carefully. After reading, you get a crossword puzzle and were asked to solve it for five minutes. After completing the crossword puzzle, you will receive a blank paper and the task is to write everything down what you had remembered of the article. Hereafter, I will hand you out a multiple choice questionnaire and ask you to make it up.

If you completed this procedure, I will ask you to do the same with the second article.

Don not hesitate to ask questions before, during or after the experiment.

You can stop the experiment at every time.

Thank you for participating!

Appendix C: Informed consent

I, …….. (name participant)
agree to participate at this experiment that will be attended by
Isabel Moning.

I am aware of the fact that my participation at this experiment is completely voluntary. I can stop processing at every time and the data, retrieved from the experiment, will be deleted.

The following points were explained to me:

1. The aim of the experiment is to find out how people reproduce articles.
2. The task includes reading articles, solving a crossword puzzle, writing everything down what I remembered and making up a questionnaire with multiple choice questions.
   The whole experiment will last approximately 45 minutes. At the end of the experiment, I will get a debriefing about the content of the experiment.
3. There is no stress of discomfort during the experiment.
4. The data collected through the experiment will be processed anonymous and will not be published on an individual identificated way.
5. The researcher will answer all further questions before, during or after the experiment, with regard to this topic.

Signature researcher:…….. Date:……..

Signature participant:…….. Date:……..

Appendix D: Articles of Challenger

With story grammar,

two sharp end and four blunt end causes

On 28 January 1986, space shuttle Challenger broke apart 73 seconds after launch, killing its seven crew members. The subsequent Rogers Commission found that the cause of the accident was the poor design of both primary and secondary O-rings on the right solid rocket booster, allowing hot gas and flame to escape, which then came into contact with the booster attachment and external tank, resulting in structural failure. The immediate cause was that the external fuel tank exploded. The problems with the O-rings had been known about for nine years but had been ignored, partly because safety was deemed ensured with the presence of the second ring. However, as was later made clear, the second ring was therefore unforeseen failure, not a failure that had been considered. Engineers' warnings that low temperatures would exacerbate the problem were also ignored by Nasa managers because of pressure to keep to the launch timetable. Now widely used as a case study for trainee engineers, this disaster taught us many lessons: that the advice of Nasa managers should be considered carefully; that the ethics of whistle-blowing and group decision-making should be introduced. Afterwards, there was a total redesign of the solid rocket boosters, in which three O-rings were incorporated, watched over by an independent oversight group as stipulated by the commission. In summing up the disaster, Richard Feynman, a member of the Rogers Commission, made a telling point to the effect that "for a successful technology, reality must take precedence over public relations, for nature cannot be fooled".

With story grammar,

four sharp end and two blunt end causes

On 28 January 1986, space shuttle Challenger broke apart 73 seconds after launch, killing its seven crew members. The subsequent Rogers Commission found that the cause of the accident was the malfunction of both primary and secondary O-rings on the right solid rocket booster, allowing hot gas and flame to escape, which then came into contact with the booster attachment and external tank, resulting in structural failure. The immediate cause was that the external fuel tank exploded. The problems with the O-rings had been known about for nine years but had been ignored, partly because safety was deemed ensured with the presence of the second ring. However, as was later made clear, the second ring was therefore unforeseen failure, not a failure that had been considered. The concerns about the O-rings did not have enough evidence to convince the management not to launch. Now widely used as a case

study for trainee engineers, this disaster taught us many lessons: that the advice of NASA managers should be considered carefully; that the ethics of whistle-blowing and group decision-making should be introduced. Afterwards, there was a total redesign of the solid rocket boosters, in which three O-rings were incorporated, watched over by an independent oversight group as stipulated by the commission. In summing up the disaster, Richard Feynman, a member of the Rogers Commission, made a telling point to the effect that " ignoring their own engineers can result in dramatically consequences".

Without story grammar,
two sharp end and four blunt end causes

The Challenger explosion (1986), in which seven crew member died, was caused by failures that led to a poor design of the "O" ring and inappropriate weather conditions on the day of the launch. Thus, failures in various parts of the organizational system combine in particular ways creating a sudden onset. In addition, the development of disasters is often ambiguous. Disasters develop over a period of time and often there are signals of this development. However, we suggest that these signals frequently go unnoticed because of the complexity of the information involved. Typically failures occur in different parts of the organizational system. As a result, signals of impending crises are diffuse as different individuals or departments have access to different pieces of information. Further, organizations may experience a problem of "variable disjunction of information," where the resources available to handle information are inadequate given the complexity of the information. Thus, it is difficult for individuals to consolidate and make sense of such information. For example, in the case of the Challenger' explosion 73 seconds after launch, a number of factors, in hindsight, were found to be involved. A weak Quality Control department, an O-ring malfunction, and pressure from Congress to launch the shuttle were some of the causes. The immediate cause of the accident was the explosion of the fuel tank.

