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Human reactions to technological failure: How accidents rooted in technology vs. human error influence judgments of organizational accountability

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Abstract

Two experiments examine how the identification of technology as a causal factor in an organizational accident influences judgments of organizational accountability. In study 1, organizations were found to be held less accountable for their actions when a misfortune was rooted in a computer error than when rooted in human error. The predicted mechanism for this effect, counterfactual thinking, was confirmed. Specifically, technologically induced accidents were found to generate fewer counterfactual thoughts of better possible outcomes than similar accidents resulting from human error. Study 2 replicated the findings of study 1 in a more natural setting and using a less intrusive measure for counterfactual thoughts.
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Developments over the past decades have given rise to the sense that we have entered into a new technological age: one that has fundamentally changed the way organizations accomplish work (Carnevale, 1991; Drucker, 1992; Huey, 1994), as well as substantially affecting the way people perceive their world. The current economic and societal transformation is centered around information-based technologies, or computers (Barley, 1996; Beniger, 1989). While the implications for the changes that computers will bring to our lives are still unfolding, the present research aims to explore some of our basic psychological responses to such technology. More specifically, we attempt to empirically examine how experiences of technological failure influence perceptions of organizational accountability.

In today's society, we encounter technological failure constantly—circuits break, computers fail, and networks go down. In addition, we are constantly confronted by human error, from ourselves, by those around us, or by others whom we may never directly observe. Our fundamental research question asks whether people tend to react differently towards technological failure (such as a computer malfunction) than to human failure (such as a miscalculation or mistake). With two experimental studies, we examine how individuals may hold organizations accountable for failures differently depending upon whether the failure was attributed to technological or human error. Despite the core role that organizational accountability plays in contemporary society, the literature has only recently begun to focus on the importance of organizational accountability to organizational life (see Greenberg & Cropanzano, 2001). The following studies contribute to this growing stream of literature. The theoretical foundation for the research rests largely upon fairness theory (Folger & Cropanzano, 2001) and the counterfactual thinking literature (for a review see Roese, 1997).

Fairness theory and organizational accountability

Founding research on attribution theory describes the differing attributions that people make based on their perceptions of the locus of control (internal vs. external)

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of an event (e.g., Heider, 1958; Rotter, 1966). Later theorists (Rosenbaum, 1972; Weiner, 1986) added the dimensions of stability and controllability to the equation. These theorists laid the foundation for current understanding of how individuals make attributions and the degree to which one is to be held accountable for subsequent outcomes. Others followed by extending the paradigm to include perceptions justice and fairness (Folger & Cropanzano, 2001). Here, we focus on fairness theory as a theoretical framework for understanding the different attributions that people may naturally make towards human error and technological failure.

In an organizational context, accountability allows for both blame and action in an effort to rebalance the scales of justice (e.g., victim compensation). Such accountability,[1] according to fairness theory (Folger & Cropanzano, 2001) and the triangle model of responsibility (Schlenker, 1997; Schlenker, Britt, Pennington, Murphy, & Doherty, 1994), consists of three essential and interrelated components: (a) an injurious event, (b) discretionary conduct, and (c) a moral transgression. For an organization (or person) to be held accountable, all three components must be present.

Take, for example, the collision of two rush hour commuter trains in Chicago (CTA) on the morning of August 3, 2001 (see Nevala, Rivedal, & Grossman, 2001). This accident resulted in over 100 injuries and also prevented hundreds more from arriving to work in a timely fashion. When such an accident occurs the first component for accountability is automatically in place—an injurious event has occurred as people were both physically and economically harmed. Now include the fact that the accident occurred because the train's conductor was distracted by a construction project on a nearby building and consequently failed to see the train obstructing the path or the red lights signaling the train to stop. Under such circumstances, the conductor was negligent of his duties (in this particular case, the conductor was a male); if he had done his job appropriately, the accident might not have happened. Thus, this additional information put the second component for accountability in place: the accident could have been avoided if the appropriate actions—actions within the control of the train's conductor—had been taken. Finally, because harm came to others such an accident can be also considered a violation of prevailing ethical and moral norms—the third component for accountability. This example illustrates a fully interconnected chain linking the three components for accountability. If this chain had been broken by any of the three components, a sense of accountability could not have been established (Folger & Cropanzano, 2001; Schlenker, 1997; Schlenker et al., 1994), and thus there would be no one to blame or against whom to take action in an effort to rebalance the scales of justice.

Judgments of accountability, however, are not always as objectively grounded as we would like. Instead, they are subjectively guided by such factors as prior experiences (Einhorn & Hogarth, 1986), individual perspectives (Einhorn & Hogarth, 1986; McGill, 1995), and the need to create internally consistent stories (Lacey, Medvec, & Messick, 2003)—all of which can influence our reasoning on a given incident. According to fairness theory, of the three interrelated components influencing perceptions of accountability, judgments about the second and third—discretionary conduct and moral wrongdoing—are particularly prone to be influenced by the subjective nature of a misfortune. And such subjectivity opens the door for the biases and heuristics of human reasoning.

The following research will focus primarily upon the perceptions of discretionary conduct, the second component of fairness theory. Our premise is that people react differently toward an organizational accident in this regard depending upon whether it was rooted in technological or human error. We will argue that when individuals evaluate a misfortune (e.g., the CTA's train collision) they have a tendency to cognitively target human factors more than technological factors. This is because, we argue, human behavior is viewed as being more discretionary than technological processes. Though it is at essence an empirical question we intend to explore, we argue here that relative to technological failures, human error is considered more internal, flexible, and controllable than is technological failure. People make choices, and machines don't. Based upon fairness theory and attribution theory as cited above, we predict that people will have a propensity to blame an organization more for a misfortune when it was directly caused by human error than if the same misfortune had been caused by a technological error.

