

The Effect of Filmed Versus Personal After-Event Reviews on Task Performance: The Mediating and Moderating Role of Self-Efficacy

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In the current study, we compared the effect of personal and filmed after-event reviews (AERs) on performance, and the role that self-efficacy plays in moderating and mediating the effects of these 2 types of AER on performance. The setting was one in which 49 men and 63 women participated twice in a simulated business decision-making task. In between, participants received a personal AER, watched a filmed AER, or had a break. We found that individuals who participated in an AER, whether personal or filmed, improved their performance significantly more than those who did not participate in a review. Furthermore, there was no significant difference in performance improvement between the personal and the filmed AER, which suggests that the 2 are quite similar in their effect. We also found that the differences in performance improvement between the personal AER group and the control group were somewhat greater than those found in the filmed AER group. Self-efficacy mediated the effect of AER on performance improvement in both types of AER. In addition, the effect of AER on performance improvement was moderated by initial self-efficacy in the personal but not in the filmed AER: The personal AER was more effective, the higher the initial self-efficacy.

Keywords: after-action review, after-event reviews (AERs), learning from experience, observational learning, self-efficacy

The effectiveness of after-event reviews (AERs) in improving individual performance has been recently demonstrated in several research studies. The context of these studies showing the applicability of this organizational learning technique has ranged from high-risk environments in the military (Ellis & Davidi, 2005; Ellis, Mendel, & Aloni-Zohar, 2009; Ron, Lipshitz, & Popper, 2006) to the more benign settings of commercial organizations and laboratory experiments (Baird, Holland, & Deacon, 1999; Ellis, Mendel, & Nir, 2006). Although these studies have produced important findings and have enhanced researchers' understanding of the processes underlying AERs, theoretical as well as applied questions still remain.

The aim of the present study is twofold: (a) The first aim is to examine whether watching a filmed AER of relevant others can promote learning and improve performance as effectively as the traditional personal AER. In cases where the focal event is relevant to more than a single individual, applying such a technique might save the time and effort involved in traditional AERs conducted in person. (b) The second aim is to investigate the complicated relations between performance, the ways AERs are conducted, and self-efficacy. Self-efficacy, on one hand, is expected to mediate the

effect of the AER on performance improvement and, on the other hand, might also moderate the effect of AER on performance.

AERs

An AER (also termed *after-action review*, *postevent review*, or *incident review*) is an organizational learning and/or organizational training procedure that gives individuals an opportunity to systematically analyze their decisions and behaviors and to evaluate their contribution to performance outcomes (cf. Busby, 1999; Ellis & Davidi, 2005).

AERs enable individuals to reflect on their performance and to understand why interim objectives were not accomplished, to know what lessons can be drawn from their past experience, and to evaluate how these lessons can be quickly internalized to improve performance (Baird et al., 1999).

Ellis and Davidi (2005) emphasized three functions that AERs serve: self-explanation, data verification, and feedback. Self-explanation is an active process whereby individuals are asked to analyze their own behavior and put forward explanations for their resulting success or failure. It has been found to promote skill acquisition (Chi, Bassok, Lewis, Reinman, & Glaser, 1989; Chi, de Leeuw, Chiu, & Lavancher, 1994; Pirolli & Recker, 1994), to assist in problem solving (Ferguson-Hessler & de Jong, 1990; Nathan, Mertz, & Ryan, 1994), and to facilitate the development of rules that help to improve subsequent performance and integrate newly learned materials with existing knowledge (Chi et al., 1994).

Data verification, the second function, is the process whereby learners are confronted with a different perception of the same data, enabling them to cross-validate the information they hold prior to making changes and corrections to their mental models. Although learners may not accept other people's views, it is argued

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that they will at least have to relate to these differing perspectives before rejecting them (Ellis & Davidi, 2005). Furthermore, analysis of past experience is susceptible to both error and mental bias, which may lead to invalid or irrelevant conclusions (Ariely & Zakay, 2001). Certain mental biases have been found to hinder learning, including the confirmation bias, which is the tendency to overlook information that contradicts assumptions (Brehmer, 1980; Feldman, 1989), and the hindsight bias, whereby outcomes strongly affect how people view their past experience (Fischhoff, 1982). The data verification function of AERs enables learners to overcome these biases and achieve a more accurate evaluation of the information upon which they base their decisions.

Finally, two kinds of feedback are provided to learners in a typical AER session. The first one is performance evaluation—relative success or failure in task performance. This feedback is provided before the beginning of the AER session. The second kind of feedback is provided during the AER session. This feedback is aimed at improving the process of task performance but is not given directly by the instructor. Learners are encouraged to gather and analyze data that will ultimately improve their performance. In other words, the AER is a kind of a guided self-explanation in which individuals learn what was right or what was wrong in their task performance. Feedback in this case is usually implicit. If explicit feedback is provided, it occurs only when learners finish analyzing the particular behavior and draw the right lesson.

