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UNMASKING EMOTIONS VIA FACIAL EXPRESSIONS – FIRST INSIGHTS ON THE ROLE OF EMOTIONAL VALENCE FOR IS DISCONTINUANCE

Victoria Alexandra Reibenspiess
German Graduate School of Management and Law, victoria.reibenspiess@ggs.de

Lennart Jaeger
German Graduate School of Management & Law, lennart.jaeger@ggs.de

Andreas Eckhardt
German Graduate School of Management and Law, andreas.eckhardt@ggs.de

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Research in Progress

Reibenspiess, Victoria, German Graduate School of Management and Law, Heilbronn, Germany, victoria.reibenspiess@ggs.de

Jaeger, Lennart, German Graduate School of Management and Law, Heilbronn, Germany, lennart.jaeger@ggs.de

Eckhardt, Andreas, German Graduate School of Management and Law, Heilbronn, Germany, andreas.eckhardt@ggs.de

Abstract

Although much research has been devoted to positive emotions and how they foster Information Systems (IS) use and continuance, less is known about the role of negative emotions and their impact on IS discontinuance. Thus, based on theories in environmental psychology towards the role of emotional valence, a research model is developed to explain the effect of cognitively appraised emotional valence on IS discontinuance. To test our hypotheses, we have conducted a laboratory experiment with eye tracking and evaluated users' emotional valence objectively based on their facial expressions using FaceReader, a facial expression analysis software. Preliminary results of our study suggest that users' initial emotional responses evoked by unexpected opposing features of the IS, when first encountered, do have significant effects on subsequent avoidance behavior. The results also reveal that cognitive system appraisal seems to influence users' emotions and behaviors differently depending on the type of the system for the task at hand. For example, we reveal that if IS are enhanced by hedonic design elements (e.g., pictures, graphics, video files), these elements could also trigger negatively valenced emotion if they are assessed as hindrance for the achievement of one's objectives.

Keywords: facial expressions, emotional valence, IS discontinuance

1 Introduction

"The value of a hedonic system is a function of the degree to which the user experiences fun when using the system... Therefore, important tactics that developers employ are the inclusion of hedonic content, animated images, a focus on colors, sounds, and esthetically appealing visual layouts. The dominant design objective is to encourage prolonged use." (van der Heijden 2004, p. 696).

For more than two decades, much research has been devoted to factors driving the early adoption and continued use of hedonic Information Systems (IS) (Atkinson and Kydd 1997; Teo et al. 1999; Moon and Kim 2001). The majority of these approaches confirm the theoretical paradigm that initial adoption and continued system use can be explained by the underlying system purpose. In a nutshell, individuals use utilitarian IS to satisfy their work- and/or task-related purposes and use hedonic IS to satisfy their entertainment and leisure purposes (van der Heijden 2004).

Nevertheless, although hedonic IS are designed to provide well being to the user, some individuals all of a sudden reduce or even quit their use. So far, only little is known about the influencing factors, mechanisms and processes leading to the discontinuance of hedonic IS (Turel 2015). Research on the

unintended and unanticipated negative impacts of IS use at the individual level has been coined as the dark side of IS use (Tarafdar et al. 2015), and the explanation of individual discontinuance is an example of these unintended and unanticipated effects. Factors increasing or decreasing the probability of discontinued use of hedonic IS are labeled as drivers and inhibitors (Cenfetelli and Schwarz 2011). In the context of discontinuance, an emphasis has put on the latter one in prior research. For example, as expectation-confirmation theory (Oliver 1980) has shown, if the use of a system meets the prior expected level of satisfaction and usefulness, continued IS use is more and discontinuance of the IS is less likely (Bhattacherjee 2001). Also, habit (Limayem et al. 2007) and addiction (Turel 2015) of using a hedonic IS have been uncovered as indirect and direct inhibitors of discontinuance. In contrast, research about factors and mechanisms driving discontinuance is rather limited. Almost exclusively, they can all be attributed to the concept of technostress that is stress induced by the mandated or voluntary use of an IS (Ragu-Nathan et al. 2008). As a result, different forms of IS use induced exhaustion, which is an individual's psychological reaction to stressors, can lead to the discontinuance of hedonic IS (Maier et al. 2015a). Also, if an individual has the belief of being overloaded by social demands through the use of a hedonic IS, discontinuance is more likely (Maier et al. 2015b).

