Advances in Reliability, Safety and Security, Part 5 – Kołowrocki, Kosmowski (eds.)
 ISBN 978-83-68136-17-3 (printed), ISBN 978-83-68136-04-3 (electronic)

Advances in Reliability, Safety and Security

ESREL 2024
Monograph Book Series

Including Successful Performance In An Event's Causal Analysis: Test Of Instructional Intervention

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Abstract

Analyzing the successful performance displayed during the progression of an event, in addition to failures, could improve organizational learning from events in the nuclear industry. Yet, the causal analysis of events is inherently steered towards finding and fixing the failures, errors, or deficiencies that caused the event or that created the circumstances for it to occur. Successful performance is often overlooked in this process. In this paper, we evaluate if providing instructions to identify the successful performance displayed during an event – in addition to failures, errors, or deficiencies – could help to bring successful performance into the scope of an event's causal analysis. We collected data for this evaluation using a survey-based vignette experiment conducted with 60 study participants with event investigation team experience who were working in the aviation, construction, manufacturing, mining, nuclear power, oil and gas, and utilities industries. Findings from this sample did not support that providing instruction to identify the successful performance displayed during an event, in addition to failures, helps to bring successful performance into the scope of the event's causal analysis. However, the insights gained from this study can inform future research and practical interventions.

Keywords: learning from events, causal analysis, safety-II

1. Introduction

The causal analysis of events is central to ensuring that event investigations in the nuclear industry go beyond describing the event to identifying why they occurred. This knowledge of "why" is important for developing measures and learning points aimed at preventing future events (IAEA, 2008). Several causal analyses methods and techniques exist and are used in practice (Ziedelis & Noel, 2012). However, all steer the event investigation team towards identifying what caused the failures, errors, or deficiencies that were directly responsible for the event (direct causes) or created the circumstances for these failures, errors, or deficiencies to occur (root causes). No attention is given to analysing the successful performance displayed during the event – performance that could have been important for facilitating the identification of an unsafe system state, implementing measures that mitigated the extent of damage caused by an event, or facilitating recovery. One consequence of this is that we lose the opportunity to draw attention to and share knowledge about good practices, or to recognize good performance that could go onto increase worker engagement and satisfaction. Another perhaps more unfortunate consequence is that we learn nothing about why or how successful performance occurred. This could promote taken-for-granted, but perhaps invalid, assumptions about why successful performance was displayed and its reliability (Hollnagel, 2012).

The belief that lessons may also be learned from the successful performance displayed during the event is evident in nuclear industry guidelines for event investigation and reporting. In particular, information about both failures *and* successes are requested to be included in the narrative event description, as "lessons may also be learned from the positive role of plant personnel involved in the event" (IAEA/NEA, 2022, p. 45). Yet, this instruction is not repeated in the guidance provided for the causal analysis phase of the work: the phase where learnings from the event are primarily derived. Without this guidance, the event investigation team could more easily fall victim to the "failure to ask why syndrome," i.e., the tendency not to analyse the successful performance in a way that could challenge assumptions about why things went as or better than expected or assess the reliability of this performance to derive additional learning (Gino & Pisano, 2011; Solberg & Bisio, 2022).

With this background in mind, in the present study we examine if providing instructions to identify the successful performance displayed during an event – in addition to failures, errors, or deficiencies – results in successful performance being included in the scope of an event's causal analysis, and thus, not taken for granted. In the sections that follow, we first outline the theoretical foundations of the study and further elaborate the intervention examined in this research. We then present the study conducted and findings. We conclude the report with a general discussion of findings, study limitations, and practical implications.

2. Theoretical foundations: the Safety-II perspective

Learning from events is traditionally derived from identifying and analysing the factors that cause events, i.e., a detailed analyses of what went wrong. The assumption is that safety can be improved by finding and fixing the problems that caused the event to occur. In more recent years, this approach has been labelled by Erik Hollnagel (Hollnagel, 2013, 2018) as falling under the "Safety-I" perspective. Challenging the Safety-I perspective, Hollnagel's work has brought attention to the benefits of learning from successful performance, i.e., on what went right during the execution of a task or activity, a perspective that he labels "Safety-II." Table 1 outlines the key beliefs we have identified as being held within the Safety-I and Safety-II perspectives from Hollnagel's various publications on the subject (e.g., Hollnagel, 2008, 2012, 2013, 2018; Hollnagel et al., 2015; Hollnagel et al., 2006).

