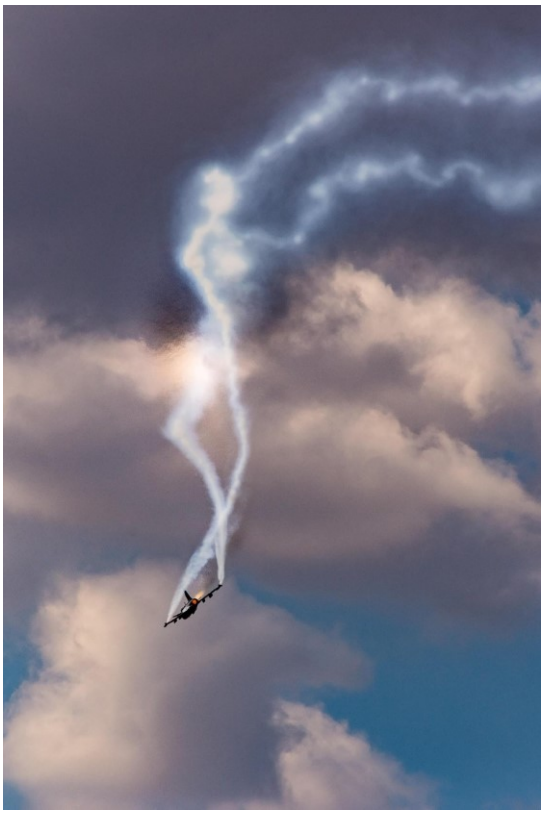

BACHELOR'S THESIS

What causes the sharp end recall effect in recall of disaster stories?

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Abstract

When people are asked to recall tragic accidents, they tend to remember more those causes that were closest to the scene of the accident in terms of time and space, referred to as sharp end factors. The purpose of the current study is to investigate what causes this sharp end effect in recall by looking at the effects of the presence or absence of sharp ends in disaster stories. Fifty participants took part in the study where they were asked to read two separate disaster stories and recall what they read. Participants were then asked to rate which factors were most blameworthy in contributing to the cause of the disaster, as well as rate the moral intention of the actors in the stories. The results indicated that the sharp end effect in recall was present when sharp end factors were mentioned in the texts. However, the absence of sharp ends in the texts did not increase recall of more remote, blunt-end factors. Furthermore, a blunt end effect in assigning blame was found to be highest when sharp end factors are included in the texts. Moreover, the inclusion of more abstract, macro-level blunt end factors did not significantly increase recall or blaming tendency of blunt ends and instead resulted in an increase of sharp end recall and blaming tendency. Finally, it was found that moral intention had no significant influence over recall and blaming tendency. The results of the study do not give a clear indication as to why the sharp end effect appears, however it is shown that recall of sharp and blunt ends could follow two different schemas.

Keywords: recall, disaster, sharp ends, blunt ends, sharp end recall, blunt end recall, blaming tendency, moral intention.

Introduction

When thinking about accidents, there is a tendency to associate them with mistakes, coincidences, or even an unintentional series of events that would not be repeated in the future. The media often informs us of tragic accidents that cost money, lead to damage, or loss of human lives. In these cases, accidents are seen more as failures of risk and safety management rather than a set of unrelated coincidences (Dekker, Nyce & Myers, 2013). Indeed, when tragic accidents are analyzed more closely, several layers of management or organization reveal themselves as sources for where the fault could have originated. In recent years, blame has shifted from individuals and actors most proximal to the accident toward more distant causes such as bureaucracy or administration (Dekker, Nyce & Myers, 2013). Suggesting that one single actor or 'human error' is to blame for causing an accident gives the illusion of control and might be more emotionally satisfying, while reality may be much more complex and intricate (Reason, 2000). Hence, much like a system, an accident is more than the sum of its parts (Rasmussen, 1997). It is precisely why we distinguish between *sharp ends* and *blunt ends* in accident analysis. Sharp ends refer to factors or causes that are closely associated with front-line workers (i.e., those closest to the site of the accident) and whose effects are immediately felt (Reason, 1990). Examples include pilots, air traffic controllers, officers, engineers, control room crews, etc. Blunt end factors are those that are more removed from the accident in space and time, whose effects may lie dormant for a longer time but can still be traced back to the accident: senior management, designers, maintenance personnel, government officials, and even policies (Reason, 1990). These factors are part of many different accident models, one of which is the Swiss Cheese Model of Reason, originally developed in 1997. It is a heuristic explanatory model which states that no single failure can cause an accident, whether it be human or technical (Reason et al., 2006). The defensive layers between the blunt and sharp end factors are represented by slices of cheese, and the potential errors are represented by the holes, constantly opening up, closing, and changing location (Reason, 2000). An accident then can only happen when the holes of each "slice" or defensive layer line up to let a trajectory of accidents occur.

Yet, accidents at the first few slices of cheese (i.e., the sharp end levels) are often emblematic of much deeper, macro-level problems in that they stem from regulatory, organizational, institutional, or administrative factors rather than from individual "errors" (Cedergren & Petersen, 2011). In order to gain broader understanding of an accident and to prevent other potential accidents from happening in the future, however, the focus should be on both sharp- and blunt end factors simultaneously. Sharp end factors are usually among the

first to be identified at the scene of the accident because of their spatial closeness and are given more attention in investigation reports, while the blunt end factors are usually identified much later in the investigation and are much more difficult to isolate (Cedergren & Petersen, 2011). Insights gained from investigating sharp end factors contribute to improving system reliability, but they provide limited explanation of the causes of an accident and they lack considerations of blunt end factors. Furthermore, sharp end factors alone cannot provide countermeasures for improving the functioning of a system, which can be found higher up in the socio-technical hierarchy (Cedergren & Petersen, 2011). In other words, while sharp end factors can be identified more easily because of their proximity to the scene of the accident, they do not provide the necessary solutions in order to improve the overall system that can only be acquired from insight into blunt end factors. To quote Reason (2000, p.769): "We cannot change the human condition, but we can change the conditions under which humans work." Risk management in the last half century has broadened its scope to include failures in organizations and corporate culture in its investigations, thus shifting away from the individual and more towards removed processes that might pose more danger if not dealt with (Dekker, Nyce & Myers, 2013). Nevertheless, even when blunt end factors buried deep in administration or bureaucracy are accounted for, the signs will still point toward the individual as the cause of accidents, positing it as "human error" (Dekker, Nyce & Myers, 2013). Geurts (2013) and Verschuur (2013) compared scientific and non-scientific reports on disasters such as Chernobyl and Challenger and found that sharp end factors are much more accentuated in non-scientific literature as compared to scientific literature; this gives insight into the human factors of sharp end elements. The reason why sharp end elements are repeatedly mentioned in non-scientific literature may stem from the idea of how failure and success are viewed in the Western world – individuals are held accountable for their actions (Dekker, Nyce & Myers, 2013; Verschuur, 2013). Therefore, it is necessary to understand that an error can only be judged if an appropriate standard of judgement, adopted by human error analysts, is present (Rasmussen, 1997).

Now that the scientific perspective on accidents has been presented, the question remains of how ordinary people view and remember accidents and disasters, as well as what kind of processes do they use to justify when remembering, blaming, or finding the cause of an accident. Human cognition is most of the time a reliable tool for passing judgement or blame on a particular situation. However, cognition can be influenced by outside factors, which in turn can affect one's moral judgement and blaming tendency. One way to explain how people remember information is through the concept of *reductive bias* (Feltovich et al., 2004). This reductive tendency is a direct result of how people learn new knowledge. Individuals, when

dealing with difficult concepts, tend to learn by engaging in oversimplification of the information, which often leads to misinformation and an incorrect application of knowledge (Feltovich et al., 2004). Their knowledge is essentially incomplete when they are forming a new understanding of a concept. Furthermore, people tend to understand complex information in simpler terms, and try to defend their faulty conceptions when confronted with a more nuanced explanation (Feltovich et al., 2004). Another explanation for how people recall and assign blame to information is through framing. Research on framing illustrates the extent to which people modify their moral judgements based on the story they are presented with. One way to explain how people remember information, judge, and assign blame is through the concept of framing. The concept of framing has been defined in multiple ways in the literature. One definition cites it as a central organizing idea used to give meaning to an event or a series of events and that it states the essence of the issue (Scheufele, 1999). Furthermore, to frame something refers to the act of selecting a certain aspect of a recognized reality and accentuating it in a way that promotes a specific causal interpretation, problem definition, or moral evaluation (Scheufele, 1999; Haider-Markel & Josslyn, 2001). In other words, frames are not intended for use in audience persuasion – they simply serve to explain the way in which people *process* information upon first encounter. Scheufele & Iyengar (2014) make use of the metaphor "mental shelf" to explain the effects of framing, specifically on which "mental shelf" the information will be stored in a person's memory. Framing *effects* are then the outcomes of how a relevant piece of information is framed and presented to the public. It has been found that framing is influenced by contextual information, and that it is also contingent upon factors such as the nature of the individual's predisposition, as well as the strength of their existing knowledge and cognitive schemas (Haider-Markel & Joslyn, 2001; Scheufele & Iyengar, 2014). Other definitions of frames and framing are more specific to the individual's own mental understanding of a particular narrative or situation – it reveals what a person sees regarding that narrative (see Druckman, 2001; Scheufele, 1999; Haider-Markel & Joslyn, 2001; Scheufele & Iyengar, 2014). Nonetheless, most relevant studies done on framing have been done in the realm of politics, media, and policies when they can be extended to include studies on blame attribution.