Interestingly, despite knowing that it is an unrealistic assumption to understand human behavior solely through rational models, and that a substantial proportion of human thinking and action is determined by emotions (Kahneman 2003), they have almost completely been neglected in discontinuance research (Turel 2015). While positive emotions are frequently considered as driver of initial adoption and continued system use (Beaudry and Pinsonneault 2005; Beaudry and Pinsonneault 2010; Davis et al. 1992; Webster and Martocchio 1992) in several IS studies, the role of negative emotions, just appeared in some initial approaches on the impact of computer anxiety on IS-related attitudes (Igbaria and Parasuraman 1989) or computer self-efficacy (Thatcher and Perrewe 2002), or the effect of envy on cognitive and affective well-being (Krasnova et al. 2015). In terms of discontinuance research, major approaches are limited to Turel (2015), who observed the effect of perceived guilt on individual discontinuance. Consequentially, the author demands further research approaches including negative emotions that explain discontinuance decisions and that shed light on why some negative emotions explain discontinuance of certain systems, but may be significantly less instrumental in explaining continuance decisions (Turel 2015).

An explanation for the limited occurrence of human emotions in discontinuance research can be less attributed to researchers' ignorance but more to the complex nature and structure of the emotion concept (Scherer 2005) and the difficulty to measure its different components (Gregor et al. 2014). Despite these challenges, within this research, we provide a novel theoretical explanation for the dissonance between the originally designed system purpose and user's negative emotional response as well as the subsequent discontinuance by introducing the concept of emotional valence to IS adoption research. Thus, we'll aim to answer the following research questions:

RQ 1: What shapes emotional valence towards an IS?

RQ 2: What is the effect of emotional valence on IS discontinuance?

In addition, we contribute to research by providing an automatic method to objectively assess four of six basic emotions (happiness, anger, sadness, and disgust) during the IS use process, which is based on observational methods (e.g. FACS) of facial expressions (Aleksic and Katsaggelos 2006; Bartlett et al. 2003; Cowie et al. 2001; Lisetti and Schiano 2000) and the use of eye tracking. This responds to several complaints by researchers about the limitations that survey-based approaches for measuring emotions imply (see for instance Sharma et al. 2009, or a discussion provided by Venkatesh et al. 2012). In this paper, we quickly introduce the concept of emotional valence, the related hypotheses, and the methodology of our research, before we provide a first snapshot on our results.

2 Research Background

Scientific research on emotions roots in the discipline of psychology, but touches the scope of many disciplines and research areas in the social sciences (Bagozzi et al. 1999; Lazarus 1991; Plutchik 2001). In the IS discipline, the concept of emotions has been applied to a number of contexts mostly accounted to IS research on human behavior (e.g. Beaudry and Pinsonneault 2005, 2010; Cowie et al. 2001; De Guinea and Markus 2009). An important publication by Beaudry and Pinsonneault (2010) classified emotion constructs applied in IS research in relation to IS adoption, and provided a framework of classification for emotions that can be experienced in relation to IT artifacts. With respect to a definition of emotion, Beaudry and Pinsonneault (2010) relied on Bagozzi et al. (1999) and Lazarus (1991) and defined emotions as *"a mental state of readiness for action that promote behavioral activation and help prioritize and organize behaviors in ways that optimize individual adjustments to the demands of the environment. (…) Emotions have specific referents and they arise in response to the appraisal of an event perceived as relevant and important to an individual"* (Beaudry and Pinsonneault 2010, p. 690). This quote contains four elements that can be found in most definitions of emotions although the wording varies from case to case (e.g. Kleinginna and Kleinginna 1981; Schwarz and Clore 1996; Thompson 1994): The mental state that implies that emotions are a mental concept, the regulation of behavioral activation by emotions, the prioritization of behavior, and most important: the specific referents in whose response emotions arise. Thus, emotions arise in response to implicit appraisals of stimuli (e.g. persons, subjects, or events) with respect to (either strong or weak) positive or negative implications for one's goals and concerns (Ortony et al. 1988).