We suggest that the mechanism behind this propensity is twofold, and covers differences in both the acquisition and the processing of information when it concerns people vs. machines. First, we may cognitively attend more easily to counterfactual information when a human is the focal actor, because, as described above, we understand these actions to be more discretionary, and thus, more mutable in nature. A choice was made where another one would have been superior. Second, we may also use the information we have differently depending on whether it concerns human or machine actions. This is where the organizational accountability becomes relevant—regardless of how we understand the situation, we also may arrive at different conclusions about the appropriate course of action, in this case, the assignment of blame, when the focal actor changes from

[1] It is important to distinguish organizational accountability as an outcome of interest from that of individuals feeling accountable for decisions as a variable that can affect decision making (see, e.g., Markman & Tetlock, 2000).

human to machine. For example, we may feel that punishment is required when a bad choice was made by a person, whereas a computer failure is an acceptable outcome from a calculated risk. These two mechanisms combine to help explain the process we empirically examine here.[2]

For example, if your computer was to suddenly fail and the latest version of an important manuscript got lost, you might find that the microprocessor (i.e., the computer's "brain") on your computer had failed and this caused your computer to cease functioning. We posit that while you may be aggravated you would most likely not feel that anything *discretionary* had happened—after all, there is a certain probability of failure within a given lifespan of a computer and perhaps your processor faced high odds of failure due to its age. If upon further investigation you come to realize that a manager at the manufacturing facility where your computer was constructed had changed the assembly process, creating a shortcut in the manufacturing process, you may then judge the failure as one where a human had made some *discretionary* (controllable) choices and you might conclude that these discretionary choices were poor ones. That is, you may then think something along the lines of "if only this person had not decided to change the manufacturing process, then I would not have lost my important manuscript." Thus, based upon fairness theory, we would predict that your evaluation of organizational accountability (the organization being the computer manufacturer, and the one responsible for the decisions of the individual under their employ) has risen considerably with this information. Thus, both the processing and the application of the information take a different path when human action is considered.

While the above example is imaginary, it illustrates our basic proposition that there is a difference in how people might evaluate a misfortune as a function of whether it was caused by technological error or human error. It is important to contrast this argument with the opposite, also plausible position in which computer-based activity is considered the more controllable of the two. Indeed, we install technological control into our lives at astounding rates for exactly this reason—to avoid the inevitable mishaps associated with error-prone human behavior. Yet, even with this evidence, we argue that psychologically, people are more comfortable assessing (processing) the discretionary choices of a person over the events caused by machinery, and subsequently assigning blame (application) based on them.

In support of this research, Morris, Moore, and Sim (1999) have demonstrated that decision makers, when given the choice, will have a propensity to choose human factors for both their blame and then subsequently their remedy decisions in the sensemaking process after an accident. In this research, we aim to narrow the scope of these previous findings by exploring the cognitive reactions of people to a specifically identified cause—either technological or human failure. That is, whereas Morris et al. (1999) document the propensity for people to *select* human causes for accidents with ambiguous antecedents, we aim to explore how people differentially *react* to the accident when the cause (human vs. machine error) is stated as fact. In this way, we hope to extend the previous work by exploring and contrasting the specific reactions of people to these two types of causal factors.

A relevant stream of research for our argument demonstrates the differences in how people react to inanimate objects such as technology vs. how they react to other humans. The literature suggests that people have a significantly stronger desire to interact with other people rather than with inanimate objects. Empirical studies have shown that people are five times more likely to seek knowledge from another person than from an inanimate source (Allen, 1977; Cross, 2001). In addition, the literature also suggests that people have a general preference to create a mental map of their environment that is based upon human characteristics. Research on anthropomorphism and personification (see Guthrie, 1997) have demonstrated that this preference for understanding the world through human-like characteristics is so strong that even nonhuman or inanimate objects will be given human-like characteristics, whether they are appropriate or not. Modern media is awash with examples of machinery having human characteristics (for example, robots with personalities, cars that can talk, or wise-cracking computers). Many people even name their automobiles and talk about them as if they had a will of their own. More in tune with the present studies, research on this topic has demonstrated that people tend to react to computers and other pieces of machinery—such as gambling devices (Delfabbro & Winefield, 2000)—as if they had human characteristics, perhaps as a default schema for otherwise inexplicable interactions (Caporael, 1986). People frequently talk back to computers out loud as if they could hear (Scheibe & Erwin, 1979), as well as apply gender stereotypes and exhibit social behaviors such as politeness and reciprocity towards computers (Nass & Moon, 2000). This stream of research demonstrates that there is a fundamental human preference for dealing with people over technological "things"—to the point where we even try to force-fit the inanimate technologies in our world into human models of behavior. Given this line of research, it makes sense that our cognitive and emotional reactions (the processing of information) to that of an actual person would be exponentially stronger than our reactions to an inanimate piece of technology, as will be our

[2] We thank an anonymous OBHDP reviewer for bringing this idea to our attention.

assignments of accountability (the application of the information).

Given the above, we hypothesize that people are less likely to hold an organization accountable for negative events caused by technological error than when caused by human error.

Hypothesis 1. Less accountability will be attributed to organizations whose failures are rooted in technological error than those rooted in human error.

The second area of research we cover is the potentially mediating role of individuals' counterfactual thoughts in their judgments of organizational accountability.

Counterfactual thoughts and organizational accountability

According to fairness theory, thoughts of what could have been (or counterfactual thinking) can influence how people determine the degree of accountability by weighing discretionary conduct (Folger & Cropanzano, 2001). When individuals are confronted with a misfortune, they commonly imagine how things might have occurred otherwise (Roese, 1997; Sanna & Turley, 1996), typically with a more favorable outcome (Kahneman & Miller, 1986). Because these alternative scenarios are contrary to the facts, they are called counterfactual thoughts. Folger and Cropanzano's fairness theory (2001) postulates that people assign accountability based on their judgment of whether the actions of the organization might have occurred in such a way that the misfortune could have been avoided. In support of this idea, research by Mandel and Lehman (1996) has demonstrated that people tend to focus specifically on preventability when forming counterfactual judgments. These "could judgments," also labeled contrasting cases in the causal attribution literature, refer to counterfactual thoughts about feasible behaviors. They play a critical role in judgments of accountability because individuals compare them to the actual outcome and attribute causation to those factors that differ between the two (e.g., Einhorn & Hogarth, 1986; Hilton & Slugoski, 1986; McGill, 1993, 1995; McGill & Klein, 1993; Roese, 1997; Roese & Olson, 1993).

