Short title: FUNCTIONS OF SMILES IN THE CONTEXT OF SHAME

What's so funny about shame? Functions of smiling and laughing in the context of shame – a mixed method approach

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Contents

List of figures **5**

List of tables **6**

Abstract **7**

1 Introduction **8**

2 Theoretical background **9**

2.1 Emotions and their regulation 10

2.2 Shame 14

2.2.1 Shame regulation 16

2.2.2 Shame signals 17

2.2.3 Shame in job interviews 18

2.3 Smiles and laughter 18

2.3.1 Types and functions of smiles and laughter 19

2.4 Practical application in Affective Computing 28

2.4.1 Automatic recognition and generation of emotional expressions 28

2.4.2 Emotions and social behavior towards computers 30

2.5 Qualitative research and mixed methods 32

2.5.1 Behavioral observations 34

2.5.2 Semi-structured interviews 34

2.5.3 Qualitative content analysis 35

3 The present study: Research questions and hypotheses **39**

4 Method **41**

4.1 Sample 42

4.2 Experimental setup 43

4.2.1 Job interview role play 43

4.2.2 Technical setup . . . 44
4.3 Procedure . . . 46
4.4 Methods of data collection . . . 47
4.4.1 Behavioral observations . . . 47
4.4.2 Semi-structured post-interview . . . 48
4.4.3 Questionnaires . . . 50
4.5 Analysis . . . 51
4.5.1 Pre-processing of the data . . . 51
4.5.2 Main analysis . . . 52

5 Results **55**
5.1 Exploratory analysis . . . 55
5.1.1 Manipulation check: Shame experience . . . 56
5.1.2 Functions of smiles . . . 57
5.1.3 Interrelation of functions and morphology of smiles . . . 61
5.2 Confirmatory analysis . . . 67
5.3 Post-interview evaluation . . . 68

6 Discussion **69**
6.1 Shame experience . . . 69
6.2 Functions and smiles and their interrelation with morphology of smiles . . . 71
6.3 Interrelation of experienced shame with frequency and duration of smiles . . . 81
6.4 General discussion, limitations and future work . . . 82

List of Figures

1 Methods of qualitative content analysis 37
2 The virtual agent used in the study. 45
3 The annotation process in NOVA 66
A1 Frequencies of smile functions and their co-occurrence with morphological aspects 104

List of Tables

1 Shame-eliciting situations used in the present study 44
2 Categories of affect and their frequencies 58
3 Categories of functions of smiles. 59
4 Annotation scheme for morphology of smiles. 62
5 Functions of smiles and their co-occurrence with morphological aspects 64

Abstract

Smiling and laughing are commonly associated with the experience of positive emotions. However, they also occur in negative or unpleasant situation. In previous studies, smiles and laughter were observed in shameful situations. The present study applies a mixed methods approach for investigating functions of smiles and laughter in shameful situations and how those reflect in the morphology of expression. Participants were observed during a shame-eliciting job interview role play with a virtual agent. In a qualitative post-interview, they elaborated on the functions of smiles and laughter displayed during the shame-eliciting situations. Results of qualitative content analysis showed that smiles and laughter serve three main function. They can serve intrapersonal and interpersonal functions and be a sign of internal emotions. Those functions can partly be linked to the morphological appearance of smiles. The gained knowledge can improve computational emotion recognition and avoid misinterpretations of smiles and laughter.

1 Introduction

Emotions are complex phenomena. Humans have an implicit understanding of their own and others' emotions and – in their everyday life – display, regulate them and react to them automatically in socially guided ways (Lewis et al., 2008). In some cases though, emotional processes go beyond an intuitive understanding. For example: Why do you cry out of happiness? Why do you start laughing when it is utterly unfitting? Why do you smile in unpleasant situations? Such questions are addressed by emotion researchers (Aragón et al., 2015; Keltner & Bonanno, 1997, e.g.). They are highly interesting not only for humans to understand their own emotions but also for virtual agents that rely on a computational model of human emotions to interact in appropriate ways.

Situations in which expressions do not reflect the internal emotional 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 (1993) (Picard et al., 2001; Soleymani et al., 2012; Valstar et al., 2016, e.g.). 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 (Feldman Barrett, 2017). It is important to take into account that emotions do not necessarily become visible to outside observers (Keltner, 1996). They may not even be consciously experienced. This is especially often the case for unpleasant emotions, which are mostly regulated in order to protect the self (Gross, 2013; Lewis et al., 2008; Nathanson, 1994). For systems that rely on the recognition of user's emotions, like training systems that aim at enhancing social skills (DeVault et al., 2014; Gebhard, Schneeberger, André, et al., 2018; Gebhard et al., 2019; Hoque et al., 2013), 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. Especially, if a user is actually experiencing negative emotions, interpreting a displayed smile as happiness can have undesired consequences for the user's well-being and the training success.

Examples of communicated components of emotions are smiles and laughter. Smiles belong to the most complicated but most underrated facial expressions (Ekman & Friesen, 1982;

Ekman et al., 1997). Generally, they are easy to recognize and often simply interpreted as a signal for enjoyment. However, they occur in various contexts – also in such with negative connotations. They come in various morphologically different appearances – not all signaling enjoyment. And they serve various functions – such as communicative functions (Chapman, 1983; Ekman, 1989; Hess et al., 2002). 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 (Lewis et al., 2008; Nathanson, 1994). For example, an internal shame experience can be masked by a smile (Ekman, 1989) or regulated by replacing it with a positive emotional experience (Nathanson, 1994). In a previous study, many instances of smiles and laughter were observed in shameful situations (Schneeberger et al., 2019; Scholtes, 2019). Understanding which role smiles and laughter play in negative situations can help to support users in an optimal way. Therefore, this work investigates functions of smiles and laughter in shameful situations and links them to their morphological appearance. This endeavor is embedded in the DFG funded project DEEP (funding code 392401413), which aims at a real-time computational emotion model that describes how externally observable signals can be linked to internal emotional experiences.

2 Theoretical background

The present work investigates functions of smiles and laughter in shameful situations and their link to the morphological appearance of smiles and laughter. The following sections provide an understanding of the concepts of smiles, laughter and shame, and how they are connected to lead to the research questions and hypotheses this work addresses.

For understanding the phenomena of smiles and shame and how they are connected, it is important to first take a look at emotions, emotional expressions and emotion regulation in general. Shame is a negative emotion that is mostly regulated. As such, in addition to the theoretical background on shame itself, shame regulation will be discussed in particular. Literature on shame describes certain observable shame signals, which will be presented. Typically, smiles and laughter are not reported as a shame signal. However, there are theoretical and empirical reasons to assume that they play a role in shameful situations. Theories and study

results about smiles and laugther and the functions they serve will be discussed with regard to this assumption. Given this theoretical background, research questions and hypotheses were formulated.

The present study is related to the field of Affective Computing. Knowledge about functions of emotional expressions and their morphological appearance can be practically applied in improving computational recognition and generation of emotional expressions as well as computational emotion models. Thus, the state of the art in this field will be introduced. The presented study used a virtual agent to elicit shame in the participants. The suitability of this approach will be demonstrated with existing research. To explain the methodical decisions made for this study, background on the used mixed methods design and the included qualitative methods will be given.

2.1 Emotions and their regulation

In the scientific community, disunity prevails about a definition of emotions due to their high complexity. To work towards an understanding of emotions, Gross (2013) proposes three core features: Firstly, emotions arise in situations relevant to the individual's goals. Secondly, emotions are multifaceted phenomena – they cause changes in subjective experience, behavior, and physiology. Thirdly, those changes can forcefully occupy individuals' awareness and interrupt current activities. A process model of emotions by Gross et al. (2000) 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 (Gross, 2013).

This work follows a model of emotions that differentiates between internal and external emotions (Moser & Von Zeppelin, 1996). External emotions are *communicated* and thus observable – they are encoded in sequences of non-verbal or verbal signals, such as vocal or facial expressions (Ekman, 1993). They can be viewed as social signals. Internal emotions are not directly observable as they occur within an individual. They can be differentiated into two sub-categories: Situational and structural emotions. *Situational* emotions represent information that is linked to a topic or situation that has been experienced. *Structural* emotions represent information about the appraisal of one's own attributes and actions. They are related to the self-concept and inform oneself about its state. Structural emotions do not necessarily become

conscious. Shame has a strong structural character (Moser & Von Zeppelin, 1996). It is not directly encoded in a specific facial expression compared to enjoyment, for instance, which is commonly associated with smiling (Ekman, 1993). Internal and external (communicated) emotions do not always match. That means, a different emotion than the currently internally experienced emotion might be communicated to the outside world (Feldman Barrett, 2017; Kappas, 2003; Moser & Von Zeppelin, 1996). Whether emotions are displayed externally depends on various variables such as social display rules (Ekman & Friesen, 1969) or emotion regulation processes (Gross, 2013).

For understanding emotions and emotional expressions, understanding the functions of emotions is essential. They can be categorized into intrapersonal, interpersonal, and socio-cultural functions (Hwang & Matsumoto, 2019). *Intrapersonal functions* refer to internal emotions as an information-processing system that helps us act very fast with minimal thinking (Tooby & Cosmides, 2008). They are linked to perception, attention, inference, learning, memory, goal choice, motivational priorities, physiological reactions, motor behaviors, and behavioral decision making (Tooby & Cosmides, 2008). Emotions are also connected to thoughts and memories. For example, they can increase or decrease memory performance (Levine & Edelstein, 2009). Positive emotions stimulate a flexible, heuristic, wide information processing, while negative emotional states stimulate a systematic, detailed, focused processing (Petty & Briñol, 2011). Emotions are important motivators of future behavior (Hwang & Matsumoto, 2019). *Interpersonal functions* represent the role emotions play for relationships and interactions with others. Emotions are constantly expressed verbally and non-verbally and others can recognize and are influenced by those emotional expressions (Elfenbein & Ambady, 2002). As such, this function is connected to external emotions. Due to their signal character, external emotions help to solve social problems by evoking responses and by signaling the state of relationships (Hwang & Matsumoto, 2019). They also regulate social interactions by indicating desired social behavior (Keltner, 2003). *Socio-cultural functions* address how emotions help to maintain the social order of communities. Both internal and external emotions have socio-cultural functions. Which emotions are valued and appropriate (Tsai et al., 2006), how emotions are displayed and regulated is defined by cultural rules (Hwang & Matsumoto, 2019). These rules inform about which emotional display is appropriate in which context (Ekman &

Friesen, 1969). That is, socio-cultural rules may explain why especially negative emotions are often not expressed openly and masked with a different, socially accepted positive emotional expression (Nathanson, 1994).

Thus, functions of emotions may also influence their regulation. Most emotions are regulated – in particular, negative and unpleasant emotions, such as anger, sadness, guilt and shame (Gross, 2013; Lewis et al., 2008; Moser & Von Zeppelin, 1996). *Emotion regulation* refers to how humans try to influence which internal emotions they experience. This process can be conscious or unconscious. Emotion regulation can mean the regulation *by* emotions, referring to how emotions regulate for example physiological variables such as heart rate, or it can mean the regulation *of* emotions, referring to how emotions themselves are regulated. Regulation happens mostly unconsciously. People regulate emotions to avoid negative emotions or to decrease the intensity of their internal experience or externally communicated signals. Negative emotions that are difficult to bear may be replaced by positive emotions. Positive emotions can be regulated, too – for example, if the socio-cultural rules indicate that they are inappropriate in a given situation. Their regulation can also involve maintaining or increasing emotion for prolonging its effects (Gross, 2013). John and Gross (2013) specify five types of emotion regulation strategies. First, *Situation Selection* refers to actively seeking or creating situations with increased chances to experience desired positive emotions and avoiding situations that are likely to elicit undesired negative emotions. Second, *Situational Modification* means modifying a given situation in a way that increases chances of experiencing desired emotions. Third, *Attentional Deployment* redirects attention to desired emotions without changing a situation. Fourth, *Cognitive Change* aims at changing one's appraisal of a situation in a way that alters the situation's emotional significance. Fifth, *Response Modulation* influences physiological, experiential, or behavioral responses. One form of response modulation is suppressing emotional expressions, such as hiding visible signals of shame in an unpleasant situation (John & Gross, 2013).

Those emotional regulation strategies are primarily of intrapersonal nature. Additionally, emotion regulation has also interpersonal components. Rimé (2013) presents three categories of regulation needs that emerge from a negative emotional experience. Firstly, he describes *cognitive needs* which are similar to the intrapersonal regulation strategies described above. Secondly, *action needs* aim at regulating emotions through concrete actions, for instance,

successful experiences or restoration of control through action. Thirdly, he presents *socio-affective needs* such as appeasement, contact, understanding, social integration, and reassurance. Emotional experiences generally evoke a need for social sharing. Sharing of both positive and negative emotional experiences can enhance well-being and strengthen social bonds. In the case of negative emotions, sharing can aid emotion regulation by satisfying socio-affective needs. However, regulating strong negative emotions sustainably, given possible long-term memories, requires cognitive regulation strategies (Rimé, 2013).

In sum, emotions can be divided into the two main categories internally experienced and externally communicated emotions, which do not always match. That is, emotions visible to outside observers do not necessarily reflect actual experienced emotions. A reason is that most emotions – especially negative ones – are regulated using certain emotion regulation strategies, which happens mostly unconsciously. Given those characteristics, understanding and recognizing emotions reliably is highly difficult. According to Darwin and Prodger (1998) and Ekman (1992), all expressions reflect experienced emotions. However, there are also arguments against this theory. Barrett (2006) views emotional expressions as social constructions and does not support a one-to-one mapping of expressions to experienced emotions, like a smile to happiness. Also some studies suggest that expressions do not consistently occur according to experienced emotions but that they are rather variable and context-dependent (Gratch et al., 2013; Hess et al., 1995; Reisenzein et al., 2006). A. J. Fridlund (1997) links expressions to social functions instead of emotions. His theory is in line with the Affect Induction Apprach (AIP) by Owren and Bachorowski (2003), which claims that expressions, in particular laughter, are solely used to unconsciously provoke positive affective responses in interaction partners. The AIP denies any connection of expressions with internal emotions. This work is based on the assumption that facial expressions like smiles can have their cause in experienced emotions and can serve several functions (Ekman, 2003). It acknowledges that a strict one-to-one mapping of facial expressions to emotions is not feasible due to their complexity and context-dependency (Barrett, 2006). The aim is to contribute to solving the problem of this complexity threefold. Firstly, by investigating different functions of smiles for one particular context, namely shameful situations. Secondly, by exploring the morphology of smiles that occur in this context. Thirdly, by exploring a possible link between the discovered functions of smiles and their morphology in

the context of shame.

2.2 Shame

Shame is a highly negative and unpleasant emotion. It arises when we determine that our actions, feelings or behavior do not meet social values, norms, rules or demands in a given social context (Lewis et al., 2008; Moser & Von Zeppelin, 1996, e.g.). In line with the process model of emotions (Gross et al., 2000), shame is not elicited by a specific event but by an evaluation of this event (Elison et al., 2006; Lewis, 1992). When being ashamed, memories of similar situations are activated unconsciously. They determine the evaluation and thus the internal experience and behavior in this situation (Nathanson, 1994). Shame belongs to the group of self-conscious emotions which occur from early childhood on after the self-concept is developed (Lewis et al., 2008). As such, shame is the result of a negative evaluation of central aspects of the self. This implies a re-evaluation of the whole self-concept (Tangney et al., 1995). In a shameful situation, according to Nathanson (1997), a new version of one's self is revealed by disclosing new undesired information. A decision has to be made about whether to accept the newly revealed (worse) version of the self and integrate it into the self-concept or whether to defend the previous self-concept. According to the self-discrepancy theory by Higgins (1987), shame arises due to a perceived discrepancy between the actual self, how it is perceived from one's own perspective, and the ideal self, which is constructed from assumptions about the other's perspective. Thus, this theory does not view shame as based on a negative evaluation from the own perspective but on an assumed negative evaluation of the self by significant others. In line with that, the sociometer theory (Leary & Baumeister, 2000) views shame as an indicator for the threat of social rejection – a threat for the fundamental human need for social relation. In response to shame, the current state self-esteem drops in order to warn the individual about this threat. Thus, shame has a warning function that helps to satisfy basic social needs. Fessler (2007) supports this view of shame as a protective mechanism that evolved due to the social nature of humans. He states that the display of open shame is a way to communicate the awareness of a faux-pas in order to restore or sustain one's social reputation and to avoid rejection. Shame is also categorized as one of the four kinds of social anxiety (Buss, 1980).

