Can Pretraining Experiences Explain Individual Differences in Learning?

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This study examined the effects of having experienced negative events related to the purpose of a training program on learning and retention. Participants were 32 private pilots who participated in an assertiveness-training study. The purpose of the training was to prevent aviation accidents caused by human error. Structured telephone interviews were conducted to determine whether participants had previously experienced 3 types of negative events related to the purpose of training. Results indicated a linear relationship between these negative events and assertive performance in a behavioral exercise 1 week after training. The same negative events, however, were not significantly related to the performance of untrained participants in the same behavioral exercise. It is suggested that previous experiences influenced posttraining performance by increasing motivation to learn.

Training and development expenditures have continued to grow in recent years, as has research on variables influencing training effectiveness. In particular, a number of researchers have argued for the need for training research that goes beyond identifying what works to determine “why, when, and for whom a particular type of training is effective” (Tannenbaum & Yukl, 1992, p. 433). As such, researchers have begun to investigate pre-training variables that play a role in determining training effectiveness. In particular, recent research has repeatedly demonstrated a positive relationship between pre-training motivation to learn and gains due to training (Baldwin, Magjuka, & Loher, 1991; Mathieu, Tannenbaum, & Salas, 1992; Quiñones, 1995; Tannenbaum, Mathieu, Salas, & Cannon-Bowers, 1991). Pretraining motivation is expected to prepare trainees to learn by heightening their attention and increasing their receptivity to new ideas (e.g., Mathieu et al., 1992). Thus, trainees who are motivated to do well in training are more likely to learn the content or the principles of a training program than are less motivated participants.

A number of factors have been hypothesized to affect training outcomes through motivation to learn. Noe (1986) suggested that trainees will be more motivated to perform well in training if they perceive that (a) high effort will lead to improved training performance, (b) high performance in training will lead to high job performance, and (c) high job performance is instrumental in obtaining desired outcomes and avoiding undesirable outcomes. Consistent with this view, several elements of the pretraining context have been examined as moderators of learning.

Pretraining Context and Motivation to Learn

Quiñones (1995) demonstrated that the manner in which a training assignment is framed (i.e., advanced or remedial) can influence training motivation and ul-
mately training outcomes through self-efficacy and perceptions of fairness. Past research has found self-efficacy to be related to both the acquisition of skills in training (Gist, 1989; Gist, Schwoerer, & Rosen, 1989; Gist, Stevens, & Bavetta, 1991; Martocchio & Webster, 1992) and attempts at skill transfer (Ford, Quiñones, Sego, & Sorra, 1992). This is consistent with Noe's (1986) argument that trainees who perceive a high likelihood that they will be able to learn if they just put forth the effort will be more motivated to learn than will those who are unsure of their ability to achieve training objectives.

Other researchers have examined pretraining contextual factors that may affect motivation through their impact on trainees' perceptions of the instrumentality of training. In other words, which elements of the pretraining context influence trainees' perceptions that the application of skills learned in training will be instrumental in obtaining desired outcomes and avoiding undesirable outcomes?

Mathieu et al. (1992) found that perceptions of situational constraints in the transfer environment lowered motivation to learn. In addition, they tested the hypothesis that high levels of career planning and job involvement would be related to higher training motivation and training outcomes for participants of a proofreading course. Although their results did not support these hypotheses, the authors pointed out that proofreading skills were important to participants' current jobs but not necessarily important to career progression. Furthermore, although proofreading was an important part of participants' current jobs, it was probably not the most enriching part. Thus, Mathieu et al. argued that the trainees might not have perceived the proofreading course as being instrumental to achieving desired job outcomes (i.e., career progression or job enrichment) and for that reason did not achieve high training outcomes. Mathieu et al. concluded that the purpose or objective of a particular training course is likely to determine which factors are antecedents of perceived training instrumentality. The present study examined pretraining experiences that were directly related to the purpose of training as a moderator of learning. Specifically, we hypothesized that individual differences in learning can be partially explained by prior negative events that a training program was designed to prevent.