Controllability of events is central to the ease with which people can form counterfactual thoughts (Mandel & Lehman, 1996; Markman, Gavanski, Sherman, & McMullen, 1995). According to fairness theory, the more easily one constructs the counterfactual contrasting case (or "could judgments") such that the organization's actions are imagined as occurring otherwise (i.e., their actions "could" have been different), the more discretionary those actions are then perceived to be, which then results in the organization being held more accountable. In other words, if it is easy to imagine a situation in which events took a different course, it is also relatively easier to imagine that the organization could have, and should have, followed this different path. This assumes, of course, that the other two components necessary for judgments of organizational accountability—an injurious event and moral transgression—are held constant.

In line with our first hypothesis, we argue that the ease of generating counterfactual thoughts targeting a technological failure is quite different than those targeting human factors. Generally speaking, every event is caused by not one but a sequence of interrelated antecedent events. This effect has been termed multiple conjunctive causality, and states that events are the result of multiple causes working together (Ragin, 1987). Not all of these causes are equally available to us in everyday thought, however. When a computer error causes an accident, there is generally one primary counterfactual thought that would "undo" the resulting damage, without delving much further back in the chain of events than the immediate accident: "If only the computer hadn't malfunctioned." When a person makes a mistake and causes an accident, on the other hand, there are myriad options about what actually caused the failure. This can be seen in the case of a hypothetical car accident: "If only the driver hadn't (1) lost his attention momentarily to the radio, (2) been interested in the scenery nearby, (3) been tired that day, (4) taken that road home, (5) left at that particular time," etc. Each of these is a reasonable reconstruction of the events that would have avoided the resulting accident. Although this example is anecdotal, discretionary events generally abound when human action is considered. In one sense, it is a mere numbers game: there are that many more choices in terms of which decisions were at fault in leading to an organizational accident when we think about human action than when we think about technology. This also indicates, again, that human actions are fraught with discretionary activities in a way that technological outcomes are not, and suggests a link between discretionary action and counterfactual thoughts.

For example, a seminal study describes the relative intensity of people's reactions and counterfactual thoughts to an event based on whether or not they were in control of certain focal antecedents. Markman et al. (1995) gave participants the opportunity to spin the "wheel of fortune" on their own, or rely for their outcome on the spin of another. Participants reacted much more strongly, and generated more counterfactual ideas, when they were in control of their own spins as opposed to relying on the fate of another's actions. More specifically, participants permitted to control the wheel's speed were more likely to focus their counterfactuals on the results of their own wheel, while participants permitted to choose which wheel was their own and which was assigned to another were more likely to focus their counterfactual thoughts on the comparison between the two wheels. We can describe these results in terms of discretionary choice. In each case, it is specifically the *choice* that the focal participant made on a particular feature that triggered people into trying to "undo" the results of that choice.

To continue with this line of reasoning, when we compare human action and machine action, we must remember that humans are responsible for creating computers in the first place (both the machines themselves and the programs which then generate the ultimate actions). As such, they are responsible for constraining the range of computer "behaviors" that result. Computers cannot "decide" to slow down a train, for example, unless a human has programmed it to act in this way. By creating these constraints, however, we may also constrain the number of available counterfactual thoughts we can easily generate when failure occurs. No discretionary choice is relevant when a computer responds to a situation based on previously constrained set of instructions. Previous research has shown that constraints of this kind will indeed limit the spontaneous generation of counterfactual thoughts (Seelau, Seelau, Wells, & Windschitl, 1995).

When organizational accidents occur, counterfactual thoughts will also spontaneously occur (Roese & Olson, 1997; Sanna & Turley, 1996) and based on the above, it is hypothesized that the content of such thoughts will focus more on the actions rooted in human error than they will focus on technological error.

Hypothesis 2. Organizational accidents resulting from technological error will generate fewer counterfactual thoughts of a better possible outcome than similar accidents resulting from human error.

It is important to make explicit the link between counterfactual thinking and perceptions of organizational accountability. Fairness theory (Folger & Cropanzano, 2001) posits that counterfactual thoughts and subsequent thoughts of organizational accountability are connected. In particular, the greater the propensity to have counterfactual thoughts about how the misfortune could have occurred otherwise, the greater the perception of organizational accountability will be. We have hypothesized above the link between human vs. technological error and accountability, and the link between human vs. technological error and counterfactual thinking. In order to understand the causality of these three interrelated variables, then, we must hypothesize the following.

Hypothesis 3. Judgments of organizational accountability will be mediated by the counterfactual thoughts about how the actions contributing to a misfortune could have occurred otherwise.

Attention is now turned toward testing our hypotheses. Two experimental studies are presented, followed by an overall discussion section. It should be noted that in the series of presented experiments technological failures are actually computer-based failures. This is in line with the key change in technology within contemporary society (Barley, 1996).

Study 1

Method

Participants were 86 voluntary graduate-level accounting students. Each participant read a fictional newspaper article, as presented in the appendix, involving the collision of two commuter trains during the morning rush hour in Chicago. The scenario was based upon actual events that occurred on August 3, 2001 when two Chicago Transit Authority (CTA) trains (the Chicago "El" trains) collided (see Nevala et al., 2001). The collision injured over 140 people and prevented hundreds more from arriving to work in a timely fashion. After reading the scenario, participants completed a decision making exercise concerning organizational accountability. In both experimental conditions the objective nature of the misfortune was held constant: an individual (the victim) fractured a rib due to the impact of the collision. The cause of the accident was manipulated as being rooted in either technological error ($n = 41$) or human error ($n = 45$). The technological error condition involved a malfunction in the train's computer program, in which the computer erroneously allowed the train to continue forward when it should have been stopped. The human error condition involved the train's conductor erroneously allowing the train to continue forward when it should have been stopped. Participants were randomly assigned to experimental conditions.

