The paradox of seduction by irrelevant details: How irrelevant information helps and hinders self-regulated learning

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ABSTRACT

Instructors often rely on seductive details, such as jokes, stories, and video clips, to keep trainees entertained. However, this extraneous information may inadvertently detract from the course content, and the between-person nature of past research precludes understanding the dynamic process by which seductive details influence learning. Using a repeated measures field study, we found that seductive details indirectly improved learning performance by reducing negative affect and indirectly hindered learning performance by increasing the speed of reviewing and decreasing time on task. Seductive details also interfered with attentional focus for trainees with low pretraining knowledge but increased attentional focus for trainees with high pretraining knowledge. Finally, seductive details moderated the effect of learning performance on attrition from training. Learning performance had a less negative effect on attrition in modules with seductive details than in modules without seductive details.

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Trainers and educators are typically evaluated based on whether trainees enjoy their courses and feel the course is useful—if trainees react favorably toward the course and the instructor, the course is assumed to be an effective learning experience. Indeed, 92% of firms participating in the American Society of Training and Development benchmarking forum use satisfaction surveys to evaluate training (Patel, 2010). At universities, student reactions are often the only metric used to evaluate teaching effectiveness and student satisfaction carries substantial weight in retention, promotion, and merit pay decisions (Adams, 1997; McCallum, 1984). Therefore, instructors often resort to showing video clips and telling jokes and stories to keep learners entertained and maximize their satisfaction. Video clips, jokes, and stories are examples of seductive details, defined as interesting and entertaining information that is irrelevant or only marginally related to the intended theme of the course (Harp & Mayer, 1998).[2]

Augmenting courses with seductive details fails to heed a century old admonition against relying upon extraneous material to spice up boring information (Dewey, 1913). Including jokes or interesting stories in lectures can "seduce" trainees' focus away from important information, negatively impacting learning (Harp & Mayer, 1997). This phenomenon, called the seductive details effect, suggests that including irrelevant information in training makes learning more engaging, but impairs retention, problem solving, and training transfer (Bartsch & Cobern, 2003; Garner, Gillingham, & White, 1989; Harp & Maslich,

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[2] By *irrelevant*, we mean that the course and seductive details cover different topics. For example, Peshkam, Mensink, Putnam, and Rapp (2011) taught about space travel and added fictional and irrelevant details to the course material such as (p. 222), "Michael Jackson was inspired by the effects of zero gravity on walking when he created his popular 'moonwalk'." By *marginally related*, we mean that there is a minor connection between the topics covered by the course and the seductive details. For example, Harp and Mayer (1998) had participants review information about the process of lightning formation. The seductive details consisted of illustrations and captions with interesting information about lightning–including a football player who had been struck by lightning–but the information did not contribute to understanding the process of lightening formation.

2005; Harp & Mayer, 1997, 1998; Lehman, Schraw, McCrudden, & Hartley, 2007; Mayer, Heiser, & Lonn, 2001; Rowland-Bryant et al., 2009; Shen, McCaughtry, Martin, & Dillion, 2006).

Seductive details have garnered interest from researchers in education and psychology because of the counterintuitiveness of the effect. However, there are several knowledge gaps that limit the relevance of this effect to applied settings. First, there has not been consistent evidence that seductive details do, indeed, impair learning. Over a third of studies failed to demonstrate the seductive details effect and another third demonstrated partial support for this effect (Rey, 2012).

Second, research on seductive details has been conducted in laboratory settings where participants are given a limited amount of time to review succinct training material. The average learning session in seductive details research is 4 min (Thalheimer, 2004). It is unlikely that trainees' attention will waiver when course materials are extremely brief and they are being observed by the experimenter. Therefore, the true effects of seductive details may only occur in lengthy training that taxes regulatory resources.

Third, the focus has been on between-person comparisons for those who viewed course material with and without seductive details. A between-person design precludes an understanding of how individuals regulate their learning over time in the presence of seductive details. Indeed, self-regulated learning is inherently a within-person process that evolves as trainees monitor their progress and adjust their learning strategies (Sitzmann & Ely, 2010).

Fourth, researchers have manipulated aspects of the instructional material (e.g., whether key points are highlighted) as well as whether seductive details are included in the instructional material (Harp & Mayer, 1998; Mayer et al., 2001; Rowland-Bryant et al., 2009). Mediating mechanisms for the effects of seductive details were then inferred based on differences in learning performance across experimental conditions. However, research has not directly measured how trainees behave when learning from material that contains seductive details (see Lehman et al., 2007, for an exception), and the short training time in previous research likely restricted variation in trainee behavior. We propose that integrating a broader theoretical base for understanding seductive details, exploring the mediating and moderating mechanisms for this effect, and overcoming previous methodological limitations will permit a better understanding of this interesting but inconsistent effect.

To investigate the intricacies of the seductive details effect, we conducted a repeated-measures field investigation of adults participating in voluntary online self-development. In online courses, the material is often extensive and can take several hours or even days to review. Furthermore, employees are increasingly given control over when and where they view the material and how much time they devote to learning (Kraiger & Jerden, 2007; Sitzmann, Kraiger, Stewart, & Wisher, 2006). Investigating the seductive details effect in a lengthy, learner controlled course ensures the external validity to work-related training. Moreover, permitting variability in behavior by providing trainees with control over their learning experience and capturing how they self-regulate in modules with and without seductive details is essential for understanding the process by which this effect occurs. Thus, we objectively capture attrition, how much time trainees devote to learning, and the speed of reviewing to assess the level and quality of effort in modules with and without seductive details. We also measure trainee reactions, negative affect, pretraining knowledge, attentional focus, and learning performance to assess the direct and moderating effects of seductive details. Finally, we make a theoretical contribution to the seductive details literature by integrating affect (e.g., Beal, Weiss, Barros, & MacDermid, 2005; Van Dillen & Koole, 2007), cognitive load (e.g., Chandler & Sweller, 1991), and self-regulation (e.g., Carver & Scheier, 1990; Winne, 1995) theories to clarify the pros and cons of including seductive details in training. In the following section, we introduce a theoretical model of the effects of seductive details on self-regulated learning.

