Lost in Multidimensional Space:

Epistemic Motivations Define and Distinguish Negative Affect

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Abstract

People's knowledge of the world is limited and frequently imprecise. Thus, epistemic challenges are commonplace and much research in psychology has investigated their consequences. However, research has not systematically investigated how states of negative affect correspond to the desire for understanding and meaning in life. We investigated the role of epistemic motivations (e.g. meaning search) as features that distinguish forms of negative affect from one another. In three studies, we used multidimensional scaling to model the perceived similarity of negative affect states and then examined to what extent people differentiate these states based on their association with epistemic motivations. These studies revealed that negative states are reliably differentiated through their relation to epistemic pursuits. These findings were verified in a fourth study in which we experimentally induced epistemic affect. Overall, these results indicate that epistemic, and existential, concerns characterize states of negative affect to a substantial degree.

Keywords: epistemology; affect, emotions; meaning; sense-making; appraisal

Lost in Multidimensional Space: Epistemic Motivations Define and Distinguish Negative Affect

At the core of human experience is a desire to understand the world (Fromm, 1947; Heine, Proulx, & Vohs, 2006; Webster & Kruglanski, 1997). Whether one is performing a simple everyday task (e.g., planning meals), or pondering a profound existential dilemma (e.g., the purpose of life) epistemic motivations (i.e., motivations concerning the construction of knowledge) are central. Consistently, experiences that disrupt the ability to draw knowledge and meaning from life can trigger negative affect. Indeed, the history of human philosophy and literature is filled with tales of epistemic anguish (e.g., Goethe, 1806/1987; Camus, 1955; Sartre, 1943/1956) and taxonomies of everyday emotions include epistemic states such as confusion (e.g., Keltner & Shiota, 2003). Yet, the empirical study of emotions has historically overlooked affections associated with epistemology (Ellsworth, 2003; Keltner & Shiota, 2003; Tomkins, 1963) and only a handful of epistemic states, such as curiosity and interest (Kashdan & Silvia, 2009), have been thoroughly investigated. In particular, the realm of epistemic negative affect remains underexplored.

Elucidating the link between negative affect and epistemic motivations is a duly needed development. Psychology has seen a proliferation of theory based around the topic of epistemic motivation (see Jonas et al., 2014). Models of cognitive dissonance (Festinger, 1957), closure (Kruglanski, 1989), terror management (Greenberg et al., 1990) and meaning-regulation (Proulx, Heine, & Vohs, 2010; Park, 2010; Van Tilburg & Igou, 2011) all centre around people's desire to understand the world. Largely, these models take a predominantly cognitive approach and, in some cases, neglect the role of affective states in epistemic processes (see Lambert et al., 2014). Yet, research demonstrates that emotions provide epistemic information (Abeyta, Routledge, Juhl, & Robinson, 2015; Van Tilburg, Sedikides, Wildschut, & Vingerhoets, in press). Thus, the current research aims to integrate affect and

epistemic motivation in a systematic fashion by examining the degree to which epistemic motivations characterize perceived differences between negative affect states. This approach will allow researchers to more easily define which negative states of affect are more or less "epistemic" and inform practitioners on how negative affect may be modified by addressing epistemic concerns.

Epistemic Affect

Historically, little attention has been paid to epistemic experiences in the psychology of emotion (Ekman, 1992; Lazarus, 1991), which is surprising given that a need to understand the world is a core function of cognitive and motivational systems (Berlyne, 1960; Silvia, 2010). In contrast, the emotional taxonomies of lay people contain numerous epistemic states (e.g., confusion; Keltner & Shiota, 2003; Rozin & Cohen, 2003) and the centrality of these affective experiences is, for example, reflected in the work of Darwin (1872/1965), who devoted a chapter to what he termed *intellectual emotions*, and in the work of Tomkins (1962), who wrote about the neglect of emotions associated with learning and knowledge.

Negative Epistemic Affect

Beyond appraisals of pleasure or pain, or restfulness versus stress, people are concerned with how much meaning and understanding they can gain from everyday life. Indeed, the desire for understanding and meaning has been recognized as a core social motivation (Fiske, 2004; Heine, Proulx, & Vohs, 2006; Pekrun, Vogl, Muis, & Sinatra, 2017). Given that negative affect serves to inform a person of some discrepancy between current states and desired goal states (Frijda, 1994; Scherer, 2009; Schwarz & Clore, 1983) it should therefore also guide people in their understanding of the world. Accordingly, we propose that epistemic motivations should characterize internal representations and experiences of negative affect and effectively differentiate how people conceptualize discrete

states. In doing so, these motivations should distinguish epistemic states from non-epistemic states.

Affect has general epistemic functions (Frijda, 1988; Schwarz & Clore, 1983): It indicates how we feel about our current situation or our state of knowledge. Beyond the pure epistemic function of affect, *epistemic* affect should concern the *quality* of one's current state of knowledge and the *motivation* for knowledge acquisition and sense-making. Feelings of *confusion*, *doubt*, and *uncertainty* signal that the quality of one's knowledge or understanding is insufficient (Carver & Scherer, 2008) and trigger attempts to repair or reassess some information (D'Mello, Lehman, Pekrun, & Graesser, 2014; Hookway, 2003; Van den Bos, 2001). Overall, epistemic states should serve epistemic functions (Pekrun et al., 2017) and as such, people should differentiate more epistemic states from less epistemic states on the bases of how much they relate to epistemic motivations. We test this assumption using a dimensional approach.

Dimensional Approaches

Dimensional models if emotion accommodate a range of affective states and provide a basis for understanding how they relate. These models vary in their complexity and representative content depending on the states examined. For example, Russell's (1980) circumplex model consists of a two-dimensional structure that represents affective experiences in a circular arrangement around the orthogonal dimensions of arousal and valence. Fontaine, Scherer, Roesch, and Ellsworth (2007) found that four features could account for interrelations among (*arousal, valence, potency-control,* & *unpredictability*) while Smith and Ellsworth (1985) refer to six (*pleasantness, anticipated effort, certainty, attentional activity, self-other responsibility/control,* & *situational control*). Although they vary in content, empirical support for each of these models is strong (see Posner, Russell, & Peterson, 2005).

We likewise use a dimensional model to understand the principles that distinguish negative affective states, with the particular goal of identifying if epistemic motivations play such a role. Importantly, while the approaches highlighted above examined general features that distinguish various affective states (see Ellsworth & Scherer, 2003; Russell, 1980; Widen & Russell, 2003) we focus especially on the *epistemic* features of *negative* affect. Our framework includes core features form earlier models (e.g., Russell, 1980), and crucially adds epistemic motivations as discriminatory components for epistemic negative affect.

Epistemic Motivations as Characteristic of Negative Affect

Our conceptualization of epistemic affect emphasizes the role of epistemic motivations, such as *sense-making* and *understanding* (e.g., Fiske, 2004). Sense-making is defined as a motivated process of organising connections or fitting information into a frame or model (Piaget, 1972; Weick, 1995). It is a cognitive process included in clinical models of threat, trauma and challenge (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008; Park, 2010). The motivation to *understand* has been identified as a core human motivation (Fiske, 2004; Fromm, 1947) and, as an epistemic pursuit, it can perhaps be considered as broader than sense-making. We choose sense-making and understanding as representative epistemic motivations to investigate. We further added meaning search to this list in to test the theoretical assumptions of meaning-regulation models.

A desire to understand the world is a common theme among conceptualisations of ‘meaning’ (King, 2012; Proulx & Heine, 2006; Van Tilburg & Igou, 2011). Indeed, epistemic coherence is a core component of meaningfulness (Martela & Steger, 2016) and in accordance with meaning regulation models, experiences that undermine our sense of coherence should trigger compensatory meaning-seeking responses (Maher, Van Tilburg, & Van den Tol, 2013; Proulx et al., 2010; Van Tilburg & Igou, 2011). If epistemic clarity is essential for meaning presence, and therefore a goal of meaning search, then meaning-

seeking motivation should similarly characterize epistemic states in multidimensional space. To test this assumption, we include meaning search as an epistemic motivation, alongside sense-making and understanding, and investigate how well these motivations distinguish states of negative affect.

Practical Relevance

The proposition that epistemic motivations characterize states of negative affect has implications for psychological interventions. If epistemic concerns perpetuate states of negative affect, then effective interventions should address these concerns. Indeed, meaning making and sense making have been identified as important variables in trauma recovery (Dollinger, 1986; Park, 2010). For example, the violation of core beliefs represents a strong epistemic challenge, and Park et al. (2008) found that positive reframing was not associated with long-term well-being among cancer survivors who had experienced a violation of core beliefs. Core belief violation instead lead to intrusive rumination. Similarly, the disruption of worldviews has been shown to disrupt recovery among those exposed to financial hardship (Guteirrez, Park, & Wright, 2017) or mass violence (Smith, Abeyta, Hughes, & Jones, 2015). Thus, clinical outcomes can be disrupted by epistemic challenges. Establishing how different states of negative affect are associated with epistemic concerns may help practitioners use discrete states as a guide to indicate when efforts to facilitate sense-making and understanding are most appropriate.

Current Research

Epistemic motivations permeate simple everyday concerns and broader existential crises, and in doing so, characterize states of negative affect. We use dimensional modelling as a tool to systematically investigate if, and how, epistemic motivations differentiate negative affect and to test theoretical assumptions of emotion models (Frijda, 1994; Scherer, 2009) and existential psychology (Proulx & Heine, 2006; Van Tilburg & Igou, 2011).

Furthermore, we aim to create a framework that will establish boundaries for this emerging category of epistemic emotion (Pekrun et al., 2017). For instance, perhaps *confusion*, *doubt* and *uncertainty* are more related to epistemic motivations than, for example, *regret* and *disappointment* (e.g., Martinez, Zeelenberg, & Rijsman, 2011). To be clear, we did not set out to test if epistemic motivation might *replace* basic emotion dimensions such as valence or arousal (e.g., Russell, 1980). Rather, we tested how useful epistemic motivation are in capturing differences between negative affective states, while using established non-epistemic characteristics (e.g., valence, arousal) as helpful benchmarks. This is important given the relevance of epistemic motivation across personal, social, and clinical settings (Heine et al., 2003; Steger, Oishi, & Kashdan, 2009).

Studies 1-3: Purpose and Approach

In Studies 1-3, we followed an approach common to many dimensional models (e.g., Fontaine et al., 2007; Russell, 1980) by assessing (A) people's judgments of the similarity of different states and (B) how these states rate on several different evaluative features, both general (e.g., valence) and epistemic (e.g., meaning search).

