What Is Interesting? Exploring the Appraisal Structure of Interest[*]

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Silvia, P. J. (2005). What is interesting? Exploring the appraisal structure of interest. *Emotion, 5,* 89-102.

Although the idea that thoughts cause feelings has a long history, systematic research on appraisals and emotions is relatively recent (Schorr, 2001). Modern appraisal theories have made important gains in psychology's understanding of emotion (Ellsworth & Scherer, 2003). According to Scherer (2001b), "As far as one can see, there is, at present, no viable alternative to an appraisal (in the broad sense of the word) explanation for the general prediction of the elicitation and differentiation of emotions" (pp. 389, 390). In light of the success of appraisal theories, it is worth applying appraisal concepts to emotions that have not yet been examined from an appraisal perspective. The present research thus analyzes interest—an emotion associated with curiosity, exploration, and information seeking (Fredrickson, 1998; Izard & Ackerman, 2000; Silvia, in press; Tomkins, 1962)—from an appraisal perspective.

Many areas of psychology explore the causes and consequences of interest, but this literature is eclectic and sprawling (see Silvia, 2001, in press). For example, there are different models of what makes art interesting (Berlyne, 1971), what makes text interesting (Schraw & Lehman, 2001), what makes vocations interesting (Savickas & Spokane, 1999), and what makes learning interesting (Hidi, 1990; Krapp, 1999). Some of these areas struggle with problems that appraisal theories handle well, such as inter- and intraindividual differences in emotional responses to similar events (Roseman & Smith, 2001). An appraisal model of interest can integrate these areas, illuminate their continuities, and resolve some unproductive problems. The present research thus develops an appraisal structure of interest and considers some implications for future work.

Interest as an Emotion

Psychologists have studied interest for a long time (Arnold, 1910; Dewey, 1913), but only recently have they viewed interest as an emotion. Tomkins (1962), who thought that interest was "the affect which has been most seriously neglected" (p. 337), saw interest as the emotion related to exploration, attention, and learning. Izard (1977) likewise attributed important developmental functions to interest, such as the cultivation of knowledge and competence (cf. Fredrickson, 1998; Izard & Ackerman, 2000). Many other emotion theories, however, have not paid much attention to interest or have suggested that it is not an emotion (Ekman, 1992; Lazarus, 1991; Oatley & Johnson-Laird, 1996; Ortony, Clore, & Collins, 1988). As a result, emotion psychology has seen little sustained research on interest. Nevertheless, a large literature has accumulated in other areas of psychology (for a review, see Silvia, in press), and recently researchers have called for more attention to interest and the family of "epistemology-based emotions" (Ellsworth, 2003; Keltner & Shiota, 2003; Rozin & Cohen, 2003).

Many emotion theories propose that emotions consist of an organized set of components. Roseman (2001), for example, defined emotions as syndromes of expressions, physiology, phenomenology, behaviors, and goals. Similarly, Scherer (2001a) proposed that emotions consist of cognitive, motivational, expressive, peripheral

[*] Acknowledgement: I thank Kristi Caddell, Morgan Fisher, Meagan Forbis, Toreka James, and Ann Phillips for assisting with data collection, Guido Gendolla, Ann Phillips, and Ed Wisniewski for their comments on earlier versions of this article, and Chris Peterson for providing the curiosity scale used in Experiment 3.

efference, and subjective-feeling components. Research suggests that interest has these components (see Silvia, in press). Interest involves reliable facial actions in adults (Reeve, 1993; Reeve & Nix, 1997) and children (Camras et al., 2002; Langsdorf, Izard, Rayias, & Hembree, 1983). Physiological parameters associated with engagement are predicted by both self-reported and behavioral measures of interest (e.g., time spent viewing an image; Berlyne, Craw, Salapatek, & Lewis, 1963; Libby, Lacey, & Lacey, 1973). Interest has clear motivational and goal components, particularly for exploration, information seeking, and learning (see Krapp, 1999; Sansone & Smith, 2000; Schiefele, Krapp, & Winteler, 1992). For example, people spend more time reading interesting text (Ainley, Hidi, & Berndorff, 2002) and process the text more deeply (Schiefele, 1999), resulting in enhanced learning.

Finally, emotions show coherence between components such as facial expressions, appraisals, and subjective experience (Bonanno & Keltner, 2004; Rosenberg & Ekman, 1994). In adults, facial expressions converge with self-reported interest (Reeve, 1993) and with behavioral measures of exploration (Reeve & Nix, 1997). In infants, facial expressions of interest predict behavioral exploration (time spent viewing a face; Langsdorf et al., 1983). Self-reported interest also converges with time spent viewing images and physiological activity (Berlyne, 1971; Evans & Day, 1971; Libby et al., 1973).

Appraisals and Interest

Most appraisal theories assume that cognitive appraisals of events cause and constitute emotional experience (Lazarus, 1991; Roseman & Evdokas, 2004; Scherer, 2001a). Research on appraisal structure identifies patterns of cognitions involved in emotions. Most theories specify an emotion's appraisal structure as a set of elemental components, such as appraising events as relevant to a goal, evaluating resources for coping with an event, making attributions of causality and responsibility, and judging an event's congruence with a motive or goal (Roseman, 2001; Smith & Ellsworth, 1985; Weiner, 1985). Unlike appraisal structure, the process of appraisal has not received much attention (Smith & Kirby, 2001). A key process issue is the temporal nature of appraisals. Some theories contend that the appraisal process is sequential (Scherer, 1999, 2001a)—early appraisals serve as inputs into later appraisals. For example, appraisals of an event's novelty and congruence with goals should occur before appraisals of "coping potential," how well one can deal with the event. Other theories contend that multiple appraisals unfold in parallel or that events are appraised thematically (Lazarus, 1991).

Few theories of appraisal structure have considered the appraisal basis of interest, although some have considered related states like boredom. In their research on the appraisal structures of positive emotions, Ellsworth and Smith (1988b) considered appraisal components associated with interest. In a retrospective study, interest was distinguished by ratings of high attentional activity and high effort (cf. Ellsworth & Smith, 1988a; Smith & Ellsworth, 1985). An alternative structure of interest is developed below, based on research from several areas. The General Discussion section compares the present appraisal model with Ellsworth and Smith's model.

Novelty-Complexity

In Scherer's (2001a) multilevel-sequential model of appraisal, one of the first judgments in the appraisal sequence is a "novelty check"—whether an event is new, sudden, or unfamiliar. We might expand the meaning of this novelty check to refer more broadly to disrupted and dysfluent processing. A novelty check would thus include a family of appraisals, such as whether people appraise something as new, ambiguous, complex, obscure, uncertain, mysterious, contradictory, unexpected, or otherwise not understood. People probably experience the output of this appraisal as a disruption in processing and a subjective feeling of uncertainty. For convenience, I use novelty or complexity to refer to this family of novelty-complexity variables. The research tradition associated with Berlyne (1960, 1967, 1971, 1974a) demonstrates that novelty and complexity affect interest. Berlyne's explanation—optimal arousal—is no longer tenable (Cupchik, 1988), but the large body of research shows reliable effects of the family of novelty-complexity variables on interest. These effects replicate in different cultures and ages, and they are general across many different stimuli and measures of interest (see Silvia, in press, chap. 2).