1. Model of the effects of seductive details on self-regulated learning

We propose that seductive details represent a double edged sword (Fig. 1)—they are advantageous for improving trainee reactions and reducing negative affect (thereby enhancing learning) but are detrimental for trainee behavior (thereby impairing learning). These competing mechanisms may explain why the seductive details effect has not been consistently observed across learning situations (Rey, 2012). Moreover, seductive details do not have a direct effect on attention (Harp & Mayer, 1998; Park, Moreno, Seufert, & Brünken, 2011; Sanchez & Wiley, 2006); rather, they interact with pretraining knowledge to shape attentional processes. Trainees who enter a course with high pretraining knowledge have the requisite cognitive capacity to deal with the demands of training so seductive details only have deleterious effects on attentional focus for trainees with low pretraining knowledge of the content domain (Sanchez & Wiley, 2006; Schnotz, Fries, & Horz, 2009). Finally, we propose that seductive details moderate the effect of learning performance on attrition from training. We elaborate on each of these predictions in the following sections.

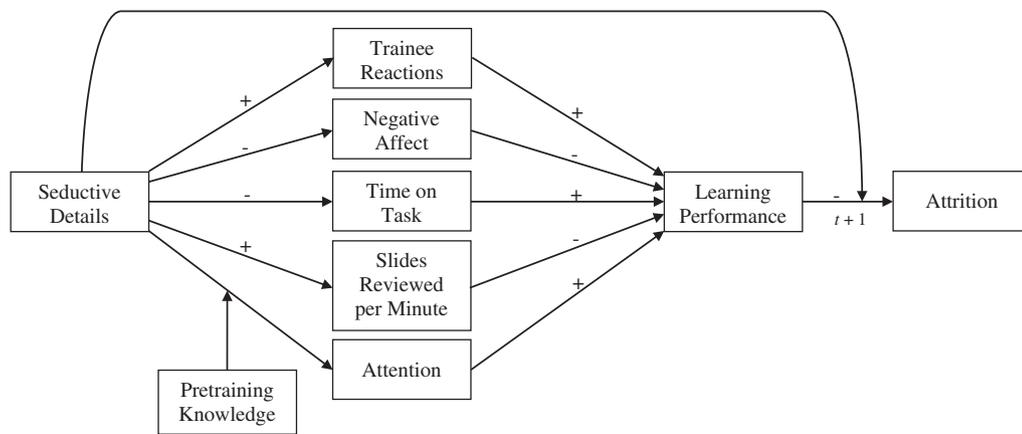## 2. Effects of seductive details on trainee affect

Trainee reactions are subjective evaluations that learners make about their training experience, including their satisfaction with and the perceived utility of the course material (Kirkpatrick, 1996; Sitzmann, Brown, Casper, Ely, & Zimmerman, 2008). The underlying logic of including seductive details in training is they keep trainees interested in learning, thereby improving satisfaction with training (Harp & Mayer, 1997; Kintsch, 1980). However, two studies investigated affective outcomes of seductive details and both failed to find a significant effect of seductive details on student reactions; yet, the brief nature of the course materials may have attenuated the effects (Garner et al., 1989; Harp & Mayer, 1997).

Theoretically, reactions capture affect experienced during training (Brown, 2005). Thus, reactions should be measured as a within- rather than between-person construct because affect varies meaningfully within individuals over time (Beal et al., 2005). Making the material interesting is valuable for energizing trainees and increasing their learning engagement (Izard & Ackerman, 2000), and engagement produces feelings of enjoyment, increasing satisfaction with training (Brown, 2005). Therefore, we expect that at the within-person level of analysis, seductive details will result in more favorable trainee reactions.

H1. Seductive details have a positive within-person effect on trainee reactions, such that trainees react more favorably toward modules that contain seductive details than modules without seductive details.

In addition to positively impacting reactions, the distracting nature of seductive details may alleviate negative affect by pulling trainees' attention away from unpleasant thoughts and feelings. Tasks that are intrinsically interesting have strong attentional pull (Beal et al., 2005), making them effective at reducing the rumination that is typical when experiencing negative affect (Koy & Yeo, 2008; Kozlowski & Bell, 2006). Van Dillen and Koole's (2007) working memory model suggests that distracting information can relieve negative affect, and this is particularly likely if the distracting information is cognitively demanding. As a demonstration of this effect, Strick, Holland, Van Baaren, and Van Knippenberg (2009) found that processing humorous information reduced negative affect. Thus, the cognitive demands imposed by adding seductive details to training may prove effective at alleviating negative affect.

H2. Seductive details have a negative within-person effect on negative affect, such that negative affect is lower in modules that contain seductive details than in modules without seductive details.

Note: t + 1 indicates time-lagged effect.

Fig. 1. Model of the effects of seductive details on self-regulated learning. *Note*: t + 1 indicates time-lagged effect.

3. Effects of seductive details on trainee behavior

We also examined the effects of seductive details on two behavioral indicators of self-regulation: time on task–which represents the overall level of effort exerted during training–and slides reviewed per minute—which represents the quality of effort, such that quickly paging through training content is one of the least effective learning strategies (Sitzmann, 2012; Sitzmann & Johnson, 2012a, 2012b). Winne's (1995) self-regulated learning theory articulates how the learning environment influences behavior and learning performance. Messages in the training environment generate automatic inferences about which tactics should be effective for learning and these inferences have direct behavioral consequences. Learning environments that foster mindful cognitive engagement set up the expectation that trainees need to exert substantial effort to learn the course content. As suggested by Pintrich (2000), trainees regulate the amount of effort exerted based on the perceived difficulty of courses. Courses that convey the message that learning is difficult elicit substantial effort from trainees, which is essential for succeeding in training (Brown & Sitzmann, 2011).

By definition, seductive details represent information that is more interesting and entertaining than the rest of the training material (Park et al., 2011). Enjoyable material can result in the unintended consequence that trainees perceive less effort is needed to learn the material (Salomon, 1984). Therefore, trainees may allocate less effort to training when they encounter seductive details, such as failing to devote sufficient time to learning and paging through training content too quickly to thoroughly process the material. Indeed, students spent less time reviewing course relevant material if the course contained seductive details (Lehman et al., 2007). Moreover, students utilize shallow learning strategies when they believe learning is easy, resulting in poor learning performance (Schommer, Crouse, & Rhodes, 1992; Winne & Hadwin, 1998). Thus, seductive details should have perilous effects on the overall level of effort and the quality of effort exerted in training.

H3. Seductive details have a negative within-person effect on time on task, such that trainees spend less time reviewing in modules that contain seductive details than in modules without seductive details.

H4. Seductive details have a positive within-person effect on the number of slides reviewed per minute, such that trainees page through the content quicker in modules that contain seductive details than in modules without seductive details.