The similarity ratings of negative affective states at Stage A, allowed us to quantify how much states differ from each other using a spatial representation where large (small) distances between two states correspond to dissimilarity (similarity). Effectively, these dimensional models spatially represent people's internal cognitive representations of negative affect (Roseman & Smith, 2001). Indeed, such approaches have been successfully used to uncover people's representations of self-relevant emotions (Van Tilburg et al., 2017; Van Tilburg et al., 2018), facial expressions of emotion (Russell, & Bullock, 1985), and music-evoked affect (Bigand, Vieillard, Madurell, Marozeau, & Dacquet, 2005).

We then used these spatial representations to evaluate the role of epistemic motivation. In Stage B, people rated the affective states on the extent to which they are

characterized by epistemic motivations (e.g., sense-making) and other evaluative features (e.g., valence). Next, we statistically fitted these features into the spatial representations identified in Stage A. Effectively, this second Stage allowed us to assess (I) how well ratings on evaluative features corresponded to the positioning of states in the spatial representation (reflected in magnitude of explained variance); and (II) what areas of the spatial representation were characterized by high versus low ratings on these feature (represented by the position of the feature as a vector in the spatial representation).

We focused in the present investigation on negative affect in particular and did so for a number of reasons. Firstly, our theoretical focus concerns psychological and more specifically existential, *threats* and *challenges.* An important facet of psychological threat relates to epistemic motivations such as the need to know and understand the world. By examining the link between negative affect and epistemic motivation we aim to understand how people respond to such challenges. Secondly, we propose that epistemic motivations relate to epistemic goals that are unmet (e.g. the search for meaning), and that unmet goals are associated with negative affect in particular (Scherer, 2009; Schwarz & Clore, 1983). Furthermore, the approach of evaluating a subset of affective states using multidimensional scaling analysis (MDS) to test the importance of distinguishing features has been taken in the past (Gray & Wegner, 2011; Van Tilburg, Wildschut, & Sedikides, 2017).

Methods: Studies 1-3

We examined epistemic negative affect in two stages (A and B) common in multidimensional scaling (e.g., Rusbult et al., 1993; Van Tilburg & Igou, 2017). The first stage examined ‘raw’ similarities and differences between states in a dimensional structure using replicated-MDS (RMDS; Jaworska & Chupetlovska-Anastasova, 2009). The second stage examined the underlying psychological features that account for these similarities and differences. As in other multidimensional scaling studies (e.g., Rusbult et al., 1993), separate

samples were used for each stage of examination. (The Supplementary Materials offer additional guidance on the Multidimensional Scaling Analysis.) The sample sizes obtained were based on prior psychology research using multidimensional scaling (e.g., Van Tilburg, Wildschut, & Sedikides, 2015).

In Stage A participants in the first sample rated the extent to which negative affective states were similar to each other. In Stage B a second sample of participants rated each of the affective states on a number of different evaluative features. We selected features that broadly capture dimensions common across previous models, namely *valence*, *arousal, depth*, *self/other responsibility*, *control*, *situational-control* and *certainty* (e.g., Fontaine et al., 2007; Smith & Ellsworth, 1985). Crucially, we also examined if epistemic motivations could effectively characterize the similarities/differences and for this purpose participants also rated the negative affective states on the three epistemic motivations described above.

We began by testing 10 different affective states in Study 1 and subsequently tested an increasing number of affective states in Studies 2 (14 states) and 3 (18 states) to verify the generalizability of the model derived. Specifically, Study 1 was designed to test if, and how, epistemic negative affective states could be distinguished from one another and from less epistemic states. In Studies 2 and 3, we added more affective states to the models in order to see if the dimensional solutions would still hold. The specific affective states and evaluative features we used in our studies are listed below.

Procedures

Study 1. Participants in Stage A (N = 42; 23 women; M_{age} = 24.41, SD = 6.49) and participants for Stage B (N = 42; 21 women; M_{age} = 22.73, SD = 4.44) were recruited using the online research service *Prolific Academic* and received 1 pound sterling for their

participation. In each participant sample (A and B) one participant was removed for careless responding.[1]

Sample A rated the similarity of 10 affective states. These consisted of five that we anticipated to be relatively epistemic (confusion, disillusionment, doubt, surprise, uncertainty), complemented by five that we anticipated to be less epistemic (anger, disappointment, frustration, regret, sadness). Overall, participants rated 45 different pairs of affective states using a scale from 1 (*very different*) to 10 (*very similar*). Sample B participants also rated the similarity of these 10 affective states. Additionally, they rated each of these 10 affective states on 10 different evaluative features (*valence, arousal, depth, self/other responsibility, control, situational-control, meaning search, understanding,* & *sense-making).* Specifically, each state was given a score of 1-10 on each feature; participants read a brief description of each characteristic to ensure consistency across interpretations (see Supplementary Materials)

Study 2. Participants at Stage A (N = 82; 44 women; M_{age} =37.73, SD = 11.10) and participants at Stage B (N = 82; 41 women; M_{age} = 35.27, SD = 11.49) were recruited online using *MTurk*. They received 1 US dollar for participation. Nine participants at Stage A were removed for careless responding. We put this increase in the careless responding[2] rate down to the larger number of emotion comparisons participants were asked to make.

Alongside the 10 affective states from Study 1 participants assessed 4 additional states. Specifically, we added guilt, shame, disgust and fear as these four states are additionally present in both Smith and Ellsworth's (1985) dimensional model and Roseman

[1] These participants either did not complete the study, or completed the study at less than half the average completion time and choose over 10 consecutive items with the same response option.

[2] These participants either did not complete the study, or completed the study at less than half the average completion time and choose over 10 consecutive items with the same response option.

Wiest, and Swartz (1994) experiential content analysis on differentiating negative affect. Overall, in Stage A, participants rated 91 different pairs of affective states, using a scale from 1 (*very different*) to 10 (*very similar*). In Stage B, different participants rated each state on the 6 features retained from Study 1[3]; *arousal, certainty, meaning search, understanding,* and *sense-making*.

Study 3. Stage A (N = 150; 72 women; M_{age} = 32.77, SD = 10.18) and Stage B (N = 82; 32 women; M_{age} = 33.56, SD = 11.33) participants were recruited via *MTurk*. They received 1 US dollar for their participation. Four participants at stage A were removed for careless responding.

Stage A participants rated the similarity of 18 different affective states. Four additional negative states (anxiety, contempt, distress, loneliness) were added to the 14 states from Study 2. *Distress* and *contempt* were again sourced from research by both Smith and Ellsworth (1985), and Roseman and colleagues (1994). Adding these states also allowed us to capture most of the negative states proposed by other taxonomies (e.g., Tomkins, 1963). We also included *anxiety* and *loneliness*. Anxiety has been labelled an 'epistemic emotion' (Miceli & Castelfranchi, 2005), and has been considered to play a role in epistemic process like cognitive dissonance (Festinger, 1957) and terror management (Greenberg et al., 1990). We also surmised that loneliness could, in part, be considered an epistemic state. Belongingness is a key feature of meaningfulness (Proulx & Heine, 2006) and social connections (Van Tilburg & Igou, 2016), and social identities are used by people to imbue life with meaning (Van Tilburg & Igou, 2011). Loneliness could thus be considered as an affective response to the absence social and epistemic resources.

[3] Four features were dropped after Study 1 on the basis that they were either not rated reliably or could not explain at least 50% of variation in the Study 1 model.

Comparing all 18 states would require 153 comparisons for each participant, so to avoid response fatigue, we presented each participant with a random selection of 60 different comparisons, resulting in a total of 8,760 different comparisons between the 18 affective states, on average 486 comparisons per state. Participants used the same 1-10 rating scale from Studies 1 and 2. At stage B, participants rated each state on the 6 features retained from Study 1—*arousal, certainty, meaning search, sense-making, understanding,* and *valence.*

Results and Discussion: Studies 1-3

Stage A: Plotting Similarities and Differences with Dimensional Structures

In each study, the Stage A similarity ratings provided a score for each pair of affective states. We organized these scores into similarity matrices, with each cell containing the similarity ratings corresponding to one of the emotion pairs that a participant rated. To establish a spatial representation of these similarity ratings across participants, we conducted replicated-MDS (RMDS; Jaworska & Chupetlovska-Anastasova, 2009). This assesses each matrix simultaneously to derive a common spatial representation of similarity ratings across participants (see supplementary materials for further details). The first step in this analysis identifies the number of dimensions that fit the data most appropriately. To determine this, we assessed the stress level of different dimensional fits and observed which model brought about the largest reduction in stress. In each study, a two-dimensional structure brought about the largest reduction in model stress. A value of *Stress* < .15 indicates adequate fit (Kruskal & Wish, 1972). In all three studies, stress values for the two-dimensional models fell below .15 (*Stress* = .085, *Stress* = .099, *Stress* = .120, respectively), indicating that a two-dimensional representation described the differences/similarities among negative affective states effectively.

Study 1. We conducted replicated multidimensional scaling analyses (RMDS) for the similarity ratings from Stage A participants. We tested all possible models, ranging from 1-9

dimensions and found that a two-dimensional structure brought about the largest reduction in model stress. Figure 1 displays the position of each state in this dimensional structure. In this representation, several epistemic states appear to cluster together toward the upper right quadrant of the two-dimensional space suggesting that people intuitively distinguish epistemic states from more general negative states such as sadness, frustration, and anger.

Study 2. After increasing the number of affective states under investigation, we again found that a two-dimensional structure brought about the largest reduction in model stress. Figure 2 displays the position of each state in this structure. The 10 affective states investigated in Study 1 occupied a highly similar location within the Study 2 dimensional structure. This was confirmed by the correlations of their dimension 1 and dimension 2 co-ordinates across the studies ($r = .98$, $p < .001$, and, $r = .90$, $p < .001$, resp.). These findings provide support for the integrity of the models we derived. As in Study 1, the affective states we hypothesized as 'epistemic' occupy a unique space around the upper right quadrant of the model. Note that the newly added state *fear* also occupied this area of the model. In Study 3, we sought to replicate the integrity of the spatial structure among an even larger range of affective states, furthering the generalizability of our findings, and testing whether the finding regarding *fear* would also replicate.