Table 1. Summary of key Safety-I and Safety-II beliefs, extracted from Erik Hollnagel's work.

Safety-I beliefs	Safety-II beliefs
Safety is achieved when as few things as possible go wrong.	Safety is achieved when as many things as possible go right.
Safety is best managed by taking actions to ensure that expected performance does not transition into malfunction.	Safety can be improved by ensuring that humans can be flexible and resourceful when accidents and incidents occur.
When things go right it is because systems and procedures function as they should and because people perform as expected.	How work is performed can vary considerably from expected performance and yet still result in acceptable/desired outcomes
Accidents and incidents are generally caused by failures, deficiencies, and malfunctions.	Accidents and incidents are generally caused by unexpected combinations of everyday performance variability.
When system components function correctly, they produce acceptable outcomes. When they malfunction, they produce unacceptable outcomes.	Even if the components of a system do not function correctly, acceptable outcomes might still be achieved.
Human performance variability is harmful and should be prevented as much as possible.	Human performance variability is inevitable and can contribute to acceptable/desired outcomes just as it can contribute to undesired outcomes.
When accident or incidents do occur, it is important to find and fix what went wrong.	When accident or incidents do occur, understanding how things usually go right can provide a basis for understanding and addressing why things went wrong.
The potential for learning is proportional to the severity of the incident or accident (the more severe, the more learning potential)	Analyzing everyday performance can generate more learning than analyzing the rare occurrence of an incident or accident.

The Safety-II perspective suggests that there is more to learn from identifying and analysing how things typically go right than from scrutinizing the rare instance in which things went wrong (Hollnagel et al., 2015). Accordingly, when failure events do occur, it promotes seeking to understand how things usually go right, as this can provide a good foundation for understanding why the event occurred. Yet, the Safety-II perspective also suggests the need to examine the successful performance displayed during the progression of a failure event. This is because the perspective acknowledges that human performance variability is inevitable, resulting from the influence and interaction of several performance influencing factors. Thus, how work was performed could have varied considerably from expected performance. Still, acceptable outcomes may have been achieved because good systems and procedures compensated for negative human variability, or because the human component varied in positive ways to compensate for less than adequate systems or procedures. Thus, the successful performance displayed during the progression of an event – performance that perhaps led to the identification of an unsafe system state, mitigated the extent of damage, or was important for system recovery – is understood to be variable. It should not be taken-for-granted that the performance is reliable and would be displayed successfully again in a future event, where the factors that influence this performance could be different.

In other research (Solberg & Bisio, 2022; Solberg et al., 2023), we have demonstrated how applying Safety-II thinking in an event's causal analysis, in addition to traditional Safety-I thinking, could improve learning from events and facilitate resilient performance in the future. Accordingly, the belief that the combination of Safety-I and Safety-II approaches are valuable in event investigations and the causal analysis of events provides the theoretical foundation of the present study.

3. Bringing successful performance into the scope an event's causal analysis: the need for intervention

As presented in Solberg and Bisio (2022), the "failure to ask why syndrome" is the result of several psychological mechanisms that direct our attention towards failures and away from successful performance. These mechanisms become institutionalized in organizational routines and practices that promote learning from failure, but often take successes for granted or see them only as something to celebrate. Systematic interventions (i.e., deliberate operations taken by organizational agents) are required to overcome these tendencies and to ensure that successful performance is examined with the same rigor and scrutiny as failed performance (Gino & Pisano, 2011). In the present study, we examine the effectiveness of one such intervention: providing instructions to identify successful performance and its influencing factors in addition to failures and their causes.

3.1. Causal analysis guidelines

Current guidelines in the nuclear industry focus the causal analysis of an event on identifying and analysing the failures, errors, or deficiencies that were responsible for the event or created the circumstances for these failures, errors, or deficiencies to occur. Exemplifying this, the IAEA/NEA Incident Reporting System (IRS) Guidelines (IAEA/NEA, 2022, p. 46) provide the following guidance on preparing the causal analysis:

Indicate clearly here, when relevant, the direct causes as well as the root causes.

- The presentation and discussion of the direct causes (i.e., the failures, actions, omissions, or conditions which immediately produced the event) is expected to identify the technical, human, and organizational deficiencies and answer the question; "How did it happen?" …
- A presentation and discussion of root causes is expected to follow. These are fundamental causes that, if corrected, will prevent recurrence of the event or of its adverse environment. Both causal factors and root causes provide the answers to the question; "Why did it happen"?

