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How gender influences the effect of age on self-efficacy and training success

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Previous research has shown age and gender differences in training, but the results have been mixed and their combined influence is only rarely examined. We fill those gaps by analysing age and gender effects on self-efficacy and training success. Study participants were trainees in an e-learning time- and self-management behaviour modelling training programme. We measured self-efficacy before and after training and time- and self-management behaviour before and 6 weeks after training. We expected the differences between pre- and post-test results to indicate self-efficacy development and we expected differences between pre- and follow-up tests to indicate training success. A hierarchical regression analysis showed that age and gender interacted in both self-efficacy development and training success. A structural equation model confirmed that men and women showed different relationships among age, self-efficacy and training success. Older women showed more positive development compared with older men. We conclude that age and gender should both be considered in future design and training evaluations.

Introduction

Employees of all ages and professions are challenged by rapidly changing environments that they must master through continuous learning and training if they and their organizations are to stay competitive (Molloy & Noe, 2010). In recent years,

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demographic changes have created new challenges in training design. As the average workforce becomes increasingly older, the target groups for vocational training have also become more mixed in terms of age. In order to match the training design with the learners' needs and to provide an efficient training to all, organizations must further understand the influence of age in training. As the literature reports different findings for the relationship of age and training outcomes, we included training success as one dependent variable in our analysis. For example, studies have found a positive relationship of age with training outcomes and job performance (Beier & Ackerman, 2005; Colquitt *et al*., 2000; Waldman & Avolio, 1986), whereas others have found older learners to progress more slowly and perform more poorly than younger learners (Kubeck *et al*., 1996). The heterogeneous findings suggest that moderating factors may further influence the relationship between age and training success.

One construct that has gained broad empirical support as a key determinant of successful training and performance is self-efficacy (Bandura, 1986; Sitzmann *et al*., 2008; Sonntag & Stegmaier, 2007; Stajkovic & Luthans, 1998). It was conceptualized within Social Learning theory and refers to an individual's judgment of his or her own capability to successfully perform a task (Bandura, 1977a). Some researchers have found self-efficacy to be negatively related to age (e.g. Chu, 2010; Maurer, 2001; Stine-Morrow *et al*., 2006), but contradictory findings also exist and factors that moderate the relationship between age and self-efficacy have been discussed (Artistico *et al*., 2003; Schulz & Stamov Roßnagel, 2010). Therefore, in this study, we consider self-efficacy as another dependent variable.

Gender is a potential moderator of the relation between age and training success and also between age and self efficacy. Some studies relating gender to training success found better results for men, others found better results for women (Gully & Chen, 2010); still, others found varying gender differences according to analysed dimensions but no 'overall pattern' (Severiens & ten Dam, 1998).

Although men and women may show the same performance levels, they may estimate their capabilities differently (Bandura, 1997). With regard to self-efficacy, many studies have shown that this is lower for women (Beyer, 1990; Sieverding & Koch, 2009; West *et al*., 2002), but some evidence supports that women have higher self-efficacy (Tsai & Lin, 2004). Furthermore, men and women may differ in their development of self-efficacy (Artistico *et al*., 2003; Chou, 2001; Chyung, 2007). Those mixed findings indicate that age and gender can affect self-efficacy and training outcomes, but the relationships may be highly complex.

Our study addresses some new aspects of training research: previous studies primarily used either self-efficacy or training success as a dependent variable, whereas we consider both. Furthermore, earlier research focused either on age or on gender, but we study their combined influence. Moreover, we use longitudinal data to analyse whether the development of self-efficacy in training is related to training success. By testing an interaction of age × gender on self-efficacy development, we expect to contribute to an ongoing discussion in training research centred around different directions of self-efficacy development in training, suggesting moderating effects (Bandura & Locke, 2003; Vancouver & Kendall, 2006; Vancouver *et al*., 2008).

The aim of this study is to analyse whether age relates to self-efficacy and training success, and whether gender affects the relationships. We implemented a time- and self-management behaviour-modelling training programme in an e-learning format and collected self-efficacy and training success data at two time points.

Self-efficacy in training

Self-efficacy is known as an individual's perceived capability to perform a specific task or activity (Bandura, 1977a). As Bandura argued, in order to successfully complete a task, the individual must not only possess the required skills, but he or she must also believe in his or her own capability. Individuals with equal skills could perform at different levels, depending on whether their self-efficacy enhances or impairs their efforts. Although global measures exist, self-efficacy is generally believed to be task specific and

has improved predictability if measured within certain contexts (Bandura, 1977a). For example, self-efficacy for development predicted training participation in organizations (Maurer *et al*., 2003), and training-specific self-efficacy predicted training effectiveness (Tziner *et al*., 2007). Self-efficacy was also found to be positively related to task effort, persistence and achievement (Gist & Mitchell, 1992); to job performance (Stajkovic & Luthans, 1998); and to training transfer (Colquitt *et al*., 2000; Molter *et al*., 2013).