4. Effects of seductive details on attention

Effective instructional design tailors the course material based on working memory capacity and other characteristics of trainees (Paas, Renkl, & Sweller, 2003; van Gog, Ericsson, Rikers, & Paas, 2005). Working memory has a limited capacity that can hold approximately seven chunks of information and simultaneously process two or three chunks of information (Paas et al., 2003; van Gog et al., 2005). Schemas (i.e., a cognitive framework used to organize and interpret information) are formed as expertise develops. Thus, previously separate pieces of information are processed as a single element, permitting simultaneously processing more information (Paas et al., 2003). The optimal instructional design ensures that the material does not surpass trainees' working memory capacity and that trainees are willing to direct their attention toward training for a sufficiently long period of time to learn the content domain, suggesting that the instructional design should differ for trainees with varying levels of expertise (Chandler & Sweller, 1991; Schnotz et al., 2009).

Pretraining knowledge may moderate the effect of seductive details because it represents whether trainees enter a course with schemas that they can use to organize the content domain. Trainees with high pretraining knowledge have schemas that they can use to organize the information presented in training, reducing the cognitive load of learning (van Gog et al., 2005). Adding extraneous load can facilitate learning when the cognitive demands of the situation are low, and one of the purported advantages of seductive details is that they help trainees maintain their attentional focus on the course (Park et al., 2011). Attention refers to the extent to which trainees are able to concentrate and maintain their cognitive focus on the training material (Zimmerman, 2000). If the material is too easy, trainees are at risk of becoming bored and failing to devote sufficient attentional resources to learning (Schnotz et al., 2009). Thus, when cognitive resources are not taxed, seductive details facilitate active engagement in training, resulting in trainees devoting additional attentional resources toward learning the course material (Park et al., 2011).

However, the vast majority of seductive details research has been conducted with students who are unfamiliar with the content domain, which may explain why some researchers have demonstrated a negative effect of seductive details on learning performance. When trainees have little knowledge of the content domain, seductive details cause the cognitive load of the situation to exceed their cognitive capacity, impairing learning performance (Park et al., 2011). Thus, pretraining knowledge is a critical determinant of whether seductive details enhance or impair attentional focus, and trainees without pretraining

knowledge of the course topic are likely to be seduced by irrelevant, entertaining details (Sanchez & Wiley, 2006).

H5. Pretraining knowledge moderates the within-person effect of seductive details on attention. Seductive details have a positive effect on attention when pretraining knowledge is high and a negative effect on attention when pretraining knowledge is low.

5. Indirect effects of seductive details on learning

Regarding learning, seductive details should have a positive indirect effect via trainee affect, a negative indirect effect via trainee behavior, and a moderated indirect effect via attention. These effects may cancel each other out, resulting in a nonsignificant effect of seductive details on learning performance. This may explain why two-thirds of studies have found non-significant or inconsistent effects of seductive details on learning performance (Rey, 2012).

In terms of affect, seductive details should enhance learning performance by improving trainee reactions and alleviating negative affect. Trainee reactions predict learning performance because trainees become engaged in learning and thoroughly process the course content when they are enjoying the learning experience (Brown, 2005). Positive emotion serves as a motivational force that increases the attentional pull of training and permits learning while expending minimal regulatory resources (Beal et al., 2005; Seo, Barrett, & Bartunek, 2004). In contrast, negative affect impairs knowledge acquisition and training performance because it causes task-irrelevant thoughts and rumination (Beal et al., 2005; Feldner, Leen-Feldner, Zvolensky, & Lejuez, 2006; Koy & Yeo, 2008; Kozlowski & Bell, 2006; Mor & Winquist, 2002). Thus, seductive details should have an indirect effect on learning performance through trainee affect; at the within-person level of analysis, performance should be greatest when trainee reactions are favorable and negative affect is low (Brown, 2005; Koy & Yeo, 2008; Lyubomirsky, King, & Diener, 2005).

Regarding behavior, we hypothesize that seductive details decrease trainees' time on task and cause trainees to quickly rather than thoroughly review the material. Together these behaviors impair learning. Resource allocation theory suggests that trainees regulate the amount of effort exerted to maintain performance at a desired level, and effort has a positive effect on learning performance (Kanfer & Ackerman, 1989; Yeo & Neal, 2004). Thus, at the within-person level of analysis, trainees learn more in modules where they spend more rather than less time reviewing the material (Sitzmann & Ely, 2010; Sitzmann & Johnson, 2012a, 2012b; Vancouver & Kendall, 2006). Moreover, quickly reviewing should have a perilous effect on learning performance because paging through the content is a waste of time. Indeed, one of the least effective learning strategies in online courses is merely clicking through the material without taking the time to thoroughly read and process the information (Sitzmann, 2012). Paging through the material represents a shallow learning strategy, and understanding at a surface level is both ineffective for mastering a content domain and much less effective than deeply processing material (Elliot, McGregor, & Gable, 1999; Pintrich, 2000; Zimmerman, 2000). Thus, seductive details should have a negative, indirect effect on learning performance via trainee behavior.

Moreover, attention has a positive within-person effect on learning performance (Carver & Scheier, 1990; Kanfer & Ackerman, 1989), suggesting that the effect of seductive details via attention is contingent upon trainees' pretraining knowledge of the content domain. Trainees divide their cognitive resources between on-task (i.e., learning the course material) and off-task (i.e., material unrelated to the course) activities (Kanfer & Ackerman, 1989). Maintaining high attentional focus enables attaining content mastery.

This represents the paradox of seductive details. Their emotionally arousing, entertaining nature enhances learning by increasing trainee reactions, decreasing negative affect, and enhancing attention for trainees with pretraining knowledge of the domain. However, their detrimental effects on both trainee behavior and attention for trainees without pretraining knowledge of the domain should counteract these advantages, resulting in a null effect on learning performance.

H6. The effect of seductive details on learning performance is indirect via trainee affect, behavior, and attention. a) Trainee reactions have a positive within-person effect on learning performance. b) Negative affect has a negative within-person effect on learning performance. c) Time on task has a positive within-person effect on learning performance. d) Reviewing more slides per minute has a negative within-person effect on learning performance. e) Attention has a positive within-person effect on learning performance.

6. Effects of seductive details and learning performance on attrition from training

Self-regulation is a cyclical process that unfolds over time as trainees receive feedback on their learning performance and decide whether to persist or withdraw from training (Carver & Scheier, 1990, 2000; Sitzmann, 2012). Performance feedback helps trainees discern the extent of their learning progress. Negative feedback suggests that trainees are not attaining content mastery and may not be benefitting from the time they are investing in the course (Carver & Scheier, 1990). Thus, learning performance is one of the strongest predictors of attrition from training, such that trainees are more likely to drop out following low than high learning performance (Sitzmann & Ely, 2010; Sitzmann, Ely, Bell, & Bauer, 2010; Sitzmann & Johnson, 2012a).