The approach reflected in the above excerpt aligns with the Safety-I belief that when accidents or incidents occur, it is important to find and fix what went wrong. Yet, the value of Safety-II thinking is also evident in the IRS Guidelines. In particular, guidance on page 45 states that information about both failures and successes in responding to the event should be included in the narrative description of the event, as "lessons may also be learned from the positive role of plant personnel involved in the event." However, without this guidance in the causal analysis section, it is questionable if successful performance and its influencing factors will be brought into the causal analysis and thus improve the likelihood that lessons are learned from this information. Accordingly, in this study we ask: ***Does providing instructions to identify successful performance in addition to failures, errors, or deficiencies during an event analysis task result in greater instances of successful performance being identified as important to examine in the event's causal analysis compared to failure-focused instructions?***

Method

3.2. Study design

We devised a study with an experimental design to address the research question put forward in this paper. In this study, we asked participants to read two event descriptions derived from real events occurring in the nuclear power industry and identify the aspects of each event that they believed should be examined in the event's causal analysis or analysed to inform lessons learned and follow up actions from the event. Participants were randomly assigned to one of three conditions: (1) a failure condition, where participants were prompted to identify the failures, actions, omissions, or conditions that produced the event; (2) a failure + success condition, where participants were prompted to identify any positive actions, decisions, and occurrences in addition to the failures, actions, omissions, or conditions that caused the event; or (3) a control condition in which no specific prompting was used.

3.3. Study participants

We recruited our study sample on Prolific (https://www.prolific.com/academic-researchers), an online research platform that helps researchers engage relevant study participants in exchange for fair payment for the participant's time and a 25% service fee. To recruit a relevant sample, we first ran a pre-screening study targeting participants who indicated that they worked on a full-time or part-time basis in the United Kingdom (UK) or United States (US) in the nuclear power, aviation, construction, manufacturing, mining, oil and gas, or utilities industry. A further filter applied narrowed the population down to those who had completed technical/community college or had an undergraduate or graduate degree and worked in a professional or consultancy role. From this filtered selection, we sought to identify people who had been actively involved in an event investigation, in roles including investigation team leaders and event analysis experts, representatives of management, specialists representing the departments concerned in the event, inspectors from the regulatory body, external experts or consultants, or human and organization factor (HOF) specialists. Respondents to the pre-screening study were offered £0.30 for their time to answer a two-minute questionnaire (equivalent to a £9.00 hourly rate, as recommended by Prolific) inquiring about their experience with event investigations, including if they had been involved in one before, and in what type of role. From the 412 responses collected in the pre-screening study, 99 respondents met the inclusion criteria and were invited to join the main study.

Sixty-six of the 99 Prolific participants we identified as eligible responded to our initial invitation to join the main study (i.e., 67%). However, only 60 participants responded in full. Of these, 41 (68%) were based in the UK and 19 (32%) were based in the US. Eight (13%) worked in aviation, 18 (30%) worked in construction, 18 (30%) worked in manufacturing, one (2%) worked in mining, two (3%) worked in nuclear power, six (10%) worked in oil and gas, and seven (12%) worked in utilities. Furthermore, 51 study participants were male (85%) and nine were female (15%). Their age ranged from 23 to 67 years old (median = 34; mean = 39, standard deviation = 12). Twenty-eight participants had completed an undergraduate degree (47%), 26 had completed a graduate degree (43%), four had completed technical/community college (7%) and two had a doctorate degree (3%).

3.4. Study procedure

In the main study, participants were offered £3.00 to spend 15 minutes reading two event descriptions and identifying the aspects of each event that they believed should be examined in the event's causal analysis or analysed to inform lessons learned and follow up actions from the event. Prior to reading the event descriptions, participants were randomly presented with one of three blocks of information, which set up the different study conditions. The information prompts used are provided in Table 2. The prompt used in the failure condition was derived from the IRS guidelines for preparing the causal analysis (IAEA/NEA, 2022)

Table 2. Study condition prompts administered in Part 2 of the main study.