Previous research has underlined the state-like, malleable character of self-efficacy in training, and several studies have reported positive self-efficacy development during training (Bandura & Jourden, 1991; Gist *et al*., 1988; Wood & Bandura, 1989). Bandura (1977b) argued that in behaviour modelling training (BMT), self-efficacy is enhanced by vicarious experience and own mastery. As we ran a BMT, self-efficacy enhancing mechanisms were likely, and an overall positive development of self-efficacy could be expected in training. Different methods for self-efficacy development have been suggested (Bandura, 1986). If learners underestimate their capabilities, positive training experiences should enhance their self-efficacy. Conversely, if learners overestimate their capabilities and the task is more demanding than they previously thought, they may lower their capability judgments and a negative self-efficacy development should occur. Gist and Mitchell (1992) asserted that the accurate judgment of an individual regarding his or her task success depends on the knowledge of the task. When facing a new task, people are more likely to judge their capabilities inaccurately. Gaining more information concerning the requirements and their own performance should improve their judgment accuracy. Both immediate and delayed self-efficacy have been found to be significantly related to training outcomes, but delayed self-efficacy was the better predictor (Lee & Klein, 2002; Yi & Davis, 2003). Applying these findings to our research, we hypothesize that capability beliefs will be adjusted in training, with self-efficacy measured after training better reflecting actual capabilities. Thus, self-efficacy after training should more accurately predict training success. Summarizing our expectations, we postulate:

H1a: Self-efficacy before and after training will be positively related to training success.

H1b: Self-efficacy will increase from pre- to post-training.

H1c: Self-efficacy after training will be more strongly related to training success than will be self-efficacy before training.

Age and self-efficacy

Older trainees are often perceived as being less confident in their learning abilities. This is hardly surprising, considering that in training literature they are frequently reported to be slower, less motivated and less effective than younger trainees. Age-related self-efficacy differences have been shown in various learning contexts. For example, compared with younger trainees, older trainees showed reduced 'self-efficacy for development and training' (Maurer, 2001) and 'self-efficacy for learning' (Touron & Hertzog, 2004). Other studies found more complex relationships. For example, older trainees had lower self-efficacy only if they perceived the context as a 'younger learners' domain,' but higher self-efficacy if they perceived the context as neutral (Artistico *et al*., 2003). Schulz and Stamov Roßnagel (2010) found that self-efficacy mediated learning competence and training outcomes, and both were moderated by the age of the learner.

A positive development of self-efficacy has frequently been shown in BMT (Bandura, 1986; Gist *et al*., 1988; Wood & Bandura, 1989), which as a training method, is very successful for older learners (Callahan *et al*., 2003). The e-learning programme was designed by also carefully considering older trainees' needs which should thus enable them to learn successfully with the programme. Therefore, an overall positive development of self-efficacy during training is expected. Furthermore, if older learners start with lower self-efficacy and perceive the training to be easily manageable, this should

enhance their self-efficacy, thereby resulting in more positive self-efficacy development in the older learner group. Given that older and younger learners possess similar levels of capability, self-efficacy adjustment processes should reduce the effect of age on self-efficacy throughout the training. Therefore, we hypothesize:

H2a: Self-efficacy before training will be lower in older learners than in younger learners.

H2b: Age will be more strongly related to self-efficacy before than to self-efficacy after training.

H2c: Development of self-efficacy will be more positive in older learners than in younger learners.

Interaction of age and gender on self-efficacy

Literature also reports gender differences for self-efficacy in classical training and in e-learning. Women showed lower self-efficacy with regard to mathematical tasks (Bandura, 1997), spatial orientation (West *et al*., 2002) or knowledge (Beyer, 1990). However, Tsai and Lin (2004) found in a student sample a higher self-efficacy in female than in male learners, and some research (Chou, 2001; Chyung, 2007) has shown larger development of self-efficacy in training for women compared with men. Sieverding and Koch (2009) suggested that women underestimate their abilities to a larger degree than men do. A reasonable explanation as to why some studies have found gender differences whereas others have not has been provided by Beyer (1990) who observed that women expected their own performance to be lower than men did, but only if the individual classified the training objective as a men's domain; no gender differences occurred when the objective was not classified as gender specific. E-learning is often considered a masculine domain in training, which could result in lower self-efficacy before training or gender differences in self-efficacy development. Overall, the findings concerning gender and self-efficacy also appear mixed. Thus, an effect of gender on self-efficacy was exploratorily analysed.

Only limited research has considered a combined age × gender influence on self-efficacy in training (Chu, 2010; Ruth, 1996; West *et al*., 2002). Longitudinal studies have found an age × gender interaction for self-efficacy development (Caprara & Steca, 2007; Caprara *et al*., 2003), demonstrating a decrease in men, but an increase in women of advanced age. Chyung (2007) showed single and combined influences of age and gender on development of self-efficacy, as well as on learning results, and an improved self-efficacy development in training was related to greater progress with regard to academic results in the study. Caprara *et al*. (2003), Chu (2010) and also Ruth (1996) reported similar patterns of self-efficacy in older, as well as in female learners, advancing the explanation of an equally disadvantageous learning environment for both groups.