Dependent variables

Organizational accountability. Judgments of organizational accountability were measured by responses to three questions that were aggregated into an overall accountability index measure ($\alpha = .81$) ranging from 1 (low accountability) to 7 (high accountability). One question measured participants' perceptions of organizational accountability directly by responses to the question, "To what degree do you hold the CTA accountable for the actions that resulted in the train collision?" Responses were measured on a scale of 1 ("not at all") to 7 ("absolutely and completely"). In addition, organizational accountability was measured by participants' assessments of victim compensation. As alluded to earlier, one of the consequences of establishing a sense of accountability for a misfortune is that it opens the door for the scales of justice to be restored. This is commonly accomplished through victim compensation, where an organization that is accountable for a misfortune compensates the victim in some manner (Walster, Walster, & Berecheid, 1978). Participants were asked how much a victim who fractured their rib in the accident should be compensated. In order to isolate compensation judgments to reflect participants' judgments of pain and suffering, they were informed in the written instructions that the victim did not lose any salary, or incur any expenses (such as medical bills or transportation) because these have already been resolved by the insurance company to everybody's satisfaction. They were instructed to award fair compensation solely for 'pain and suffering' from the accident. Participants' victim compensation judgments were recorded on a scale of 1 ("the minimum of $0") to 7 ("the maximum allowable") with the midpoint being 4 ("the typical payment"). Finally, organizational accountability was measured by assessments of organizational blame for the misfortune. This was measured by responses to the following question: "On a scale of 1 to 100, to what degree do you feel the CTA should be blamed for the train collision and resulting damages—1 is not at all and 100 is absolutely and completely?" Responses to this question were mathematically transformed into scale ranging from 1 to 7, so that all questions would be of equivalent weight in the aggregated index measure.

Counterfactual thoughts. In order to verify the existence and the extent to which participants had counterfactual thoughts, also measured were the ratings of the extent to which they had thoughts about how the situation could have occurred with a better outcome. Counterfactual thoughts were measured by responses to two questions that were aggregated into an overall counterfactual thought index measure ($\alpha = .85$). The first question measured the presence of counterfactual thoughts by participants' responses to the following question:

> Many times in a situation as this, people contemplate how things could have been different. Do any such thoughts occur to you when thinking of this incident? Specifically, to what extent do you have thoughts about how this incident could have occurred differently?

Participants' responses were recorded on a scale of 1 ("Thoughts of worse possible outcomes") to 7 ("Thoughts of better possible outcomes") with the midpoint being 4 ("No such thoughts").

In addition, an independent third party assessed participants' counterfactual thoughts. Participants, in an open-ended question, were asked: "What are your thoughts about this accident? Please use the allotted space below (the 10 lines) to provide a detailed narrative." Two independent coders, blind to the hypotheses and to experimental condition, were asked to complete the following task: "Count the number of incidences that participants imagined how the accident might have occurred otherwise—specifically, (1) count the number of incidences that participants report thoughts of a better possible outcome and also (2) the number of incidences where they report thoughts of worse possible outcomes." Inter-rater agreement was sufficiently high ($r_{wg} = .91$) and the counts of the two coders, when divergent, were averaged together to provide a single measure. It should be noted that there were no reported thoughts of downward counterfactuals (i.e., thoughts of a worse possible outcome).

It should be noted that both of these measures for counterfactual thoughts are in line with the research on counterfactual thinking where the generation of counterfactual thoughts are often assessed by the mere existence of such thoughts, the number of such thoughts generated, or the intensity to which counterfactuals are experienced (Galinsky, Seiden, Kim, & Medvec, 2002; Markman, Gavanski, Sherman, & McMullen, 1993; Sanna & Turley-Ames, 2000). In line with prior research on this subject, the counterfactual index measure used in this study is a composite of both intensity and quantity.

Results

Organizational accountability

Although the objective nature of the misfortune was held constant across experimental conditions, the degree to which participants held the organization accountable for the outcome varied as a function of experimental condition—supporting Hypothesis 1. Participants in the human error condition found the CTA organization significantly more accountable for the misfortune ($M = 4.01$, $SD = 1.30$) than participants in the technological error condition ($M = 3.53$, $SD = 1.13$), $F(1, 84) = 6.29$, $p < .05$, $\eta^2 = .10$.

Counterfactual thoughts

Supporting our second hypothesis, participants' counterfactual thoughts were found to vary by experimental condition. Participants reported that misfortunes rooted in human error could be more easily imagined as having a better outcome ($M = 4.01$, $SD = 1.29$) than those rooted in technological error ($M = 2.84$, $SD = .97$), $F(1, 84) = 22.12$, $p < .001$, $\eta^2 = .21$.

Mediation analysis

As may be seen in Fig. 1, the nature of the organizational accident was a significant predictor of organizational accountability. Mediation analyses was conducted as per the four steps set forth by Kenny, Kashy, and Bolger (1998) (see also Baron & Kenny, 1986). The three variables of interest to the mediation analysis include (1) causal nature of the organizational accident (technological or human error), (2) counterfactual thoughts (the hypothesized mediator), and (3) organizational accountability. First conducted was a regression analysis using organizational accountability as a criterion variable and