A threat of social rejection is especially salient in performance situations where one is

evaluated regarding certain desired attributes or in situations where one could be rejected from a desired group membership (Dickerson et al., 2004). Fear of rejection depends on the social relationship with others. It is particularly present in interactions with individuals with which we have a personal relationship and whose opinion we value (Izard, 1977). Shame only emerges when we care about the interaction partner's opinion of us (Hahn, 2001). An example for evaluative performance situations in which the interaction partner's opinion is important are job interview situations.

The described theories highlight the strong interpersonal nature of shame. Although shame is generally perceived as a negative emotion, it has several useful functions. For example, it promotes human development by pointing out socially undesirable behavior. We learn to avoid undesirable behavior that leads to shameful situations and to apply socially desirable behavior instead (Hilgers, 2006). Thus, shame regulates social behavior, which facilitates the basic human need of social integration (Izard, 1977; Leary & Baumeister, 2000).

Shame and embarrassment. Shame has a row of related concepts, of which embarrassment appears as the closest and the most difficult to differentiate. Shame and embarrassment belong to the category of self-conscious emotions. They result from a negative evaluation of the self (Lewis et al., 2008). R. S. Miller and Tangney (1994) found shame to be a more intense and longer lasting emotion than embarrassment. Due to this aspect, some researchers consider embarrassment and shame to be different intensities of the same emotion, respectively embarrassment to be a less intense form of shame (Izard, 1977; Tomkins, 1963). Everyday language does often not differentiate between embarrassment and shame. In German as well as in English language, embarrassment (Peinlichkeit) is commonly used as a synonym for shame (Scham) (Kalbe, 2002). Research on synonyms for the term shame in English language has discovered three lexical components of shame which are commonly used. The term "ashamed" refers to internally attributed states or events related to an undesired social status, socially unaccepted behavior (faux pas) or to psychical or physical issues. "Embarrassed" is used in the context of feelings of insecurity in social interaction or a violation of courtesy standards. The term "humiliated" is linked to a loss of status due to external causes (Krawczak-Glynn, 2014).

The present work uses interviews with German participants which address the participant's

shame experience in common language. Due to the conceptual and linguistic connections of shame and embarrassment, this work treats them as representatives of the same concept.

2.2.1 Shame regulation

For adults, negative emotions like shame do rarely become conscious (Moser & Von Zeppelin, 1996) and are regulated unconsciously (Gross, 2013). As shame is such unpleasant emotion that threatens the self-concept, humans developed strategies to regulate it so that it is not experienced consciously or expressed openly (Nathanson, 1994). As mentioned above, a shame-eliciting event leads to an internal dilemma whether to accept a newly revealed (worse) version of the self or whether to defend the previous self-concept. Nathanson assumes that we mostly opt for the latter. He describes four general shame regulation strategies which form the Compass of Shame: Withdrawal, Avoidance, Attack Other and Attack Self (Nathanson, 1994, 1997). They are described in the following.

Due to a high level of attention that is focused on the self, people typically feel exposed and wish to hide or disappear in a shameful situation (Izard, 1977). To account for this wish, the unpleasant experience of shame can be regulated by *Withdrawal*. It can be illustrated by the phrase ”wanting to sink into the ground with shame.” However, most often, Withdrawal does not manifest in extreme ways such as actually leaving the situation, but in more subtle ways. For example, shamed individuals might cover their mouth or other parts of their face with a hand and avoid eye contact with the person in who’s presence the shameful event happened. The *Avoidance* strategy is used to deceive the self or the other by denying or ignoring a shameful event. It is characterized by directing the gaze and attention elsewhere. The *Attack Self* strategy attacks and blames the self for the shameful event. It aims at retaining control over the situation by anticipating accusations that others might make. When committing a social faux-pas, one might preemt others’ negative reactions by degrading the own behavior (e.g., ”I’m sorry, this is so stupid of me!”). Besides verbal comments, this strategy may be accompanied by facial expressions of disgust toward oneself. The *Attack Other* strategy directs the attention away from the self and toward the other. The goal is to place the other to a lower social status position than oneself. For example, a shame-eliciting statement can be answered with a disdainful comment on the other, in turn – a counter-attack, so to speak. In contrast to the other three strategies, which try to maintain a positive relationship, a

discontinuation of the relationship is accepted or desired. Nonverbally, this strategy is expressed by forceful and broad movements, making oneself appear bigger, and physical expressions of anger and disgust.

2.2.2 Shame signals

For recognizing shame, both bodily and facial expressions are relevant (Aviezer et al., 2008; Carroll & Russell, 1996; Darwin & Prodger, 1998; Noh & Isaacowitz, 2013). App et al. (2011) discovered in their study that the body (rather than the face alone) is the main medium for nonverbal expressions of emotions such as shame. Izard (1977), on the other hand, views facial expressions as the main medium for the social exchange of inner states. Commonly accepted indicators of shame are averting gaze and head (Hahn, 2001; Izard, 1977; Lewis et al., 1992; Seidler, 2001), which is supported by empirical evidence (Keltner, 1995; Stipek et al., 1992). A study found interviewees to avoid eye contact with the interviewer when answering personal or potentially shame-eliciting questions (Exline et al., 1965). Avoiding eye contact with the person in whose presence one feels ashamed reflects the wish to hide, break contact and protect oneself from the other's gaze (Hilgers, 2006), in accordance with the Withdrawal strategy of shame regulation. As described in the previous section 2.2.1, it can also be connected with the Avoidance strategy (Nathanson, 1994). The wish to to hide when being ashamed can also be expressed by (partially) covering or touching the face with the hands (Blumenthal, 2014; Buss, 1980; Retzinger, 1995). Furthermore, several authors describe shrinking, collapsing or leaning forward of the upper body as indicators of shame (Hahn, 2001; Lewis et al., 1992; Nathanson, 1994) – empirically supported by Stipek et al. (1992). Immobility (Blumenthal, 2014; Retzinger, 1995; Tiedemann, 2007) and the inability to speak respectively remaining silent (Blumenthal, 2014; Hahn, 2001; Lewis et al., 1992; Tiedemann, 2007) are also reported as responses to shame. Blushing is also indicated as a possible sign of shame in some works (Hahn, 2001; Izard, 1977; Nathanson, 1997; Tiedemann, 2007). However, according to Izard (1977), blushing varies so much from person to person that it cannot be considered a general sign of shame. In a previous study examining reactions of participants in shame-eliciting situations, in addition to the aforementioned signals, other social signals, that are not typically associated with negative emotions like shame, were observed frequently – smiles and laughter (Schneeberger et al., 2019; Scholtes, 2019).

2.2.3 Shame in job interviews

As mentioned, shame can occur predominantly in social interactions that hold a potential of social rejection, such as evaluative or performance situations. A fear of rejection is particularly present when the interaction partner's opinion of us is important and valued. A situation that typically fulfills those characteristics, is the job interview situation. Job interviews are highly evaluative and hold high personal stakes, as the occupational future of the interviewees depends on the impression they make on the interviewer (Jansen et al., 2012; McCarthy & Goffin, 2004). This impression can be influenced, for example, by the interviewee's clothing style (Forsythe, 1990) or even the initial handshake (Stewart et al., 2008). Throughout the whole interview, interviewees are under pressure to appear in a favorable light while generating appropriate verbal and non-verbal responses, which results in a continuous high cognitive load (Barrick et al., 2009; Nordstrom et al., 1996). Interviewers can for example address inconsistencies or unfavorable aspects of the interviewee's curriculum vitae (Berkelaar & Buzzanell, 2014) or test interviewees' reactions in stressful situations with challenging questions or behavior (Campion et al., 1997; Freeman et al., 1942). Given those aspects of job interview situations, experiencing anxiety during job interviews is common (McCarthy & Goffin, 2004). They might also account for the experience of shame in job interviews (Jackson et al., 2009). It can be assumed that applicants desire to get accepted for the given job position they applied for. The decision for accepting or rejecting an applicant depends on the interviewer and her or his opinion about the applicant. If confronted with challenging questions or disapproving comments (e.g., "This answer was not very impressive."), applicants' fear of rejection by the interviewer might increase. Those conditions support the occurrence of shame and shame regulation strategies. As such, the job interview presents a suitable scenario for investigating shame and related phenomena, which was also confirmed by Schneeberger et al. (2019) and Schneeberger, Hladký, et al. (2021). Thus, it is used in the present work.

2.3 Smiles and laughter

Smiles seem to be easily recognized, yet they are one of the most complicated and underestimated facial expressions (Ekman & Friesen, 1982). Smiles and laughter are commonly viewed as indicators of positive emotional states. Smiling individuals are mostly assumed to be

happy (Deutsch et al., 1987). Also, they are perceived more positively than non-smiling individuals. The more intense a smile, the happier, more beautiful and more sympathetic a person is perceived (Otta et al., 1996). In addition, smiling people are perceived more kind, polite, honest, humorous (Deutsch et al., 1987; Reis et al., 1990; Ruback, 1981; Thornton, 1943), sociable, competent (Reis et al., 1990), relaxed (Deutsch et al., 1987), familiar (Baudouin et al., 2000) and more attractive (Mueser et al., 1984; Reis et al., 1990). Otta et al. (1996) found the positive effect of smiles on rated attractiveness and kindness to be independent of the form of smile. Moreover, there is a variety of studies linking experienced happiness to smiling and laughing (Cacioppo et al., 1986; Ekman et al., 1990; Ekman, Freisen, et al., 1980). However, research suggests that smiles and laughter do not always represent the internal emotional state of a person. Humans smile and laugh not only in positive situations, but in various contexts – even in unpleasant situations, where experiencing happiness is very uncommon (Keltner & Bonanno, 1997; Papa & Bonanno, 2008, e.g.). Besides communicating experienced emotions, smiles and laughter seem to serve certain functions. Also, they come in various forms.

2.3.1 Types and functions of smiles and laughter

Not all smiles are equal. Smiles can be distinguished by their appearance as well as by different functions they serve. This led to theories on types of smiles, which attempt to categorize them according to morphological appearance and functions. A common approach to investigate the morphology of facial expressions, such as smiles, is the Facial Action Coding System (FACS) by Ekman and Friesen (1976). It is an anatomically based system that divides facial expressions into the involved muscle groups. They are called Action Units (AUs). The present work uses the FACS as a guideline to describe facial expressions.

On a basic level, smiles can be categorized into two types: Duchenne and non-Duchenne smiles – named after the anatomist Duchenne de Boulogne who first discovered the difference (Ekman, 1989). His findings were later confirmed by Ekman and colleagues in multiple studies (Ekman & Friesen, 1982; Frank et al., 1993, e.g.). Duchenne smiles involve two muscle groups: Firstly, the zygomatic major (AU12), referred to as lip corner puller. Secondly, the orbicularis oculi muscles – the muscles surrounding the eyes (AU6), also called Duchenne marker (Ekman & Friesen, 1976, 1982). Their activation causes laugh lines to appear around the eyes. Ekman,

Roper, et al. (1980) found that a majority of people are unable to voluntarily activate the orbicularis oculi. That is, generally, Duchenne smiles are produced automatically and genuinely as a result of internally experienced emotions. They are commonly assumed to be a signal of happiness or enjoyment (Hess et al., 2002). Thus, this type of smile is also called felt, enjoyment, genuine, spontaneous or authentic (Ambadar et al., 2009; Ekman & Friesen, 1982). Non-Duchenne smiles involve only the lip corner puller (AU12). They are also termed unfelt, false, non-enjoyment, social, deliberate, voluntary, controlled, forced, or masking (Ambadar et al., 2009; Ekman & Friesen, 1976, 1982). They are perceived as less authentic in western cultures (Thibault et al., 2012). However, also a strong voluntary activation of the lip corner puller leads to the cheeks being pushed up which results in a Duchenne expression (Messinger et al., 2008). That is, it is harder to distinguish felt from false smiles, when the smile is very strong (Ekman & Friesen, 1982). Accordingly, stronger smiles are perceived as more authentic (Korb et al., 2014). Also, there is increasing evidence showing that both Duchenne and non-Duchenne smiles can be produced voluntarily and spontaneously, which contradicts the presented assumptions on Duchenne smiles as typical signals of experienced positive emotions (Krumhuber & Manstead, 2009; Schmidt et al., 2009; Schmidt & Cohn, 2001; Smith et al., 1996). Some studies show that Duchenne smiles can serve social functions (Hess & Bourgeois, 2010; Mehu et al., 2007, e.g.).

The concept of laughter is tightly related to the concept of smile. Often, smiles merge into laughter and vice verca (Pollio et al., 1972). In laughter, the same action units as in smiling are activated, but typically with stronger intensity and longer duration. In addition to the nonverbal signals, laughter is characterized by accompanying laughter vocalization or audible respiration sounds (Ruch, 1997). As in felt smiles, in felt spontaneous laughter, the lip corner puller and the muscles surrounding the eyes are activated. It is also called emotional laughter as it reflects the experience of positive emotions. In false voluntary laughter, the latter are not included – just as in false smiles. It aims at signaling others that positive emotions are experienced, while in fact, they are not (Ruch & Ekman, 2001). According to Ruch (1992), smiles and laughter can be viewed as different degrees of enjoyment instead of separate concepts. Ruch (1997) investigated smiles and laughter as a unified concept in categories of enjoyment and non-enjoyment displays. Due to the close relationship of smile and laughter, this work views laughter as a special case of smile.

Consequentially, laughter might not always be separately mentioned.

Ekman and Wiltschek (1989) describes eighteen different types of smiles. It is the largest coherent categorization system of smiles in scientific literature. It presents smiles as representatives of internal emotional experiences and as social signals. Sixteen of Ekman's types are presented in the following paragraphs, classified according to their functions. Two types irrelevant to the present topic are excluded. Further theories and evidence by other authors are presented, some of them contradictory to Ekman's assumptions and to what was presented so far.

Representative functions of smiles. Eleven of Ekman's smile types, described in the following, are associated to or represent a certain emotional experience Ekman and Wiltschek (1989).

Felt smiles occur due to uncontrollable genuine positive emotions. They are categorized as enjoyment smiles. In line with the description of the Duchenne smiles above, they are characterized by an activation of the lip corner puller and the muscles surrounding the eyes. The more intense the emotion, the more intense and longer the smile. *Dampened smiles* occur also due to actual experienced enjoyment. As such, they are a kind of felt smiles and typically activate the muscles around the eyes. However, they involve an effort to hide those emotions or make them appear less intense by keeping the emotional expression or experience under control. In addition to pulling the lip corner up, this may involve pressing the lips together (AU24), tightening the lip corners, referred to as dimpler (AU14), or pulling down the lip corners, referred to as lip corner depressor (AU15). Ambadar et al. (2009) call this group of facial movements smile controls and include also the chin raiser (AU17).