Personal AER, Filmed AER, and Performance

AERs are traditionally conducted by instructors or managers with their trainees or subordinates (e.g., Baird et al., 1999; Ellis & Davidi, 2005; Ron et al., 2006). In a typical AER, individuals systematically review and analyze their decisions and actions and their associated consequences (with the help of a manager, an instructor, or a mentor), trying to figure out what were their mistakes, what were their successful decisions or actions, why mistakes occurred, and what they can learn from these mistakes in order to improve their future performance and achieve their aims. One of the goals of the present study is to examine whether the same benefits can be obtained simply by watching an AER of a relevant other (a person who coped with the same task under the same conditions). This way of conducting such AERs is especially relevant in training contexts where different individuals across the organization are trained to perform similar tasks.

The idea that individuals can improve their performance by observing an AER of a relevant other is consistent with Bandura's social learning theory (Bandura, 1977a, 1986), which is based on four observational learning processes in modeling: attention, retention, production, and motivation. It should be noted, however, that unlike traditional modeling methods, learners in the filmed AER method do not imitate the filmed trainee's task behavior: They do not watch the model performing the task but only watch his or her behavior during the AER. That is, they only watch the trainee model's efforts to understand his or her mistakes. It is assumed that in the filmed AER method, trainees learn by extracting useful information from the trainee model-instructor interaction, and from the comparison to their own experience under similar conditions.

All four learning processes are relevant to learning in the filmed AER method. First, since the filmed AER method does not show the trainee model actually performing the task, learners must pay even more attention to the information generated in the interaction between the trainee model and the instructor. Second, in order to draw the right lesson from the AER and ultimately to produce the correct behaviors, learners in this condition not only need to store the relevant information by means of symbolic representation in memory (Bandura & Jeffery, 1973; Gerst, 1971), but must first change their mental models pertaining to the required behaviors, and only then convert them into overt actions (Ellis & Davidi, 2005). Third, a learner in the filmed AER also needs to put together a set of responses that depends on whether the necessary lessons have been drawn from the filmed AER session. Fourth, the consequences of following the behavior of the trainee model must be favorable if emulation is to be encouraged.

Comparative analysis of the relative effectiveness of the two AER methods reveals that they differ in at least three characteristics: psychological safety, quality of behavioral analysis, and task complexity. Each of these three characteristics has a potential influence on the three functions of the AER: self-explanation, data verification, and feedback.

Quality of Behavioral Analysis and Task Complexity

These two characteristics are imperative for data verification and self-explanation during AER. Basically, learners in the personal AER enjoy the opportunity to verify their own perceptions regarding various aspects of their task performance against those of the instructor, whereas learners in the filmed AER do not. However, if the trainee model analyzes his or her behavior genuinely and thoroughly and also discusses it with the instructor, he or she can provide observers with comprehensive, rich, and useful information and learning should be effective in both methods—the personal and the filmed AER. The more detailed and systematic is the analysis and the greater the psychological safety, the higher the odds that trainees will have the opportunity to watch the trainee model analyzing performance problems that are relevant to their own experience. In terms of task complexity, the simpler the task, the easier for the trainee model to cover in his or her analysis all aspects of the task under investigation, and for the observers to follow most of the problematic issues of task performance that are relevant to them.

Psychological Safety

The filmed AER method has one clear advantage over the personal AER method—learners' psychological safety, a notion that has been used by Schein and Bennis (1965) at the individual level and by Edmondson (1999) at the group level. When learners feel more secure in discussing their errors, they are more willing to draw lessons from them. As opposed to the personal AER method, learners watching the filmed AER method do not feel threatened by the instructor and consequently do not feel they have to put the blame for their failed actions on the task characteristics or on other situational factors (Tetlock, 1985a, 1985b). Therefore, it is much easier for them to attribute their failures to internal causes when they are not the ones under investigation. In other words, in filmed

AERs, the validity of the trainees' self-explanations is even less likely to be jeopardized by attributional errors.

In sum, it is argued that both AER methods, personal and filmed, will have similar effects on performance improvement, and therefore we proposed the following:

Hypothesis 1: Performance improvement of trainees who receive either a personal AER or a filmed AER will be greater than for those who did not receive an AER.

The Mediating Role of Self-Efficacy

In terms of Bandura (1982, 1997), self-efficacy concerns the judgments of how well one can execute courses of action required to deal with prospective situations. After 25 years of research, it is now well established that beliefs of personal efficacy contribute to human performance. Several meta-analyses have been conducted across diverse areas of performance such as work-related performance (Sadri & Robertson, 1993; Stajkovic & Luthans, 1998), academic achievement and persistence (Mulon, Brown, & Lent, 1991), and athletic performance (Moritz, Feltz, Fahrback, & Mack, 2000). Furthermore, a particular meta-analysis including only experimental studies has demonstrated the causal effect of perceived self-efficacy on performance (Boyer et al., 2000). These robust findings have been qualified by several studies demonstrating that belief in one's capability has no determinative function or is self-debilitating (cf. Judge, Jackson, Shaw, Scott, & Rich, 2007; Richard, Diefendorff, & Martin, 2006; Vancouver, & Kendall, 2006; Vancouver, Thompson, Tischner, & Putka, 2002; Vancouver, Thompson, & Williams, 2001). As already noted, however, in the present study we focus on the effects of AERs on performance and self-efficacy and on the effect of self-efficacy on performance and not on the other direction of causality.