Coping Potential

Although important, a novelty check cannot be the only appraisal relevant to interest. Many experiments find an inverted-U relation between novelty variables and interest (Walker, 1981). This quadratic pattern suggests that at least one other variable is interacting with novelty to predict interest. Coping potential is probably the second appraisal component. Coping potential refers broadly to estimates of resources, power, abilities, and control in relation to an event (Bandura, 1997; Lazarus, 1991; Scherer, 2001a). Judgments of coping potential appear in the appraisal structures of many emotions (see Ellsworth & Scherer, 2003). For interest, coping potential probably refers to people's appraisals of whether they can understand the ambiguous event. Upon appraising something as unfamiliar, complex, and ambiguous, people would appraise the likelihood that the poorly understood event can be represented coherently.

Research in the psychology of art suggests that appraisals of coping potential affect interest. Feeling able to understand art is associated with finding art interesting. In one experiment, for example, experts rated abstract art as more understandable and as more interesting (Millis, 2001, Study 3). Differences between experts and novices and between adults and children may stem from differences in appraised ability to understand art (Bragg & Crozier, 1974; Francès, 1976; Hare, 1974; Hekkert & van Wieringen, 1996; Walker, 1980). Other experiments show that providing titles for abstract paintings increases the viewer's ability to understand the paintings (Russell & Milne, 1997). In turn, people enjoy the art more, especially when the titles promote elaborated representations (Millis, 2001). Providing extensive information about a painting, such as the artist's biography and the context of the work, has a large effect on both understanding and emotions (Russell, 2003). Taken together, these experiments suggest that interest can be enhanced by increasing appraisals of coping potential.

The Present Experiments

The simplest appraisal structure of interest involves two appraisal components: an appraisal of novelty, broadly defined, and an appraisal of coping potential in relation to comprehending the obscure event. Although this structure is simple, it is important for research to aim for parsimonious descriptions of appraisal structure (see Scherer, 1997). Past research suggests that this appraisal structure is plausible—variations in the relevant appraisals affect feelings of interest. But past research preceded the hypothesis, so it offers indirect support at best. Several new experiments were thus conducted to directly test the predicted appraisal structure of interest. Research on appraisal structure often opts for breadth (studying many emotions) over fidelity (studying one emotion in detail). As a result, hypothetical scenarios and retrospective reports are common ways of testing appraisal hypotheses (e.g., Scherer, 1997; Smith & Ellsworth, 1985). The present experiments opted for fidelity, as interest was the only emotion under investigation (cf. Kuppens, Van Mechelen, Smits, & De Boeck, 2003). Instead of asking people to recall past episodes of interest, the experiments measured actual emotional experience in response to potentially interesting situations. This minimized memory biases and enabled stronger inferences about the causal role of appraisals (see Roseman & Evdokas, 2004).

Particular attention was paid to convergent and discriminant validity. To enhance convergent validity, the four experiments differed in the operationalization of appraisals (measured vs. manipulated), the measurement of interest (self-reported feelings, choice, behavioral measures), and the sources of interest (random polygons, visual art, and poetry). To enhance discriminant validity, the experiments assessed the validity of appraisals relative to individual differences. Correlational appraisal research probably has not paid enough attention to potential "third variable" problems. It is conceivable that traits relevant to interest—such as curiosity (Kashdan, Rose, & Fincham, 2004), openness to experience (McCrae, 1996), and positive affectivity (Watson, 2000)—act as confounding variables that cause both appraisals and interest. Measures of these traits were thus included.

Experiment 1

In this experiment, participants viewed randomly generated polygons that varied in complexity and picked the "most interesting" polygon. Coping potential was measured by self-reported appraisals of one's ability to understand abstract art. If appraisals of complexity and coping potential affect interest, then people high in

coping potential should pick relatively complex polygons as the most interesting. Experiment 1 examined discriminant validity in two respects. First, the effects of appraisals were compared with the effects of trait curiosity and openness to experience, two important traits relevant to interest. Coping potential should still predict polygon choice after controlling for these traits. Second, interest was compared with enjoyment, a related but distinct positive emotion (Fredrickson, 1998; Izard & Ackerman, 2000). One group of participants picked the "most enjoyable" polygon. Complexity and coping potential should predict interest, but they should be relatively unimportant in predicting enjoyment; these components are peripheral to the appraisal structure of happiness (Lazarus, 1991; Roseman, 2001; Scherer, 2001a).

Method

Participants and Design

Participants were 77 students enrolled in general psychology at the University of North Carolina at Greensboro (UNCG) who received credit toward a research participation option. One person was excluded for not following instructions, leaving a total sample of 76 people (67 women and 9 men). Each person was randomly assigned to one of two between-subjects conditions: judgments of interest, or judgments of enjoyment. The experimenter was unaware of the participants' condition assignments.

Procedure

People participated in groups of 3–8 people. First, they completed a questionnaire that assessed appraisals of ability to understand art along with measures of individual differences. A 4-item scale measured appraised ability to understand art: "I'm good at understanding what a piece of art means"; "I can usually find some meaning in a piece of art, even if I do not understand it at first"; "Abstract art makes sense to me"; "I'm confident in my ability to comprehend complex pictures." These four items were selected from a larger item pool based on pretesting. In a validation study, people completed this scale and then rated abstract pictures for comprehensibility. Self-reported appraisals predicted ratings of how well people understood the pictures, whereas a measure of general self-efficacy (Snyder et al., 1991) did not.

Two individual differences relevant to interest were measured. People completed the Curiosity and Exploration Inventory, a 7-item measure of trait curiosity (Kashdan et al., 2004), and the 12-item Openness to Experience scale from the NEO Five-Factor Inventory (Costa & McCrae, 1992). Trait curiosity was measured because of its theoretical relevance to interest (see Silvia, in press, chap. 5); openness was measured because it predicted interest in art and random polygons in past research (Furnham & Walker, 2001; Rawlings, Twomey, Burns, & Morris, 2002). All items were answered on 7-point scales ranging from 1 (strongly disagree) to 7 (strongly agree).

Judging interest and enjoyment

After completing the measures of individual differences, participants encountered the manipulation of interest versus enjoyment judgments. In the interest condition, people read,

> The following page contains 22 images. Please look at each image and consider how interesting or boring the image is to you. After looking at each image, please circle the image that you feel is the most interesting to you personally, the one that makes you feel the most interested and curious. Circle only one image. Afterward, please continue with the questionnaire.

In the enjoyment condition, people read,

> The following page contains 22 images. Please look at each image and consider how pleasant or unpleasant the image is to you. After looking at each image, please circle the image that you feel is the most pleasant to you personally, the one that you find the most enjoyable and likable. Circle only one image. Afterward, please continue with the questionnaire.