Human beings transmit many emotions via facial expressions, but only six – the so-called 'basic emotions' – are universally recognized (Ekman 1993). As such, facial expressions are considered to be aspects of an emotional response and social communication (Adolphs 2002; Darwin 1872; Fridlund 1994; Russell and Fernandez-Dols 1997). In general, these dual aspects that shape a facial expression occur simultaneously, although certain circumstances or situations can emphasize one or the other (e.g. involuntary expressions that accompany intense basic emotions or voluntary expressions modulated by culturally shaped display rules). The muscular mobility of the human face is governed by complex neural control that implies both automatic and volitional components (Adolphs 2002). Thus, a face is able to convey information apart from static features/characteristics (skin color, gender). There is scientific evidence to suggest, that the face represents a communication channel that is able to physically transmit many kinds of psychological states and attributes (e.g. emotions, socially relevant categories) (Adolphs 2002; Cowie et al. 2001). Thereby, the recipient of facially transmitted information relies on the detection of the position and shape of the mouth, eyes, eyelids, wrinkles, and extraction of features related to them (Cowie et al. 2001). These facial movements and changes are induced by basic facial muscles, that also serve the scientists as indicators for emotional measurement, either by an automatic facial recognition software based on observational coding (e.g. FACS by Ekman and Friesen 1977) or technologically supported methods like facial electromyography (EMG) (see Dimberg et al. 2002).

With respect to the application of emotion measures in IS contexts, there is only a small amount of research that has explicitly focused on facial expression measurement (e.g. Aleksic and Aggelos 2006; Wang et al. 2014) and a predominant focus on means of self-reports of survey participants (e.g. Beaudry and Pinsonneault 2005, 2010; De Guinea and Markus 2009).

3 Theoretical Model and Hypotheses

Figure 1 illustrates our research model. In the following we first examine on the relationship between cognitive system appraisal and emotional valence (on the left) and we then focus on its effect on avoidance behavior (on the right).