Condition	Prompt used
Failure condition	In the next part of the survey, you will be asked to read two event descriptions and respond to questions about each. When reading the event descriptions, try to identify the failures, actions, omissions, or conditions that produced the event, as well as any technical, human, and organizational deficiencies that explain why they happened. In both events, human performance plays a significant role in the event initiation and development. Therefore, try specifically to identify how human errors affected the event initiation and development and what could have given rise to these errors. Please click forward to read the first event description and answer the questions that follow as prompted.
Failure+ success condition	In the next part of the survey, you will be asked to read two event descriptions and respond to questions about each. When reading through the event descriptions, in addition to identifying the failures, actions, or omissions that caused the event, please also identify any positive decisions or actions that occurred. In both events, human performance plays a significant role in the event initiation and development. Therefore, try specifically to identify how human factors affected the event initiation and development in both negative and positive ways and what could have given rise to the errors that occurred as well as to positive performance. Please click forward to read the first event description and answer the questions that follow as prompted.
Control condition	In the next part of the survey, you will be asked to read two event descriptions and respond to questions about each. Please click forward to read the first event description and answer the questions that follow as prompted.

The event descriptions read by respondents, provided in Table 3, were based on the Golfech 2 event that occurred on 19 October 2016[1] and on the Forsmark 1 event that occurred on 25 July 2006[2], both of which are also described in Solberg et al. (2023). These two events were selected because they both contain aspects of successful performance, specifically, recovery success. In the Golfech 2 event, successful performance was displayed when the control room operators (CROs) on duty detected a discrepancy during the draining activity that indicated there was an issue, stopped the draining activity, and sent a field operator to confirm the position of the vent. It was also displayed when they restored the water level in the pressurizer quickly after a sudden drop. In the Forsmark 1 event, successful performance was displayed when the CROs recognized the situation as being like a training scenario and read signals from neutron detectors in the core to determine reactor status, and again when they restored power to the two downed systems manually.

Table 3. Event descriptions provided to study participants.

Event	Description provided
Event 1 (based on Golfech 2)	In this event, the nuclear power plant was shut down for refuelling. Preparations were being made to drain the main primary circuit so that the lid of the vessel could be opened and the unloading/reloading of the core with fuel assemblies could be performed. Related to this, a field operator visited the reactor building to open the pressurizer vent on the main primary circuit, in accordance with the procedures for the draining activity. However, the field operator was interrupted and never opened the vent. Meanwhile, control room operators thought that the vent had been opened. So, they began draining the primary circuit as specified in their operating procedures. Initiating this activity with the pressurizer vent closed led to the primary circuit being placed under a vacuum. As a result, the water level measurements captured by sensors in the primary circuit, which control room operators use to monitor the progression of the activity, were no longer representative of the real situation. However, the procedures for the activity did not provide control room operators with clear, unambiguous guidance on water level value measurement and monitoring indicators. Therefore, diagnostic errors were made, and control room operators were unable to establish that there was an issue while monitoring the activity. Eight hours went by, and a shift change occurred. Then, operators detected a discrepancy that clearly indicated there was an issue with the activity. This was when the expected acceleration of the drop in the water level of the primary circuit, corresponding to the complete emptying of the pressurizer, did not occur. At this point, control room operators interrupted the drainage activity and sent a field operator to the reactor building to check the position of the vent. Hearing that the vent was closed, control room operators requested that it be opened. Opening the vent resulted in a sudden drop in the water level measured in the pressurizer. But control room operators acted quickly to restore the water level.
Event 2 (based on Forsmark 1)	This event occurred when the plant was in operation at full power. The event started with a short circuit in a switchyard outside the plant, where the owner and operator of the electricity grid was conducting maintenance work. (The short circuit occurred because a technician executing a maintenance procedure failed to earth the new switchbox). The short circuit in the switchyard resulted in severe voltage fluctuations that spread to the electrical systems of the nuclear power plant. The fluctuations exceeded the tolerance in-built into the plant's electrical systems design. Two of four electrical systems were knocked out from overvoltage. Two of the plant's four diesel driven generators did not start automatically following the disturbance. The failure of the two electrical systems resulted, as intended, in an automatic scram of the reactor. In the event of a reactor scram, the reactor is shut down by inserting control rods into the core. Indications of the control rod positions are provided in control room instrumentation when they are fully inserted. However, because of the electrical disturbance, much of the instrumentation in the control room was lost. Control room operators had no indication about the position of half of the control rods, meaning that they did not know if they had been fed into the reactor as needed to shut it down. The situation was reported to be regarded as stressful. However, operators recognized it as being like one from a training scenario. They read signals from the neutron detectors in the core to determine that the reactor output power was as expected. After eight minutes, operators still had no indication in their instrumentation that all control rods had been inserted into the core. However, their readings of the neutron detectors indicated that the reactor was fully shut down. After 22 minutes, operators were able to determine what had happened and restore power manually. The two failed electrical systems were restarted. Supervisory facilities in the control room were restored. Indication that all control rods were inserted into the core was obtained in the control room instrumentation. Reactor status was verified.

