Understanding Shame Signals: Functions of Smile and Laughter in the Context of Shame

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Abstract—**Computational emotion recognition focuses on observable expressions. In the case of highly unpleasant emotions that are rarely displayed openly and mostly unconsciously regulated – such as shame – this approach can be difficult. In previous studies, we found participants to smile and laugh while experiencing shame. Most current approaches interpret smiles and laughter as signals of enjoyment. They neglect the internal emotional experience and the complexity of social signals. We present a planned mixed-methods study that will investigate underlying functions of smiles and laughter in shameful situations and how those reflect in the morphology of expression. Participants' smiles and laughter during shame-eliciting situations will be analyzed using behavioral observations. Semi-structured interviews will investigate their functions. The gained knowledge can improve computational emotion recognition and avoid misinterpretations of smiles and laughter. In the scope of the open science initiative, we describe the planned study in detail with its research questions, hypotheses, design, methods, and analyses.**

Index Terms—**social signals, smile, laughter, shame, emotion recognition, mixed methods, open science**

I. INTRODUCTION

Emotions are complex phenomena. Humans have an implicit understanding of their own and other's emotions and – in their everyday life – display, regulate them and react to them automatically in socially guided ways [1]. In some cases though, emotional processes go beyond an intuitive understanding. For example: Why do you cry out of happiness? How come this baby looks so cute you want to squeeze its face a bit too hard? Why do you start laughing when it is utterly unfitting? Why do you smile in unpleasant situations? Such questions are addressed by scientific research (e.g. [2], [3]). They are highly interesting not only for humans to understand their own emotions but also for machines that need a model of humans' emotions to interact with them in a socially appropriate way.

Situations, in which expressions do not reflect the internal affective state of an individual, pose a major challenge for computational emotion recognition and generation. Many approaches rely on the interpretation of observable emotional expression as mapped to basic emotions described by Ekman [4]. Such mapping can easily lead to misinterpretations of a user's internal state. A one-to-one mapping of facial expressions to internally experienced emotions does not always reflect the reality of human emotions [5].

For systems that rely on the recognition of user's emotions, like social training systems [6]–[9], an understanding of the user's internal state is crucial. When neglecting that externally communicated and internal components of emotions do not always match, these systems might react inappropriately to users, which can lead to undesired outcomes.

Examples of communicated components of emotions are smiles and laughter. According to Ekman and Friesen, smiles belong to the most complicated but most underrated facial expressions. Generally, they are easy to recognize and interpreted as a signal for enjoyment. However, they occur in various contexts – also in such with negative connotations. They come in various forms – not all signaling enjoyment. And they serve various functions – such as communicative functions [10]–[12]. This impacts the design of virtual agents [13]. However, which role smiles and laughter play in complex emotions that do not have clear externally communicated components, remains understudied. One of these complex emotions is shame. As shame is highly unpleasant, it is often regulated and not displayed externally [14], [15]. For example, an internal shame experience can be masked by a smile [11]. In a previous study, we observed many instances of smiling and laughing in shameful situations [16]. This paper presents our planned study examining the functions of smiles and laughter in shame-inducing situations. We outline the study that will be conducted in summer 2021 to advocate scientific transparency in the scope of the open science initiative. We explicitly formulate research questions and a priori hypotheses before data collection, we describe the design, procedure, and measurements in detail, and the analysis of the hypotheses before the start of the study [17].

II. BACKGROUND AND RELATED WORK

Because of their complexity, disunity prevails about a concrete definition of emotions. They can be described as short-termed automatic full-system responses to internal or external stimuli that follow a certain pattern [18]. This work differentiates between externally communicated and internal (situational and structural) components of emotions [19]. *Externally communicated* components show in non-verbal social signals – for example in social interactions. *Situational* components are related to an experienced situation or a certain topic. *Structural* components are linked to the appraisal of attributes and actions of the Self and can update the self-concept. A process model

of emotions by [20] suggests that a stimulus event is followed by an individual appraisal of that event before an emotion arises. An expression of that emotion is the last element in the process. Emotion regulation can alter this process in a way that for example the initial emotion is replaced by another – thus not experienced consciously [21], [22]. Also, emotions do not necessarily become visible to outside observers: Social signals might be suppressed or they might display a different emotion [23]. Especially highly unpleasant emotions such as shame are rarely experienced consciously and displayed openly [14], [19].

