Self-efficacy and interest: Experimental studies of optimal incompetence

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Abstract:
How does self-efficacy affect interest? The interest-and-interests model assumes that factors that induce interest—novelty, complexity, conflict, and uncertainty—do so non-linearly. Self- efficacy should thus affect interest quadratically, because it reflects uncertainty about an activity's outcome. When self-efficacy is low, interest is low because the activity's outcome is certain. When self-efficacy is moderate, the person's success on the task seems likely, but not inevitable. But as self-efficacy becomes very high, success seems completely certain, and the task is thus uninteresting. Two experiments tested these predictions. Experiment 1 asked people to rate the interestingness of differentially difficult activities; Experiment 2 manipulated self-efficacy regarding a fuzzy dart game. In both experiments, interest was a quadratic function of self-efficacy. Implications for theories of vocational interest development and change are considered.
Keywords: Interest; Self-efficacy; Vocational interests

Article:
1. Introduction

Beliefs about personal agency are foundational to motivated activity (Bandura, 1997). Self-efficacy plays an important role in many theoretical issues, such as when people feel their lives are meaningful (Feldman &Snyder, 2000), how people cope with traumatic events (Snyder, 2000), and when people take responsibility for failure instead of blaming others (Duval & Silvia, 2001, 2002; Silvia &Duval, 2001). Vocational interest research has long explored the conceptual possibilities of self- efficacy theory (Hackett &Betz, 1981). Indeed, self-efficacy appears to be one of the major variables in modern vocational psychology (Betz, 2000; Betz & Borgen, 2000).

Self-efficacy theory has impacted vocational psychology so much because agency beliefs seem to promote interest development. Quite a lot of research, both experimental and correlational, finds that self-efficacy increases interest and performance (Lent, Brown, &Hackett, 1994). These effects of self-efficacy are distinct from effects of abilities, personality variables, and outcome expectancies (Bandura, 1997; Don- nay & Borgen, 1999). Apart from providing a foothold into understanding how interests develop—a historically obscure issue (Savickas, 1999)—this work has clarified why people often do not enact vocational interests (Betz, 1999) and explained some important gender and ethnic differences (Hackett &Betz, 1981).

2. Sources of interest

Why does self-efficacy increase interest? Intuition suggests that people should be interested in what they expect to do well; this seems reasonable. But intuition is not enough, and researchers have not been very specific about why self-efficacy should make something interesting (e.g., Bandura, 1997, pp. 218–223; Lent et al., 1994). In-deed, intuition also suggests that people have a lot of boring competencies. Adults can walk miles without stumbling, and can speak coherently for hours, but they probably find neither of these activities very interesting. Anyone with a VCR and a video card probably has high self-efficacy for movie renting, but this alone does not make all movies interesting. Activities probably cease to be interesting at very high levels of self-efficacy.

The interest-and-interests model (Silvia, 2001a, in press) suggests some reasons why self-efficacy would affect interest quadratically. This approach views interest as a basic emotion (Izard, 1977). As a basic emotion, interest must have properties characterizing all emotions (see Silvia, in press, chap. 2): facial expressions (Reeve, 1993), universality, subjective-experiential qualities, constructive functions across the life-span (Fredrickson, 1998, 2001), and appearance in early infancy (Langsdorf, Izard, Rayias, &Hembree, 1983). In this approach, then, interest is not simply liking or valuing something (cf. Evans, 1965; Lent et al., 1994), a disposition toward attention (White, 1967), a state of wanting or diffuse motivation (Ortony &Turner, 1990), or "liking and willful engagement in a cognitive activity" (Schraw &Lehman, 2001, p. 23). Interest is more specific, by being defined as a basic emotion, and more general, inasmuch as emotions have profound implications for human functioning across the life-span (Abe & Izard, 1999; Magai &McFadden, 1995).

Like all emotions, interest has innate inducers, the unlearned factors that amplify and attenuate an emotion's intensity. An emotion's set of innate inducers tends to be small and circumscribed—emotions, as evolved systems, could not have anticipated the modern human's set of possibly emotional circumstances (Darwin, 1872/1998). Innate inducers thus tend to be abstract, general, and thematic (Lazarus, 1991; Tomkins, 1962), such as perceiving threat (fear), experiencing loss (sadness), or achieving a goal (happiness). This enables a vast number of things to arouse an emotion indirectly, by affecting the emotion's small number of innately-inducing variables. Opening one's wallet at the checkout stand and finding it empty can arouse anxiety, but the fear system did not evolve to recognize checkout lanes as innately fearful contexts.

