

## **Are the sources of interest the same for everyone? Using multilevel mixture models to explore individual differences in appraisal structures.**

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### **Abstract:**

How does personality influence the relationship between appraisals and emotions? Recent research suggests individual differences in appraisal structures: people may differ in an emotion's appraisal pattern. We explored individual differences in interest's appraisal structure, assessed as the within-person covariance of appraisals with interest. People viewed images of abstract visual art and provided ratings of interest and of interest's appraisals (novelty–complexity and coping potential) for each picture. A multilevel mixture model found two between-person classes that reflected distinct within-person appraisal styles. For people in the larger class (68%), the novelty–complexity appraisal had a stronger effect on interest; for people in the smaller class (32%), the coping potential appraisal had a stronger effect. People in the larger class were significantly higher in appetitive traits related to novelty seeking (e.g., sensation seeking, openness to experience, and trait curiosity), suggesting that the appraisal classes have substantive meaning. We conclude by discussing the value of within-person mixture models for the study of personality and appraisal.

**Keywords:** interest | personality | multilevel modeling | latent-class analysis | finite mixture models

### **Article:**

Although the roots of appraisal theory run deep, empirical research on appraisal first flourished in the 1980s and early 1990s, when several classic appraisal theories were developed (e.g., Lazarus, 1991; Roseman, 1984; Scherer, 1986; Smith & Ellsworth, 1985). This generation of appraisal research, for the most part, focused on appraisal structures, the sets of appraisals associated with each emotion. As appraisal research developed, researchers began to test the generality of appraisal structures across theories, methods, and cultures (Roseman & Smith, 2001).

One straightforward extension of appraisal research is the study of individual differences. Many studies, for example, have examined individual differences in tendencies to experience particular emotions, such as anger, happiness, shame, sadness, and interest (e.g., Watson, 2000). Other studies have examined individual differences in the tendency to make particular appraisals and how these differences contribute to emotion (e.g., Dodge, 1993; Silvia, 2008a; Smith & Kirby, 2009 this issue ; Smith & Pope, 1992; van Reekum & Scherer, 1997).

Recently, researchers have considered whether appraisal structures themselves can vary across people (Kuppens, Van Mechelen, & Rijmen, 2008; Kuppens, Van Mechelen, Smits, & Ceulemans, 2007). The appraisal structures identified by the classic studies might represent population structures, the typical structures that result from aggregating across different subpopulations. For example, studies of anger usually find that appraisals of goal incongruence, other accountability, and unfairness predict anger (Kuppens, Van Mechelen, Smits, & De Boeck, 2003). Although this structure describes the sample as a whole, it may conceal distinct subpatterns of appraisal. Imagine, for example, that only two of the three appraisals are necessary to become angry, but people differ in which two are important. Aggregating across these subgroups will give the impression that all three appraisals are important; the subgroups' differences would appear to be error variance.

To date, few studies have explored individual differences in appraisal structures, in part because psychology's typical statistical models presume that the population is homogeneous (i.e., without distinct subgroups). Kuppens and his colleagues (2007) considered whether people differ in the appraisals associated with anger. People completed guided imagery tasks for situations that varied in appraisals relevant to anger, and they gave reports of appraisals and anger. Several "person types" appeared in the data, indicating individual differences in appraisal-anger relations. For example, for some people, appraising an event as deliberately caused was necessary for anger; for other people, however, this appraisal was unnecessary for anger. Aggregating these distinct appraisal patterns yielded the typical appraisal structure found in past research.

The possibility of individual differences in appraisal structures is intriguing: it extends the study of personality and appraisal beyond issues of amount and into issues of kinds. Some appraisal theories imply that appraisal structures should be the same for everyone (e.g., Roseman & Smith, 2001); other theories presume widespread individual differences in appraisal processes (e.g., Scherer, 2001). Finding that people differ in an emotion's appraisal structure would clearly suggest that appraisal structures aren't invariant and that individual differences in appraisal are much broader and more complex than previously believed. Moreover, finding variance in appraisal structures would raise new and interesting questions for appraisal theories, such as why people differ and how the differences develop.