Moreover, learning performance increases self-focused attention, which is advantageous following high performance and detrimental following low performance (Carver & Scheier, 2000). Seductive details should reduce self-focused attention by taking trainees' minds off their performance. This should be advantageous when performance feedback is negative because negative feedback reduces motivation and task persistence (Butler & Winne, 1995), and self-focused attention following negative feedback results in withdrawal behavior (Carver, Blaney, & Scheier, 1979; Carver & Scheier, 2000). Indeed, distraction from a negative stimulus abates reactions to that stimulus (Carver & Scheier, 2000). However, self-focused attention is beneficial following positive feedback because confidence in one's ability perpetuates persistence in training (Sitzmann, 2012). Thus, seductive details may also diminish the benefits of self-focused attention following positive performance feedback. This is consistent with research demonstrating that self-focused attention enhances persistence when outcome expectancies are favorable, but decreases persistence when outcome expectancies are unfavorable (Carver & Scheier, 2000). Thus, learning performance should have a less negative effect on attrition in modules with seductive details than in modules without seductive details.

H7. Learning performance has a negative within-person effect on attrition from training, such that trainees are less likely to drop out when their learning performance is high rather than low.

H8. Seductive details moderate the within-person effect of learning performance on attrition from training. Learning performance has a less negative effect on attrition in modules with seductive details than in modules without seductive details.

7. Method

7.1. Participants

Three-hundred ninety-five adults were recruited online and received free training in exchange for research participation. The majority

of participants were employed full time (44%), whereas 33% were unemployed, 14% were employed part time, 5% were retired, and 4% were students. Participants worked an average of 25 h a week ($SD = 19.1$). There was also variability in participants' educational backgrounds: 4% had not completed high school; 42% had a high school diploma or general education diploma; 23% had an associates or technical degree; 23% had a bachelor's degree; 7% had a master's degree; and 1% had a graduate or professional degree. The average age of participants was 45 years ($SD = 12.5$; ages ranged from 18 to 83) and 76% were female.

7.2. Experimental design and procedure

Advertisements for free online Microsoft Excel™ training were posted on Google™ to recruit research participants. People who clicked on an advertisement were transferred to the training website where they created a user account. After logging into training, participants provided informed consent for participating in research. The training consisted of eight modules that covered a variety of Excel functions including formulas, macros, and charts. The course utilized video-based instruction to demonstrate how to perform various functions in Excel along with text-based instruction to define the Excel functions and summarize the information covered in the videos. The data used in the training examples were available for trainees, and they were encouraged to practice as the techniques were demonstrated. The course was designed to take approximately 5 h to complete, but trainees were given control over the pace of instruction—they could determine the amount of time spent on each module and choose to complete the course in a single day or spread it out over several weeks. However, trainees were required to review the content in a predetermined order. After finishing each module, trainees completed a multiple-choice test to assess their knowledge of the material and received feedback on their learning performance.

The seductive details used in this study were cartoons, which is consistent with the definition of seductive details as interesting and entertaining but irrelevant information (Garner et al., 1989; Garner, Brown, Sanders, & Menke, 1992; Harp & Mayer, 1997, 1998).[3] The cartoons included both a picture and a caption, representing seductive illustrations and seductive text, which is expected to attract strong emotional interest (Harp & Mayer, 1997; Park et al., 2011). In the modules that included seductive details, a cartoon was added about one-third of the way into the module and a second was added about two-thirds of the way into the module. Each cartoon occupied its own slide, such that the slides containing seductive details did not convey any relevant training material. The addition of two cartoons per module represents an 8% increase in the number of slides (there was an average of 24.5 content relevant slides per module). In contrast, Harp and Mayer (1997, 1998) added an additional 150 irrelevant words to a 550 word document (27% increase) and 6 irrelevant illustrations to the 6 relevant illustrations (100% increase). Likewise, Park et al. (2011) added 4 irrelevant slides to an 11 slide learning module, representing a 36% increase in material. Our manipulation represents a more realistic manipulation of seductive details, which is similar to how instructors intersperse jokes throughout a lecture. Trainees spent an average of between 1.01 and 3.38 (SD ranged from 0.90 to 2.01) min reviewing the seductive details across training modules.

Before starting training, participants were randomly assigned to experimental conditions that differed based on which modules and how many modules contained seductive details. Thus, the design represents a 2 (seductive details or no seductive details) × 8 modules repeated measures experimental design.[4]

7.3. Measures

Trainee demographics and pretraining knowledge were assessed pretraining. After finishing each module, trainees completed a survey to assess their reactions to the course, negative affect, and attention followed by an exam to assess their learning performance. Both trainee reactions and attention were assessed on a five-point Likert scale ranging from *strongly disagree* to *strongly agree* and negative affect was assessed on a five-point Likert scale ranging from *not at all* to *extremely so*. Time on task, slides reviewed per minute, and attrition were captured by the learning management system.

7.3.1. Trainee reactions

Trainee reactions were assessed with three items adapted from questions included in Sitzmann et al.'s (2008) meta-analysis of the trainee reactions literature. The questions tapped a combination of affective (i.e., *I am satisfied with the material I just reviewed* and *I enjoyed reviewing the material*) and utility (i.e., *I will use the material covered in this module*) reactions. Across the eight modules, coefficient alpha ranged from .87 to .94.

7.3.2. Negative affect

The Positive and Negative Affect Schedule (PANAS) is too long to administer frequently in repeated measures designs. Thus, we followed the example of Koy and Yeo (2008) and Seo and Ilies (2009) and utilized four items from the PANAS that are pertinent to online training. Trainees indicated how they felt while reviewing the course material, and rated the adjectives *upset*, *distressed*, *irritated*, and *frustrated*. Across the eight modules, coefficient alpha ranged from .93 to .97.

7.3.3. Time on task

Time on task reflects the number of hours that trainees spent reviewing the course material and was captured by the learning management system, such that time spent viewing the seductive details and completing surveys did not bias the data. Time on task ranged from an average of 0.33 to 0.64 h per module.

7.3.4. Slides reviewed per minute

Slides reviewed per minute represent the total number of times that all the training slides in a module were viewed divided by the number of minutes spent in the training module. Reviewing the seductive details was not included in the total number of slides reviewed or time data for this measure. On average, each module contained 25 slides and trainees viewed each slide an average of 1.5 times. The number of slides reviewed per minute ranged from an average of 1.46 to 1.89.