The interest-and-interests model, following Berlyne's (1960, 1971, 1978) seminal work, assumes that only four variables—conflict, complexity, novelty, and uncertainty—can induce interest directly. Berlyne (1960) dubbed these collative variables because they involve collating incoming and existing information, or collating several regions of a differentiated stimulus field. These variables represent abstract structural properties of information (Garner, 1962), and thus seem likely to be innate inducers. Other variables can then affect interest indirectly by affecting one of the collative variables. This assumption conflicts with other models, which assume that many factors directly induce interest. For example, studies of interest and reading argue that variables such as coherence and prior knowledge make a text more interesting (see Schraw &Lehman, 2001; Tobias, 1994). Recent research based on the interest-and-interests model, however, finds that these variables do not induce interest directly; they affect interest indirectly by reflecting a text's complexity or novelty (Silvia, in press, chap. 4).

Assuming that only four variables induce interest is essential to understanding why self-efficacy might affect interest quadratically. There are two implications of this assumption. First, the interest-and-interests model predicts that self-efficacy affects interest indirectly. More specifically, self-efficacy affects uncertainty about how the activity will resolve, which in turn affects interest. When self-efficacy is very low, people do not believe they are capable of succeeding—failure seems certain. Likewise, when self-efficacy is incredibly high, success seems certain. When self-efficacy sits between these extremes, the outcome becomes uncertain, and thus possibly interesting. In short, self-efficacy beliefs affect a person's certainty about the activity's outcome. This aspect of uncertainty, not self-efficacy, promotes interestingness. Second, Berlyne (1960) demonstrated that the collative variables have anon-linear effect on interest. As something becomes more novel, complex, conflicted, or uncertain, it becomes more interesting—to a point. When something is very novel, complex, conflicted, or uncertain, it becomes aversive. This yields the classic "inverted-U curve" proposed by Berlyne and his contemporaries (Fiske & Maddi, 1961; Hebb, 1955) and found in a lot of research (Walker, 1980). If self-efficacy affects interest because it contains information about uncertainty, then self-efficacy should affect interest quadratically.

Other theories also suggest that self-efficacy might affect interest quadratically. Csikszentmihalyi's (1975) research finds that nearly any task can become interesting if its difficulty matches the person's ability. People are bored by easy tasks and frustrated by difficult tasks. Moderately difficult tasks, however, are usually intriguing. And as Bandura (1997) suggests, "At least moderate perceived efficacy may be required to generate and sustain interest in an activity, but increases in perceived efficacy above the threshold level do not produce

further gains in interest. Indeed, supreme self-assurance may render activities unchallenging and, thus, uninteresting" (p. 220). Achievement motivation researchers found that people preferred moderately difficult tasks over easy and strenuous tasks (Atkinson, 1964), although they did not relate their findings to interest per se. Finally, this quadratic pattern appears to be a quality of motivation more generally (Brehm &Self, 1989; Wright &Kirby, 2001). Motivational intensity increases as the difficulty of achieving the goal increases. Yet when the goal becomes impossible to attain, or when the goal is not worth the required effort, then motivational intensity declines.

3. The present experiments

Two experiments tested the optimal incompetence hypothesis, the prediction that high levels of self-efficacy render an activity less interesting. These studies involve experimental analogs in the lab rather than correlational tests in the field. Past studies probably did not find quadratic patterns because the naturalistic range of self-efficacy can be small. Too few students have supremely high math self-efficacy, for example, to enable a good test of the optimal incompetence hypothesis. Manipulating self-efficacy enables a larger range, and thus a better view of potentially nonlinear effects. Experimental designs also offer stronger inferences about cause–effect orderings. We can be certain from an experiment that (manipulated) self-efficacy is causing changes in (measured) feeling of interest, and not the other way around. Indeed, the opposite causal direction is not implausible; positive affect can bias estimates of self-efficacy (Gendolla, Abele, & Kr€usken, 2001).

4. Experiment 1

Experiment 1 was an initial test of the optimal incompetence hypothesis. People read about activities that differed in their difficulty. Ratings of perceived task difficulty, confidence of success, and interest in the task were measured.