Our research extends this nascent field (Kuppens et al., 2007), using a different emotion, methodological approach, and statistical model. We used multilevel mixture models

(Asparouhov & Muthén, 2008) to explore latent classes in the within-person appraisal structure of interest, the emotion associated with curiosity, exploration, and intrinsic motivation (Izard, 1977; Silvia, 2006b; Tomkins, 1962).

### Interest and its appraisal structure

Interest is an underdog in the psychology of emotion. Although it is a prominent emotion in some theories (e.g., Izard, 1977; Tomkins, 1962), interest isn't discussed in many emotion theories or in most appraisal theories (cf. Ellsworth & Smith, 1988). Nevertheless, research suggests that interest has the features that an emotion ought to have. Interest's emotion components—particularly the expressive, functional, cognitive, and subjective components—have been widely studied (see Silvia, 2006b, 2008b). Interest's central function is to motivate curiosity and exploration in response to new and uncertain things. By fostering learning and exploring for their own sake, interest promotes the growth of knowledge, competence, and expertise (Abe & Izard, 1999; Fredrickson, 1998; Kashdan, 2009; Tomkins, 1962). To use one example, research in reading shows that interesting texts promote the use of deeper text-processing strategies, longer engagement with the text, and ultimately better comprehension and memory (see Ainley, Hidi, & Berndorff, 2002; Sadoski, 2001).

The appraisal structure of interest, according to recent research (Silvia, 2006b, 2008b), involves two components: an appraisal of novelty–complexity, and an appraisal of coping potential. For interest, these appraisals are metacognitive: they evaluate aspects of knowing and understanding. As understood within the multilevel sequential-check model of appraisal (Scherer, 2001), people first appraise an event's novelty, viewed broadly as appraisals of incongruity, complexity, unexpectedness, obscurity, and uncertainty (Berlyne, 1960). Following this appraisal, an appraisal of coping potential assesses the person's ability to comprehend the new, complex event. Events that are appraised as complex yet potentially comprehensible are experienced as interesting.

This appraisal structure is congruent with past research (see Silvia, 2006b, chap. 2). One literature shows that the family of novelty–complexity variables affects interest (see Berlyne, 1960, 1971; Walker, 1980); a different literature shows that coping potential affects interest (Millis, 2001; Russell, 2003; Russell & Milne, 1997). Many recent studies have shown that novelty–complexity and coping potential predict the experience of interest, both in experimental designs, between-person correlational designs, and within-person correlational designs (see Silvia, 2005a, b, 2006a, 2008a). These effects have replicated for measured and manipulated appraisals, for self-report and behavioural measures of interest, and for interest in random polygons, visual art, and poetry. Moreover, this appraisal structure is specific to interest: it doesn't predict related positive emotions, such as enjoyment (Turner & Silvia, 2006).

### Multilevel studies of in vivo data

When testing appraisal theories, research should examine appraisals and emotions in response to real events. Historically, appraisal research has relied on studies of retrospective events, hypothetical scenarios, or guided imagery. These methods are useful for studying many emotions at once (e.g., Smith & Ellsworth, 1985), and naturalistic studies have generally replicated studies using other methods (e.g., Tong et al., 2007). Nevertheless, the value of studying appraisals and emotions in response to real events is obvious. Furthermore, appraisal research, like most emotion research, usually examines between-person effects rather than within-person effects. Strictly speaking, appraisal theories predict within-person relationships between emotion components, so research ought to test these predictions using models for within-person data structures.