This manipulation was modeled on past research on differences between interest and enjoyment (Aitken, 1974; Berlyne, 1963; Brown & Farha, 1966).

The polygons

People then viewed 22 black-and-white polygons taken from a set developed by Day (1968, 1971). Each polygon had a different number of sides. Complexity was manipulated by varying the number of sides of the polygon, from 4 to 160. Ratings of a polygon's complexity correlate around.90 with the number of the sides (Nunnally & Lemond, 1973). Random polygons are one of the most widely used manipulations of stimulus complexity in research on interest (see Berlyne, 1971).

Results

Data Reduction

The four items measuring appraisals of ability to understand formed a scale with reliable scores (α =.92). A principal-axis factor analysis of the four items found one factor that explained 81% of the variance; factor loadings ranged from.83 to.89. Each participant's responses to the four items were thus averaged to form a single "appraisal of ability to understand" score. The scales of Trait Curiosity (α =.69) and Openness to Experience (α =.80) were also acceptably reliable. Gender was not included in the statistical analyses because too few men participated in the study (n = 9; 12% of the sample).

Ability to Understand, Interest, and Enjoyment

To see whether appraised ability to understand predicted what polygons people selected, correlations between appraisals and the complexity of the selected polygon were assessed. Polygon choice is clearly an ordinal variable, so rRI coefficients were computed (see Chen & Popovich, 2002, pp. 40–41; Wherry, 1984). The rRI correlation, a special case of Pearson's r, estimates the relationship between one continuous variable (appraised ability) and one ordinal variable (polygon choice). Table 1 displays the coefficients. When people selected the polygon they found most interesting, their appraised ability to understand complex art significantly predicted the complexity of the chosen polygon (rRI =.36, p <.028). As expected, a higher appraisal of ability predicted choosing more complex polygons as the most interesting polygon. When asked to select the polygon they found most enjoyable, however, people's appraised ability to understand was unrelated to the complexity of the chosen polygon (rRI = −.087, ns). These correlations differed from each other (Z = 1.95, p <.026, one-tailed). This supports the predicted appraisal structure of interest and highlights differences between interest and enjoyment.

Table 1
Predictors of Polygon Choice: Experiment 1

Variable	Ability to understand	Trait curiosity	Openness to experience
Interest	.360*	.154	.147
Enjoyment	−.087	−.159	−.038

Note. $n = 38$ per condition. The coefficients are r_{RI} correlations, which estimate the relationship between a continuous variable and an ordinal variable (Chen & Popovich, 2002, pp. 40, 41). All other coefficients are nonsignificant at $p > .34$.
* $p = .028$.

Predictors of Polygon Choice: Experiment 1

Interest and Enjoyment

The second hypothesis concerns differences between judgments of interest and enjoyment. If interest differs from enjoyment, then judgments of the most interesting and enjoyable polygons should diverge. A Kolmogorov-Smirnov test for two samples tested whether the two distributions differed. This test is sensitive to differences in shape (skew and kurtosis) as well as differences in central tendency. This test was significant (K-S: Z = 1.61, p <.012), indicating that the samples of interest and enjoyment did not come from the same population distribution. Following this overall test, analyses tested whether interest was associated with choosing more complex polygons. Ratings of interest and enjoyment diverged in the predicted direction. People who selected the most interesting polygon chose polygons that were significantly more complex (Mdn = 15.5), relative to people who selected the most enjoyable polygon (Mdn = 10), Mann-Whitney: Z = 2.12, p <.034. Table 2 displays descriptive statistics for judgments of interest and enjoyment.

Table 2
Selections of the Most Interesting and Most Enjoyable Polygon: Experiment 1

Variable	*Mdn*	*M*	*SD*	Minimum	Maximum
Interest	15.5	15.71	4.59	5	21
Enjoyment	10.0	11.68	7.51	1	22

Note. $n = 38$ per condition. The polygons ranged in ordinal complexity from 1 to 22.

Selections of the Most Interesting and Most Enjoyable Polygon: Experiment 1

Discriminant Validity of Appraisals

Thus far, appraisals of coping potential predicted the complexity of the polygons that people found most interesting, and this appraisal dimension distinguished interest from enjoyment. It is important to consider, however, whether appraisals predicted interest beyond the effects of individual differences related to interest. Perhaps ability appraisals merely reflected variance from higher order constructs, such as trait curiosity or openness to experience. Several findings suggested the unique predictive power of appraisals of ability. First, at the zero-order level, neither openness to experience nor trait curiosity predicted polygon choice. Nonsignificant correlations appeared within the two conditions (see Table 1). Second, regression analyses found that appraised ability was the only significant predictor of polygon choice. Polygon choice was rank-transformed to minimize errors resulting from nonnormality (Judd & McClelland, 1989), and ability, trait curiosity, and openness to experience scores were entered simultaneously. When people selected the most interesting polygon, appraised ability significantly predicted choosing more complex polygons ($\beta = .446$, $p < .031$), but neither curiosity ($\beta = .161$, $p = .34$) nor openness ($\beta = -.171$, $p = .42$) predicted polygon choice. When people selected the most enjoyable polygon, neither ability, curiosity, nor openness predicted polygon choice (all βs within $\pm .17$, ns).

Discussion

Experiment 1 offered several findings relevant to the appraisal structure of interest. First, choices of the most interesting polygon differed significantly from choices of the most enjoyable polygon. The central tendency of the interest distribution was significantly more complex than that of the enjoyment distribution, indicating a basic divergence of interest and enjoyment. Second, appraisals of ability to understand predicted interest but not enjoyment. Apart from supporting the prediction that appraisals of ability to understand are implicated in interest, this finding is congruent with the appraisal perspective's assumption that each emotion has a unique appraisal structure (Lazarus, 2001; Roseman & Smith, 2001; Scherer, 2001a). Third, appraised ability predicted interest beyond the effects of trait curiosity and openness to experience. These traits have broad effects on processes related to interest and intrinsic motivation (Silvia, in press, chap. 5). It was thus critical to demonstrate that they were not "third variables" that caused both interest and appraisals. In summary, Experiment 1 found that appraisals of ability to understand demonstrated predictive and discriminant validity with regard to interest.

Experiment 2

Experiment 2 sought to replicate and extend the previous study using different manipulations, different complex stimuli, and different dependent measures. Most appraisal theories contend that appraisals cause emotional experience (Roseman & Evdokas, 2004). The causal role of an individual-difference variable, such as the self-report measure of appraisal used in the first study, is ambiguous. To enable stronger inferences about the causal role of appraisals in interest, Experiment 2 manipulated appraisals of coping potential. Two conditions were created. In both conditions, people read a complex, novel, and abstract poem. In a low-ability condition, people simply read the poem and then completed the dependent measures. In a high-ability condition, people received information that made the poem comprehensible and thus should have boosted their appraised ability to understand the poem.