4.1. Participants and design

Thirty undergraduate students—12 women and 18 men—at the University of Kansas participated and received credit toward a research participation option. The perceived difficulty of different tasks was manipulated between-participants, creating easy, moderate, and high difficulty conditions. Each person was randomly assigned to one of these conditions using randomized blocks of six. Separate blocking sets were created for each gender to ensure equal proportions of men and women in each condition.

4.2. Procedure

Sessions were run in groups of 2–8 people. After completing an informed consent form, participants read a list of activities and imagined doing each activity. The difficulty of the activities was manipulated. In the easy condition, people imagined incredibly simple activities, for which they surely had "supreme self-assurance" (Bandura, 1997): Walk into a store and buy a can of soda; Ask someone for the time; Borrow a pen from another student. In the moderate condition, people imagined more difficult activities: Stay up all night without sleeping; Learn to speak a second language; Drive 8 hours in one day. And in the high difficulty condition, people imagined activities that most students find very difficult: Memorize 10 pages of text; Get all As during one semester; Learn to speak five foreign languages. These items were chosen from a larger pool of activities based on pretesting. A separate sample of college students had rated the difficulty of 30 different activities. The 9 activities used in the main study were chosen because they elicited the most consistent responses, and they showed the most between-group contrast in perceived difficulty.

Participants completed three dependent measures for each activity. Two items assessed self-efficacy for the activity: "How difficult would this activity be for you personally?" and "How confident are you that you can do this activity successfully?" The third item, "How interesting would this activity be for you personally?," measured interest in the activity. Each question was answered on a 7-point rating scale, anchored by not at all and very much so. After everyone had completed the questionnaire, the experimenter explained the true purpose of the study, described the different hypotheses being tested, and thanked the participants for contributing to the research.

5. Results and discussion

Gender did not participate in any significant effects or interactions, all Fs < 1.3, ns. Polynomial contrasts were conducted for each item to see how the activity's difficulty affected the dependent variables. Fig. 1 illustrates the pattern; Table 1 provides descriptive statistics.

5.1. Manipulation checks

Not surprisingly, the difficulty manipulation affected perceived difficulty. A significant linear effect indicated that perceived difficulty increased as manipulated difficulty increased, $F(1, 27) = 206$, $p < .001$. The quadratic trend approached significance, $F(1, 27) = 4.06$, $p < :054$, reflecting the slightly different slopes within the two components of the linear trend. Confidence in successful task performance showed a similar pattern: confidence decreased as the task's difficulty increased, $F(1, 27) = 165$, $p < .001$. The quadratic trend was not significant, $F < 1$. These two items, as manipulation checks, suggest that the manipulation of self-efficacy was successful.

5.2. Interest

Interest showed a different pattern than perceived difficulty and confidence. The linear trend was not significant, $F(1, 27) = 1.9$, but the quadratic trend was signifi-

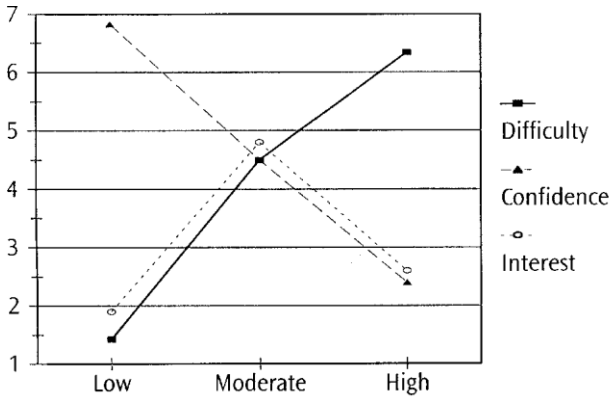

Fig. 1. Effects of manipulated difficulty on ratings of difficulty, confidence of success, and interestingness.

Table 1
Descriptive statistics for Experiment 1

		M	*SD*	Lower CI	Upper CI
Difficulty	Easy	1.43	.65	.97	1.90
	Moderate	4.50	.93	3.83	5.18
	Difficult	6.37	.69	5.87	6.86
Confidence	Easy	6.83	.28	6.63	7.03
	Moderate	4.50	1.03	3.76	5.24
	Difficult	2.40	.80	1.83	2.97
Interest	Easy	1.90	.77	1.35	2.45
	Moderate	4.80	1.16	3.97	5.63
	Difficult	2.60	1.32	1.65	3.55

Note. $n = 10$ per condition.

cant, $F(1, 27) = 35.3$, $p < .001$. As predicted, interest increased as self-efficacy increased, and then declined as self-efficacy became very high. This provides some preliminary support for the optimal incompetence hypothesis. Self-efficacy, quantified here as perceived task difficulty and subjective confidence (Bandura, 1997), had a quadratic effect on task interest: both easy and difficult tasks were judged as uninteresting.

