3-4-2015

Emotions in Information Systems Research – A Five Component View

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Abstract. Many scientific viewpoints and research streams occurred over the last decades with the objective to create structure and common understanding on a more abstract level how emotions affect human behavior (e.g. constructivist or appraisal theories). As a consequence, Information Systems (IS) researchers have adopted diverse mixed up theoretical foundations about emotions. This brings the need for a more structured way to study emotions in the IS field. Thus, within this research a five component view on emotions is developed, based on appraisal theories of emotions and the 3-emotions´ nomological network by Gregor et al. (2014). The new view provides better guidance for IS researchers studying the occurrence or effect of human emotions in terms of a better understanding of the emotion concept and an easier transfer of theoretical considerations from psychology to the IS field, especially the adaptation of emotional constructs and their subjective and objective measurement.

Keywords: emotions, appraisal, five component view, action tendencies, emotion theory

1 Introduction

As Kahneman already pointed out in his Nobel Prize speech, it is an unrealistic assumption to understand human behavior solely through rational models [1], as a substantial proportion of human thinking and action is determined by emotions. There are several studies showing how strongly emotions affect cognition [2]. Further, emotions impact memory and information processing, the perception of risk [3] and economic decision making [4].

Emotions have also raised significant attention in IS research. For more than two decades, emotional constructs, such as computer anxiety [5, 6] or perceived enjoyment [7] have been regarded in IS research. Nevertheless cognitive constructs are still more common in the theoretical considerations about IS usage behavior. Although emotions have sometimes be regarded as complement to these cognitive constructs, recent research indicates that constructs, once understood as purely cognitive, such as perceived usefulness, can be detected at the neuronal level in brain areas that are known for emotional activity to date [8, 9].

12th International Conference on Wirtschaftsinformatik,
March 4-6 2015, Osnabrück, Germany

Vornewald, K.; Eckhardt, A.; Krönung, J. (2015): Emotions in Information Systems Research – A Five Component View, in: Thomas. O.; Teuteberg, F. (Hrsg.): Proceedings der 12. Internationalen Tagung Wirtschaftsinformatik (WI 2015), Osnabrück, S. 1756-1770

In general, research on emotions can be subordinated to the so called 'affective sciences', which continue to grow [10] and steadily improves our understanding of emotions and their cause and impact. However, the status quo of research in the IS field is almost completely neglecting these new psychological theories in affective sciences, thus causing a lack of systematic investigation of affective phenomena in IS research [11]. However, in order to better transfer these new insights and perspective to IS field, a comprehensive understanding at the utter most level is necessary.

In recent years there have been a few studies empirically investigating the influence of emotions on IS usage (e.g., [12, 13]). Conceptual studies integrating differing psychological viewpoints and research streams are even less common. In this context, Beaudry and Pinsonneault [14] have examined the effect of emotions on the use of IS, while Zhang et al. [11] have created a theoretical framework to classify affective concepts in IS research. Furthermore, Gregor et al. [15] have developed a nomological network to understand emotions on the basis of different response systems. So far the latter model provides the only groundwork for the use of multiple measurement approaches for emotion studies in the IS context emphasizing a particular need of more conceptual work incorporating all the newest ideas and developments of the affective sciences field.

Our review of literature within the field of psychology revealed a vast amount of theories and models regarding emotions. In this quantity the component process model (CPM), developed by Scherer [16], appeared especially useful for our purpose. For that reason, by drawing on the CPM we develop a five component view on emotions based on and enhancing the 3-emotions' nomological network by Gregor et al. [15]. While this model is mainly focused on the response level, our model take the view on a deeper level helping to better understand emotion causation. Further contributions of the five component view are, a better understanding of the relationship between cognitive and emotional constructs, a more precise specification of the triggers of emotions in the IS context, as well as more facilitated assessment of the subsequent behaviors. In addition, it opens up new possibilities to explain the relations of an emotion to its physiological concomitants and bodily expressions or other constructs, such as stress. By applying our five component view, the adaptation of emotional constructs from psychology to IS research approaches will be significantly facilitated and improved.