Blame attribution can also be understood in other ways. . For instance, Malle (2021) investigates the concept of *moral judgement,* or "how blameworthy a behavior is, how morally blameworthy an agent is or how much blame [an] agent deserves." There are several layers of moral judgements that can be conceptualized as a *hierarchy*, with *blame judgements* on top.

Blame judgements are formed from *evaluation* and *wrongness judgements*; they fully incorporate justification, and they handle unintentional norm violations along with assigning blame (Malle, 2021). What makes this process nuanced and complex is the way an individual evaluates blame judgements by incorporating several different sources of information at once, such as the agent's contribution to the event, reasoning for their actions, what the agent could or should have done, as well as a "warrant," or evidence that a moral judgement is justified, which in turn motivates people to process causal and mental information surrounding the event (Malle, 2021; Monroe & Malle, 2019). People use blame in order to regulate behavior in others, hence it is socially regulated (Monroe & Malle, 2019). Because acts of blaming are closely regulated by norms of moral criticism, people often look for a single entity that has broken the moral standard to attribute blame to. Moreover, they often do so in a rapid fashion – it only takes about 2.5 seconds for people to update their blame judgements after being presented with more information (Malle, 2021). The *motivated-blame perspective* states that people are likely to be influenced by information presented to them at an earlier time point and an inherent desire to attribute blame, which affects their later cognitive processing of causal and moral information – all in favor of strengthening their already-formed attributions (Monroe & Malle, 2019). According to this theory, people play the role of prosecutors that hand out punishments rather than understand the problem correctly. Research on the motivated-blame perspective suggests that there is a bias among people that increases their blaming tendency when being initially presented with negative information, resulting in a tendency to accept information that aggravates blame and disregard information that relieves it (Monroe & Malle, 2019). A different theory – the Morality as Mind Perception account (MMP) – also gives explanations on how and why people make moral judgements and attribute blame. MMP affirms that when people make judgements of blame, they use their intuition to assess whether harm-causing persons are more blameworthy than non-harm-causing persons (Pizarro, Tannenbaum & Uhlmann, 2012). Harmful acts are said to be more informative of a person's moral character – the more harmful the act, the more blameworthy an individual will be evaluated (Pizarro, Tannenbaum & Uhlmann, 2012). A fundamental aspect of the MMP is "the motivation to assess an individual's underlying moral character" (p. 186) with questions that encompass the complete morality of the moral agent in question such as "Is this person good or bad?," "Was there a breaking of a moral rule?," "Do you think the person intended to act in such a way?," etc. (Pizarro, Tannenbaum & Uhlmann, 2012). Nonetheless, there are cases where individuals can judge a misdemeanor as morally wrong despite a clear lack of agency or harm; that is, an individual can be blamed for a harmful act they did not (directly) commit (Pizarro,

Tannenbaum & Uhlmann, 2012). In conclusion, theories on moral judgement and the concept of framing reveal much about people's mental processes when remembering knowledge and assigning blame to a moral agent. They aim to give an account of how people process information, how they rationalize their choices, as well as what cognitive processes might be at play when such cognitive processes occur.

Besides moral judgement, studies have considered other elements such as story grammar that might influence recall and blame attribution of disaster stories. Research on the effects of story grammar on recall conclude that information texts containing story grammar are better remembered and later recalled (Rumelhart, 1980; Madler, 1977). Moning (2014) investigated the effects of story grammar on recall of disaster stories. It posed the question whether story grammar plays a role in how much detail, facts or causes people remember from the stories they read, operating under the assumption that story grammar increases their chances of retaining the information. The second question this research aimed to answer was whether people who read disaster texts without story grammar assigned more blame to sharp end causes than to blunt end ones. To investigate this, Moning (2014) used two manipulations of independent variables. The first one was the presence or absence of story grammar, while the second one involved the number of sharp- or blunt end causes mentioned in the story. The results of the study confirmed that recall of overall information was indeed larger for participants that read texts containing story grammar. Moreover, participants that read texts with story grammar recalled more story grammar elements (i.e., theme) than those that read texts with no grammar present. Importantly, it was found that participants in both groups recalled more sharp ends than blunt ends on average.

The research of Berkemeier (2021) explored what causes sharp end effects in recall of disaster stories. Her study attempted to answer whether there was a connection between recall and blaming tendency of both sharp and blunt ends, as well as whether the recall order of either sharp or blunt ends was affected. The research introduced two types of manipulation to the independent variable: whether sharp ends are mentioned (yes or no) and whether blunt end blaming at the end of the text is mentioned (yes or no). The methods of the study were similar to those used in Moning (2014) with some modifications. Nonetheless, Berkemeier's study (2021) yields interesting results in terms of recall and blaming tendency for both sharp and blunt end factors. Overall, it was found that there was a stronger sharp end effect in terms of recall and a stronger blunt end effect in terms of blaming tendency, leading to the conclusion that recall and blaming tendency are governed by two separate processes – one immediate and

one elaborate (Berkemeier, 2021). However, participants assigned at least some blame to sharp end factors, regardless of their presence in the texts (Berkemeier, 2021).

The purpose of the present study is to investigate the role of sharp end effects in recall of disaster stories, as well as blaming tendency of participants toward factors mentioned in the disaster stories. The study will build on the research carried out by Berkemeier (2021), with added modifications. It will look into the effect of recall of disaster reports of two accidents. One disaster story was chosen specifically because of its emphasis on more abstract, macro-level blunt ends (i.e., those at the very end of the blunt end spectrum) in order to measure whether there are any differences in blunt end recall from Berkemeier (2021), who utilized less abstract, meso-level blunt ends. To this end, the Challenger story will be adapted from the research of Moning (2014). Recall will be measured with a free recall task, asking the participants to write down as much as they can remember about each disaster story separately. In addition to recall, blaming tendency will be investigated using a responsibility questionnaire asking the participants who they think was responsible for the cause of the accident. According to the motivated-blame perspective, participants will have an inherent desire to blame despite conflicting information or not having a clear understanding of the problem situation (Monroe & Malle, 2019). Therefore, this study will look into the degree of blame participants assign to test whether the motivated-blame perspective holds true. Another reason for the inclusion of the responsibility questions in this study is to test whether the finding of Berkemeier (2021) about recall and blaming being two separate processes can be replicated in the context of the present study. The study will investigate one independent variable, which is the presence or absence of sharp ends in the texts, while blunt ends will be present in all versions of the texts. The texts used in the study of Berkemeier (2021) will be adapted to include sharp ends in one condition and blunt ends across all conditions. Blaming statements will also be removed from the original texts. The texts will not include blaming of any kind, as per the motivated-blame perspective, yet participants will still be asked blaming questions. Another modification from the research of Berkemeier (2021) is that the blaming questions will be presented one after the other individually. This modification will force participants to judge and assign blame to individual factors rather than evaluate all factors presented as a whole and not be influenced by the rest of the questions. In addition to the blaming questions, this study will introduce morality questions, where participants will be asked to judge the moral intention of the people mentioned in the texts. The purpose behind this inclusion is to explore how participants utilize moral judgement when reading disaster stories. According to Pizarro, Tannenbaum & Uhlmann (2012), participants would likely assign larger blame to actors who commit more harmful acts.

By evaluating how good or bad an individual in the disaster stories is, it will reveal what act participants view as harmful or harmless. In order to answer the research questions, four hypotheses have been formulated, starting with recall, and moving toward blaming tendency:

1. Recall of sharp ends will be higher than recall of blunt ends for participants who read texts that contain sharp end factors.
2. Blaming tendency of sharp ends will be higher than blaming tendency of blunt ends for participants who read texts that contain sharp end factors.