Applied to our research, older learners might be less familiar with training in general and with e-learning in particular, which could manifest in lower self-efficacy before training. Traditionally, women are thought to be less familiar with computers, but this relationship might have changed now that both genders are using computers equally. This could be particularly valid for younger learners in western societies. However, if older women are less familiar with computers, age and gender might place them in particularly disadvantageous learning positions. Therefore, older female learners, in particular, are more likely to underestimate their ability, so that age and gender effects on self-efficacy could amplify one another. Considering this in the context of our own study, we hypothesize that if the actual ability to succeed in a task is similar in men and women, regardless of age, self-efficacy development in training should be more positive in older than in younger learners and should be more positive in women than in men. The suggestion of a moderating age × gender interaction on self-efficacy development is in line with the notion of Gist and Mitchell (1992) who stated that self-efficacy development could be more positive for those who have underestimated their abilities before training. We postulate:

H3: Gender will moderate the relationship between age and self-efficacy development. The relationship will be more positive for women than for men.

Age and training success

The relation between age and training success seemed to be not entirely clear. Existing literature suggests that under certain circumstances, age could be either positively or negatively related to training success. For example, Waldman and Avolio (1986) found that an increasing age was associated with improved job performance, but with training outcomes Kubeck *et al*. (1996) concluded a negative relationship. Hertzog *et al*. (2008) largely explained the negative effect of age by changes in cognitive functions, such as reduced concentration, lower speed or decreased memory capacity.

There is some evidence that the relationship between age and training success differs according to the type of training success measure (Warr *et al*., 1999). For example, Colquitt *et al*. (2000) reported age to be negatively related to performance but positively related to skill acquisition and to training transfer. BMT is not only a highly effective training method that particularly enhances training transfer (Burke & Hutchins, 2007; Taylor *et al*., 2005), but it is also highly effective for older adults (Callahan *et al*., 2003). As we used a BMT in our study, a positive relationship between age and our transfer-related training success measure seems likely. We postulate:

H4: Age will be positively related to training success.

Interaction of age and gender on training success

Although researcher can easily access participants' ages and genders, few studies have analysed their combined influence on learning outcomes. With regard to age, some studies report negative relationships, whereas others report positive relationships, e.g. with training success and job performance (Kubeck *et al*., 1996; Waldman & Avolio, 1986). With regard to gender, differences in training have also been found for learning orientation (Severiens & ten Dam, 1998), learning styles (Lau & Yuen, 2009) or technology acceptance (Ong & Lai, 2006). There is some evidence supporting higher course grades in women (Dwyer & Johnson, 1997), but also evidence supporting better test results in men (Ackerman *et al*., 2001). Given these inconsistent findings, we also analyse the role of gender and training success in our study.

Regarding an interaction between age and gender, Williamson (2000) reported a higher learning orientation and greater progress in older women compared with older men. This points in the same direction as the findings of Caprara *et al*. (2003) that with increasing age, a more positive development in various personality variables existed in women, but not in men. Considering those few findings, we expect to observe greater training success for older women compared with older men, but a difference might not be observed between younger men and women. We postulate:

H5: Gender will moderate the relationship between age and training success. The relationship will be more positive in women compared with men.

Method

Participants

The number of participants and their data were collected three times: right before the training (t_1), directly after the training (t_2) and 45 days after the training was completed (t_3). A total of 1101 trainees started the time- and self-management e-learning programme (t_1), and 477 participants also completed the post-test (t_2). From the 477 who completely answered the post-test, remaining 268 also answered the follow-up test, 45 days later (t_3). That is a drop-out rate of 56.7 per cent until the end of the post-test questionnaire and another 43.8 per cent between post- and follow-up test. The rate is

high but not unusual for a longer web-based training that is offered free of charge on the web (e.g. Hänggi, 2007; Patterson & McFadden, 2009).

Participants were recruited via advertisements, bulletin boards, seminar announcements and email newsletters. The mean age in the sample was 39.66 (SD = 11.67) and 56.1 per cent were women. Participants had largely completed some form of higher education (29.2 per cent high school, 52 per cent university) and had worked in various vocational areas, with a broad distribution over more than 10 fields. Of the total sample, 33.6 per cent had previously participated in time- and self-management training, and 37.5 per cent already had experience with e-learning.

Procedure

The BMT was entirely web based and all participants registered on the web or via email. They agreed to anonymous use of their data for research purposes, and were informed that the aim of the study was to assess learning habits. Technical user requirements were checked automatically and technical help was available 7 days per week by phone or via a feedback button. The programme began by welcoming the participants and explaining its functions and navigation. A pre-test and a questionnaire followed. Thereafter, participants worked with the e-learning programme, took a post-test and answered a questionnaire. In an email that was sent 45 days later, they were asked to complete a follow-up test.

The e-learning BMT, tests and questionnaires took approximately 2.5 h to complete. The programme consisted of three modules covering the time- and self-management topics 'setting goals and priorities', 'planning and scheduling tasks and work days', and 'dealing with unexpected disturbances'. All requirements of a BMT were covered: each module contained an introduction presenting key learning points, a video with critical time- and self-management situations, and several interactive elements, allowing for practice and immediate feedback. The BMT contained three videos showing a male model challenged by workday time- and self-management situations but who managed to successfully handle them over the course of time.

Measures

Age and gender

Participants stated their gender and chronological age in a pre-test questionnaire.