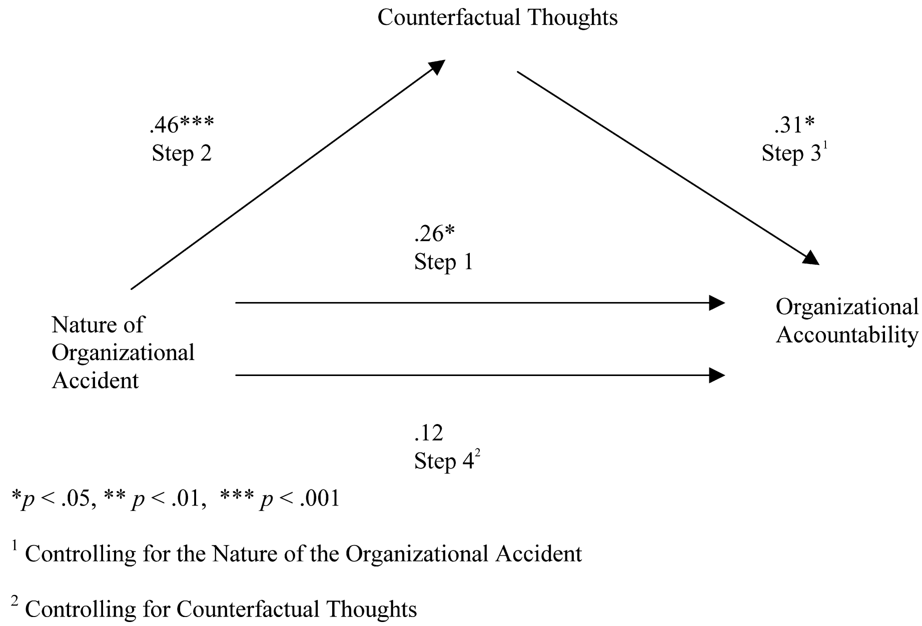

Fig. 1. Mediation effects on organizational accountability by counterfactual thinking in study 1.

the cause of the organizational accident as a predictor demonstrating that the nature of the organizational accident was correlated with judgments of organizational accountability, $\beta = .26$, $t(84) = 2.51$, $p < .05$. As illustrated in Fig. 1, which presents the beta coefficients and their respective levels of significance, this statistically significant relationship established that there was an effect that may be mediated—thus, step 1 criterion of the mediation analysis is met.

Next a regression analysis was conducted using participant's reported counterfactual thoughts as a criterion variable and the cause of the organizational accident as a predictor which demonstrated that the nature of an organizational accident was correlated with the hypothesized mediator, $\beta = .46$, $t(84) = 4.70$, $p < .001$. In all, because this relationship is statistically significant, step 2 criterion is met for the hypothesized mediator.

Also presented in Fig. 1 are the effects from the potential mediator to the outcome, organizational accountability, controlling for the initial variable. Using organizational accountability as the criterion variable in a regression equation with (a) the cause of the organizational accident and (b) counterfactual thoughts as predictors, it was found that counterfactual thoughts, the hypothesized mediator, was correlated to the dependent variable organizational accountability, $\beta = .37$, $t(84) = 3.66$, $p < .001$, and remained significant even when controlling for the nature of the of organizational accident, $\beta = .31$, $t(83) = 2.79$, $p < .01$. Thus, step 3 criterion is met and counterfactual thoughts are found to mediate this relationship.

Finally, analysis was done to explore the relationship between the nature of the organizational accident and perceptions of organizational accountability when controlling for the identified mediating variable, step 4 of the four-step procedure. As Fig. 1 illustrates, when controlling for counterfactual thoughts in this regression equation the significant relationship between type of organizational accident and organizational accountability, $\beta = .26$, $t(84) = 2.51$, $p < .05$, is reduced to nonsignificance, $\beta = .12$, $t(83) = 1.05$, *ns*, indicating that counterfactual thinking completely mediates this relationship.

We also tested whether the indirect effect was significant, the indirect effect being the relationship between the causal nature of the misfortune and perceptions of organizational accountability via counterfactual thoughts. Using the Baron and Kenny (1986) modification to the Sobel test which is distributed as Z, it was demonstrated that this indirect effect was indeed significant, $Z = 2.43$, $p < .05$.

Thus, supporting Hypothesis 3, counterfactual thoughts were found to be a mediating mechanism between the nature of an organizational accident (technological or human error) and judgments of organizational accountability.

One notable concern regarding our analysis is the potential for alternative models other than one presented and tested. That is, because the proposed mediator (counterfactual thinking) and outcome (organizational accountability) were not manipulated and also not measured in temporal order, alternative models may be proposed. For example, there may be reverse causal effects. This alternative model is one where perceptions of organizational accountability cause counterfactual thinking. Indeed, a mediation analysis of this alternative model does suggest that partial mediation is present. Thus, it cannot be ruled out on the basis of empirical analysis. In addition, an alternative model would be to treat both counterfactual thinking and organizational accountability as outcome variables. This latter alternative also cannot be ruled out on an empirical basis. However, we believe our tested model is on solid ground in that it fits the prevailing theoretical models linking counterfactual thinking to causality and related judgments (i.e., blame, compensation, affect, etc.) and has been empirically validated by a large stream of previous research.

Research on the link between counterfactual thinking and perceptions of causation has proliferated since Kahneman and Tversky (1982) wrote their seminal book chapter about the mental "simulation" or the running of alternative scenarios (to the actual outcome) through the mind. They identified the link between counterfactual thinking and perceptions of causality. Solidifying the theoretical model of counterfactual thinking as an *antecedent* to determinations of causality and related judgments was the publication of Norm Theory (Kahneman & Miller, 1986). This theory is often cited as one of the most influential theories of the 1980s (Roese & Olson, 1995) as it set the direction for ensuing research in the area of counterfactual thinking and its effects. The substantial body of empirical work in this stream of research presents and confirms counterfactual thinking as an antecedent to perceptions of causality and/or related decisions—as opposed to the other way around (e.g., Branscombe, Owen, Garstka, & Coleman, 1996; Creyer & Gurhan, 1997; Davis, Lehman, Silver, & Wortman, 1996; Jervis, 1996; Lipe, 1991; Macrae, 1992; Macrae, Milne, & Griffiths, 1993; Mandel & Lehman, 1996; McGill, 1993, 1995, 2000; McGill & Klein, 1993; Nario & Branscombe, 1995; Roese & Olson, 1996; Spellman & Mandel, 1999; Wells & Gavanski, 1989; Williams, Lees-Haley, & Price, 1996). Furthermore, one of the basic tenets of fairness theory (which we are putting to the test) is the notion that counterfactual thinking is an antecedent to perceptions of causation and consequently the related perception of accountability. In summary, given the previous work in this stream of research and the general consensus that counterfactual thoughts are an antecedent to perceptions of causality and related judgments (such as accountability) we feel that our presented model is on solid ground.