Study 3. Figure 3 illustrates the position of each state on the Study 3 derived spatial structure. The original 10 affective states from Study 1 again emerged in highly similar positions across dimensions 1 and 2, reflected in high correlations between the coordinates of these states in this study and in Study 1 on dimension 1 ($r = .96$, $p < .001$) and dimension 2 ($r = .97$, $p < .001$). Likewise, the 14 states tested in Study 2 also occupy highly similar positions in this structure, as indicated by the high correlations between coordinates across these studies ($r = .91$, $p < .001$ for dimension 1; $r = .83$, $p < .001$ for dimension 2). The more

epistemic affective states continue to cluster toward the upper right quadrant of the model, with fear and now anxiety also occupying this area.

Overall, across three studies, we found highly similar spatial structures that represent the similarities/differences between a range of negative and epistemic states of affect. In each study, epistemic states were clustered together in the upper right-hand quadrant of this space. Surprise appears to be somewhat of an exception, as it is separate from these states in Studies 1 and 2, due to a low score on dimension 2 (y-axis). Interestingly, fear was located among this cluster of epistemic states in both Studies 2 and 3.

Stage B: Evaluative Features

We investigated whether participant's conceptualisations of negative affect are strongly characterized by differences in epistemic motivations; including meaning search.

In each study, Stage B participants rated each state on several evaluative features. We estimated how these features corresponded to the spatial representations following the analytic approach by Rusbult et al. (1993). First, scores for each state on each evaluative feature were averaged across participants. Reliability coefficients were assessed to determine the appropriateness of these aggregations. Features' average scores were then regressed onto the Dimensions 1 and 2 coordinates from the spatial structure derived. The resultant R^2 figures indicate how well these features characterized the two-dimensional model; whether the size of the distances between the positions the states occupied in the spatial representation corresponded to them having different ratings on evaluative features.

In addition, regressing an evaluative feature onto the coordinates for each dimension gives standardised regression coefficients that represent direction cosines indicating *how* a characteristic fits the two-dimensional model. More specifically, the coefficients define a vector extending from the model origin (Rusbult et al., 1993). The *length* of this vector

reflects fit, whereas its *angle* indicates how the characteristic in question corresponds with the two-dimensional space (See supplementary materials for further details).

Study 1. Participants rated each state on 10 different evaluative features. Reliability coefficients revealed that three features (*depth, self/other responsibility, & situational control*) were not rated reliably across participants (all α's < 0.50), and these were therefore excluded from further analyses. The appropriateness of this aggregation was confirmed for the remaining seven features ($0.68 \geq \alpha \geq 0.85$). Regression analyses yielded high explained variances for six of the seven features, all $R^2 \geq 0.68$. These were: *certainty, sense-making, arousal, search for meaning, understanding,* and *valence*. Table 1 displays explained variance figures for each of these features. Figure 1 displays the superimposed vectors for the top 6 features in terms of explained variance. These six vectors correspond to estimations of how the states in the model, positioned orthogonally to the vector direction, are related to the feature in question. For example, *doubt* was characterized as highly related to meaning search. Conversely, *anger* and *frustration* show little relation to this feature. The length of the vector is analogous to its explained variance; the direction of the vector distinguishes areas in the spatial representation characterized by increasingly higher levels of that evaluative feature and moving against the direction of the vector distinguishes areas in the spatial representation characterized by increasingly low levels of that feature. For example, moving towards the upper left quadrant is associated with higher meaning search and moving towards the lower right quadrant is associated with lower meaning search.

Epistemic motivations. As predicted, participants intuitively used criteria of epistemic motivations to differentiate discrete states. *Sense-making* proved the most explanatory of these features (see Table 1). The model displayed *doubt, uncertainty, confusion, surprise,* and *disillusionment* on the 'positive' half of the epistemic vectors with *surprise* detached from this cluster due to a high arousal score. Crucially, *meaning search* occupied a similar position

in this structure and dissected the upper right quadrant between dimension 1 and 2. States of *sadness* and *disillusionment* scored higher on meaning search compared to the other epistemic features, while *surprise* scored lower.

Arousal, valence and certainty. Core features of general affective states also proved explanatory in distinguishing states of more and less epistemic affect. As displayed in Figure 1, *arousal* occupied a position close to the y-axis of the model. Affective states high on this axis were characterised as low in arousal. Similarly, valence occupied a position close to the x-axis and states higher on this axis were considered less negative. Together, *arousal* and *valence* had an almost orthogonal relationship indicating they are distinct features of the model, consistent with dimensional models of emotion (e.g., Russell, 1980). Certainty dissected the bottom left quadrant, indicating it is not orthogonally related to arousal or valence. Affective states scoring high in certainty included *anger, regret,* and *frustration.*

Study 2. Six features were retained from Study 1 due to the high explained variance and high reliability scores. Ratings again proved reliable for these 6 features (all α's >.90). Regression analysis revealed that 5 of the 6 features explained over 50% of the variance in this structure. These were *sense-making, understanding, search for meaning, certainty,* and *valence.* Thus, we replicated findings from Study 1 regarding the relevance of epistemic motivations. As Table 1 illustrates, in this model, they accounted for more variance than even core features like *arousal*, *valence* and *certainty*. In particular, arousal explained considerably less variance than the other features (R^2 =.12), and also less than in Study 1. The additional affective states made arousal much less of a distinguishing factor. As above, we fitted these feature vectors to the spatial structure (Figure 2). The orientations of these five vectors within this two-dimensional structure corresponded strongly with what we found in Study 1, further verifying the integrity of the spatial structure.

Epistemic motivations. Epistemic motivations populated the upper right quadrant of the model in a similar fashion to Study 1 and again distinguish *doubt*, *uncertainty*, *confusion*, *surprise* and *disillusion* as 'epistemic' states. This consistency provides further support for the presence of an epistemic vector within a dimensional model of negative affect. However, an additional finding within this model suggests that *fear* can also be classified as an epistemic state. One may suggest that fear appears to be a statistical artefact in this regard but an examination of the feature ratings reveals that participants did indeed rate fear as above the midpoint on the epistemic features, and also above the average scores that other affective state received—fear seemed accurately portrayed on model's epistemic features.

Valence and certainty. In accordance with Study 1, *certainty* was orientated to the bottom left, distinguishing *anger*, *regret*, and *frustration* as highly certain states. Of the new states, both *shame* and *guilt* were also characterized in this way. Likewise, valence occupied a position close to the main vertical axis and as before, states higher on this dimension (e.g., *surprise*, *confusion*) are characterized as less negative.

Study 3. The ratings of the Study 3 affective states on the six evaluative features retained from Study 1 proved reliable across participants (all α's ≥ 0.92). Regression analysis revealed that three of the six features explained over 50% of the variance in this structure. These were *search for meaning, sense-making,* and *understanding.* The remaining three each explained comparatively little (for *arousal*, R^2 =.45, for *certainty*, R^2 = .42, & for *valence*, R^2 = .42). Standardised coefficients indicated that this *search for meaning* vector dissected the more epistemic quadrant of the model alongside *sense-making* and *understanding*. We found that *fear* again emerged among the epistemic states and scored highly on all three epistemic motivations. *Loneliness* and *anxiety* also emerged as highly related to these features along with the same five epistemic states from Studies 1 and 2 (*confusion, doubt, disillusionment, surprise,* and *uncertainty*).

Overall, these three studies attest to the reliability of our findings regarding the epistemic nature of negative affect. As these states were reliably differentiated according to their relation to epistemic motivations, emotions that have been labelled epistemic in prior research (e.g., Darwin, 1872/1965; Keltner & Shiota, 2003; Rozin & Cohen, 2003) can be separated from comparatively less epistemic states. Furthermore, we found that participants' understanding of affective states were strongly characterized by differences in epistemic qualities such as meaning, understanding, and sense-making—thus linking affective states to epistemic and existential processes. Remarkably, these features differentiate the affective states on our model to an even greater extent than core affective features like valence and arousal. This finding emphasises the role of epistemic motivation in the interpretations and experiences of negative affect.

In Studies 1-3, we rely on subjective perceptions of the similarity between states to derive relational models. However, there is some distinction to be made between current affective experiences and beliefs about such experiences (Robinson & Clore, 2002). We therefore sought to validate the MDS findings in a fourth Study by manipulating epistemic challenge and measuring participants' actual experiences of affective states.

Study 4: Validation by Experience

In Study 4, we aimed to validate the MDS models by inducing experiences of negative affect via epistemic challenge (e.g. Pekrun et al., 2017). We tested the validity of the epistemic boundaries established in the spatial structures by investigating if this manipulation more strongly affects states classified as more (vs. less) epistemic. Furthermore, we investigated whether the reported similarity of emotional states is reflected in the actual experience of these states (Roseman & Smith, 2001; Russell & Bullock, 1985) by deriving a new dimensional model based on the correlations of state *experiences* rather than on participants *judgments* of these states' similarity.

Method

Participants. Given the explanatory power of epistemic motivations in our MDS models of negative affect we reasoned that a manipulation should have a medium to strong effect. A power analysis calculation, assuming this effect size (d = .6) in a between-subjects design, suggested that 90 participants were required to achieve approximately 80% power at an alpha of .05 (two-sided). Overall, 91 participants (53 women; M_{age} = 37.99, SD = 12.39; age range: 20 – 75 years) were recruited via Prolific Academic. Participants were compensated with £0.80 for their participation. An attention check required people to identify certain words from a sentence, provided by the researcher. All participants successfully passed this attention check.

Procedure. Participants assigned to the experimental condition wrote about an experience or event when "*things just do not make any sense, where you could not understand what was going on, or where you felt a need to search for meaning*". Those assigned to the control condition were instructed to write about "an *event in your life that you perceive as ordinary, or mundane*", adopting a procedure similar to earlier research (e.g., Van Tilburg, Igou, & Sedikides, 2013; Van Tilburg, Sedikides, & Wildschut, 2015). After the writing task, participants reported how much they experienced each of the 3 epistemic motivations (i.e., sense-making, understanding, & meaning search) and the 18 affective states from studies 1-3. Experience of each state and motivation were rated on a scale of 1-7.

Results and Discussion

By examining all three epistemic motivations (sense-making, understanding and meaning search) using a between-subjects MANOVA, we found that the manipulation was effective, $F(3, 87) = 10.13$, $p < .001$, $\eta_p^2 = .26$, $\Lambda = .74$. Univariate analysis showed that all 3 motivations were significantly higher in the epistemic challenge condition compared to the control condition (see Table 2).