The accumulating findings that self-efficacy promotes performance give rise to the important question of how to boost self-efficacy and ultimately task performance. In the present study, we argue that the AER is an effective tool for increasing learners' self-efficacy, the rationale being that it helps them to make sense of their past behavior by creating valid cognitive models of the reasons for their failed or successful performance (Ellis & Davidi, 2005; Ellis et al., 2006). When learners can trust these models, they feel greater mastery of their own behaviors and, as a result, their self-efficacy is increased. In other words, AERs boost self-efficacy by fostering empowering appraisals of performance. For example, self-explanation facilitates appraisal of performance by enabling learners to better explain the outcomes of their actions, create rules to improve performance, and assist in the acquisition of skills. The data verification function assists in elaborating the reasons for these outcomes and overcomes mental biases in interpreting information, while the feedback function provides detailed information on overall success or failure along with specific information about task performance. Additionally, studies indicate that AERs can assist learners in identifying more internal and specific causes of behavior, leading to a greater sense of control and accountability, and a more accurate model of their performance (Ellis et al., 2006). Thus, by clarifying the reasons for outcomes, providing ways to improve and overcome challenges, and cultivate self-knowledge that may boost self-efficacy, AERs can lead to more empowering appraisal of performance and raise self-efficacy.

Similarly, verbal modeling such as that in the filmed review can also build self-efficacy. Findings show that observing symbolic models who exhibit useful skills and strategies can raise observers' beliefs in their own capabilities (Bandura, 1982; Schunk, 1987) and promote the development of cognitive skills (Schunk, 1981; Schunk & Gunn, 1985; Schunk & Hanson, 1985). Models that convince people of their efficacy can weaken the impact of direct failure and increase determination to persevere in the face of repeated failure (Brown & Inouye, 1978; Weinberg, Gould, & Jackson, 1979). Findings show that participants initially low in computer self-efficacy reported significantly higher software self-efficacy after behavioral modeling compared to an interactive tutorial (Gist, Schwoerer, & Rosen, 1989). Similarly, observational learning processes were found to have a positive influence on both declarative knowledge and self-efficacy (Yi & Davis, 2003).

Based on this evidence, we expected that both personal and filmed reviews would increase self-efficacy. Furthermore, in light of the above, namely that AERs are expected to promote self-efficacy and self-efficacy is expected to increase performance, we hypothesized that self-efficacy would mediate the effect of AERs on performance improvement.

Hypothesis 2: The higher the increase in self-efficacy, the higher will be the improvement in performance.

Hypothesis 3: Self-efficacy improvement of individuals who received either a personal AER or a filmed AER will be greater than for those who did not receive an AER.

Hypothesis 4: Increase in self-efficacy will mediate the effect of AERs on performance change.

The Moderating Role of Self-Efficacy

An important element of learning from experience during AER is how learners make sense of their experience during task performance. Failing to accurately interpret experience as success or failure or failing to attribute behavior to the right cause may hinder learning from this experience (Hogarth, Gibbs, McKenzie, & Marquis, 1991). That is, learners must be prepared to approach those epistemic authorities who are able to help them in selecting the right evidence from their experience and interpreting it in terms of success and failure in order to improve and validate their mental models and ultimately to improve their performance (Ellis & Kruglanski, 1992; Kruglanski, 1989; Kruglanski et al., 2005). In the personal AER condition, there is no appropriate external epistemic authority that can explicitly help trainees to interpret their moves or decisions in terms of success or failure. Learners, then, must rely on themselves, that is—on their own epistemic authority (self-ascribed epistemic authority). Therefore, in this condition, learners with high self-ascribed epistemic authority are expected to benefit more from their experience than learners with low self-ascribed epistemic authority (Ellis & Kruglanski, 1992; Kruglanski et al., 2005). In other words, the advantage of learners receiving personal AER over learners who do not receive AER is contingent upon their own epistemic authority. Such contingency does not exist in the filmed AER condition, where learners are not challenged to analyze their behavior by themselves and they do not necessarily perceive the model as a reliable and expert source of

information. In sum, we may predict that the effect of personal AER on performance improvement will be moderated by self-ascribed epistemic authority, while the effect of filmed AER will not.