Apart from being interesting in its own right, interest is a good emotion for testing in vivo, within-person relationships of appraisal and emotion. First, interest's appraisal structure has only two appraisals, and both are easy to measure repeatedly via self-report. Second, it is easy for researchers to manipulate the experience of interest during the course of a laboratory study. Dozens of laboratory experiments have varied interest using realistic stimuli, such as music, visual art, natural scenes, essays, poetry, and short stories (see Berlyne, 1971; Silvia, 2006b, chap. 2). Some emotions, however, are not easy to evoke in a lab setting; other emotions, for ethical reasons, probably could not be evoked more than once. Because interest is easily manipulated over time, researchers can use interest to examine in vivo appraisal–emotion relations in response to real events over time.

#### Multilevel mixture models of appraisal

Our analytic approach applies latent class models to a traditional multilevel model. In a typical multilevel model of appraisal and emotion, the within-person covariance of appraisals and emotions is estimated. Such a model yields estimates of the typical within-person effects of appraisals on emotion. A mixture-model extension explores the presence of latent classes in the multilevel data (Asparouhov & Muthén, 2008). In this approach, the traditional multilevel model represents a 1-class model, in which the underlying population consists of one homogeneous class. When using a multilevel mixture model, multiple classes are identified. Thus, at a conceptual level, within each class a traditional mixed model is defined. All people from the same class are assumed to be similar in that the mixed model for that class best describes their responses.

When using a multilevel mixture model, one can expect to obtain population parameters describing the proportion of people that belong to each class in addition to values indicating the probability that each person belongs to any given class (which can be used to determine class membership). Also, for each class, the mixed model parameters (i.e., within-person effects) can be estimated. Differences between classes can be described based on the patterns of within-person effects. Multilevel mixture models (which subsume the more commonly used growth

mixture models) have been used in many longitudinal contexts, from adolescent behaviour (e.g., Nagin, 1999) to studies of aging (e.g., Small & Bäckman, 2007).

If classes represent meaningful clusters of people, then the classes ought to differ in other meaningful ways, such as in dimensions of personality. Predicting class membership with other constructs is thus a valuable way of illuminating the nature and validity of a class solution. In the present research, we assessed several traits that fall within the openness to experience factor of personality (McCrae, 2007), such as openness, curiosity, and sensation seeking. Of the five major factors, openness is the most relevant to interest, novelty-seeking, appetitive motivation, and exploration (Silvia, 2006b, chap. 4). Dozens of studies show that people high in the openness cluster of traits are more sensitive to and responsive to novelty. For example, people high in openness prefer complex visual art over simple art, seek out novel instead of familiar experiences, and show stronger physiological activation to novelty (e.g., Feist & Brady, 2004; Kashdan, 2004; Rawlings, Twomey, Burns, & Morris, 2002; Zuckerman, 1994). If we find a class in which the novelty–complexity appraisal is the major (or only) predictor of interest, we would expect people in that class to be relatively high in openness.

#### The present research

The present research examined individual differences in interest's appraisal structure. We explored whether people differed in the within-person relationships between interest and its appraisals. In our study, people viewed a broad range of images, and for each they rated feelings of interest and interest's appraisals. The study thus affords a look at within-person responses to real situations. Our research extends the evidence for an appraisal approach to interest, which is relatively new, and adds to the growing literature on individual differences in appraisal structure (Kuppens et al., 2007). More generally, the present research illustrates how multilevel mixture models can be applied to explore individual differences in appraisal–emotion relationships.

## METHOD

### Participants

A total of 191 students—153 women, 38 men—enrolled in general psychology at the University of North Carolina at Greensboro participated and received credit toward a research option. Around 94% spoke English as a native language.

### Procedure

People participated in small groups, ranging from 3 to 8 people per session; they didn't communicate with each other during the session, and they couldn't see each other's questionnaires. After collecting consent forms, the experimenter explained that the study was about people's impressions, feelings, and reactions related to different kinds of visual art. The

experimenter emphasised that there were no right or wrong answers concerning people's impressions and opinions, and that people should feel free to be candid.