Negative Affect. Using a between-subjects MANOVA on the experience of all 18 states of negative, we found a significant effect of writing condition $F(18, 72) = 6.93$, $p < .001$, $\eta_p^2 = .63$, $\Lambda = .37$, with participants in the epistemic challenge condition reporting higher ratings for all 18 states of negative affect. Specifically, 15 of these 18 states differed significantly across conditions at an alpha level of .001. For the 3 remaining states (contempt, disgust & guilt), *p*-values ranged from .004 to .055. Overall, univariate effect sizes ranged from $\eta_p^2 = .041$ (disgust) to $\eta_p^2 = .54$ (confusion). These latter two findings relate to an important prediction that stems from the Study 1-3 findings; negative states should systematically vary in their relation to epistemic motivations.

The explanatory power of epistemic motivation in the MDS models suggest that differences in affective states are reflected in their epistemic qualities and the models delineate which states should be more or less associated with epistemic motivations. We tested the predictive validity of these delineations in two-ways. First, we divided states into two categories (epistemic vs. non-epistemic) based on the Study 3 model. Specifically, perpendicular lines from affective states to vectors on the model can be used to establish a rating for each state on each vector (see supplementary materials). Using this approach, states that achieved a positive rating for all three epistemic vectors were categorized as epistemic. Thus, nine states (*anxiety, confusion, distress, doubt, disillusionment, fear, surprise* and *uncertainty*) formed the *epistemic* group of affect and the nine remaining states (*anger, contempt, disgust, disappointment, frustration, guilt, regret, sadness,* & *shame*) formed the *non-epistemic* group of affect. Reliability coefficients of $\alpha = .93$ and $\alpha = .91$, respectively, confirmed the appropriateness of these groupings and scores were aggregated across the states within each category.

We then conducted a mixed ANOVA with writing condition (control vs. epistemic motivation) as between-subjects factor and affect category (epistemic v non-epistemic) as a

within-subjects factor. As hypothesized, there was a significant main effect of writing condition, $F(1,89) = 44.94$, $p < .001$, $\eta_p^2 = .34$ and a significant category × condition interaction, $F(1,89) = 10.72$, $p = .002$, $\eta_p^2 = .12$. In line our predictions, simple effects analysis revealed that while there was no significant difference across emotion categories in the control condition ($p = .575$), a significant difference emerged within the experimental conditions with participants experiencing higher levels of epistemic negative affect ($M = 4.29$, $SD = 1.20$) compared to non-epistemic negative affect ($M = 3.76$, $SD = 1.37$), $F(1,89) = 15.79$, $p < .001$, $\eta_p^2 = .15$. Thus, states in the MDS model most associated with epistemic motivation, were most effected by a manipulation of epistemic challenge.

Importantly, we categorized states as epistemic versus non-epistemic in the above analysis to test how much participants experience more versus less epistemic states on average. However, the dimensional models do not define a 'hard' boundary between epistemic and non-epistemic states. Rather, states vary by degree. In addition, grouping states in a categorical manner tells us little about how each individual state is associated with epistemic motivation, and how well this corresponds with predictions derived from the MDS model. To address these issues, we computed correlation coefficients between each state and each epistemic motivation. We then tested how well these correlations correspond to the state 'ratings' on each vector in Study 3 using rank order correlations. As Table 3 illustrates, the emotion vector ratings and correlation coefficients correspond closely, such that lower correlation coefficients align with more negative vector ratings and higher correlation coefficients align with more positive vector ratings. The overall consistency between vector ratings and participants experiences was confirmed for all three epistemic motivations with significant positive rank order correlations for sense making ($\rho = .81$, $p < .001$), understanding ($\rho = .66$, $p = .003$) and meaning search ($\rho = .71$, $p = .001$). Overall, these findings support the validity of the dimensional structures derived in Studies 1-3.

Modelling affective experiences. To further verify the structure of the spatial models derived in Studies 1-3 we calculated pair-wise correlations for each pair of emotions experienced by participants in this study and used these values as proxy similarity ratings (Shepard, 1980; Van Tilburg & Igou, 2016). In previous studies, we combined similarity matrices from each participant to derive a scaling solution. However, in the present study, we used the single 18 × 18 similarity matrix of the absolute correlations between the experiences of emotional states (Van Tilburg & Igou, 2017, Study 2 & 3).

As in previous studies, a two-dimensional solution fit the data appropriately with a stress level below .15 (*Stress* = .03), indicating adequate fit (Kruskal & Wish, 1972). Figure 4 illustrates the position of each state on the two-dimensional structure derived from correlations of emotional experiences. The positioning of the 18 states corresponds strongly with what we found in Studies 1-3 when spatial structures were derived based on participant similarity ratings. The highly similar location of states across Studies is confirmed by high correlations between dimensional coordinates across studies. The coordinates of the 10 states from Study 1 correlate strongly with coordinates on both dimensions here ($r = .85$, $p = .002$ for dimension 1; $r = .88$, $p = .001$ for dimension 2). Likewise, for the 14 states in Study 2 ($r = .88$, $p < .001$ for dimension 1; $r = .77$, $p = .001$ for dimension 2) and the 18 states in Study 3 ($r = .77$, $p < .001$ for dimension 1; $r = .74$, $p = .001$ for dimension 2).

Overall, the results of Study 4 provide strong evidence for the validity of the spatial structures we derive in Studies 1-3. First, we found evidence to support key assumptions of our theoretical approach; namely that conceptualizations of the relation between emotional states is reflected in the experiences of these states. By experimentally manipulating epistemic challenge we verify predictions derived from the MDS models about which states should be more, or less, associated with different epistemic motivations. These experimental findings further elucidate the epistemic nature of negative affect.

General Discussion

For some time, emotion researchers have theorized on the epistemic nature of affective states (Darwin, 1872/1965; Ellsworth, 2003; Keltner & Shiota, 2003; Rozin & Cohen, 2003; Tomkins, 1962). With the current research, we shed further light on this topic. We explored the epistemic features of negative affect and thereby link these affective states to epistemic motivations. Specifically, we investigated weather epistemic motivations differentiate negative states of affect by assessing both conceptualisations and experiences. Affective states most characterized by epistemic pursuits serve epistemic functions and can be considered more epistemic in nature.

Across four studies we gained insights into the nature of negative affect and examined how negative states related to epistemic processes. In Studies 1-3, we assessed similarities and differences among states of negative affect and established three separate spatial structures that model their interrelations. We modelled an increasing number of affective states and each time obtained a similar two-dimensional structure with highly consistent locations for the affective states assessed. In Study 1, epistemic motivations differentiated more epistemic states (e.g., doubt) from less epistemic states (e.g., anger), while core affective features helped reveal how epistemic states differ from one another. Studies 2 and 3 extended these findings across a broader range of negative states, establishing the reliability of the dimensional model obtained. The explanatory power of epistemic motivations remained consistent throughout all three studies and compared favourably with core features like affect and arousal. Finally, Study 4 evidenced the validity of these findings in an experimental test. The relations between experiences of affective states and epistemic motivations corresponded to the relations established in the MDS models. Our findings have significant implications for the study of many different affective states and epistemic

processes. We will consider the implications of these findings for affective states and epistemic process independently.

States of Epistemic Affect

Confusion. Across all three studies, confusion was found to be associated with epistemology. This is consistent with past research, which has classified confusion as a 'knowledge emotion' (Silvia, 2010) that is highly prevalent during learning activities (D'Mello, 2013). Our analysis rates confusion as less negative, but higher in arousal (Study 1 and Study 3) than epistemic states such as doubt, uncertainty, and disillusionment. It is also related to meaning search.

Doubt and uncertainty. Doubt and uncertainty share many characteristics, but our findings suggests that they can be distinguished from one another. Specifically, doubt and uncertainty vary most in arousal and valence with doubt considered more negative and less arousing. These states overlap their relation to epistemic motivations, including meaning search. This interrelation is supported by past literature demonstrating that both states are associated with compensatory responses linked to meaning-regulation (e.g., Van den Bos, 2009). Future research should expand on the phenomenological distinctions between these two related states and explore what divergent behaviours they may predict.

Disillusionment. Janoff-Bulman and Berg (1998) suggested that *disillusionment* is an antecedent to meaning making efforts that trigger post-traumatic growth. Past research suggests that disillusionment predicts marriage breakdown (Huston et al., 2001) and is associated with political radicalisation (Maher, Igou, & Van Tilburg, 2018). Investigating the unique affective components of this experience helps to better understand the processes that lead to these outcomes. Our research indicates how disillusionment may differ from sadness and disappointment. Specifically, disillusionment may be higher in arousal than sadness but

lower in arousal than disappointment. Also, replicating previous findings, this research suggests that disillusionment is related to meaning search (Maher et al., 2018).

Surprise. Within the relational structures we derived, surprise was high in arousal (Study1), and moderately related to epistemology (Studies 1-3). Among the epistemic negative states, surprise emerges as the least negative, though not entirely detached from the other feelings. This finding is consistent with prior findings that classify surprise as either mildly positive (e.g., Fontaine et al., 2007) or mildly negative (e.g., Noordewier & Breugelmans, 2013). Unlike many of the other epistemic states tested, surprise has not been related to meaning regulation process in the past.

Anxiety and fear. In recent years, literature has increasingly highlighted the palliative features of epistemic processes (e.g., Greenberg et al., 1990; Jost, Glaser, Kruglanski, & Sulloway, 2003; Proulx, Inzlicht, & Harmon-Jones, 2012). Our research further supports such theories by demonstrating that people relate experiences like fear and anxiety to epistemic pursuits. Indeed, knowledge that violates expectations can trigger anxiety, even when it is a source of good news (i.e., learning that your test scores have improved; Plaks & Stecher, 2007). Accordingly, by clinging to epistemic frameworks (Greenberg et al., 1990; Jost et al., 2003) or bolstering a sense of meaning (Proulx & Inzlicht, 2012) people attempt to reduce feelings of fear and anxiety (Proulx, et al., 2012).

Loneliness. Belongingness and social connection are core components of meaningfulness (Proulx & Heine, 2006). Consistently, loneliness has been regarded as a form of existential distress (Fromm, 1947) associated with the search for meaning (Van Tilburg, Igou, & Maher 2018). Our findings further evidence the existential character of loneliness and additionally relate it to sense making and understandings. Indeed, group membership and social identities serve epistemic functions (Kruglanski, 1989) and understanding is one of 4 core social motivations (Fiske, 2004). Consistently, in Study 4 we

found that experiences of loneliness were correlated with a desire to understand more. Taken together, our results, and previous findings, suggest that loneliness may classified as an epistemic emotion.