A. Shame and its Signals

Shame occurs when we evaluate that our actions, feelings, or behavior do not meet social values, norms, rules, or demands that apply to the situational context. In line with the process model of emotions [20], shame is not elicited by an event but by our evaluation of this event [24]. Shame has a strong interpersonal nature. It emerges particularly when individuals value their interaction partner's opinion and care about their view of them. The Self fears rejection by the other in a shameful situation [25]. Such situation poses a threat to the relationship and the self-concept. Displaying shame can restore or sustain one's social reputation by communicating the awareness of a faux pas, thus protecting the relationship [25], [26]. However, to protect one's self-concept, shame is often immediately regulated unconsciously and not displayed openly [19], [22], [27]. An example is the job interview situation, as interviewees generally care about the interviewer's view of them and want to appear in a favorable light [28]. If interviewers point out that interviewees do not meet their expectations, interviewees might experience shame and fear rejection for the job position they desire.

Characteristic observable signals of shame and shame regulation described in existing literature are avoiding eye contact, lowering or directing the head away from the interaction partner, (partially) covering the face with the hands, and collapse or forward-leaning of the upper body [24], [25], [29]–[31]. These shame signals issue from the wish to disappear and protect oneself from the other person's gaze in whose presence the shameful event happened [31]. However, in a previous study examining reactions of participants in shame-eliciting situations, in addition to the aforementioned signals, other social signals that are typically not associated with negative emotions were observed frequently – smiles and laughter [16]. This leads to the assumption, that smiles and laughter are associated with the experience of shame or a shame regulation process. Thus, we will investigate in the planned study whether higher levels of shame are linked to higher frequency and duration of smiles and laughter.

B. Smiles, Laughter, and their Functions

Smiles are easily recognized, yet they are one of the most complicated facial expressions. One muscle is necessary for a smile – the zygomatic major, referred to as lip corner puller. Smiles involving only the lip corner puller are defined as false smiles (also non-duchenne, unfelt, non-enjoyment, deliberate, voluntary, forced). Felt smiles (also duchenne, enjoyment, genuine, spontaneous) involve also the orbicularis oculi muscles – the muscles surrounding the eyes [32], [33]. Smiles and laughter are commonly recognized as indicators of positive emotional states. Yet, they occur in various contexts – also in such with negative connotations – and serve various functions. Besides signaling happiness, smiles and laughter can be used to signal appeasement and to reduce conflict. They can as well signal dominance [10], [34]. They can serve social functions by regulating interpersonal interactions and the quality of relationships [11], [22]. Smiling and laughing can even help to overcome negative emotions and promote well-being [3], [35], [36]. Ekman and Friesen propose that smiles are often used deliberately to mask true internal feelings by feigning happiness or contentment [33]. According to Nathanson, the negative emotion shame can be regulated by replacing it with a positive emotion, showing in expressions of enjoyment [22]. Thus, smiles and laughter can be regarded as key players in emotion regulation, which is often employed in shameful situations. Smiles and laughter might be a driving force for promoting emotion regulation or they might be a visible signal of emotion regulation. We found hints to this in qualitative interviews of a previous study [37]. Those findings and theories support the assumption that smiles and laughter are highly relevant phenomena occurring in and contributing to negative situations eliciting shame and shame regulation. Yet, there is a lack of concrete research on functions of smiles and laughter in shame-eliciting situations – thus they are explored in this work.

