Does Your Smile Mean That You're Happy? – A Multi-Channel Analysis of Emotional Reactions

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Abstract

In Information Systems (IS) research, emotions are primarily measured using facial expressions of participants or self-reported survey results. To unite both measurement foci, we analyze the impact of facial emotional reactions to computer-induced stimuli on self-reported evaluations towards the respective stimulus by using a multi-method experimental approach with multi-channel analysis. We collected emotional expressions of happiness of 176 participants using eye-tracker and webcam technology together with a post-experimental survey. We contribute to IS research by supplementing self-reported measures of emotion with a physical emotional measure in response to a system's feature, and by relating these measured emotional physical responses to individual behavior.

1. Introduction

"*Facial expressions provide perhaps the most effective means of communicating emotion. Not entirely under the control of the emoter, they make emotional states transparent in a way that thoughts and beliefs can never be*" [1] p. 227. This state published by Etcoff and Magee in 1992, expresses what has been researched for over a century and published in a wide range of well-known journals in the social and behavioral sciences (e.g., [2]–[4]), fields of biology and its sub discipline neurobiology (e.g., [5, 6]). Facial expressions are the most reliable, cross-cultural, multi-dimensional, non-verbal representatives of an individual's implicit emotional responses to situational and informational stimuli ([7, 8]).

This reciprocity between bodily expressions and emotions traces back to Darwin (1872) who defined attitude as a collection of motor behaviors that conveys an organism's emotional response towards a certain stimulus. Yet, the first knowledgeable peak of research interest on facial expressions and their associations with emotions occurred much later in the 1970s. This research resulted in a number of observational coding systems to identify facial expressions (e.g., Facial Action Scoring Technique (FAST) [9], the Facial Action Coding System (FACS) [10], Discriminative Facial Movement Coding System (MAX) [11]). Later, these coding systems were endorsed by a number of methodologies, most of them resident in the fields of neurology and physical science (see [7,12]).

Thereby for all of these methods, whether based on pure observation or advanced measurement techniques, a necessary milestone serving as a guideline for the analysis emotions by means of facial expression was set by the definition of six basic emotions. These basic emotions (happiness, fear, anger, disgust, sadness, surprise) can be cross-culturally understood and are identifiable by means of facial expressions ([4, 13]). They can be arranged within a two-dimensional space spanned by the axes arousal and pleasantness, and are manifested as both distinct facial expressions ([4, 13]) and different autonomic response patterns [14]. Thus, facial expressions represent implicit measures of an individual's perceived basic emotions [15].

However, as for most implicit measures, the measurement of a specific emotion in response to a particular stimulus by means of a facial expression remains difficult for the following reasons: First, individuals' capability to voluntarily control facial muscles and thus fake emotional faces (e.g., [14]), second, the interference of cognitive processes (e.g., [7, 16]), and third for the fact that the face constitutes an important tool for unconscious social interaction (e.g., [8]). The latter implies, for instance, that within social groups as a sign of belongingness, mimic structures are adapted from other individuals [8]. So, although recent research allows the interpretation of facial expressions with respect to emotions with reasonable correctness, the situation in which they are measured, the respective individual's knowledge of this situation, and voluntary control of facial expressions modify interpretation. For this reason, the measurement of emotions in psychological sciences by means of facial expressions is either accompanied by neurological techniques (see [7] for an overview) or the comparison with self-reported perceptions as explicit measures of emotion (e.g., [17]).

In Information Systems (IS) research, the analysis of individual emotions touches the scope of two research communities dealing with human behavior and IS: Human-Computer Interaction and IS adoption. In the latter, the major focus lays on the impact of emotional drivers on individual adoption decisions, whereby emotions are predominantly measured by means of self-reports of survey participants (e.g., [18]). In contrast, in the discipline of Human-Computer Interaction, facial expressions in order to assess emotional responses to computer-induced stimuli, have been analyzed by using observational (e.g.,

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FACS),physiological methods (e.g., electromyography (EMG) [15], as well as using questionnaires [19]). The combination of both focuses (the HCI and the IS adoption-related), results in the following objective: The impacts' comparison of facial emotional reactions to computer-induced stimuli on self-reported perceptive evaluations towards the respective stimulus and system.

Within this research, we aim at addressing this objective by using a multi-method experimental approach basing on the combined analysis of facial expressions by means of the FACS and eye-tracking data (implicit emotion measures) as well as self-reported perceptive measures (explicit emotion measures) at two points in time. Thereby, certain design features are linked to facial emotional responses, and their impact on self-reported perceptive evaluations and behavioral variables is analyzed. Thus, we contribute to IS research on human behavior by complementing self-reported measures of emotion with a physical emotional measure in response to a feature of a system, and by linking these measured emotional physical responses to individual behavior. By comparing both implicit (physical) and explicit (overt self-reported perceptions) measures of emotional responses, we also provide a more detailed picture of the benefits and limitations of both measures and about their internal relationship.