### Individual differences

Each person received a questionnaire containing demographic items and individual-differences scales. We measured a range of individual differences related to trait levels of interest, curiosity, and appetitive motivation. We assessed openness to experience, the Big Five factor most associated with curiosity, exploration, and aesthetic interests (McCrae, 2007), with the IPIP Openness scale (Goldberg et al., 2006). We assessed sensation seeking, the tendency to seek new and varied experiences (Zuckerman, 1994), with a brief scale (Hoyle, Stephenson, Palmgreen, Lorch, & Donahue, 2002). We assessed trait curiosity with two brief measures of global trait curiosity—the VIA Curiosity/Interest in the World scale (Peterson & Seligman, 2004) and the Curiosity and Exploration Inventory (Kashdan, Rose, & Fincham, 2004)—and two measures of narrower facets of trait curiosity: epistemic curiosity (Litman & Spielberger, 2003) and perceptual curiosity (Collins, Litman, & Spielberger, 2003). These four curiosity scales capture different aspects of curiosity, but they correlate highly and tap the same latent construct (e.g., Litman & Silvia, 2006). The self-report items used 5-point Likert scales (1 = strongly disagree, 5 = strongly agree). Finally, we asked people how many courses related to the arts they had taken in college (assessed as a count) and how interested they were overall in art (1 = not at all, 5 = very interested).

### Appraisals and interest

Following the measures of individual differences, participants viewed 12 images taken from books and journals of experimental visual art. These pictures have been used in past research on interest and aesthetics (Silvia, 2005a, b, 2006a, 2008a). The images were black-and-white, abstract, and generally non-representational. To expand the within-person variance in interest and appraisals, we selected relatively complex and relatively simple pictures, based on a pre-test of 30 pictures.

The images appeared in the same random order for each person. People viewed each image for as long as they wished; afterward, they gave ratings of emotions and appraisals on a set of 7-point semantic-differential scales, which have been used extensively in past work (e.g., Berlyne & Peckham, 1966; Evans & Day, 1971; Silvia, 2005a, 2008a; Turner & Silvia, 2006). Interest was measured with two items: interesting–uninteresting and boring–exciting. Appraisals of the image's complexity was measured with complex–simple. Appraisals of coping potential (one's ability to understand the picture) was measured with three items: comprehensible–incomprehensible, coherent–incoherent, and easy to understand–hard to understand. These items were averaged to form composite scores, after reverse-scoring as needed. High scores reflect high levels of interest and appraisals of high novelty and high coping potential.

## RESULTS

## Statistical model

Figure 1 depicts the multilevel mixture model. The within-person effects of both appraisals on interest, and the interest intercept, were modelled as random, as denoted by the filled circles. These three random effects were allowed to vary across latent classes. The latent classes were thus identified by between-person differences in the within-person slopes and intercepts. In our model, the latent classes existed at the between-person level, consistent with our assumption that between-person features are the source of differences in within-person relationships (Asparouhov & Muthén, 2008). At the between-person level, the random effects' within-class variation was fixed to zero, which simplified the model and its estimation.<sup>1</sup> All analyses were conducted with Mplus 5.1, using maximum-likelihood with robust standard errors. We modified the Mplus defaults for random starting values, particularly the number of initial-stage (1000) and final-stage (100) sets, the perturbation factor (20), and the seed value (various).