This study will also put forth exploratory hypotheses which will investigate other dependent variables. The first exploratory hypothesis will look into whether the recall of blunt end factors in both conditions will be different if sharp ends are not present. Berkemeier (2021) found that despite the removal of sharp ends from the texts, blunt end recall did not improve. The second exploratory hypothesis will look into whether the blunt end blaming tendency will be different between conditions. Berkemeier (2021) found a strong blunt end effect in assigning blame regardless of the number of sharp ends present in the text. The third exploratory hypothesis will investigate whether there is a difference between sharp- and blunt end recall between the two stories ICE Hanover and Challenger. Moning (2014) found that sharp- and blunt end elements of Challenger were recalled less often than the texts of the Tenerife disaster. The reason given for the appearance of this finding was that Challenger contained more technical details that were difficult for participants to comprehend. In addition to this, the fourth exploratory hypothesis will investigate the difference between sharp- and blunt end blaming tendency between the two stories. The results of Moning (2014) regarding the complex nature of the Challenger story are relevant here, however it might be worth to further investigate. The fifth and final exploratory hypothesis will look into the assigned moral intention participants give to actors in the text. The study of Berkemeier (2021) looked solely into judgements of blame in order to see who participants see as blameworthy. Adding a moral judgement aspect to this study will provide more depth to the aspect of blaming tendency. Thus, the five exploratory hypotheses are as follows:

1. Recall of blunt end factors will be different between the two conditions if sharp end factors are not present in the texts
2. Blaming tendency of blunt end factors will be different between the two conditions if sharp end factors are not present in the texts
3. There will be a difference between sharp end and blunt end recall between the story of ICE Hanover and the story of Challenger

4. There will be a difference in sharp end and blunt end blaming tendency between the story of ICE Hanover and the story of Challenger
5. There will be a difference between assigned moral intention between both conditions

Methods

Participants

A total of 51 people participated in the experiment. Participant recruitment occurred through contact of personal channels, use of social media platforms such as Instagram, as well as via Test Subject Pool SONA by the University of Twente. For participation, a good internet connection and a functioning microphone were required. It was allowed for participants to turn off their cameras as per their request, however only after notifying the researcher. Moreover, potential participants had to be current or former students at a university, be at least 18 years of age, and possess sufficient English language skills.

Further criteria were also required of the participants. They must not possess any prior knowledge of the disaster stories (i.e., ICE Hanover & Challenger) that would hinder or influence their recall. A participant was fit to continue with the experiment if they were judged to have limited or no prior knowledge by the researcher. If the participants could name key causes or specific details of the accident, their responses were not eligible to be used in the data. The data of one participant was removed for this reason.

Of the remaining 50 participants, 33 (66%) were female, 13 (26%) were male, 2 (4%) were non-binary, and 2 (4%) preferred not to specify. The participants' ages ranged from 18 to 39, with a mean of 23.0 (*SD*=3.1). Moreover, 30 (60%) participants were Macedonian, 8 (16%) were Dutch, 5 (10%) were German, 2 (4%) were French, and 5 people were of different nationalities (10%). Of the 50 participants, 26 (52%) were randomly allocated in Condition 1, and 24 (48%) were allocated to Condition 2. This study was approved by the BMS Ethics Committee of the University of Twente.

Materials

The materials used for this research were adapted from Berkemeier (2021) on disaster recall & Moning (2014) on story grammar. Namely, one of the stories used for the purpose of this research was taken from Berkemeier (2021), while the other was taken from Moning (2014). Much like in Berkemeier (2021) and Moning (2014), scientific and non-scientific literature was used to write the stories, either containing factual or fabricated information in order to fit the required amount of sharp- and blunt ends in each conditions. The “sharp ends present” condition (i.e., Condition 1) contained four sharp ends and four blunt ends, while the “sharp ends absent” condition (i.e., Condition 2) contained four blunt ends and no sharp ends. Below, the disaster stories, as well as the coding schemes, responsibility and morality questions, will be discussed in detail.

Disaster stories

For this research, the story that was taken from Berkemeier (2021), which was the ICE Hanover disaster, remained unchanged in one condition. In the second condition, the sharp end factors were rewritten in a passive form, thereby transforming them into contextual information. Information was omitted and added as necessary to make the texts readable and equal in length. The Space Shuttle Challenger disaster was the subject of the second story. The versions of Moning (2014) were used as inspiration for the stories of this research. The texts of this research were written similarly to those of ICE Hanover in order to retain familiarity for the participants. The ICE Hanover texts both had an equal number of words, which is 297. For the Challenger texts, the text in the "sharp ends present" condition contained 296 words, while the one in the "sharp ends absent" condition contained 298 words. Furthermore, each of the texts were tested for readability (by using http://www.readabilityofwikipedia.com/score). The ICE Hanover texts had Flesch reading scores of 66 in the "sharp ends present" condition and 65 in the "sharp ends absent" condition. The Challenger texts, on the other hand, had Flesch reading scores of 52 in the "sharp ends present" condition and 50 in the "sharp ends absent" condition. These texts had lower Flesch scores because of the amount of scientific jargon that, if removed, would not have been properly understood by the participants.

Responsibility and morality questions

In addition to the stories, the participants were asked responsibility and morality questions based on the content of the stories. They were asked to rate each factor based on how much they perceive it to be responsible for causing the accident. The 5-point Likert scale was used to express responsibility and ranged from "not at all responsible" to "extremely responsible." Moreover, a "not applicable" button was also included, which was red and in bold. The purpose of this button was to provide an option for participants to abstain from assigning blame to any of the factors they read about. There were eight responsibility questions in total, equal to the number of factors in the text. For the morality questions, participants were asked to rate the actors in the texts based on how good or bad the actors' moral intentions, or rather how morally good or bad their actions were perceived by the participants. The scale ranged from "extremely bad" to "extremely good," along with a "not applicable" button to the right. There were five morality questions for the ICE Hanover text, and five morality questions for the Challenger text.

Coding scheme

The coding of recall information and coding schemes were also adapted from Berkemeier (2021) with modifications based on the disaster stories of this experiment. Every

version of the disaster stories used a separate coding scheme table to account for differences in the contents of the stories based on the manipulations. In the condition "Sharp ends present" there were three categories of information, namely contextual information, sharp ends, and blunt ends. The condition "Sharp ends absent" only had the categories contextual information and blunt ends, as there were no sharp ends mentioned in the stories of this condition. All the coding scheme tables can be found in Appendix 1.

Design

This research employed a between-subjects design. The independent variable was "sharp ends present/absent," with two conditions "sharp ends present" and "sharp ends absent." In the first condition, "sharp ends present," participants read two different disaster stories that contained an equal number of sharp- and blunt ends, while in the other condition participants read stories that contained no sharp ends whatsoever.

Three dependent variables were measured. The first one was participants' recall of the information presented in the texts. This was measured with a free recall task, similar to the studies of Berkemeier (2021) and Moning (2014), which consisted of three elements: "recall of sharp ends," "recall of blunt ends," and "recall of contextual information." The second dependent variable, blaming tendency, was measured with a series of responsibility questions similar to those used in the research of Berkemeier (2021). The third dependent variable, moral intention, was measured with a series of morality questions.

Procedure

The experiment was conducted entirely online, due to COVID-19 restrictions in place, through a secure video conferencing software, namely Google Meets. Meetings with the participants were conducted one-on-one at a scheduled time. The participants were not required to be on camera, but they were asked to share their audio and their screen with the researcher.

The participants were provided with a link to the meeting as well as a link to the experiment, which was done using Qualtrics. After reading the informed consent and agreeing to participate, they were asked to provide an email address that the researcher would be able to use to share the results of the study with the participant. The survey contained clear instructions that the participant was able to follow on their own but was informed by the researcher that they were allowed to ask questions regarding any task or instruction.

Participants were then asked several questions regarding their prior knowledge about the ICE Hanover and Space Shuttle Challenger disaster. It was imperative that participants

knew little to no information about the disasters because it could influence their recall and blaming tendency later in the survey. They were further asked about their reading comprehension level and how they perceived their English proficiency on a scale from "very bad" to "very good." They were also asked whether they had attended a study program that was held in English.

After answering this, the participant was able to move on to reading the stories. The participants were randomly allocated to a condition, either "sharp ends present" or "sharp ends absent." The story order was also randomized, meaning that participants were randomly assigned to either read the ICE Hanover story or the Challenger story first. In the end, 25 people started with the ICE Hanover story and 25 started with the Challenger story. The participants were told they had about 5 minutes to read the story, with the option to do it twice if enough time was left. A timer was presented above the story indicating exactly how much time had elapsed. Next, the participants were asked to perform a verbal calculation task, where they were to count back starting with a random three-digit number by either seven or nine out loud for two minutes. The purpose of this task was to momentarily distract the participants from the story they read, as well as to find out how much they recalled without depending on their working memory. The researcher set a timer on their device and let the participant know when the two minutes had elapsed. After completing the calculation task, the participants were presented with the free recall task and were asked to write down everything they remembered from the text they had read. They had unlimited time to complete the free recall task and were instructed to write down as much as they could remember. After this, the participants were asked to read the second story and the same process was repeated for the second disaster story.

Then, the participants were asked whether they recognized any of the stories after reading them and if so, which.

In the next section, participants moved on to answering the responsibility and morality questions. As previously mentioned, each question was presented one by one, with one question per page. After answering one question, the participants were instructed to move on to the next page where the process was repeated. The sets of questions were also presented randomly – participants either answered the ICE Hanover questions first followed by the Challenger questions or vice versa. However, the responsibility questions were always followed by the morality questions.

In the final section of the survey, the participants were asked to provide some demographic information, such as their gender, age, nationality, their level of education and their study/working field. Once all required information was filled in, the survey was

completed. At this time, the participants were debriefed by the researcher on the background of the study, as well as all the manipulations and variables that were used for the experiment. They were asked one last time whether they were comfortable with their data being used for the purpose of the experiment. After this was completed, the participant was thanked for their time and participation. The time it took for participants to complete the experiment ranged from 25 minutes up to 65 minutes.