2. Emotions and facial expressions

Plutchik [20] states that emotions have always been a central concern to humans, and within every endeavor, every major human enterprise and event, emotions are somehow involved. Theologists have theorized on their impact with respect to religious faith. Writers, musicians, and artists have always attempted appeal to them. In any way, emotions are the central feature of human consciousness. Although this may sound pathetically many if not all human beings of a healthy psychological state will have experienced the importance, impact, and strength of emotions before they come of age. Scientific research on emotions roots in the discipline of psychology, but touches the scope of many disciplines and research areas in the social sciences [20]–[23]. In IS, the concept of emotions has been applied to a number of contexts mostly accounted for IS research on human behavior (e.g., [15, 23]). A notable publication by Beaudry and Pinsonneault [18] 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 the definition of emotion, Beaudry and Pinsonneault [18] relied on Bagozzi et al. [21] and Lazarus [22] 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*" ([18] p. 690).

With reference to this definition of emotions, this quote contains four elements that can be found in most definitions of emotions although the wording varies from case to case (e.g., [25]): 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 (also referred to as stimuli) 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 [26]. Thereby, the stimulus is an identifiable reference point that contains information about an expectable emotional reaction (e.g., a suffering child vs. a smiling face) at least in broad emotional categories (sadness or happiness).

In order to structure the huge variety of forms and manifestations of emotions, either defined on the basis of behavior (e.g., crying/smiling) or social emotions that have different names in a given language (see [7], p.28, or [15] for an overview), many researchers have developed classification frameworks (e.g., [13, 19, 22]). These frameworks usually differ depending on the respective conceptualization of emotions. Some researchers (e.g., [20]) view emotions as continuous concepts whose manifestations can be subordinated to discrete categories that can but do not necessarily have to pass a neutral state. Others (e.g., [3, 13]) have defined frameworks mostly in the shape of two-dimensional spaces, where each emotion or emotion group can be located in. In emotion research, it is frequently referred to as the dimensional structure of emotion categories, where the six basic emotions and a neutral state are depicted into a two-dimensional space with the two axes arousal and pleasantness (see for more information Online Appendix [7].

Meanwhile, researchers have identified more than these six basic emotions as superior categories of emotion (see [15]), however, the major reason why the six basic categories are still referred to as basic emotions [3, 7, 13, 14] is that they can be transmitted via non-verbal communication channels (e.g., facial expressions) and be understood cross-culturally only by means of these channels [3]. Although this represents the prevailing opinion, there exists some reservations against the applicability of basic emotions [27], [28].

Apart from basic emotions and their subgroups, it is important to again extend the focus from detail to conceptual level and delineate emotions from related concepts. Even in social psychology, emotions as moods are often subsumed under the generic term affect [25]. Affect, which as such is also often interchanged with attitude (see [29]), can also refer simply to valence - the positive and negative aspect of things. Thus, emotions are affective, but not all affective things are emotions [25]. Given the four elements of the definition of emotion stated above, maybe the most important aspect regarding this question is the reference of emotion to a stimulus. Affect in its core, by contrast, is defined as an intrinsic aspect of consciousness [30] that is mental but not cognitive or

reflective [31]. Further, affect is a neurophysiologic state consciously accessible as a simple, non-reflective feeling inside oneself. The respective feeling may change from time to time, but a person will always have some sort of feeling (core affect) at any moment. Thereby, core affect may not have known causes or be linked to stimuli – what distinctively differentiates it from emotion or mood [32]–[35]. Thus, emotions are specific whereas affect is more primitive. Emotion can be defined as an "*internal, short-termed affective state (feeling) induced by or in response to a specific stimulus*".

Apart from the response to a specific definition for the term emotion, another important aspect that distinguishes emotion from related terms is time. Due to the definitional connection with the stimulus, it seems somehow logical, that emotions are a rather short-term concept of the human mind [36]. Emotion emphasizes a person's subjective feeling. This feeling is short-termed and exists only as long as the supporting cognition, perceptions, or other elicitors are active. An 'emotional episode' refers to the process-based view of the emotion in responding to a stimulus [33].

Clore and Palmer [36] have developed a useful framework bringing terms related to emotion and affect that are often mis-specified or interchanged into relation dependent on the presence of a stimulus and the temporal constraint of the respective construct. Zhang [35] introduced an adapted form of this framework to the IS field. The framework points out that for the term emotion the presence of a stimulus and the temporal constraint are essential to distinguish it from other concepts. The term 'affective evaluation' is often misinterpreted as attitude, however, attitude by definition also encompasses a cognitive component (see [29]), and thus cannot be classified into a framework of purely affective concepts. Affective evaluation in this sense can be regarded as the affective component of attitude. Also, the framework points out, that if these concepts or constructs were to be measured, an affective evaluation and an emotion may have to be measured differently because an emotion is temporally constrained whereas an affective evaluation is not.