Negative Pretraining Events

As Noe (1986) pointed out, participants may find a training program instrumental in avoiding negative outcomes, or events, as well as obtaining desired outcomes. Negative events have been described as those that have "the potential or actual ability to create adverse outcomes for the individual" (Taylor, 1991, p. 67). Such negative events have been shown to increase physiological, affective, and behavioral activity as well as cognitive analysis (Taylor, 1991). In addition, negative goal-related events have been associated with higher levels of self-focused attention and analysis (Lavallee & Campbell, 1995). Finally, there is some evidence to suggest that negative events have a positive impact on organizational performance as well. Russell, Mattson, Devlin, and Atwater (1990) suggested that prior negative life events may be important sources of individual development that influence future knowledge, skills, and motivation. Russell and colleagues reported positive relationships between retrospective accounts of negative life events and peer ratings of leadership for students at the U.S. Naval Academy (Russell et al., 1990) as well as between negative life events and performance outcomes for retail store managers (Russell & Domn, 1990).

It has been argued that reactions to negative events have evolutionary benefits (Hansen & Hansen, 1988; Peeters & Czapinski, 1990) because they enhance the ability to remove or avoid similar threats in the future (Taylor, 1991). We suggest that these same reactions to negative events may increase receptivity to new ideas offered in training, heighten attention to behavioral objectives, and increase self-analysis of training performance, resulting in better retention of skills. Thus, efforts to persuade participants that training can help them to avoid negative events may trigger enhanced readiness to learn for trainees who have previously experienced similar events.

In this study, we investigated the relationship between specific negative pretraining events that a training program was designed to prevent and posttraining performance of the trained skill in a behavioral exercise. The purpose of the particular training program was to enhance pilots' ability to avoid aviation-related accidents by stating and maintaining opinions, ideas, and observations to their crew members in an assertive manner (see Prince & Salas, 1993). Given this purpose, three types of critical incidents were expected to moderate posttraining performance: (a) having previously flown with a captain who used unsafe procedures, (b) having previously experienced a potentially life-threatening incident in which crew coordination was a causal factor, and (c) having previously been pressured to take a flight that the pilot felt uncomfortable taking because of weather or mechanical problems.

We hypothesized that these negative events would moderate the posttraining performance of assertive communication skills. Specifically, we anticipated a positive linear relationship between the number of negative events (0–3) that participants reported having had prior to training and their assertive performance during a behavioral exercise 1 week after an assertiveness training program. It has been suggested that effective team performance-related assertive-
ness is a complex skill as well as an important team-related attitude (Smith-Jentsch, Salas, & Baker, 1995). Furthermore, attitudes regarding assertive behavior in the context of a team do not necessarily predict whether an individual is able to effectively apply this skill in a team situation (Smith-Jentsch et al., 1995). Therefore, although negative events themselves may have a direct impact on attitudes regarding performance-related assertiveness, they were not expected to directly influence participants' ability to apply this complex skill, particularly in a behavioral exercise under "maximum performance conditions" where social inhibitions are not a significant factor (Smith, 1994). In other words, we expected that negative events would not have a direct effect on assertive performance but rather would interact with training to produce enhanced posttraining performance. Thus, we did not expect negative events to be related to the performance of untrained participants evaluated in the same behavioral exercise.

Method

Participants

Participants were 32 private pilots who had participated in the evaluation of a cockpit resource management training program (Smith, 1994). These participants ranged in age from 18 to 36 years, with a mean age of 21 years. Participants' flight experience ranged from 47 to 270 flight hours and averaged 123 hr.

Procedure

Participants were randomly assigned to a trained group and an untrained control group. Trained participants received 2 hr of assertiveness training 1 week prior to being evaluated in a simulated flight. Participants assigned to the untrained control group participated only in the simulated flight where their assertive skills were evaluated.

Training. Half of the participants were randomly assigned to receive team performance-related assertiveness training. Participants were trained in groups of 2-6 individuals. The training was given jointly by the researcher and one of three commercial pilots. Training lasted approximately 2 hr and followed a behavior role-modeling format (i.e., lecture, demonstration, practice, and feedback).

The lecture portion of the training discussed the importance of assertiveness in the cockpit; principles behind the concept of assertiveness; behavioral examples of passive, aggressive, and assertive behavior; and the consequences of using each of these approaches for the individual and the team. The commercial pilot provided a number of aviation examples throughout the course. Trainees then viewed videotaped conflict situations that required assertiveness in the cockpit. For each scene, a model demonstrated first ineffective and then effective performance. Finally, each participant practiced generating his or her own assertive responses in role-played cockpit situations with the commercial pilot. Feedback was provided by both trainers. This method has previously been shown to enhance acquisition of team performance-related assertive skills (Smith-Jentsch et al., 1995).