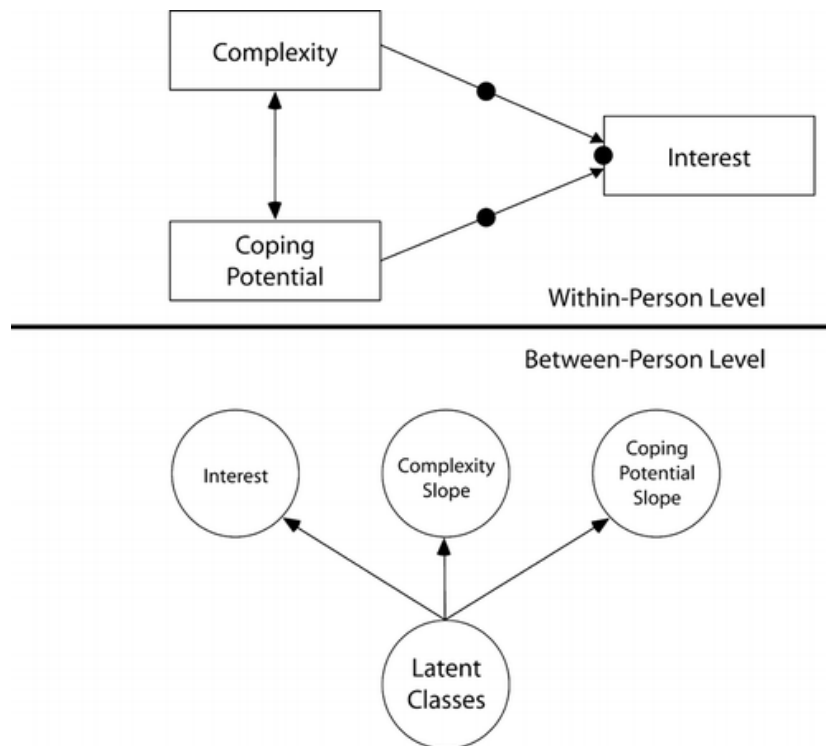


Figure 1. The multilevel mixture model.

### A 1-class multilevel model

As a benchmark, we conducted a 1-class multilevel model, in which both appraisals predicted interest. The intraclass correlation was low (.068), indicating that most of the variance was at the within-person level. As expected, both appraisals significantly predicted interest. On average, people rated a picture as more interesting when they appraised it as more complex ( $b=0.439$ ,  $p<.001$ ) and as more comprehensible ( $b=0.226$ ,  $p<.001$ ). Figure 2 depicts these effects in the MLM column; Table 1 provides descriptive statistics. Apart from replicating past research, this

model shows that both appraisals predicted interest for the sample as a whole, and that the effect of complexity was somewhat larger than the effect for coping potential.

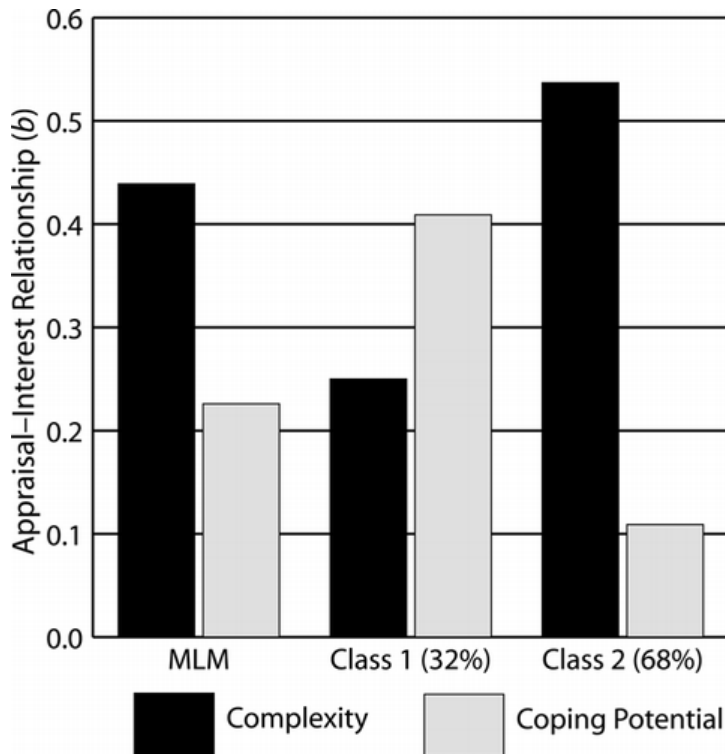


Figure 2. Appraisal-interest relationships for the 1-class model and the 2-class model.