Study 2

Study 1 provided us with some insights about how people react to descriptions of misfortunes caused by either technological failures or by human error. With any research of this kind, however, there is always the limitation presented by requiring participants to imagine the scenario, instead of experience it for themselves. In study 2, we changed this to a real-life setting by taking advantage of a real organizational misfortune: the malfunctioning of a university's e-mail server for an entire day. In this way, participants did not need to generate hypothetical responses to the situation—they were already experiencing them first-hand.

In addition, our methods change slightly in this study to counteract another possible concern in the items used for study 1. It is possible that the counterfactual thinking measure used was too intrusive since we specifically asked people to rate their counterfactual thoughts, without measuring whether they had spontaneously generated these on their own. That is, the questionnaire measure may have actually prompted participants to generate counterfactual thoughts. Though we may argue that both experimental conditions (i.e., technological or human error) received the same prompting potential and there was still a clear and distinct difference in reported results, suggesting an effect that goes beyond simple prompting of participants, the second experiment was modified to address this concern. In this study, the relationship between the cause of an organizational accident (i.e., technological or human failure) and organizational accountability was examined without any prompting of participants for their counterfactual thoughts.

Method

Participants were 89 voluntary graduate-level business students. Unlike the scenario-based experiment in study 1, this study had participants reporting their perceptions regarding a real life organizational accident that they experienced. As before, the objective nature of the misfortune was held constant and the information provided was manipulated to indicate the outcome resulted from either technological error ($n = 43$) or human error ($n = 46$).

The organizational accident was an actual outage in the campus e-mail service that restricted e-mails to campus addresses exclusively. That is, participants could not send e-mail to others outside of the university and this restriction lasted for the entire work day (i.e., more than 8 h). The target organization was known as the Office of Information Technology (OIT), which manages the computer network at a major Midwestern university. Four hours into the e-mail outage, participants were given a written questionnaire in their mailboxes asking their opinion about the outage. In the questionnaire participants were informed that their e-mail outage was "believed to be the result of a computer error that consequently fried the server" (i.e., the technological error condition) or "believed to be the result of a human error that consequently fried the server" (i.e., the human error condition). Participant had until the end of the day, 6:00 PM, in which to respond by turning the questionnaire in to an unattended box located in the student mailroom. This allowed for a maximum of 5 h in which to complete the questionnaire. At the time of this deadline the e-mail outage was still in effect. Response rate was 74% (72% for the technological failure condition, 76% for the human error condition).

Dependent variables

Organizational accountability. Judgments of organizational accountability were measured in the similar fashion to that of study 1. In particular, organizational accountability was assessed by participants' responses to three questions that were aggregated into an overall accountability index measure ($\alpha = .86$) ranging from 1 (low accountability) to 7 (high accountability). One question measured participants' perceptions of organizational accountability directly by responses to the question, "To what degree do you hold the OIT accountable for the campus wide e-mail outage?" Responses were measured on a scale of 1 ("not at all") to 7 ("absolutely and completely"). In addition, organizational accountability was measured by participants' assessments of "victim" compensation. In this case the compensation is represented by a fine levied upon OIT and paid to the university. In order to isolate compensation judgments to reflect participants' judgments of pain and suffering, they were informed in the written instructions that the university will not incur monetary losses, as these will be reimbursed by an insurance policy held by the OIT. They were instructed that this fine was to be based solely for 'pain and suffering' from the e-mail outage. Participants' compensation judgments were again recorded on a scale of 1 ("the minimum of \$0") to 7 ("the maximum allowable") with the midpoint being 4 ("the average fine"). Finally, organizational accountability was measured by assessments of organizational blame for the misfortune. This was measured by responses to the following question: "On a scale of 1 to 100, to what degree do you feel the OIT should be blamed for the e-mail outage—1 is not at all and 100 is absolutely and completely?" As before, responses to this question were mathematically transformed into scale ranging from 1 to 7, so that all questions would be of equivalent weight in the aggregated index measure.

Counterfactual thoughts. In contrast with the first study, questions regarding counterfactual thoughts were not explicitly asked. Instead, only the open-ended question was asked: "What are your thoughts about this e-mail outage? Please use the allotted space below (the 10 lines) to provide a detailed narrative." Two independent coders, blind to the hypotheses and to experimental condition, were asked to "count the number of incidences that participants imagined how the e-mail outage might have occurred otherwise." Inter-rater agreement was sufficiently high ($r_{wg} = .91$) and the counts of the two coders, when divergent, were averaged together to provide a single measure.

Results

Organizational accountability

Significant differences were found in participants' perceptions of organizational accountability. Replicating the findings of Study 1, and supporting Hypothesis 1, participants were more likely to perceive the organization as being more accountable for a misfortune when the cause is attributed to human error ($M = 6.20$, $SD = .88$) than when attributed to technological error, ($M = 5.42$, $SD = 1.10$), $F(1, 87) = 13.62$, $p < .001$, $\eta^2 = .14$.

Counterfactual thoughts

As in the first study, the cause of the organizational accident was found to influence participants' counterfactual thoughts. Specifically, participants had fewer counterfactual thoughts when organizational accident was caused by a technological error ($M = 3.07$, $SD = 1.30$) than when caused by human error ($M = 4.67$, $SD = 1.46$), $F(1, 87) = 29.82$, $p < .001$, $\eta^2 = .26$. This pattern again supports Hypothesis 2. Furthermore, the reported results replicate the findings of the first study and do so with a less intrusive measure for counterfactual thoughts.

It should be noted, however, that in this study the quantity of counterfactual thoughts are measured as opposed to direction of counterfactual thought as was measured in study 1. Recognizing this, we had the two coders mentioned earlier (still blind to the hypotheses and to experimental condition) code the counterfactual thoughts they identified previously as being either upward (imagining a better possible outcome) or downward (imagining a worse possible condition). Both coders identified 100% of counterfactual thoughts as being upward in direction. Taken together, the reported results suggest that participants in both experimental conditions had upward counterfactual thoughts—though more of them in the human error condition than in the computer error condition.