To develop our five component view, the remainder of this paper is as follows. First, we provide a brief overview of the state of knowledge on the study of emotions in psychology. Section 2 will deal with the definition of emotion. Subsequently section 3 provides an overview of emotion theories. Afterwards, we outline the discrepancies for the studies on emotions in IS research in terms of the inconsistent mix up of theories and conceptions. Finally, section 4 introduces our new five component view on emotions for IS research.

2 Defining Emotion

A definition of emotion is important in order to distinguish the research object intelligible [17] and to make insights comparable among different disciplines [18]. Definitions thus become pragmatic tools in the search for intension [19].

There is a very high number of definitions of emotion [20]. There is by no means a consensus on the understanding of emotions and thus about what a definition of emotion must include [21]. In particular, the interdisciplinary dialogue and scientific cooperation is hindered by these circumstances [22].

In order not to lose the connection to psychological research on emotions and thus the benefit of future findings, knowledge of the debate about the definition of emotions is necessary. The scope of the proposed definitions ranges from abstract working definitions, which are just a collection of examples [17], to more complex approaches such as the CPM by Scherer [18], in which the definition itself is again part of a whole theory. Here, emotion is defined, "*as an episode of interrelated, synchronized changes in the states of all or most of the five organismic subsystems in response to the evaluation of an external or internal stimulus event as relevant to major concerns of the organism*" [18]. The five subsystems are a cognitive, a neurophysiological, a motivational, a motor expression, and a subjective feeling component [18]. Due to the empirical evidence in favor of Scherer's component process model and its applicability, it represents the underlying thinking for the development of our five component view within section 4.

3 Emotion Theory

3.1 Overview

Depending on the type and accuracy of the subdivision, a different number of emotion theories can be distinguished from each other. Most theorists agree that emotions serve adaptive responses to stimuli that are crucial for the well-being of the organism [23]. However, different emotion theories have different approaches to explain the underlying mechanisms. A four-part structure according to this same criterion is conducted by Brosch et al. [23]. This structure includes the basic emotion theories, the appraisal theories of emotion, dimensional theories of emotion and the constructivist theories of emotion. All four have in common that they are part of the current debate about emotions in the affective sciences, and thus are relevant for everybody conducting research about emotions.

It should be noted that other authors have made several different subdivisions. Moors [24] for example delineates six theories from each other. While Gendron and Barrett [25] only differ between appraisal theories, basic emotion theories and constructivist theories by assigning a part of the dimensional approaches to constructivists theories. Gross and Barrett [26] in turn differentiate some theories side by side on a continuum. A detailed description of the debates about emotion theories would be

beyond scope of this paper, however, the four theory types listed above will be presented shortly.

3.2 Emotion Theories

Basic emotion theories are also called categorical theories or discrete theories, and assume a certain number of basic emotions. The proposed basic emotions are divided into positive (e.g. satisfaction or enjoyment), negative (e.g. anger or disgust) and others (e.g. interest and surprise) [27], and vary in number depending on the author (e.g., [28, 29]). From the combination of basic emotions more emotions can be created [30].

All basic emotion theorists agree that basic emotions are discrete and cause a fixed number of neural and physically expressed states. In addition, they contain a feeling and a motivation component [31].

Next, the dimensional theories are explained, which can represent an infinite number of emotional states as opposed to categorical theories. Therefore, basic emotion theories offer a broader basis to discuss the similarities and variations of different emotions, and hence not limited to valence and arousal. The main assumption of dimensional theories is that different emotions can be represented by variations on some dimensions [23]. The number of dimensions vary [32]. However, valence (pleasant – unpleasant) and arousal (high – low) are very frequently applied [33]. The best known model, which takes a dimensional approach, is Russell's circumplex model [34, 35]. It contains the dimensions of valence and arousal, allowing a circular representation of affect.