Some smiles are not related to positive but to negative emotions. They can be labeled non-enjoyment smiles, such as the following three (Ekman & Wiltschek, 1989). *Miserable smiles* are a signal of currently experienced negative emotions such as sadness. Individuals do not attempt to hide those negative emotions but rather expose and acknowledge them with this expression. The miserable smile shows that one is not resisting but accepting the misery, in a sense of bearing it with a smile. Often they are asymmetrical. They may also complement or immediately follow an expression of negative emotions. They can appear similar to dampened smiles. The difference is that miserable smiles do not involve the muscle surrounding the eyes. *Contempt smiles* are characterized by lifted and tightened lip corners (AU12 and AU14).

Contempt is specifically characterized by asymmetry so that only one side of the face may be involved in this expression. *Fearful smiles* are, in fact, not really smiles. When experiencing fear, a facial expression that resembles a smile may occur. The lip corner are pulled outward towards the ears, which results in a rather rectangular shape of the mouth that can be mistaken for a smile. Fear shows in widened eyes and lifted eyebrows which pull together. *Embarrassment smiles* are characterized by avoiding eye contact with the other, in whose presence an embarrassing event occurred. The gaze is directed down or sideways during a felt smile, which may be dampened. This may be accompanied by briefly lifting the chin boss. According to Keltner (1995), smiles associated with experienced embarrassment are characterized by gaze and head aversion, pressed lips, and touching the face.

One smile can also represent two or more different simultaneous emotions, both positive and negative. Ekman and Wiltschek (1989) describe the five most common emotional blends. *Enjoyable-anger smiles* occur when a person enjoys being angry. It may be also called cruel or sadistic smile. In addition to a felt smile, they typically involve narrowed lips and may be accompanied by a raised upper lip and by expressions of anger, such as lowered and narrowed eyebrows. *Enjoyable-contempt smiles* represent enjoyment of feelings of contempt. It appears as a combination of the felt smile and expressions of contempt, such as tightened lip corners. *Enjoyable-fear smiles* show in a combination of the felt smile and expressions of fear, such as widened eyes and lifted eyebrows which pull together. *Enjoyable-excitement smiles* combine felt smiles with expressions of excitement such as raised upper eyelids. They are similar to *Enjoyable-surprise smiles* where, in addition, the brows are raised and the jaw dropped.

Interpersonal functions of smiles. The following four of Ekman's smile types all have the same appearance but serve different social functions. Those social smiles are generated consciously, involve usually the lip corner puller (without the muscles surrounding the eyes) and are often asymmetric. *Qualifier smiles* intend to reduce the harshness of an unpleasant or critical statement. They are displayed deliberately and abruptly. Often, they are accompanied by nodding and a head tilt which results in looking down at the recipient. Typically, they force the recipient to smile back in turn. *Compliance smiles* signal that one is willing to accept an undesired fate. It looks similar to the qualifier smile, but does not involve a tilted head. Instead, it may involve briefly raised eyebrows, sighing or flinching. *Coordination smiles* serve as

regulators in social interactions, signaling courtesy and cooperation. They are used to unobtrusively indicate agreement, understanding, behavioral intentions, and appreciation of others' appropriate behavior. Characteristic is a slight, usually asymmetrical activation of the lip corner puller. The muscles around the eyes are not involved. *Listener response smiles* are a special case of coordination smiles, used to signal a speaking person that everything is understood and encourage him or her to continue. Those social smiles may be replaced by a felt (Duchenne) smile, when genuine enjoyment is involved. One may enjoy giving a qualifying message, complying, coordinating, or listening (Ekman & Wiltschek, 1989).

Hess and Bourgeois (2010) conducted a study where they manipulated emotional context and social context. For the emotional context, one of two emotions was made salient: anger or happiness. For the social context, participants either interacted with a person of different or equal social status. Generally, Duchenne smiles prevailed. Non-Duchenne smiles occured only rarely, even in a context where anger was salient. That is, people were able to smile in a believable genuine way independently of the context the social interaction took place in. Their results showed also that Duchenne smiles occured more frequently in social interactions with status differences, independent of the emotional context. That is, in situations where individuals of different social status interact, Duchenne smiles might not necessarily reflect a genuine positive emotion. Instead, it is likely that they can be used as a tool to influence social interactions and thus serve a certain social function. An example situation where interaction partners have different social status is the job interview, where usually a higher social position is attributed to the interviewer.

Mehu et al. (2007) showed that Duchenne smiles play an important role in social situations that require cooperation and generosity. Moreover, in this study, Duchenne smiles were not associated with internal experiences of positive emotions. That suggests that Duchenne smiles can be used as a tool to regulate relationships and enhance cooperation. The results of Hess and Bourgeois (2010) and Mehu et al. (2007) contradict previously presented theories and research on Duchenne smiles.

Smiles and laughter can also be used to signal *appeasement* and *reduce conflict* – a social function not represented in Ekman's smile types (Ekman & Wiltschek, 1989). Appeasement smiles seem to have their roots deep in human evolution. Primate research has shown that primates use an expression of bared teeth, which appears as the equivalent to human smiles, to

signal appeasement (Preuschoft, 1992; Van Hooff, 1972). They use laughter to maintain interactions and strengthen relationships (Ross & Zimmermann, 2009). Mauersberger and Hess (2019) show that smiling can help to enhance interaction quality despite an ongoing argument. In a study by Ikuta (1999), more smiles were observed in conflict-situations than in non-conflict situations. The results were explained with smiles serving a conflict reducing function. Also, people that are accused of something are treated with greater indulgence when they smile (LaFrance & Hecht, 1995) which hints towards an appeasing effect of smiling. Wood and Niedenthal (2018) describe the appeasing and conflict reducing function of laughter as *affiliation laughter*, which often occurs at the end of critical statements (Provine, 1993). Appeasement smiles often accompany embarrassing situations and apologies (Preuschoft & van Hooff, 1997). That is, Ekman's embarrassment smiles might as well be connected to an appeasing function.

There is evidence on another interpersonal function which can be viewed as a counterpart to appeasement smiles – *dominance* smiles. Empirical data suggests that smiling faces are perceived as more dominant than non-smiling faces. Interestingly, also strong Duchenne smiles were shown to signal dominance (Hess et al., 1997; Knutson, 1996; Senior et al., 1999). As described, Duchenne smiles are often associated with happiness. Situations in which dominance is important, however, are not expected to be associated with happiness. This supports the assumption that Duchenne smiles may be not solely a signal of happiness but may as well serve social functions. Dominance laughter can be used to signal disapproval and status superiority without directly harming the relationship (Boxer & Cortés-Conde, 1997; Grammer & Eibl-Eibesfeldt, 1990). Conversely, some studies show higher dominance to be associated with less smiling (Dabbs, 1997; Keating et al., 1981).

According to Hess et al. (2002), appeasement and dominance are the most important functions of smiles. Interestingly, these two functions seem to reflect in the dominance-submissiveness dimension of the *pleasure-arousability-dominance (PAD) model* of emotional states by Mehrabian (1996). The PAD model presents dominance and submissiveness as opposite poles of one dimension. The dimension ranges from feelings of a lack of influence and control over a situation, reflected by the submissiveness pole, to feelings of influence and control over the situation, represented by the dominance pole. Submissiveness is connected to feelings of fear, anxiety and loneliness while dominance is characterized by feelings of anger,

boldness and relaxation (Mehrabian, 1996; Russell & Mehrabian, 1977). In view of the PAD model, dominant smiles might have a goal of gaining or signaling control over a social situation. Appeasing smiles, on the other hand, may signal submissiveness and may be a result of fear. That two functions of smiles seem to be representatives of counterparts on a dimension of emotional states illustrates the diversity and broadness of smiles and their functions.

Situations of social discomfort, such as shameful situations, are one of the main contexts that elicit laughter (Glenn & Holt, 2013; Jefferson, 1984; Khudyakova & Bergelson, 2015, e.g.). Laughing in a shameful context can signal to others that one is coping with the situation in a positive way and that the situation is not taken too seriously (Devillers & Vidrascu, 2007; Norrick, 2010; Panksepp, 2000). It can facilitate a positive appraisal of the situation, in line with the emotion regulation strategy Cognitive Change introduced in section 2.1. In addition, laughter can suggest to the interaction partner to view the situation more positively, as well (Devillers & Vidrascu, 2007; Norrick, 2010; Panksepp, 2000). This may help to make a self-confident impression and to sustain social reputation.

False smiles intend to convince others that the smiling person is experiencing positive emotions while, in fact, no particular emotions or negative emotions are experienced. When no particular emotion is experienced but a smile is used to feign positive emotions, it is called *phony smile*. In the case of negative emotions, false smiles are used to mask them. Thus, they are called *masking smile* (Ekman & Friesen, 1982). Ekman and Wiltschek (1989) label false smiles as smiles that lie. The ability to detect this lie varies dramatically among humans. When rating whether a smile is felt or false, accuracy rates range from random chance to 100% (Ekman et al., 1997; Ekman & O'Sullivan, 1991; Frank et al., 1993). The reasons for this remain unclear (Manera et al., 2011). In those studies, participants rated smiles spontaneously based on subjective impressions. Recognition accuracy might be increased when applying a systematic approach such as the FACS (Ekman & Friesen, 1976). It is possible to produce a false smile that is morphologically indistinguishable from a felt Duchenne smile, although this should be rather rare (Ekman & Friesen, 1982; Ekman, Roper, et al., 1980). Ekman and Friesen (1982) deems phony smiles to be more successful in this regard, as no particular emotion is experienced that could lead to contradictory expressions that have to be covered up, like in masking smiles. A few clues may distinguish fake smiles from authentic smiles: Asymmetry, no involvement of the

muscles around the eyes, inappropriate offset time (abrupt or stepped decrease), and signs of the masked emotion visible in the face. Ruch (1997) presents possible morphological features of smiles and laughter that are not based on a genuine experience of enjoyment. In addition to the aspects of false smiles that Ekman and Wiltschek (1989) describe, he involves the following two. First, activation of the caninus muscle, referred to as cheek puffer (AU13), which results in the lip corner pointing upward while the cheeks appear puffed. Second, activation of the buccinator muscle, referred to as dimpler (AU14), which forms dimples at the corners of the mouth. The present study, using the FACS as a basis, aims at gathering new knowledge about smiles, which could help to understand how false smiles can be recognized.

Taken together, those finding and theories support the social function of smiles and laughter. In addition to interpersonal regulation, there is evidence that smiles and laughter can also be intrapersonal emotion regulation strategies.

Intrapersonal functions of smiles. As described by Nathanson (1994), shame can be regulated by replacing it with a positive emotion, showing in expressions of enjoyment. Emotional expressions that do not match the currently experienced emotion or emotional valence of the context can be called dimorphous expressions. They are assumed to regulate emotions (Aragón et al., 2015). The display of dimorphous expressions such as positive emotional expressions in negative situations can be explained with the facial feedback hypothesis. It postulates that facial expressions have the potential to evoke the emotion which the displayed expression is typically associated with. That is, smiling and laughing may induce positive emotions in the smiling or laughing individual (Foley et al., 2002; Morreall, 1982; Neuhoff & Schaefer, 2002). The undoing hypothesis holds a similar assumption. Due to their association with positive emotions, Duchenne expressions are assumed to undo harmful physiological and psychical effects of negative emotions (Fredrickson, 1998, 2001; Keltner & Bonanno, 1997). This hypothesis could be supported in a row of studies. A lab study by Fredrickson and Levenson (1998) showed that negative effects of fear, induced by a film, on the cardiovascular system could be compensated through a dimorphous expression, namely spontaneously smiling during the film. However, they did not differentiate between Duchenne and non-Duchenne smiles. Similar results were found when anxiety was induced through a speech preparation task. Subsequently, participants watched a film inducing positive, negative, or no specific emotions.

Films inducing positive emotions compensated the negative cardiovascular effects of anxiety (Fredrickson et al., 2000). Although the authors did not capture smiles or laughter, they were likely evoked by the positive films. A naturalistic study by Keltner and Bonanno (1997) showed that Duchenne expressions, especially Duchenne laughter, help to regulate negative emotions due to the death of a spouse. Participants who laughed and smiled genuinely during an interview about the bereavement could regulate negative emotions more effectively. They reported reduced distress and anger and increased enjoyment after the interview. This effect did not occur when only non-Duchenne expressions were displayed. Also Ruch and Ekman (2001) postulate that Duchenne laughter can help to cope with unpleasant situations or feelings. They explain that while laughing, self-attention is reduced. It can be regained through voluntary attempts to suppress laughter. That is, spontaneous unrestricted laughter can promote emotion regulation. When shame is elicited, a high amount of attention is directed at the self (Izard, 1977). Laughter could help to regulate shame by reducing this attention for the duration of the laughter episode.

In sum, smiles and laughter were found to serve both inter- and intrapersonal functions as well as representative functions. They can represent certain emotional states but often they serve social functions and regulate relationships and emotions. There are conflicting theories and evidence on Duchenne and non-Duchenne smiles. The question in which contexts they can occur and which functions they serve seems unresolved. Traditionally, Duchenne smiles were assumed to represent a positive emotional state while non-Duchenne smiles were assumed to serve social functions. However, there is evidence that also Duchenne smiles can serve interpersonal functions and that they are involved in emotion regulation processes.

Given the presented theories and empirical evidence, 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 it. This supports the assumption that they are relevant phenomena occurring in and contributing to negative situations eliciting shame and shame regulation. As shame is a highly complex emotion where a one-to-one mapping of facial expressions is not possible, they may come in various forms, exceeding existing theories on smile types. Also, they may serve a variety of functions, such as inter- and intrapersonal regulation. They could be connected to Nathanson's shame regulation strategies (Nathanson, 1994). Schneeberger, Hladký, et al. (2021)

investigated those strategies in a qualitative study. In addition to Nathanson's four, they found 15 strategies that could not be categorized given existing theories. In this study as well as a study that used a similar shame-eliciting setup, smiles and laughter were unexpectedly observed during situations that were confirmed to elicit shame (Schneeberger et al., 2019; Scholtes, 2019). As those studies aimed at other well-established shame signals, smiles and laughter were not investigated. However, it can be considered that they were connected to shame regulation investigated by Schneeberger, Hladký, et al. (2021).

Due to the complexity of the smile phenomenon, neither the presented collection of smile types nor any other is exhaustive, which also Ekman and Wiltschek (1989) acknowledge. Some theories on why and in what form smiles occur in shameful situation exist. However, there is no coherent empirical evidence on the topic. Therefore, this work is dedicated to discovering the functions smiles serve in the context of shame and linking them to the morphology of smiles. To account for the diverging theories and results, that indicate the diversity and multifaceted nature of shame and smile, the present study investigates them in an explorative mixed method approach.

2.4 Practical application in Affective Computing

The present work is associated to the field of Affective Computing – a multidisciplinary research area including computer science, psychology, and cognitive science. Affective Computing researchers study and develop systems and devices that recognize, interpret and simulate human affects. For that, understanding users' emotions is crucial. Situations in which expressions do not reflect the internal affective state of an individual pose a major challenge for computational emotion recognition and generation.

2.4.1 Automatic recognition and generation of emotional expressions

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 Baltrušaitis et al. (2015) and Zhang et al. (2018). Baltrusaitis et al. (2018) introduced the facial behavior analysis software OpenFace that integrates facial action units, facial landmarks, and eye gaze as data sources. Kartynnik et al. (2019) 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 Picard et al. (2001), Soleymani et al. (2012), and Valstar et al. (2016). Computational models of emotions are presented by Conati and Maclaren (2009) and Marsella et al. (2010). Belkaid and Sabouret (2014), and Gebhard, Schneeberger, Baur, et al. (2018) aim to combine both, emotion recognition and modeling 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 training systems that aim at enhancing social skills (DeVault et al., 2014; Gebhard, Schneeberger, André, et al., 2018; Gebhard et al., 2019; Hoque et al., 2013; Schneeberger, Sauerwein, et al., 2021).