**Table 1 has been omitted from this formatted document.**

#### Latent classes in appraisal-interest relations

Next, we examined whether these within-person effects varied across latent classes. We evaluated multilevel mixture models with 2 classes and 3 classes. The problem of choosing the correct number of latent classes is an active area of research. To date, promising indicators available in Mplus include a likelihood ratio test (LRT), an adjusted LRT, a bootstrapped version of the LRT, and the Bayesian Information Criterion (see Brame, Nagin, & Wasserman, 2006; Lo, Mendell, & Rubin, 2000; McLachlan & Peel, 2000; Nylund, Asparouhov, & Muthén, 2007; Tofghi & Enders, 2008).

Several statistical indicators favoured a final solution with 2 latent classes. First, the 1-class model was rejected in favour of the 2-class model: the LRT ( $p < .0001$ ), adjusted LRT ( $p < .0001$ ), and bootstrap LRT ( $p < .0001$ ) were significant, and the Bayesian Information Criterion (BIC) was smaller for the 2-class model (8128.748) than for the 1-class model (8201.016). These indicators further suggested retaining the 2-class model instead of a 3-class model. The LRT ( $p = .72$ ) and the adjusted LRT ( $p = .73$ ) were both non-significant, the bootstrap LRT was



marginal ( $p=.07$ ), and the BIC was smaller for the 2-class model (8128.748) than for the 3-class model (8145.279).

Figure 2 depicts how the appraisal–emotion relationships varied between the classes. The first class contained around 32% of the observations. For this class, both appraisals significantly predicted interest, but the coping potential appraisal had a larger effect than the novelty–complexity appraisal (see confidence intervals in Table 1). The second class contained around 68% of the observations. For this class, both appraisals significantly predicted interest, but the novelty–complexity appraisal had a larger effect than the coping potential appraisal (see Table 1).

It thus appears that the overall multilevel model obscured two distinct patterns of appraisal. In one pattern, the coping potential appraisal had a larger weight; in the other pattern, the novelty–complexity appraisal had a larger weight.

### Predicting class membership

One way to illuminate the meaning of the classes is to examine whether other variables meaningfully predict class membership. (This is akin to the use of personality traits to predict distinct “person types” of anger appraisal; Kuppens et al., 2007.) We thus examined whether the two classes differed in the individual differences that we measured at the start of the experiment. To compare the classes, we used the posterior-probability sampling method afforded by Mplus 5.1, which is more computationally efficient than including a large set of Level 2 covariates in the model.

Table 2 lists the descriptive statistics for each class and the p-value for the between-class comparison. People in Class 2—the class in which interest was driven largely by the novelty–complexity appraisal—were significantly higher in openness to experience, sensation seeking, and all four measures of trait curiosity. They also expressed a greater overall interest in art. Class 2 contained relatively fewer women, although the percentage difference was not great (i.e., 78% to 82%). The classes did not differ in the number of art courses taken in college.

Table 2 Individual differences across the two latent classes

	Class 1 (32%)	Class 2 (68%)	$\chi^2$ (1 df)	p-value
Openness to experience	3.65	3.84	45.66	.001
Sensation seeking	3.12	3.40	50.68	.001
Trait curiosity (VIA)	3.61	3.78	38.16	.001
Trait curiosity (CEI)	3.55	3.64	12.83	.001
Epistemic curiosity	3.45	3.67	54.34	.001

Perceptual curiosity	3.54	3.78	56.91	.001
Overall interest in art	3.12	3.51	38.86	.001
Number of art classes	1.21	1.15	0.21	.65
Gender	82%	78%	5.18	.023

Note: The traits were measured using a 1–5 response scale; the values for gender are proportions of women per class.

The consistency of the findings across different scales suggests that the classes differ meaningfully on the broad dimension of personality related to curiosity, openness, and appetitive motivation. Many studies have shown that people high in the family of curiosity variables—openness to experience, sensation seeking, and trait curiosity—seek novel experiences, prefer complexity to simplicity, and generally find things more interesting (see Berlyne, 1960, 1971; Kashdan, 2004; Silvia, 2006b, 2008a; Zuckerman, 1994). For these people, then, the novelty–complexity appraisal has a larger weight in bringing about feelings of interest.