However, because of the diffuse nature of these signals it was difficult for NASA to see the relationship among these signals and predict the explosion. In technology intensive organizations it is possible to predict that there will be technological failures over time. However, we suggest that because of the complexity of the information involved, it is difficult to trace the development of disasters and predict the onset of a particular disaster. Signals of a disaster in hindsight often seem obvious. However, prior to a disaster they are usually diffused and/or ambiguous.

Without story grammar,

four sharp end and two blunt end causes

The Challenger explosion (1986), in which seven crew member died, was caused by a malfunction of the O-ring, allowing hot gas and flame to escape, on the day of the launch. Thus, failures in various parts of the organizational system combine in particular ways creating a sudden onset.In addition, the development of disasters is often ambiguous. Disasters develop over a period of time and often there are signals of this development However,we suggest that these signals frequently go unnoticed because of the complexity of the information involved. Typically failures occur in different parts of the organizational system. As a result, signals of impending crises are diffuse as different individuals or departments have access to different pieces of information. Further, organizations may experience a problem of "variable disjunction of information," where the resources available to handle information are inadequate given the complexity of the information. Thus, it is difficult for individuals to consolidate and make sense of such information. For example, in the case of the Challenger's explosion 73 seconds after launch, a number of factors, in hindsight, were found to be involved. The immediate cause of the accident was the explosion of the fuel tank. However, because of the diffuse nature of these signals it was difficult for NASA to see the relationship among these signals and predict the explosion and the concerns about the low temperatures and the O-rings did not have enough evidence to convince the management. In technology intensive organizations it is possible to predict that there will be technological failures over time. However, we suggest that because of the complexity of the information involved, it is difficult to trace the development of disasters and predict the onset of a particular disaster. Signals of a disaster in hindsight often seem obvious, but it is very important the the management never ignore the opinions of their own engineers to reduce the risks. However, prior to a disaster they they are usually diffused and/or ambiguous.

Appendix E: Articles of Tenerife

With story grammar,

four sharp end and two blunt end causes

The best known of these events is the Tenerife crash in 1977, when two jumbo jets crashed on an airport runway. At 17:06 on 27 March 1977, two Boeing 747 aircraft collided on the runway of Los Rodeos airport on the island of Tenerife. The jets were Pan Am flight 1736 en route to Las Palmas from Los Angeles via New York and KLM flight 4805 from Amsterdam, also heading for Las Palmas. Both had been diverted to Tenerife because of a terrorist incident on Las Palmas. After several hours, the airport at Las Palmas re¬opened and the planes prepared for departure in the congested (due to re¬routed aircraft) Los Rodeos airport. The KLM plane taxied to the end of the runway and was waiting for air traffic control (ATC) clearance. The Pan Am plane was instructed to taxi on the runway and then to exit onto another taxiway. The KLM plane was now given its ATC clearance for the route it was to fly – but not its clearance to begin take¬off. The KLM captain apparently mistook this message for a take¬off clearance, released the brakes, and despite the flight engineer saying something, he proceeded to accelerate his plane down the runway. Due to the fog, the KLM crew could not see the Pan Am 747 taxiing ahead of them. Neither jet could be seen by the control tower and there was no runway radar system. The KLM flight deck engineer, on hearing a radio call from the Pan Am jet, expressed his concern that the US aircraft might not be clear of the runway, but was overruled by his captain. Ten seconds before collision during take-off, the Pan Am crew noticed the approaching KLM plane but it was too late for them to manoeuvre their plane off the runway. All 583 passengers and crewmembers on the KLM plane and on the Pan Am plane were killed. Analyses of the accident revealed problems relating to communication with ATC.

With story grammar,

two sharp end and four blunt end causes

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The KLM plane taxied to the end of the runway and was waiting for air traffic control (ATC) clearance. The Pan Am plane was instructed to taxi on the runway and then to exit onto another taxiway. The KLM plane was now given its ATC clearance for the route it was to fly – but not its clearance to begin take¬off. The KLM captain apparently mistook this message for a take¬off clearance, released the brakes, and despite the flight engineer saying something, he proceeded to accelerate his plane down the runway. Due to the fog, the KLM crew could not see the Pan Am 747 taxiing ahead of them. Neither jet could be seen by the control tower and there was no runway radar system. Ten seconds before collision during take-off, the Pan Am crew noticed the approaching KLM plane but it was too late for them to manoeuvre their plane off the runway. All 583 passengers and crewmembers on the KLM plane and on the Pan Am plane were killed. Analyses of the accident revealed problems relating to team coordination and fatigue.