6. Experiment 2

The first study supports the optimal incompetence hypothesis, but it is not an ideal test. Asking people how they would feel offers, at best, an indirect look at psychological processes. Indeed, people's judgments of how they

would feel in a situation usually differ from how they actually feel when put in the situation (Gilbert & Wilson, 2000). For these reasons, Study 2 asked people to work on an actual task, manipulated self-efficacy, and measured feelings of interest in the task. This offers a more ecological look at the psychological dynamics of interest and self-efficacy. Using different methods and measures also allows several studies to converge and thus make a convincing case collectively (Mills, 1969).

6.1. Participants and design

Thirty-three undergraduate students—9 women and 24 men—at the University of Kansas participated and received credit toward a research participation option. People were assigned to condition using randomized blocks; separate blocking sets were used for each gender to ensure equal proportions of men and women in each condition. There were three between-person conditions: an easy, a moderate, and a difficult condition.

6.2. Procedure

People participated in the study individually. After collecting an informed consent form, the experimenter described the study as an exploration of physical performance and aspects of personality. People expected to work on a physical dexterity task and then complete a battery of personality questionnaires. Participants actually only completed the "dexterity task." The task was the game Spaghetti War!, a fuzzy dart game available in toy stores. In this game, participants throw ping-pong balls covered with velcro onto an adhesive board. The board has regions like a conventional dart board, such that the smaller central areas are worth more points when hit with the ball. This game was chosen because it is familiar to most college students, and it was easy to manipulate its difficulty.

Participants were told that they would play five rounds of the task, and then fill out a brief questionnaire assessing their impressions of the task. The experimenter explained that people were randomly assigned to play the game at different distances from the board, presumably to get a better sense of how personality and dexterity relate. The goal, explained the experimenter, was to score a bull's-eye by hitting the board's center region. To manipulate self-efficacy regarding the game, the experimenter varied the distance from the board. In the easy condition, people were to throw the balls at the board from three feet away; self-efficacy should thus be high in this condition. In the moderate condition, people played from a distance of eight feet. In the difficult condition, people played from 18 feet away. Informal pretesting suggested that these distances would create distinct levels of self-efficacy for task success (scoring a bull's-eye).

To establish a subjective sense of self-efficacy, people first did a single practice round, in which they threw all three balls at the board and computed their score. Then they completed a "preliminary questionnaire" intended to assess pre-task self-efficacy. This questionnaire contained three items. The first item asked "Do you own a game similar to this game?," answered in a yes/no format. Two other questions measured self-efficacy: "How well do you expect to do on this task?" and "How certain are you that you will do well at this activity?," measured on 7-point scales. The experimenter then left the room, and the participant played five rounds.

After finishing the game, participants completed a "Task Impressions" questionnaire. People were asked "How interesting was the task?;" "How much would you like to play another five rounds?;" and "Would moving the throwing line closer to the board make the task more interesting?." Each question was answered on a 7-point scale. The experimenter then explained the experiment's true purpose, thanked the participant for helping with the research, and answered questions about the study.

6.3. Results and discussion

Gender was not entered as a variable in the analyses because there were too few women ($n = 3$) in each condition. Two participants said they owned a fuzzy dart game; removing them from the analyses did not affect the findings.

6.4. Manipulation checks

Responses to the pre-task questionnaire were analyzed to see if the self-efficacy manipulation was successful. Responses to "How well do you expect to do on this task?" showed a significant linear trend, $F(1, 30) = 27.2, p < .001$; the quadratic trend was not significant, $F < 1$. Responses to "How certain are you that you will do well at this activity?" also showed a significant linear trend, $F(1; 30) = 65:6$, $p < :001$, and no quadratic trend, $F < 1.95, p < .17$. The means are shown in Table 2. People's expectancy and certainty of success increased as their distance to the board decreased. This suggests that the manipulation of difficulty successfully manipulated perceptions of task-relevant self-efficacy.