The differentiation between dimensional theories and constructivist theories can be performed at no clear criterion. Rather, it depends on the selected level of consideration. The term dimensional theory is used when one want to focus on the steady feature of the dimensional models, especially in comparison to discrete views. In contrast, the term constructivist theory is used when it comes to emotion causation, or to the question what emotions really are.

Constructivist approaches assume that emotions are psychical compounds that are constructed from more basic psychological ingredients [25]. However, the individual components themselves are no emotions [36] and can be part of other mental states. Thereby psychological construction models can explain the extreme heterogeneity of emotional reactions, that are actually all part of one emotion category (e.g. fear) [36]. The categories in turn are not biologically separated by constructivist approaches [37]. So emotions occur from an ongoing, continuously changing constructive process [26]. However, this process may have a biological basis [36, 38]. Based on this feature, a further differentiation is possible. Gross and Barrett [26] differ again between psychological construction and social construction models. The foregoing description applies especially to the psychological constructivism. Social constructivist approaches however assume that emotions emerge from culture, social conventions and agreed-upon meaning [39, 40], but not from biological conditions. What both approaches have in common is that they consider emotions as created and thus not as a biological "*natural kinds*" [41].

Constructivist theories have received increasing attention in recent years [40], and, even if they have some similarities with appraisal theories, they are the leading alternative to them [42]. In this work we build on appraisal theories, better providing us with components and tools to understand and explain emotions in IS related situtations. A detailed explanation now follows.

Appraisal theories of emotion date back to Arnold [43] und Lazarus [44] [45]. Current representatives are for example Roseman, Scherer, Ellsworth und Frijda [46–48]. The basic assumption of appraisal theories is that the assessment of the current, remembered or imagined environment occupies a central role in the triggering and the differentiation of emotions [33],where emotions themselves are in turn adaptive responses to environmental influences that have an impact on the well-being of the organism. Appraisal theories understand emotions as processes, which is why the terms emotion and emotional episode are used interchangeably [45].

The emotional episode triggers a series of changes in organismic subsystems or components. These components are the mentioned above appraisal component (evaluation), motivational component (action tendencies / action readiness), somatic component (peripheral physiological responses), motor component (expressive and instrumental behavior) and the feeling component (subjective experience). Appraisal theories are accordingly a componential theory and the emotional episode, a recursive and continuous process [18, 45, 49]. The appraisal process establishes a connection between the organism and the triggering event. Therefore appraisal theories not only describe emotions, but also explain them [33]. Appraisal theories also include assumptions about cultural and development-specific differences, therefore, they can explain how the same stimulus triggers different emotions [37].

The appraisal itself is represented by a number of appraisal dimensions. The number and type of the proposed variables is slightly different depending on the author (see [33] or [45] for an overview of appraisal variables of different authors). Typical appraisal dimensions are for example novelty, intrinsic pleasantness, certainty/predictability, goal significance, agency, coping potential and compatibility with social or personal standards [33]. The appraisal variable itself can be either categorical (e.g. [50]) or dimensional (e.g. [51]) [45]. Examples of appraisal theories include the CPM of Scherer [16] and the OCC-Model of Ortony, Clore and Collines [52]. Especially the CPM underwent an detailed scrutiny, verifying it components and explanatory power [19, 49, 53].

Finally, it should be noted that the classification of the various theories is always very blurred. Ultimately, there is always a specific classification criterion that assigns a model to one or the other type of theory. However, researchers can only benefit from rough knowledge of the debate about emotion theories. Following it will be shown which theories and models have been adapted in IS research.

3.3 Overview of Emotion Theories adopted in IS Research

In their MIS Quarterly article in the year 2010, Beaudry and Pinsonneault [14] name appraisal theories as their theoretical basis (more specific: [54, 55]). More precisely they referred to the appraisal-tendency framework (ATF), which was developed

by Lerner, Keltner and Tiedens [56–58]. The ATF itself also builds on the theory of Smith and Ellsworth [55] [58] and is a specific emotion approach [59].