Without story grammar,
two sharp end and four blunt end causes

On March 27 1977, flights KLM 4805 and Pan Am 1736 were both diverted to Los Rodeos, Tenerife as Las Palmas airport, their original destination, was closed because of a bomb explosion. The crewmembers on board had difficulties to fight against their fatigue on board. Limited taxi space at Los Rodeos meant that the Pan Am plane had to park behind the KLM plane in such a way that it could not depart until the KLM plane left. When they were ready to leave to continue to Las Palmas, KLM began its taxi for takeoff and was initially directed to proceed down a runway parallel to the takeoff runway. This directive was amended shortly thereafter and KLM was requested to taxi down the takeoff runway and at the end to make a 180 degree turn and await further instruction. The missing runway radar system deteriorated the situation of both airplanes. Pan Am was requested to follow KLM down the takeoff runway and to leave the takeoff runway at taxiway C3, use the parallel runway for the remainder of the taxi, and then pull in behind the KLM flight. On arriving at the end of the runway, and making the 180 degree turn to place himself in takeoff position, the KLM captain was advised by the copilot that he should wait because they still did not have an ATC clearance. The captain asked him to request it and he did, but while the copilot was still repeating the clearance, the captain opened the throttle and started to takeoff. Then the copilot, instead of requesting takeoff clearance or advising that they did not yet have it, added to his readback that they are now at takeoff. The tower, which was not expecting the aircraft to take off because it had not been given clearance, interpreted this sentence as that they are

now at takeoff position. Due to the strict time pressure, the captain of KLM decided to take-off. The copilot of the KLM had doubts about the take- off clearance as did the flight engineer but neither was able to overcome the captain's ego. The planes collided about 13 seconds later during take-off and 583 people died.

With story grammar,

four sharp end and two blunt end causes

On March 27 1977, flights KLM 4805 and Pan Am 1736 were both diverted to Los Rodeos, Tenerife as Las Palmas airport, their original destination, was closed because of a bomb explosion. The crewmembers on board had difficulties to fight against their fatigue on board. Limited taxi space at Los Rodeos meant that the Pan Am plane had to park behind the KLM plane in such a way that it could not depart until the KLM plane left. When they were ready to leave to continue to Las Palmas, KLM began its taxi for takeoff and was initially directed to proceed down a runway parallel to the takeoff runway. This directive was amended shortly thereafter and KLM was requested to taxi down the takeoff runway and at the end to make a 180 degree turn and await further instruction. The missing runway radar system deteriorated the situation of both airplanes. Pan Am was requested to follow KLM down the takeoff runway and to leave the takeoff runway at taxiway C3, use the parallel runway for the remainder of the taxi, and then pull in behind the KLM flight. On arriving at the end of the runway, and making the 180 degree turn to place himself in takeoff position, the KLM captain was advised by the copilot that he should wait because they still did not have an ATC clearance. The captain asked him to request it and he did, but while the copilot was still repeating the clearance, the captain opened the throttle and started to takeoff. Then the copilot, instead of requesting takeoff clearance or advising that they did not yet have it, added to his readback that they are now at takeoff. The tower, which was not expecting the aircraft to take off because it had not been given clearance, interpreted this sentence as that they are now at takeoff position. The controller replied that the KLM can stand for take off but has to wait until the ATC will call them. Pan Am also appeared unclear about its meaning and, in order to make their own position clear, they said that they were still taxiing down the runway. The tower requested Pan Am to report when it left the runway clear. Pan Am responded to the Tower that they will report them when they were clear. On hearing this, the KLM flight engineer asked if he is not clear then. The Captain ignored the flight engineers warning signals and did not answer. The copilot and flight engineer made no further objections. The planes collided about 13 seconds during take-off later and 583 people died.

Appendix F: Recognition Questionnaires

Multiple Choice Questionnaire

Tenerife

Please read the instructions carefully: The task is to answer the questions and to find the answer. Please make a cross on the chosen answer. After finishing the this page, you will be asked to make up another one.

1.When did the disaster take place?

1967	1977
1987	1997

2.How many victims were affected?

57	205
583	1024

3.What happened exactly?

The two airplanes almost collided	The two airplanes collided during take-off
The two airplanes collided minutes after take-off	One airplane exploded on the airport

4.What was the main cause for the accident?

The miscommunication between the pilot and the tower	The worries about working time limitations
The captain ignoring the flight engineer's warning	The fatigue of the crew managment

5.What was ultimately causing the disaster?

The poor weather (fog)	The lack of the ground radar system
The confusion about the ATC clearance	The wrong preparation for the take-off by the tower

Multiple Choice Questionnaire

Challenger

Please read the instructions carefully: The task is to answer the questions and to find the answer. Please make a cross on the chosen answer. After finishing the this page, you will be asked to make up another one.

1.When did the disaster take place?

1966	1976
1986	1996

2.How many astronauts died?

2	7
18	25

3.What happened exactly?

The space shuttle could not be started	The space shuttle exploded on the ground before departure
The space shuttle exploded 6,5 minutes after launch	The space shuttle exploded 73 seconds after launch

4.What was the immediate cause of the accident?