Data analysis

The data collected were analyzed using the analytical software IBM SPSS version 26, with a significance level of 0.05. The dependent variables that were investigated were average sharp end recall (of Condition 1), average blunt end recall, average total recall, as well as average sharp end blame, average blunt end blame, and average moral intention. Additionally, the average recall of all story elements was analyzed in order to verify whether there was any difference between the recall of the disaster stories.

The data was explored with descriptive statistics. To determine the normality of the data, values of skewness and kurtosis were checked, as well as the Shapiro-Wilk test to identify potential outliers. In order for outliers to be excluded from analysis, they must have significantly changed the results, specifically more than four standard deviations in one variable. Additionally, removing said outliers should change the data to a substantial degree. If a dependent variable was determined to be normally distributed, the means between the groups of the two conditions were compared using an independent measures t-test. If that was not the case and the dependent variable did not possess normality, a Mann-Whitney U test was used instead.

Results

Checking for normality

All data were normally distributed with the exception of the assigned moral intention in Condition 1 ($W(26)=0.94$, $p=0.12$) and the average assigned blame divided between the stories ICE Hanover ($W(26)=0.95$, $p=0.24$) and Challenger ($W(26)=0.93$, $p=0.09$) in Condition 1, and again in Condition 2 between ICE Hanover ($W(24)=0.96$, $p=0.48$) and Challenger ($W(24)=0.92$, $p=0.06$). The means, standard deviations, and medians of all data are presented in Tables 1-4 below.

Overall recall between disaster stories

To check whether there was a difference between the two stories (ICE Hanover and Challenger), the recall of all elements for both conditions was averaged and compared. It was found that the averages were very similar, with an average of 46.82% (*SD*=0.22) for the ICE Hanover disaster and 47.82% (*SD*=0.17) for the Challenger disaster. A paired sample t-test showed no significant difference between the ICE Hanover and Challenger stories, $t(49)=-0.39$, $p=0.70$. Because of the similarity, it was acceptable to treat the stories as duplications, and compare the data of both stories together.

Hypothesis 1

The first hypothesis was that recall of sharp ends will be higher than that of blunt ends for participants who read texts that contain sharp end factors. A paired samples t-test was used to compare the average sharp end and blunt end recall in the condition where sharp end factors were present (i.e., Condition 1). A significant difference was found between sharp end recall ($M=0.60$, $SD=0.21$) and blunt end recall ($M=0.42$, $SD=0.24$) in Condition 1, $t(25)=3.65$, $p=0.00$. In other words, participants indeed recalled more sharp ends than blunt ends when reading texts containing sharp ends. The first hypothesis is thus accepted. The means and standard deviations are presented in Table 1 below.

Table 1

Means and standard deviations of sharp- and blunt end recall per condition

		Average recall (sd)	
		Sharp ends	Blunt ends
Presence of sharp ends	Yes (Cond.1)	0.60 (0.21)	0.42 (0.24)
	No (Cond. 2)	-	0.47 (0.25)

Hypothesis 2

The second hypothesis was that blaming tendency of sharp ends will be higher than that of blunt ends for participants who read texts that contain sharp end factors. A paired samples t-test was used to compare the average blaming tendency of sharp and blunt ends between participants in Condition 1. A significant difference was found between sharp end blame

(M=3.12, SD=0.50) and blunt end blame (M=3.96, SD=0.38) in Condition 1, t(25)=-8.88, p=0.00. In other words, participants that read texts containing sharp ends assigned more blame to blunt end factors than to sharp end factors. This runs counter to the hypothesis, which means that it is rejected. The means and standard deviations are presented in Table 2 below.

Table 2

Means and standard deviations of blaming tendency per condition

		Average blaming (sd)	
		Sharp ends	Blunt ends
Presence of sharp ends	Yes (Cond.1)	3.12 (0.50)	3.96 (0.38)
	No (Cond. 2)	-	3.61 (0.75)

Exploratory hypothesis: Blunt end recall

The first exploratory hypothesis was that recall of blunt ends will be different between conditions if sharp ends are not present. An independent sample t-test was used to compare the average recall of blunt ends between the two conditions. No significant difference was found between blunt end recall in Condition 1 (M=0.42, SD=0.24) and Condition 2 (M=0.47, SD=0.25), t(48)=-0.74, p=0.47. In other words, participants did not recall blunt ends any differently between both conditions. Thus, the hypothesis is rejected. The means and standard deviations are presented in Table 1.

Exploratory hypothesis: Blunt end blaming tendency

The second exploratory hypothesis was that blaming tendency of blunt ends will be different between conditions if sharp ends are not present. An independent sample t-test was used to compare the average blaming tendency of blunt ends between the two conditions. A significant effect was found between blaming tendency of blunt end factors in Condition 1 (M=3.96, SD=0.38) and Condition 2 (M=3.61, SD=0.75), t(48)=2.14, p=0.04. In other words, participants that read texts containing sharp ends assigned more blame to blunt end factors than participants who did not read texts containing sharp ends. Therefore, the hypothesis is accepted. The means and standard deviations are presented in Table 2.

Exploratory hypothesis: Sharp and blunt end recall between stories

The third exploratory hypothesis was that there will be a difference between sharp- and blunt end recall between the stories of ICE Hanover and Challenger. A Wilcoxon sign rank test was used to compare the sharp- and blunt end recall of both stories between conditions. A significant effect was found between the sharp end recall of ICE Hanover (*Mdn*=0.50, *N*=26) and that of Challenger (*Mdn*=0.75, *N*=26) in Condition 1, *Z*=-2.09, *p*=0.04. In other words, participants on average recall more sharp end elements in the Challenger story than in the ICE Hanover story when they read texts containing sharp ends. Besides, no significant effect was found between blunt end recall of ICE Hanover (*Mdn*=0.38, *N*=26) and Challenger (*Mdn*=0.50, *N*=26) in Condition 1, *Z*=-0.41, *p*=0.68. Moreover, no significant effect was found in blunt end recall of ICE Hanover (*Mdn*=0.50, *N*=24) and Challenger (*Mdn*=0.50, *N*=24) in Condition 2, *Z*=-0.17, *p*=0.86. To put it more concretely, participants on average recalled blunt ends in both stories equally between both conditions. As a difference between the sharp and blunt end recall is observed, the hypothesis is thus accepted. The medians are presented in Table 3 below.

Table 3

Medians for average recall of stories per condition

		ICE recall		Challenger recall	
		Sharp end	Blunt end	Sharp end	Blunt end
		Mdn	Mdn	Mdn	Mdn
Sharp ends	Present	0.50	0.38	0.75	0.50
	Absent		0.50		0.50

Exploratory hypothesis: Sharp and blunt end blaming tendency between stories

The fourth exploratory hypothesis was that there will be a difference in the sharp and blunt end blaming tendency between the ICE Hanover and Challenger stories. A Wilcoxon rank test was used to compare between the sharp end blame between ICE Hanover (*Mdn*=2.50, *N*=26) and Challenger (*Mdn*=3.75, *N*=26) in Condition 1. A significant effect was found between the sharp end blaming tendency between the two stories, *Z*=-3.75, *p*=0.00. Moreover, a paired sample t-test was used to compare the sharp end blame between the two stories in Condition 2. A significant effect was found between ICE Hanover (*M*=2.72, *SD*=0.83) and Challenger (*M*=3.74, *SD*=0.74), *t*(23)=-5.95, *p*=0,00. In other words, participants on average assigned more blame to sharp end factors in the Challenger story than in the ICE Hanover story

in both conditions. Furthermore, to compare blunt end blaming between the stories in Condition 1, a paired sample t-test was utilized. No significant effect of blunt end blaming was found between ICE Hanover (M=4.06, SD=0.50) and Challenger (M=3.81, SD=0.65), $t(25)$=1.50, p=0.15. Finally, to compare blunt end blaming between stories in Condition 2, a Wilcoxon sign rank test was used. No significant effect was found of blunt end blaming between ICE Hanover (Mdn=3.88, N=24) and Challenger (Mdn=3.62, N=24), Z=-1.53, p=0.13. In other words, participants recall more blunt end elements in the ICE Story than in the Challenger story. As a difference between sharp and blunt end blaming is observed, the hypothesis is thus accepted.

Table 4

Means, standard deviations and medians for average blaming tendency of stories per condition

		ICE blaming		Challenger blaming	
		Sharp end	Blunt end	Sharp end	Blunt end
		Mdn	M (SD)	Mdn	M (SD)
Sharp ends	Present	2.50	4.06(0.50)	3.75	3.81(0.65)
		M (SD)	Mdn	M (SD)	Mdn
	Absent	2.72(0.83)	3.88	3.74(0.74)	3.62

Exploratory hypothesis: Moral intention

Finally, the fifth exploratory hypothesis was that there will be a difference between the assigned moral intention was between the two conditions.. For this, a Mann-Whitney U test was used. No significant effect was found in assigned moral intention between Condition 1(Mdn=3.15, n=50) and Condition 2 (Mdn=3.00, n=50) , U= 298.50, z= -0.26, p= 0.80. In other words, there was no significant difference between the participants in the two conditions in assigning moral intention. Participants gave an average score of “neither good nor bad” to the actors in the stories.