Evaluative Features

Across three studies, we established vectors that characterized different two-dimensional representations of negative affective states. In Study 1 we found high explained variance for features of *arousal, certainty, meaning search, sense-making* and *understanding.* In Study 2, we replicated what we found with respect to the epistemic motivations and *valence*. However, within this Study 2 model, both *certainty* and *arousal* offered little explanatory value. In Study 3, we further substantiated the explanatory value of epistemic pursuits to differentiate states of negative affect. Even with 18 different states under assessment, each epistemic characteristic accounted for over 50% of variance within the model. Finally, in Study 4 we manipulated epistemic challenge and demonstrated that experiences of epistemic motivations and affective states correspond in the way the MDS models predict. Overall, these results highlight the prominence of epistemic features among negative states of affect.

Broadly speaking, our findings support the assumptions of the meaning maintenance model. This model explains that epistemic challenges function as meaning threats and trigger compensatory responses that serve to reaffirm meaning (Proulx & Heine, 2006). Consistently, we found that relation to *meaning search* proved a distinguishing factor among an eclectic group of negative affective states and corresponded strongly with other epistemic pursuits. Previously, the affective components of meaning maintenance have proved difficult to conceptualise (Proulx & Inzlicht, 2012). However, there is already evidence to suggest that *fear* (Lambert et al., 2013), and *uncertainty* (Van den Bos, 2009) are influential in this regard, and our research suggests that *doubt, disillusion*, and *confusion* may play similar roles.

Different states of affect may motivate distinct forms of meaning regulation. Such a prediction would be consistent with a feeling is for doing approach to affect (Zeelenberg & Pieters, 2006), which proposes that each emotional state serves distinct motivational functions. As such, and as we have found here, specific functions should prove effective criteria for differentiating affective states. Strategies of meaning-regulation vary highly (see Jonas et al., 2013) and it is possible that different affective states predict divergent meaning-regulation behaviour. For example, disgust sensitivity has been shown to moderate *defensive* responses to mortality salience (Kelley et al., 2015). Consistently, our research suggests disgust is inversely related to *meaning search*, a non-defensive strategy. Moreover, while the constructs of *understanding* and *sense-making* overlapped strongly in these dimensional models, meaning search proved at least partially distinct. The search for meaning could be considered a broader, more abstract epistemic process. Indeed, there is research to suggest that negative states of affective are distinguishable based upon whether they broaden or narrow cognitive processing (Gable & Harmon-Jones, 2010).

Affective sates can be distinguished according to their motivational intensity (Gable & Harmon-Jones, 2010). States high in approach motivation narrow attentional focus; states low in motivational intensity broaden it. Meaning search is an abstract concept that has been associated with high levels of construal (Kelly, Davis, Kim, Tang, & Hicks, 2016) and the search for meaning may be more closely related to affective states that broaden cognitive focus. Our findings are consistent with this account, in relation to states of disgust and anger (high motivational intensity – low relation to meaning search), as well as sadness and loneliness (low motivational intensity – high relation to meaning search), but perhaps less so with regard to fear (high motivational intensity – high relation to meaning search). However, there is already evidence to suggest that, unlike other high intensity emotions, fear and anxiety can be objectless states (Ohman, 2000). Since emotional clarity is related to higher

presence of meaning, it stands to reason that an objectless state may increase search for meaning and broaden the focus of attentional processes. Future research may wish to explore these features of fear and anxiety experiences, and how they influence cognitive processing, in greater depth.

Limits on Generality

We see our approach as complementary to existing models of affect. Specifically, we do not assess (nor set out to assess) the underlying dimensions of affect in general, and do not suggest that epistemic motivations in some way 'replace' core dimensions of general affect discovered by researchers including Russell (1980), Smith and Ellsworth (1985) and Fontaine et al. (2007). Instead, we show that people strongly differentiate between affective states based on their epistemic qualities, as they do in terms of valence and arousal. This is important because it suggests that the causes or consequences of these emotions may in part be understood from an epistemic perspective. For example, the negatively valanced state of *doubt* may promote behaviours that are pleasurable (hence reducing negative affect), and the finding that this state is *also* characterized by a meaning search may suggest that such pleasure will follow from a meaning-restoring activity. Thus, core dimensions of emotion models (affect, arousal) and our epistemic motives are likely complementary and interactive.

Our research was not designed to represent the definitive list of states of epistemic affect. We focused on the painful, negative experiences that are associated with lack of or inadequate explanations and expectations that people have about the world. Thus, an examination of positive affect would be beyond the scope of the current research; however, research on states such as interest and curiosity (Kashdan & Silvia, 2009) hint at epistemic processes associated with positive valence. Of course, the addition of positive states to the model would likely increase the explanatory power of a feature such as valence. However, when examining negative affect in isolation, other features become important, and our results

suggest that epistemic motivations are an important feature of negative affect. Although we focus on negative affect, we are confident that our research will contribute to future models examining evaluative dimensions for both negative and positive states.

Conclusion

A desire to understand the world around us is a core human need (e.g., Heine et al., 2006). As much as any other core human need, it is an emotive pursuit and affective states likely have a role to play when our epistemic coherence is challenged. Here, we aimed to establish a profile of the negative affective states involved in this process—epistemic states versus non-epistemic negative affective states. The unanimity and boundaries of any such category of affect had not previously been empirically demonstrated and past research often failed to link negative states to epistemic process. Our results demonstrate that epistemic motivations are a central part of people's representations of negative affect that help explain how negative feelings are differentiated. These findings highlight the importance of epistemology in people's everyday lives. People strive for meaning and understanding in everyday life and this is reflected in the fact that affective systems help guide people in their understanding of the world. Overall, our work makes an important contribution by shedding light on an underexplored realm of negative affect. We propose that future research incorporate these findings within and beyond models of epistemic threat.

References

Abeyta, A. A., Routledge, C., Juhl, J., & Robinson, M. D. (2015). Finding meaning through emotional understanding: Emotional clarity predicts meaning in life and adjustment to existential threat. *Motivation and Emotion, 39,* 973-983. doi:10.1007/s11031-015-9500-3

Berlyne, D. E. (1960). *Conflict, arousal, and curiosity*. New York, NY: McGraw-Hill.

Bigand, E., Vieillard, S., Madurell, F., Marozeau, J., & Dacquet, A. (2005). Multidimensional scaling of emotional responses to music: The effect of musical expertise and of the duration of the excerpts. *Cognition & Emotion, 19,* 1113-1139. doi: 10.1080/02699930500204250

Camus, A. (1955). *An absurd reasoning. The myth of Sisyphus and other essays.* New York: Vintage.

Carver, C. & Scheier, M. F. (2008) Feedback processes in the simultaneous regulation of action and affect. In J.Y. Shah, & W.L. Gardner (Eds.), *Handbook of motivation science* (pp. 308-324). New York, NY: Guilford.

Darwin, C. (1965). *The expression of emotions in man and animals*. Chicago, IL: Chicago University Press. (Original work published 1872).

D'Mello, S., Lehman, B., Pekrun, R., & Graesser, A. (2014). Confusion can be beneficial for learning. *Learning and Instruction, 29,* 153-170. doi:10.1016/j.learninstruc.2012.05.003

D'Mello, S. (2013). A selective meta-analysis on the relative incidence of discrete affective states during learning with technology. *Journal of Educational Psychology, 105,* 1082-1099. doi:10.1037/a0032674

Dollinger, S. J. (1986). The need for meaning following disaster: Attributions and emotional upset. *Personality and Social Psychology Bulletin, 12,* 300-310.

Ekman, P. (1992). Are there basic emotions? *Psychological Review, 99,* 550–553. doi:10.1037/0033-295x.99.3.550

Ellsworth, P. C. (2003). Confusion, concentration, and other emotions of interest: Commentary on Rozin and Cohen (2003). *Emotion, 3,* 81–85. doi:10.1037/1528-3542.3.1.81

Ellsworth, P. C., & Scherer, K. R. (2003). Appraisal processes in emotion. In P. C. Ellsworth & K. R. Scherer (Eds.), *Handbook of affective sciences* (pp. 572-595). Oxford, UK: Oxford University Press.

Festinger, L. (1957). *A theory of cognitive dissonance*. Stanford, CA: Stanford University Press.

Fiske, S. T. (2004). *Social beings: A core motives approach to social psychology.* New York, NY: Wiley.

Fontaine, J. R., Scherer, K. R., Roesch, E. B., & Ellsworth, P. C. (2007). The world of emotions is not two-dimensional. *Psychological Science, 18,* 1050-1057. doi:10.1111/j.1467-9280.2007.02024.x

Frijda, N. H. (1988). The laws of emotion. *American Psychologist, 43,* 349-358.

Frijda, N.H. (1994). Varieties of affect: Emotions and episodes, moods, and sentiments. In P. Ekman & R. Davidson (Eds.), The nature of emotions: Fundamental questions (pp. 59-67). New York: Oxford University Press.

Fromm, E. (1947). *Man for himself.* New York, NY: Holt, Rinehardt, & Winston.

Gable, P. A., & Harmon-Jones, E. (2010). The blues broaden, but the nasty narrows: Attentional consequences of negative affects low and high in motivational intensity. *Psychological Science,* 21, 211–215. doi:10.1177/0956797609359622

Goethe, J. W. (1806/1987). *Faust: Part One.* Oxford, UK, Oxford University Press

Greenberg, J., Pyszczynski, T., Solomon, S., Rosenblatt, A., Veeder, M., Kirkland, S. &

Lyon, D. (1990). Evidence for terror management theory 11: The effects of mortality salience on reactions to those who threaten or bolster the cultural worldview. *Journal of Personality and Social Psychology, 58,* 308-3 18. doi:10.1037/0022-3514.58.2.308

Gray, K., & Wegner, D. M. (2011). Dimensions of moral emotions. *Emotion Review, 3,* 258-260. doi:10.1177/1754073911402388

Heine, S. J., Proulx, T., & Vohs, K. D. (2006). Meaning maintenance model: On the coherence of human motivations. *Personality and Social Psychology Review, 10,* 88-110. doi:10.1207/s15327957pspr1002_1

Hookway, C., (2003). Affective states and epistemic immediacy, *Metaphilosophy, 34,* 78-96. doi:10.1111/1467-9973.00261

Huston, T. L., Caughlin, J. P., Houts, R. M., Smith, S. E., & George, L. J. (2001). The connubial crucible: Newlywed years as predictors of marital delight, distress, and divorce. *Journal of Personality and Social Psychology, 80,* 237-252. doi:10.1037/0022-3514.80.2.