With respect to the measurement of emotions, as for most psychological responses/states, two methodological approaches can be distinguished [37]. The two measurement approaches are the so-called 'implicit-' and 'explicit measures' of emotion. Using the example of emotions, explicit measures are measures that imply some sort of overt expression and a reflective state [38]. The most common example for explicit measures of psychological responses/states are self-reports as they are used in many surveys or interviews. With reference to the reflective state, an explicit measure of a psychological construct assumes that some sort of cognitive activity translates the construct into the measure, what certainly implies an error with respect to the response/state (if it is as emotion not cognitive-centered) and moderator variables (e.g., honesty with regards to self-reports or personality) that affect the translation from the 'real' psychological response/state to the measure [39].

With respect to the measurement of emotion, IS research predominantly focuses on explicit measures by means of self-reported questionnaire data (see Beaudry and Pinsonneault [18] for an overview). However, more researchers complain about the limitations that these approaches imply (see for instance Sharma et al. [40], or a discussion provided by Venkatesh et al. [41]), and call out for new measurement approaches for all kinds of psychological constructs that are frequently applied to IS contexts (e.g., attitudes, emotions).

Implicit measures of psychological responses/states can be defined as "*outcomes of measurement procedures that are caused in by an automatic manner by psychological attributes*" [35], p. 347. Given this, it seems clear why self-reports can never be implicit measures. Validity implies that variations in the attribute (e.g., psychological state) cause variations in the measure [39], however, implicit measures have the premise that these variations are automatic [37]. Automatic in this sense means that a process can operate even when participants do not have a substantial amount of cognitive resources or time (of the instigating stimulus, the process or the outcome of the process) [42]. Thus, from this perspective, an implicit measure can be defined as "*... a measurement outcome that is causally produced by the to-be-measured attribute in the absence of certain goals, awareness, substantial cognitive resources, or substantial time*" [35], p. 350. A very commonly applied example for an implicit measure is the Implicit Association Test (e.g., [43]).

With respect to Table 1 and the definition of implicit measure that implies automaticity, it becomes clear that an implicit measure can only be a snapshot of constructs that are temporally unconstrained, whereas they hold the potential to provide a very clear and unbiased picture of the temporally constrained constructs, because of their instantaneous character. However, recalling the six basic emotions that can be validly measured by means of facial expressions [3], implicit measures in contrast to explicit measures have two disadvantages using the example of emotions: First, their interpretation is much more complicated, and second, that what can be measured with sufficient validity is often limited. Questionnaire items to measure a certain emotion in response to an IT artifact, are not limited to the six basic emotions as would be an implicit measure on the basis of facial expression for the same response. Moreover, explicit measures take a certain cognitive recall of the emotion into account (e.g., [14]). On the one hand, this recall limits the unbiased (non-cognitive) measurement of the emotion, but on the other hand, enables these measures to measure an emotion at any time. However, the main if not central advantage of implicit measures over explicit measures is that the avoidance of an introspective access to the measured responses and thus the avoidance of conscious control of a participant over the outcome is a necessary condition of implicit measures [42, 43].

As to the relationship between implicit and explicit measures of emotion, researchers in social psychology assume that both capture different representations of the

same psychological state/response that only partially overlap [44]. Figure 1 graphically illustrates how implicit and explicit measures differ and at what points they interrelate. As illustrated in the figure using the example of an emotion, the process of emotional measurement begins with the confrontation of an individual with a stimulus, and the emotional reaction. If the respective emotion is developed it is measureable through its representations that can be either associative or propositional. However, although positioned parallel in Figure 1, there is a time-related difference between associative and propositional representations. Before emotional associations can be expressed in an explicit format, they have to be retrieved from the associative memory and translated into a propositional format. As soon as the emotional response is present in the cognitive mind in this propositional format, it can be explicitly expressed (e.g., "I feel good") [38].

Thus, the path from propositional representation of an emotion to its explicit measure is reflective and requires a certain amount of cognitive activity, whereas the path between the associative measure and the implicit measure is impulsive [38]. As to the factors that potentially influence measurement variation, Figure 1 lists some examples of moderators developed by Gschwendner et al. [38]. Since cognition is involved in the process of propositional emotional representations cognition is also a problem in the sense that individuals are conscious about their expressions of the respective emotion and are able to express/report only a cognitively selected part of it [7, 8, 12, 14]. In the case of implicit measures, due to the predominantly automatic response, conscious intended biases of the measures are unlikely, what with respect to emotion makes implicit measures very valuable, because they are able to measure emotion without cognitive interference [37]. However, implicit measures also face biases that are due to unconscious adaptations (e.g., the adaptation of mimics within groups) [12].
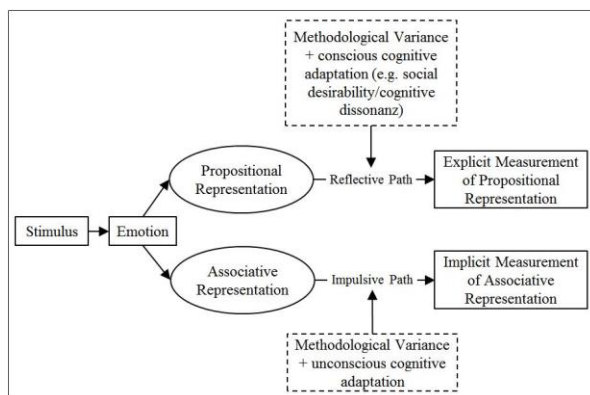