As described in Solberg et al. (2023), in both the Golfech 2 and Forsmark 1 events, operators returned the system to within expected (normal) state boundaries despite several negative performance influencing factors. However, the successful performance displayed in each also varied considerably in its apparent desirability. The successful performance displayed by operators in the Golfech 2 event, while appropriate, came late during the progression of the event and corrected their own earlier errors. With the Forsmark 1 event, the successful performance displayed by operators was both appropriate and timely and was initiated in response to externally caused failures. We regarded these distinctions as important for gauging the generalizability of study findings. For example, the prompt to identify both failures and successful performance displayed during an event could be more effective when the successful performance displayed was clearly apparent and desirable, as it was in the

[1] https://www.french-nuclear-safety.fr/asn-informs/news-releases/golfech-npp-significant-safety-event-rated-level-2-on-the-ines-scale
[2] https://analys.se/wp-content/uploads/2015/05/forsmark-incident-bakgrund2007-1.pdf

Forsmark event. Or alternatively, more apparent and desirable successful performance such as that displayed during the Forsmark event could be more easily taken-for-granted, and thus more often overlooked. Examining responses in relation to the qualitative differences between the two events was intended as an exploratory element of the study.

Following each event description, participants were asked: (1) What about this event do you believe should be examined in the event's causal analysis? For each aspect of the event that you believe should be included, please briefly explain why you believe it is important to examine. (2) Are there any additional aspects of the event that you believe should be analysed in order to inform lessons learned from the event and actions that could be taken to improve system performance and resilience in the future? The purpose of including the second question was to see if study participants identified successful performance as something important to analyse and learn from when it was not elicited in relation to a question about aspects important for the "causal analysis" of the event, which could be implicitly associated with analysing failures even if the condition manipulation tried to deter this. The responses to the two questions about the events were made in an open text format.

3.5. Consent for personal data processing

Participant's Prolific ID was used to match data across three data collection rounds (the pre-screening survey and the two parts of the main study) and with the demographic data available about study participants from Prolific. Even though the research team was not able to link this pseudonymised identifier to a name or other direct identifying information, it is still considered personal data in that it can be linked to a person indirectly. Accordingly, consent for personal data processing was required from each study participant in line with European General Data Protection Regulation (GDPR) requirements.

3.6. Analytical strategy

We coded study participant's responses to the four open response questions included in part 2 of the study (i.e., to the two questions following each of the two events) to generate quantitative data that could be analysed in relation to the different study conditions. To do this, we read through the responses and identified instances where the need to analyse successful performance displayed during the event was called out. In Event 1, we expected this could be related to when CROs detect a discrepancy in their readings that indicates there is an issue with the draining activity, stop the activity, and send a field operator to confirm the position of the vent. It could also be related to the quick recovery response to restore the water level, after it drops suddenly. In Event 2, we expected that respondents could pick up on CRO's recognition of the situation being like one from a training scenario, their work around to read signals from the neutron detectors in the core to determine reactor status, or their ability to diagnose the issue and restore power manually. However, we were also open to other instances of successful performance, both human performance and system performance, that respondents themselves may have identified.

When we found a response that identified successful performance as something important to analyse, we coded the response with a "2." To be coded with "2," the response needed to indicate that the successful performance was to be analysed. Often this was indicated by the respondent in their use of words such as "analysed," "examined," "questioned," "learned from." On the other hand, responses that merely described the successful performance displayed or that suggested it should be re-applied or commended with no indication that it should be analysed was coded "1." Table 4 provides examples of responses that received a code of "2" and "1." When a response only focused on errors, failures, and deficiencies, we coded the response with a "0."

Table 4. Example of coding strategy applied to responses where successful performance was identified.

Successful performance identified as important to analyze; Code = 2	Successful performance described or identified, but not as something to analyze; Code = 1
"The fact that control room operators were able to act quickly to restore the water level once they realized there was an issue. This is important to examine because it suggests that there may be effective emergency response procedures in place that helped prevent a more serious incident from occurring."	"After a shift change, the new control room staff noticed a discrepancy and checked the vent condition. They also stopped the drain down. This is all good practice."
"The control room staff appear to have reacted in accordance with their training and should be commended - but their actions still analyzed to verify that the procedures that they followed remain appropriate and don't need improving."	"The cool-headed actions of the control room staff to use the neutron detectors to verify the position of the control rods is to be commended. The fact they fell back on a training scenario shows they were competent and well trained/prepared."
"The operators were able to recognize the situation from training and successfully respond. Examining the training scenarios provided to the operators and their effectiveness can help identify best practices and areas for improvement."	"Training for similar scenarios should continue to be performed since the training the control room had received allowed them to divert a potentially dangerous situation in this event."