Discussion

The purpose of this study was to examine possible explanations for the occurrence of the sharp end effect when reading disaster stories, following the findings of Berkemeier (2021). In particular, this study aimed to answer how sharp end factors are recalled more than blunt end factors. Additionally, blaming tendency of sharp and blunt ends was tested to see whether

blaming follows the same pattern as recall. The study included one manipulation, which was the exclusion of sharp end factors in one of two conditions. That is, one condition was named "sharp ends present," while the other "sharp ends absent." The rationale behind this manipulation was to see how blunt ends were recalled and assigned blame to without the presence of sharp ends. To put it another way, to see whether blunt ends are recalled/assigned blame to more when sharp ends are not mentioned. The results showed that sharp end factors on average were recalled more often than blunt ends, confirming the sharp end effect found in previous research (Moning, 2004, Berkemeier, 2021). However, this study found that blame was assigned more toward blunt end factors rather than sharp end factors on average. This was in line with the research of Berkemeier (2021) who found the same blunt end effect in assigning blame and determined that recall and blaming tendency followed two separate processes.

Starting with the first hypothesis, sharp ends were on average recalled more than blunt ends, confirming the results found in Berkemeier (2021) and Moning (2014). In the research of Berkemeier (2021), the sharp end effect was found even when the number of sharp- and blunt ends in the stories was balanced across conditions. In the current study, sharp end factors were only presented in one condition and were shown to be better recalled than blunt ends. One explanation for this may be found in the notion of reductive bias (Feltovich et al., 2004), specifically that people oversimplify the information contained in the disaster stories in order to understand it better. It could be the case that, according to the reductive bias, people learn by associating with their own experience (Feltovich et al., 2004).Another, more speculative explanation for the sharp end effect in recall is that sharp end factors are remembered more because people sympathize and relate to them. For example, participants may relate to the two passengers in the ICE Hanover story because they too would either be in shock or immediately report the damage. Additionally, the sharp end recall effect may be explained in a broader sense, namely in the way that success and failure are understood in societies of the West (Dekker, Nyce & Myers, 2013). Because of its focus on autonomy, individuality, responsibility, and choice, explanations for actor-caused accidents seem commonsensical and mundane (Dekker, Nyce & Myers, 2013). While in the research of Dekker, Nyce, & Myers (2013) this notion is related to blaming, one can argue that it also applies to recall. Participants may have been able to recall more sharp ends because of society's wider implication and established social schemas that one is responsible for one's own mistakes and the consequences that come with them.

The second hypothesis of this study was rejected, as the opposite effect was found, that participants on average assigned more blame to blunt ends rather than sharp ends. . This finding

runs counter to other research done in this area. Reason (2000), for example, states that it is more emotionally satisfying for people to assign blame to individuals because it yields a false sense of control. Moreover, blaming tendency does not seem to follow the "actor-focused explanation for events" that was plausible for recall tendency (Dekker, Nyce & Myers, 2013). An explanation of why the blunt end effect in assigning blame is present is that participants hold people or organizations accountable because of their power to prevent disasters from happening in the future. Bucher (1954) stated that participants who trail the line of responsibility toward more remote factors assign blame because they know organizations and corporations will not do anything drastic to prevent similar disasters from happening in the future. Another explanation as to why blunt ends are blamed more than sharp ends may be found in how Malle (2021) explains the processes of blame judgements. He suggests that an individual processes blame judgements in complex and nuanced ways that involve evaluation and deliberation. It could be the case that blunt end factors, because of their complexity and abstractness, are evaluated in this way. Malle (2021) also suggests that these complex processes are fast, almost immediate. The research of Berkemeier (2021) suggests that recall and blaming follow two separate processes – while recall of information is cognitively more intensive and time-consuming, blaming is immediate and less straining on cognition. This dual-processing effect between sharp and blunt end recall was also found in this study.

Moreover, the results found that the removal of sharp end factors in one condition did not significantly increase the recall of blunt end factors. This was also consistent with the research of Berkemeier (2021). The blunt end factors' distance from the disaster in terms of space and time and their abstract nature (Hollnagel, 2002) could have resulted in the effect of lower blunt end recall as compared to sharp end recall among participants. This is a strange but interesting finding that blunt ends are recalled equally between conditions, and it asserts that sharp ends, when added to the texts, improve recall. That must mean that participants in Condition 1 recall far more than those in Condition 2. However, this is impossible from a limited working-memory perspective, and because of the calculation task which forces participants to recall the stories with their long-term memory. Thus, long-term memory plays a pivotal role in the appearance of the sharp end effect in recall. A speculative assumption for this is that participants use two different schemata when recalling sharp and blunt ends. Because literature connecting schemas with sharp and blunt end recall of disasters is sparse, support for this argument could not be found.

The second exploratory hypothesis showed that blunt end blaming is higher for participants who read texts containing sharp ends. This is contrary to what is intuitively expected – to find blunt end blame higher with participants that read texts without the intervention of sharp ends. This finding is interesting because it implies that, when adding sharp ends to the texts, blunt end blaming tendency increases. At this point in time, it is unclear why this effect appears as there is no literature to support this finding. Moreover, the motivated-blame perspective (Monroe & Malle, 2019) was an important guiding theory for this study. It specifically states that participants have an inherent desire to attribute blame to the factors in the stories despite blame not being mentioned in them. Participants in the study had the option to opt out of assigning blame when they chose the "Not applicable" option yet blaming was still present. However, an alternative explanation could suggest that participants engaged in blaming because of other, non-related factors such as being presented with a blaming question and feeling pressured to assign blame, or confusion about what the "Not applicable" button means. Nonetheless, the setup of this study did not allow to properly investigate whether people are predisposed to assign blame to factors they read about in disaster stories.

The results found significant difference in how sharp ends between the two stories, ICE Hanover and Challenger are recalled. The inclusion of the Challenger story in this study was purposeful in order to compare how blunt end recall in Berkemeier (2021) would be different from that of this study. Instead, recall of blunt ends was equal across conditions and the sharp end effect was found, with sharp end factors in Challenger being recalled better than those of ICE Hanover. Moreover, the readability score of Challenger was lower than that of ICE Hanover, so reading difficulty could be excluded as a possible explanation. Moning (2014), in comparing the stories of Challenger and Tenerife, found that Challenger recall was lower and posited that its complexity and difficulty for comprehension could have resulted in reduced recall. Berkemeier (2021) cited as a limitation the use of meso-level blunt ends instead of macro-level ones. Because blunt end recall was the same across conditions, it could be stated that the use of macro-level blunt ends did not improve blunt end recall. Thus, the sharp end recall effect between the stories could again be explained using the reductive bias, namely that people oversimplify information and learn by associating that information with their own experience (Feltovich et al., 2004).

Furthermore, the results showed a significant effect in terms of sharp end blaming between the Challenger and ICE Hanover story, namely that more blame is assigned to sharp ends in Challenger in both conditions. It is surprising to see a sharp end effect in assigning blame here because a blunt end effect in assigning blame was observed until now. An

explanation for this finding could be that participants found the sharp end factors of the Challenger story much more polarizing and blameworthy than those of ICE Hanover. Participants, thus, could have engaged in so-called *blame validation* (Pizarro, Laney, Morris & Loftus, 2006), namely that they took part in biased searches of validation that would back up their own judgements concerning the disaster. Besides, a blunt end effect in assigning blame was observed more in the ICE Hanover story rather than in Challenger, although no conclusions can be drawn beyond the sample population. An explanation for this could again be found in the findings of Bucher (1954), specifically that participants found the blunt end factors in the ICE Hanover story more blameworthy because those (i.e., DeutscheBahn engineers and regulations) had the power to prevent similar disasters from happening in the future.

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A new addition to this study were the morality questions which were added to provide more depth into the responsibility dimension and were inspired by the research of Malle (2021) and Pizzaro, Tannenbaum, & Uhlmann (2012). The results of the present study showed no significant effect in how participants judged the moral character of the actors in the story and gave an average score of "neither good nor bad." One interpretation of this result may be that participants did not think the actors in the stories intended for the events to have happened, hence having neither good nor bad intentions for their actions. Hence, the intention of the actors was missing from the stories..

Lastly, in Berkemeier (2021), the responsibility questions were presented together on one page, and it was assumed that presenting the questions together could have influenced participants to answer in a certain way. To determine whether there is any difference to how participants assigned blame, this study presented the questions (i.e., responsibility & morality) one-by-one on separate pages. It was found that there were no apparent differences between this study and that of Berkemeier (2021) in how participants assigned blame to the factors. In other words, presenting the questions one-by-one did not considerably influence participants' answers to the responsibility and morality questions. Therefore, it could be the case that other factors influence participants' blaming tendency besides how the questions were presented.

Limitations

One limitation of the study was that no concrete explanation could be found for why blunt ends are recalled equally well between conditions, despite the removal of sharp ends in one condition. The explanation that recall of sharp and blunt ends follow two separate schemas or processes is not supported by any literature linking schemas to disaster recall. Likewise, no

explanation could be found for why blunt end blaming is higher when sharp ends are present in the texts. These findings provide a first insight into the notions of sharp- and blunt end schemas for recall, and blunt end blaming increase in the presence of sharp ends.