Method

Participants and Design

Thirty-five students enrolled in general psychology at UNCG participated and received credit toward a research participation option. Three people were excluded because they were not native speakers of English, leaving a total sample of 32 people (29 women and 3 men). Each person was randomly assigned to one of two between-subjects conditions: low ability to understand, or high ability to understand. The experimenter was unaware of the participants' condition assignments.

Procedure

People first completed seven filler "personality items" that were taken from real personality scales or invented ad hoc (e.g., "I'm a very self-reflective person"). Their purpose was to divert attention from the study's true purpose and to enable the experimenter to remain unaware of each person's condition assignment, which was on the second page of the questionnaire.

Manipulation of ability to understand

After the filler items, people read a poem. The manipulation of appraised ability to understand was contained in the instructions preceding the poem. In the low-ability condition, people read,

> The following page has a poem by Scott MacLeod. Please read it, see how you feel about it, and then give your impressions and reactions on the following pages. This poem is entitled "The Whitest Parts of the Body," and it is from his book The Life of Haifisch.

In the high-ability condition, people read,

> The following page has a poem by Scott MacLeod. Please read it, see how you feel about it, and then give your impressions and reactions on the following pages. This poem is entitled "The Whitest Parts of the Body," and it is from his book The Life of Haifisch. ("Haifisch" means "shark" in German. All of the poems in this book, including the poem that you will read, are about killer sharks.)

People in both conditions then read the poem (MacLeod, 1999). This 117-word poem is abstract, complex, unfamiliar, and ambiguous. The first stanza, for example, reads, "such daring against men with a throat so big separated by a hundred years full of misfortune: the bloody flux. taken by a fit of madness prone to eating human flesh and measured, in due course, by naturalists."

The manipulation should make the high-ability group feel more able to understand the poem, because people in this group received information that illuminated the poem's meaning. Without this hint, the poem is too abstract to interpret easily.

Dependent measures

People completed the dependent measures after reading the poem. Interest was measured with four items: "I found the poem interesting"; "I thought this poem was boring (reverse scored)"; "This poem made me feel curious"; "I would be interested in reading other poems by this writer." Appraised ability to understand the poem was measured with four items: "I felt able to understand the poem"; "This poem was easy to understand"; "I could get a sense of what the author wanted to express"; "This poem was basically meaningless" (reverse scored). People responded to each item on a 7-point scale ranging from 1 (strongly disagree) to 7 (strongly agree). The items were presented in a random order.

Results

Data Reduction

The four items measuring interest ($\alpha = .88$) and the four items measuring appraisals of ability to understand the poem ($\alpha = .89$) formed scales with reliable scores. Gender was not included in the analyses because too few men participated in the study ($n = 3$).

Manipulation Check

The manipulation of ability had the expected effects on appraisals of ability. As anticipated, people in the high-ability condition reported feeling more able to understand the poem, $t(30) = 2.77$, $p < .009$, $d = .98$, relative to people in the low-ability condition (see Table 3).

Table 3
Effects of Manipulated Ability to Understand on Interest and Appraisals of Ability: Experiment 2

	Interest		Appraised ability	
Condition	*M*	*SD*	*M*	*SD*
Low ability	2.85	1.11	2.91	1.33
High ability	3.81	1.33	4.23	1.38

Note. $n = 16$ per condition. Scale values ranged from 1 to 7.

Effects of Manipulated Ability to Understand on Interest and Appraisals of Ability: Experiment 2

Effects of Appraisals on Feelings of Interest

Did feeling able to understand the complex poem make it more interesting? People in the high-ability condition reported finding the poem more interesting than did people in the low-ability condition, $t(30) = 2.22$, $p < .035$, $d = .78$. Table 3 shows the descriptive statistics.

Thus far, the major predictions have been supported: The manipulation check suggested a successful manipulation of appraised ability to understand, and the manipulation of appraisals significantly affected feelings of interest. Nevertheless, perhaps the manipulation increased interest for some reason other than by affecting appraisals of ability. For example, the manipulation may have affected appraisals of the poem's complexity or appraisals of pleasantness. Mediation analyses thus assessed whether the manipulation affected interest because it affected appraised ability to understand the poem. If self-reported appraisals of ability fully mediate the effect of the manipulation on interest, then it would be unlikely that the manipulation's effect on interest was confounded.

The first mediation analysis used Baron and Kenny's (1986) causal steps method. The manipulation significantly predicted feelings of interest ($\beta = .375$, $p < .035$) and perceived ability to understand the poem ($\beta = .452$, $p < .009$). When the manipulated variable and the mediator were considered simultaneously, the manipulation's direct effect on interest was no longer significant ($\beta = .119$, $p > .47$). The mediator's effect, however, was significant ($\beta = .567$, $p < .001$). This pattern of effects implies that appraised ability to understand significantly mediated between the manipulation of information and feelings of interest.

Several new methods of mediation analysis have been developed since Baron and Kenny (1986) presented their causal steps method (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002). As MacKinnon et al. (2002) pointed out, the Baron and Kenny method indirectly suggests mediation. To assess mediation directly, the modified Sobel test was conducted (see Kenny, Kashy, & Bolger, 1998, p. 260; MacKinnon et al., 2002). This test directly assesses the extent to which a mediator carries the effect of an independent variable on a dependent variable. This test was significant ($Z = 2.12$, $p < .033$), suggesting that appraised ability mediated the effects of the manipulation on feelings of interest.

Discussion

Appraisal research has been criticized for relying on retrospective self-reports, hypothetical scenarios, and correlational designs (e.g., Parkinson, 1995). Whereas Experiment 1 measured appraised ability, Experiment 2 manipulated appraisals by providing information that enabled the participants to understand the poem. The manipulation significantly increased interest, and mediation analyses suggested that it increased interest by increasing appraisals of ability to understand. This experiment thus strengthens our confidence in the causal role

of appraised coping potential in the experience of interest. Furthermore, Experiment 2 provides convergent validity by demonstrating this effect with poetry, a more realistic object than Experiment 1's random polygons.

Experiment 3

Whereas Experiments 1 and 2 emphasized how appraisals of ability to understand predict interest, Experiment 3 examined the joint effects of ability and complexity appraisals. In this experiment, people viewed pictures taken from books and journals of visual art. Complexity was manipulated—half of the pictures were fairly simple, and half were fairly complex. Using authentic visual art, as opposed to random polygons, enhances the experiment's ecological validity and connects appraisal processes to the study of aesthetics (Berlyne, 1971; Tan, 2000). Experiment 3 also extended the quantification of appraised ability. Experiment 1 measured appraisals of general ability to understand art; Experiment 2 manipulated ability appraisals. In Experiment 3, people rated each picture on a series of bipolar semantic differential scales (see Berlyne & Peckham, 1966; Evans & Day, 1971). For each picture, they rated their interest and their appraisals of the picture's comprehensibility. People thus indicated their appraised ability to understand specific pictures, as opposed to their general ability to understand art (see Experiment 1). This method of measuring ability appraisals comes closer to traditional ways of measuring coping potential and offers a converging look at how appraisals relate to interest.