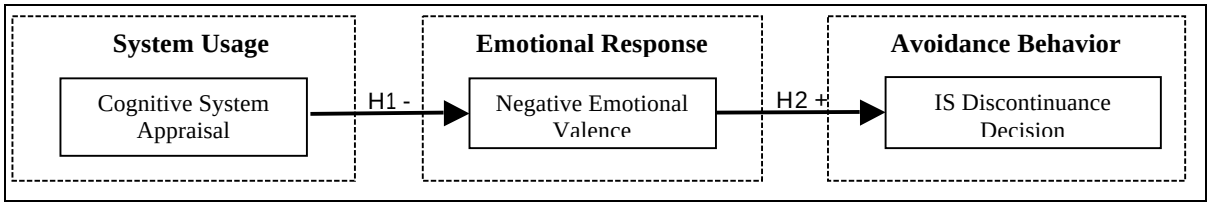

Figure 1. Research Model

3.1 Cognitive System Appraisal and Negative Emotional Valence

According to cognitive appraisal theories of emotions, emotional valence is an outcome of cognitive appraisal (Lazarus 1982). Due to the fact that arousal by itself only represents an undifferentiated physiological state, the emotion-inducing stimulus needs to be cognitively appraised so that individuals are able to interpret and explain their felt arousal, which in turn makes experiencing a particular emotion consciously possible (Frijda 1986; Lazarus 1982; Ortony et al. 1988). It has been shown that the valence of emotion is determined by the primary cognitive appraisal related to the mental processing of motivational congruence/incongruence to differentiate between positively and negatively valenced emotional reactions (Frijda 1986; Lazarus 1991). The appraisal of motivational congruence/incongruence deals with the relationship between the stimulus and the goals and objects of an individual. An individual will feel a positively valenced emotion (i.e. pleasantness), when the stimulus is evaluated as being supportive of reaching the objectives or satisfying the individual's intentions. If, however, a stimulus is assessed as preventing the achievement of the objectives or the realization of one's intentions, negatively valenced emotion (i.e. unpleasantness) is felt (Frijda 1986; Lazarus 1991). Following Deng and Poole (2010), we define emotional valence as "*the feeling of pleasantness/unpleasantness toward a stimulus as a result of motivational congruence/ incongruence appraisal, which pertains to whether the stimulus is conducive or obstructive to reaching a user's goals or satisfying the user's relevant motives*" (p. 715).

Transferring this knowledge to the IS context relates emotional valence to the cognitive appraisal towards the use of an IS, as well as its continuance and discontinuance. We follow the rationale that an IS is a perceived function of the relative salience of its hedonic and utilitarian attributes or features (Chernev 2004). As IS are designed to provide instrumental value to the user (e.g. performing a specific task). 'Instrumental' implies that there is an objective external to the interaction between user and IS, such as increasing task performance (van der Heijden 2004). In contrast, other IS labeled as hedonic systems are designed to provide self-fulfilling value to the user. It is evident that certain kinds of relation effects exist between the instrumental value of a system and an individual's emotional valence. For example goal-oriented IS users strongly focus on achieving their task in the most efficient way would positively evaluate a system supporting their task fulfillment. Features distracting or even hindering the task fulfillment would thus evoke feelings of unpleasantness, as the individual would cognitively appraise them threat for task efficiency and the likelihood to fulfill the task (Deng and Poole 2010). Thus, we hypothesize:

Hypothesis 1: The more features an IS contains that are not directly related to task fulfillment the more negative the emotional valence.

3.2 Avoidance Behaviors based on Emotional Valence

Emotions provide individuals with the ability to respond to the changes in their surrounding environment by triggering different psychological situations and behaviors (Deng and Poole 2010). They are a state of motivational arousal leading individuals to actively work toward a particular goal or outcome (Brehm 1999). As such their function is to evoke behavior that advances or prevents important possible outcomes. According to research in psychology and neurobiology, affective and behavioral response tendencies are based on two types of motivation: approach and avoidance (Davidson et al.

1990; Gray, 1990; Lang, 1995). As suggested by them, experiencing positively valenced emotions (e.g., pleasantness) may encourage individual's action (e.g. approaching and exploring) by promoting approach motivation. On the other hand, negatively valenced emotions (e.g. unpleasantness) may induce individuals to act defensively (e.g. protective, withdrawing) by triggering avoidance or defensive motivation. Strong empirical support that emotional valence significantly predicts approach or avoidance behaviors has been found in non-IS environments, such as traditional retail environments among others (Frijda et al. 1989; Mehrabian and Russell 1974; Schwarz 1986).

With respect to avoidance behaviors (e.g. withdrawing) in the context of IS use, Turel (2015) has called for an analysis of discontinuous usage as an adaption behavior to avoid the dark side of an IS. His empirical findings indicate that negative emotions may explain the discontinuance of certain systems, but may be significantly less vital in explaining continuance decisions (Turel 2015). Further supporting this proposition, negatively valenced emotions such as anger (Beaudry and Pinsonneault 2010) and anxiety (Compeau et al. 1999) have been shown to not always significantly determine system use. Prior research has shown that discontinuance decisions could occur both for the use of highly habituated IS at the job as well as hedonic systems (e.g. Facebook) that users sometimes quit when they become a 'tedious distraction', a time waster, and thus also the cause of negatively valenced emotions (Cruz 2013; Rushkoff 2013; Turel 2015). Based on this arguing we suggest that negatively valenced emotions will motivate avoidance behavior in the form of IS discontinuance and hypothesize:

Hypothesis 2: The more negative the emotional valence the more likely the IS discontinuance decision.