Another limitation of the study was that the method of this research did not allow for proper investigation of the motivated-blame perspective, or people's innate desire to attribute blame. Specifically, in order for the motivated-blame perspective to be investigated, the participants should not have been directly presented with the responsibility questions, as they could have been influenced to answer them. Despite the inclusion of the "Not applicable" button, it is still unclear whether the answers were given because of an inner desire to assign blame or other, unpredictable factors.

Another limitation of the present study is the inclusion of the moral intention concept, which asked of participants to rate the underlying moral intention of the actors in the stories, or whether they possessed good or bad intentions. The stories in the current study, however, did not contain any information on the moral intention of the actors. Thus, participants were asked to judge the actors' moral intention based on limited information. Because of the lack of literature connecting disaster stories and moral intention, these results were exploratory and provided a first insight into this area of research. In hindsight, the concept of moral intention as it was carried out was not fully applicable to this study. However, its inclusion is valuable because it provides an insight into how the connection between morality and responsibility could be improved.

Finally, the last limitation of the study is that it is still unclear what causes the sharp end effect in recall. The stories used for this research were either taken directly from Berkemeier (2021) or, in the case of the Challenger story, adapted to follow a similar structure. Insights from this study and that of Berkemeier (2021) confirm that the sharp end effect occurs much more in recall. The manipulation of removing the sharp ends in one condition promoted the blunt ends in that condition. More concretely, there was nothing to oppose a higher blunt end recall, yet it was still stagnant in both conditions. Berkemeier (2021) found a similar effect in which the removal of sharp ends did not increase blunt end recall. A speculation that recall follows two different schemas, one for sharp- and one for blunt ends, was made, however there is no concrete evidence No other firm conclusions can be drawn based on this study, as no definite evidence was found as to why the sharp end effect appears.

Future research

For future research, it would be interesting to see whether sharp and blunt end recall indeed follow two separate schemas or processes. Additionally, future research could investigate whether the sharp end effect in assigning blame between the stories of ICE Hanover and Challenger stories can be replicated.

To look into the inherent desire to blame, participants could be given more freedom in terms of assigning blame to factors in the stories. That is, participants could opt out or, if they are assigning blame, to look into which factors they choose. Contrary to this study, the questions could not be made mandatory. Alternatively, another method for assessing the inherent desire to blame could be to engage in conversation with or interview the participants about the events in the stories. The researcher could lightly allude that some factors caused the accidents to happen, or it could be left solely to the participant to name the factors as blameworthy. The conversation or interview could be recorded, or the researcher could take extensive notes on how the participant has answered a question.

Moreover, to investigate moral intention more effectively, the intentions of the actors could be included in the stories. That way, participants have a bigger incentive to assign moral judgement to the actors. This could be done by including additional words such as "unintentionally" or "with intention" to accompany the actions of the actors. Also, the questions for assigning moral intention could not be mandatory, which would give participants the choice to assign or not assign moral intention. On the other hand, an interview or conversation with the participants could be utilized instead of the questions.

Lastly, the characteristics of the sample could be extended to include larger age ranges, and educational levels, spanning different professional careers. If the results of this study can be replicated with a wider sample, that will provide further support for the appearance of the sharp end effect in recall and the blunt end blaming tendency as a generalizable and universal phenomenon in people.

Conclusion

In conclusion, this study sought to find what causes the sharp end effect in recall of disaster stories by replicating the study of Berkemeier (2021). The same sharp end effect in terms of recall that was found in Berkemeier (2021) and Moning (2014) was replicated in the current study. Furthermore, it was found that removing sharp end factors from the texts does not improve recall of blunt end factors. The blunt end effect in assigning blame that was found in Berkemeier (2021) was also replicated in this study. Finally, it was found that the inclusion

of the Challenger story for its abstract, macro-level blunt ends did not significantly improve blunt end recall or blaming tendency. However, it did increase sharp end recall and blaming tendency.

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Appendices

Appendix A – Informed Consent

Welcome!

Thank you already in advance for participating in the experiment today. The experiment should take around 60 minutes in total to complete. In the experiment, you will read three short stories sequentially about different accidents or disasters, solve verbally several calculation tasks after each story and then write down everything you remembered of the story. If you do have any questions before, during, or after the experiment, feel free to ask them, the researcher will be present during the whole experiment.

There are no right or wrong answers to any of the tasks or questions. Please be assured that your responses will be kept completely confidential. If your research results are to be used in scientific publications or made public in any other manner, then they will be made completely anonymous. Your personal data will not be disclosed to third parties without your express permission. Your participation in this research is voluntary. You have the right to withdraw this consent at any time during the experiment and without the need to give any reason. If you request further information about the research, now or in the future, you may contact Nina Pendaroska (n.pendaroska@student.utwente.nl)

If you have any complaints about this research, please direct them to the secretary of the Ethics Committee of the Faculty of Behavioural, Management and Social Sciences at the University of Twente, Drs. L. Kamphuis-Blikman P.O. Box 217, 7500 AE Enschede (NL), telephone: +31 (0)53 489 3399; email: l.j.m.blikman@utwente.nl).

By clicking the button below, you acknowledge that your participation in the study is voluntary, that you are at least 18 years old, and that you are aware that you may choose to terminate your participation in the study at any time and for any reason.

- (●) Yes, I consent
- ( ) No, I do not consent

Appendix B – Exclusion Criteria Questions

The following questions are here to test whether you have previous knowledge on the topic of these texts. If you know any information about the topic, please write it down. If not, you can leave the question blank.

Are you familiar with the ICE disaster near Hanover?

- Yes
- No

What happened during the ICE disaster nearby Hanover?

_____

Do you have any additional information about the ICE disaster nearby Hanover?

- No
- Yes _____

Are you familiar with the Space Shuttle Challenger disaster?

- Yes
- No

What happened during the Space Shuttle Challenger disaster?

_____

Do you have any additional information about the Space Shuttle Challenger disaster?

- No
- Yes _____

Please answer the following questions honestly:

How do you rate your ability to read short English stories?

Were/are you part of a study program that was/is taught in English at a university or university of applied sciences?

- Yes
- Yes, but only temporary
- No

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Please answer the following questions honestly. It is not a problem if the question applies to you, as it only serves for the further analysis to deliver truthful events.

Now that you have read the two disasters, did you recognize any of them?

- Yes, namely _____
- No

Appendix C – Disaster Stories

ICE Hanover

Contextual information

Sharp Ends

Blunt ends

Condition 1 – Sharp Ends Present

In 1998, hundreds of people had been traveling onboard the ICE of Deutsche Bahn*. Shortly after the stop in Hanover, the tire of a wheel broke at a high speed and punctured the floor. The train conductor noticed some vibrations but did not consider them severe. Two passengers from the first wagon noticed that a piece of the cracked wheel came up through the floor. One of the two passengers was completely in shock while the other one went to report the damage to the train crew. According to the Deutsche Bahn policies, an emergency stop was only allowed after visual inspection by the train manager. Precious time elapsed by insisting on investigating the damage before stopping the train. In the meantime, the broken wheel rim slammed against the guard rail of the next switch point. The switch point was close to an overpass bridge, pulling it away from the railway track. Shortly after, the back part of the train was being slammed against the road bridge. The bridge collapsed, burying parts of the train underneath it. Of the train's twelve wagons, most were either derailed, torn in half next to the bridge, or were crushed into the bridge by the back engine. Over one hundred people died or were injured, some critically. The failure was traced back to the design and testing of Deutsche Bahn because the wheel design decisions were only based on analysis and theory. Additionally, Deutsche Bahn did not replace the wheels on time, even though they were being worn below the recommended standard in diameter. Furthermore, the emergency operation procedures of Deutsche Bahn contributed to the disaster as well. Lastly, the placement of the switch, an inherent hazard for high-speed trains, at the overpass bridge, contributed to the severity of the disaster. To this day, the disaster near Hanover remains the worst railway disaster in Germany.

297 words

Flesch score: 66

Condition 2 – Sharp Ends Absent

In 1998, hundreds of people had been traveling onboard the ICE of Deutsche Bahn*. Shortly after the stop in Hanover, the tire of a wheel broke at a high speed and punctured the floor. Some vibrations were felt in the train but were not considered severe. Two passengers from the first wagon noticed that a piece of the cracked wheel came up through the floor. The two passengers were surprised by this sudden and shocking event. The damage was then immediately reported to the train crew. According to the Deutsche Bahn policies, an emergency stop was only allowed after visual inspection by the responsible authorities. Precious time elapsed before the damage caused by the wheel was finally investigated. In the meantime, the broken wheel rim slammed against the guard rail of the next switch point. The

switch point was close to an overpass bridge, pulling it away from the railway track. Shortly after, the back part of the train was being slammed against the road bridge. The bridge collapsed, burying parts of the train underneath it. Of the train's twelve wagons, most were either derailed, torn in half next to the bridge, or were crushed into the bridge by the back engine. Over one hundred people died or were injured, some critically. The failure was traced back to the design and testing of Deutsche Bahn because the wheel design decisions were only based on analysis and theory. Additionally, Deutsche Bahn did not replace the wheels on time, even though they were being worn below the recommended standard in diameter. Furthermore, the emergency operation procedures of Deutsche Bahn contributed to the disaster as well. Lastly, the placement of the switch, an inherent hazard for high-speed trains, at the overpass bridge, contributed to the severity of the disaster. To this day, the disaster near Hanover remains the worst railway disaster in Germany.