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. Many approaches rely on the interpretation of observable emotional expression as mapped to basic emotions described by Ekman (1993). It is important, though, to differentiate between various causes for smiles and various morphological patterns. 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 (Feldman Barrett, 2017). 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 Gebhard et al. (2019), misinterpreting users' emotional state due to 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, functions of smiles are investigated and linked to their morphological appearance. The resulting information can be used to improve computational

social signal interpretation and computational emotion models.

2.4.2 Emotions and social behavior towards computers

Computer systems are increasingly optimized for natural social interactions with humans and even attempt to recognize and interpret their emotions. Consequentially, there is an increased research effort to investigate human-computer interactions regarding emotional and social aspects. A row of studies exists that show evidence on humans experiencing emotions and showing social behavior when interacting with computers and robots, some of which are illustrated in the following.

A study by Nass and Moon (2000) shows evidence about courtesy towards computers and transfer of social stereotypes regarding gender and ethnic origin to computers when a generated voice or a virtual face is designed accordingly. These social behaviors are explained by learned schemata according to which humans respond when certain incentives activate them. If appropriate incentives are given by a computer, due to the learned schema, humans react automatically in a socially adequate way (Nass & Moon, 2000). Furthermore, it is possible to establish and maintain a trust-, affection- and respect-based relationship between a human and a virtual agent with human-like appearance and socially adequate verbal as well as non-verbal behavior (Bickmore & Picard, 2005). Accordingly, frustrated people that get empathic support by a virtual agent report reduction of negative emotions. Interestingly, this effect shows with an agent without human appearance and voice (Klein et al., 2002). In another study, over 50% of participants interacting with a robot reported to feel an emotional connection to the robot and to view it as a companion or even as family member (Friedman et al., 2003). S. Kim et al. (2021) found that autistic children show prosocial behavior in a therapeutic setting with a robot. They show that smiling is a signal of prosocial behavior towards robots. Shank et al. (2019) report that emotions like surprise, happiness, disappointment and unease occur in interaction with virtual agents with artificial intelligence, especially if the virtual agent is presented to hold a crucial social role or acts in a human-like way. A crucial social role can for example be a job interviewer that decides upon your employment in a desired position.

As described in section 2.2, shame is characterized as an emotion that arises solely in interpersonal situations. The requirement for experiencing shame is therefore the presence of a

counterpart. Studies in the field of computer science found evidence that virtual agents and robots can represent a social counterpart and elicit shame like humans do. Bartneck et al. (2010) and Menne (2017) show that humans can experience shame in the presence of a humanoid robot. During a health examination without the presence of another human, participants in Bartneck et al. (2010) showed significantly more shame in front of a humanoid robot than in front of a technical box. In Menne (2017), shame-eliciting tasks had the same effect independent of whether they were performed in front and on orders of a human or a humanoid robot.

Schneeberger et al. (2019) showed that a virtual agent in the role of a job interviewer elicits shame like humans do. In a 2 x 2 between-subjects design, 103 participants were distributed over four conditions. Within a job interview role play, they experienced either five shame-eliciting or neutral situations with either a human or a virtual agent as interviewer. For the role play, Schneeberger et al. (2019) developed realistic shame-eliciting statements of job interviewers that were evaluated in a qualitative pre-study with 26 participants. Schneeberger et al. investigated behavioral signals of shame and shame regulation as well as self-reported uneasiness and discomfort in the situations. Results from both observational and questionnaire data indicated that participants experienced a higher level of shame in the shame-eliciting interview compared to the neutral interview. In the shame-eliciting interview, both data sources indicated no significant difference of the level of experienced shame between the human interviewer condition and the virtual interviewer condition. A short version of this role play (with two shame-eliciting statements) was used in a mixed-methods study by Schneeberger, Hladký, et al. (2021). Ten participants took part in a job interview role play with a virtual agent. In questionnaires, participants reported significantly higher experienced shame after the job interview than before. After the job interview, they elaborated on their shame experience and applied shame regulation during the job interview in a qualitative post-interview. Three proficient raters analyzed recordings of the job interviews and the post-interviews and confirmed that in 18 out of 20 situations, shame was induced. Shame was rated as induced based on an explicit mention of shame experience, descriptions of applied shame regulation strategy and observable shame signals. The present study uses both studies by Schneeberger et al. as basis.

2.5 Qualitative research and mixed methods

Qualitative research focuses on natural phenomena of everyday life, such as emotions and behavior. Instead of being strictly guided by existing theories, it aims at discovering theoretically new things. Typically, empirical phenomena are used as starting points for gaining new knowledge that may be generalized and lead to new theories. Due to this theoretical openness, the qualitative research process operates without concrete a-priori hypotheses. Instead, it can be guided by open research questions (Breuer, 2020). Qualitative methods of data collection and analysis often require a big investment of time and focused attention of the researchers, as investigations are usually explorative, detailed and aim at collecting all information relevant to understanding the studied phenomena. Data collection methods include, for example, interviews, observations, introspection and role plays. A prominent example of data analysis is the qualitative content analysis (Mey & Mruck, 2010). A core aspect of qualitative research is the process of simultaneous data collection and data analysis in which both influence each other. As such, data collection and analysis are strongly intertwined, so that a strict separation is not always feasible (Sandelowski, 2000).

Many authors recommend a problem-oriented method integration which allows flexibility regarding the combination of methods that best suit the given research question and data (Bethmann, 2020; Johnson et al., 2007; Sandelowski, 2000, e.g.). Accordingly, alongside with quantitative and qualitative, a new research approach is gaining attention – mixed methods research. Mixed methods refers to the combination of elements of qualitative and quantitative research within one study. The combination can refer to underlying scientific theories, the research question, methods of data collection, analysis and interpretation. It merges two traditional research approaches to optimize gain of knowledge and create results that capture a more complete and accurate picture of reality. Mixed methods studies can include quantitative and qualitative approaches in equal shares or they can be qualitative or quantitative dominant (Johnson et al., 2007). Greene et al. (1989) describe five functions of the mixed methods approach. Firstly, it can serve a mutual *validation* of results from multiple methods. Furthermore, a *complementary* function refers to obtaining a more comprehensive picture of the studied phenomenon, as each method investigates it from a different perspective. Similarly, the

function of *expansion* concerns the investigation of different aspects of a phenomenon with different methods. Diverging results can initiate new considerations on the phenomenon, which can motivate further research – a function called *initiation*. The function of *development* refers to a case where one method enables the investigation of a phenomenon with another method. For example, an initial qualitative exploration of an understudied phenomenon can serve as a basis to develop a questionnaire about it.

An approach characterized by its flexibility regarding commitment to a theory and regarding the use of methods is called *qualitative descriptive studies*. A combination of research methods – that is, mixed methods – is recommended. Especially techniques that capture a phenomenon in a natural way, as if not under observation, are described as favorable. Central data collection methods are semi-structured interviews and behavioral observations. The main data analysis method is qualitative content analysis (Sandelowski, 2000). The goal of qualitative descriptive studies is a descriptive summary of the information extracted from the data. The form in which the data is arranged and presented is determined by the characteristics of the specific study and data and must be determined by the researcher. Purpose-oriented sampling techniques like maximum variation sampling are characteristic. Its goal is a sample that is heterogeneous regarding demographics and/or the studied phenomena. It allows the exploration of both interpersonally and individually occurring manifestations of the studied phenomena (Sandelowski, 2000). Qualitative descriptive studies are recommended for researching understudied phenomena in their natural condition (H. Kim et al., 2017; Sandelowski, 2000). The present study researches the phenomena of smiles and laughter occurring in shameful situations. As described, there is lack of coherent research on this topic. Emotions can only be fully captured when observed in their natural condition, as authentic emotions only occur in authentic settings. Thus, the approach of qualitative descriptive studies is suited for the topic at hand. The core methods of the present study are behavioral observations, semi-structured interviews and qualitative content analysis. As such, it can be viewed as a qualitative dominant mixed methods study. Characteristics of those core methods are described in the following.

2.5.1 Behavioral observations

Observations form a basic method of empirical sciences. Their application is particularly recommended for complex phenomena such as nonverbal behavior in social interactions. Behavioral observations can be applied directly in a situation or to recorded video material (Flick, 2013; Kochinka, 2010). The present study investigated the nonverbal behaviors of smiles and laughter during a social interaction, which were video recorded. For that, behavioral observations are a suited research method. They can be structured or unstructured (Kochinka, 2010). In this study, observations were structured – more specifically, morphologically segmented based on the FACS (Ekman & Friesen, 1976). In morphological segmentation, the behavioral observation is systematically structured by the observer focusing on specific action units. Morphological aspects involved in smiles occurring in negative situations were selected for investigation based on the reviewed literature. They are illustrated in table 4 in section 5.

2.5.2 Semi-structured interviews

For qualitative data like internal experience, the interview – especially in semi-structured form – is an appropriate investigation method. It is the most used interview style for qualitative data (DiCicco-Bloom & Crabtree, 2006). Semi-structured interviews are characterized by their flexibility and thoroughness. Open questions allow an exploration of the topic that may bring up yet unconsidered aspects. As such, they allow a deep understanding of the investigated phenomenon. Moreover, this interview style gives space for reciprocity and the establishment of positive rapport between interviewer and interviewee. A core strength is that at the same time, it provides a structuring guideline for the interviewer. This guideline ensures that all important aspects are covered (Galletta, 2013) and the comparability of results (Polit & Beck, 2009). For gaining information about internal experiences, semi-structured interviews are especially suited, as the collected data is rather personal, and retrieving it requires a careful and complex inquiry approach (Fylan, 2005).

Since this study required participants to reflect on their feelings, thoughts and behavior during shame-eliciting situations, this interview form was chosen as the most appropriate inquiry method. The observation of own mental processes and states is called *introspection*. It can refer to physical, cognitive, voluntary or emotional processes in consciously experienced situations

(Titchener, 1912; Witt, 2010). Introspection data is only accessible to the introspecting individual itself. It can be made accessible for others through *retrospection*. In retrospection, introspection data is recalled as a memory and described in verbal or written form. In this form, introspection data can be subjected to scientific analysis. As such, intro- and retrospection are qualitative methods of data acquisition (Witt, 2010). In this study, video material that shows participants in the situation to be recalled is used to aid retrospection. Intro- and retrospection are facilitated through high *psychological mindedness*. Psychological mindedness refers to the interest and ability to reflect on psychological processes and to see relationships among thoughts, feelings, and actions (Hall, 1992). As such, for investigating internal processes and states as in the present study, a sample with high psychological mindedness is favorable.

2.5.3 Qualitative content analysis

Qualitative content analysis is a flexible form of analyzing verbal and visual data. Its goal is usually a summary of the informational content of this data (Morgan, 1993). A main advocate of qualitative content analysis is Mayring (Flick, 2013). He describes it as a mixed methods approach, as it contains qualitative and quantitative analysis steps. He presents qualitative content analysis as methodologically based on quantitative content analysis and guided by traditional research standards (Mayring, 2014). The techniques of qualitative content analysis represent the most systematic and strongest rule-based forms of qualitatively oriented text analysis approaches. The rules were developed based on psychological and psycho-linguistic theories of text comprehension and processing (Fenzl & Mayring, 2017). Yet, qualitative content analysis is not a rigid instrument. It provides a procedural framework that has to be adapted according to the data and research question at hand (Mayring, 2014). Fenzl and Mayring (2017) developed a software that supports text analysis in scientific projects based on the techniques of qualitative content analysis by Mayring (2014).

Content analysis works with a category system, also called coding system, that is used to label and categorize text passages according to their content. Quantitative content analysis uses a pre-defined, rigid coding system and applies it to the data using a top-down approach. By contrast, in qualitative content analysis it is common to generate the coding system from the data in a bottom-up approach. Also here, a pre-defined coding system can be applied, but it can or

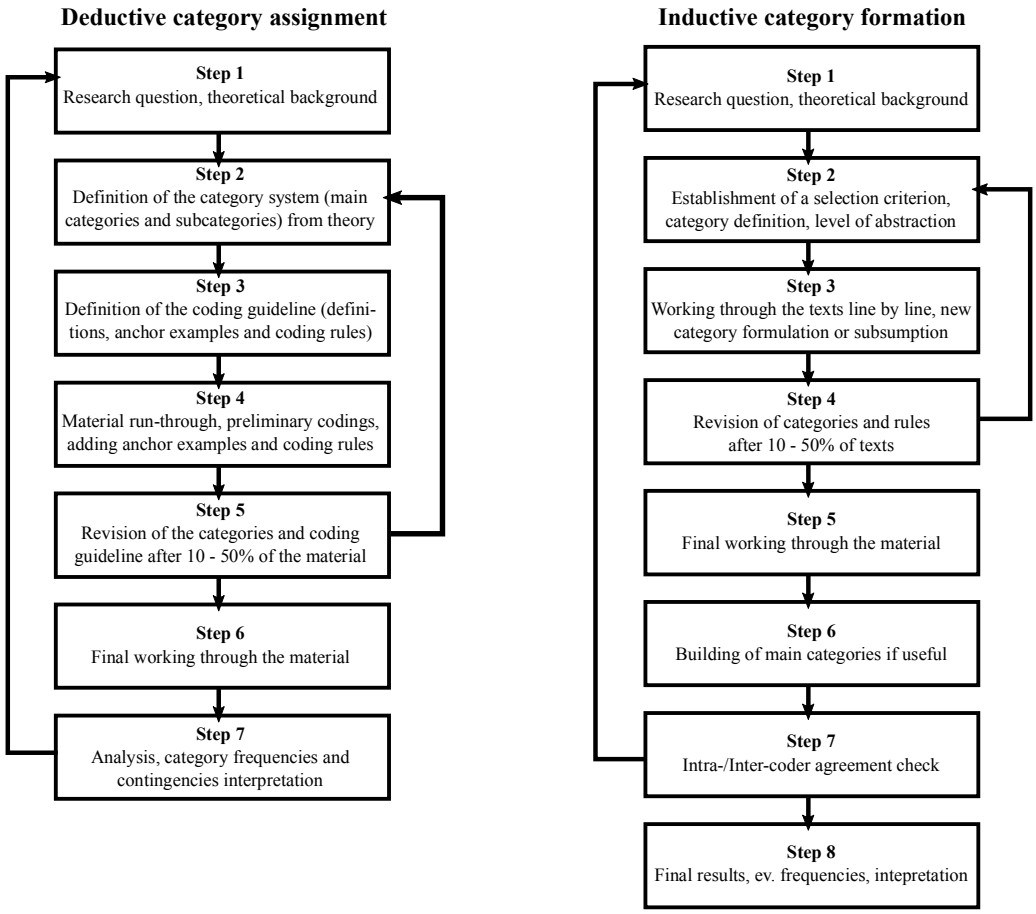
even should be adapted in the course of analysis. This ensures the development of a coding system that fits the data optimally (Sandelowski, 2000). For analyzing the content of a text, it is typically divided into sections, to which the categories are assigned. How the text is sectioned has to be specified upfront by defining so called units of analysis. This procedure ensures systematic and reproducible results and allows an evaluation of inter-coder agreement (Mayring, 2014). Mayring (2014) describes three units of analysis: Coding, context and recording unit. The *coding unit* is the smallest component of material that can be categorized. It indicates the sensitivity of the analysis. Conversely, the *context unit* is the largest component which can be assigned to one category. It determines what context can be considered when deciding what category to apply. The recording unit, also called unit of analysis, defines the portion of the material to which the category system is applied. Context and recording unit may be the same.