4 Research Methodology

To provide empirical support for our hypotheses and to control our participants' behavior, we conducted a laboratory experiment with 176 individuals. This should be particularly valuable for the study of emotional expressions where empirical data are difficult to collect and respondents' self-reported measures might be biased.

By letting one half of the participants use an IS with additional hedonic elements, such as photos, graphics, and a video file (n = 88) and the other half of the participants the same IS but without the hedonic elements (n = 88) (see Figure 2), we ensured that implicit emotional expressions of the experimental group would not be influenced by any other tendency and enabling us to make comparisons among different targets or emotions. To reduce possible distortions regarding artificiality, we developed a laboratory setting with a real world task that every participant is confronted with in real life. Thus we set up the experiment in the context of online recruitment and let both groups view and judge a subsection in an online job board. As our focus is solely on the IS use context and not its contextualization in recruitment, we just refer to the online job board as IS throughout the paper.

A Tobii T120 eye tracker, also simultaneously filming their facial expressions, captured participants' viewing behavior during the experiment.

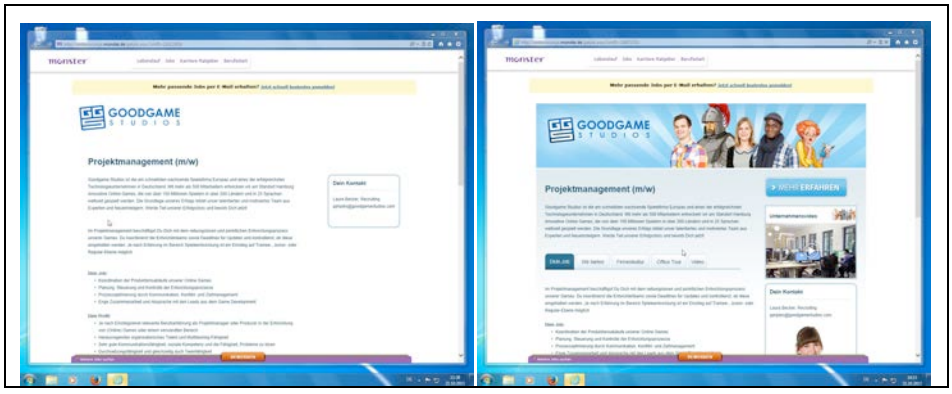

Figure 2. IS without and with Hedonic Elements

4.1 Experimental Design

The experiment took place in a separated and quiet room, which solely included a PC, to prevent the individual of being distracted by any external influence. After calibrating the eye tracker, the experimenter explained the individual the upcoming experiment and the related task. She also explained why the system is needed and called attention to the fact that the individual should behave as usual and should not get stressed due to the system observing his fixations and filming his facial expressions. To accustom participants to this special experimental and monitoring situation and to alleviate their stress, participants played a computer game of skill for two minutes before starting the actual experiment. Within the following experiment, the participants' task consisted of viewing an online job ad of an online gaming company as long as they wanted and answering three multiple choice questions about it afterwards. To control for several factors that might influence our results, data was gathered in a pre- and post-experimental questionnaire containing questions on participants' demographics (age, gender, age, and occupation) and personality, and their pre- and post-system-related attitudes and intentions. To check for perceived realism (Eroglu 1987), we asked the participants in the post-experimental survey to rate the scenario's realism in the experiment. For checking the manipulation in our experiment, we also asked the participants to rate the level of pleasantness, enjoyment, and distraction of the additional system elements. Members of the other group were asked, whether they missed additional elements such as video files, slideshows or graphics within their system.