Figure 1. Relationship between implicit and explicit measures (adapted from Gschwender et al. 2006)

2.1. Facial expressions as implicit measures

As the preceding section indicated, facial expressions represent an implicit measure of emotions, whereas only six – the so-called 'basic emotions' – have found to be transmittable via facial expressions [3]. Before we dig deeper into the implicative meanings of facial expressions, it is necessary to first provide an answer to what facial expressions really are. Facial expressions are considered to be aspects of an emotional response and social communication [5, 7, 44]. 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 [7].

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) [7, 15]. 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 [15]. These facial movements and changes are induced by basic facial muscles, that also serve the scientists as indicators for implicit emotional measurement, either by pure observational coding (e.g., FACS by Ekman and Friesen [10]) or technologically supported methods like facial electromyography (EMG) (see [14]).

Regarding facial muscles, the orbicularis oculi and zygmatic major are activated to produce a smile and thus express predominantly happiness that is characterized by a high perception of pleasure, whereas the corrucator superficili is activated during frowning in anger, which is characterized a relatively high state of arousal and unpleasantness (see Figure 3 in Online Appendix).

However, when facial expressions as implicit emotion measures are discussed, it is also necessary to discuss problems with respect to validity. As Ekman and Friesen [10], and many others (e.g., [7, 45]) have shown, facial expressions are able to transmit (basic) emotion, and reversely, facial expressions represent an implicit measure for (basic) emotions [37]. But, the extraction and thus measurement of pure basic emotions is limited due to two factors: The first is that another central function of facial expressions is the creation and expression of social belongingness by means of mimic adaptations [12]. In classic studies, Meltzoff and Moore [48] provided evidence that neonates imitate basic facial gestures (e.g., tongue protrusion and mouth opening) suggesting a biological basis for imitation skills that signalize social belonging. The same can be observed for other facial gestures that also transmit emotional reactions, which certainly creates problems if facial reactions serve as implicit measures for emotion (e.g., a smile in response to a stimulus vs. a smile as mimic imitation of another smiling individual).

The second threat to validity in the measurement of emotions by means of facial expressions is the volitional control of facial muscles (see [14]). Everybody can

intentionally make faces, and professional actors are without a doubt the masters in doing so and thereby transmit fake emotions that are perceived as real by the recipients and occasionally cause real emotional responses within the recipients (e.g. laughing). These volitionally (and thus cognitively) controlled faces hold the potential to substantially bias the implicit measurement of real emotions.

In the same manner, in which individuals can fake their implicit emotional reaction, individuals can also be biased in a survey creating fake answers (e.g., due to social desirability bias). Thus, it is important to consider the relative truth values of emotions expressed through implicit and explicit measures as both could be subject to some extent of self-regulation by the participants themselves. Given the subjective nature of emotions and affect, even both expressions can be misleading.

However, Figure 1 implicitly provides an answer to how a facial reaction can be identified as fake. An indicator for the identification of real emotions is that only they are cognitively translated from an associative into a propositional representation of that emotion and thus be explicitly measured [38]. Further, real emotional responses have been reported to occur faster than fake ones given the confrontation with a specific stimulus, which is accounted for the cognitive processing that is required to volitionally create the fake emotion [14]. Thus, the comparison with explicit measures provides valuable information about the validity of the implicit measure of emotion.

With respect to the application of implicit emotion measures by means of facial expressions in IS contexts, there is only a small amount of research that has explicitly focused on facial expression measurement (e.g., [15]). Nonetheless, this small amount of research has extended the scope of prior research and brought the implicit measurement of emotional responses by means of facial expressions into the context of IS research.

Within this research, however, for the reasons stated above, we set focus on the relationship between facial expressions as an implicit measure of a concrete emotion (happiness) in response to a design element of hedonic character and the explicit self-report measures of this emotion by means of its manifestations in terms of social presence [49], arousal and pleasantness. By means of the application and comparison of both implicit and explicit measures of happiness in response to IT-induced stimuli (hedonic design elements), we aim at addressing two objectives: The first is to get an idea of real and fake emotions transmitted by means of the facial expressions by the participants, and the second is to explore the relationship between implicit and explicit emotion measures in the IS context and derive valuable insights for further research. Thereby, the hedonic design elements that served as stimuli for the emotion of happiness were part of online job ads that represented the IT artifact.