6.5. Interest and other measures

The item "How interesting was the task?" showed a non-significant linear trend, $F < 1$, and a significant quadratic trend, $F(1, 30) = 7.1, p < .012$. As predicted by the optimal incompetence hypothesis, interest was low when the task was difficult and increased significantly when the task was moderately difficult, $F(1, 30) = 4.7$, $p < .04$. Interest then decreased significantly when the task became easy, $F(1; 30) = 5:9, p < :02$. The means are shown in Table 2.

The desire to repeat the task showed a similar pattern: the linear trend was not significant ($F < 1$), but the quadratic trend was, $F(1, 30) = 6.7, p < .02$. People in the moderate difficulty condition expressed the most desire to play the game again. This group was significantly higher than both the easy condition ($p < .03$) and difficult condition ($p < .05$).

Finally, the item "Would moving the throwing line closer to the board make the task more interesting?" revealed only a significant linear trend, $F(1,12:1) = 62.9$, $p < .001$ (df corrected for unequal variances); the quadratic trend was not significant, $F < 1$. As expected, people agreed most with this possibility when they were farthest

Table 2
Descriptive statistics for Experiment 2

		M	*SD*	Lower CI	Upper CI
Task interestingness	Easy	2.81	1.47	1.83	3.81
	Moderate	4.45	1.51	3.44	5.46
	Difficult	3.00	1.73	1.84	4.16
Success expectancy	Easy	5.91	.83	5.35	6.47
	Moderate	4.91	1.04	4.21	5.61
	Difficult	3.27	1.55	2.23	4.32
Performance certainty	Easy	6.36	.67	5.91	6.82
	Moderate	5.18	.87	4.59	5.77
	Difficult	3.00	1.26	2.15	3.85
Desire to repeat task	Easy	3.00	1.34	2.09	3.90
	Moderate	4.45	1.21	3.64	5.27
	Difficult	1.18	1.66	2.06	4.29
Desire to make task easier	Easy	1.27	.47	.96	1.59
	Moderate	3.55	1.21	2.73	4.36
	Difficult	4.91	1.45	3.94	5.88

Note. $n = 11$ per condition.

from the board. This suggests that people were aware of the effects of difficulty on task interest.

In sum, manipulating self-efficacy on the task—operationalized as task difficulty—had non-linear effects on interest. Consistent with the optimal incompetence hypothesis, self-efficacy increased task interest, up to a point. When self-efficacy was very high, due to the task's low difficulty, the task became boring. I should note that both experiments used single-item measures of interest. According to the interest and-interests model, conventional multi-item measures of interest are inappropriate when they conflate interest, enjoyment, feelings of competence, and intentions to repeat the activity (e.g., Chen, Darst, & Pangrazi, 2001; Sansone, Weir,

Harpster, & Morgan, 1992). The basic emotion of interest is related to these factors, but a construct should not be identified with its effects. Simple measures of subjective experience are thus appropriate, although not necessarily ideal.

7. General discussion

Vocational research has found that self-efficacy promotes interest in activities (Betz, 2000; Donnay & Borgen, 1999; Lent et al., 1994). But it is not clear why feeling able to do something would evoke interest; people feel able to do a lot of different things, but not all of the things are interesting. Some other variables must be involved to connect self-efficacy to interest. I have approached this issue from the perspective of emotion psychology. Interest, according to the interest-and-interests model (Silvia, in press, 2001a), is a basic emotion induced by four collative variables: novelty, conflict, complexity, and uncertainty (Berlyne, 1960). Self-efficacy can affect interest by affecting these variables, particularly uncertainty about an activity's outcome. If so, then self-efficacy should affect interest quadratically, because all of the collative variables affect interest quadratically. Two experiments tested this hypothesis. The first experiment presented people with activities differing in difficulty, and asked people how interesting the activity would be to them personally. The second experiment asked people to play a fuzzy dart game at different distances from the dart board. In both studies, interest was a quadratic function of difficulty. Finding this effect in two experiments with different procedures gives us more confidence in the effect's validity, inasmuch as all experiments and measures are imperfect (Mills, 1969).