4.2 Data Collection and Evaluation

The whole average experiment duration was approximately 50 minutes. During the entire time participants' viewing behavior and facial expressions were recorded. Regarding our research endeavor to observe emotional valence and its impact on discontinuance of IS with distracting hedonic elements, eye tracking and facial expression analysis software were used to observe user behavior and the expressed emotions during use. To measure individuals' IS use with and without hedonic elements during the facial expression of emotions in an objective way, we gathered data on their number and duration of eye fixations, saccades, and their average viewing time (e.g., Eckhardt et al. 2013). Within this research-in-progress paper, we just use average viewing time as a measurement for IS discontinuance for depicting first results. To objectively measure emotions we observed facial expressions. They represent a measure of emotions, whereas only six – the so-called 'basic emotions' – are universally recognized (Ekman 1993). Expressed basic emotions (i.e. happiness, anger, disgust, sadness) were simultaneously recorded via webcam.

The FaceReader software is based on Ekman and Friesen's theory of the Facial Action Coding System (FACS). This theory declares that certain patterns of facial expression coincide with basic emotions (Ekman and Friesen 1977). The FACS is a system produced for describing and interpreting all visually distinguishable facial movements in an anatomically oriented coding system, based on the definition of Action Units (AU) of a face that cause facial movements. Each AU may correspond to several muscles that together generate a certain facial action. 58 AU were considered responsible for expression control, gaze direction, and orientation. The FaceReader software measures a subset of generally used AU (Noldus 2016). Figure 3 provides an example of the FaceReader's measurement based on the AUs of the FACS of the emotion happiness displayed by a participant in response to stimuli in the IS. FaceReader's robustness and reliability was tested in several studies highlighting that the software corresponds with the evaluations of trained observers in up to 89% of all cases (Lewinski et al. 2014; Terzis et al. 2010).

With respect to our hypotheses, we focus on the emotional expression of happiness, sadness, anger, and disgust. To identify participants expressing these emotions, we use the quantitative output of FaceReader in terms of graphics and vector of values for the six emotions and an overall valence of emotional state. For each basic emotion the detection algorithm ranges from 0 to 1, representing the intensity of the emotion. "0" stands for an emotion, which is not visible respectively recognizable in the

facial expression, whereas "1" stands for an emotion, which is completely present in the facial expression (Noldus 2016). The FaceReader considers the emotion with the maximum value as the dominant one using a threshold value of it being active for 0.5 seconds. The global mean average score of the values of all six basic emotions to perform the calculations was used. To determine if the emotional state of an individual is either positive or negative the valence as a general measure with values ranging from -1 to +1 is applied. Valence is computed as the value of the positive emotions minus the maximum of the negative ones.

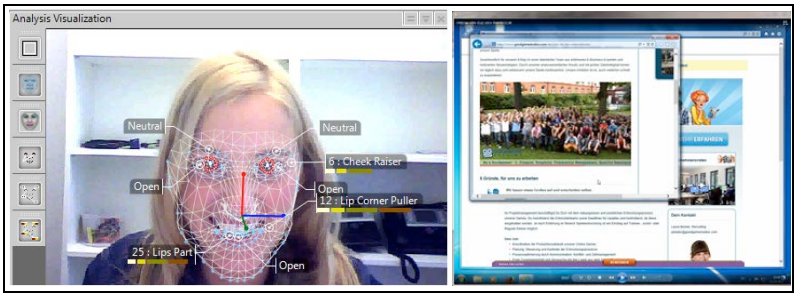

Figure 3. FaceReader Analysis Visualization for the Emotional Expression of Happiness

5 Data Analysis

In order to take a first step to reach our research objective of examining the role of emotional valence for the cognitive appraisal of IS with hedonic elements and the discontinued use of them, a preliminary analysis was undertaken. For this purpose, we report initial results of the FaceReader procedure applied to identify all emotional expressions of happiness, anger, disgust and sadness.

The sample's demographic characteristics with 176 individuals can be briefly described as follows. Of the participants, 90 (51.1%) were male and 86 (48.9%) were female. Most participants belonged to the age group between 22 and 30 years (70.5%). The majority of participants held a High School Degree (70.5%), while 17% have already obtained a Bachelor's degree.