Beaudry and Pinsonneault [14] use two appraisal dimensions (goal achievement and control) to classify emotion in four blocks. The four classes are achievement, challenge, loss, and deterrence emotions. Different emotions are then divided into these classes. For their study, they then examine the impact of one exemplary emotion (anger, anxiety, excitement, and happiness) per class. This is contrary to findings, according to which at least four dimensions are needed to classify emotional words [60].

Another attempt to structure the application of emotions in the IS research is the affective response model (ARM) from Zhang [11]. Although it focuses not only on emotions, rather on affect in general, it should be mentioned in this review. Because the majority of the affective constructs used in the IS research are emotions. The ARM is based on Russell's conception of Core Affect [11, 38]. Emotions are in this view, an affective concept alongside others such as perception of affective quality and defined as stimulus-related core affect [11, 38, 61, 62]. Aside from the constructivist reference, Zhang also argues with further theoretical considerations. For instance, she uses Scherer´s CPM when it comes to the definition of emotion. Nevertheless, the ARM is very different in the used terminology from the model presented in the following. Apart from the quite different purpose, these disparities are rooted mainly in the used theoretical basis.

Eventually, Gregor et al. [15] developed a nomological network for the better understanding and assessment of emotions in the IS research. They use a functional view on emotion, by highlighting their evolutionary adaptive function. As theoretical foundation the 3-systems´ emotion theory [63] is used. It builds on the bio-informational theory by Lang [64]. Accordingly, there are three major components that are part of emotions: action, physiology und subjective experience [65]. Furthermore, these three components are almost congruent with Izard´s emotion Triad (subjective feelings, physiological activation, and motor expressions; [66]).

The emotional experience is triggered by an IS stimulus. Followed by an initial appraisal process [51]. The three emotion systems all contribute to the emotional experience, because they have channels, containing information about the emotional experience. Furthermore, they are connected with cognitive and other (e.g. vision) processes [67, 68]. Two other factors are important. Firstly, the context, in which the emotion takes place, is not negligible. Secondly, individual characteristics influence the emotional experience [69].

Particularly interesting for the IS research is the outcome behavior. It is reflected in attitudes, intentions or actions [70]. The model offers some more advantages. On the one hand it offers a way to consider emotional responses in a broader perspective, on the other different measurement methods can be assigned to the three response systems [15, 71]. Self-reports are assigned to the language response system, facial behavior or vocal characteristics to the behavior response system and ANS or CNS-measures to the physiological response system. Thus, the model provides a solid foundation for the future growth in studies applying multi-measures of emotion.

From a strictly theoretical point of view the model can´t be assigned to any theory alone. Instead, it contains influences from various theories, mentioned above. For example, the theory of Lang [64, 65] is combined with an initial appraisal [51]. Further, the functional view is influenced by thoughts, originated in basic emotion theories. Our five component view proposed in the next section is based on the appraisal component, which already exists in the model, providing us with a good starting point within IS research.

3.4 Implications for IS Research Based on Emotion Theory

The Major finding of our literature review on emotions in IS research is that various models and conceptions of emotion were adopted and mixed in the IS research but partially without incorporating all elements and components of the underlying theoretical concepts in psychology. As outlined, there are influences and mixed approaches of appraisal theories (e.g., [13–15]), constructivist theories (e.g., [11]), basic emotion theories (e.g., [15]), and dimensional theories (e.g., [11, 15]).
Apart from that, challenges in the illustration of types of emotion theories in IS research do also exist. Since Yin et al. [13] only present appraisal theories and dimensional theories as prominent approaches among psychologists, *"to characterize different emotions"* [13], neglecting the existence of basic emotion theories. In contrast, Gregor et al. [15] state that *"there are two dominant perspectives."* to classify and measure emotions, namely dimensional and discrete views [15]. Although this reduction is justified with respect to the measurement of emotions, it does not in the context of classification as it makes no sense to neglect appraisal theories in this regard.Hence, it is our objective to provide a more comprehensive view on emotions for a better and flawless transfer from psychology to the IS field.