Mediation analysis

Using the same four-step mediation analyses used in the first study as outlined by Kenny et al. (1998), participants' counterfactual thoughts were again found to be a mediating mechanism. We first conducted a regression analysis using organizational accountability as a criterion variable and cause of failure as a predictor, demonstrating that there was an effect that may be mediated, $\beta = .37$, $t(87) = 3.69$, $p < .001$, satisfying step 1 criteria.

In addition, when conducting a regression using participant's counterfactual thoughts as a criterion variable and cause of failure as a predictor, the cause of the organizational accident was found to be correlated with the mediator, $\beta = .50$, $t(87) = 5.46$, $p < .001$, satisfying step 2 criteria.

Next, using organizational accountability as the criterion variable in a regression equation with (a) counterfactual thoughts and (b) cause of failure as predictors, it was found that counterfactual thoughts, the hypothesized mediator, were correlated with perceptions of organizational accountability, $\beta = .71$, $t(87) = 9.51$, $p < .001$, and remained significant even when controlling for cause of failure, $\beta = .70$, $t(86) = 8.10$, $p < .001$. Thus, taking these first three steps together, counterfactual thoughts were again found to mediate the relationship between the cause of organizational accident and organizational accountability, supporting Hypothesis 3.

Finally, when controlling for counterfactual thoughts in this regression equation the significant relationship between cause of accident and judgments of organizational accountability, $\beta = .37$, $t(87) = 3.69$, $p < .001$, was reduced to nonsignificance, $\beta = .01$, $t(86) = 11$, *ns*. Thus, the present study found counterfactual thoughts to be a complete mediator, replicating the findings of study 1 (see Fig. 2).

We also tested whether the indirect effect was significant. Again, the indirect effect is the relationship between the causal nature of the misfortune and perceptions of organizational accountability via counterfactual thoughts. Using the Baron and Kenny (1986) modification to the Sobel test which is distributed as Z, it was demonstrated that this indirect effect was indeed significant, $Z = 4.55$, $p < .01$.

Taken together, study 2 replicated the reported effects of study 1 with a different and more experiential context. Furthermore, this effect was clear and distinct despite efforts to downplay any prompting of participants' counterfactual thoughts.

General discussion

The two studies presented provide evidence that individuals tend to treat organizational accidents rooted in technology differently than those rooted in human behavior. Specifically, relative to organizational accidents caused by human behavior, technologically induced accidents tend to allow organizations to escape the full brunt of accountability for the ensuing harm caused by their failures.

From a theoretical perspective, this research extends the framework established by Folger and Cropanzano's (2001) fairness theory as well as our understanding of how counterfactual thoughts affect organizational life. For one, it empirically confirms the concept that judgments of organizational accountability are mediated by counterfactual thinking. In addition, the data advances the theory by demonstrating that the cause of an event can influence judgments of organizational accountability. Because accidents rooted in technology were found to generate fewer frustrating counterfactual thoughts of a better possible outcome than those resulting from human error, they also resulted in reduced levels of perceived accountability. In summary, the results not only verified the speculated mechanism for accountability judgments, but also advance the theory by demonstrating that the causal nature of an organizational accident can influence accountability decisions.

These findings also provide several important extensions of our knowledge of counterfactual thoughts into the organizational realm. First, we advance the counterfactual thought literature to a new level of analysis

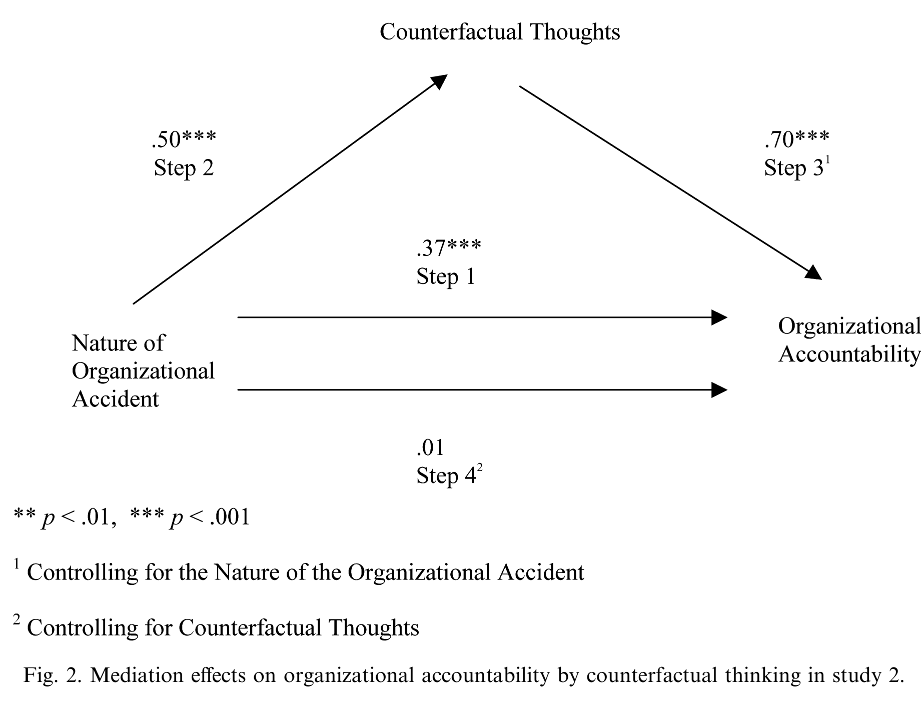

Fig. 2. Mediation effects on organizational accountability by counterfactual thinking in study 2.

with finding that people are willing to blame an entire organization for the actions of one employee. Previous research in counterfactual thoughts has most often focused on the blame assigned to the focal actor, and not the larger organizational structure that potentially assumes responsibility for the individual. Indeed, this finding is somewhat counter to previous research (such as Morris et al., 1999), which demonstrates that in the majority of organizational accidents, decision makers often focus on the individual and not the larger organizational context.