4. Findings

4.1. Responses identifying successful performance as important to analyze

Figure 1 summarizes findings related to successful performance identification for Event 1 (Golfech). As shown in this figure, successful performance was identified as something important to analyze in one of the 20 responses received in the control condition (5%), in two of the 18 responses received in the failure condition (11%), and in three of the 21 responses received in the failure + success condition (14%). The frequency and percentage of responses that identified successful performance as something important to analyze was highest in the failure + success condition where study participants were specifically prompted to identify both negative and positive performance. This finding indicated that successful performance displayed during the progression of an event was more readily identified as something to examine in the event's causal analysis when there is a specific prompt to do so. However, the findings should be seen in light of the number of responses that did not mention successful performance in the same condition. That successful performance was more frequently identified as important to analyse in the failure + success condition than in the other two conditions does not provide meaningful support that the prompt to consider both failures and successes worked effectively, when most responses in this condition did not mention successful performance at all.

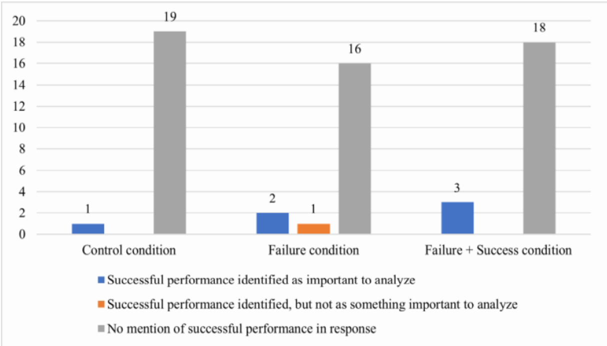

Fig. 1. Count of responses identifying successful performance for Event 1 (Golfech) across study conditions.

Figure 2 summarizes findings related to Event 2 (Forsmark). As evident in this figure, there were more responses identifying successful performance as something important to analyse for Event 2 than for Event 1. Here, successful performance was identified as something important to analyse in two of the 19 responses received in the control condition (11%), in six of the 19 responses received in the failure condition (32%), and in seven of the 21 responses received in the failure + success condition (33%). Yet, findings related to Event 2 also failed to provide clear support that successful performance was more readily identified as something to examine when there is a specific prompt to do so. While there were slightly more responses that identified successful performance as important to analyse in the failure + success condition, on a percentage basis, successful performance was as frequently identified as something important to analyse in the failure condition as it was in the failure + success condition.

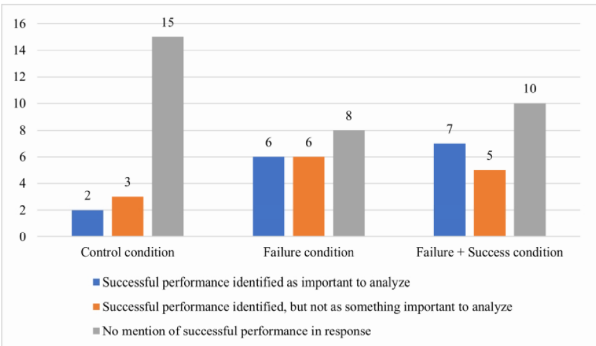

Fig. 2. Count of responses identifying successful performance for Event 2 (Forsmark) across study conditions.

Figure 2 also indicates that in Event 2 there were several more instances in which successful performance was described or acknowledged as something to commend or to re-apply than identified as something important to analyze. This illustrates propositions made in our earlier research (Solberg & Bisio, 2022) about how people might take the reasons for successful performance for granted, and thus commend or suggest re-applying it, instead of seeing this performance as variable and reliant on the interaction of several influencing factors, some of which may be unstable or degraded.