7.3.5. Pretraining knowledge

Pretraining knowledge of the course topic was assessed with a single item, *How knowledgeable are you about Microsoft Excel?* Trainees responded on a five-point Likert scale with the anchors *not at all*, *a little*, *moderately*, *quite a bit*, and *very*. This measure is similar to that used by Towler et al. (2008) who found a strong correlation between responses to a single item, self-report measure of pretraining knowledge and scores on a Microsoft Excel exam.

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[3] We conducted a pilot study ($N = 22$) to ensure that the cartoons used in this research met the definition of seductive details. The cartoons were rated as significantly more interesting, entertaining, funny, and engaging than the Excel course ($t(21) = 4.45, 8.66, 14.59, 3.17$, respectively, $p < .05$). Moreover, participants were asked whether the seductive details and Excel course cover the same topic, and their ratings suggest that the seductive details and Excel course are generally unrelated ($M = 1.45, SD = 1.01$ on a five point-Likert scale where 1 indicates *Not at All* and 2 indicates *A Little*).

[4] Ten experimental conditions were created for this research because the number of possible experimental conditions with eight modules and a manipulation with two levels is 256. For each of the eight modules, half of the experimental conditions contained seductive details. One condition contained no seductive details, one contained seductive details in all eight modules, and the rest contained seductive details in between two and six modules.

Table 1
Intraclass correlation coefficients, descriptive statistics, and correlations among study variables at the within- and between-person levels of analysis.

Variable	ICC	Mean	SD	1	2	3	4	5	6	7	8
1. Seductive details	–	0.49	0.50	–	–	−.03	−.03	−.06	.02	.01	.03
2. Pretraining knowledge	–	2.17	0.81	–	–	–	–	–	–	–	–
3. Trainee reactions	.48	4.35	0.74	–	.00	–	−.31*	.00	−.07*	.34*	.09*
4. Negative affect	.35	1.24	0.60	–	−.12*	−.38*	–	.03	.08*	−.44*	−.04
5. Time on task	.41	0.48	0.33	–	−.22*	.12*	.00	–	−.35*	−.04	.12*
6. Slides reviewed per minute	.49	1.68	0.98	–	.17*	−.13*	.00	−.52*	–	−.08*	−.08*
7. Attention	.54	4.35	0.93	–	.13*	.51*	−.49*	.05	−.10	–	.04
8. Learning performance	.30	0.67	0.23	–	.14*	.02	−.17*	.13*	−.09	.07	–
9. Attrition	.15	0.84	0.36	–	−.09	.15*	−.05	.02	.13*	.00	−.07

Note. Between-person correlations are below the diagonal and within-person correlations are above the diagonal. Seductive details were coded such that 1 indicates that the module contained seductive details and 0 indicates that the module did not contain seductive details. Attrition was coded such that 1 indicates that trainees withdrew from the course and 0 indicates that trainees completed the course.

 * $p < .05$ (two-tailed).

7.3.6. Attention

Attention was assessed with three items adapted from Lee, Sheldon, and Turban (2003): *I felt distracted and found it hard to pay attention, I had to work hard to keep my mind on-task,* and *I had a difficult time focusing on the course material.* The items were reverse scored so that high scores reflect greater attentional focus on the course material. Across the eight modules, coefficient alpha ranged from to .92 to .99.

7.3.7. Learning

A six-item multiple-choice assessment of declarative and procedural knowledge was administered at the conclusion of each module. Within each exam, trainees were asked to recall factual information presented during training and the sequences of actions for executing Excel functions. The average scores ranged from 56 to 76% correct across the eight modules.

7.3.8. Attrition

Data from the learning management system was used to assess attrition. Of the 395 trainees who started the course, 92 (23%) dropped out in module 1, 125 (32%) dropped out in module 2, 47 (12%) dropped out in module 3, 19 (5%) dropped out in module 4, 19 (5%) dropped out in module 5, 14 (3%) dropped out in module 6, 9 (2%) dropped out in module 7, and 8 dropped out in module 8 (2%). Thus, 62 (16%) trainees completed the course. This attrition rate is typical of most voluntary online courses. For example, Korn and Levitz (2013) reviewed the attrition rate of over 9 million trainees in online courses and found between 5 and 18% completed training.

7.4. Data analysis

Hierarchical linear modeling with full maximum likelihood estimates was used to analyze the within-person results for the continuous outcomes—trainee reactions, negative affect, time on task, slides reviewed per minute, attention, and learning. SAS PROC MIXED was used to run the analyses following the model building procedure specified by Bliese and Ployhart (2002). Hierarchical generalized linear modeling was used to predict attrition. Generalized linear models are extensions of mixed-effect models to cases where standard linear modeling assumptions are violated (Littell, Milliken, Stroup, Wolfinger, & Schabenberger, 2006). We ran the analyses with SAS PROC GLIMMIX following the procedure outlined by Littell et al. (2006) and Raudenbush and Bryk (2002).

In each of the analyses, module was included as a covariate because time dependent analyses can be sensitive to order effects. Module was centered such that the intercept represents scores in the first module of the course. Seductive details were dummy coded; 0 indicates that no seductive details were included in the module and 1 indicates that seductive details were included in the module and 1 indicates that seductive details that were included in the module. All other predictors were grand mean centered. Attrition was coded such that trainees

received a 0 in modules that they completed and a 1 in the module where they dropped out. Due to the directional nature of the hypotheses and reduced statistical power caused by the high attrition rate, we used one-tailed tests of significance for the hypothesized effects. Two-tailed tests were used for non-hypothesized effects.

One of the advantages of hierarchical linear modeling and hierarchical generalized linear modeling with repeated measures data is the robustness in calculating parameters with all available data, despite missing data points (Bryk & Raudenbush, 1992; Ployhart, Holtz, & Bliese, 2002). Thus, if trainees dropped out, their survey data and learning performance scores from the modules they completed were included in the analyses.

8. Results

Intraclass correlation coefficients (ICCs), descriptive statistics, and correlations among study variables are presented in Table 1. Learning performance was positively correlated with pretraining knowledge and time on task ($r = .14, .13$, respectively, $p < .05$) and negatively correlated with negative affect ($r = −.17, p < .05$) at the between-person level of analysis. Learning performance was also significantly correlated with trainee reactions, time on task, and the number of slides reviewed per minute at the within-person level of analysis ($r = .09, .12, −.08$, respectively).

H1 through H4 suggest that seductive details have positive effects on trainee reactions (H1) and the number of slides reviewed per minute (H4) and negative effects on negative affect (H2) and time on task (H3). Seductive details did not have a significant effect on trainee reactions ($\Upsilon = −0.02$; Table 2),[5] but had significant effects on negative affect, time on task, and the number of slides reviewed per minute ($\Upsilon = −0.05, −0.03, 0.09$, respectively). Specifically, negative affect was 3.7% lower and trainees spent 8.3% less time reviewing in modules with seductive details than in modules without seductive details. In addition, the number of slides reviewed per minute was 5.9% greater in modules with seductive details. Thus, the results support H2, H3, and H4 but not H11.