Janoff-Bulman, R., & Berg, M. (1998). Disillusionment and the creation of value: From traumatic losses to existential gains. In J. Harvey (Ed.), *Perspectives on loss: A sourcebook* (pp 35-49). Washington, DC: Taylor & Francis.

Jaworska, N., & Chupetlovska-Anastasova, A. (2009). A review of multidimensional scaling (MDS) and its utility in various psychological domains. *Tutorials in quantitative methods for psychology, 5,* 1-10. doi: 10.20982/tqmp.05.1.p001

Jonas, E., McGregor, I., Klackl, J., Agroskin, D., Fritsche, I., Holbrook, C., Nash, K., Proulx, T., & Quirin, M. (2014). Threat and defense: From anxiety to approach. In J. M. Olson & M. P. Zanna (Eds.), *Advances in experimental social psychology* (Vol. 49, pp. 219–286). San Diego, CA: Academic Press.

Jost J. T., Glaser J., Kruglanski A. W., Sulloway F. (2003). Exceptions that prove the rule:

Using a theory of motivated social cognition to account for ideological incongruities and political anomalies. *Psychological Bulletin, 129,* 383–393. doi:10.1037/0033-2909.129.3.339

Kashdan, T. B., & Silvia, P. J. (2009). Curiosity and interest: The benefits of thriving on novelty and challenge. In S. J. Lopez, C. R. Snyder, S. J. Lopez, C. R. Snyder (Eds.), *Oxford handbook of positive psychology (2nd ed.)* (pp. 367-374). New York, NY: Oxford University Press.

Kelley, N. J., Crowell, A. L., Tang, D., Harmon-Jones, E., & Schmeichel, B. J. (2015). Disgust sensitivity predicts defensive responding to mortality salience. *Emotion, 15,* 590. doi: 10.1037/a0038915.

Kelly, N. J., Davis, W. E., Kim, J., Tang, D., & Hicks, J. A. (2016). Motivating the academic mind: Abstract construal of academic goals enhances motivation. *Motivation and Emotion*, 42, 193-202.

Keltner D., & Shiota M. N., (2003). New displays and new emotions: A commentary on Rozin and Cohen. *Emotion, 3,* 86–91. doi:10.1037/1528-3542.3.1.86

Kruglanski, A. W. (1989). *Lay epistemics and human knowledge: Cognitive and motivational bases*. New York: Springer

Kruskal, J. B., & Wish, M. (1978). *Multidimensional scaling.* Newbury Park, CA: Sage.

Lambert, A. J., Eadeh, F. R., Peak, S. A., Scherer, L. D., Schott, J. P., & Slochower, J. M. (2014). Toward a greater understanding of the emotional dynamics of the mortality salience manipulation: Revisiting the “affect-free” claim of terror management research. *Journal of Personality and Social Psychology, 106*, 655-678. doi:10.1037/a0036353

Lazarus, R. S. (1991). *Emotion and adaptation.* New York: Oxford University Press.

Maher, P. J., Igou, E. R., & Van Tilburg, W. A. P., (2018). Brexit, Trump, and the polarizing effect of disillusionment. *Social Psychological and Personality Science*, *9,* 205-213. doi:10.1177/1948550617750737

Maher, P. J., Van Tilburg, W. A. P., & Van Den Tol, A. J. M. (2013). Meaning in music: Deviations from expectations in music prompt outgroup derogation. *European Journal of Social Psychology, 43*, 449-454. doi:10.1002/ejsp.1969

Martela, F., & Steger, M. F. (2016). The meaning of meaning in life: Coherence, purpose and significance as the three facets of meaning. *Journal of Positive Psychology*, *11*,1 – 15. doi: 10.1080/17439760.2015.1137623

Martinez, L. M., Zeelenberg, M., & Rijsman, J. B. (2011). Behavioural consequences of regret and disappointment in social bargaining games. *Cognition and Emotion*, *25*, 351-359. doi:10.1080/02699931.2010.485889

Miceli, M., & Castelfranchi, C. (2005). Anxiety as an "epistemic" emotion: An uncertainty theory of anxiety. *Anxiety, Stress & Coping: An International Journal*, *18*, 291-319.http://dx.doi.org/10.1080/10615800500209324

Nolen-Hoeksema, S., Wisco, B. E., & Lyubomirsky, S. (2008). Rethinking rumination. *Perspectives on Psychological Science*, *3*, 400-424. doi: 10.1111/j.1745-6924.2008.00088.x

Noordewier, M., & Breugelmans, S. (2013). On the valence of surprise. *Cognition & emotion*, *27*, 1326-34. doi: http://doi.org/10.1080/02699931.2013.777660

Ohman, A. (2000). Fear and Anxiety: Evolutionary, cognitive and clinical perspectives, and information processing mechanisms. In M. Lewis & J.M. Haviland-Jones (Eds.) *Handbook of emotions* (2nd ed., 573-593) New York: Guilford Press.

Park, C. L. (2010). Making sense of the meaning literature: an integrative review of meaning making and its effects on adjustment to stressful life events. *Psychological Bulletin, 136*, 257-301. doi: 10.1037/a0018301

Pekrun, R., Vogl, E., Muis, K. R., & Sinatra G. M. (2017). Measuring emotions during epistemic activities: the Epistemically-Related Emotion Scales. *Cognition and Emotion, 31*, 1268-1276. doi:10.1080/02699931.2016.1204989

Piaget, J. (1972). *To Understand Is To Invent*. New York, NY: The Viking Press

Posner, J., Russell, J. A., & Peterson, B. S. (2005). The circumplex model of affect: An integrative approach to affective neuroscience, cognitive development, and psychopathology. *Development and Psychopathology, 17*, 715-734. doi:10.1017/S0954579405050340

Proulx, T., & Heine, S. J. (2006). Death and black diamonds: Meaning, mortality, and the Meaning Maintenance Model. *Psychological Inquiry, 17*, 309-318. doi:10.1080/10478400701366985

Proulx, T., Heine, S. J., & Vohs, K. D. (2010). When is the unfamiliar the uncanny? Meaning affirmation after exposure to absurdist literature, humor, and art. *Personality and Social Psychology Bulletin, 36,* 817-829. doi: 10.1177/0146167210369896

Proulx, T., & Inzlicht, M. (2012). Moderated disanxiousuncertlibrium: Specifying the moderating and neuroaffective determinants of violation-compensation effects. *Psychological Inquiry, 23*, 386-396. doi:10.1080/1047840X.2012.734912

Proulx, T., Inzlicht, M., & Harmon-Jones, E. (2012). Understanding all inconsistency compensation as a palliative response to violated expectations. *Trends in Cognitive Sciences, 16, 285-291.* doi*:* 10.1016/j.tics.2012.04.002

Robinson, M. D., & Clore, G. L. (2002). Belief and feeling: Evidence for an accessibility model of emotional self-report. *Psychological Bulletin,* 128, 934–960. doi:10.1037/0033-2909.128.6.934

Roseman, I. J., & Smith, C. A. (2001). Appraisal theory: Overview, assumptions, varieties, controversies. In K. R. Scherer, A. Schorr, & T. Johnstone (Eds.), *Appraisal processes in emotion: Theory, methods and research* (pp. 3-19). New York, NY: Oxford University Press.

Roseman, I. J., Wiest, C., & Swartz, T. S. (1994). Phenomenology, behaviors, and goals differentiate discrete emotions. *Journal of Personality and Social Psychology,* 67, 206–211.

Rozin, P., & Cohen, A. B. (2003). High frequency of facial expressions corresponding to confusion, concentration, and worry in an analysis of naturally occurring facial expressions of Americans. *Emotion, 3,* 68-75. doi: 10.1037/1528-3542.3.1.68

Rusbult, C. E., Onizuka, R. K., & Lipkus, I. (1993). What do we really want? Mental models of ideal romantic involvement explored through multidimensional scaling. *Journal of Experimental Social Psychology, 29,* 493-527. doi:10.1006/jesp.1993.1023

Russell J. A. (1980). A circumplex model of affect. *Journal of Personality and Social Psychology, 39,* 1161-1178. doi:10.1037/h0077714

Russell, J. A., & Bullock, M. (1985). Multidimensional scaling of emotional facial expressions: Similarity from preschoolers to adults. *Journal of Personality and Social Psychology, 48,* 1290-1298. doi:10.1037%2F0022-3514.48.5.1290

Sartre, J. P. (1943/1956). *Being and Nothingness: An Essay on Phenomenological Ontology*. Translated by Hazel E. Barnes. NY: Philosophical Library.

Scherer, K. R. (2009). Emotions are emergent processes: they require a dynamic computational architecture. *Philosophical Transactions of the Royal Society B: Biological Sciences,* 364, 3459–3474. http://doi.org/10.1098/rstb.2009.0141

Schwarz, N., & Clore, G. L. (1983). Mood, misattribution, and judgments of well-being: Informative and directive functions of affective states. *Journal of Personality and Social Psychology, 45*, 513-523. doi:10.1037/0022-3514.45.3.513

Silvia, P. J. (2010). Confusion and interest: The role of knowledge emotions in aesthetic experience. *Psychology of Aesthetics, Creativity, and the Arts*, 4, 75-80. doi:10.1037/a0017081

Smith, A. J., Abeyta, A. A., Hughes, M., & Jones, R. T. (2015). Persistent grief in the aftermath of mass violence: The predictive roles of posttraumatic stress symptoms, self-efficacy, and disrupted worldview. *Psychological Trauma: Theory, Research, Practice, and Policy, 7*, 179-186. http://dx.doi.org/10.1037/tra0000002

Smith, C. A., & Ellsworth, P. C. (1985). Patterns of cognitive appraisal in emotion. *Journal of Personality and Social Psychology, 48,* 813–838. doi:10.1037/0022-3514.48.4.813

Steger, M. F., Oishi, S., & Kashdan, T. B. (2009). Meaning in life across the life span: Levels and correlates of meaning in life from emerging adulthood to older adulthood. *Journal of Positive Psychology, 4,* 43-52. doi: 10.1080/17439760802303127

Tomkins, S. S. (1962). *Affect, imagery, consciousness: Vol. 1. The positive affects.* New York, NY: Springer.