Thus, although from an epistemological standpoint, our research cannot be distinctively subordinated to positivistic explanatory research and due to its novelty also contains explorative and indicative elements (see [50], we derive the

following propositions with respect to our research objective formulated within the introduction:

P1: Facial zygomatic activity (facially transmitted happiness) in response to hedonic design elements in online job advertisements leads to an increase in self-report measures for pleasure, social presence, and arousal.

P2: The effect of the implicitly (via facial expression observation) measured happiness on the explicit self-report measures of pleasure and arousal is higher for the measures of pleasure.

3. Research methodology

To provide empirical support for the propositions for the impact of implicit or explicit emotions as well as their interrelation while interacting with a website containing hedonic elements and to have perfect control over 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 self-reported measures might be biased.

By letting one-half of the participants viewing a website with hedonic elements, such as photos, graphics, and a video file (experimental group) and the other half of the participants the same website with the same written information, but without the hedonic elements and just plain text black on white (control group), 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 (see Figure 6 & 7 in Online Appendix). Furthermore, by manipulating the exogenous variables and assigning participants randomly to the experimental conditions, causal inferences drawn from the results may be stronger. To minimize possible distortions regarding artificiality, we developed an as realistic as possible laboratory setting. We set up the experiment in the context of online recruitment and let both groups view and judge an online job ad of an online gaming company.

Furthermore, it is important to emphasize that the website was deliberately developed in cooperation with practitioners to trigger positive emotion. More specifically, the positive working atmosphere of the pleasant employer as well as the outstanding human working relationships within the company should be expressed by hedonic elements in the online job ad (see Figure 6 in Online Appendix). To ensure whether the elements were perceived as transporting the desired effects of triggering positive emotions, before the main experiment a pretest was conducted with 20 participants and could confirm the objective pursued.

3.1. Experimental design

After an individual had completed the survey, s/he went together with the experimenter into a separated and quiet room, which solely included a PC. This setting prevented the individual from being distracted by any external

influence. The experimenter explained the individual the upcoming experiment and the related task. Additionally, he 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 as well as filming his facial expressions. To accustom participants to this special experimental and monitoring situation and in order 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 s/he wanted. To control for different factors that might affect our results, data was collected in a pre- and a post-experimental questionnaire containing questions on test persons' demographics (gender, age, etc.) and personality, and their pre- and post-system-related attitudes and intentions. For manipulation check, we also asked the test persons to rate the level of enjoyment and distraction of the hedonic system elements. Participants of the control group were asked, whether they missed additional elements such as video files, or graphics within their online job ad (see Figure 7 in Online Appendix).

During the complete time, participants' viewing behavior and facial expressions were recorded using eye-tracking and the webcam. We used the Logitech C920 HD PRO webcam and the Tobii Pro X2-30 eye tracker, which is a small stand-alone eye tracker that can be attached to the bottom of the screen and is designed to capture data at 30 Hz. Regarding our research endeavor to observe implicit emotional expressions in regard to hedonic elements in the design of the online job ad and their impact on explicit emotional indications, eye-tracking was used to observe which viewed hedonic elements representing stimuli for the participants' expressed emotions in terms of a smile, which were simultaneously recorded via webcam (see Figure 4 in Online Appendix).

3.2. Facial action coding system

After the experiment, we analyzed the visual data using the facial action coding system (FACS) by Ekman and Friesen [10]. 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. As some muscles give rise to more than one action unit, correspondence between AU and muscle units is only approximate. 58 AU were considered responsible for expression control, gaze direction, and orientation. The FACS model has been used to synthesize images of facial expressions.

The FACS model has recently inspired the derivation of facial animation and definition parameters in the framework of the ISO MPEG-4 standard [51]. In particular, the facial animation parameter set (FAP) was designed in the MPEG-4 framework to allow the definition of facial shape and texture, as well as the animation of faces reproducing expressions, emotions, and speech pronunciation. The FAPs are based on the study of minimal facial actions and are closely related to muscle actions. They represent a complete set of basic facial actions and therefore allow the representation of most natural facial expressions. All FAPs involving translational movement are expressed in terms of the facial animation parameter units (FAPU). Within our research, we focused on the emotional expression of happiness. To identify participants with the emotional expression of happiness, we used two FAPU corresponding to fractions of distances between two key facial features – the horizontal distance between pupils and the horizontal distance between the labial angles (see Figure 5 in Online Appendix).