Functions of smiles might be represented in different morphological appearances of smiles [10]. Ekman and Wiltschek describe 18 different types of smiles characterized by a certain morphology and function [11]. Examples are the contempt smile, embarrassment smile, and false smile. The lip corner puller and eye muscle activation play a big role as they distinguish enjoyment from non-enjoyment smiles. Gaze aversion, pressed lips, and raised chin can occur together with a smile, which is characteristic for embarrassment (also described by [32]). False smiles are often marked by asymmetry. A type of false smiles are masking smiles – they are displayed to cover actual internal emotions. Moreover, different types of smiles can result from experiencing multiple emotions simultaneously. As an example, enjoyment might be paired with contempt, so that a felt smile is paired with expressions of contempt (tightened lip corners). Some types of smiles serve different social functions, such as the listener response smile. As smiling or laughing in negative situations might be viewed as inappropriate, the urge to smile or laugh might be suppressed, resulting in expressions of smile controls such as depressed lip corners, raised chin, tightened lips, and pressed lips [32]. In [38], non-enjoyment smiles are also characterized by dimple-like wrinkles at the lip corners (dimpler) and puffed cheeks in combination with sharply upward pointed lip corners (cheek puffer).

Due to the complexity of the smile phenomenon, neither

this collection of smile types nor any other is exhaustive. For smiles in shameful situations, no detailed description exists. Therefore, this work is dedicated to discovering the morphology of smiles occurring in the context of shame and linking it to the functions they serve. To do so, study subjects will be observed experiencing three shame-eliciting situations in a job interview role-play after which they will be asked to elaborate on their experience.

C. Recognition and Generation of Emotional Expressions

For the field of Affective Computing, understanding emotions of the user is crucial. Thus, many attempts are made to recognize social signals of emotions automatically and integrate knowledge about them into computer models. Recent approaches to detect facial action units are made by [39] and [40]. Baltrusaitis and colleagues introduced the facial behavior analysis software OpenFace that integrates facial action units, facial landmarks, and eye gaze as data sources [41]. [42] present MediaPipe Facemesh – a software to approximate the geometry of a human face. These approaches enable to recognize the communicated component of emotions that are encoded in social signals. Methods of computational emotion recognition are introduced by [43]–[45]. Computational models of emotions presented by [46], [47]. [48], and [49] aim to combine both, emotion recognition and modelling emotions. Those methods and models can be used to create believable virtual agents that can socially interact with users. An important application for such agents are social training systems [6]–[9], [50].

Despite many efforts, current approaches are not yet able to capture, generate or model the full complexity of human emotions and emotional expressions – especially when differentiating between the externally communicated and internal components of emotions. This work aims at contributing to their improvement. For the application in social training systems, high accuracy in recognizing and interpreting user's emotional expressions is crucial. Especially smiles are often simply interpreted as happiness or contentment. It is important, though, to differentiate between various causes for smiles and various morphological patterns. Especially, if a user is actually experiencing negative emotions, such as shame, interpreting a displayed smile as happiness can have serious consequences for the success of the training. For example in the case of a virtual therapeutic assistant for health care treatment as in [9], misinterpreting users' emotional state by an insufficient recognition of emotional expressions might have a negative impact on their well-being and the treatment success. Understanding which functions smiles and laughter have in negative situations can be important to support users in an optimal way. This work will investigate observable morphological aspects of smiles that occur in shameful situations. Those can be integrated into computational social signal recognition approaches. Further, we will investigate functions of smiles and link them to their morphological appearance. The resulting information can be used to improve social signal interpretation and emotion models.

III. STUDY OUTLINE

In our planned study, we want to investigate the following general research question: What are the functions of smiles and laughter in shame-eliciting situations and how do those functions reflect in the morphology of smiles?

The analysis will follow two approaches: *Exploratory* analyses reflect the qualitative part of the study and *confirmatory* analyses test the quantitative data.

For the exploratory analysis, we formulate 4 specific research questions:
- RQ1: Do smiles and laughter serve different functions of shame as captured in the post-interview?
- RQ2a: Are functions and morphology of smiles interrelated?
- RQ2b: Are functions and frequency of smiles interrelated?
- RQ2c: Are functions and duration of smiles interrelated?