Self-efficacy

This indicates the individuals' capability belief of handling a specific situation or task (Bandura, 1977a). As recommended in previous research (Maurer *et al*., 2003; Tziner *et al*., 2007), domain-specific items were created, reflecting the individual's capability to learn time- and self-management skills through training. Data were collected in a pre-test and after the training (post-test). Participants answered a three item-scale on a 5-point Likert scale ('1 = strongly disagree' to '5 = strongly agree'). An item-example is 'I can improve my competencies with this time- and self-management training'. Cronbach's α was 0.76 in the pre-test and 0.63 in the post-test. We measured the development of self-efficacy by subtracting pre-test scores from post-test scores. A positive measure indicated a positive development of self-efficacy in training.

Training success

This indicates a change in self-rated time- and self-management behaviour. Data were collected before the training and 45 days after completion. Pre-test scores were subtracted from follow-up test scores, and a positive difference indicated long-term training success. Participants were asked about their behaviour in terms of using time- and self-management mechanics and strategies. Time- and self-management behaviour was measured using a 12-item, 5-point Likert scale ranging from '1 = never' to '5 = very often'. The scale contained adapted items from time- and self-management literature and from the German translation of the time management behaviour scale

(König & Kleinmann, 2006; Macan, 1994; Seiwert, 2005; Uhlig, 2005). An item example is 'I collect upcoming tasks in written form'. The scale reached a Cronbach's α of 0.86 (pretest) and 0.85 (follow-up test).

Analysis

We tested correlations between all relevant variables and tested with *t*-tests if there were changes in self-efficacy or training success in the total sample. We then ran multiple regression analyses using the statistics program SPSS 18.0 (SPSS Inc. Released 2009. PASW Statistics for Windows, Version 18.0. Chicago, IL: SPSS Inc.) to test moderating effects. Because of the complex structure of relations, we additionally developed a model including age, gender, training success, and self-efficacy before and after training, and tested them in a structural equation model (SEM) using the statistics program AMOS 18.0 (AMOS 18.0. Amos Development Corporation, Chicago, IL: SPSS Inc.).

Results

The means, standard deviations and intercorrelations of the study variables in the total sample are presented on the left of Table 1. Correlations for men are displayed in the lower left corner and for women in the upper right corner. The intercorrelations in Table 1 show that for women, age was significantly related to self-efficacy before training, after training and training success, but not to the development of self-efficacy, whereas for men the pattern was different. Furthermore, development of self-efficacy and training success were more strongly related in women ($r = 0.201$, $p < 0.001$), compared with men ($r = 0.153$, not significant [ns]). Overall, the pattern differed substantially between men and women, which supports our initial notion of including gender in the analysis.

A positive relationship between self-efficacy before training, after training and training success was expected in H1a, but this was only partially confirmed. Only self-efficacy after training was significantly related to training success ($r = 0.121$, $p > 0.05$). In H1b, we expected to find an overall positive development of self-efficacy from pre-training (t_1) to post-training (t_2). For the total sample, a *t*-test comparison of mean scores showed a small positive but not significant development of self-efficacy ($t = 0.589$, ns, $p = 0.556$). Therefore, H1b was not supported. As expected in H1c, the findings showed that self-efficacy before and after training was differently related to training success, with a stronger relationship between self-efficacy after training and training success ($r = 0.248$, $p = 0.01$) compared with self-efficacy before training and training success ($r = 0.127$, $p = 0.189$, ns).

Table 1: Means and standard deviations for the total sample, and intercorrelations between age, self-efficacy (SE) and training success separated by gender

Variable	M	SD	1	2	3	4	5
1. Age	39.33	11.97	1	0.228**	0.280**	0.044	0.299**
2. SE (t_1)	4.04	0.68	0.173	1	0.427**	–0.527**	0.122
3. SE (t_2)	4.09	0.68	–0.015	0.519**	1	0.540**	0.331**
4. SE Development (t_1/t_2)	0.02	0.70	–0.189**	–0.447**	0.528**	1	0.201**
5. Training Success (t_1/t_3)	0.43	0.59	–0.028	0.127	0.248**	0.153	1

Note: * $p < 0.05$; ** $p < 0.01$.
Correlations are displayed for *men in the lower left* and for *women in the upper right* corner.
Men n (t_1) = 544; (t_2) = 202; (t_3) = 109.
Women n (t_1) = 557; (t_2) = 275; (t_3) = 179.

In H2a, we postulated that self-efficacy before training will be lower in older learners than in younger learners, and in H2b we postulated that self-efficacy before training should be stronger related to age than self-efficacy after training (H2b). We found the expected decrease in the influence of age on self-efficacy which confirmed H2b. However, contrary to our expectations in H2a, age was already positively related to self-efficacy before training ($r = 0.187$, $p < 0.01$), and to a lesser degree, but still positively, to self-efficacy after training ($r = 0.161$, $p > 0.01$). Furthermore, the development of self-efficacy in training was not significantly related to age in the average of the total sample ($r = –0.042$, ns). Therefore, H2c was not supported when we analysed the total sample.

However, as shown in Table 2, the development of self-efficacy substantially differed in men and in women. A gender-differentiated analysis, giving more detailed information, will be provided in a subsequent section of this paper. With regard to gender, we additionally explored whether self-efficacy before training was lower in women, which could have initiated a stronger development of self-efficacy. Not accounting for age, men and women barely differed in self-efficacy before training (women M = 4.067, men M = 4.069); thus, differences in the development of self-efficacy between men and women of the total sample average were not significant ($t = 0.007$, ns).