Performance measure. A PC-based flight simulation was used to evaluate gains due to training in participants' ability to apply assertiveness toward the attainment of unique team problems (Smith, 1994). This team task simulation has been used by a number of other researchers to both train and evaluate aircrew coordination (Bowers, Salas, Prince, & Brannick, 1992). Participants were assigned to a copilot position in a three-person flight crew, with two confederate pilots playing the roles of captain and flight engineer. The simulation was performed under what Sackett, Zedock, and Fogli (1988) referred to as "maximum performance conditions": (a) explicit awareness of being evaluated, (b) acceptance of explicit instructions to maximize effort, and (c) a short enough measurement period to allow focused attention on the goal. Specifically, participants were instructed to use assertiveness to the best of their ability during a 35-min flight scenario in which their interaction with two confederate teammates would be evaluated. Trained participants were evaluated 1 week after receiving assertiveness training.

Participants' ability to use assertiveness was evaluated by two raters, unaware of the experimental conditions, who viewed videotapes of the simulated flights. These raters used behaviorally anchored rating scales to assign ratings from 1 (least effective) to 5 (most effective) for each of four scripted conflict situations that required assertiveness during the simulation.

Previous negative event categories. Data regarding negative experiences related to the purpose of training were collected as part of a follow-up interview. Two naive research assistants conducted structured telephone interviews with participants from the original study approximately 1 year later. On the basis of the specific knowledge, skills, abilities, and motivations that constituted the training content, we developed three biodata items in the form of negative events that the training program was designed to prevent (cf. Russell, 1994). In particular, participants were asked whether they had experienced three specific negative events prior to their participation in the study: (a) Had you experienced a potentially life-threatening aviation incident in which crew coordination was a causal factor prior to participating in the study? (b) Had you flown with a captain or instructor who you felt had used unsafe procedures prior to participating in the study? and (c) Had you felt pressure to take a flight that you felt uncomfortable taking because of weather or mechanical problems prior to participating in the study?

Because data on training-related negative events were collected after the initial study, we took the following measures to enhance the accuracy of the responses:

1. Dated participation records allowed us to remind respondents of the precise date they had participated in the study.

2. Pilots are required to keep a flight log that contains details about the dates, the times, the aircraft type, and the names of crew members, as well as a textual description of each flight. Respondents were encouraged to consult these detailed logbooks to verify the accuracy of their recollections while the interviewer remained on the phone.

3. Respondents were required to describe the incidents in detail rather than being able to respond with a simple yes or no answer. This requirement reduced the potential for faking, which is a prime concern in research relying on biodata (Russell, 1994).
In addition, the following factors supported our confidence in the accuracy of respondents’ descriptions:

4. Respondents were new pilots who had only a limited amount of flight experience. Thus, critical incidents such as those the pilots were asked to describe appeared to be very salient.

5. The majority of the respondents’ flight hours were with instructors who were linked to a particular course in their curriculum. The structured nature of this flight training was helpful in placing incidents in time.

Results

Previous Negative Event Categories

Of the 40 pilots whose maximum performance had been evaluated in the original study, interviewers were able to reach 32 (80%) by telephone. All of these pilots agreed to participate in the follow-up telephone interview. Of the 32 who were interviewed, 15 had been in the control group, and 17 had received the assertiveness training.

Each event category was scored dichotomously: If a respondent reported having experienced an event prior to the study, his or her answer was scored as 1; if the respondent reported that he or she had not experienced an event prior to the study, the answer was scored as 0. Cronbach’s alpha for the three incident categories was .58. Although this alpha was lower than we would have preferred, it was not particularly problematic, given that it was based on only three dichotomously scored items that are not believed to be completely parallel (Nunnally & Bernstein, 1994). We added the three scores into a composite negative event score that could range from 0 (no experiences) to 3 (experiences in all three categories).

A t test was performed to examine the difference between the average number of negative events that were reported by trained and untrained participants. Results indicated that the groups did not differ in the number of incidents they reported, t(30) = -1.29, p = .21.