Another contribution of these results to the counterfactual literature is in terms of causal inference. Several implications can be gleaned here: first, people seem unwilling to delve back (i.e., generate counterfactual thoughts) into the chain of events that cause a computer to fail, and instead seem resigned to the fact that the computer failed. With human action, people seem more willing to explore the various decision points and consider each of these for possible mutation. In addition, our mediation analyses provide support for the idea that an event's cause can specifically lead to counterfactual thoughts, which in turn inspire judgments of accountability, an idea originally introduced by Wells and Gavanski (1989).

Overall, these data give us some insight into the psychological ways that people make sense of the technology that they encounter in their lives. Interacting with a machine is nothing like interacting with a human, nor is our reaction to malfunctions in machines the same as our reactions to errors made by people. More specifically, and of theoretical importance, our results imply that people see human actions as more controllable than technological ones. This highlights an interesting inconsistency in the thoughts and behaviors of modern society: human events may be considered psychologically both more controllable and more mutable, but technology is adopted at astonishing rates to guide (and control) our lives for the purported reason that it is objectively more reliable and controllable.

In addition, this research was limited to examining accountability for only negative events. However, the construct of accountability is applicable to those of good outcomes as well. It may be that judgments of accountability are not symmetrical for good and bad events, particularly given the stream of research that documents differences in affective and cognitive responses to positive and negative stimuli (see Taylor, 1991). It would be fascinating to know whether, when presented with a situation of extraordinary organizational success, people were similarly likely to credit humans instead of machines, or if in this case, the primary assumption is that humans do not accomplish greatness as often as technology does. Results on this topic would help enlighten us about people's overall Gestalt view on technology: as a primarily beneficial tool that occasionally falters, or as a completely unknown quantity, not worthy of extreme credit or blame.

From a practical perspective, this research has important implications in the area of organizational impression management (see Ginzel, Kramer, & Sutton, 1993). Our results suggest that people treat technology as a more disembodied and random force, not worthy of the same degree of reaction as is human action. It suggests also that technology may be potentially used strategically as a scapegoat to avoid perceptions of liability or, conversely, that using the more human angle may gain leverage in establishing perceptions of greater liability. Contrast, for example, two airline crashes that occurred in close chronological order to each other during the year 2000—a passenger jet from Singapore Airlines crashed during take off in Taipei due to pilot error (see Chu, 2000b), and a passenger jet from Air France crashed in Paris due to an engine failure (Goldberg, 2000). Both resulted in significant loss of life but whereas Singapore Airlines (whose misfortune was rooted in human error) assumed immediate responsibility for victim compensation even before an official ruling on the cause of the accident (Chu, 2000a), Air France (whose misfortune was rooted in technological failure) did not. Although these examples are dramatic, it nevertheless provides anecdotal but real evidence that organizational accidents rooted in human error are interpreted differently than those rooted in technological failure.

Left to explore are some of the psychological reasons behind the reactions we have demonstrated. For example, it may be the case that people's resistance to focusing on technological failure is rooted in a protective sense of denial about the failure rate for computers. In other words, if we admit that sometimes computers fail and danger ensues, we will be forced to recognize the frailty of our whole society, and the psychologically safer alternative is to downplay the failure entirely in this case. Or, it may be a sense of moral fairness and reciprocity that guides this reaction: the "punitive sentiment" (Price, Cosmides, & Tooby, 2002) dictates that we have a basic psychological need to issue punishment to people for wrongful action, just as we would be punished for our own mistakes. This same sentiment might not apply to technology. Finally, it is possible that what we are observing is a modified version of the psychological state of "learned helplessness" (Peterson, Maier, & Seligman, 1993), in which case the sense of computers as something outside of our understanding and control trains us to respond passively and not even try to help the situation when trouble occurs. Future research can tease apart these issues and explore the psychological mechanisms behind this phenomenon.

It is important to recognize that the findings in this research may be specific to this point in time for our society. It may be the case that as technology becomes an increasingly comfortable and routine part of our existence, our perceptions and expectations about it will change as well. Perhaps our society is in its infancy in terms of embracing technology as an actor in our lives. With greater experience and greater knowledge about technology and how it works (and why it doesn't), people may develop different models and instincts for blame when technologically rooted accidents occur.

On a more societal level, it is often proclaimed by both the academic and popular presses that a new revolutionary transition is underway due to the technological developments over the past decade—specifically, information-based technologies or computers. And, indeed, much of our organizational processes and tools are increasingly being based on the new advances centered on computer-based technologies. Generally, such advances are heralded as positive contributions to society. It is clear, though, that the organization or individual who adopts technology as the key to their success in today's hyper-competitive marketplace must understand the psychological and cognitive frameworks that people carry with them about these tools. Only then can the full implications of technology on the social fabric of our society be recognized.

Appendix. Stimulus material for study 1

A slow moving Brown Line CTA train rear-ended another train during Friday morning's rush hour sending 141 people to hospitals. The dramatic rush hour crash near Wendell Street caused a myriad of injuries (broken bones, bruises, spilled coffee) and it shut down the Purple and Brown Lines for over 2 h preventing thousands of other commuters from arriving downtown as they expected.

The National Transportation Safety Board is leading the investigation of the accident and believes the cause of the accident to be (human error) (a computer error). The operation of the Chicago's subway system during rush hour requires precisely coordinated train movement in order to prevent congestion related delays or gridlock. (This is accomplished by having an on-board conductor that coordinates the train's movement through subway system. Authorities state that the train's conductor was distracted by a construction project on a nearby building and erroneously allowed the train to continue when its path was blocked and also failed to engage the emergency brakes when the two trains were in close proximity to each other.) (This is accomplished by an on-board central computerized system that coordinates the train's movement through subway system. Authorities state that the train's computer program malfunctioned and erroneously allowed the train to continue when its path was blocked and also failed to engage the emergency brakes when the two trains were in close proximity to each other.)

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