For the confirmatory analysis, we formulate 3 hypotheses:
- H1: Self-reported shame, measured with the SGSS questionnaire, will be higher after the job interview role-play than before.
- H2a: There is a positive correlation between self-reported shame, measured with the SSGS questionnaire, and frequency of smiles.
- H2b: There is a positive correlation between self-reported shame, measured with the SSGS questionnaire, and duration of smiles.

We will employ a mixed-methods design integrating quantitative as well as qualitative methods of data collection and analysis [51]. The qualitative descriptive method [52] and the qualitative content analysis [53] serve as the basis for the qualitative part. Methods will include pre- and post-experimental questionnaires about shame experience, semi-structured post-interviews, and behavioral observations using video material. The behavioral observations will be annotated using the annotation tool NOVA [54].

In the planned study, participants will experience a job interview role-play with three shame-eliciting situations. This scenario was tested and used in a previous study [16] which showed that a virtual agent can elicit shame just as humans do. Their procedure will be used as a guideline. Here, the planned study will be conceptualized as an online study, where the experimenter controls the virtual agent Gloria – the job interviewer – in a Wizard-of-Oz setup.

The planned study received approval from the ethical review board of the Faculty of Mathematics and Computer Science, Saarland University. The research questions, hypotheses, included variables, desired sample size, outlier handling, and planned analyses were preregistered on AsPredicted [1].

IV. STUDY METHODS

A. Participants

The sample of participants will consist of psychology students of German universities – regular universities and

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[1]https://aspredicted.org/c72w9.pdf

distance-learning universities. We plan a sample size of 30, which will be influenced by considerations of maximum variation [52], saturation sampling [55] and economical factors (limited time frame for completing the study and a time-consuming in-depth qualitative analysis process). Participants will be recruited via social media student groups and study platforms. They will be rewarded with course credit.

A sample consisting only of students enhances the chance that participants can put themselves in a job interview situation, as they did not yet complete their career path and will likely still engage in a job search. Thus, an immersive role-play and elicitation of emotions connected to a job interview experience should be rather likely. Psychology students in particular were found to have a higher psychological mindedness than students from other fields. Psychological mindedness is the interest and ability to reflect on psychological processes and to see relationships among thoughts, feelings, and actions [56]. This is important for the planned study as, in the post-interview, participants should reflect on their feelings and thoughts in the shame-eliciting situations and on the reasons and purposes of their smiles and laughter. Including only psychology students raises the probability of successful data collection in the post-interview. Students of distance-learning universities have a higher variability in age (average age: 38.3)[2] and other demographic and socio-economic factors than students from regular universities (average age: 23,7)[3]. As such, the study benefits from a more heterogeneous sample, as recommended for qualitative designs [57], [58].

B. Procedure

Before the experiment, participants will receive the link and instructions for the video chat where the experiment will take place. On the day of the experiment, participants will enter the video chat room, where they will be welcomed by the experimenter and informed about the procedure. They will be told they will have a job interview with a female interactive virtual agent for a position they much desire. After that, they will be asked to fill in a questionnaire that includes demographic data and items assessing their current shame experience. Next, the experimenter tells that she will leave the video chat room and the virtual interviewer will take over. The participants will assume to be alone with the virtual agent. In fact, the experimenter will be still in the chat room and will follow the job interview role-play controlling the reactions of the virtual agent. In the job interview, after an introduction, the first shame-eliciting situation occurs with the interviewer saying "A brief question before we start: Where did you get this outfit? Somehow it doesn't really fit you". The participants get some time to react to this statement, then the interviewer asks to describe their academic and professional background. This is followed by the second shame-eliciting statement: "All