In H3 and H5, we expected an interaction between age and gender on the development of self-efficacy, as well as on training success, tested in regression analyses. Table 2 shows the results.

We conducted separate stepwise multiple regressions with development of self-efficacy and training success as dependent variables and entered age, gender and the interaction term age × gender in three steps. The independent variables were centred and gender was dummy coded with (a) men and (b) women as reference groups. The interactions were plotted for men and women at ±1SD of age, following suggested procedures (Aiken & West, 1991).

H3 predicted an interaction of age × gender on the development of self-efficacy. When age was entered in step one, it had no significant effect on the development of

Table 2: Results of the moderated regressions with direct effects and interactions of age × gender on self-efficacy development and on training success

	SE development (pre-post training)			Training success[b] (pre-follow-up training)		
	B	SE B	β	B	SE B	β
Step 1						
Age	–0.002	0.003	–0.042	0.008	0.003	0.167**
	$\Delta R^2 = 0.000$	$\Delta F = 0.825$		$\Delta R^2 = 0.028$	$\Delta F = 7.641$**	
Step 2						
Age	–0.002	0.003	–0.044	0.008	0.003	0.166**
Gender	–0.015	0.067	–0.011	–0.005	0.074	–0.044
	$\Delta R^2 = 0.002$	$\Delta F = 0.049$		$\Delta R^2 = 0.000$	$\Delta F = 0.004$	
Step 3						
Age[a]	–0.010	0.004	–0.183*	–0.001	0.057	–0.031
Gender	–0.029	0.067	–0.021	–0.021	0.005	–0.017
Age × gender	0.013	0.005	0.175*	0.015	0.074	0.247*
	$\Delta R^2 = 0.012$	$\Delta F = 5.69$*		$\Delta R^2 = 0.023$	$\Delta F = 6.383$**	
	R^2 gesamt = 0.014			R^2 gesamt = 0.051		

Note: ** $p < 0.01$; * $p < 0.05$.

[a] Beta weights displayed for men. For women: age on SE development B = 0.003, β = 0.047; age on training success 0.013 and β = 0.287.

[b] Change of time- and self-management behaviour.

self-efficacy ($\beta = -0.042$, ns). Gender also showed no significant effect on the development of self-efficacy when it was entered in step two. However, after including the interaction term age × gender in step three, age was negatively related to the development of self-efficacy in men ($\beta = -0.183$, $p < 0.05$), but not in women ($\beta = -0.047$, ns), with gender acting as a moderator on the relationship between age and development of self-efficacy ($\beta_{men} = 0.175$, $\beta_{women} = -0.175$, $p < 0.05$). Self-efficacy changed more positively during training for older women than for older men, as shown in Figure 1. Simple slope tests revealed that the effect was significantly different from zero in men, but not in women. Thus, the data support H3.

In H4, we posited a main effect of age on training success, which we found in average of the total sample ($r = 0.167$, $p < 0.01$). In the study, older participants showed larger progress in time and self-management behaviour from pre- to follow-up test than younger participants.

In H5, we postulated that older female learners should be more successful in training than older male learners but no such difference was expected for younger male compared to younger female learners. In step one, age was entered into the regression and had a positive impact on training success ($\beta = 0.167$, $p < 0.01$). The effect remained significant when gender was included in step two. Gender itself had no significant effect on training success. After the interaction term age × gender was added in step three, neither age nor gender showed a significant direct effect any longer, but the interaction of both was significant. Gender moderated the relationship between age and training success ($\beta_{men} = 0.247$, $\beta_{women} = -0.247$, $p < 0.05$). With increasing age, training success increased for women but decreased for men, as shown in Figure 2. Simple slope tests revealed that the effect of age on training success was positive and significantly different from zero in women ($\beta = 0.287$, $p < 0.01$) but not in men ($\beta_{men} = 0.031$, ns). Thus, the data support H5, suggesting an age × gender interaction on training success. In sum, with increasing age, self-efficacy and time- and self-management behavior developed more positively in women than in men throughout the training.

We further tested if self-efficacy after training mediated the relationship between self-efficacy before training and training success. The mediation analysis (Baron & Kenny, 1986) showed that self-efficacy after training mediated the relation between self-efficacy before training and training success, which was confirmed by a Sobel test (*Sobel-z* = 4.24, $p < 0.001$).

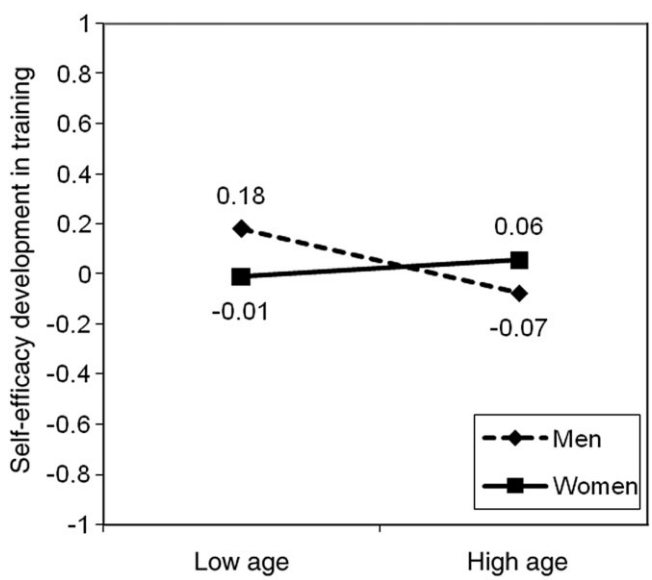

Figure 1: Interaction of age × gender on development of self-efficacy in training.