4 A Five Component View on Emotions

4.1 Specification of the Five Component View

By applying Scherer´s five component approach, our view and the 3 emotions´ nomological network differ in two important facets; First, a stronger consideration of the appraisal component and second, the adding of a motivational component. This is due to the applied CPM with its emotional episode embracing changes in its five components [51]. It was chosen by us because in its evolution over decades it has proven its usefulness and capability to account for emotions [19, 49]. Thereby our view comprises the five components listed above. Different measurement methods can be well assigned to the three components, where the 3-emotions' nomological network offers a good foundation for the future use of multi-measures in IS research.

Gregor et al. [15] exclusively focus on response systems, i.e. measurable expressions, triggered by emotions. However, if one takes a broader view of emotions, a view which is already present in the model of Gregor et al. [15], but not specified in every detail. Then it appears useful, also to measure cognitive processes (appraisals) and triggered action tendencies. In contrast, we argue that by taking into account cog-

nitive appraisals and action tendencies, a better picture of emotions can be obtained. Thus, in section 4.2 the benefits of a five-component perspective for the IS research are explained, which outweigh the increased complexity in our thinking.

Scherer's five components (cognitive/appraisal, neurophysiological/bodily symptoms, motivational/action tendencies, motor expression/facial and vocal expression, subjective feeling/emotional experience; [18]) are largely congruent with the model proposed by Gregor et al. [15], though providing a broader view on all emotional components However the two models significantly differ by the addition of the motivational component, what make our view more complex to some extent In return every component can be described precisely, i.e. there are no ambiguous components like cognitive processing and the link between an emotion and a specific behavior can be better understood. The appraisal and the cognitive component are already included in the nomological network, but now are merged. This makes sense, since it is the appraisal component, which explains the cognitive content of an emotion. The neurophysiological component corresponds approximately to the physiological system, the motor expression component to the behavioral system and the subjective feeling component to the language system. The whole model is shown in figure 1. Furthermore, the measurement methods are mapped to the individual components.

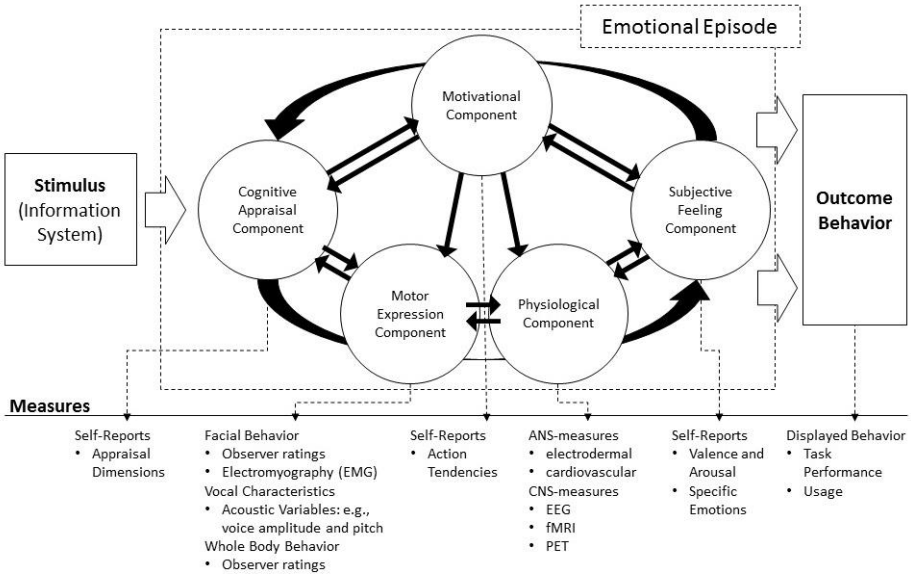

Fig. 1. A Five Component view on Emotions including associated measures (based on [15, 49, 71])