According to Ellis and Kruglanski (1992), the concept of self-ascribed epistemic authority bears a strong resemblance to the concept of self-efficacy used in Bandura's (1977b, 1986, 1986) theory of social learning. In Bandura's (1977b, 1986, 1986) theory, self-efficacy refers to individuals' expectations of successfully performing behaviors necessary to attain desired outcomes. In this sense, both self-ascribed epistemic authority and self-efficacy refer to a person's own perceived competence in a domain. However, whereas the notion of self-efficacy refers to perceived behavioral capabilities, the notion of self-ascribed epistemic authority refers to one's cognitive expertise—that is, to one's perceived knowledge in a domain and one's ability to adequately conceptualize pertinent topics and issues. In practice, however, the two constructs are expected to have the same predictions with regard to cognitive tasks, because of the high correlation between knowing what to do and how to do it. Thus, we proposed the following:

Hypothesis 5: Self-efficacy will moderate the effect of the personal AER on performance improvement: The higher the self-efficacy, the stronger will be the effect of the personal AER.

Method

Participants and Research Design

The participants in our study were 112 students at the Faculty of Management and the Faculty of Social Sciences, Tel Aviv University, Tel Aviv, Israel (49 men and 63 women). The independent variables were (a) type of review (personal, filmed, and no AER—the control group), (b) self-efficacy, and (c) trials (before vs. after AER). Sex (male or female) was used as a control variable. Participants were randomly assigned to one of three experimental conditions of type of AER: personal review ($n = 36$), filmed review ($n = 38$), and no review—the control group ($n = 38$). The performance task under each condition was percentage of market share captured in a computer game (described below). The dependent variable was performance improvement. It should be noted that the study was conducted by one of two alternative experimenters, using two different male models in the filmed review condition: 54 students participated in the experimental sessions conducted by the first experimenter using a film portraying one of the models, and 58 students participated in the experimental sessions conducted by the second experimenter using a film portraying the second model. The experimenter effect was controlled for in the statistical analysis.

The Task: Beer War Game

The Beer War Game is a simulation of a beer market comprising 10 cities and numerous competing beer manufacturers. The primary objective of the game is to capture the greatest market share, by expanding supply and pushing other competitors out of the market. Each player starts the game with \$20,000 in funds and 1,000 L of beer. Participants play against simulated competitors.

Throughout the game they have access to information about demand and sales of various makes of beer in each of the cities, production costs, local wage levels, their own and competitors' market shares, product quality, and product price. This information can be used to calculate supply and demand of their beer and to determine the next move to be executed. A map shows the location of each city, transport routes between them, and the various actions the player can execute. Players have an unlimited number of turns in the time allotted, and they perform various actions throughout the game. These include constructing a brewery, extending a brewery, transporting beer to a city, transferring money, buying a new brand, and changing beer prices at each location. Each move requires an investment of the players' funds. At the end of each turn, a message is displayed showing sales and the market share captured. The players, then, decide on their next moves and give instructions on how to carry out their decisions.

Dependent Variable: Performance

The performance measure was determined by the cumulative quantity of market share captured during the 15 min of game play. Market share is the proportion of beer sold by the player (in liters) against the total requests for beer in the market.

Measure of Self-Efficacy

The measure of self-efficacy for performing the Beer War Game was based on self-efficacy questionnaires that were used, for example, by Bandura and Cervone (1983) and by Locke, Fredrick, Lee, and Bobko (1984). Participants were first required to answer a simple "yes" or "no" on whether they would or would not be able to capture each of a series of market shares ranging from 1% to 7% (seven items). For each of the seven performance levels, participants rated the strength of their ability to attain them on a 10-point scale, ranging from 1 (*high uncertainty*) to 10 (*complete certitude*). The final calculation of self-efficacy was made by adding together the confidence values. For example, if the participant answered in the affirmative on capturing a market share of 1%, 2%, and 3% with levels of confidence of 10, 6, and 4, respectively, the total self-efficacy value was 20.

Procedure

The experimental session was divided into three phases:

First phase. Participants arrived individually at the experimental laboratory. At the beginning of the experimental session, the researcher read out the following statement:

You are going to take part in an economic simulation game where you are a player competing in the market for the production and sale of beer in a country with 10 cities. You will receive written instructions, which will remain with you for the duration of the game, and a pencil and paper for making notes. You will be given eight minutes to review the instructions before the start of the game. After reading the instructions there will be a short demonstration of the interface of the game before the game starts. The duration of the game is 15 minutes. In this time you are to capture the biggest market share possible, which is expressed by the quantity of beer sales (in liters) over the total demand in the country. You will be given two minutes notice before the end of the game. You are asked to think out aloud during the game, and to share with the experimenter your thoughts and reasons for the

actions you take and the moves you make. You are also asked to read out the market share that you capture after each move.

After these instructions, a demonstration of the game was given, in which the players were told the city they were to start in and were given information relating to the city and amount of beer, how to transport beer, how to execute the next move and view market share captured, and what was meant by their own and competitors' sales. Before starting the game, participants filled out a self-efficacy questionnaire on their confidence in their ability to capture the various amounts of their market share.