The low temperature	The poor design of the O-rings
The flame of the external tank	The escape of gas

5.Who was ultimately causing the disaster?

The crewmember responsible for the launch make a fatal mistake	The managers who kept pressuring for launch because of time pressure
The wrong preparation for the launch by the managers	The Nasa Managers by ignoring the warning signals of the O-rings

Appendix G: Coding schemes of Challenger and Tenerife

Coding scheme – Challenger

1) Demographic information

1a) Participation number**:** Give each participant a unique number, beginning with 1 and proceeding upward without duplication until 64.

1b) Age _____

1c) Gender 0 man 1 woman

2) Article characteristics

2a) Foreknowledge over Challenger 0 Yes 1 No

2b) Did the text contain a story grammar? 0 Yes 1 No

2c) Were there more blunt end than sharp end causes in the article? 0 Yes 1 No

2d) How was the story order? Tenerife-Challenger or Challenger-Tenerife 0 TC 1 CT

3) Setting

3a) Is the location (KSC) mentioned? 0 Yes 1 No

3b) Characters 0 Yes 1 No

Is the NASA management mentioned? 0 Yes 1 No

Are the engineers mentioned? 0 Yes 1 No

3c) Is the date mentioned (January, 28, 1986)? 0 Yes 1 No

4) Theme (included all blunt end causes)

4a) Is the lack of sleep of the crewmembers mentioned? 0 Yes 1 No

4b) Is it mentioned that the space shuttle was declared operational despite known problems? 0 Yes 1 No

4c) Is the pressure to launch mentioned? 0 Yes 1 No

4d) Is the low temperature mentioned? 0 Yes 1 No

4e) Is the poor design of the O-rings mentioned? 0 Yes 1 No

5) Plot (included all the sharp end causes)

5a) Is it mentioned that opinions of the engineers were ignored? 0 Yes 1 No

5b) Is the malfunction of the O-rings mentioned? 0 Yes 1 No

5c) Is the escape of hot gas mentioned? 0 Yes 1 No

5d) Is the explosion of the fuel tank mentioned? 0 Yes 1 No

6) Resolution

6a) Is the explosion of the space shuttle mentioned 0 Yes 1 No

6b) Is the number of deadly victims mentioned? 0 Yes 1 No

7) Questionnaire

7a) Is the first question correct answered?	0 Yes 1 No
7b) Is the second question correct answered?	0 Yes 1 No
7c) Is the third question correct answered?	0 Yes 1 No
7d) Is the fourth question correct answered?	0 Yes 1 No
7e) Is the fifth question correct answered?	0 Yes 1 No

Coding scheme – Tenerife

1) Demographic information

1a) Participation number: Give each participant a unique number, beginning with 1 and proceeding upward without duplication until 64.

1b) Age _____

1c) Gender woman

2) Article characteristics

2a) Foreknowledge over Tenerife 0 Yes 1 No

2b) Did the text contain a story grammar? 0 Yes 1 No

2c) Were there more blunt end than sharp end causes in the article? 0 Yes 1 No

2d) How was the story order? Tenerife-Challenger or Challenger-Tenerife 0 TC 1 CT

3) Setting

3a) Is the location (Tenerife and/ or Los Rodeos) mentioned? 0 Yes 1 No

3b) Characters

Is the KLM/ Pan Am aircraft mentioned? 0 Yes 1 No

Are the Tower controllers mentioned? 0 Yes 1 No

3c) Is the date mentioned (March, 27, 1977)? 0 Yes 1 No

4) Theme (included all blunt end causes)

4a) Is the time pressure mentioned? 0 Yes 1 No

4b) Is the crew management training mentioned? 0 Yes 1 No

4c) Is crew management organisation mentioned? 0 Yes 1 No

4c) Is the missing runway radar system mentioned? 0 Yes 1 No

5) Plot (included all the sharp end causes)

5a) Is the bad weather (fog) mentioned? 0 Yes 1 No

5b) Is it mentioned that there was a difficulty understanding the instructions of the tower 0 Yes 1 No

5c) Is it mentioned that there was no clear tax way? 0 Yes 1 No

5d) Is the false assumption of the take-off clearance mentioned? 0 Yes 1 No

6) Resolution

6a) Is the collision between the KLM aircraft and the Pan Am aircraft mentioned 0 Yes 1 No

6b) Is the number of deadly victims mentioned? 0 Yes 1 No

7) Questionnaire

7a) Is the first question correct answered? 0 Yes 1 No

7b) Is the second question correct answered? 0 Yes 1 No

7c) Is the third question correct answered?	0 Yes 1 No
7d) Is the fourth question correct answered?	0 Yes 1 No
7e) Is the fifth question correct answered?	0 Yes 1 No