According to Scherer [49] "*emotion is conceptualized as an emergent, dynamic process based on an individual's subjective appraisal of significant events.*" [49]. The emotional episode is thus initiated by a first cognitive appraisal, as shown by the appraisal component on the left side of figure 1. The appraisal is considered as a multi-

level process, which causes changes in all other components. The result is a recursive process, which is shown, due to abstraction reasons, in simplified form without a central representation in figure 1 (see [49] for a more detailed description). The corresponding methods to measure a change in the components are shown below. A comprehensive description of the measurement methods of the original three components was adopted by Gregor et al. [15] from Mauss and Robinson [71] and will not be repeated at this point. Since the new components are not outlined in this context, it is to be noted that there is some evidence in psychology for measuring appraisals and action tendencies via self-reports (e.g., [72, 73]), coming with the downside of subjectivity bias. An issues which is addressed among other things in the following section.

4.2 Benefits of the Five Component View

To understand our selection of the CPM as underlying theory, we outline the advantages of a five component perspective in this section. There are several reasons to add a motivational component. On the one hand, some researchers [19] agree that the three-component model of Lang [64] is too rough. On the other hand action tendencies could be highly relevant for IS research. Action tendencies are represented by the motivational component. Action tendencies (also called action readiness) can be measured via self-reports (e.g. [73–75]) and are used in particular by appraisal theorists to differentiate specific experienced emotional episodes [76]. Action Tendencies were mentioned several times in reference to emotions in the IS research but were not integrated in the models as distinct construct (e.g. [11, 13, 14]). Typical items to query action tendencies include: "*I felt like sharing my feelings with other people*", "*I wanted to help someone, to take care of someone*" or "*I wanted to make amends*" (from [74, 76]). Especially in research about the use of IS in an organizational environment, this offers an opportunity for additional explanatory potential, i.e. a better understanding of the impact of emotions on a change in human motivation and thus subsequent actions.

Furthermore, the motivational component contains the functions of preparation and direction of action. Thus, the relationship between the emotional episode and the outcome behavior can be modeled more accurately than in the 3-emotions´ nomological network. At the same time, it could also be seen in figure 1 that changes in the motivational component result in changes in other components, especially in physiological responses and motor expressions. Imagine a situation in which the operating system crashes, destroying the work of the past hour. The appraisal of the situation and the resulting change in action tendencies trigger physiological responses such as an increased heart rate or expressions such as a petrified face. But also new appraisals of the situation emerge as a result of the change in action tendencies.

We used the appraisal component already exists in the nomological network as a starting point to extent our view on emotions. Appraisal theories assume that there is a variable relationship between outer stimuli and emotion. At the same time, there is a stable relationship between a specific cognitive appraisal and a specific emotional episode [45]. In the following, five advantages for the integration of cognitive appraisals are discussed for IS research.

The already discussed appraisal dimensions offer a much higher accuracy when differentiating various emotional episodes from each other. For example, the emotions anger and shame, which hardly can be distinguished on the basis of valence, can be differentiated from each other by the appraisal dimension agency [77]. The same applies to sadness and anger [78]. Also other complex situations can be explained by appraisal dimensions. For example, a person on a diet, presented with a chocolate cake. High intrinsic pleasantness (direct benefit) is here associated with lower goal conduciveness (diet) [79]. Such cases can also be found in the IS context. Imagine a person with a problem which can be solved by a novel IS (high goal conduciveness). But the system is very complex and the usage is not enjoyable (low intrinsic pleasantness). This advantage of appraisal dimensions has already been recognized in the IS research. Hence, Yin et al. [13] distinguish the emotions anxiety and anger, which do not differ in their valence, based on the appraisal dimension certainty.