During the game the experimenter recorded all the participants' moves and outcomes. The requirement that the participants think out aloud during the game was aimed to help the instructor follow the learner's actions during the AER and in later reruns. After 15 min the game was stopped and the total market share captured recorded. The experimenter provided this particular information to the participants.

Second phase. During this stage participants were randomly assigned to one of three conditions: a personal AER of about 10 min, a 10-min filmed AER, or a break of 10 min. In the two AER experimental conditions, participants were told that the goal of the AER was to help them to learn from their experience in order to improve their future performance.

(a) Personal AER. Under this condition the experimenter guided the participants through a personal review focusing on both the failed and successful moves, initiated by them; the logic motivating their moves; and the resulting consequences and conclusions. Additional questions addressed alternative courses of actions, moves not used in the first trial, and possible ways of achieving the goal of the game.

(b) Filmed AER. Under this condition the participants watched a video recording of an AER in which the same experimenter debriefs a male model after playing the same game under the same circumstances. In the video, the experimenter guides the model through a personal review in the same format as the one given to participants in the first condition, with the intention of improving their concept of the game and their future performance.

(c) Control group. Participants in the control group were simply told they would be granted another opportunity to improve their performance. Instead of receiving an AER, they were given a 10-min break.

Third phase. After the review or break, participants were asked to fill out the self-efficacy questionnaire once again. They then started the second trial of the game, the only difference being that they began in a different city. Participants were again given 15 min to play and were asked to think out aloud. After the game ended, the total market share captured was again recorded. The experimental session ended with a short debriefing of the study. The timeline of the study is displayed in Figure 1.

Results

Tables 1 and 2 display the means, standard deviations, and intercorrelations of the dependent variables for the personal AER, the filmed AER, and the control group. To test our five hypotheses, were performed hierarchical ordinary least squares regression analyses on the data.

The Effect of AERs on Performance

To examine the effect of the AER methods on task performance, we regressed PERF2 (performance in the second trial, after the AER manipulation) on two orthogonal contrasts: One, labeled *personal versus filmed AER*, aimed at examining whether there is a difference in performance improvement between personal and filmed AERs. The other, labeled *AER versus control*, aimed at capturing the difference in performance improvement between the two types of AERs (personal and filmed) and the control group. In the first contrast, the personal AER was weighted as +1 and the filmed AER was weighted as -1; in the second contrast, the personal and filmed AER were weighted as +1/2 and the control group was weighted as -1. Four control variables were included in our regression model: PERF1 (performance in the first task, before the AER manipulation), SE1 (self-efficacy before PERF1 and the experimental manipulation), sex, and instructor. The results of these regressions are presented in Table 3. Note that, since PERF1 is controlled for, the coefficients of the independent variables in these regressions represent their net effect on PERF2, controlling for PERF1. In other words, we tested the effect of the independent variables on the improvement in performance between the first and the second task.

Step 1 in Table 3 presents the effects of the control variables. SE1 did not have a significant effect on PERF2 beyond the effects of PERF1 and sex. In contrast and not surprisingly, PERF1 had a strong effect on PERF2, namely—when SE1, sex, and the experimenter are held constant, the higher the performance obtained in the first trial, the higher the performance achieved in the second trial. Finally, a sex effect was found. By and large, the performance of the male participants improved more than that of the women. No experimenter effect was found, suggesting that our results are not sensitive to some idiosyncratic influences of the experimenter.

More important are the results of Step 2, which showed a significant AER versus control contrast. Thus, consistent with Hypothesis 1, those participants who participated in an AER, whether personal or filmed, improved their performance significantly more than those who did not participate in a review. In addition, as expected, there was no significant difference in performance improvement between personal and filmed AER, suggesting that the two are similar in their effect on performance.

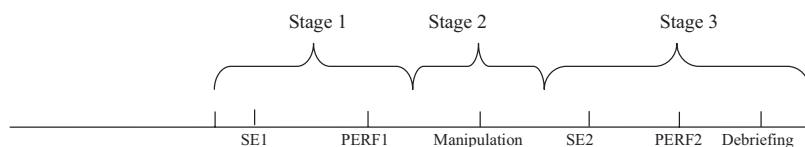


Figure 1. Timeline of the study. PERF1 = performance in the first trial; SE1 = initial self-efficacy; SE2 = self-efficacy after manipulation; PERF2 = performance in the second trial.

Table 1
Means, Standard Deviations, and Intercorrelations of All Measures

Variable	<i>M</i>	<i>SD</i>	1	2	3	4
1. PERF1	1.94	1.55	—			
2. PERF2	4.63	3.45	.63**	—		
3. SE1	27.02	14.84	.74**	.53**	—	
4. SE2	31.38	15.68	.66**	.59**	.92**	—

Note. *N* = 112. PERF1 = performance in the first trial; PERF2 = performance in the second trial; SE1 = initial self-efficacy; SE2 = self-efficacy after manipulation.