Tomkins, S. S. (1963). *Affect, imagery, consciousness: Vol. II. The negative affects.* New York, NY: Springer.

Van den Bos, K. (2001). Uncertainty management: The influence of uncertainty salience on reactions to perceived procedural fairness. *Journal of Personality and Social Psychology, 80*, 931-941. doi:10.1037/0022-3514.80.6.931

Van den Bos, K. (2009). Making sense of life: The existential self trying to deal with personal uncertainty. *Psychological Inquiry, 20*, 197-217. doi:10.1080/10478400903333411

Van Tilburg, W. A. P., & Igou, E. R. (2011). On boredom and social identity: A pragmatic meaning-regulation approach. *Personality and Social Psychology Bulletin, 37*, 1679-1691. doi:10.1177/0146167211418530

Van Tilburg, W. A. P., & Igou, E. R. (2017). Boredom begs to differ: Differentiation from other negative emotions. *Emotion, 17*, 309-322. doi:10.1037/emo0000233

Van Tilburg, W. A. P., & Igou, E. R. (2016). Going to political extremes in response to boredom. *European Journal of Social Psychology, 46*, 687-699. doi:10.1002/ejsp.2205

Van Tilburg, W. A. P., Igou, E. R., & Maher, P.J.M. (2018). Our Daily Dread: Everyday Existential Threats Predict Aggressive Tendencies. *Manuscript under review.* Kings College London, United Kingdom.

Van Tilburg, W. A. P., Igou, E. R., & Sedikides, C. (2013). In search of meaningfulness: Nostalgia as an antidote to boredom. *Emotion, 13*, 450-461. doi:10.1037/a0030442

Van Tilburg, W. A., Sedikides, C., Wildschut, T., & Vingerhoets, A. J. (in press). How nostalgia infuses life with meaning: From social connectedness to self-continuity. *European Journal of Social Psychology.* doi: 10.1002/ejsp.2519

Van Tilburg, W. A. P., Wildschut, T., & Sedikides, C. (2018). Nostalgia's place among self-relevant emotions. *Cognition and Emotion, 32,* 742-759. doi: 10.1080/02699931.2017.1351331

Webster, D. M., & Kruglanski, A. W. (1997). Cognitive and social consequences of the need for cognitive closure. *European review of social psychology*, *8*(1), 133-173. doi:10.1080/14792779643000100

Widen, S. C., & Russell, J. A. (2003). A closer look at preschoolers' freely produced labels for facial expressions. *Developmental psychology, 39*(1), 114 -128. doi:10.1037/0012-1649.39.1.114

Weick, K. (1995). *Sensemaking in Organisations.* London: Sage.

Zeelenberg, M., & Pieters, R. (2006). Feeling is for doing: A pragmatic approach to the study of emotions in economic behavior. In D. DeCremer, M. Zeelenberg, & J. K. Murnighan (Eds.), *Social psychology and economics* (pp. 117–137). Mahwah, NJ: Erlbaum.

Table 1: *Explained variance figures for each characteristic across all three Studies*

	Arousal	Certainty	Meaning Search	Sense Making	Understanding	Valence
Study 1	0.83	0.89	0.69	0.85	0.68	0.68
Study 2	0.12	0.61	0.72	0.77	0.77	0.52
Study 3	0.45	0.42	0.63	0.59	0.59	0.42

Table 2: *Mean (SD) ratings for epistemic motivation across writing conditions*

	Sense Making	Understanding	Meaning Search
Epistemic challenge	5.28 (1.20)	4.94 (1.52)	4.70 (1.64)
Control	3.73 (1.94)	3.04 (1.88)	3.06 (1.84)
p	0.00	0.00	0.00
η_p^2	.19	.23	.18

Table 3: *Vector ratings (Study 3) and correlation coefficients (Study 4) between each affective state and epistemic motivation*

	Sense Making		**Understanding**		**Meaning Search**	
	Vector	r	Vector	r	Vector	r
Anger	-0.75	.188	-0.79	.296	-0.91	.186
Anxiety	0.42	.252	0.44	.395	0.50	.283
Confusion	0.85	.354	0.80	.513	0.57	.384
Contempt	-0.41	.064	-0.50	.060	-0.86	.026
Disappointment	-0.61	.147	-0.61	.293	-0.55	.158
Disgust	-0.86	.121	-0.93	.190	-1.15	.073
Disillusionment	0.05	.143	0.09	.364	0.25	.192
Distress	0.21	.204	0.17	.355	0.01	.225
Doubt	0.76	.210	0.82	.352	0.99	.317
Fear	1.03	.223	1.02	.356	0.92	.270
Frustration	0.03	.221	-0.04	.391	-0.31	.182
Guilt	-1.00	.013	-0.93	.121	-0.61	.111
Loneliness	0.28	.071	0.38	.205	0.74	.125
Regret	-0.69	.114	-0.64	.260	-0.41	.182
Sadness	-0.28	.177	-0.19	.314	0.15	.208
Shame	-1.19	.037	-1.18	.204	-1.05	.120
Surprise	1.06	.279	0.98	.274	0.61	.144
Uncertainty	0.98	.290	1.02	.420	1.10	.389

Note: In Study 3, the scale on each vector is from -1.5 to 1.5

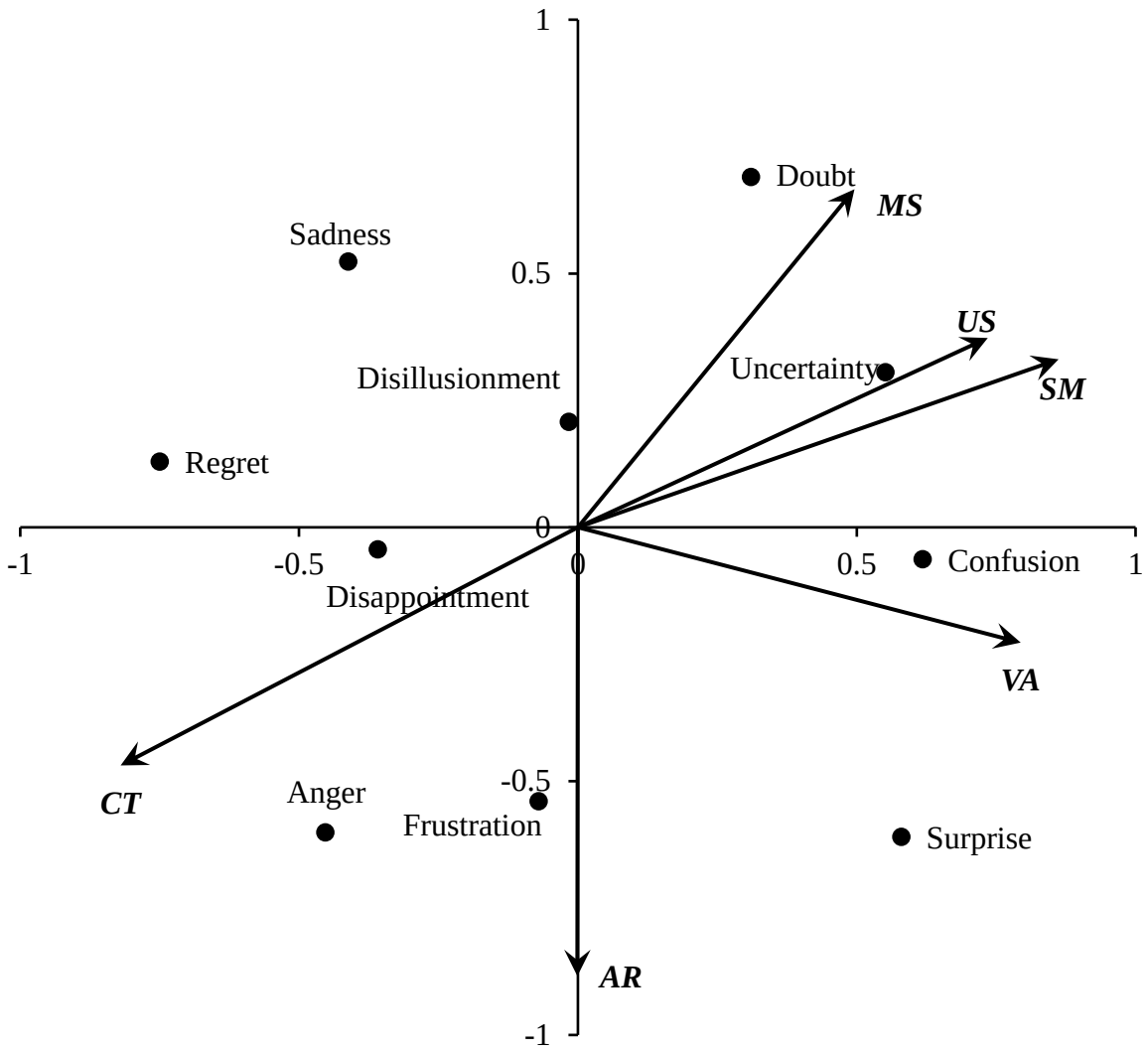

Figure 1. Two-dimensional representation of affective states in Study 1 with evaluative features as vectors.

Note: MS = meaning search; *US* = relation to understanding; *SM* = relation to sense-making; *VA* = valence; *AR* = arousal; *CT* = certainty.