A further observation based on responses to both events, was the split of responses acknowledging the importance of analyzing successful performance between Question 1 (What about this event do you believe should be examined in the event's causal analysis?) and Question 2 (Are there any additional aspects of the event that you believe should be analysed in order to inform lessons learned from the event …?). Fig. 3 summarizes the count of responses identifying successful performance as important to analyze across events and conditions for each of the two questions. The findings presented in this figure indicate that the successful performance displayed in Event 2 was nearly as frequently acknowledged in response to Question 2 (combined count, across conditions = 7), as an additional aspect of the event that could be important for learning as it was in response to Question 1 (combined count, across conditions = 9), as an aspect important to examine in the causal analysis of the event. This aligns with our assumption that the causal analysis of an event could be implicitly associated with identifying and analysing the factors that gave rise to the failures that caused the event, and not the factors that could have given rise to the was only identified in response to Question 1 (combined count, across conditions = 6) and not in response to Question 2 could have to do with the fact that this performance was late in the event sequence and was undertaken to correct the operator's own earlier errors. Thus, it was less successful by normative standards than the successful recovery performance displayed by CROs in Event 2. Another observation for Event 2 is that, in the failure + success condition, successful performance was more frequently identified in response to Question 1 (count = 4) than in response to Question 2 (count = 3). These findings were reverse in the failure condition, where successful performance was more frequently identified in response to Question 2 (count = 4) than to Question 1 (count = 3). Perhaps the prompt provided in the failure + success condition contributed in some way to this result, but this could not be sufficiently tested with the data available.

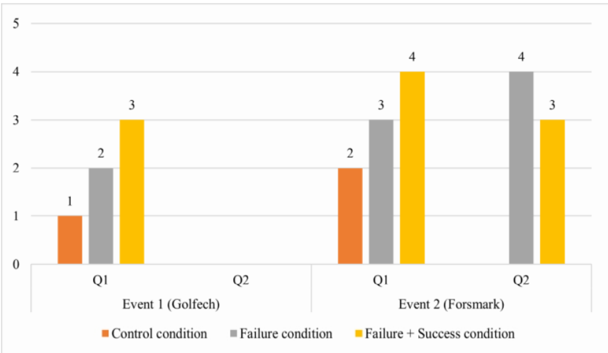

Fig. 3. Count of responses identifying successful performance for Event 2 (Forsmark) across study conditions.

5. Discussion

In this study, we evaluated if providing instructions to identify the successful performance occurring during an event, in addition to failures, errors, and deficiencies, could help to bring successful performance into the scope of an event's causal analysis. We tested the potential effectiveness of this intervention with data collected from an experimental vignette study conducted with 60 people who worked in the nuclear power, aviation, construction, manufacturing, mining, oil and gas, or utilities industry and who had been actively involved in an event investigation. The data was examined to determine if a relationship existed between the different instructional conditions and the identification of successful performance as something important to examine in the event's causal analysis. Our findings from this study were not conclusive, but they indicate that the instructional intervention was not successful in its objective. While we found that responses that identified successful performance as important to analyse, in addition to failures, were more frequent in the failure + success condition than in the failure and control conditions, the differences between conditions were marginal. Moreover, the majority of responses across events and conditions only focused only on failures and made no mention of successful performance.

One reason that the instructional intervention was not successful could be because the instructions of what to identify came before the event description participants were asked to read, and thus may not have been activated during the subsequent task they were given (answering the open response questions about what was important to analyse in each event). Many participants could have simply forgotten what they had been asked to identify on, if anything, prior to responding to the open response questions. If this is the case, then they might have, by default, focused on the failures, errors, and deficiencies evident in each event, as it is common practice to analyse these. Considering our findings, future research could examine if placing instructions of what to focus within the event analysis task itself could help to improve the effectiveness of this intervention.

Another explanation is that focusing on successful performance, in addition to failures, could represent a dramatic shift in the approach to event analysis work. Accordingly, it could take a more comprehensive intervention to get people to look at an event using a different frame from what they are used to. Drawing from classical change management approaches (Schein, 1996), future research could try to confront participants with their default event analysis practices and justify the value that can be derived by analysing successful performance in addition to failures before implementing interventions that could help to change the approach taken.

An additional, interesting finding from our analysis was that successful performance was more readily identified as something important to analyse in Event 2 (Forsmark), an event in which the successful performance displayed by CROs was more prominent and noticeable than in Event 2 (Golfech) because it was more in-line with normative expectations of successful performance. This countered concerns raised in our earlier research (Solberg & Bisio, 2022) that more normatively desirable successful performance could be more easily taken-for-granted, and thus overlooked. That this finding was made in both the failure and failure + success conditions indicates that the saliency of the successful performance displayed by CROs in response to the failure event they encountered could be more powerful for prompting closer examination of this performance than instructions on what to focus one's attention on. Thus, in this case, saliency bias (giving more weight or attention to information that is more prominent or noticeable) could have played an advantageous role. Future research could be conducted to examine more explicitly what contributes to the saliency of successful performance displayed during events, if saliency does predict closer examination of this performance in an event analysis, and the factors that may influence the extent in which it is examined. Of course, this should be complemented with further research aimed at identifying mechanisms that promote the analysis of successful performance in events regardless of how prominent or noticeable it is, as the analysis of both could contribute to additional learning from the event.