Mayring (2014) differentiates three main forms of content analysis. First, *Summary* aims at an abstract overview of the essential contents of the material. Second, *Explication* aims at providing supplementary material for explaining vague text segments. Third, *Structuring* aims at extracting aspects of the material according to pre-defined criteria. He further differentiates nine sub-forms which describe specific procedures of analysis. This work focuses on two sub-forms, described in the following. For the analysis of semi-structured interviews, a summary sub-form is applied – *inductive category formation*. It is faster and more economic than other forms (Mayring, 2014). Inductive category development is one of the most common procedures of qualitative content analysis. The goal is to develop a category system that represents the material in abstract form. It is an explorative data-driven method, meaning that in the course of analysis, the coding system is generated from the data. Before the analysis, a topic of categories that is theoretically founded must be defined. Here, two analyses were performed – one on the topic of shame experience and one on functions of smiles and laughter. Besides the definition of a specific research question and units of analysis, a definition of the selection criterion and the level of abstraction of category names is required before the start of analysis (Fenzl & Mayring, 2017; Mayring, 2014). The analysis process is iterative – the researcher works through the text multiple times. In a first iteration, new categories are formulated. Generated categories are systematically applied to the data. After 10 to 50 percent of the data, when no new categories are found, a second iteration starts from the beginning of the text. Formulated categories and rules

are revised and adjusted where necessary. Categories that were generated in a later stage of the first iteration are checked for a possible applicability to earlier text passages. In a final iteration, all generated categories are applied to the full text material. If feasible, categories are summarized into higher-level categories (Mayring, 2014). Figure 1 shows all steps of inductive category formation (Mayring, 2014, p. 80).

Figure 1

Methods of qualitative content analysis



For analyzing video material, a structuring sub-form is used – *deductive category assignment*. Mayring (2014) describes it as the most crucial form of analysis. Originally, it was developed for text material, but Mayring et al. (2005) show that it is applicable to video material, as well. In this form of analysis, a pre-defined category system is systematically applied to the video material. Two forms of category systems can be used: Nominal (or qualitative) category

systems, contain independent categories, which is the case in the present study. Morphological aspects of smiles form the categories. In ordinal category systems, the categories can be arranged in a certain order. Higher-level categories need to be developed based on theoretical considerations concerning the research question and subdivided into labels which can be applied to the video material. The video sections that fall into the defined categories are labeled and extracted. Before the main analysis, the categories need to be defined and illustrated by anchor samples – examples that represent typical video passages of each category and their labels. Also, coding rules need to be documented. In a trial run-through, the pre-defined category system is revised and adjusted and anchor samples are added. The further process is similar to inductive category formation, described above. Figure 1 shows all steps of deductive category assignment (Mayring, 2014, p. 97).

After the content analytical process is completed, the resulting data is summarized numerically, using descriptive statistics. The frequency of the occurrence of the categories can be analyzed and compared. In quantitative content analysis, a numerical description of the data is the end result. Qualitative content analysis goes beyond this by searching for patterns and regularities in the discovered data. It entails an interpretation of the data by trying to analyze not only the manifest but also the latent content of the data. That is, in a last step, the results are organized and interpreted with regard to the research question (Mayring, 2014; Sandelowski, 2000). This way of analysis can be called *quasi-statistical analysis style* (W. L. Miller & Crabtree, 1992). As described, qualitative content analysis follows a systematic rule-bound step-by-step process, with each step defined in advance. The analysis process is transparent, can be repeated and evaluated intersubjectively and controls for scientific quality criteria. Thereby, qualitative content analysis meets the requirements for being classified as scientific method (Flick, 2013; Mayring, 2014).

The approach of qualitative content analysis is especially suited for the the present study, as it investigates complex empirical phenomena that require a flexible approach. As described, no coherent theory exists on functions of smiles in shameful situations and their morphological appearance. As such, it is sensible to use a bottom-up approach that generates knowledge based on the empirical data. This approach allows the development of a coding system that fits the data of the present study optimally. The analysis of the data based on an individually created

category system ensures that the resulting structure of smile functions and morphological aspects will represent the empirical data in its entirety. Conversely, applying a rigid pre-defined category system could lead to the loss of important information.

3 The present study: Research questions and hypotheses

This work investigated 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?* It emerged from empirical evidence and existing theories that were presented in the previous sections. The most important aspects that lead to specific research questions and hypotheses are summarized in the following. Shame is a highly unpleasant emotion and therefore mostly regulated and not displayed openly. That is, in shameful situations, external emotional expressions do not necessarily reflect the internal emotional experience (Lewis et al., 2008; Nathanson, 1994). In a previous study, smiles and laughter, which are generally associated with the experience of positive emotions, were frequently observed in shameful situations (Schneeberger et al., 2019; Scholtes, 2019). This led to the assumption that they serve a certain function in the this context. As shame is assumed to be mostly regulated in order to protect the self-concept, smiles and laughter could be connected to shame regulation. Nathanson (1994) introduced four shame regulation strategies. Although he does not mention smiles or laughter to be characteristic, a connection is possible. Some authors described smiles and laughter so serve certain emotion regulating or social functions (Ekman & Wiltschek, 1989; Hess & Bourgeois, 2010; Mauersberger & Hess, 2019; Neuhoff & Schaefer, 2002, e.g.). As such, the present study aimed at discovering possible functions of smiles and laughter in shame-eliciting situations.

There are conflicting theories and empirical results on the forms in which smiles appear. For example, Duchenne smiles, involving both the lip corners being pulled up and an activation of the eye muscles that causes wrinkles around the eyes, are traditionally viewed as indicators for enjoyment (Hess et al., 2002). Some authors found Duchenne smiles to occur in contexts where enjoyment is rather unlikely, though. Thus, they might as well serve social functions (Hess & Bourgeois, 2010; Mehu et al., 2007, e.g.). Ekman and Wiltschek (1989) provide a collection of smile types based on their function and appearance. This collection is not exhaustive, though

(Ekman & Wiltschek, 1989). Some theories on the functions and morphological appearance of smiles occurring in the context of shame exist. However, there is no coherent empirical evidence or theory on the topic. Therefore, this work investigates the functions smiles serve in the context of shame and links them to their morphological appearance. As diverging theories and results point out the diversity the phenomena of shame and smile, the present study applies a mixed methods approach. The analysis followed two approaches: *Exploratory* analyses reflect the qualitative part of the study and *confirmatory* analyses test the quantitative data.

Shame has a strong interpersonal nature, so that it occurs mainly when we care about a social interaction partner's opinion of us. The chance for shame to be elicited is higher in evaluative or performance situations that hold potential for social rejection (Hahn, 2001; Izard, 1977). Job interviews are a suitable scenario to elicit shame, as they fulfill those conditions. Thus, in the present study, participants took part in a shame-eliciting job interview role play, like in Schneeberger et al. (2019) and Schneeberger, Hladký, et al. (2021). Before and after the job interview, they assessed their experienced shame via questionnaire (State Shame and Guilt Scale, SSGS by Marschall et al. (1994)). In a qualitative post-interview, they elaborated on smiles and laughter they showed during the job interview and elaborated on the functions they served in that context. For the exploratory analysis, two specific research questions were formulated:

- RQ1: Do smiles and laughter serve different functions in shame-eliciting situations as captured in the post-interview?
- RQ2: Are functions and morphology of smiles interrelated?

As mentioned, smiles and laughter were found to occur in shame-eliciting situations (Schneeberger et al., 2019; Scholtes, 2019), which lead to the supposition that smiles and laughter are associated with the experience of shame or shame regulation processes. Thus, the present study investigated whether higher levels of shame are linked to higher frequency and duration of smiles and laughter with confirmatory analyses. For that, three hypotheses were formulated:

- H1: Self-reported shame, measured with the SSGS questionnaire, will be higher after the job interview role play than before.

- H2a: There is a positive correlation between self-reported elicited shame, measured with the SSGS questionnaire, and frequency of smiles.
- H2b: There is a positive correlation between self-reported elicited shame, measured with the SSGS questionnaire, and duration of smiles.

The formulation in RQ1, H2a and H2b was marginally adjusted compared to the pre-registration for reasons of clarity. Two pre-registered research questions were not included in the final analysis. They were aimed at investigating the interrelation between functions and frequencies as well as duration of smiles. Their investigation was not feasible because smiles that served different functions often merged without clear separation. One smile might span over a longer period of time but at some point in time serve a different function than previously. This point in time could hardly be defined by participants. As such, connecting functions of smiles to frequency and duration was not sensible.

4 Method

The goal of the present work is to investigate the functions of smiles and laughter in shame-eliciting situations and how they reflect in the morphology of smiles and laughter. To do so, participants were observed during a shame-eliciting job interview role play with a virtual agent. They took part in a qualitative semi-structured post-interview that investigated the functions of smiles and laughter showed during the shame-eliciting situations. A mixed-methods design integrating quantitative as well as qualitative methods of data collection and analysis was applied (Giddings & Grant, 2006), guided by the approach of qualitative descriptive studies (Sandelowski, 2000). The 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]. A detailed study protocol was published (Hladký et al., 2021).

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

4.1 Sample

This study applies a mixed methods design. Therefore, different factors influence sample size planning. A priori power analyses were conducted using G*Power (Faul et al., 2007) to determine the minimum sample size for testing the quantitative-oriented hypotheses. For H1, the effect size was assumed based on results of Schneeberger, Hladký, et al. (2021) which found an effect size of $d = 0.85$ when comparing self-reported shame experiences before and after a shame-inducing job interview. Given this effect size, at a significance criterion of $\alpha = .05$, the power analysis indicated a sample size of $N = 17$ for a paired samples t-test. For H2a and H2b, no previous study could be used as a reference. Thus, a small effect size of $d = 0.3$ at a significance criterion of $\alpha = .05$ was assumed. The power analysis indicated a sample size of $N = 267$ for Pearson's correlation.

For qualitative studies, a sample size of one to 30 participants is recommended (B. Fridlund & Hildingh, 2000). As the present study employed a qualitative dominant mixed methods design, it was influenced by considerations of maximum variation (Sandelowski, 2000), saturation sampling (Schneider et al., 2017) and economical factors (time-consuming in-depth qualitative data collection and analysis process). A sample size of $N = 20$ resulted. As each participant experienced three shame-eliciting situations, this resulted in 60 situations included in the analysis. The sample consisted of 16 female and four male particpants aged between 19 and 58 with an average age of $M = 30.75$ ($SD = 11.79$). Seven reported to be in employment currently. On average, participants have experienced $M = 6.6$ ($SD = 4.9$) job interviews before – at least one and at most 20. Nineteen had no prior experience with virtual agents. One reported experience with a virtual chat agent.

The sample consisted of psychology students. Eleven studied at distance-learning and nine at regular universities. 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 is probable. Psychology students in particular were found to have a higher psychological mindedness than students from other fields (Hall, 1992). This is important for the present 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 interview data collection. By including students from both distance-teaching and regular universities, the study benefits from a more heterogeneous sample, as is recommended for qualitative designs (Mason, 2010; Morse, 2000). Students of distance-learning universities have a higher variability in age and other demographic and socio-economic factors ("Hochschulstatistik Fernuniversität in Hagen," 2021, e.g.) than students from regular universities (Statistisches Bundesamt, 2021, e.g.). Participants were rewarded with course credit.

4.2 Experimental setup

This study orients on two previous studies examining shame using a job interview role play with a virtual agent (Schneeberger, Hladký, et al., 2021; Schneeberger et al., 2019).

4.2.1 Job interview role play

According to Freedman (1969), the role playing method uniquely captures real and natural behavior – incomparable to any other research method in this respect. It is specifically recommended for studies examining nonverbal expressions (Sader, 2013), as was the case in the present study. Acceptance and effectiveness of role plays have been demonstrated in several studies. For example, Bosse et al. (2010) showed that communication skills can be effectively trained through role playing. The method enjoyed a high level of acceptance among the participants of the aforementioned study and was subjectively rated as realistic and effective. Schneeberger et al. (2019) used a job interview role play including five shame-eliciting situations. Here, a shortened version of it – with three shame-eliciting situations – is used for economic reasons. The interviewer's statements in the three shame-eliciting situations are presented in table 1. The job interview was fully structured and scripted. The complete original script in German can be found in appendix B.

Table 1

Shame-eliciting situations used in the present study

Situation	Statement of the interviewer
1	A brief question before we start: Where did you get this outfit? Somehow it doesn't really fit you.
2	All the other applicants have already said what you said. You haven't exactly stood out.
3	Well, that answer was not very impressive. I've already heard better from the other applicants.

4.2.2 Technical setup

Schneeberger et al. (2019) conducted the study in a controlled lab setup in person. They used a virtual interviewer with realistic appearance which was presented on a tv screen. The virtual agent could interact autonomously with the participants. Due to the COVID-19 pandemic, the present experiment was conducted online in a home office setup. Experimenter and participants interacted through a video chat software (Microsoft Teams or Skype). During the experiment, the participants experienced a job interview role play with a virtual agent. The virtual agent is depicted in figure 2. Due to limited technical possibilities in the home office setup, an autonomous interaction of the virtual agent like in Schneeberger et al. (2019) could not be implemented. Instead, the interaction with the virtual agent was realized through a Wizard-of-Oz setup, similar to Schneeberger, Hladký, et al. (2021). In the field of Human-Computer-Interaction, the Wizard-of-Oz setup describes an experiment in which a participant assumes to interact with an autonomous system with artificial intelligence. In fact, the functionality of the system is simulated by a human experimenter, the so-called ”wizard” (Martin & Hanington, 2012; Weiss et al., 2009). That is, in the present study, the virtual agent was controlled by the experimenter. She monitored the interaction through the video chat software to time the reactions of the virtual agent with a web application especially designed for this purpose. This setup allowed the simulation of a natural real-time interaction with appropriate turn-taking behavior with the virtual agent. Throughout the experiment, the participants remained unaware

Figure 2

The virtual agent used in the study.

of this setup. Due to a cover story, they assumed the virtual agent to interact autonomously and were not aware that the experimenter monitored and controlled the interaction. For that, the experimenter told that she will not hear nor see them during the job interview and that the participants will be alone with the virtual agent. Participants were told that for the interaction with the virtual agent to work, the video chat software had to stay active, as it was linked to the agent's system – the agent would see and hear them through the video chat software. To make it more believable, the experimenter turned off her webcam and microphone and could be reached only via chat. The virtual agent was presented to the participants on a webpage which they were instructed to put to full-screen mode.

During the job interview, the experimenter was video- and audio-recording the participants via OBS studio, a screen recording software. Those recordings were used in the following post-interview and in the analysis process. The post-interview was recorded in the same way for the later analysis. Participants' consent for the recordings was collected upfront.

4.3 Procedure

Participants were recruited via social media student groups and study platforms. The study was advertised as an opportunity to practice a job interview with a virtual agent. Interested students had to sign up for an one-hour appointment in an online calendar.

Before the experiment, participants received the link and instructions for attending the video chat. They were instructed to prepare themselves and their surroundings in a way that would allow them to put themselves in a job interview situation as realistically as possible. On the day of the experiment, participants entered the video chat room, where they were welcomed by the experimenter and informed about the procedure. They were told they will have a job interview with a female interactive virtual agent towards which they can behave naturally – as if interacting with a human. They were asked to put themselves in the job interview situation as well as possible and imagine that they apply for a position they much desire that matches their personal profile. After that, they filled in an online questionnaire that included consent form, demographic data and items assessing their current shame experience. Next, the experimenter told that she will leave the video chat and the virtual agent will take over to conduct the job interview. She pointed out that the participants will be alone with the virtual agent during the job interview. She instructed them to write her a chat message after they completed the job interview or in case of any problems. In fact, the experimenter stayed in the chat room to control and time the reactions of the virtual agent.