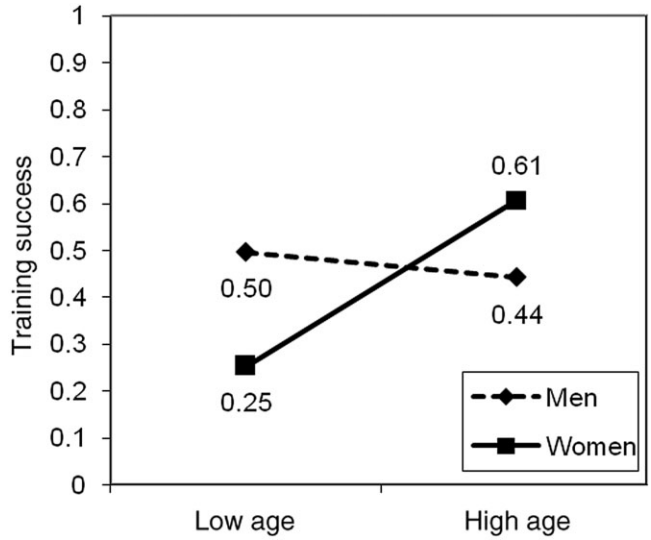

Figure 2: Interaction of age × gender on training success.
Note: Reported are standardized regression weights. M = male, F = female participants; SE = self-efficacy; SE_{pre} = self-efficacy before training; SE_{post} = self-efficacy after training.

SEM

As suggested by Keith and Frese (2005), we tested a SEM in addition to our regression analysis, as the structural equation model includes all information and all parameters are estimated simultaneously, so that the complex structure of the above-described relationships can more easily be understood. In a SEM, an overall model fit can indicate whether gender as a moderator should be integrated in the model. We conducted the procedure with a series of SEMs with the statistics program AMOS 18.0, using the full information maximum likelihood method (Enders & Bandalos, 2001). We analysed the relations of self-efficacy before and after training, training success and age for the total sample, and for men and for women in different models. For all models, we examined whether the gender of the trainees influenced the relationships by grouping the dataset into male and female participants. We tested whether the data fit into a fully constrained model (presuming no gender differences), and tested the same model with all paths being unconstrained (presuming gender differences). A better fit of the unconstrained model would suggest a better model fit with gender differentiation. Initially, we compared two theoretically plausible models. Model 1 included a relationship between age and self-efficacy before and after training, and training success, as shown in Figure 3, plus a direct path from self-efficacy before training to training success. This fully constrained model (model 1) achieved a good fit with χ^2 (315, N = 1101) = 503.639, root-mean-square error of approximation (RMSEA) = 0.023. However, the path from self-efficacy before training to training success was not significant ($\beta = -0.044$, $p = 0.552$), which was also shown in the gender differentiated model.

As we have also theoretically reasoned that self-efficacy before training should be less predictive than self-efficacy after training for training success, we excluded the 'self-efficacy before training and training success path' and tested the reduced model (model 2). Again, the model fitted the data well, with χ^2 (316, N = 1101) = 503.922, RMSEA = 0.023. A model comparison confirmed that self-efficacy after training mediated the relationship between self-efficacy before training and training success. With no impairment of the model fit, we decided on the parsimonious alternative model 2, which we then tested for men and women (all paths unconstrained). Table 3 presents the fit indices of the major three models and a chi-square comparison of models 2 and

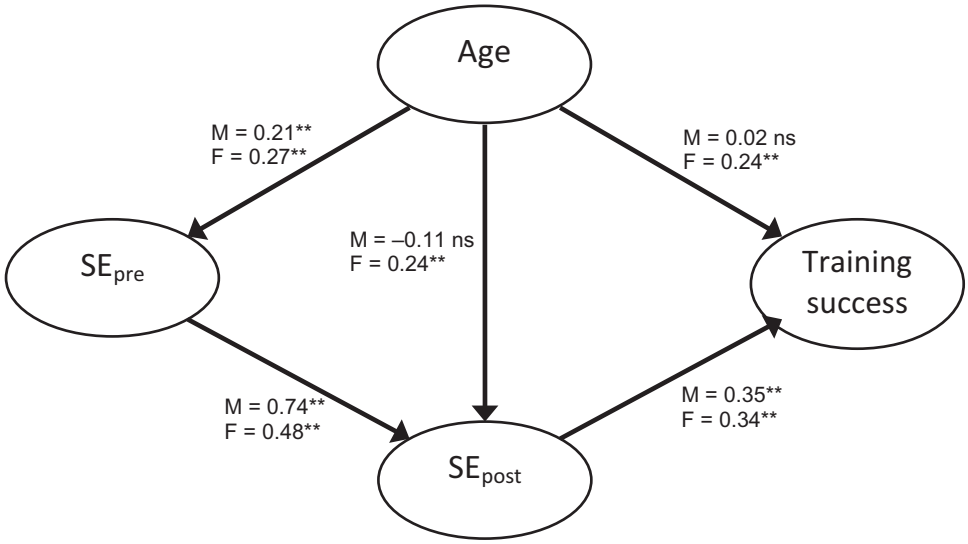

Figure 3: Structural equation model of the hypothesized relations regarding self-efficacy before and after training, training success and age, differentiated by gender.