H5 suggests that seductive details have a positive effect on attention when pretraining knowledge is high and a negative effect on attention when pretraining knowledge is low. The seductive details by pretraining knowledge interaction was significant, and the direction of the effect was consistent with H5 ($\Upsilon = 0.10$; see Fig. 2). Seductive details increased attentional focus on training when pretraining knowledge was high, but decreased attentional focus on training when pretraining knowledge was low.

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[5] We ran a post-hoc analysis to determine the predictors of trainee reactions since one aspect of the course design–seductive details–did not have a significant effect on this outcome. The results revealed that trainee reactions were 4.9% more favorable when the number of slides reviewed per minute was low rather than high ($\Upsilon = −0.10$). Thus, trainees are more satisfied when they slow down while reviewing the course content.

Table 2
The effects of seductive details on self-regulated learning.

	H1	H2	H3	H4		H5	H6	H7	H8
	Trainee reactions	Negative affect	Time on task	Slides reviewed per minute	Attention	Attention moderated effect	Learning	Attrition time lagged	Attrition time lagged moderated effect
Intercept	4.47[†] (0.04)	1.20[†] (0.03)	0.44[†] (0.02)	1.73[†] (0.05)	4.34[†] (0.06)	4.35[†] (0.06)	0.67[†] (0.01)	−0.63[†] (0.22)	−0.66[†] (0.22)
Module	−0.05[†] (0.01)	0.02 (0.01)	−0.01[†] (0.00)	−0.04[†] (0.01)	0.00 (0.01)	0.00 (0.01)	−0.01[†] (0.00)	−0.48[†] (0.08)	−0.46[†] (0.08)
Seductive details	−0.02 (0.03)	−0.05[*] (0.03)	−0.03[*] (0.01)	0.09[*] (0.04)	−0.01 (0.04)	−0.02 (0.04)	0.00 (0.01)	0.15 (0.21)	0.17 (0.21)
Pretraining knowledge	0.00 (0.05)	−0.07 (0.03)	−0.05[†] (0.02)	0.14[†] (0.04)	0.13[†] (0.06)	0.09 (0.06)	0.05[†] (0.01)	−0.25 (0.14)	−0.27 (0.14)
Trainee reactions							0.02 (0.01)		
Negative affect							−0.03[*] (0.01)		
Time on task							0.07[*] (0.02)		
Slides reviewed per minute							−0.02[*] (0.01)		
Attention							−0.02[*] (0.01)		
Learning performance								−0.85[*] (0.47)	−1.69[*] (0.68)
Seductive details × pretraining knowledge						0.10[*] (0.05)			
Seductive details × learning performance									1.70[*] (0.95)

Note: Seductive details were coded such that 1 indicates that the module contained seductive details and 0 indicates that the module did not contain seductive details. We included separate columns for main and moderated effects because main effects should not be interpreted when interaction terms are included in the equation.
[†] $p < .05$ (two-tailed for non-hypothesized effects).
[*] $p < .05$ (one-tailed for hypothesized effects).

Next, we tested H6—the effect of seductive details on learning performance is indirect via trainee affect, behavior, and attention. Trainee reactions did not have a significant within-person effect on learning performance ($\Upsilon = 0.02$), and attention had a significant effect on learning performance, but the effect was in the opposite direction of the hypothesis ($\Upsilon = -0.02$). Thus, the results failed to support H6a and e. However, negative affect, time on task, and the number of slides reviewed per minute had significant effects in the hypothesized direction ($\Upsilon = -0.03, 0.07, -0.02$, respectively), supporting H6b, c, and d. We compared trainees who were one standard deviation above and below the mean on these predictors to determine the strength of the effects. Learning performance was 3.9 percentage points higher when negative affect was low rather than high, 4.5 percentage points higher when time on task was high rather than low, and 4.2 percentage points higher when the number of slides reviewed per minute was low rather than high. Moreover, seductive details did not have a significant effect on learning performance ($\Upsilon = 0.00$).[6]

To explain the negative effect of attention on learning, we tested whether another predictor was causing an increase in the magnitude of this relationship, consistent with MacKinnon, Krull, and Lockwood's (2000) definition of suppression. Negative affect caused a significant suppression effect for attention on learning performance ($z' = 2.53$). When attention was the only predictor of learning performance, the effect was nonsignificant ($\Upsilon = 0.00$). Importantly, removing attention from the model did not affect the relationship between negative affect, time on task, or slides reviewed per minute and learning performance.

To test the significance of the indirect effects, we followed the suggestion of MacKinnon, Lockwood, Hoffman, West, and Sheets (2002) and used the z' method. As noted by Preacher and Hayes (2008),

indirect effects can exist even when the independent variable does not have a significant effect on the dependent variable. Seductive details had a significant indirect effect via negative affect, time on task, and slides reviewed per minute ($z' = 1.31, -2.13, -1.94$, respectively). Thus, seductive details indirectly improved learning by reducing negative affect and indirectly diminished learning by decreasing time on task and increasing the speed of reviewing.

The final two hypotheses suggest that learning performance has a negative within-person effect on attrition (H7) and this effect is moderated by seductive details (H8). Supporting H7, learning performance had a negative effect on attrition from the subsequent module (logit = -0.85, $p < .05$). Specifically, the probability of dropping out was 4.1 percentage points greater following low than high learning performance. In addition, the learning performance by seductive details interaction was significant when predicting attrition, and the direction of the effect was consistent with H8 (logit = 1.70, see Fig. 3). Learning performance had a negative effect on attrition in modules without seductive details, such that the probability of dropping out was 7.9 percentage points greater when learning performance was low rather than high. However, the probability of dropping out was the same regardless of trainees' learning performance in modules with seductive details.