In the job interview, after an introduction, the first shame-eliciting situation occurred 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 got some time to react to this statement, then the interviewer asked to describe their academic and professional background. This was followed by the second shame-eliciting statement: “All the other applicants have already said what you said. You haven’t exactly stood out”. Participants were given some time to react before the interviewer went on describing the offered position. Then, participants were 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 was 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 concluded the job interview and handed over

to the experimenter. The job interview role play took five minutes, on average. Immediately after the job interview, participants filled in an online questionnaire assessing their current shame experience. Afterward, participants returned to the video chat with the experimenter. She revealed that the actual purpose of the study was not concerning the job interview itself but how participants react to and cope with unpleasant situations. The semi-structured post-interview followed which was 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. The post-interview took on average 35 minutes, ranging from 20 and 45 minutes. In the end, participants were debriefed and asked to fill in a short online questionnaire assessing the quality of the post-interview and their openness in the post-interview. The whole procedure took about one hour, on average.

4.4 Methods of data collection

The constructs of smiles and shame experience were focus of investigation. They were represented by five dependent variables: frequency of smiles, duration of smiles, morphology of smiles, functions of smiles, and shame experience. Those variables were captured by three data collection methods: behavioral observation, semi-structured interview, and questionnaires.

4.4.1 Behavioral observations

The first three variables were captured applying behavioral observation techniques to the recorded video material. Subjects of observation were participants in the three shame-eliciting situations described in section 4.2.1 and 4.3. Frequency, duration and morphological aspects of smiles were systematically registered in NOVA – a tool for annotating and analyzing behavior in social interactions (Baur et al., 2013). *Frequency of smiles* was captured by counting instances of smiles of each participant throughout the three shame-eliciting situations. *Duration of smiles* was captured by summing up the seconds in which participants smiled throughout the three shame-eliciting situations. *Morphology of smiles* represents morphological changes in the face that are connected with smiles. They were captured and analyzed in a process of deductive category assignment. As such, in the present study, observations represented a data collection instrument and an analysis method at the same time. Thus, the method of behavioral observations

will be addressed in greater detail in in section 4.5.2. For this study, morphological aspects relevant to negative situations were selected. The basis for this selection was the cited literature on types of smiles and on shame as well as observations in studies using the same shame-eliciting scenarios (Schneeberger, Hladký, et al., 2021; Schneeberger et al., 2019). The anatomical approach of Ekman and Friesen (1976) for describing facial actions was used as a reference. The following aspects were taken into account for the annotation: lip corner puller, eye muscles activation, lip corner tightener, gaze aversion, (Ekman, 1989; Ekman & Friesen, 1982), cheek puffer, dimpler (Ruch, 1997), smile control (lip corner depressor, chin raiser, lip tightener, press lip, suck lip) (Ambadar et al., 2009), symmetry of lip action (Ekman, 1989), intensity (coded as "teeth showing" or "no teeth showing"), and laughter. Here, laughter is not conceptualized as a separate phenomenon but as a type of smile, as they share a common morphological basis (for details, see section 2.3). Therefore, laughter is not always separately mentioned in the course of this work. Additionally, body adaptors were included, which could be touching body or face, as this is associated with shame (Keltner, 1995; Retzinger, 1995).

4.4.2 Semi-structured post-interview

This work aims to investigate functions of smiles in shameful situations and link them to their morphological appearance (see section 4.4.1). Self-reports about experienced shame and functions of smiles were obtained qualitatively in semi-structured post-interviews, conducted by the experimenter. For qualitative data like internal experience, interviews – especially in semi-structured form – are an appropriate investigation method (DiCicco-Bloom & Crabtree, 2006). For the application, guidelines by Schneeberger, Hladký, et al. (2021) and Galletta (2013) were followed. The post-interview followed after the completion of the job interview with the virtual agent. It was divided into three sections, corresponding to the three shame-eliciting situations of the job interview. Each section had two sub-sections. The affect sub-section aimed at information about shame experience. The function sub-section aimed at information about functions of smiles and laughter. In section one of the post-interview, participant and experimenter watched together the video-recording of the participant during the first shame-eliciting situation. For that, the experimenter shared her screen showing the video. After watching the recorded situation, in the affect sub-section, the experimenter asked the participants

to try to remember and tell how they felt in that situation. In the function sub-section, participants were interviewed about every smile, laughter, or a facial expression resembling a smile, they showed in the recorded situation. The video material was used to support the process by working through it repeatedly, as required. This procedure was repeated in section two and three, addressing the second and third shame-eliciting situation respectively.

The interviewer followed an interview guideline to make sure all important questions were covered. This ensured the comparability of interview results. At the same time, there was space for individual variations of the interview which allowed a deeper exploration of participants' internal experiences. Questions were asked in open format, allowing an in-depth understanding of participants' experiences. General questions in the beginning enabled the participants to elaborate more freely on the topic of interest (e.g., "What do you think, why did you smile in that situation?"). They were followed by more specific questions, which were aimed at helping the participants formulate their thoughts and at gaining more detailed information. They were asked adaptively and varied depending on what the participant had already said and depending on what was visible in the video. Additional questions were asked if the participant's answers required or suggested it. The specific questions were generated based on theories on functions of smiles and laughter presented in section 2.3. Examples are:

- ”Did the smile/laughter come automatically or did you smile/laugh intentionally or consciously?”
- ”Did you want to achieve something with your smile/laughter?” or ”What did you want to achieve with the smile/laughter?”
- ”Did you smile/laugh to communicate something to the interviewer or did you rather smile for yourself?”
- ”Did the smile/laughter help you deal with the situation in any way?”
- ”Did you feel the need to smile/laugh?” or ”Did you suppress a smile/laughter?”

In this way, the experimenter guided the participant through the three shame-eliciting situations, so that a possible function was recorded for every instance of smile and laughter. This allowed a connection of the functions with the morphology of smiles during the analysis process. For the a successful interview, establishing positive rapport between experimenter and participant

is essential (DiCicco-Bloom & Crabtree, 2006). The interviewer used well-established nonverbal immediacy behaviors to show interest and engagement by orienting the body toward the interviewee, smiling, showing open postures, and making eye contact – in this case by looking directly into the webcam (Imada & Hakel, 1977). On the verbal level, the interviewer self-disclosed (Collins & Miller, 1994) and elicited an in-group feeling (Fu et al., 2012), for example, by confirming that it would also be difficult for her to talk about internal experiences. To create a relaxed atmosphere from the beginning of the experiment, in which participants would be more likely to talk openly, small talk and off-topic talk was included in the introduction and possible throughout the experiment. Participants were encouraged to speak openly by the experimenter showing interest and appreciation of what is said, for instance, with verbal and non-verbal backchanneling signals (McNaughton et al., 2008). Well-established interviewing techniques like paraphrasing and summarizing of participant's statements were applied. They help establishing rapport and ensure a correct understanding of what was said (Will, 2006).

4.4.3 Questionnaires

Complementary to the qualitative post-interview, the dependent variable shame experience was assessed quantitatively with the *State Shame and Guilt Scale (SSGS)* (Marschall et al., 1994). It is used for the manipulation check. That is, to test whether shame was elicited through the job interview. The SSGS was also originally developed as a manipulation check for shame induction in an experimental study (Marschall, 1997). It captures the momentary (state) experience of shame, guilt and pride. For this study, only the five items for shame experience were taken into account. On a 5-point Likert scale, participants rated to what degree the item statements reflect their current feelings (1 = "not at all" to 5 = "very strongly"). Item examples are "I want to sink into the floor and disappear" and "I feel small". Here, a german translation was used, approved by two experts: A certified German-English translator and a German state examinated English teacher. Marschall et al. (1994) report an internal consistency of α = .89 for the shame subscale in a study with 142 Psychology students. The scale score was computed as mean score of the four items. The participants of the current study were presented with the SSGS questionnaire at two times: They rated their subjective shame experience before and after the job interview role play.

An *evaluation questionnaire* assessed the quality of the post-interview and participants'

openness regarding their internal experience during the job interview. It was created and applied by Schneeberger, Hladký, et al. (2021) in a study setting similar to this one. It consisted of four items – two of them formulated positively (”In the interview I openly said what I felt” and ”The interview was agreeable”) and two formulated negatively (”It was difficult for me to talk about the experienced situation in the interview” and ”I was reluctant to talk about my feelings”). On a 5-point Likert scale, participants rated how much they agreed with the item statements (1 = ”Very strong rejection” to 5 = ”Very strong agreement”). The two negatively formulated items were recoded. Then, all items were averaged to form a mean evaluation score.

4.5 Analysis

This work employs a mixed methods design, involving quantitative as well as qualitative analyses. This approach provides a broader view on the studied constructs by gathering information in diverse ways. It is suited for researching complex social phenomena, as in the present study (Giddings & Grant, 2006). The analysis process is oriented on guidelines by Sandelowski (2000) on qualitative descriptive studies and by Mayring (2014).

4.5.1 Pre-processing of the data

Before an analysis was possible, the raw qualitative data had to be pre-processed. To analyze the contents of the post-interviews, the audio-recordings were transcribed into text first. The transcription process took about one hour per participant. Corresponding to the post-interview, the transcription was divided into three sections with two sub-sections, respectively. As a criterion of quality, a certain system of transcription has to be determined upfront and employed constantly (Mayring, 2014). The transcription procedure followed the *selective protocol* described by Mayring (2014) and recommended by Bethmann (2020) – an economic procedure in which only those parts of the audio recorded interview are transcribed that are relevant for the research question. As described in section 4.4.2, the post-interview included parts which were important for creating a positive atmosphere and rapport but did not serve answering the research question. In some cases, part of participant’s answers were not relevant to the research question and thus did not need to be transcribed. This is due to the semi-structured interview style allowing participants to speak more freely and, in some cases,

due to difficulties to answer the questions directly.

4.5.2 Main analysis

Qualitative content analysis (QCA) was employed to assess whether shame was elicited successfully (manipulation check), whether smiles and laughter serve different functions in shameful situations (RQ1) and whether functions and morphology of smiles are interrelated (RQ2). The process was guided by Mayring (2014). Qualitative content analysis is a standard procedure for analyzing interview transcripts and video material (Sandelowski, 2000). The required data was captured in the semi-structured post-interviews (see section 4.4.2) and by behavioral observation (see section 4.4.1). The analysis process was technically supported by QCAmap – a free software for systematic text analysis based on the techniques of qualitative content analysis available at www.qcamap.org. (Fenzl & Mayring, 2017). The whole analysis process took about three hours per participant.

For the manipulation check, shame experience and functions of smiles were investigated exploratively – they were inductively extracted from the transcribed post-interviews by *inductive category formation* (Mayring, 2014) – a specific technique of qualitative content analysis. An overview is given in section 2.5.3.

The manipulation check is performed both by testing H1 with the SSGS questionnaire and by investigating shame experience qualitatively using QCA. Using both quantitative and qualitative methods serves two functions of mixed methods. Firstly, a more comprehensive picture of shame experience is generated as the two different methods investigate it from different perspectives (complementary function). Secondly, the results of both methods can be validated mutually (validating function) (Greene et al., 1989).

Inductive category formation is recommended for exploring research topics for which exists no sufficient theoretical basis yet and such that benefit from a theoretically open approach to gain novel insights (Mayring, 2014) – as is the case for the research topic at hand, namely functions of smiles and laughter in the specific context of shame. Thus, pre-defining categories or codes for functions of smiles was not feasible. Also, as the concept of shame can be described in many ways using common language, an open approach without pre-defined categories was assumed to benefit the results. As described in section 2.5.3, in the course of analysis, the coding

system was generated from the post-interview data. That is, the text was systematically searched for instances of shame descriptions and functions of smiles. For the latter, 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. In an iterative process, the generated codes were systematically applied to the data. The discovered instances were then structured and checked for similarities and patterns which lead to the formation of categories. Discovered categories may be summarized to higher-level categories. The inductive category formation process is cyclic and iterative, such that categories may be revised when working through the text repeatedly. In the end, the frequencies of categories were described quantitatively. An interpretation of the category system and quantitative results with respect to the research question followed.

The content-analytical units were determined before the analysis, as proposed by Mayring (2014) and required for the use of QCAmap (Fenzl & Mayring, 2017). They were the same for both the manipulation check and RQ1. The *coding unit* was set to be a single word. The *context unit* was defined as the transcribed post-interview of one participant. That is, the whole post-interview material of the participant that is currently analyzed could be taken into account for coding decisions. The reason for this was that sometimes participants addressed a topic that was not relevant of the current interview section, but to a different section. As such, limiting the context unit to a particular section of the text was not suitable. The *recording unit* was defined as the transcribed post-interviews. Through the pre-processing of the data (see section 4.5.1) applying the selective transcription protocol, irrelevant text elements were filtered out beforehand. As such, the whole transcribed text was relevant for the analysis. In addition, the default recording unit in the QCAmap software is fixed to all texts.

As required for inductive category formation, the selection criterion and the level of abstraction of category names were defined in QCAmap before the start of analysis (Mayring, 2014). For the manipulation check analysis, the selection criterion was defined as all references to affects experienced in the specific shame-eliciting situation. For the RQ1 analysis, it was defined as all references to functions of smiles or laughter in the specific shame-eliciting situation, such as descriptions of why they 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 level

of abstraction was defined, for the manipulation check, as participants' descriptions of affects experienced during a situation. For RQ1, it was defined as key points of participants' descriptions referring to functions of smiles or laughter with no details or context needed.

For answering RQ2, first the morphology of smiles was investigated by *deductive category assignment*. Its general process and requirements are described in section 2.5.3. For applying this technique of qualitative content analysis to video material, the example of Mayring et al. (2005) was used as a basis. QCAmap does not yet support video material. Instead, as described in section 4.4.1, NOVA was used. Before the analysis, categories were developed based on theoretical considerations concerning the research question, as described in section 4.4.1. Individual labels, which can be applied to the video material during the annotation process, were assigned to the categories. The theoretical considerations that led to the definition of categories were described in section 2.3. The categories and their labels were illustrated by anchor samples in the form of pictures. In a trial run-through, the pre-defined category system was revised and adjusted and anchor samples were added. A full overview of the resulting annotation scheme will be presented in table 4 in section 5. It shows the categories and their single labels used for annotating the videos, the morphological appearance they represent and, if applicable, the corresponding Action Unit (AU) as described by Ekman and Friesen (1976). Figure 3 in section 5 shows how the annotation looked in NOVA. Based on this annotation scheme, video recordings of the participants in the shameful situations were analyzed regarding the occurrence and morphology of smiles. The video sections that fall into the defined categories were labeled and extracted. The further process is similar to inductive category formation, described above. The content-analytical units were determined before the analysis. The *coding unit* was set to be a single video frame. The *context unit* and *recording unit* was defined as the video recording of single shame-eliciting situations.

After determining the morphological aspects of all smiles displayed in the shame-eliciting situations, they were linked to the functions described for each instance of smile. This was realized by assigning a smile ID to each instance of smile that was addressed in the post-interview and labeling both the post-interview transcriptions and the respective video recording in NOVA with this ID. The functions registered for each smile instance were made available through the qualitative content analysis as described above. A quasi-statistical descriptive analysis style was applied to find patterns in the data, connecting the functions of

smiles to morphological aspects. Specifically, the crosstabs function of IBM SPSS was used to reveal which morphological aspects co-occurred in what frequency with each smile function. The goal was to find and define a structure that reveals how functions of smiles reflect in their appearance.