4. Research results

In order to reach our objective to uncover the interplay between implicit emotional expressions and explicit emotional indications toward an IS, we first report the results of the FACS procedure applied to identify all emotional expressions of happiness as well as the related stimuli triggering these expressions. Afterwards, we observe the impact of the implicit emotional expressions on the explicit emotion indications by clustering for these participants showing emotional expressions to one of these stimuli.

4.1. Scoring procedure and data cleaning

Two researchers independently judged the recorded film sequences using the FACS [10]. To ascertain internal validity, both watched the clips and recorded emotional expressions of happiness and the horizontal distances for the two FAPUs as well as the related stimuli and the time of observation. This resulted in a total of 20 valid clips out of 90 with participants showing emotional expressions of happiness. Intercoder agreement between the two coding researchers was on average at 92 percent. Several of these 20 participants with emotional expressions showed more than one of them, resulting in a total of 34 implicit emotional states of happiness. An AU database was created from the judges' open-ended coding of AUs. Each record in the database consisted of one or more AUs from the same clip based on the time stamp in which they were observed, as well as the related stimulus for the emotional expression gained through the eye-tracking technology. In total, we identified 11 stimuli based on hedonic elements of the online job ad of the online gaming company. Nine of these stimuli were short video sequences, and two of them were pictures from the slideshow in the online job ad. Most frequently occurred stimulus triggering an emotional expression of happiness was the appearing of a comic figure from an online game on the outside wall of the company's headquarters. For nine out of 90 participants this stimulus triggered an emotional experience of happiness. Further, five participants smiled during the film sequence while employees of the hiring company perform a

Mexican wave and while they watched a picture of the company's coffee kitchen cardboard standups of comic figures (see Table 2 in <u>Online Appendix</u>).

4.2. Data analysis

As the temporal issues of facial expressions being instantaneous and the affect states being of longer duration, it is important to emphasize that in our data analysis, we considered only the facial expressions as immediate reactions (emotions) and not the long-term reactions (such as affective evaluations). Immediate reactions in the form of facial expressions set the stage for the mechanics of emotion building but can become long-term reactions without temporal constraints.

4.2.1. Constructs for measuring explicit emotions.
For analyzing the interrelation of implicit and explicit emotions we observe how the showing of emotional expressions influences the degree of explicit indicated emotions such as identified in prior research [18, 32]. As exemplifying explicit emotions we chose pleasure and arousal [50, 51], known as determining dimensions for happiness from the emotional wheel [20]. Pleasure is the degree to which a user feels good or happy with the target object. Arousal is the degree to which a user feels excited, stimulated, or active [34]. Previous research has postulated that pleasure and arousal are distinct constructs (e.g.,[54]) as well as basic dimensions in classifying emotions (e.g., [34]).

Further to account for the important role of social connection in human behavior, we included the construct of social presence [49], [55] in our approach, known as an important emotion concept enhancing trust in e-commerce environments. Social presence comprises a psychological connection with users, which perceive a website as warm, personal, sociable, thus creating a feeling of human contact [56]. Examples of features that encourage social presence contain socially rich text content, personalized greetings [55], human-centric pictures, or human video [57]. If elements are added to the job ad, such as human images of people working at that organization then there is more likely to be an impact on the user that provokes an emotive response including a perception of social presence [49] (see Table 3 in <u>Online Appendix</u> for measurement items).

4.2.2. Results.
We compare the degrees for these participants showing implicit emotional expressions (group "All emotion"), with these participants that do not show emotional expressions (group "No emotion") as well as the control group who viewed an online job ad without hedonic elements during the experiment.

Additionally, we compared the means of all subgroups expressing an emotion of happiness due to a specific stimulus with the group of all participants showing emotional expressions. Therefore, Table 1 provides the means of the respective items for explicit emotions for the three most occurring stimuli – appearing comic figure on the wall of company's headquarters (Stimulus 1), laughing employees performing the Mexican wave (Stimulus 2), and

coffee kitchen with cardboard standups of comic figures (Stimulus 3). Although we only have a small number of participants all reacting to the same stimulus, we can report some really interesting results.

As one can see in Table 1, for each two items of pleasure and social presence the mean values are higher for participants expressing implicit emotions of happiness during the experiment compared to those showing no emotional expression (see values[a]). By comparing the explicit emotional indications for pleasure, social presence, and arousal for each stimulus with all participants with emotional expressions (All emotion) as well as the participants without any emotional expression (No emotion), we evaluated highly differing results. These participants showing an emotional expression of happiness due to an appearing comic figure on the wall of the company's headquarters (Stimulus 1) scored higher or even for the items of pleasure compared to all participants with emotional expressions as well those participants without emotional expressions (see values[b]). However, for the explicit emotions of social presence and arousal, they score significantly lower compared to both groups (see values[c]).