Assertive Performance Ratings

Participants were assigned ratings on the basis of their ability to apply assertiveness during the four simulated conflict situations. These four conflict ratings assigned by two raters were averaged, and a correlation was computed between the two average ratings for each participant. Intrarater reliability for these overall ratings was .97. The mean of the two overall assertiveness ratings was used as the criterion measure in the regression analyses. To investigate the internal consistency of participants’ assertiveness across the four conflicts in the simulation, the two raters’ ratings were averaged for each conflict, and coefficient alpha was computed for the four averaged conflict scores. Internal consistency computed in this manner was .86. Table 1 shows the means, the standard deviations, and the intercorrelations among all variables for the total sample.

Pretraining Experiences and Posttraining Performance

Training, negative events, and their dummy-coded interaction were entered into a hierarchical multiple regression analysis (Cohen & Cohen, 1983). As can be seen in Table 2, the interaction term, when entered last into the hierarchical regression, added, as hypothesized, a significant and unique increment of the variance in performance, ΔR² = .06, F(1, 28) = 3.08, p < .05 (one-tailed).

Together, training, negative events, and their interaction accounted for 48% of the variance in performance among all respondents. The multiple regression equation for both the trained group and the control group was calculated to

\[ Y = 2.45 + 0.37 (T) + 0.12 (NE) + 0.49 (T \times NE), \]

where training (T) can assume the values 0 (not trained) or 1 (trained), and negative events (NE) can assume the values 0 (experienced none of the events), 1 (experienced any one of the events), 2 (experienced any two of the

Table 1

Means, Standard Deviations, and Intercorrelations Among Study Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Assertive performance</td>
<td>3.16</td>
<td>1.06</td>
<td></td>
<td>.86</td>
<td>.47</td>
<td>.79</td>
<td>.39</td>
<td>.23</td>
</tr>
<tr>
<td>2. Negative events (aggregate)</td>
<td>1.19</td>
<td>1.06</td>
<td></td>
<td>.47*</td>
<td>(58)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Life-threatening event</td>
<td>0.47</td>
<td>0.51</td>
<td></td>
<td>.42*</td>
<td>.79*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Unsafe captain</td>
<td>0.22</td>
<td>0.42</td>
<td></td>
<td>.21</td>
<td>.70*</td>
<td>.41*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Pressure to take a flight</td>
<td>0.50</td>
<td>0.51</td>
<td></td>
<td>.39</td>
<td>.72*</td>
<td>.31</td>
<td>.23</td>
<td></td>
</tr>
</tbody>
</table>

Note. Numbers in parentheses represent coefficient alphas. N = 32.

*p < .05.
Table 2
Results of the Hierarchical Multiple Regression Analysis

<table>
<thead>
<tr>
<th>Step</th>
<th>Variable added</th>
<th>Multiple regression equation</th>
<th>Increment (I)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$R^2$</td>
<td>$F$</td>
</tr>
<tr>
<td>1</td>
<td>Training (T)</td>
<td>.29</td>
<td>12.35</td>
</tr>
<tr>
<td>2</td>
<td>Negative events (NE)</td>
<td>.42</td>
<td>10.39</td>
</tr>
<tr>
<td>3</td>
<td>$T \times NE$</td>
<td>.48</td>
<td>8.45</td>
</tr>
</tbody>
</table>

* One-tailed.

As predicted, trainees' posttraining performance varied significantly as a function of the number of negative events they had previously experienced. In fact, those trainees who reported having had previous experiences in each of the three categories received performance ratings that were, on average, about 2 scale points higher (on a 5-point scale) than those for trainees who reported having had none of the previous experiences (see Figure 1). In contrast, the average difference in performance among untrained participants who reported experiences in all and in none of the incident categories was less than 0.5 scale point.

To examine whether one or two of the negative events contributed all of the predictive power and accounted for the interaction, we conducted a moderated regression analysis with a dummy-coded training effect, three main effects corresponding to each rationally keyed negative event, and three training by negative event interaction effects. Results indicated that when entered together in the equation, none of the negative events alone contributed a significant amount of unique variance. Thus, the three negative events appear to have had an additive effect on trainee performance, as indicated by the linear relationship between the number of negative events and posttraining performance, regardless of which of the three events had been experienced and in what combination (see Figure 1).

Discussion

This study investigated prior negative events related to the purpose of training as a moderator of learning and retention. Based on the purpose of a targeted training program (i.e., to prevent aviation-related accidents), three negative events were hypothesized to moderate posttraining performance. Previous research has demonstrated positive relationships between negative life events and performance outcomes across multiple populations (Russell & Domm, 1990; Russell et al., 1990). In the present study, however, negative events did not have a direct effect on performance. Instead, they interacted with training to produce enhanced posttraining performance. In other words, control participants' ability to apply the target skill in a behavioral exercise was not related to the number of negative events they had previously experienced. As predicted, however, the number of negative event types trained participants had previously experienced did predict their ability to apply the trained skill (i.e., assertiveness) 1 week after training.