A further gain compared with the nomological network is related to the emotion causation. Appraisal Theories assume, „*that the organism's evaluation of its circumstances (current or remembered or imagined) plays a crucial role in the elicitation and differentiation of its emotions.*" [33]. Therefore the appraisal component is shown as a starting point on the left side of figure 1. Appraisal Dimensions are indeed only tools to represent this assessment process and need to be improved in future concerning their accuracy [48]. But they also allow a more accurate picture of what exactly triggered the emotion. By examination of cognitive appraisals it can thus be better understood what exactly caused an emotion.

In addition, the interactions between appraisal values (measured via self-reports) and physiological responses (e.g. [49, 72, 80]) or facial and vocal expressions (e.g. [49, 55]) were studied in detail [45]. These mutual relations are indicated by the arrows in figure 1. This knowledge also offers IS research, a better foundation to the use of physiological measures, such as in the NeuroIS field [81]. So, a particular physiological pattern (e.g. activity in a certain brain region) is classified much more accurately on the basis of appraisal dimensions, than just on the basis of emotional words or valence and arousal. Apart from that, these linkages can mitigate the limitations coming with self-reported measures.

Furthermore, there are studies on the interactions of emotions, appraisals and stress (e.g. [82]). Stress is a concept, more and more applied in IS field over the last years ([83, 84]). Since new findings suggest a relationship between cognitive appraisals, emotions, and stress [85], appraisals may help in this respect to better understand the relationship between emotions and stress in IS research.

A fifth advantage can be noted regarding the low convergence between the different types of measures. Appraisal dimensions could offer sharper explanations for the low connection in future, than the two-systems perspective of Kahneman [86] used by Gregor et al. [15]. However, it is fundamentally correct to understand emotions at different levels. The low correlation is explained by the fact that an emotion arises from the changes and the interactions of the individual components. Thereby a change in one component triggers changes in all others [49], as shown in figure 1. This is the already above mentioned recursiveness of an emotional episode. To understand emo-

tions as good as possible, one has to understand this interaction. Using our component view provides a better basis for this.

Appraisal dimensions were rarely used in IS-related studies. The same applies to action tendencies. An understanding of emotions, which contains these two components, however, provides a better foundation for the application of new measurement methods and allows a clearer differentiation of emotions in our field.

4.3 Limitations of the Five Component View

The limitations of the five component view are outlined in three steps as followed. First, in designing our view we were limited in large part to evidence from psychology research, relying on the completeness of the CPM. Due to the solely theoretically character of our paper, we cannot account for empirical evidence. So we are forced to refer on evidence outside IS research, lacking any IS context. Second, our model results in a more complex picture of emotions. This is especially an issue, because we did not provide empirical proof for the enumerated advantages and increased explanatory power compared to the 3 emotions´ nomological network. A third problem occurs when it comes to the measures of emotions. The self-report measures proposed for three of our components are associated with some problems. So it is questionable to what extent one is able to reflect his cognitive appraisals. In this regard we can only point to psychological studies using this kind of measures, since this constructs were never measured in an IS context so far.

5 Conclusion

Building on the 3-emotions´ nomological network, designed by Gregor et al. [15], a five component view on emotions is proposed in this research. This view is based on appraisal theories of emotions, especially on Scherer´s CPM [51]. Apart from the broader view on emotion, several advantages are enumerated. Thus, emotions become better understood, with respect to their triggering (appraisal dimensions) and their effects (action tendencies), by adding an appraisal and motivational component to the nomological network by Gregor et al. [15]. At the same time insights from physiological studies, within the wide field of appraisal theories, become easier to adopt. Furthermore, cognitive appraisals are a more sophisticated model, helping to understand the intertwined relationship of cognition and emotion.

Although appraisal theories were used as a theoretical foundation partially in prior research (e.g. [13]), appraisal dimensions were barely measured directly in IS research so far. The same applies to action tendencies. Hence, an evaluation of the proposed model has still to be done empirically. Therefore, an interesting avenue for further research is, how these constructs can be integrated into existing models explaining human behavior in an IS context. One can imagine that the extent to which cognitive appraisals will complement the existing cognitive constructs within IS research could be a notably progression.

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