** *p* < .01.

The Mediating Role of Self-Efficacy

To demonstrate the mediating role of self-efficacy on the relationship between AER and performance, we needed the following four conditions: (a) the independent variable (AER) predicts the dependent variable (performance improvement); (b) the independent variable (AER) predicts the proposed mediator (self-efficacy); (c) the proposed mediator (self-efficacy) significantly predicts the dependent variable (performance improvement); and (d) the contribution of the independent variable (AER) drops substantially for partial mediation and becomes insignificant for full mediation when entered into the model together with the mediator—self-efficacy (Baron & Kenny, 1986). Our findings demonstrate that all four conditions were met:

The effect of AER on performance improvement. As already shown above and in line with Baron and Kenny’s (1986) first condition and Hypothesis 1, the independent variable (AER) significantly predicts the dependent variable (performance improvement).

The effect of AERs on self-efficacy improvement. To examine the effect of AERs on self-efficacy improvement, we regressed SE2 (self-efficacy after the experimental manipulation) on SE1, two additional controls (sex and experimenter), and our two orthogonal contrasts (personal vs. filmed AER, and AER vs. control). The results of these regression models are presented in Table 4. Note that, since SE1 is controlled for, the coefficients of the independent variables in these regressions represent their net effect on SE2 controlling for SE1, or, in other words, their effect

Table 2
Means and Standard Deviations of Performance and Self Efficacy Scores in the Three Experimental Conditions

Variable	Type of AER					
	Personal		Filmed		No AER	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
PERF1	2.16	1.76	2.12	1.61	1.54	1.21
PERF2	5.79	4.04	4.98	3.28	3.19	2.45
SE1	26.72	15.45	30.07	16.29	24.26	12.35
SE2	31.97	16.64	36.23	16.65	25.97	11.99

Note. AER = after-event review; PERF1 = performance in the first trial; PERF2 = performance in the second trial; SE1 = initial self-efficacy; SE2 = self-efficacy after manipulation.

Table 3
Regression Coefficients of PERF2 on Type of AER and Control Variables

Step and variable	β	<i>R</i> ²	ΔR^2
1			
Experimenter	.08	.45**	
Sex	-.27**		
PERF1	.53**		
SE1	.06		
2		.50**	.05**
Experimenter	.09		
Sex	-.22**		
PERF1	.47**		
SE1	.08		
Personal AER vs. filmed AER vs. control	.10		
AER vs. control	.19**		
3		.53**	.03**
Experimenter	.06		
Sex	-.17*		
PERF1	.50**		
SE1	-.37		
Personal AER vs. filmed AER vs. control	.12		
AER vs. control	.13		
SE2	.50**		

Note. *N* = 112. AER = after-event review; PERF1 = performance in the first trial; PERF2 = performance in the second trial; SE1 = initial self-efficacy; SE2 = self-efficacy after manipulation.

* *p* < .05. ** *p* < .01.

on the improvement in self-efficacy between the first and the second task.

Step 1 in Table 4 presents the effects of the control variables. Not surprisingly, SE1 had a strong effect on SE2. In addition, similar to the results regarding PERF2, the model documented a sex effect—by and large, men improved their self-efficacy more than women. Again, no experimenter effect was found. The second regression model (Step 2) included, in addition to the control variables, the two orthogonal contrasts, personal versus filmed AER and AER versus control group.

Step 2 in Table 4 yielded a significant effect of the AER versus control variable, indicating that those who participated in an AER, whether personal or filmed, increased their self-efficacy signifi-

Table 4
Regression Coefficients of SE2 on Type of AER and Control Variables

Step and variable	β	<i>R</i> ²	ΔR^2
1			
Sex	-.11**	.86**	
Experimenter	.05		
SE1	.88**		
2		.88**	.02**
Sex	-.10**		
Experimenter	.05		
SE1	.86**		
Personal vs. filmed AER	-.03		
AER vs. control	.13**		

Note. *N* = 112. AER = after-event review; SE1 = initial self-efficacy; SE2 = self-efficacy after manipulation.

** *p* < .01.

cantly more than those who did not participate in an AER. This finding is consistent with Hypothesis 2. In addition, there was no significant personal versus filmed AER contrast, suggesting that in our study, the effect of the two types of AER on change in self-efficacy is rather similar.

The effect of self-efficacy on performance improvement. In order to test the third condition, that improvement in self-efficacy is positively related to performance improvement, we computed a third regression analysis (see Table 5). In accord with Hypothesis 3, the results show that the third condition was also met, namely the mediator (self-efficacy) was significantly related to the dependent variable (performance).

Finally, it should be noted that the effects of SE1 and SE2 on performance improvement are diametrically opposite. Whereas the effect of SE1 is significantly negative, the effect of SE2 is significantly positive. These results are consistent with Hypothesis 4. They clearly suggest that these are changes in self-efficacy that affect changes in performance.