5.1. Limitations

We devised a quantitative study in the present research, as our intention was to test if providing instructions to prompt the consideration of successful performance, in addition to failures, errors, and deficiencies could help to bring successful performance into the scope of an event's causal analysis. However, the small sample recruited for this study limited our ability to conduct more robust statistical analyses of the data collected, i.e., inferential tests to identify significant differences in the count of cases where successful performance was identified as important to analyse across conditions. Future studies conducted with larger samples are needed to statistically verify results. Qualitative studies could also explore why instruction to identify successes in addition to failures is overlooked.

A second limitation of the study is that the events presented to study participants were based on events occurring in the nuclear industry. As such, some study participants could have had knowledge of the event beyond the description we provided, and this could have influenced their responses. Given that only two of the 60 participants were working in the nuclear industry, we expect that knowledge of the event among study participants was minimal. Still, including a question asking respondents if they were familiar with the events described could help future studies to control for previous knowledge effects. Future studies could also be conducted with additional scenarios.

Furthermore, our study was based on responses from study participants residing in the US and UK who were spread between several different industries. We went into this research with the assumption that the focus on failure in the causal analysis of events was generalizable to all safety-critical industries. However, it could be that these industries vary with regards to their "Safety-I" versus "Safety-II" focus, a factor which we did not control for in our study but could be included in future research. Furthermore, it could be that the extent to which the successful performance displayed in events is identified as important to analyse might be influenced by national, industry, or organizational culture, which future studies could be better designed to evaluate.

5.2. Practical implications

The direct practical implications of this study are limited, given that we did not find support for the intervention we examined. On the other hand, our findings do indicate that getting event investigation teams to analyse the successful performance displayed in events, in addition to failures, could be challenging. Given the findings of this study, it is difficult to see how the suggestions that lessons can be learned from the successful performance displayed during failure events, as made in current industry incident reporting guidelines, are going to promote this focus. Therefore, if learning from the successful performance that is displayed during the progression of failure events is desired, a more systematic approach is likely needed than the one's considered in this research. As indicated earlier in this discussion, classical change management approaches could be useful for this purpose.

One approach that could be relevant is Lewin's model, which describes three key stages of initiating and implementing change (Schein, 1996). The first stage, "unfreezing" is concerned with disrupting the status quo and creating awareness about the need for change. It typically involves challenging existing beliefs, practices, and behaviours. The second stage, "change," involves implementing new practices or behaviours and encouraging people to adopt them. This is a task that requires effective communication, training, and support. The third stage, "refreeze," is about stabilizing a new way of working, by reinforcing the changes, making them part of norms and standards, and ensuring that they become engrained into organizational culture and individual habits. Starting on this process requires a better understanding of what messages about learning from successful performance are useful in broadening people's mindset about event analysis such that it also encompasses Safety-II beliefs. It also requires identifying what communication, training, and support are important for helping people to analyse successful performance occurring during events, in addition to failures - as well as the factors that are important for reinforcing this approach to event analysis work as a new standard.

6. Conclusion

The present study builds on previous research (Solberg & Bisio, 2022; Solberg et al., 2023) that demonstrates how analysing the successful performance displayed during the progression of an event, in addition to failures, can contribute to new knowledge and improved organizational learning. We evaluated if providing instructions to identify successful performance, in addition to failures, errors, and deficiencies, prompted further consideration of successful performance in the event's causal analysis. Data was collected in a survey-based experimental vignette study conducted with 60 study participants with event investigation experience working in the aviation, construction, manufacturing, mining, nuclear power, oil and gas, and utilities industries. Findings from this sample did not support that this instructional intervention was sufficient for bringing successful performance into the scope of the event's causal analysis. The insights gained from the research suggest that more systematic interventions are likely necessary to address and change institutionalized find-and fix approaches to event analysis.

Acknowledgements

This work was supported by the OECD Nuclear Energy Agency (NEA) Halden Human-Technology-Organisation (HTO) Project. Thanks to the members of the Programme Review Group of the Halden HTO Project for review and constructive comments.

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