Table 3: Fit indices and model comparison for the hypothesized and alternative models

Model	Description	χ^2	d.f.	Ratio	RMSEA	$\Delta\chi^2$	Δd.f.
Model 1	Direct path SEpre-TS included, no gender differentiation, all paths constrained	503.639	315	1.60	0.023	—	—
Model 2	Parsimonious model, direct path SEpre-TS excluded, no gender-differentiation, all paths constrained	503.922	316	1.59	0.023	—	—
Hypothesized Model 3	Parsimonious model without direct path SEpre-TS, all paths unconstrained (gender-differentiated)	482.712	311	1.55	0.022	21.21**	5

Note: ** $p < 0.01$; N = 1101.
RMSEA = root-mean-square error of approximation; SE_{pre} = self-efficacy before training; SE_{post} = self-efficacy after training; TS = training success.

3. A good model fit is indicated by a low χ^2, a χ^2/d.f. ratio lower than two, and an RMSEA < 0.05 (Schermelleh-Engel *et al*., 2003).

Testing gender as a moderator in the parsimonious model, we compared a fully constrained model (alternative model 1) with a fully unconstrained model (hypothesized model). A chi-square test showed that the model was significantly improved by unconstraining the paths $\Delta\chi^2 = 21.21$, $p < 0.001$, and a good fit was achieved with χ^2 (311, N = 1101) = 482.712, RMSEA = 0.022. Comparing all tested models, the hypothesized model 3 was the best fit for the data. This is shown with standardized regression weights for men (M) and women (F) in Figure 3.

Aiming to identify which specific path coefficients differed in men and women, we compared the fully constrained model 2 to a series of models in which only one path was allowed to vary. A significant $\Delta\chi^2$ would again indicate a significant gender difference for that relationship. By allowing the path from age to self-efficacy after training to vary (men = –0.11, ns, women = 0.24, $p < 0.001$), the model fit significantly improved ($\Delta\chi^2 = 15.24$, Δd.f. = 1, $p < 0.001$). Unconstraining the age-training success path also showed some improvement of the model, but failed to reach significance ($\Delta\chi^2 = 2.45$, Δd.f. = 1, $p = 0.11$). The results of the $\Delta\chi^2$-tests showed that allowing other paths to vary further improved the model fit a little, but for no other paths alone the difference was significant.

The detailed SEM path-analysis provided further information adding to the regression analysis. The fully gender-differentiated model 3 (Figure 3) best described the data. The relationships between age, self-efficacy before and after training, and training success are better represented in separate models for men and women. Overall, the pattern suggested not a general difference between men and women regarding the development of self-efficacy or training success, but a difference with increasing age. Older female trainees positively developed in self-efficacy during training. In contrast, older men showed a negative development of self-efficacy in training. The SEM showed that the largest difference between men and women was in the relationship between age and self-efficacy after training. Self-efficacy after training was positively related to training success, suggesting that learners who experienced a positive development of self-efficacy in training were also more likely to show a long-term positive development of time- and self-management behaviour. The findings underline the importance of a positive training experience for older female and male learners to benefit from training.

Discussion

In this study, our objectives were to analyse whether individuals of different age and gender benefit differently from training, and whether self-efficacy differs with age and gender. We expected that self-efficacy, training success and age would be related, and that men and women would differ in their self-efficacy development during training. Based on other evidence (e.g. Caprara & Steca, 2007; Williamson, 2000), we expected gender to moderate the relationships. Our results partly confirmed our hypotheses.

We hypothesized that the influence of age on self-efficacy should decrease during the training, but we failed to observe that general effect, perhaps because of the different development of self-efficacy in subgroups that could have levelled each other out. As hypothesized, self-efficacy after training predicted long-term training success more accurately than self-efficacy before training did, and self-efficacy after training served as a mediator between self-efficacy before training and training success. The results support the notion of Bandura (1977b) that self-efficacy is a key variable in training. As self-efficacy after training turned out to be the better predictor for training success, self-efficacy measured after training should gain more attention in training research and practice. This is in line with few existing suggestions in literature (Colquitt *et al*., 2000; Lee & Klein, 2002).