Experiment 3 further examined the discriminant validity of appraisals. In the first experiment, appraisals of ability predicted interest beyond the effects of trait curiosity and openness to experience. To extend this finding, Experiment 3 measured three additional individual differences. First, a different measure of trait curiosity was included. Experiment 1 used the Curiosity and Exploration Inventory, a scale that emphasizes positive subjective experiences (Kashdan et al., 2004). Experiment 3 used the Curiosity subscale of the Values in Action Inventory (Peterson & Seligman, 2004), which gives less weight to subjective experience. Second, measures of trait positive affectivity (PA) and negative affectivity (NA) were included (Watson, 2000). These were included on an exploratory basis. PA correlates highly with measures of trait curiosity (e.g., Kashdan et al., 2004), and interest is a marker for high positive activation (Watson, Clark, & Tellegen, 1988). Low NA might predict interest, given theories of how anxiety inhibits exploration (e.g., Spielberger & Starr, 1994).

If interest comes from appraising something as both complex and comprehensible, then complexity should moderate the relationship between appraisals of ability and interest. For complex pictures, appraised understanding should predict interest. People who appraise the pictures as easy to understand should find them interesting, whereas people who appraise the pictures as hard to understand should find them uninteresting. For simple pictures, in contrast, appraised understanding should not predict interest. This pattern of results would demonstrate the interactive role of the two appraisal components in predicting interest.

Method

Participants and Design

Eighty-two people enrolled in general psychology at UNCG participated and received credit toward a research participation option. Five people were excluded for substantial missing data, leaving a final sample of 77 (59 women and 18 men). The complexity of the visual art (simple, complex) was manipulated within subjects.

Procedure

People participated in groups of 4–8. The experimenter explained that the experiment was about the psychology of art and that the participants would be asked to view a series of pictures and give their impressions of each picture. Participants received a questionnaire that began with measures of individual differences. People first completed the 10-item Curiosity subscale of the Values in Action Inventory (Peterson & Seligman, 2004), which measures trait curiosity. Participants responded on 7-point scales (endpoints: strongly disagree, strongly agree). Next, people completed the trait form of the Positive and Negative Affect Schedule (PANAS; Watson et al., 1988).

Following the measures of curiosity, PA, and NA, participants viewed 12 images of contemporary experimental visual art. The pictures were taken from books by Ken Harris (2001), Geof Huth (1990), Gustav Morin (2003),

Spencer Selby (2003), and Andrew Topel (2002), and from the literary journals Generator (Byrum, 1998) and Score (Hill & Selby, 2000). All images were black-and-white, nonrepresentational, and devoid of words. Each picture's complexity was determined through pretesting, in which a separate sample of participants (n = 34) rated 30 pictures. Complexity was operationalized by ratings on a cluster of novelty-complexity variables, denoted by high complexity, uncertainty, and novelty. The 6 most complex and the 6 least complex pictures were used in Experiment 3.

The pictures were presented in the same random order for each participant. After viewing a picture, people rated their impressions on a set of 7-point semantic differential scales. Interest was measured with two scales: Interesting-Uninteresting and Boring-Exciting. Appraised ability to understand the picture was measured with three scales: Comprehensible-Incomprehensible, Coherent-Incoherent, and Easy to Understand-Hard to Understand. Participants also rated the picture's complexity, as a manipulation check (Complex-Simple).

Results and Discussion

Data Reduction

After reverse scoring as needed, the two items measuring interest and the three items measuring appraised ability were averaged to form interest scores and ability scores for each of the 12 pictures. Higher numbers indicate greater interest and greater appraised ability. Estimates of internal consistency indicated that the scales of trait curiosity (α =.86), PA (α =.90), and NA (α =.82) were sufficiently reliable.

Appraised Ability, Complexity, and Interest

How did appraised ability and complexity affect interest in visual art? The proposed appraisal structure of interest predicts that interest will depend on both complexity and ability. When complexity is high, appraised ability should predict interest—people high in ability should find the picture interesting, whereas people low in ability should find it uninteresting. When complexity is low, however, appraised ability should be unrelated to interest.

Figure 1 shows the zero-order Pearson correlations between interest and appraised ability as a function of complexity. The expectations of the appraisal model were supported. For simple pictures, appraised ability did not significantly predict interest ($r = -.09$, ns, 95% confidence interval [CI] = −.31–.14). For complex pictures, however, appraised ability significantly predicted interest ($r = .41$, $p < .001$, 95% CI =.21–.58). As their confidence intervals show, the correlations differed significantly from each other. (This difference is not because of restricted variance—ratings of simple and complex pictures had similar ranges and standard deviations.)

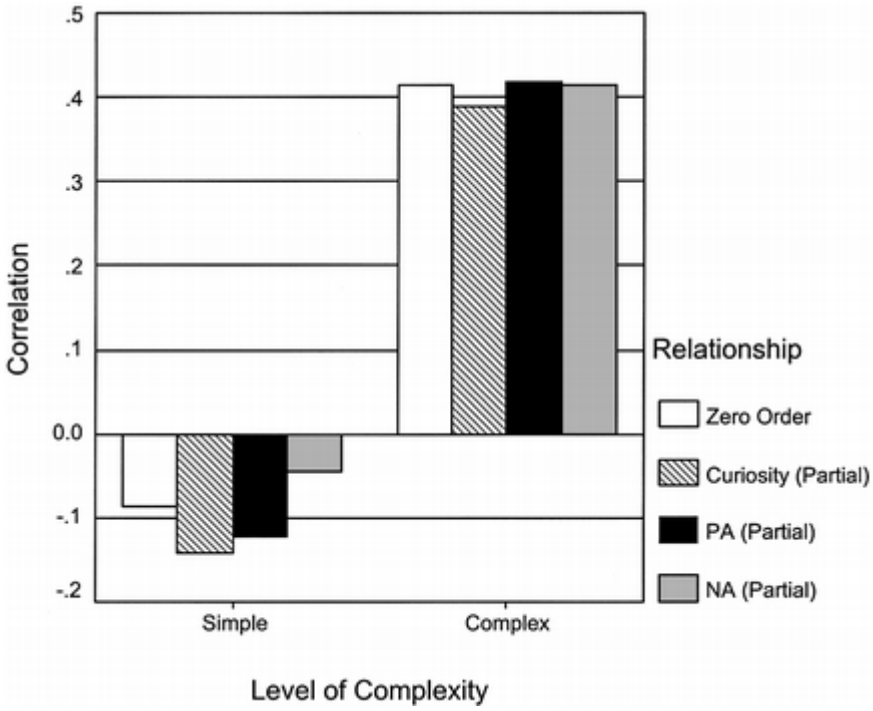

Figure 1. Correlations between appraisals of ability and interest as a function of stimulus complexity: Experiment 3. PA = positive affectivity; NA = negative affectivity

Subsequent analyses examined the validity of appraisals beyond individual differences related to interest. Figure 1 displays partial correlations that controlled for the influences of trait curiosity, PA, and NA. It is apparent that the relationship between interest and ability was not driven by these third variables. Controlling for curiosity, PA, and NA had no appreciable effect on the relationships between interest and appraised ability. Experiment 3 thus demonstrated an interactive effect of complexity and appraised ability in predicting interest. When complexity was low, appraised ability did not predict interest; when complexity was high, however, appraised ability strongly predicted interest. This pattern is congruent with the assumption that components in an appraisal structure are coherently related. This effect was unaffected by individual differences, further showing the discriminant validity of appraisals.