The hypotheses were tested by statistical analysis. H1 assumed self-reported shame to be higher after the job interview role play than before. A paired samples *t*-test compared the average self-reported shame in the SSGS shame experience pre-questionnaire to the post-questionnaire. This analysis was performed as a manipulation check, to test whether shame was successfully induced in the job-interview role play.

H2a and H2b describe that there is a positive correlation between self-reported shame and frequency as well as duration of smiles. They were addressed by Spearman's correlation. It was operationalized by correlating a variable holding the difference between self-reported shame in the post- and the pre-experimental SSGS questionnaire with frequency of smiles and duration of smiles respectively. These analyses were used to reveal whether the phenomena of shame and smiling are related such that they systematically occur together.

5 Results

The present study employed a mixed methods design. The analysis and results can be divided into two parts. The first part addresses the exploratory analysis, representing the qualitative and major share of the study. The second part refers to confirmatory statistical analyses which represent the quantitative portion of this work. An additional section describes the evaluation of the post-interviews.

5.1 Exploratory analysis

For the qualitative part of the study, the success of experimental manipulation as well as the qualitative research questions (RQ1 and RQ2) were investigated exploratively. For that, the transcribed post-interviews as well as the video recordings of the job interview role plays were subjected to qualitative content analysis.

5.1.1 Manipulation check: Shame experience

For investigating whether shame was elicited successfully, as a manipulation check, descriptions of experienced affect during the three shame-eliciting situations were analyzed using inductive category formation – a form of qualitative content analysis (for more information see section 2.5.3). In this context, the term affect is used to represent all internal experiences participants described, as not all can be classified as emotions. In the affect sub-section of the post-interview, participants were asked how they felt for each of the three experienced shame-eliciting situations separately. As such, descriptions exist for 60 situations in total.

In a first analysis step, 26 level 1 categories were formed based on 160 descriptions of affect in the post-interview material. In a second step, eight main categories (level 2) were formed. The whole category system is presented in table 2.

Often, participants described multiple affects for one situation. The category shame was assigned only if participants mentioned the word shame or words containing shame (e.g., ashamed) or if they confirmed that they experienced shame. Descriptions of affects that are related to shame were categorized based on the theoretical scientific background on shame presented in section 2.2 (e.g., embarrassed, unpleasant and hurt). When participants specifically noted that they were *not* or *rather not* ashamed, it was categorized separately. Besides mentions of shame or shame-related affects, descriptions that reflect Nathanson's shame regulation strategies were found. Other negative or positive affects were described and categorized as well. They are labeled as positive/neutral and negative/neutral because, for example, for surprised, challenged, and relaxed, participant's descriptions could take either neutral or negative respectively positive valence. Some descriptions of negative affect were directed at or related to the interviewer.

The most important results are as follows. Of all affect-related descriptions, 34% were categorized as shame or affects closely related to shame. Descriptions of shame-related affect formed with 23% the largest part. The most prominently mentioned shame-related affect was *unpleasant* – mostly reflecting in descriptions of having an unspecified unpleasant feeling or the situation being unpleasant. Shame itself was mentioned in 11% of descriptions. Nathanson's shame regulation strategies – mostly Attack Other – were found in 21% of descriptions. Negative

affects that are not directly connected to shame were represented in 26% of descriptions, of which 8% were related to or directed at the interviewer – predominantly *angry*. The remaining 18% concerned other negative/neutral affects – mostly *surprised* and *insecure*. Participants mentioned in 10% of descriptions that they were not ashamed. Detailed results are shown in table 2.

5.1.2 Functions of smiles

RQ1 addressed whether smiles and laughter serve different functions in shame-eliciting situations. Similar to the manipulation check, this was investigated by applying content analytical inductive category formation to the function sub-section of the post-interviews.

The analysis showed that, for 97% of smile instances, participants reported various functions their smiles and/or laughter served in the shame-eliciting situations. In total, 30 categories were formed based on 232 text segments representing functions of smiles. The 30 categories were a result of initial categorization and thus are labeled as level 1. Further categorization led to three main categories (level 4), which in turn were organized into eight sub-categories (level 3). One level 3 category was further sub-divided into three level 2 categories. Five text segments described smiles that occurred due to the study situation (e.g., ”In that moment I was figuring what the study probably wants to test”). These segments were excluded from further analysis. An overview of the category system including example quotes of participants is provided in table 3.

The main (level 4) categories are characterized as follows. The category *sign of internal emotion* – in the following referred to as *sign* functions – covers all descriptions of participants about smiles representing a positive or negative internal emotional experience, such as insecurity, anger or shame.

Intrapersonal functions include all descriptions of smiles as manifestations or trigger of internal processes that seemed mostly associated to emotion regulation. Participants described, for example, that smiles helped them to enhance their own well-being or that they smiled in order to devalue the negative situation. *Interpersonal functions* represent all descriptions of smile functions related to the interpersonal relationship between interviewee and interviewer. This category represents a broad variety of sub-functions. It includes smiles being used to regulate the own social status by signaling dominance. Furthermore, smiles served a row of relationship

Table 2

Categories of affect and their frequencies

Described experienced affect		**Frequency**
Level 2	**Level 1**	
Shame-related affect		**37** **23%**
	unpleasant	17
	attacked	11
	inferior	3
	hurt	3
	embarrassed	2
	fear of rejection	1
Shame	ashamed	**18** **11%**
Negative affect concerning other		**14** **8%**
	angry	9
	indifferent/resignating/rejecting	3
	hostile	1
	annoyed	1
Other negative/neutral affect		**29** **18%**
	surprised	16
	insecure	11
	challenged	2
Positive/neutral affect		**7** **4%**
	self-confident	4
	superior	1
	relaxed	1
	amused	1
No/low shame		**17** **10%**
	not ashamed	13
	rather not ashamed	1
	Not ashamed anymore	3
Regulation strategy		**34** **21%**
	Attack Other/Depreciation	27
	Attack Self	7

Note. For main categories (level 2), relative frequencies are shown underneath the absolute frequencies.

Table 3

Categories of functions of smiles.

Category levels of functions of smiles				
4	**3**	**2**	**1**	**Participants' quotes (examples)**
Sign of internal emotion	Sign of negative emotion		sign of insecurity	"I was perplexed and surprised", "I didn't know what to say" "Because I had not expected it at all and was very insecure"
			sign of anger	"Actually I'm super annoyed with her and that's why a pissed pressed smile", "I was furious"
			sign of shame/embarrassment	"I smiled because I was embarrassed" , "I was really a bit embarrassed because I couldn't think of anything else to say"
			unspecified negative feelings	"I don't remember if it was because I didn't feel taken seriously or due to negative emotions"
	Sign of positive emotion		sign of amusement	"Because I found the situation somehow also absurdly funny", "comedy of the situation"
Intrapersonal regulation	Negate/devaluate situation		negate/devaluate situation	"devaluate the provocative question with a smile", "smile away the attack"
	Positive self- focused processes		enhance own well-being	"Smiling makes you feel better", "You have to get some confidence, and tell yourself 'You can do this - smile!'" , "It was to calm myself down", "Instead of being sad now I rather try to make myself happy"
			internal self-regulation	"it was rather regulating and totally spontaneous. It helped me not to escalate" "the short smile was more for me personally. I grinned briefly and quickly tried to regulate myself."
			sign of self-satisfaction	"In the end I am satisfied with what I have said and I smile", "I expected this negative statement and smiled because it turned out I was right"

Note. This table continues on the next page.

Category levels of functions of smiles

4	3	2	1	Participants' quotes (examples)
Interpersonal functions	Social status regulation		show dominance / status	"I put myself very much above her", "to keep the status despite that it was such an attack on my self-esteem", "to show superiority", "to gain back the control"
	Relationship support	General relationship enhancement	appeasement	"I smiled to relax the situation", "I didn't want confrontation, because I wanted the job."
			enhance relationship	"I still have to communicate with the person and smiling always helps quite well"
			display acceptance of other's opinion	"I want to show her 'okay, this is new for me but I gladly accept the criticism'" "with such a smile you also signal that you accept what the other person says and somehow take it seriously for yourself"
		Social display rule	show courtesy	"I just tried to squeeze out a smile, to stay polite", "it's still a job application situation and you smile anyway"
			disagree in socially accepted manner	"I contradicted her but in a socially acceptable way", "By still being able to smile joyfully, I actually show that I can't quite agree with her."
		Positive social self-representation	display ability to deal positively with negative situation	"That I can also show that I can laugh about it, so that I look good in front of her" "I wanted to show her that even in unpleasant situations where I am attacked, I can still keep a polite facial expression and that I try not to take everything so personally"
			display professionalism/ seriousness	"to restraint from saying anything else and remain professional towards the interviewer", "I had to smile but I actually tried to say it seriously, so I tried to suppress it"
			show self-confidence	"I want to demonstrate to her that I won't be influenced by her negative feedback" "I was so self-confident in that moment"
			pos. self-presentation	"to appear sympathetic", "to look good in front of her"
	Relationship rejection/harm		sign of resignation	"there's nothing I can say anymore anyway", "resignation and waiting to see what follows"
			depreciation of other	"I made fun of her and ridiculed the situation", "I felt fooled and could not take it seriously from that point onwards", "that's a pretty despising smile and I also had contemptuous thoughts"
			reject other/ relationship termination	"at some point this 'kiss my ass'-smile appeared", "because I wanted nothing more to do with her"
			provoke/attack other	"it was a provoking smile" ,"the best way to show your teeth to your opponent is to smile"
			highlight faux pas of other/"You hurt me"	"to show that it attacked and hurt me, I suppressed the smile", "I thought back to that I am not taken seriously and am criticized non-stop, so I suppressed the smile"
	Mask internal emotions		mask feeling of discomfort	"I was a bit embarrassed, but I just tried to put on a smile", "I wanted to hide the discomfort", "hide the insecurity"
			mask true (unspecified) feelings	"I kind of show it but not entirely"

Note. This is a continuation of table 3 (see previous page).

supporting functions, which included, for example, signaling appeasement, courtesy and a positive self-presentation in front of the other. Conversely, also relationship rejecting or harming functions were described. For example, smiles were used to express depreciation of the other or as a cue of a tendency to terminate the relationship. A last found interpersonal function of smiles is masking internal (mostly negative) emotions.

Some level 1 categories are more specific than others, which is due to individual differences in participants' descriptions. For example, a rather general level 1 category *positive self-representation in front of other* exists, that is arranged in the similarly named level 2 category *positive social self-presentation*. Such general level 1 categories formed simply due to rather general formulations of participants. In turn, more specific level 1 categories, such as *Display ability to deal positively with negative situation*, resulted from more specific formulations of participants. Both more general and more specific level 1 categories were found to address a similar function, so that they were subsumed under a common higher-level category.

An overall amount of 111 instances of smiles, shown throughout the three shame-eliciting situations, were evaluated regarding their functions. Participants assigned in total 229 functions to the 111 smile instances. That is, they often described multiple functions per smile. Also, multiple function categories could be assigned to one function description.

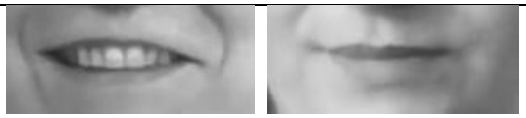
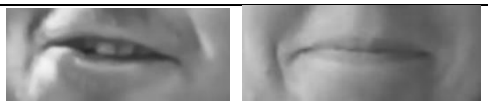
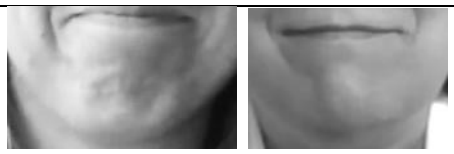
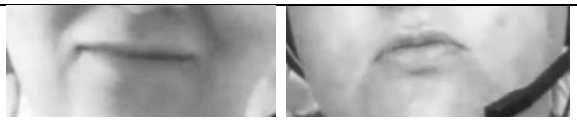
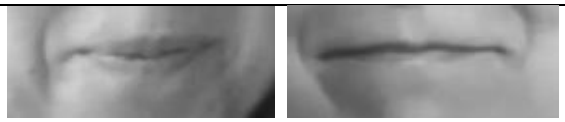
The frequency distribution of level 4 and 3 categories is shown on the left side in table 5. A table showing the complete frequency distribution including all levels can be found in figure A1 (see appendix). The most striking results – in table 5 marked bold – are as follows. The frequency of use was unequally distributed over the three main (level 4) categories. Interpersonal functions were the most represented – 65% of all assigned functions belong to this level 4 category and are distributed over its sub-categories. Of interpersonal functions, the level 3 category *Relationship support* was represented with the highest percentage (23%), followed by the category *Relationship rejection/harm* (19%). Only a relatively small portion of 18% were intrapersonal functions and 17% represented sign functions.

5.1.3 Interrelation of functions and morphology of smiles

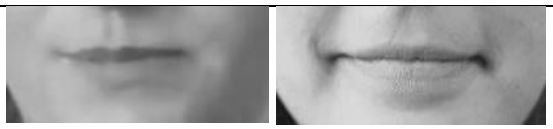
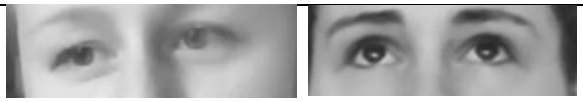
RQ2 addressed the possible interrelation of functions and morphology of smiles. In order to investigate this interrelation, at first, thef morphology of smiles was explored by applying

Table 4

Annotation scheme for morphology of smiles.

Category	Label	Description and morphological appearance	AU
Duchenne	Non-Duchenne	 Only lip corner puller (AU12) without eye muscle activation (AU6)	12
	Duchenne	 lip corner puller (AU12) + eye muscle activation (AU6, causing wrinkles around the eyes)	6 + 12
Symmetry	Non-symmetric	 labeled when lips were in some form asymmetric	
Intensity	Teeth Showing	 labeled when teeth were visible due to smile or laughter. No label indicated that teeth were not visible due to smile or laughter.	12 + 25
Smile Control	Lip Corner Depressor	 also labeled, when present only on one side of the mouth (in that case it was combined with the category Symmetry)	15
	Chin raiser		17
	Purse lip		23
	Press lip		24
	Suck lip		28

Note. This table continues on the next page. Description and morphological appearance serve as anchor samples.

	Other	Other facial actions that appeared to suppress a smile	
Other Lip Action	Cheek Puffer		13
	Dimpler/ Lip Corner Tightener		14
Laughter	Laughter	Any type of audible laughter	
Gaze	Gaze Aversion	 labeled when gaze was averted in any direction	
Body Adaptor	Face Touch Body Touch	 labeled when touching or fidgeting of face or body occurred	
Smile ID	No label, free numerical entry	Category used to link the information about the smiles retrieved from the post-interview to their annotated morphological appearance	

Note. This is a continuation of table 4 (see previous page). Description and morphological appearance serve as anchor samples.