Initial results of all video sequences were grouped according to the emotion analyzed and the tested system. The duration for the emotions happiness, sadness, anger and disgust elicited by viewing the IS (with and without hedonic elements) was calculated in percentage. Emotions of surprise and fear were excluded from our analysis, since the former can be either positive or negative and is, therefore, not used to calculate valence. The latter was not expected to be expressed by the participants based on the design of our systems and the task of looking at job ads that were both not considered to be fear evoking.

Table 1 shows the computed mean value for the emotions across all participants. Here, the emotion happiness is the dominant one for both systems and has a high proportion of the total time (66.8% and 72.5%). By comparing the durations of both groups regarding the occurred negative emotions, we found some interesting initial insights that indicate first support for our hypotheses. In both systems, participants displayed negative emotions, but in the system with hedonic elements (33.2%) even longer than in system without hedonic elements (27.5%).

System	Happy	Sad	Angry	Disgusted
With hedonic elements	66.8%	21.4%	9.4%	2.4%
Without hedonic elements	72.5%	11.7%	15.8%	0.0%

Table 1. Averaged Duration of Expressed Basic Emotions

Table 2 shows the average in percentage of the participants with positive and negative valence towards the system with and without hedonic elements. The valence indicates whether the emotional status of a

participant is positive or negative. A positive valence indicates a positive emotion (e.g. happiness) while a negative valance value indicates a negative emotion (e.g. sadness). We observed that 64.7 % of the participants viewing the IS with hedonic elements have negative emotions while only 60% of the participants viewing the IS without hedonic elements show negative emotions.

Information System	Positive Valence	Negative Valence
With hedonic elements	35.3%	64.7%
Without hedonic elements	40.0%	60.0%

Table 2. Average of Positive and Negative Valence

Initial results indicate a direct relation between an individual's facial expression of an emotion and his/her avoidance behavior, i.e. discontinuous usage. Positive emotions, expressed by positive valence are related to approach behaviors while negative emotions, expressed by negative valence are related to avoidance behavior.

6 Next Steps

After having finished our data collection, we are currently in the process of data analysis and determining whether the preliminary results found can be confirmed and the assumptions can be substantiated. Due to the richness of our data set containing both subjective (user beliefs on emotions, cognitions, and intentions) and objective parts (facially expressed emotions and user behavior based on eye fixations), we have a great variety and variability of options to evaluate our data.

By gathering data on all basic emotions simultaneously, we could measure emotional valence in two different ways: first by taking the computed value of happiness minus the maximum value of sadness, anger, and disgust, or second by taking the respective mean values for evaluation. This fosters the discussion if the longitude or the peak of valenced emotions is more meaningful. Due to the simultaneous character of our data, we currently consider different methods and techniques that can be used to evaluate their relationship.

Another focal point will be to evaluate whether the emotions the participants indicate within the questionnaires, correspond with the emotions they express facially in nonverbal manner. The first results show a negative emotional valence for both the use of the IS with and without hedonic elements. Thus, one might conclude that there are factors in addition to system purpose and user's goal orientation triggering these negative emotions. Within the data evaluation, we control for the effect of several demographic and experience-related variables (i.e. prior system or task experience) as well as individual differences. In this regard, we also consider certain degrees of hedonism provided by design features and their configuration in terms of interactivity and personalization. Related to the preliminary results for our second hypothesis, we found some first empirical evidence that negative emotional valence directly leads to discontinuance of the IS without hedonic elements but for the IS with hedonic elements, the result was the opposite. Thus, we need to think through to add additional endogenous variables in our research such as discontinuance intention or the intention to recommend system use to others. In order to test the second hypothesis, the following approach is planned. Initially we will compare the difference regarding viewing time within the two groups (with/without hedonic elements group) by using standard deviation. To consider further factors potentially influencing the differences in viewing time of both groups, we will analyze additional data in form of gaze fixations. The inclusion of gaze fixation data will give us the opportunity to show which elements the participants viewed (e.g., whether he watched the video) and which elements elicited negative or positive valence.

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