the other applicants have already said what you said. You haven't exactly stood out". Participants are given some time to react before the interviewer goes on describing the offered position. Then, participants are asked to explain how they would handle a situation in which their team colleagues ignore their ideas and do not take them seriously. Their explanation is answered with the third shame-eliciting statement: "Well, that answer was not very impressive. I've already heard better from the other applicants". After some time for them to react, the interviewer concludes the job interview and hands over to the experimenter. Immediately after the job interview, participants will be asked to fill in the post-questionnaire assessing their shame experience. Afterward, the experimenter will reveal that the actual purpose of the study was not the job interview itself but how they react to and cope with unpleasant situations. The semi-structured post-interview will follow which is targeted to reveal whether shame was elicited and -– if the participants smiled or laughed – why did they do so, and what functions it served for them or the interaction. A video recording of the participants experiencing the shame-eliciting situations will be used to facilitate the process: Experimenter and participants will go together through single occurrences of smiles and laughter in the video. In the end, participants will be debriefed and asked to fill in a short questionnaire assessing the quality of the post-interview and their openness in the post-interview.

C. Measurements

The manipulation in this experiment will be the shame-eliciting job interview role-play. The constructs of smiles and shame experience will be the focus of investigation – they will be represented by five dependent variables. To capture them, three data collection methods will be used:

- behavioral observation
- semi-structured interview
- questionnaires

Smiles will be investigated using four dependent variables: Frequency of smiles, duration of smiles, morphology of smiles, and functions of smiles. The first three variables will be captured applying behavioral observation techniques to the recorded video material. Subjects of observation will be participants in the three shame-eliciting situations described in IV-B. Instances, duration and morphological aspects of smiles will be systematically registered and annotated in NOVA – a tool for annotating and analyzing behavior in social interactions [54]. Functions of smiles – the fourth variable – will be assessed based on information from the semi-structured post-interviews. **Frequency of smiles** will be captured by counting instances of smiles. **Duration of smiles** will be captured by summing up the seconds in which participants smiled.
Morphology of smiles represents morphological changes in the face that are connected with smiles. Every instance of smile or laughter will be registered and annotated regarding its morphological aspects. For this study, we select aspects relevant to negative situations. The basis for this selection is the cited literature on types of smiles as well as observations in studies using the same shame-eliciting scenarios [16]. The

anatomical approach of Ekman and Rosenberg (1997) for describing facial actions will be used as a reference. The following aspects will be taken into account for the annotation: lip corner puller, eye muscles activation, lip corner tightener, gaze aversion, [11], [33], cheek puffer, dimpler [38], lip corner depressor, chin raiser, lip tightener, lip press, lip suck [32], symmetry of lip action [11], intensity (coded as "teeth showing" or "no teeth showing"), and laughter. Here, laughter will not be conceptualized as a separate phenomenon but as a type of smile, as they share a common morphological basis. Therefore, laughter is not always separately mentioned in the course of this paper. As in felt smiles, in felt laughter, the zygomatic major (lip corner puller) and orbicularis oculi muscles (muscles surrounding the eyes) are activated. In false laughter, the latter are not included – just as in false smiles [59]. Moreover, according to [60], smile and laughter can be viewed as different degrees of enjoyment instead of separate concepts. Laughter is characterized by accompanying laughter vocalization or audible respiration sounds [38].

Functions of smiles represent information about the purpose the smile fulfills for the smiling individual or the social interaction. They will be explored qualitatively in the semi-structured post-interview. For qualitative data like internal experience, interviews – especially in semi-structured form – are an appropriate investigation method [61]. We will follow guidelines for the application by [37] and [62]. Open questions will be employed allowing an in-depth understanding of participants' experiences. General questions will be the participants to elaborate more freely on the topic of interest (e.g. "How did you deal with the situation?", "How did you react?"). They will be followed by questions more narrowed down and specifically asking about the topic of interest (e.g. "Did the smile help you in some way to cope with the situation?"). The experimenter will guide the participant through the video recording of the shame-eliciting situations, addressing every single instance of smile and laughter. In that way, a possible function will be recorded for every instance. This will allow a connection of the functions with the morphology of smiles in the following analysis process.