Experiment 4

Thus far, the findings of Experiments 1–3 converge on the hypothesized appraisal structure of interest. The predicted effects have appeared for random polygons, visual art, and poetry, for both manipulated and measured appraisals of ability and complexity, and for several measures of interest. All three experiments, however, have used self-report measures of emotion. Appraisal research has been criticized for relying too heavily on self-reports of emotions and their antecedents (Parkinson, 1995). If the hypothesized appraisal structure of interest is valid, then it should predict behavioral manifestations of interest. Experiment 4 thus measured interest behaviorally. No self-reports of appraisals or emotional experience were taken in the experiment. Experiment 4 thus conservatively tests the generality of the appraisal structure of interest.

People viewed random polygons that varied in complexity. Instead of choosing the most interesting polygon or rating the polygons' interestingness, however, people simply viewed each polygon for as long as they wished. Many experiments suggest that viewing time is a valid behavioral indicator of interest (see Berlyne, 1971, pp. 216–219; Nunnally, 1981; Silvia, in press, chap. 2). For example, viewing time correlates with self-reported interest (e.g., Evans & Day, 1971), and manipulations of novelty and complexity affect both viewing time and self-reported interest (Berlyne, 1974b).

Method

Participants and Design

Forty women enrolled in general psychology at UNCG participated and received credit toward a research participation option. Two people were excluded for not understanding or following the instructions, leaving a final sample of 38. The experiment used a 2 (appraisals of ability) × 10 (polygon complexity) mixed design, with the last variable manipulated within subjects.

Procedure

Earlier in the semester, the participants had completed the 4-item self-report measure of appraised ability to understand complex art used in Experiment 1. High and low scorers were recruited to participate in the present experiment; they did not know that this was the basis for recruitment. Each person participated individually. The experimenter greeted the participants and took them to a private lab room. People were seated at a table that contained a flat-panel monitor and a response pad. The participants learned that the experiment concerned many different dimensions of personality. They expected to view some pictures and then complete some measures of personality. People in fact only viewed pictures; the cover story was intended to obscure the experiment's true purpose.

For the study's "first part," people were told that black-and-white pictures would appear on the screen. They could view each picture for as long as they wished, according to how interesting or boring they found it. They were told to press a button on the response pad to move to the next picture. The pictures were randomly generated polygons, similar to the set used in Experiment 1. Ten levels of complexity were manipulated. To increase reliability, each level of complexity had three different polygons, yielding a total set of 30 polygons. Participants viewed the images on the monitor and responded by pressing any button on the response pad. Each person saw the 30 images in a different random order. The presentation and timing were controlled by SuperLab Pro Version 2.0 (Cedrus Corporation, 2002). Participants made their responses on a Cedrus RB-620 response pad (Cedrus Corporation, 2002), which records responses with a timing accuracy of 1 ms. People completed demographic questions after viewing the pictures.

Results and Discussion

How did appraisals of ability and polygon complexity affect viewing times? Each level of complexity had three polygons, so the three viewing times were averaged for each level of complexity. A mixed-model analysis of variance on viewing times found significant main effects for complexity, $F(9, 324) = 15.95$, $p < .001$, and ability, $F(1, 36) = 9.83$, $p < .003$, as well as a significant interaction, $F(9, 324) = 2.07$, $p < .031$. Figure 2 shows the pattern of effects.

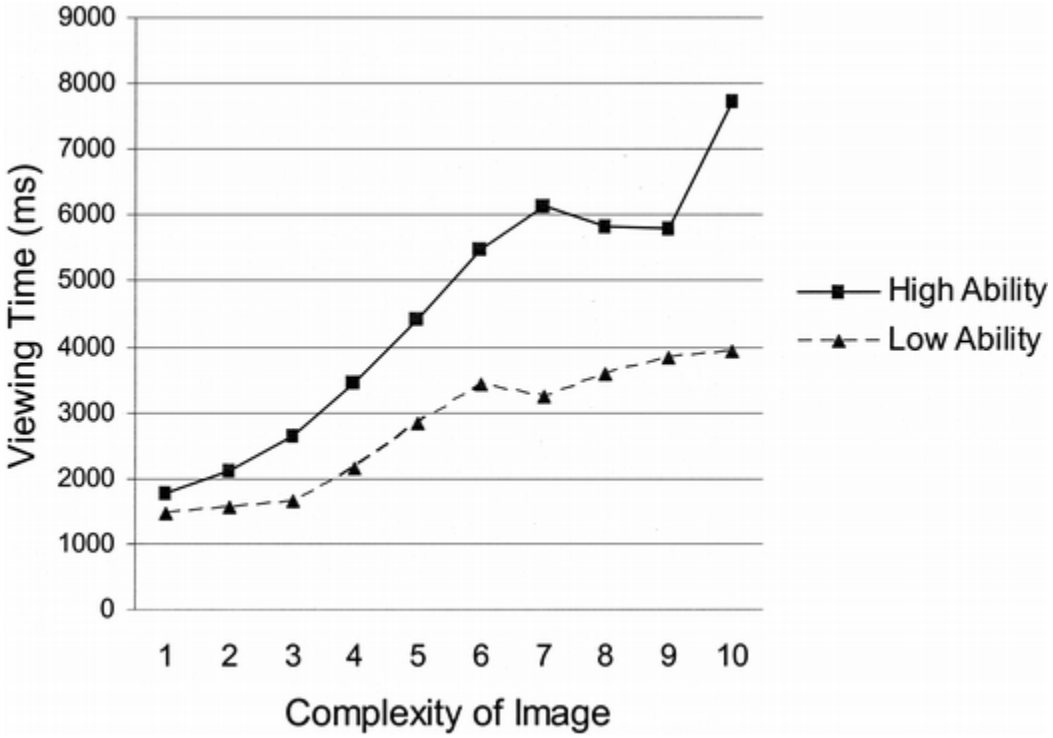

Figure 2. Time spent viewing random polygons (in milliseconds) as a function of appraised ability and the complexity of the polygons: Experiment 4

The pattern of viewing times fully supported the hypothesis. People with low and high appraisals of ability responded similarly to the simple polygons. The high-ability and low-ability groups did not differ at the first two levels of complexity, as indicated by confidence intervals, but they differed at the third and subsequent levels (see Table 4). As the polygons increased in complexity, people high in appraised ability spent more time viewing them. As a result, viewing time was highest when both ability and complexity were at their highest values.