9. Discussion

To seduce or not to seduce? That is the question faced by many instructors that we sought to answer. We observed that the effects of seductive details are incredibly complicated. First, trainee reactions and learning performance are the outcomes of interest to most training professionals, but seductive details do not improve trainee reactions nor directly affect learning performance. Second, the effect of seductive details on learning performance is indirect—they alleviate negative affect (which is advantageous for learning) but cause trainees to engage in suboptimal behavior (which is perilous for learning). Third, seductive details have differential effects on attention depending on whether or not trainees have a basic understanding of the domain before starting
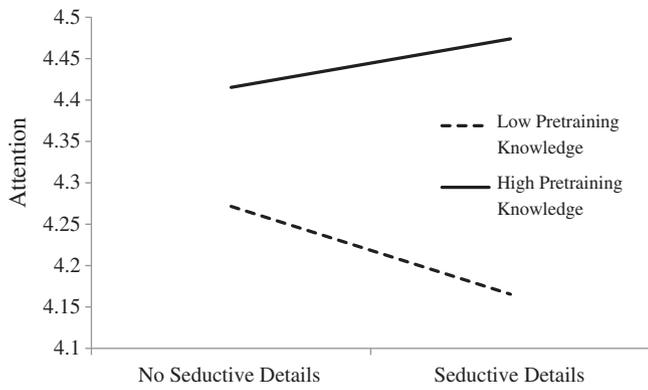
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[6] We ran a post-hoc analysis to assess if the effects of affect, behavior, and attention were moderated by seductive details, and found seductive details did not significantly interact with trainee reactions, negative affect, time on task, slides reviewed per minute, or attention when predicting learning performance ($\Upsilon = -0.03, -0.05, -0.01, -0.01, 0.00$, respectively).

Fig. 2. Graph of the seductive details by pretraining knowledge interaction when predicting attention.

Fig. 3. Graph of the seductive details by learning performance interaction when predicting attrition from training.

the course. Among trainees with higher pretraining knowledge, seductive details increase attentional focus, whereas the opposite occurs for trainees with lower pretraining knowledge. Fourth, seductive details are beneficial for reducing attrition after trainees receive feedback revealing poor learning performance. Thus, seductive details both help and hinder self-regulated learning. The theoretical and practical implications of our findings will be discussed in the following section.

9.1. Theoretical and practical implications of seductive details

Seductive details did not have a significant within-person effect on learning in learner controlled online training. This contradicts previous research indicating that seductive details impair learning performance at the between-person level of analysis (e.g., Bartsch & Cobern, 2003; Harp & Maslich, 2005; Harp & Mayer, 1997, 1998; Lehman et al., 2007; Shen et al., 2006). However, Rey (2012) conducted a meta-analysis of the seductive details literature and discovered that imposing time limits on learning moderates the effect on both retention and training transfer. Seductive details had a moderate to large negative effect on both of these outcomes when time limits were imposed for reviewing the course material, but non-significant effects when trainees were provided with unlimited time to review the material. Thus, the seductive details effect may only occur in time-restricted training environments.

Although seductive details did not have a direct effect on learning, they altered the learning process via attention, affect, and behavior. Regarding attention, the effect of seductive details was moderated by pretraining knowledge of the content domain. Pretraining knowledge is valuable for reducing the cognitive demands of training, and trainees with mental models of a domain can simultaneously process more information (Sweller, Van Merrienboer, & Paas, 1998). This simultaneous processing capability may have enabled trainees with pretraining knowledge to maintain to their attentional focus on training when the material contained seductive details. In contrast, attentional focus was adversely affected by seductive details among trainees with low pretraining knowledge. Without an existing schema of the domain, trainees may not be capable of simultaneously learning a skill and processing irrelevant information (Park et al., 2011).

However, attention had a negative within-person effect on learning performance when examined in concert with trainee affect and behavior, which contradicts the study hypothesis as well as theoretical and empirical evidence on the value of concentrating cognitive resources on learning (Kanfer & Ackerman, 1989; Sitzmann & Ely, 2010; Yeo & Neal, 2004). Moreover, attention did not have a significant effect on learning when examined without the other predictors in the model. Inexperienced students often struggle with distinguishing between seductive and relevant training material (Garner et al., 1992; Sanchez & Wiley, 2006), and we relied on self-report data to measure attention. It is possible that trainees who focused their attention on irrelevant
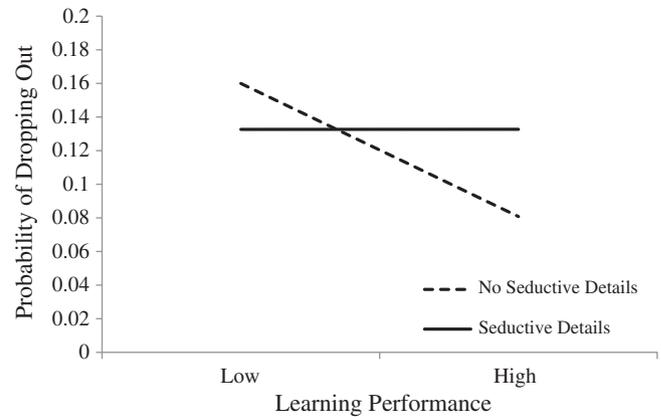
details reported high attentional focus, but concentrating on the wrong information negated the benefit for learning performance. Specifically, trainees may have accurately reported that they were focusing their attention on the course content, but their focus may have unduly targeted the seductive details to the detriment of learning relevant course material.

Seductive details also moderated the learning performance/attrition relationship. The key to understanding this effect is determining when self-focused attention is helpful and when it is harmful. Poor learning performance causes trainees to drop out of training, whereas high learning performance results in perpetuated confidence and higher achievement with a low probability of dropping out (Carver & Scheier, 2000; Carver et al., 1979; Sitzmann & Ely, 2010). Seductive details distract people, pulling their focus away from their learning performance. This was useful for reducing attrition following poor learning performance, but mitigated the benefits of high learning performance.

The nonsignificant effect of seductive details on learning can also be explained by their opposing effects on negative affect and behavior. Regarding behavior, time on task represents the overall level of effort exerted and our results demonstrate that trainees attained higher learning performance when they spent more time reviewing. This is consistent with meta-analytic evidence indicating that effort is among the self-regulatory processes with the strongest between-person effect on learning performance, and effort accounts for incremental validity in learning after controlling for cognitive ability (Sitzmann & Ely, 2011). Moreover, this study contributes to a growing body of research demonstrating that effort is also among the strongest predictors of learning performance at the within-person level of analysis (Sitzmann & Ely, 2010; Sitzmann & Johnson, 2012a, 2012b; Vancouver & Kendall, 2006; Yeo & Neal, 2004).

In addition to the amount of effort exerted, we captured the quality of effort by objectively measuring the number of slides reviewed per minute. Quickly paging through the training content is one of the least effective learning strategies (Sitzmann, 2012). Consistent with this argument, trainees learned more in modules where their time per slide was high rather than low. Furthermore, objectively measuring self-regulatory processes is invaluable for reducing respondent burden, which can be substantial when researchers administer multiple or lengthy surveys (Golinelli et al., 2010). In the self-regulated learning domain, time on task (i.e., effort) is the only self-regulatory process that is routinely measured with objective rather than self-report data (Sitzmann & Ely, 2011). Objectively measuring constructs reduces the same-source bias that can occur when multiple regulatory processes are measured with self-report surveys, suggesting that we need to continue exploring aspects of learning that leave a behavioral trail.