Interestingly, for the second stimulus ("laughing employees performing the Mexican wave"), we almost found the complete opposite results. As shown Table 1 for all items of pleasure, social presence, and arousal those participants reacting with an emotional expression of happiness to the second stimulus scored significantly higher in explicit emotion compared to the entire experimental group with expressed emotions as well the remaining 70 participants without expressed emotions (see values[d]).

Lastly, for those participants reacting to the third stimulus, the results are slightly mixed up. For each two items of pleasure and social presence, the participants in this subgroup had higher mean values than those participants without expressing emotions (see values[e]), but lower mean values for each one item of pleasure, social presence and arousal compared to the group of all participants expressing implicit emotions (see values[f]). In order to check for manipulation and interference of our treatment, we also compared the mean values with those of the control group. We can state that for all items of the three explicit emotion constructs the mean values are higher for participants in the experimental group (see values[g] and value[i]) than for participants in the control group making our treatment (hedonic elements in the online job ad) in the lab experiment both valid and effective and excluding issues of manipulation.

Thus, our results lead to the partial support for our first and full support for our second proposition. As proposed, facial zygomatic activity (facially transmitted happiness) in response to hedonic design elements in online job ads lead to an increase in self-report measures for pleasure (proposition 1). In contrast, this does not apply to social presence and arousal, leaving us with only partial support for our first proposition (see significant values[a] for pleasure in comparison to not significant values[h] for social presence and arousal). Further, in regard to the second proposition,

we found support that the effect of the implicit emotion expression of happiness on the explicit self-report measures of pleasure and arousal is higher for the measures of pleasure (see significant values[a] for pleasure in comparison to non-significant value[h] for arousal.

5. Limitations

Despite the controlled laboratory experiment and the use of objective eye-tracking data, this research has some limitations. First, lab experiments are criticized for their artificial settings as compared to real-world scenarios [58]. We addressed this issue by asking the participants to perform a task (viewing an online job ad) that is as realistic as possible to minimize the potential bias derived from artificial lab settings [58]. Also, our observations of implicit emotional expressions and participants' viewing behavior only included the reactions to one specific online job ad, so the results might differ for other IS or web elements. Although we had a reasonable sample size of 176 participants (90 participants in the experimental group / 86 participants in the control group) for our lab experiment, the majority of our sub-group evaluations were based on rather small sample sizes. This was due to the fact that only 20 participants showed emotional expressions of happiness toward the hedonic elements of the online job ad. While emotional expressions based on cognitions are rather easy to trigger via funny and entertaining text passages, emotional expressions based on affect are rather seldom, as IS are primarily utilitarian systems in nature with more the objective of supporting their than just entertaining them. Yet, compared to other lab experiments on similar topics our small sample sizes in the subgroups are still acceptable and conclusions based on the results are still reasonable [15].

Table 1. Data analysis – Impact of implicit emotional expression on explicit emotion indication

Construct	Explicit Emotion - Pleasure			Explicit Emotion - Social Presence				Explicit Emotion - Arousal
Source	Kim et al. 2004; Kim et al. 2007			Gefen and Straub 2003; Cyr et al. 2009				Kim et al. 2007
Experimental group without expressed emotions (n=70) ("No Emotion")								
Mean	2.643[i]	2.671[i]	2.800[i]	3.086[i]	2.443[i]	2.571[i]	2.957[i]	3.129[i]
Control group (n=86)								
Mean	3.116	3.128	3.093	3.721	3.477	3.337	3.756	3.942
Experimental group with expressed emotions (n=20) ("All emotions")								
Mean	2.500[g]	2.250[g]	2.350[g]	2.650[g]	2.150[g]	2.500[g]	2.900[g]	3.000[g]
DIF: All emotion vs. No emotion	0.143	0.421[a]	0.450[a]	0.436[a]	0.293[a]	0.071[h]	0.057[h]	0.129[h]
DIF: All emotion vs. Control group	0.616	0.878	0.743	1.071	1.327	0.837	0.856	0.942
Stimulus 1: Appearing comic figure on the wall of company's headquarters (n=9)								
Mean	2.667	2.000	2.222	2.889	2.667	2.667	3.444	3.222
DIF: Stimulus 1 vs. All emotion	-0.167	0.250[b]	0.128	-0.239[c]	-0.517[c]	-0.167[c]	-0.544[c]	-0.222[c]
DIF: Stimulus 1 vs. No emotion	-0.024	0.671[b]	0.578[b]	0.197	-0.224[c]	-0.095	-0.487[c]	-0.094
DIF Stimulus 1 vs. Control Group	0.450	1.128	0.871	0.832	0.810	0.671	0.311	0.720
Stimulus 2: Laughing employees performing the Mexican wave (n=5)								
Mean	1.600	1.600	2.200	1.800	1.600	1.800	2.200	2.200
DIF: Stimulus 2 vs. All emotion	0.900[d]	0.650[d]	0.150	0.850[d]	0.550[d]	0.700[d]	0.700[d]	0.800[d]
DIF: Stimulus 2 vs. No emotion	1.043[d]	1.071[d]	0.600[d]	1.286[d]	0.843[d]	0.771[d]	0.757[d]	0.929[d]
DIF Stimulus 2 vs. Control Group	1.516	1.528	0.893	1.921	1.877	1.537	1.556	1.742
Stimulus 3: Coffee kitchen with cardboard standups of comic figures (n=5)								
Mean	2.600	2.200	2.600	2.600	2.000	2.800	3.000	3.200
DIF: Stimulus 3 vs. All emotion	-0.100	0.050	-0.250[f]	0.050	0.150	-0.300[f]	-0.100	-0.200[f]
DIF: Stimulus 3 vs. No emotion	0.043	0.471[e]	0.200[e]	0.486[e]	0.443[e]	-0.229	-0.043	-0.071
DIF Stimulus 3 vs. Control Group	0.516	0.928	0.493	1.121	1.477	0.537	0.756	0.742