Contrary to our expectations, we failed to find lower self-efficacy for female learners or for older learners *in general*, perhaps because our trainees were generally well educated, which could be a sample-related effect that might have reduced the impact. As hypothesized, we found a significant interaction between age and gender on the development of self-efficacy in training. Older women started with lower self-efficacy compared with men and developed more positively in training. The findings suggest that *older female* learners, rather than female learners in general, underestimate their abilities before training. The mastery experience and positive performance feedback in training are likely to have generated positive capability adjustment processes and positive development of self-efficacy in training. This effect was theoretically reasoned by Gist and Mitchell (1992). In contrast to women, in men self-efficacy during training

developed more negatively during training. This could be explained by older men starting the training with high levels of self-efficacy but facing a need for adjustment of their capability beliefs during training. Our study supports previous findings that showed age × gender interactions on self-efficacy (Caprara *et al*., 2003). For older learners, the findings also align with findings that men tend to overestimate whereas women tend to underestimate their abilities (Sieverding & Koch, 2009). Particularly in e-learning, older female learners might still be disadvantaged and show lower self-efficacy before training and enhanced development of self-efficacy in training (e.g. Chu, 2010). We might reasonably explain that such gender differences in self-efficacy were found only in older learners because education has generally been more equal for younger generations.

Our data additionally showed that gender had a moderating effect on the relation of age and training success. Older women showed higher training success than younger women, whereas older men showed marginally lower training success than younger men. We suggest a threefold explanation. Firstly, training success could partially be driven by the development of self-efficacy. Participants who started with low self-efficacy developed more positively in training, perhaps because they held a negative self-stereotype regarding their learning capability in particular, or perhaps because they were not used to e-learning or training in general. For example, older people who had negative self-images within a learning context have been shown to have reduced self-efficacy and training success (Levy, 1996). Positive capability adjustment processes may have spread to motivation and thus enhanced training success. Although this explanation relates to individual differences, it is likely that it is not age or gender itself, but rather negative stereotypes and lack of learning opportunities for a still disadvantaged learner group might be the underlying reasons.

Different learner behaviour in older men and women might provide a second explanation for the age × gender interaction with training success. For example, more active course participation and stronger learning orientations were reported in older female learners, and more passive learning behaviour in older men (Williamson, 2000). Third, as women grow older, they have been found to develop more optimistically than men regarding several personality dimensions (Caprara *et al*., 2003). Thus, women could show more positive development in other characteristics contributing to their larger improvement in training, further strengthening their training success. More active learning orientations and optimistic development in women could explain the gender-related differences, irrespective of self-efficacy.

Practical implications

We found that older male learners started with high capability beliefs that seemed to be lowered during training, whereas women seemed to have increased their beliefs. Overestimating capabilities is often related to lower training performance (Bandura & Locke, 2003; Vancouver & Kendall, 2006). Therefore, integrating interventions that only strengthen self-efficacy appear to be unsuitable to enhance training effectiveness. We agree with Gist and Mitchell (1992) that explaining the underlying psychological mechanisms of self-efficacy and training success could be an appropriate intervention to help older men and women start training with realistic capability judgments. This could also increase the likelihood of a positive development of self-efficacy in training for men.

Maurer (2001) argued that training design should include the requirements of older learners. Based on our findings, this should be combined with a gender perspective. It seems particularly important to motivate older women to participate in training in general and in new media training in particular. Older women showed great potential; they seemed to have started with less confidence than men, but to have ultimately derived greater benefits from the training. Stories about older women achieving learning successes might be provided as positive role models for enhancing women's self-efficacy and encouraging their training participation.

Our findings also have implications for training design and evaluation. Training design should consider the positive relationship between development of self-efficacy and training success. A positive development of self-efficacy is more likely if individuals realistically judge their capabilities before training. Consequently, training designs should consider enhancing realistic capability judgments. Moreover, self-efficacy after training was a better predictor of training success than self-efficacy before training, in accordance with previous research (Lee & Klein, 2002; Sitzmann *et al*., 2008). Thus, training should focus more on positive development of self-efficacy to strengthen self-efficacy after training as a good indicator for long-term training success.

The results show that men and women differ in the development of self-efficacy and in training success with increasing age. Previous research suggested that gender differences in self-efficacy, for example regarding e-learning, are based on cohort effects: older learners might show larger differences based on more gender-pronounced socialization. Gender differences might narrow in the future (see Chyung, 2007), so actions to solve the issue may become obsolete, but as the workforce is greying currently, requirements of older learners must be addressed today and training must be customized to keep them productive.

Limitations and conclusions

As with all studies, ours has limitations. Although the sample reflected a reasonable distribution of age, gender and profession, our findings may be only partially generalized. We offered the programme free of charge on the web and recruited the trainees anonymously through various channels. This made self-selection processes likely. However, the sample reflects a realistic training group.

Because our results are related to an e-learning time- and self-management programme, as for any training study, we cannot exclude the possibility that they are confounded with the training method or the learning object. Self-efficacy and time- and self-management behaviour were both self-reported measures and carry the risk of being subjectively biased. However, as we measured at different points and compared the data, we might have reduced the risk.

The videos used in the programme primarily featured male actors. We opted for male actors in order to reduce complexity as research suggests that female trainees learn just as well from male as from female models (Gramß & Struve, 2009). Nevertheless, further research should also be conducted using female models. Moreover, further studies could benefit from including additional variables.

We know of no other study that has explicitly analysed training participation, preferred training methods or learning style of older men versus older female learners. The work could inspire further longitudinal research including these interesting and neglected aspects.

We have shown gender moderating the influence of age: our analysis confirms that self-efficacy before training, after training and training success have different relationships to age in men and women. We compared older women with older men, and found a more positive self-efficacy development in training and also greater training success in women. Therefore, future training design and evaluation should consider the effects of both age and gender.

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