Regarding affect, we found that seductive details did not have a significant effect on trainee reactions, which is surprising given that

researchers consistently suggest that seductive, irrelevant information is added to courses to increase student satisfaction (e.g., Harp & Mayer, 1997; Kintsch, 1980). Thus, it is ironic that two studies have found that seductive details do not have a main effect on student reactions at the between-person level of analysis (Garner et al., 1989; Harp & Mayer, 1997), and the current study demonstrates that this effect is also non-significant at the within-person level of analysis. However, seductive details do influence one aspect of trainee affect—that is, they relieve negative affect. In math, science, and other courses that many find anxiety provoking, the fun nature of seductive details may help trainees relax, relieving negative affect and helping them learn the course material. Yet, trainees may also page through the course content quickly and fail to devote sufficient time to learning, negating the learning benefits of relieving negative affect.

Instructors are typically evaluated based on trainee reactions because these surveys provide a common metric for comparison across courses (Adams, 1997). This places instructors in a precarious position. They must choose whether they want to appease trainees to ensure they receive favorable ratings or design the course to maximize learning and training transfer. To receive favorable annual evaluations and promotions, many instructors have succumbed to the pressure to emphasize learner satisfaction to the decrement of learning. However, "the fact that learning has declined and stagnated during the twenty-five or so years that higher education has relied on student opinion as a measure of 'good' teaching speaks for itself" (Stone, 1995, p. 13).

Furthermore, our results support the conclusion that trainee reactions tell us more about the trainees than about the course they are rating (Adams, 1997; Goldman, 1993). Specifically, seductive details did not have a significant effect on trainee reactions, but trainees' behavior in the course was a significant predictor of trainee reactions.[7] Trainee reactions were more favorable in modules where trainees took their time reviewing each page of content rather than quickly paging through the course material. Thus, ineffective trainee behavior is related to dissatisfaction with the course, and it may be time for academic and training institutions to realize that trainee reactions are a poor indicator of instructional effectiveness. Indeed, trainee reactions have weak effects on post-training declarative and procedural knowledge and do not account for any variance in training transfer after controlling for pretraining knowledge of the training content (Sitzmann et al., 2008). If we are truly interested in understanding training effectiveness, learning and transfer must be directly measured to promote a learning environment where the primary goal is knowledge acquisition rather than having fun.

Considering both the pros and cons, we conclude that instructional designers should limit the use of seductive details in training. The members of the training and education community should challenge themselves to collectively develop videos and active learning exercises that keep trainees engaged in learning while also maintaining a focus on the core content, rather than relying on irrelevant information to energize trainees. Even the most mundane topics can be of interest when organizational blunders and correct applications are included as part of the discussion. Doing our due diligence in creating interesting, relevant content should relieve negative affect while also avoiding the perilous behavioral consequences of seductive details.

10. Study limitations and directions for future research

There are several limitations to the current research. Foremost, research is needed to verify that time on task and slides reviewed per minute adequately capture the level and quality of effort exerted during training. Moreover, attention was captured via a self-report measure. Although this is a common method of assessing attention (Lee, Sheldon, & Turban, 2003), research should establish that trainees are both willing

and able to report the extent to which their cognitive resources were consistently directed toward reviewing the training content.

In addition, over 20% of trainees dropped out during the first module, which is similar to the attrition rate in other studies focusing on voluntary online training (e.g., Korn & Levitz, 2013; Sitzmann, 2012; Sitzmann & Johnson, 2012a, 2012b). These trainees were not included in the analyses predicting affect, behavior, attention, or learning performance because they left the training environment before completing any of the study measures. Also, because trainees were given the freedom to complete training when and where they wanted, we do not know the conditions under which trainees reviewed the material. It is possible that trainees engaged in off-task activities (e.g., watching television, answering email) while reviewing the material, attenuating the effects of seductive details and self-regulation. This may explain why we failed to find the expected relationship between attention and learning performance. Future research should verify the current results in both laboratory and field settings and with a lower attrition rate to ensure that the high percentage of trainees who failed to complete the course did not attenuate the effect of seductive details on learning performance.

Future research should also examine individual differences that moderate the seductive details effect (Towler, 2009). Characteristics of trainees such as general intelligence, motivation, mastery orientation, or metacognitive ability may moderate the relationship between seductive details and learning. Investigating moderators of the seductive details effect will offer insight as to when and why seductive details have their effect on learning and inform practitioners as to which trainees are most affected by seductive details. It would also be useful to know whether the seductive details effect is more or less pronounced in different types of courses. It is possible that seductive details have stronger effects in mundane courses because of the contrast between the seductive and prosaic information, but, on the contrary, the content may also be so mundane that even seductive details cannot keep trainees engaged.

Further, we examined the affective, behavioral, and attentional mechanisms by which one type of seductive detail–cartoons–affect learning. Future research should explore different types of seductive details to determine whether the type (e.g., joke, story, video, irrelevant text) and topic relevance moderates their effect on learning and attrition from training. Specifically, topic relevant entertaining details may cause individuals to mentally organize information around the entertaining details rather than the main points of the instructional material, impairing learning (Harp & Mayer, 1998; Lehman et al., 2007). They may also impair knowledge formation by interrupting the causal chain of ideas when entertaining details are inserted between important points (Harp & Mayer, 1998). Cognitive mapping of trainees' mental models would offer insight into how topic relevant and irrelevant extraneous information exerts its effects. For example, Kozlowski et al. (2001) had trainees rate the similarity of task concepts to measure knowledge structure coherence. Comparable methods could be used to assess whether seductive details interfere with forming a coherent understanding of a domain.

11. Conclusion

The seductive details effect indicates that adding interesting but irrelevant information to training impairs learning performance. However, the short training time, laboratory setting, and between-person approach employed in previous research likely obscured the process by which seductive details exert their effects. To overcome these limitations, we employed a within-person design, directly measured mediating processes, and afforded trainees substantial control over their learning experience to increase the external validity to work-related training. Reducing the constraints imposed by laboratory settings revealed that seductive details do not have uniform effects across trainees or learning processes. Rather, seductive details live up to the Latin term

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[7] Although trainee reactions were measured after trainee behavior, it is not possible to determine a causal relationship between these variables.

seduce from which they were derived. Seduce means *to lead astray*, which can be both an asset and a liability in self-regulated learning.

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