Although measures of mediating processes were not available, we suspected that negative pretraining events enhanced trainee performance by increasing the perceived instrumentality of training in avoiding negative outcomes (i.e., aviation mishaps) and thus increased motivation to learn. In other words, trainees who had experienced undesirable incidents where assertiveness might have helped them were likely to have put forth more effort toward learning the training material. Trainees who had experienced fewer or none of the three negative events, however, might not have believed they had an immediate need for such training.

Figure 1. The relationship between ratings of assertiveness in the simulation exercise and the number of negative event types previously experienced as depicted by the regression lines for trained and untrained participants.
Study Limitations

Measures of training motivation and perceived instrumentality were not available for participants in this study. Therefore, we can only suggest on the basis of logical arguments that these variables mediated the effect of pretraining negative events on learning. Anecdotally, the trainer reported that those participants who had personal stories to tell seemed to be more attentive to the lecture and more involved during the role-play portion of training. This is consistent with previous research that has suggested that negative events tend to increase cognitive activity and self-analysis (Lavallee & Campbell, 1995; Taylor, 1991). Thus, the discussion of negative events that training was designed to prevent might have stirred up unpleasant memories for some, which, in turn, heightened their desire and readiness to learn. Additional research is needed to investigate mediating variables that might have been responsible for the relationships demonstrated in this study.

The fact that data regarding pretraining experiences were collected after the initial study is another limitation of this research. However, on the basis of the factors cited in the interview procedure (e.g., pilots keep detailed flight logs), we felt fairly confident in our respondents' ability to place the negative events in time. In addition, the fact that trained participants, on average, did not report having experienced a significantly greater number of event types than did untrained participants gives one confidence that the previous incidents recalled were not confounded with experimental condition. Furthermore, the pattern of results (i.e., previous experiences were related to performance only for trained participants) was consistent with the hypothesis that trainees who had previously experienced negative events that the training was designed to prevent were more motivated to learn and thus demonstrated enhanced performance in the behavioral exercise 1 week after training.

Practical Implications

The results of this study provide empirical support for what training practitioners have long suspected: that a first and critical step of the training process should be to create a perceived need for training in the minds of participants. Future research is needed to investigate ways of creating a perceived need for training in the minds of participants who have not personally experienced situations in which the trained skills or knowledge would have been useful to them.

As is common with most cockpit resource management training courses, the present training program began with videotaped re-creations of airliner mishaps in which a lack of assertiveness was a causal factor. This was done for the very reason of creating a perceived need for training. It is generally accepted that nonassertive communication is a causal factor in many accidents involving commercial airlines. However, not all trainees aspired to be airline pilots, and those who did were several years away from that goal. Thus, the immediacy of the perceived need for this type of training might have differed for those in the course who had not already experienced unpleasant incidents that could have been avoided by using assertive communication. It may be that videotaped re-creations of negative incidents are most effective to the extent that they depict specific settings that trainees are likely to encounter in the immediate future.

In this study, participants who had experienced three specific negative events related to the purpose of training learned more than did those who had not. Once such training-related events are identified, measures can be developed to distinguish between individuals who may benefit most from training and those who may not benefit at all. Simulated scenarios can then be developed to allow certain prospective trainees to be confronted with these uncomfortable events prior to training.

An emphasis on encouraging trainees to share personal experiences related to the purpose of training may help to create a need in the minds of those who have not had such experiences. Although this was done in the present program, the composition of classes differed significantly with respect to the number of trainees who had stories to tell. If such individuals can be identified prior to training, it may be advantageous to evenly distribute them across training classes.

In sum, this study provided empirical evidence that conceptually relevant pretraining negative events accounted for individual differences in learning and retention. We argued that these experiences affected training outcomes through their influence on motivation or readiness to learn. These results add to the growing knowledge base that seeks to determine why, when, and for whom particular training methods are effective. Reliable group differences in learning and retention are often hidden behind simple mean differences between trained and untrained controls. Future research should continue to investigate pretraining variables that determine training effectiveness as well as effective methods for enhancing the perceived instrumentality of training.

References


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