Shame experience as a fifth dependent variable will be captured using self-reports from two data collection methods. The State Shame and Guilt Scale (SSGS) captures shame with 5 items that are answered on a 5-point Likert scale. Item examples are "I want to sink into the floor and disappear" and "I feel small". We use a German translation approved by a certified German-English translator. The authors report an internal consistency of $\alpha = .89$ for the shame subscale in a study with 142 participants [63]. In the post-interview described above, questions like "How did you feel in that situation?" will investigate whether shame was experienced. The applied interviewing technique will allow participants to mention feelings of shame on their own before being asked about it more directly. Shame experience will be captured based on the mention of shame, synonyms, or descriptions of shame, as shame is often not named directly [64].

Demographics will include age, gender, university, and expe-

rience with job interviews.

V. ANALYSIS

This work employs a mixed-methods analysis, involving quantitative as well as qualitative analyses [51].

A. Pre-Processing of the Data

Before an analysis will be possible, the raw qualitative data has to be pre-processed. To analyze the contents of the post-interview, the audio-recording will be transcribed into text first. Next, to extract information about the *shame experience*, the text will be systematically searched for mentions of shame and its synonyms, related concepts, and descriptions of shame. As a guideline, before the start of the analysis process, examples are extracted from two sources: 1) established questionnaires assessing shame [63], [65], [66] and 2) interview material of a previous qualitative study assessing shame [37].

B. Main Analysis

To answer RQ1, we will employ **qualitative content analysis**. Functions of smiles will be investigated exploratively – they will be inductively extracted from transcribed post-interviews without pre-defining them. The text will be therefore systematically searched for instances of functions of smiles. Such instances can be descriptions of why the participants smiled or laughed, what purpose it served for them or the interpersonal interaction, or in what way it helped them to cope with the situation. The discovered instances will be then structured and checked for similarities and patterns which eventually leads to the formation of categories. Discovered categories may be summarized into higher-level categories. The qualitative content analysis process will not be linear but cyclic, such that categories might be revised when working through the text repeatedly. In the end, the frequencies of categories will be quantitatively described. An interpretation of the category system and quantitative results with respect to the research question will follow. The analysis process will be technically supported by QCAmap – a software for systematic text analysis based on the techniques of qualitative content analysis [53].

For answering RQ2a, video recordings of the participants in the shameful situations will be analyzed regarding the morphology of smile and laughter instances as described in IV-C. Every instance will be checked for its morphological aspects. The function registered for the particular instance was made available through the qualitative content analysis as described above. A **quasi-statistical descriptive analysis** style will be applied to find patterns in the data, connecting the functions of smiles to morphological aspects. RQ2b and RQ2c will be addressed in the same way: Frequency of smiles and duration of smiles will be investigated regarding a link to their function. The goal will be to find and define a structure that reveals how functions of smiles reflect in their appearance, their frequency, and their duration.

The hypotheses will be tested applying **statistical analysis**. For H1, a *t*-test will compare the average self-reported

shame in the shame experience pre-questionnaire to the post-questionnaire. This analysis will be performed as a manipulation check, to test whether shame was successfully induced in the job-interview role-play. H2a and H2b will be addressed by correlation of self-reported shame in the SSGS questionnaire with frequency of smiles and duration of smiles respectively. These analyses will be used to reveal whether the phenomena of shame and smiling are related such that they systematically occur together.

VI. Conclusion

In this paper, we presented our study on examining the functions and morphology of smiles and laughter in shame-inducing situations, planned for summer 2021. Doing so, we serve the demands for open science by formulating research questions and a priori hypotheses, describing the design, procedure, measurements, and analysis.

Our aim is to gain information about shame signals that can improve social signal interpretation and emotion models and avoid undesired misinterpretations of smiles and laughter. Integrating this knowledge into social training system can significantly improve their quality and success.

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