Why has past research not found anon-linear relation between self-efficacy and interest? The first reason is that researchers probably were not looking for it. Self- efficacy is linearly related to a lot of variables (Bandura, 1997), so it seems reasonable to look for linear links between interest and self-efficacy. And common research designs do not usually optimize the chances of uncovering non-linear effects. Most experiments create only two levels of a variable. If an experiment creates two levels of self-efficacy (e.g., Campbell &Hackett, 1986), then it can show only a linear effect. Quadratic patterns can thus create a “file drawer bias” because experiments with two levels of a non-linear variable might find no difference between the conditions. Without an intermediate condition to reflect the quadratic pattern, researchers might conclude that the study failed and leave the results unpublished. Quasi-experiments and correlational studies encounter a different problem: the restricted range of self- efficacy found in natural settings. Most research on self-efficacy and interest is correlational. Many of the domains, such as math efficacy, have skewed population distributions—most students fear math. If few research participants are at the very high end of self-efficacy, then the observed data would not reflect an underlying quadratic pattern. Experimental research can overcome this problem, as long as several levels of self-efficacy are created, because manipulating a variable enables some control over the variable's observed range. The present experiments created three levels of self-efficacy and tried to stretch the range of self-efficacy to include very high and very low levels.

Regardless of why past work has not observed this finding, the present research suggests some implications for thinking about self-efficacy and interest. The most apparent implication is that theories of self-efficacy and interest development (e.g., Betz, 2000; Lent et al., 1994) should recognize that self-efficacy can occasionally stunt interest development by rendering the activities uninteresting. This possibility has already been considered by Lent et al.'s (1994) social-cognitive model:

Parsimony and extant social cognitive findings incline us to frame our hypotheses generally in terms of linear bivariate relations at the present time. However, further research is needed to help delimit the specific conditions under which our postulated relations are accurate, are strengthened or weakened, or are better characterized by alternative, non-linear forms (p.114).

If the goal is to increase feelings of interest in an activity, increasing self-efficacy might not always be the answer. For counseling purposes, however, it is probably safe to say “self-efficacy increases interest.” Given the complexity of most occupations, self-efficacy does not often reach prodigious levels. Counselors probably would not find themselves trying to decrease self-efficacy to preserve a vocational interest. More commonly,

clients need help targeting and developing skills (Prediger, 1999), and gaining knowledge that reduces their uncertainty about their own possible roles in the world of work. For theoretical purposes, however, knowing self-efficacy's "microdynamics" (Bandura, 1997) enhances our conceptual understanding of both interest and self-efficacy.

The quadratic link between self-efficacy and interest might offer some insight into occupational change. There is not a lot of research on why people change careers; extant studies show many different reasons (Breeden, 1993; Kanchier &Unruh, 1989; Roe &Baruch, 1967). One likely reason, based on the present findings, is that people can acquire too much skill and knowledge for their current career. If the job does not expand in uncertainty to meet growing skill—such as by promotions to new jobs, or changing responsibilities—people can become bored with their current career and desire something more interesting. Surely this is not the only reason for career change, but it might be useful for future researchers to consider excessive competence when approaching this relatively understudied area.

Finally, a few limitations of this work should be emphasized. First, these experiments were not on enduring interests per se, but rather on the momentary experience of interest. Vocational psychology is more concerned with enduring interests than with momentary emotional feelings, so I should point out that generalizing the present findings to vocational interests requires some additional conceptual steps. The interest-and-interests model distinguishes between interest (as a basic emotion) and enduring interests (as idiosyncratic motives). I assume that emotional interest always participates in the development of long-term interests. If an activity fails to evoke feelings of interest, no long-term interest will develop or persist (Prenzel, 1992; Silvia, 2001a). So emotional interest is critical to the development of enduring interests, but it is not the same.

Furthermore, vocational psychologists use "interest" in many different ways (Crites, 1999; Savickas, 1999; Silvia, 2001b). As noted earlier, I view interest as a basic emotion, synonymous with the lay usage of curiosity (Berlyne, 1978); others consider interest in terms of preferences and attitudes (Evans, 1965; Lent et al., 1994), or in terms of general approach motivation. The distinction matters, because sometimes uncertainty affects interest and liking differently (Berlyne, 1970, 1974; see Silvia, 2001a). Finally, self-efficacy might affect interest through other pathways, such as resistance to frustration, persisting in the face of impediments, and so forth. The activities used in the present research are too simple and brief to illuminate such processes. Future work thus needs to see if self-efficacy has direct effects on interest beyond uncertainty, and if uncertainty is the only mediator.

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