Table 4
Effects of Appraised Ability to Understand and Polygon Complexity on Viewing Time: Experiment 4

Condition	Value 1	Value 2	Value 3	Value 4	Value 5	Value 6	Value 7	Value 8	Value 9	Value 10
Low ability										
M	1,449	1,550	1,665	2,159	2,831	3,439	3,246	3,584	3,846	3,922
95% CI	1,098–1,800	944–2,156	900–2,429	1,182–3,137	1,616–4,046	1,756–5,122	1,736–4,756	2,286–4,883	2,272–5,420	2,216–5,628
High ability										
M	1,768	2,122	2,644	3,455	4,413	5,469	6,120	5,824	5,803	7,730
95% CI	1,398–2,138	1,483–2,761	1,838–3,449	2,425–4,486	3,132–5,693	3,695–7,243	4,529–7,712	4,455–7,193	4,144–7,463	5,932–9,529

Note. $n = 20$ in the low-ability condition; $n = 18$ in the high-ability condition. Values have been rounded to the nearest millisecond. CI = confidence interval.

Effects of Appraised Ability to Understand and Polygon Complexity on Viewing Time: Experiment 4

This experiment thus replicates the prior three experiments with a behavioral measure of interest. Because the viewing time measure conceptually replicated the self-report measures, this experiment contributes to the convergence of evidence on the appraisal structure of interest and alleviates concerns about problems associated with self-reports (see Parkinson, 1995). Furthermore, this experiment demonstrates the interactive role of the two appraisal components. Interest was at its highest when people high in appraised ability encountered images high in complexity, thus illustrating the coherence of the two appraisal components.

General Discussion

Interest has been discussed in many areas of psychology (see Silvia, in press), and it is a prominent part of some theories of emotion (e.g., Fredrickson, 1998; Izard, 1977; Tomkins, 1962). Relative to other emotions, however, interest has received little research attention (Ellsworth, 2003). One reason for this may be the lack of a general model that explains the elicitation of interest and its differentiation from other emotions. Appraisal theories of emotions successfully explain these facets of emotional experience (Roseman & Smith, 2001) and thus provide a powerful framework for understanding the causes and consequences of interest. Because few studies have applied appraisal concepts to interest, the present research examined the appraisal structure of interest. On the basis of theories of appraisal structure and process (Roseman, 2001; Scherer, 2001a), two appraisal components were considered: an appraisal of novelty-complexity, viewed as a family of appraisals centered around new, unexpected, and complex events—and an appraisal of coping potential, viewed as the ability to understand the poorly understood event identified by the first appraisal.

Four experiments provided evidence for the role of these appraisals in the elicitation of interest. Appraisals of coping potential predicted finding complex polygons (see Experiment 1) and abstract poetry more interesting (see Experiment 2). Interest clearly depended on both appraisal components. Appraised coping potential did not predict interest in simple pictures, but it strongly predicted interest in complex pictures (see Experiment 3), reflecting the coherence of the two appraisal dimensions. Furthermore, behavioral expressions of interest—time spent viewing an image—were highest when both appraisals were at their highest. People spent the most time viewing a picture when the picture was highly complex and they felt highly able to understand complex art (see Experiment 4).

It is worth emphasizing the evidence for convergent and discriminant validity. Appraisals of novelty-complexity and of coping potential predicted interest regardless of whether the appraisals were measured or manipulated, whether interest was measured with self-report scales or behavioral measures, or whether the interesting things were randomly generated polygons, abstract poetry, or visual art. These experiments also supported the discriminant validity of appraisals. Experiments 1 and 3 examined whether appraisals explained interest beyond the effects of relevant individual differences. Appraisals explained interest as expected; controlling for openness to experience (McCrae, 1996), PA and NA (Watson, 2000), and two measures of trait curiosity (Kashdan et al., 2004; Peterson & Seligman, 2004) did not diminish these effects. Likewise, appraisals of coping potential predicted interest but not enjoyment, a distinct positive emotion (see Experiment 1).

Ellsworth and Smith's (1988b) Appraisal Model of Interest

Having viewed the empirical evidence, it is easier to compare the present appraisal structure of interest with a structure proposed by Ellsworth and Smith (1988b). Interest was not the focus of their research; their goal was to examine the differentiation of many positive emotions. They found that interest was characterized by appraisals of pleasantness, high attentional activity, and high effort. Interest was distinguished from other positive emotions by its association with high attentional activity. This appraisal structure overlaps with the structure developed here, if attentional activity and effort are understood broadly. Smith and Ellsworth (1985) defined attentional activity as an appraisal of whether something deserves or demands attention. Both novelty-complexity and coping potential could overlap with this appraisal. Likewise, assessing something as complex could influence an appraisal of effort. High effort might reflect a holistic appraisal of both novelty-complexity and coping potential, provided that appraising an event as poorly understood yet understandable implies that the event deserves effort. If coping potential were low, people would disengage instead of expending effort (Silvia, 2003; Wright & Kirby, 2001).

At the same time, the appraisals proposed by Ellsworth and Smith (1988b) need to be interpreted broadly to map onto the present research. The present appraisal structure, in contrast, aligns closely with the experiments' manipulations. It is thus easier to understand the findings in terms of appraisals of novelty-complexity and coping potential. The visual art used in Experiment 3 varied in complexity; it seems awkward to reframe this manipulation as a manipulation of effort or attention demand. Similarly, Experiment 2 manipulated coping potential—adding information increased self-reported coping potential, which in turn fully mediated the effect of the manipulation on interest. High coping potential may affect appraisals related to effort or attention, but

these latter appraisals clearly were not manipulated. The complexity of the random polygons used in Experiments 1 and 4 was defined by the number of sides. Complexity represents what was manipulated better than attention demand or effort.

Furthermore, the appraisal structures diverge in their inclusion of a pleasantness appraisal. Ellsworth and Smith (1988b) proposed that a pleasantness appraisal was involved, whereas the present research did not include this appraisal. If the function of interest is to motivate exploration and information seeking (Izard & Ackerman, 2000; Tomkins, 1962), then it is unclear why the tendency to explore would be limited to pleasant things. Many studies find interest in unpleasant events. In other appraisal research, interest occurred during many negative situations (Ellsworth & Smith, 1988a). Research in aesthetics finds that people can be interested by disturbing art (e.g., Rawlings et al., 2002) and that complex images and music can be interesting but unpleasant (e.g., Crozier, 1974; see Silvia, in press, chap. 2). Thus, evidence suggests that an appraisal of pleasantness may not be central to interest.