297 words

Flesch score: 65

Challenger

Condition 1 – Sharp Ends Present

In 1986, the Space Shuttle *Challenger* fell apart shortly after lift-off, killing all seven crew members. The immediate explosion of the fuel tank contributed to the accident's severity. After months of investigation, NASA found that a breakdown occurred in the primary and secondary O-rings on the right solid rocket booster (SRB). This breakdown allowed hot gases to escape and come into contact with the external fuel tank. The loss of *Challenger* was an example of NASA's poor communication and decision-making at the time. NASA officials debated whether launching *Challenger* was smart while on a teleconference call the night before. The failure was partly due to early testing and design of the engineers from Morton-Thiokol. They did not properly test the polymeric material behavior of the O-rings at different temperatures. With the launch date of the shuttle coming closer, the engineers got concerned about the O-rings freezing on launch day. During the conference, however, Morton-Thiokol managers refused the engineers' warnings. They reversed their decision, approving the launch. These managers were put under pressure by NASA officials who thought the data provided by Morton-Thiokol engineers were not convincing. NASA was also under pressure from Congress to keep up with the launch schedule. A final reason for not delaying the launch was because of President Ronald Reagan's speech scheduled on the evening of the launch. The speech would have boosted NASA's publicity and justified their spending on the shuttle program. On the day of the launch, the temperature was just below freezing. The shuttle quickly exploded and began to break apart. The crew cabin was detached in one piece. It fell into the ocean and the cabin crew lost their lives. To this day, the Space Shuttle *Challenger* disaster remains one of the most tragic accidents in NASA history.

296 words

Flesch score: 52

Condition 2 – Sharp Ends Absent

In 1986, the Space Shuttle *Challenger* fell apart shortly after lift-off, killing all seven crew members. The immediate explosion of the fuel tank contributed to the accident's severity. After months of investigation, NASA found that there was no other significant malfunction to any part of the space shuttle other than the spontaneous explosion of the fuel tank. The loss of *Challenger* was an example

of NASA's poor communication and decision-making at the time. NASA officials debated whether launching *Challenger* was smart while on a teleconference call the night before. The failure was partly due to the early testing and design of the engineers from Morton-Thiokol. They did not properly test the polymeric material behavior of the O-rings at different temperatures. With the launch date of the space shuttle coming closer, Morton-Thiokol engineers and NASA representatives discussed other possible malfunctions to the shuttle's parts but could not find anything else that was troubling. This resulted in the approval of the *Challenger*'s launch the following morning. The involved Morton-Thiokol managers were put under pressure by NASA officials who thought that the data provided by Morton-Thiokol engineers were not convincing. NASA was also under pressure from Congress to keep up with the launch schedule. The launch of *Challenger* was supposed to be followed by a public address of then-president Ronald Reagan. The speech would have mentioned NASA's success in their space missions, which would have justified their spending on the shuttle program. On the day of the launch, the temperature was just below freezing. The shuttle quickly exploded and began to break apart. The crew cabin was detached in one piece. It fell into the ocean and the cabin crew lost their lives. To this day, the Space Shuttle *Challenger* disaster remains one of the most tragic accidents in NASA history.

298 words

Flesch score: 50

Appendix D – Calculation Task

Figure 1

Example of a calculation task from Condition 1 following the ICE Hanover story

In the following, you will have to complete a calculation task. You can see the starting number below this text. Please try to think aloud during this task by verbally repeating the first number, what you subtract from the number and what the result of each calculation is.

899

Start with 899 and count back by *seven*, until the researcher says 'Stop'. Please think aloud the whole time. You can start by reading out the example to the researcher.
Example: 899 - 7 = 892
892 - 7 = ...

Appendix E – Free Recall Tasks

Please write down everything you remember from the ICE Hanover story you just read:

Please write down everything you remember from the Space Shuttle Challenger story you just read:

Appendix F – Responsibility Questions

ICE disaster near Hanover

Please indicate to what extent you feel that each of these factors (if any) were responsible for causing the ICE train disaster

Q56. The conductor not considering the vibrations as severe

Not at all responsible	Slightly responsible	Moderately responsible	Very responsible	Extremely responsible	*Not applicable*
○	○	◉	○	○	○

Q63. The train manager insisting on investigating the damage before stopping the train

Not at all responsible	Slightly responsible	Moderately responsible	Very responsible	Extremely responsible	*Not applicable*
○	○	○	○	◉	○

Q62. The passenger being in shock

Not at all responsible	Slightly responsible	Moderately responsible	Very responsible	Extremely responsible	*Not applicable*
◉	○	○	○	○	○

Q61. The passenger reporting the damage

Not at all responsible	Slightly responsible	Moderately responsible	Very responsible	Extremely responsible	*Not applicable*
○	○	○	○	○	◉

Q60. The design and testing procedures of the wheels by DetscheBahn

Not at all responsible	Slightly responsible	Moderately responsible	Very responsible	Extremely responsible	*Not applicable*
○	○	○	○	◉	○

Q59. DeutscheBahn not replacing the worn-down wheels ahead of time

Not at all responsible	Slightly responsible	Moderately responsible	Very responsible	Extremely responsible	*Not applicable*
○	○	○	○	◉	○

Q58. The emergency operation procedures of DeutscheBahn

Not at all responsible	Slightly responsible	Moderately responsible	Very responsible	Extremely responsible	*Not applicable*
○	○	○	○	○	◉

Q57. The placement of the switch at an overpass bridge

Not at all responsible	Slightly responsible	Moderately responsible	Very responsible	Extremely responsible	*Not applicable*
○	◉	○	○	○	○

Space Shuttle Challenger disaster

Please indicate to what extent you feel that each of these factors (if any) were responsible for causing the Challenger disaster

Q65. The breakdown of the O-rings on the right solid rocket booster

Not at all responsible	Slightly responsible	Moderately responsible	Very responsible	Extremely responsible	*Not applicable*
○	○	○	○	○	◉

Q72. NASA not communicating properly surrounding the launch of Challenger

Not at all responsible	Slightly responsible	Moderately responsible	Very responsible	Extremely responsible	*Not applicable*
○	○	◉	○	○	○

Q71. Morton-Thiokol engineers not properly testing the O-rings

Not at all responsible	Slightly responsible	Moderately responsible	Very responsible	Extremely responsible	*Not applicable*
○	○	○	◉	○	○

Q70. Morton-Thiokol engineers being concerned about the O-rings freezing

Not at all responsible	Slightly responsible	Moderately responsible	Very responsible	Extremely responsible	*Not applicable*
○	○	○	○	◉	○

Q69. Morton-Thiokol managers approving the launch despite concerns of freezing

Not at all responsible	Slightly responsible	Moderately responsible	Very responsible	Extremely responsible	*Not applicable*
○	○	○	○	◉	○

Q68. NASA officials not convinced by the data provided by Morton-Thiokol engineers

Not at all responsible	Slightly responsible	Moderately responsible	Very responsible	Extremely responsible	*Not applicable*
○	○	○	○	◉	○

Q67. Congress pressuring NASA to stay up-to-date with the launch calendar

Not at all responsible	Slightly responsible	Moderately responsible	Very responsible	Extremely responsible	*Not applicable*
○	○	○	○	◉	○

Q66. President Ronald Reagan scheduling a speech the day of the launch

Not at all responsible	Slightly responsible	Moderately responsible	Very responsible	Extremely responsible	*Not applicable*
○	◉	○	○	○	○

Appendix G – Morality Questions

ICE Disaster near Hanover
Please indicate to what degree you think these actors possess a good or bad moral intention according to their actions in the text

---

Q73. The train conductor

Extremely good	Somewhat good	Neither good nor bad	Somewhat bad	Extremely bad	*Not applicable*
○	○	○	◉	○	○

Q77. Passenger in shock

Extremely good	Somewhat good	Neither good nor bad	Somewhat bad	Extremely bad	*Not applicable*
○	○	○	○	○	◉

Q76. Passenger reporting the damage

Extremely good	Somewhat good	Neither good nor bad	Somewhat bad	Extremely bad	*Not applicable*
◉	○	○	○	○	○

Q75. The train manager

Extremely good	Somewhat good	Neither good nor bad	Somewhat bad	Extremely bad	*Not applicable*
○	○	○	○	◉	○

Q74. DeutscheBahn

Extremely good	Somewhat good	Neither good nor bad	Somewhat bad	Extremely bad	*Not applicable*
○	○	○	○	◉	○

Challenger Disaster
Please indicate to what degree you think these actors possess a good or bad moral intention according to their actions in the text

Q79. NASA

Extremely good	Somewhat good	Neither good nor bad	Somewhat bad	Extremely bad	Not applicable
○	○	○	◉	○	○

Q83. Morton-Thiokol engineers

Extremely good	Somewhat good	Neither good nor bad	Somewhat bad	Extremely bad	Not applicable
○	◉	○	○	○	○

Q82. Morton-Thiokol managers

Extremely good	Somewhat good	Neither good nor bad	Somewhat bad	Extremely bad	Not applicable
○	○	○	◉	○	○

Q81. Congress

Extremely good	Somewhat good	Neither good nor bad	Somewhat bad	Extremely bad	Not applicable
○	○	○	○	◉	○

Q80. President Ronald Reagan

Extremely good	Somewhat good	Neither good nor bad	Somewhat bad	Extremely bad	Not applicable
○	○	◉	○	○	○

Appendix H – Demographics

What is your gender?