The mediating effect of self-efficacy. Consistent with Hypothesis 4, the findings displayed in Table 3 (Step 3) indicate that self-efficacy fully mediates the effect of AER on performance. When both variables, self-efficacy and the AER versus control contrast, enter the regression model, the effect of self-efficacy remains significant, whereas the effect of AER (AER vs. control) turns out to be nonsignificant.

The Moderating Role of Self-Efficacy

To test the moderating role of self-efficacy on performance improvement (Hypothesis 5), we used SE1 as the moderator. (Note that in examining the mediating effect of self-efficacy we used SE2, rather than SE1. Note also that because SE1 was measured before the manipulation, it was orthogonal to the AER manipulation.) Two dummy variables examined the effect of AER on performance. The first examined the difference in performance improvement between the personal AER and the control—personal AER was coded as 1, and filmed AER and control were coded as 0. The second examined the difference in performance improvement between the filmed AER and the control—filmed

AER was coded as 1, and personal AER and control were coded as 0. The dummies we used here were different from the dummies used in the previous analyses because Hypothesis 5 concerns differences between the two experimental groups rather than differences between these two groups and the control group. It should be noted that in the dummy coding method, the coefficient of the first dummy variable directly reflects the difference between the performance of the personal AER group (assigned the Dummy Code 1) and the control group when all the other variables are held constant. Similarly, the coefficient of the second dummy variable directly reflects the difference between the performance of the filmed AER group (assigned the Dummy Code 1) and the control group when all the other regressors are held constant.

Again, PERF1 was used (in addition to sex and experimenter) as a control, allowing the coefficients of the independent variables to represent their net effect on PERF2 controlling for PERF1, or, in other words, their effect on the improvement in performance.

The results of the regression models relevant to Hypothesis 5 are presented in Table 6. Most relevant to the examination of this hypothesis are the interaction effects in Step 4 in this table. Consistent with Hypothesis 5, the interaction between personal AER and SE1 was significant, whereas the interaction between filmed AER and SE1 was not. These results suggest that performance improvement in the personal AER condition, but not in the filmed AER condition, occurred primarily among those with high initial self-efficacy (SE1) and that it occurred primarily among participants with high initial self-efficacy.

Finally, two other things are worth noting in the results of Table 6. First, whereas the effect of personal AER on performance improvement was significant, the effect of filmed AER, though positive, did not reach significance. This suggests a tendency of personal AER to be somewhat more effective than filmed AER. Second, the effect of SE1 on performance improvement was not significant, suggesting that by and large initial self-efficacy was not associated with performance improvement in our study.

Discussion

Supporting previous findings (Darling, Parry, & Moore, 2005; Ellis & Davidi, 2005; Ellis et al., 2006; Ron et al., 2006), our results demonstrate the effectiveness of AERs in improving performance. Trainees, who participated in an AER, whether personal or filmed, improved their performance significantly more than those who did not participate in a review. Furthermore, there was no significant difference in performance improvement between the personal and the filmed AER, which suggests that the two are quite similar in their effect. However, this particular result is not conclusive because we also found that the differences in performance improvement between the personal AER group and the control group were somewhat greater than those found in the filmed AER group. Such minor differences between the two methods might occur if the filmed AER does not cover all the actions that are relevant to the various observers. In the present study, we selected the best filmed AER out of a collection that we had. We did not have the ideal or the ultimate AER format that covers all potential problems of task performance. Had our participants been able to observe the full range of actions needed to successfully complete the task, they could have been able to improve their performance more substantially.

Table 5
Regression Coefficients of PERF2 on SE2 and Control Variables

Step and variable	β	R^2	ΔR^2
1			
Experimenter	.08	.45**	
Sex	-.27**		
PERF1	.53**		
SE1	.06		
2			
Experimenter	.05	.50**	.05**
Sex	-.16*		
PERF1	.55**		
SE1	-.48*		
SE2	.60**		

Note. $N = 112$. PERF1 = performance in the first trial; PERF2 = performance in the second trial; SE1 = initial self-efficacy; SE2 = self-efficacy after manipulation.

* $p < .05$. ** $p < .01$.

Table 6
Regression Coefficients of PERF2 on Type of AER, SE1, Type of AER \times SE1 Interaction, and Control Variables

Step and variable	β	R^2	ΔR^2
1			
Experimenter	.08	.452**	
Sex	-.27**		
PERF1	-.53**		
SE1	.06		
2			
Experimenter	.09	.50**	.047**
Sex	-.22**		
PERF1	.47**		
SE1	.08		
Personal AER vs. control	.25**		
Filmed AER vs. control	.13		
3			
Experimenter	.13	.54**	.04**
Sex	-.20**		
PERF1	.45**		
SE1	.08		
Personal AER vs. control	.28**		
Filmed AER vs. control	.18*		
SE1 \times Personal AER vs. Control	.22*		
SE1 \times Filmed AER vs. Control	.02		

Note. $N = 112$. AER = after-event reviews; PERF1 = performance in the first trial; PERF2 = performance in the second trial; SE1 = initial self-efficacy.