The differences between the present appraisal structure and Ellsworth and Smith's (1988b) appraisal structure may stem from methodological differences. In the present research, the appraisal structure was derived from past experimental research and established appraisal dimensions (Scherer, 2001a). The structure was then tested in real situations to avoid biases resulting from retrospective reports of emotions. In Ellsworth and Smith's research, participants recalled and described past pleasant experiences and rated them on self-report scales. Although that method enabled data on a broad range of positive emotions, it did not enable much detail about any single emotion. Moreover, by encouraging the selection of memorable, extended emotion episodes, it may have enhanced the contribution of pleasantness to interest. The present research opted for fidelity over breadth—the experiments have little to say about positive emotions other than interest, yet they offer detailed information about the convergent and discriminant validity of the appraisal structure of interest. A direct comparison of the two appraisal structures deserves attention in future work.

Appraisal Processes and Interest

Although the present experiments focused on appraisal structure, they have implications for the study of appraisal process. One process issue is whether appraisals unfold sequentially or simultaneously (Scherer, 1999). The appraisal structure explored in the present research implies a sequential process, although the experiments did not address this. It seems likely that the novelty check precedes the coping potential check, because people must identify a disruption in processing before assessing their ability to comprehend the source of the disruption. This does not negate the possibility that people can eventually appraise situations thematically (Lazarus, 2001), particularly as they become experienced in the domain. Yet, because interest is fundamentally linked to novelty, there may be fewer instances in which people can make holistic appraisals rooted in past appraisal processes. This is an intriguing question for future research.

Because interest's appraisal structure is fairly simple, involving few appraisal components, interest should transform into other emotions as the appraisal process unfolds. Interest thus may be especially useful for studying transitions in emotional experience. Many researchers have pointed out that interest is closely tied to surprise, shame, anxiety, and happiness (Berlyne, 1960, 1971; Izard, 1977; Tomkins, 1962). A sequential process of appraisal can explain these temporal relationships. If an appraisal of coping potential follows an appraisal of novelty, then we would expect a shift from surprise to interest (Tomkins, 1962). Surprise, driven by the first appraisal of novelty, should shift following a subsequent appraisal of coping potential (cf. Gendolla & Koller, 2002). One may also explain links between interest and shame (e.g., Nathanson, 1992) by noting that appraisals of compatibility with moral standards follow the appraisals involved in interest (Scherer, 2001a). The process of reappraisal (Lazarus, 2001) also illuminates temporal shifts in interest. A shift between interest and anxiety could stem from the reappraisal of coping potential. If high coping potential is reappraised at a lower value, then interest should shift to anxiety, reflecting the belief that the event cannot be managed. Conversely, if low-appraised coping potential is reappraised at a higher value, then anxiety should shift to interest, reflecting the reduction in perceived threat. Such predictions are speculative, but they highlight the

value of the appraisal perspective for making new predictions about the dynamics of interest and its relations to other emotions.

Theoretical Issues for Future Research

Several unresolved theoretical issues are raised by this research. One set of issues concerns the meaning of the novelty-complexity and coping potential appraisals. First, are novelty and complexity sufficiently equivalent to be viewed as a single appraisal? The present research views the novelty-complexity appraisal broadly, akin to Berlyne's (1960, 1971) notion of "collative variables." In an extensive analysis, Berlyne (1960, chap. 2) pointed out that variables such as uncertainty, novelty, conflict, and complexity all involve comparing information, such as comparing information with one's expectations or with other incoming information. Each variable could thus create subjective feelings of uncertainty and, in modern terms, a sense of disrupted or dysfluent processing. For this reason, he often used the terms interchangeably, sometimes using conflict or uncertainty to cover them all. Empirical research supports Berlyne's unitary view. Manipulations of novelty, uncertainty, and complexity have similar effects on measures of choice, viewing time, and self-reported interest (see Berlyne, 1971). Moreover, semantic differential studies find that ratings of these properties are highly correlated—"collative property" factors routinely appear in multivariate studies (e.g., Berlyne, 1971, 1974a; Crozier, 1974; Evans & Day, 1971). This research suggests that novelty and complexity may typify a coherent family of appraisals captured by a novelty check.

Second, one may question whether "coping potential" accurately represents what was measured and manipulated. The present usage may seem uncommon because appraisal research usually assesses coping potential in the context of dealing with a demanding event, such as forestalling harm or achieving a performance goal. Nevertheless, if a goal is primarily epistemological, such as learning something new or closing a gap in knowledge, then people can appraise resources, skills, and opportunities for achieving the goal. Evidence for this comes from research on metacognition, which finds that the self-regulation dynamics developed by action theories (e.g., Carver & Scheier, 1981) extend to the self-regulation of knowledge and learning (Thiede, 1999). People can set learning goals, assess their ability to achieve them, and monitor their progress. In fact, many of these experiments assess people's judgments of their ability to learn something (e.g., Thiede & Dunlosky, 1999), which resemble appraisals of coping potential. Given these theories and findings, it seems reasonable to speak of appraisals of coping potential in regard to goals associated with learning, comprehension, and understanding.

A second set of issues concerns the possibility that additional appraisals are central to interest. This issue is complex. On the one hand, some appraisal theories assume that a lot of emotions can be identified, each with a unique appraisal structure (Ellsworth & Scherer, 2003). From this perspective, adding appraisal components would specify new emotions that fall within the family of interest-related or "epistemology-based" emotions (Keltner & Shiota, 2003). On the other hand, an appraisal structure is essentially unfalsifiable if competing structures are said to represent different but related emotions. The possibility of additional components thus should not be dismissed offhand.

Candidates for a third component include appraisals of pleasantness, goal congruence and motive consistency, and expected reward. It seems unlikely that pleasantness is central to interest; the evidence reviewed earlier shows interest in unpleasant things. Appraisals of goal congruence and expected reward are more complex, but a few reasons suggest that they may not be essential to interest. First, if the function of interest is to motivate exploration and information seeking (Izard & Ackerman, 2000), then it would be sensible for interest to occur in the absence of information about relevance to other goals and the likelihood of rewards. Second, these appraisals were probably normally distributed among participants in the present research. The samples varied in artistic training and aptitude, past experience with art and poetry, and other values and attitudes that would affect whether the pictures and poetry were congruent with a goal or expected to be rewarding. Third, it is conceivable that these appraisals covaried with the individual-difference measure of coping potential (see Experiments 1 and 4), but the manipulation of coping potential (see Experiment 2) and the image-specific

assessment of coping potential (see Experiment 3) indicate that coping potential was not confounded with other appraisals.

These arguments suggest that appraisals of pleasantness, goal congruence, and expected reward are not pivotal to interest's appraisal structure. Yet, no experiments have directly tested the necessity of these appraisals—this is a central task for future research. The present studies are the first step in exploring the appraisal structure of interest. They provide a starting point for future research and a methodological strategy for evaluating the causal role of appraisals. When examining the relevance of other appraisal components, future research should manipulate the appraisals when possible, measure momentary feelings of interest, and assess the discriminant validity of the appraisals relative to other emotions.

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