## DISCUSSION

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## METHOD

## RESULTS

## DISCUSSION

Do the same appraisals predict the same emotions for everyone? Traditionally, appraisal research has assumed that appraisal structures apply to everyone: people may vary in tendencies to make appraisals (e.g., Smith & Pope, 1992), but the appraisal structure itself doesn't vary. Recently, however, research has suggested that appraisal structures may vary across people (Kuppens et al., 2007). The differences may be quantitative, such as shifts in each appraisal's weight, or qualitative, such as differences in the appraisals that make up the appraisal structure.

In our study, we explored whether people varied in how interest's appraisals predicted interest in response to real events. Two latent classes appeared in the data; the classes differed in which appraisal had a stronger weight. For both classes, both appraisals significantly predicted interest. In the larger class, however, the novelty–complexity appraisal had a larger effect on interest; in the smaller class, the coping potential appraisal had a larger effect. The overall appraisal structure thus concealed interesting individual differences in how the appraisals predicted interest.

These two classes differed in other variables, notably traits related to openness, novelty-seeking, and curiosity. We found that people high in the openness cluster of traits were more likely to be in the class in which interest was strongly predicted by novelty–complexity appraisals. This finding is consistent with the collected body of work on openness: people high in this family of traits prefer complex and unfamiliar stimuli, seek and enjoy novel experiences and intense sensations, tend to feel curious during daily life, and show stronger physiological responses to novelty (Kashdan, 2004; Kashdan & Steger, 2007; Silvia, 2006b, chap. 4; Spielberg & Starr, 1994; Zuckerman, 1994). Novelty thus plays a major role in the behavioural, physiological, subjective, and cognitive components that typify people high in openness. Although these class differences provide information for the validity of the class solution, they are nevertheless exploratory and preliminary. There are many ways in which the classes could differ, and the openness family may not be the most important one. Future work should assess a broader range of individual differences to illuminate the meaning of the differences in appraisal structure.

#### Implications for appraisal theory and research

Some appraisal theories endorse a probabilistic link between appraisals and emotions (see Kuppens et al., 2003). Scherer's (2001) theory, for example, allows for a wide range of individual differences in appraisal, including differences in both the process and structure of appraisal (see van Reekum & Scherer, 1997). His theory also views emotion components, including appraisal components, as loosely and dynamically coupled. The present findings are easy to incorporate into Scherer's theory, given its interest in individual differences and its probabilistic view of appraisal dynamics. Other theories, however, consider the appraisal–emotion link to be more deterministic than probabilistic. Smith, for example, has suggested that an appraisal pattern can represent a necessary and sufficient set of conditions for an emotion (see Roseman & Smith, 2001; Smith & Kirby, 2004; Smith & Pope, 1992).

The present findings clearly favour the probabilistic approach. In our study, two contrasting patterns of appraisal appeared. Both appraisals predicted interest in both groups, but the appraisals' weights were sharply different. The typical appraisal structure—novelty–complexity and coping potential—captures the sample-level appraisal effects, but it misses information about distinct subgroup effects. Past work on anger (Kuppens et al., 2007), too, indicates that anger's appraisal components are loosely linked to the experience of anger, and that some components are not necessary for some people to become angry. Both studies have found that the classes and “person types” are predicted by other dimensions of personality, which creates confidence in the meaningfulness of the subgroups.

We would thus agree with theories that propose a broad, expansive role for individual differences in appraisal processes. Individual differences in appraisals themselves, such as tendencies to view events as goal incongruent, as caused by oneself, and as manageable, have attracted most of the attention thus far. Smith and Kirby (2009 this issue), for example, make a compelling case for the value of understanding between-person appraisal differences in levels of

appraisal. Considering other dimensions of variation—such as variation in appraisal–emotion links and in process variables like speed, depth, and sequence—enriches, rather than competes with, this area. Over time, research on the many intersections of individual differences and appraisal could lead to a comprehensive model of how personality, appraisal, and emotion intersect (cf. Kuppens et al., 2008).