* $p < .05$. ** $p < .01$.

Furthermore, in the present study we did not try to lay particular emphasis on any target behavior of the model, nor did we try to instruct our participants to pay attention to critical elements in the model's behavior, such as the way the model gathers information during AER, or whether the model focuses on negative and/or positive actions. Salience of targeted behaviors has been proven to be a critical factor in training effectiveness (Mann & Decker, 1984; Thelen & Rennie, 1972). Jentsch, Bowers, and Salas (2001) demonstrated that different characteristics of the model were differently recognized by learners. For example, negative behaviors and behaviors whose consequences were shown were better recognized than positive behavior and behaviors whose consequences were not shown. In sum, considering these factors in future research might act to diminish the minor differences between personal and filmed AERs that were found in the present study.

The Moderating and Mediating Roles of Self-Efficacy

The fact that in the present study we used two repeated measures of self-efficacy enabled us to test its two roles in the relations between AERs and performance. For the moderating role, we used self-efficacy as measured before the AER manipulation (which was assumed to be independent of the AER influence), and for the mediating role we used self-efficacy as measured after the AER manipulation (holding the first measure of self-efficacy constant).

Initial self-efficacy was found to be notable as a moderator of the AER influence on performance improvement. It was found that the stronger the self-efficacy, the stronger the effect of the AER on performance improvement. Those who perceived their ability in

the relevant domain as high might have learned more from their experience and might have ultimately improved their performance. As expected, this effect was found only in the personal AER condition. Specifically, in a personal AER session, where trainees are required to understand what they have done right or wrong and to work out the reasons for their behavior (Ellis et al., 2006), those who can count on their own judgment are more likely to do better than those who cannot. High self-efficacy participants are probably more likely to perceive the personal review as a challenging source of instruction and therefore make more of an effort to learn from this condition (e.g., Salmon, 1984). In contrast, in the filmed AER, trainees with high self-efficacy are more likely to doubt the credibility and trustworthiness of the filmed model and diminish the value of the performance information originating from the filmed review.

We also found that self-efficacy mediated the relations between the AER and performance improvement. That is, when self-efficacy is held constant, the effect of personal and filmed AERs disappears. This reflects the important cognitive role that self-efficacy has in the AER process—namely to help in data interpretation. At the end of the review process, learners are supposed to know not only what to do next time they undergo a similar experience, but also to understand what they have done wrong or right and especially why they did it. In other words, they are supposed to have richer and more valid cognitive models of the reasons for their failed or successful performance (Ellis & Davidi, 2005; Ellis et al., 2006). This kind of knowledge increases their feeling of mastery of their own behaviors and, as a result, their self-efficacy is increased. It seems that the combination of the three AER functions, self-explanation, data verification, and feedback, acts to boost self-efficacy by fostering opportunities to increase learners' sense of mastery in the area of the relevant task. These feelings are associated with their self-efficacy and ultimately with their future performance.

Implications and Limitation

The study has important implications for training in organizations. In many organizations, there are employees who are doing similar tasks or need to learn from the same events or the same action scenarios. Therefore, given the similar effect of personal and filmed AERs on performance improvement, soldiers in a ground navigation course, for example, can improve their performance by watching AERs of other soldiers who participated in the same course and were trained in the same topographical area. Members of a fire brigade can learn from events that their colleagues have experienced, simply by watching their AERs. This mode of learning may save time and money for the organization. In general, high reliability organizations (Weick, Sutcliffe, & Obstfeld, 1999) that do not have many opportunities to learn from incidents may benefit from using filmed AERs. In this regard, filmed reviews may offer a cost-effective, technology-based, and easy-to-use tool to provide training throughout the organization.

To the best of our knowledge, this is the first study to investigate the effect of filmed AER on task performance. More studies are needed to reconstruct the filmed AER in such a way that it will be equally as effective as a personal AER. For example, further research is needed to test the effect of task complexity on AER effectiveness and to help us design the AER in such a way that the

two methods will be equally effective. In applied terms, organizations should be aware of the difficulties in designing a filmed AER that covers all of the relevant aspects of the task and also highlights all the potential task problems and task difficulties as well. It seems the more complex or unstructured the tasks are, the more difficult it is to design an optimal filmed AER. Furthermore, since learners vary in their capabilities, different filmed AERs might be appropriate for different learners. This issue is also relevant to personal AERs, but in these types of AERs instructors have more flexibility in modifying the AER, according to the trainees' needs. All of these issues are still open to further research.

The second limitation of our study is that we used only one criterion for testing the relative effectiveness of the two AER methods. Another criterion could be, for example, learner's satisfaction. One may argue that learners under the personal AER condition will be more satisfied because they can ascribe the learning to their own efforts. This question should also be tested in the future.

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