Note: Significant mean differences of +0.2 are marked in green, mean differences of -0.2 are marked in red.

6. Discussion

We conducted a multi-method experimental approach with multi-channel analysis to assess and compare the impact of facial emotional reactions to computer-induced stimuli on self-reported perceptive evaluations of emotion towards the respective stimulus and system. While we captured participants' implicit emotional expressions of happiness using eye-tracker and webcam technology, explicit indications of emotions were gathered by a post-experimental questionnaire containing items for the explicit emotion of pleasure [52], social presence [49], [55], and arousal [52]. Results analyzed using the FACS procedure [10] and test for mean inequality lead to the partial support for our first and full support for our second proposition. First, as one can see in Table 1 and as discussed in the previous section facial zygomatic activity (facially transmitted happiness) in response to hedonic design elements in online job ads lead to an increase in self-report measures for pleasure. However, by comparing the impact of emotional expressions of happiness for the explicit emotion of social presence, we need to acknowledge that for almost half of the items of social

presence the mean values are lower. By observing the impact of facial zygomatic activity on emotional arousal, we only found a significant increase for the second identified stimulus in our multi-channel analysis, while for the other two stimuli there are no significant differences between these participants expressing their emotions of happiness and those who don't, leaving us with only partial support for our first proposition. By comparing the second respectively third lines in the second and fourth column from the left within Table 1, we found support for our second proposition that the effect of the implicit emotion expression of happiness on the explicit self-report measures of pleasure and arousal is higher for the measures of pleasure. While 13 out of 16 items for pleasure increase after showing an emotional expression, only one out of four increases for the evaluative explicit emotion of arousal.

On the whole, our research advances knowledge on the measurement of emotions, a significant IS topic, by conducting a multi-method experimental approach basing on the combined analysis of facial expressions by utilizing the FACS and eye-tracking data (implicit emotion measures) as well as self-reported perceptive measures (explicit emotion measures). Thus, our study contributes to the scarcely addressed topic of new implicit measurement approaches for all kinds of psychological constructs (e.g., attitudes, emotions) [41] in IS research in two ways.

First, considering that in current IS literature the major focus lays on the impact of emotional drivers on individual adoption decisions, whereby emotions are predominantly measured by utilizing self-reported questionnaire data (e.g., [18]), and researchers more and more complain about the limitations that these approaches imply (Sharma et al. [40]), we contribute to IS research on human behavior by complementing self-reported measures of emotion with a physical emotional measure in response to system's feature, and by linking these measured emotional physical responses to individual behavior.

Second, bearing in mind that volitionally (and thus cognitively) controlled faces hold the potential to substantially bias the implicit measurement of real emotions [14], the comparison with explicit measures provides valuable information about the validity of the implicit measure of emotion. Thus, we contribute to IS literature, by comparing both implicit and explicit measures of happiness in response to IT-induced stimuli (hedonic design elements) to get an idea of real and fake emotions transmitted by means of the facial expressions and to explore the relationship between implicit and explicit emotion measures in the IS context. Further, we provide a more detailed picture of the benefits and limitations of both measures and their internal relationship.

Our research provides a further very interesting implication for future research. While observing our results, we can see a reasonable increase for all items of pleasure, social presence, and arousal, if participants prior watched and emotionally expressed a feeling of happiness toward the video sequence where laughing employees of the company performed the Mexican wave. Compared to the other two stimuli observed in the analysis, this is the only stimulus transferring positive human emotion to the participants, while the other two referred to the more uncommon and funny situation and pictures (appearing comic figure on an outside wall; comic figure standups in the coffee kitchen) without any including positive human emotion. Emotional expressions of happiness in this way might be more represented by some kind of fake information and not true implicit emotions. It will be a great objective for future research to further carve out the importance of positive human information as a driver of "honest" emotion expressions of happiness, as especially these implicit emotions could lead to significantly higher use and acceptance of IS.

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