Moreover, the present research suggests that there are degrees of types. In the research by Kuppens and his colleagues, the appraisal types were relatively qualitative: some person-types lacked some appraisals. In our study, the appraisal types were relatively more quantitative: both classes involved both appraisals, but the appraisals differed in their weights. Unlike the research on anger, we didn't find a type in which an appraisal was wholly omitted. It thus seems likely that individual differences in appraisal–emotion relationships can take different forms. Given the early stage of this line of work, it isn't yet clear if these differences vary according to emotions, to appraisal components, or to other individual differences.

To date, the study of appraisal–emotion kinds has been necessarily exploratory: appraisal theories do not yet make strong predictions about how appraisal structures should differ, let alone about how other constructs should predict those differences. Nevertheless, the next issue for this young body of work is to examine how and why people differ in an emotion's appraisal structures.

Apart from its specific findings, the present research illustrates a methodological strategy for exploring latent appraisal classes using *in vivo* data. It is possible to study many emotions using multilevel designs. For example, studies using controversial art have supported within-person appraisal predictions for anger and disgust (Silvia & Brown, 2007). Given sufficient observations at both levels, researchers can explore possible between-person latent classes identified by within-person appraisal–emotion relationships. Latent class models are not the only approach to classification, but they are unusually versatile: they can accommodate many outcome types, and the latent classes can be outcomes or predictors in a larger structural model (Skrondal & Rabe-Hesketh, 2004). It is encouraging, we think, that our research broadly supported past work, which used different methods and models.

#### Considering limitations and future directions

The present research was limited to one emotion, so we could only speculate about whether latent appraisal classes would appear for other emotions. This question obviously awaits future work. Appraisal research in general sorts into studies that examine many emotions at once versus studies that examine a single emotion in detail. Combined, these traditions provide both breadth and depth. To date, research on classes of appraisal structures has focused on one emotion at a time, such as our focus on interest and Kuppens et al.'s (2007, 2008) focus on anger. The statistical models needed to classify people into latent groups are complex, and adding many more appraisals and many more emotions is not always practical, particularly when within-

person responses to real events are collected. Nevertheless, a broad study of latent appraisal classes for several emotions is a good goal for future work. Studying members of an emotion family—such as the knowledge emotions (confusion, surprise, and interest) and the hostile emotions (anger, disgust, and contempt)—seems particularly promising.

Studying many emotions at once could address an intriguing question: does an unusual appraisal–emotion relationship generalise to several emotions that implicate the appraisal? Stated differently, are the individual differences in appraisals specific to an emotion, or are they general across different emotions? For example, Kuppens et al. (2007) found a person-type in which people could be angry without appraising the event as deliberately caused. Appraisals of causality/responsibility appear in several appraisal structures, such as the structure for pride, in which people appraise the self as responsible. Do people in this person-type also experience pride regardless of whether they attribute a positive event to their own efforts, or is the lack of contingency specific to anger only? Similarly, in our study we found that the novelty–complexity appraisal has a stronger effect on interest for some people. For these people, does the novelty appraisal have a larger weight for the other emotions in which it appears, such as surprise and confusion, or is its greater weight specific to interest only? Regardless of whether the differences are specific or general, it's clear that individual differences in appraisal–emotion relationships can be intricate and subtle.

### Acknowledgements

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### Notes

When exploratory methods are used, one is naturally concerned about the stability of the final model, particularly when many aspects of a model could be varied. The model's central effects—the coefficients, number of classes, and class proportions—don't appreciably differ due to changing the centring, to freely estimating the random effects' within-class variances, or to allowing interest's Level 2 and residual Level 1 variances to vary across classes. Similarly, running an alternate specification of the model (fixed within-person paths that vary across classes, instead of between-person random effects that vary across classes) yields essentially identical findings, as one would expect.

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