- Male
- Female
- Non-binary/third gender
- Prefer not to say

What is your age?

_____

What is your nationality?

- Dutch
- German
- Other (specify optional) _____

What is your (acquired) level of education?

- High school
- Bachelor's
- Master's
- PhD
- Other

What is your study program/working field?

_____

Appendix I – Coding Schemes

Participant ID: […] ; Condition: Sharp Ends Present

ICE Disaster

Coding scheme content

Code		**Yes (1)** **No (0)**		
	1. Contextual information (17)			
1.	1a) People had been traveling onboard of ICE of Deutsche Bahn			
2.	1b) The tire of a wheel broke at a high speed			
3.	1c) The tire of a wheel punctured the floor			
4.	1d) Two passengers from first wagon noticing piece of wheel that came up through floor			
5.	1e) According to Deutsche Bahn policies, an emergency stop was only allowed after visual inspection by the train manager			
6.	1f) Precious time elapsed			
7.	1g) The broken wheel rim slammed against the guard rail of the next switch point			
8.	1h) The switch point was close to an overpass bridge			
9.	1i) The train got pulled away from the railway track			
10.	1j) The back part of the train was being slammed against the road bridge			
11.	1k) The bridge collapsed			
12.	1l) Parts of the train got buried underneath it			
13.	1m) Most wagons were derailed			

14.	1n) Most wagons were torn in half			
15.	1o) Most wagons were crushed into the bridge by the back engine			
16.	1p) People died or were injured, some critically			
17.	1q) The disaster remains the worst railway disaster in Germany			
	2. Sharp end factors (4)			
1.	2a) Is 'the train conductor noticing some vibrations but not considering them severe' mentioned?			
2.	2b) Is 'the passenger in shock' mentioned?			
3.	2c) Is 'the passenger reporting the damage' mentioned?			
4.	2d) Is 'the train manager not immediately stopping the train (due to policies)' mentioned?			
	3. Blunt end factors (4)			
1.	3a) Is it mentioned 'that the failure was traced back to design (decisions) and testing of Deutsche Bahn as it was based only on analysis and theory'?			
2.	3b) Is 'the missing wheel replacement on time by Deutsche Bahn mentioned even though it was worn below the diameter standard'?			
3.	3c) Is 'the contribution of the emergency operation procedures of Deutsche Bahn to the disaster' mentioned?			
4.	3d) Is 'the contribution of the placement of the switch' mentioned?			
Total score (25) **__ out of 25**				

Participant ID: […] ; Condition: Sharp Ends Absent

ICE Disaster

Coding scheme content

		Points
Code		**Yes (1)** **No (0)**
***Contextual information* (20)**		
1.	1a) People had been traveling onboard of ICE of Deutsche Bahn	
2.	1b) The tire of a wheel broke at a high speed	
3.	1c) The tire of a wheel punctured the floor	
4.	1d) Some vibrations were felt but were not considered severe	
5.	1e) Two passengers from first wagon noticing piece of wheel that came up through floor	
6.	1f) The two passengers were surprised by this sudden and shocking event	
7.	1g) The damage was reported to the train crew	
8.	1h) According to Deutsche Bahn policies, an emergency stop was only allowed after visual inspection by the responsible authorities.	
9.	1i) Precious time elapsed	
10.	1j) The broken wheel rim slammed against the guard rail of the next switch point	
11.	1k) The switch point was close to an overpass bridge	
12.	1l) The train got pulled away from the railway track	
13.	1m) The back part of the train was being slammed against the road bridge	

14.	1n) The bridge collapsed	
15.	1o) Parts of the train got buried underneath it	
16.	1p) Most wagons were derailed	
17.	1q) Most wagons were torn in half	
18.	1r) Most wagons were crushed into the bridge by the back engine	
19.	1s) People died or were injured, some critically	
20.	1t) The disaster remains the worst railway disaster in Germany	
	Blunt end factors (4)	
1.	3a) Is it mentioned 'that the failure was traced back to design (decisions) and testing of Deutsche Bahn as it was based only on analysis and theory'?	
2.	3b) Is 'the missing wheel replacement on time by Deutsche Bahn mentioned even though it was worn below the diameter standard'?	
3.	3c) Is 'the contribution of the emergency operation procedures of Deutsche Bahn to the disaster' mentioned?	
4.	3d) Is 'the contribution of the placement of the switch' mentioned?	
Total score (24) **__ out of 24**		

Participant ID: […] ; Condition: Sharp Ends Present

Challenger Disaster

Coding scheme content

		Week 1		
Code		**Yes (1)** **No (0)**		
	1. Contextual information (16)			
1.	1a) Space Shuttle Challenger fell apart after liftoff			
2.	1b) The launch killed all seven crew members			
3.	1c) The explosion of the fuel tank contributed to the accident			
4.	1d) The breakdown allowed hot gases to escape			
5.	1e) The breakdown allowed hot gases to come into contact with the external fuel tank			
6.	1f) NASA officials debated whether launching Challenger was a smart idea			
7.	1g) NASA officials were at a press conference the night before the launch			
8.	1h) Ronald Reagan's speech would have boosted NASA's publicity			
9.	1i)Ronald Reagan's speech would have justified NASA's spending			
10.	1j) The temperature was below freezing on the day of the launch			
11.	1k) The shuttle exploded			
12.	1l) The shuttle began to break apart			
13.	1m) The crew cabin was detached in one piece			

14.	1n) The shuttle/crew cabin fell into the ocean			
15.	1o) The cabin crew lost their lives			
16.	1p) The disaster remains one of the most tragic in NASA history			
	2. Sharp end factors (4)			
1.	2a) Is 'breakdown of the O-rings' mentioned?			
2.	2b) Is 'the engineers being concerned about the O-rings freezing' mentioned?			
3.	2c) Is 'the managers refusing the warnings and approving the launch' mentioned?			
4.	2d) Is 'President Ronald Reagan's speech' mentioned?			
	3. Blunt end factors (4)			
1.	3a) Is 'NASA's poor communication and decision' mentioned?			
2.	3b) Is the 'early testing and design of M-T engineers (due to not properly testing the material)'?			
3.	3c) Is 'NASA officials who thought data provided by engineers was not convincing' mentioned?			
4.	3d) Is 'the pressure from Congress to keep up with launches' mentioned?			
Total score (24) **__ out of 24**				

Participant ID: […] ; Condition: Sharp Ends Absent

Challenger Disaster

Coding scheme content

		Points
Code		**Yes (1)** **No (0)**
***Contextual information* (21)**		
1.	1a) The Space Shuttle Challenger fell apart after lift-off	
2.	1b) The launch killed all seven crew members	
3.	1c) The explosion of the fuel tank contributed to the accident	
4.	1d) NASA found there was no other malfunction other than the fuel tank	
5.	1e) NASA officials debated whether launching Challenger was a smart idea	
6.	1f) NASA officials were at a press conference the night before the launch	
7.	1g) Morton-Thiokol engineers discussed other malfunctions to the shuttle	
8.	1h) NASA representatives discussed other malfunctions to the shuttle	
9.	1i) Nothing else was found that was troubling	
10.	1j) The launch of Challenger was approved for the next morning	
11.	1k) Morton-Thiokol managers were put under pressure	
12.	1l) The launch of Challenger was supposed to be followed by Ronald Reagan's speech	
13.	1m) The speech would have mentioned NASA's success in their space missions	

14.	1n) The speech would have justified NASA's spending on the shuttle program	
15.	1o) The temperature was below freezing the day of the launch	
16.	1p) The shuttle exploded	
17.	1q) The shuttle began to break apart	
18.	1r) The crew cabin detached in one piece	
19.	1s) The shuttle/crew cabin fell into the ocean	
20.	1t) The crew cabin lost their lives	
21.	1u) The disaster remains one of the most tragic in NASA history	
	Blunt end factors (4)	
1.	3a) Is 'NASA's poor communication and decision' mentioned?	
2.	3b) Is the 'early testing and design of M-T engineers (due to not properly testing the material)'?	
3.	3c) Is 'NASA officials who thought data provided by engineers was not convincing' mentioned?	
4.	3d) Is 'the pressure from Congress to keep up with launches' mentioned?	
Total score (25) **__ out of 25**		