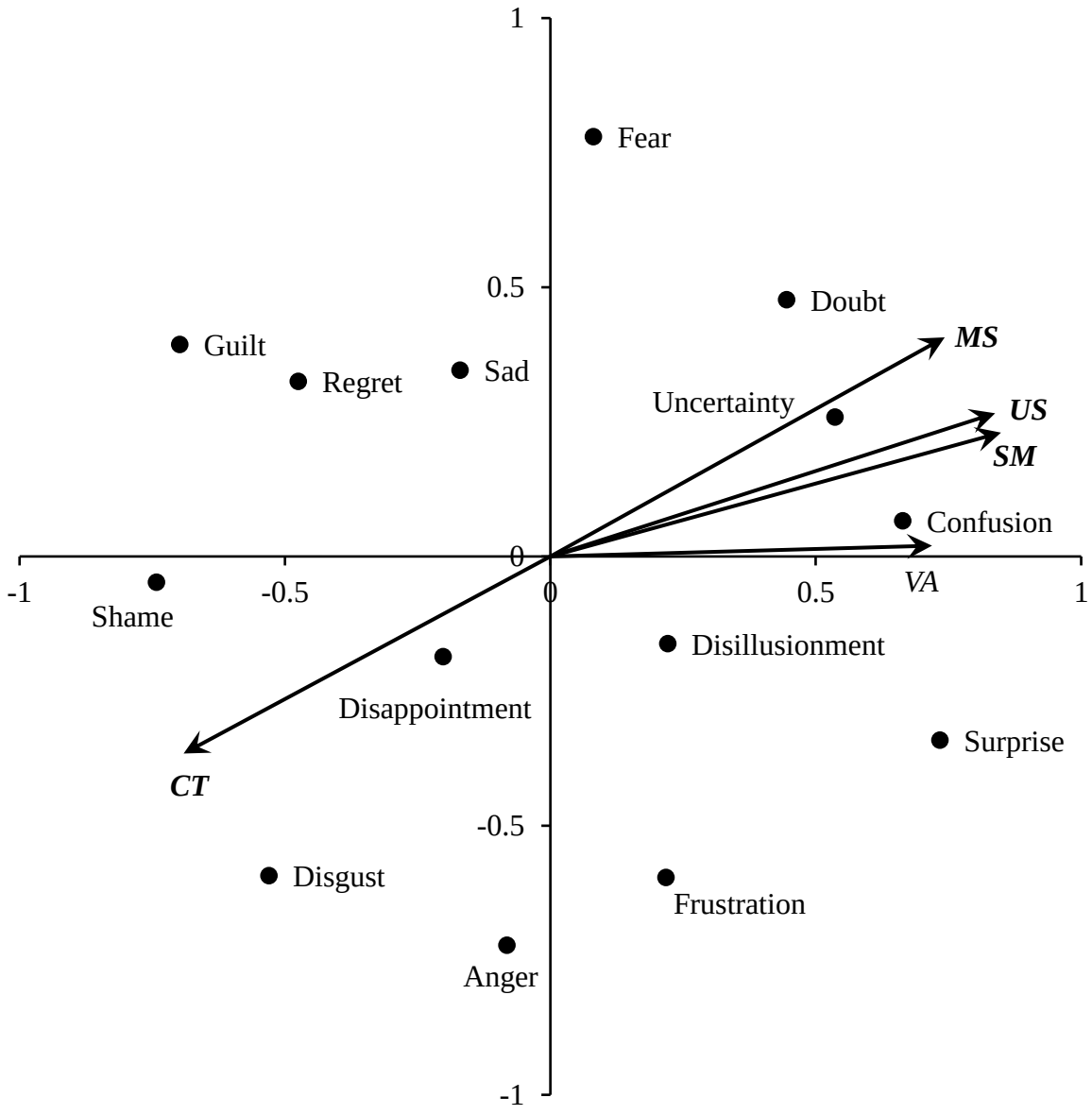

Figure 2. Two-dimensional representation of affective states in Study 2 with evaluative features as vectors.

Note: MS = meaning search; *US* = relation to understanding; *SM* = relation to sense-making; *VA* = valence; *CT* = certainty.

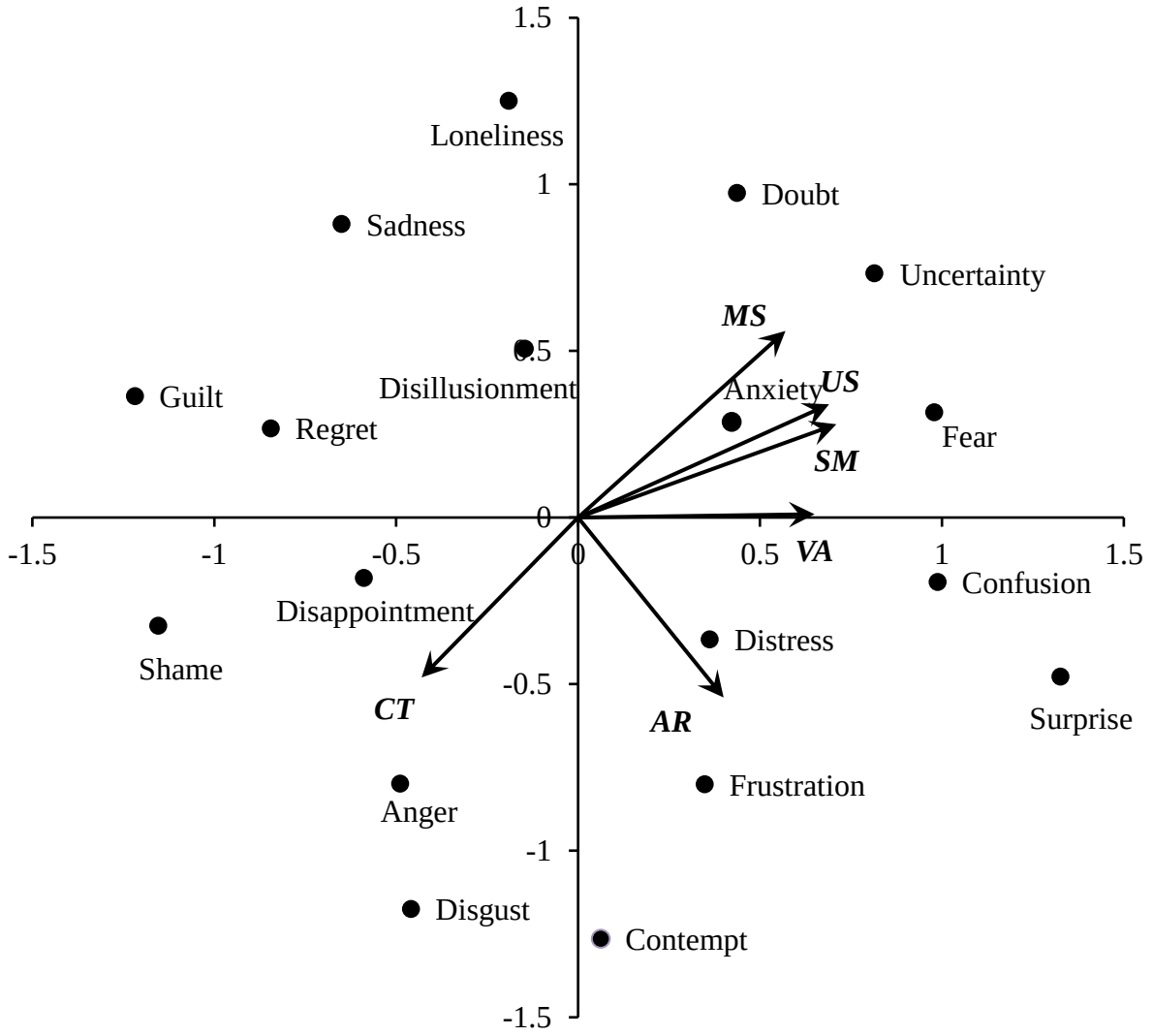

Figure 3. Two-dimensional representation of affective states in Study 3 with evaluative features as vectors.

Note: MS = meaning search; *US* = relation to understanding; *SM* = relation to sense-making; *VA* = valence; *AR* = arousal; *CT* = certainty.

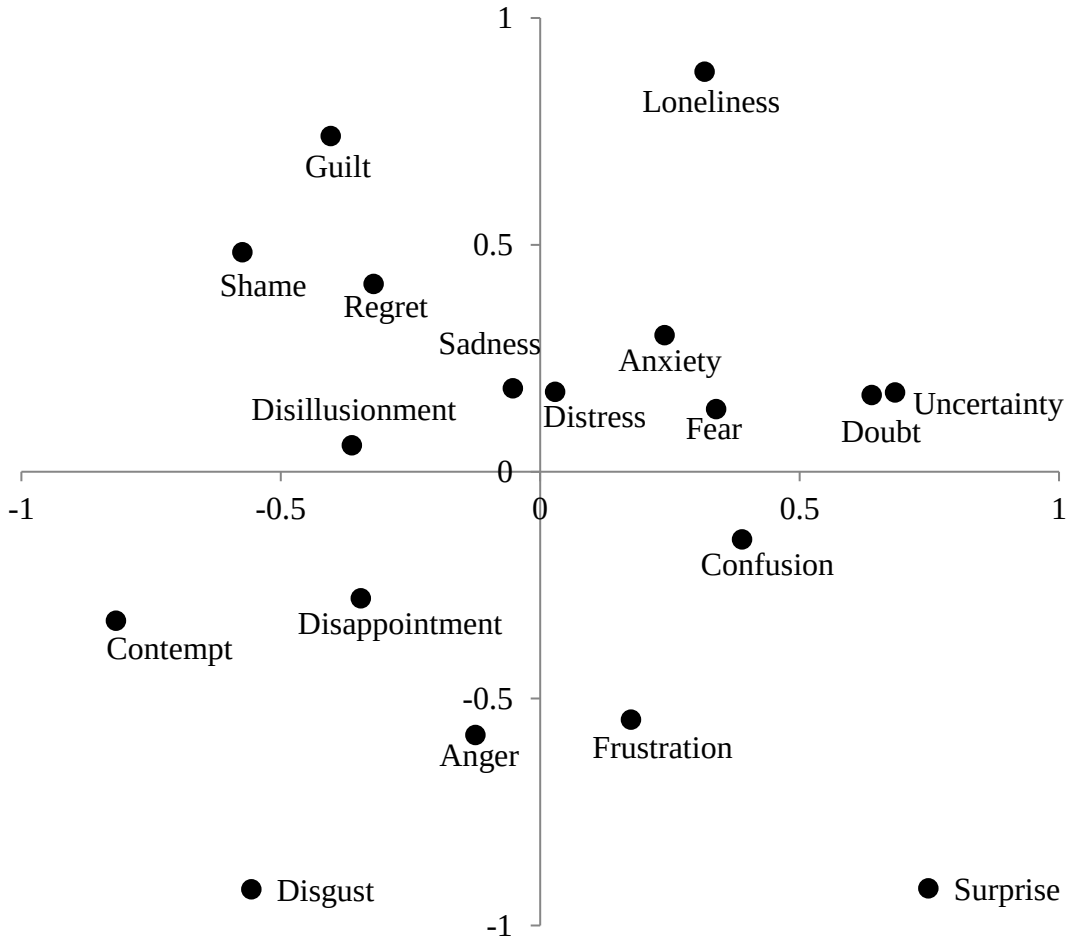

Figure 4. Two-dimensional representations of the similarity of affective states based on participants' experiences in Study 4