Table 5

Functions of smiles and their co-occurrence with morphological aspects

Functions of smiles			Co-occurrence frequency of morphological aspects with functions of smiles									
Level 4	**Level 3**	**Frequency of function**	**Non-Duchenne**	**Duchenne**	**Asymmetry**	**Intense**	**Smile Control**	**Dimpler**	**Cheek Puffer**	**Laughter**	**Gaze Aversion**	**Body Adaptor**
Sign of internal emotion		40 17%	33 **83%**	14 35%	14 35%	11 28%	23 58%	7 18%	6 15%	11 **28%**	24 60%	3 8%
	Sign of negative emotion	33 14%	27 **82%**	10 30%	10 30%	9 27%	19 58%	4 12%	5 15%	8 24%	19 58%	2 6%
	Sign of positive emotion	7 3%	6	4	4	2	4	3	1	3	5	1
Intrapersonal functions		42 18%	26 **62%**	20 **48%**	17 **40%**	21 **50%**	24 57%	3 7%	6 14%	8 19%	27 64%	2 5%
	Negate/devaluate situation	2 1%	1	0	1	0	3	1	1	1	1	0
	Positive self-focused processes	40 17%	25 63%	20 50%	16 40%	21 53%	21 53%	2 5%	5 13%	7 18%	26 65%	2 5%
Interpersonal functions		150 **65%**	112 **75%**	54 36%	64 **43%**	50 33%	91 **61%**	22 15%	18 12%	30 20%	79 53%	5 3%
	Social status regulation	20 9%	15 75%	6 30%	16 **80%**	5 25%	12 60%	3 15%	2 10%	4 20%	12 60%	1 5%
	Relationship support	54 **23%**	47 87%	16 30%	20 37%	18 33%	29 54%	5 9%	4 7%	10 19%	27 50%	1 2%
	Relationship rejection/harm	45 **19%**	25 **56%**	21 **47%**	17 38%	17 38%	33 **73%**	11 24%	6 13%	11 24%	24 53%	0 0%
	Mask internal emotions	28 12%	25 **89%**	11 39%	11 39%	10 36%	17 61%	3 11%	6 21%	5 18%	16 57%	3 11%

Note. Relative frequencies are shown underneath absolute frequencies. Relative frequencies for the level 3 categories sign of positive emotions and negate/devaluate situation are omitted due to their general low occurrence frequency. Results including level 1 and 2 categories can be found in Appendix A.

deductive category assignment to the video material of the job interviews using NOVA. The final category system including anchor samples, that resulted from revising the pre-defined category system, is presented in table 4. The anchor samples are represented by pictures and descriptions of the morphological aspects. The annotation process with NOVA is illustrated in figure 3, which shows the annotated video of one participant in situation 1 during the job interview.

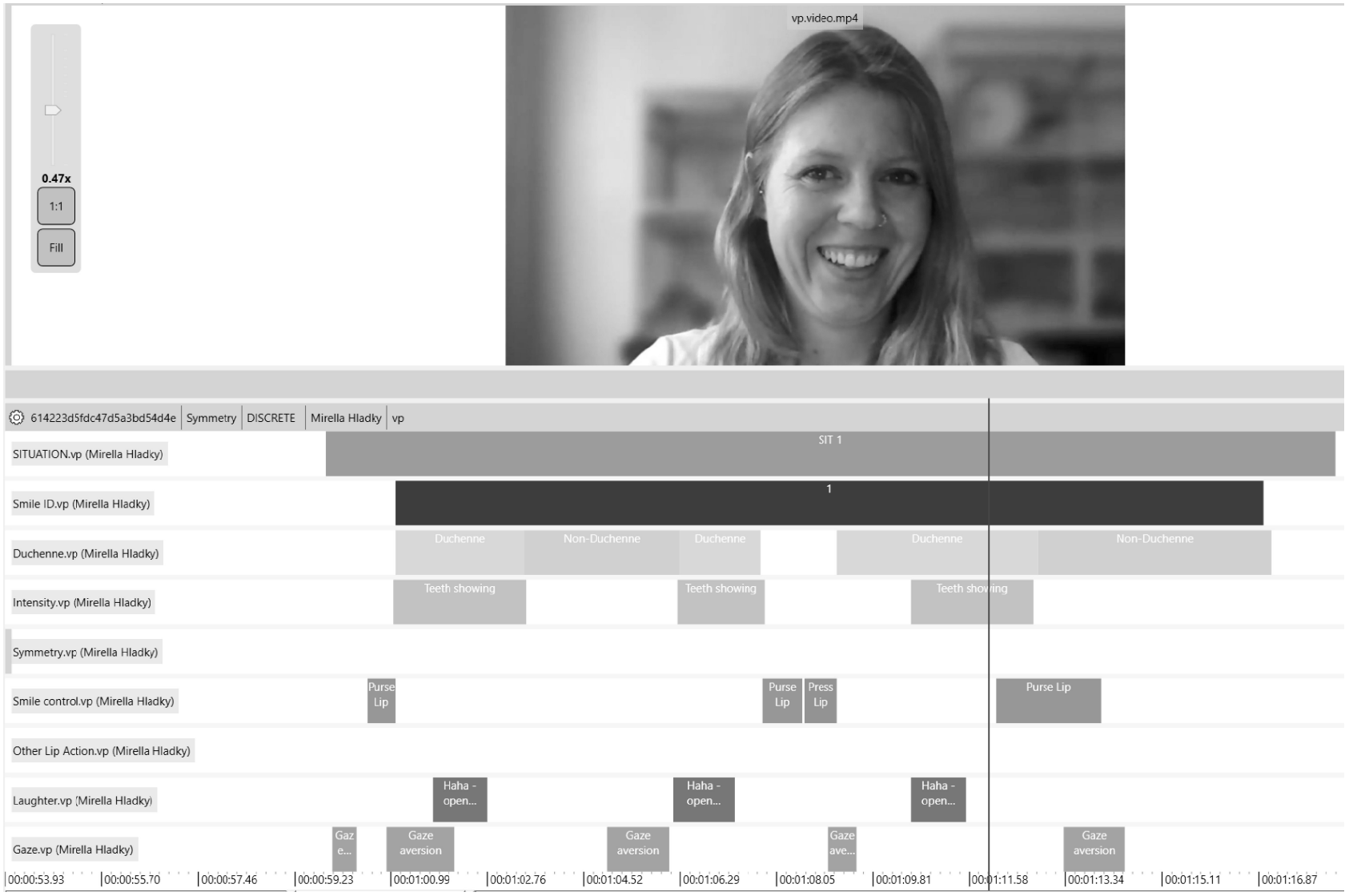
After determining the morphological aspects of all smiles displayed in the shame-eliciting situations, they were linked to the functions described for each instance of smile. Table 5 shows how often each morphological aspect occurred with each function of smiles. The first column with values shows the frequency of functions – that is, how often participants' smiles represented each function. The following columns show how often each observed morphological aspect co-occurred with each function. Table 5 shows absolute frequencies as well as percentages underneath each absolute value. The percentages show the frequency with which each morphological aspect occurred for a smile of the respective function category relative to the total frequency of the function category. For reasons of space, this table shows only the frequencies for level 4 and 3 function categories. A complete table including level 2 and 1 categories can be found in appendix A (figure A1).

The most striking results are marked bold and described in the following. Often, a single described function was marked by both Duchenne and non-Duchenne smiles, as they often merged in a way that, for example, the smile sequence started with a non-Duchenne smile and then developed into a Duchenne smile or vice versa. Participants often described one function for such a smile sequence, which could include multiple morphological changes. When smiles were reported to be a sign of internal (mostly negative) emotions, such as insecurity, anger, or shame, they most often involved a non-Duchenne smile (82%). Laughter occurred generally not very often. However, compared to other function categories, it shows the highest relative co-occurrence rate with the sign function (28%).

Smiles that served intrapersonal functions, in 62% of cases, were marked by non-Duchenne smiles. Although they were connected less often with Duchenne smiles, the frequency of 48% was the highest of relative co-occurrence rates of Duchenne smiles with smile functions. That hints that smiles of the intrapersonal category often merged from non-Duchenne to Duchenne or vice versa. Also, intrapersonal functions were, with a relative frequency of 50%, the most often connected

Figure 3

The annotation process in NOVA



with intense smiles (smiles with teeth showing). Smiles in this category were also relatively often asymmetric (40%).

Smiles that served interpersonal functions were in 75% of all cases associated with non-Duchenne smiles. However, differences could be observed for the sub-categories of interpersonal functions. The level 3 category *relationship rejection/harm* had similar frequencies for Duchenne (47%) and non-Duchenne (56%) displays. This indicates that smiles of this sub-category merged from non-Duchenne to Duchenne or vice versa in many cases. The level 3 category *mask internal emotions* is characterized by the highest relative rate of non-Duchenne smiles (89%) of all level 4 and level 3 functions.

Smiles in the interpersonal functions category were, in comparison to other level 4 categories, the most often accompanied by smile controls, such as pressing or pursing the lips (61%), and the most often asymmetric (43%). In the level 3 sub-category *relationship rejection/harm*, 73% of smiles were controlled, which represents the highest smile control rate among all level 3 and 4 functions. The level 3 sub-category *social status regulation* was stronger than any other category marked by asymmetric smiles (80%).

Other morphological aspects were in general observed infrequently, such as dimpler, cheek puffer and body adaptors, or occurred rather consistently throughout smiles of different functions. Gaze aversion was observed in over 50% of cases over all functions relatively uniformly. Smile controls co-occurred with each level 4 smile function category on a medium high level (between 58% and 61%). The functions *Sign of positive emotion* and *Negate/devaluate situation* represent only 3% respectively 1% of all applied functions. Thus, no relative co-occurance frequencies with morphological aspects were calculated.

5.2 Confirmatory analysis

H1 represents the manipulation check. It states that self-reported shame, measured with the SSGS questionnaire, will be higher after the job interview role play than before. On average, self-reported shame was lower before (M = 1.38, SD = 0.33) than after the job interview role play (M = 1.76, SD = 0.60). No outliers were identified. To check the statistical significance of the difference, pre- and post-experimental SSGS questionnaire data was compared with a paired samples t-test. A Kolmogorov-Smirnov test indicated that normal distribution was given for the

difference between the scale score of post- and pre-experimental questionnaires. The difference between pre- and post-experimental shame experience of 0.38 was statistically significant, $t(19) = -3.03$, $p = .007$, with a medium to big effect of $d = 0.67$ (Cohen, 1988).

H2a stated that there is a positive correlation between self-reported elicited shame and frequency of smiles. H2b assumed a positive correlation between self-reported elicited shame and duration of smiles. The self-reported elicited shame was represented by a variable holding the difference between self-reported shame in the post- and the pre-experimental SSGS questionnaire. This variable had a mean value of $M = 0.38$ ($SD = 0.56$), which means that, on average, shame was increased by 0.38 after the job interview role play compared to before. A maximum increase of 1.80 and minimum increase of -0.40 was found. The latter means that lower shame was reported after the job interview than before. This was the case for three participants. Throughout the three shame-eliciting situations, participants smiled on average $M = 7.15$ times ($SD = 3.72$) – at least twice and at most fourteen times – with an average total duration of $M = 36.45$ seconds ($SD = 26.05$) – at least 2.04 and at most 121.12 seconds. Precondition checks for parametric Pearson's correlation revealed that the variable smile duration is not normally distributed and holds one outlier. A visual scatterplot inspection indicated non-linearity for the correlation of self-reported elicited shame with both smile frequency and duration. Due to those precondition violations, the non-parametric Spearman's correlation was used which is robust against those violations and suited for testing a correlation for paired samples (Field, 2013). The analysis showed no significant correlation between self-reported elicited shame and smile duration, $\rho(18) = 0.22$, $p = .35$, and smile frequency, $\rho(18) = 0.18$, $p = .44$.

5.3 Post-interview evaluation

Participants rated the quality of the post-interview and how open they spoke about their experiences on a 5-point Likert scale. On average, the evaluation score was $M = 4.4$ ($SD = 0.37$). A score of 3.5 was the lowest rating. The participants had a chance to leave a comment in a free-text entry field in the questionnaire. Four comments reflected positive experiences, such as that the self-reflective process during the post-interview was interesting and fun and that there was a pleasant atmosphere. Similar positive feedback was given personally after debriefing, with a strong focus on the self-reflection that was required of the participants. Many participants described the

self-reflection in the post-interview as a positive and valuable experience. Negative feedback was not mentioned.

6 Discussion

The present work aimed at investigating what functions smiles and laughter serve in the context of shame, as those expressions were not assumed to be typically associated with the experience of shame, as shown in section 2.2.2. Additionally, a possible link between those functions and the morphological appearance of expressions was explored. Also, to further analyze the connection between shame and the occurrence of smiles, a potential correlation between experienced shame and the frequency and duration of smiles was tested. The resulting knowledge can improve computational emotion recognition and avoid misinterpretations of smiles and laughter. Twenty study participants experienced three shame-eliciting situations embedded in a job interview role play. Before and after the role play, the participants rated their experienced shame via questionnaire. Additionally, they took part in a qualitative post-interview in which they elaborated on how they felt (affect sub-section) on why they smiled or laughed in the shame-eliciting situations and what purpose it served (function sub-section). The data was analyzed in a mixed methods design that integrated quantitative as well as qualitative methods of data collection and analysis. The qualitative-explorative part of the study was guided by two research questions. The quantitative-confirmatory part of the study tested three hypotheses. The overall study outcome is as follows. Results indicate that shame was successfully elicited. Smiles and laughter were found to have served several different functions in the shame-eliciting situations. Those functions can be partly linked to the morphological appearance of smiles. No positive correlation between self-reported elicited shame and frequency as well as the duration of smiles was found. A detailed description and interpretation of those results follows.

6.1 Shame experience

The manipulation check – that is, whether shame was successfully elicited – was investigated twofold, in both parts of the study. Firstly, by statistically testing hypothesis H1, which stated that self-reported shame will be higher after the job interview role play than before. The statistical analysis of questionnaire data confirmed that shame was successfully elicited.

Three participants reported lower shame after the job interview than before. This could indicate that they applied highly effective emotion regulation strategies. For example, they might have replaced negative emotions with positive emotions (Nathanson, 1994).

Secondly, qualitative content analysis was applied to the affect sub-section of the post-interview. This analysis showed that the job interview predominantly elicited negative affects of different kinds. While shame itself was mentioned relatively seldom, negative affects that are theoretically and semantically related to shame as well as shame regulation strategies were addressed in about half of participants' descriptions. Another portion of descriptions related to negative affects might be a hint towards shame regulation, as well. Also, regulation processes might involve replacing shame with a different emotion that does not impair the self-concept and is thus easier to bear (Gross, 2013; Nathanson, 1997; Tangney et al., 1995). That could be, for example, anger directed at the interaction partner, which was one of the other described affects.

The results do not consistently and clearly confirm that shame was elicited in each situation. One reason for that could be that shame is more challenging to talk about than other emotions (Keltner, 1996). Participants' descriptions seem to reflect the aspects of shame introduced in section 2.2 such that shame is mostly regulated as it puts a person into a highly unpleasant state (Lewis et al., 2008; Moser & Von Zeppelin, 1996, e.g.). For instance, feelings described as unpleasant could be interpreted as experienced shame, as well. A quote by a participant highlights the connection and the difficulty of describing shame experiences: "It was unpleasant, because I had the feeling that I did something wrong and that she noticed it, that it was somehow unfitting." This quote reflects some of the main characterstics of shame – a highly unpleasant emotion that arises when we notice that we do not meet expectations of others in a social situation (Hahn, 2001; Lewis, 1992, e.g.). The self-discrepancy theory views shame as based on an assumed negative evaluation of the self by others (Higgins, 1987). However, this participant stated further that she was not ashamed, that it was just unpleasant, because she has a high self-confidence. This reflects on one hand, that she might have an effective shame regulation strategy or that self-confidence might be a protective factor for shame. On the other hand, it hints that scientific definitions of shame and implicit common definitions that influence common language, differ. Another example of this issue is illustrated by participant 15 confirming in situation 1, that she felt that her whole self-concept was attacked. This reflects one

of the core aspects of shame (Nathanson, 1997; Tangney et al., 1995). However, she denied having experienced shame.

Some participants described how they managed regulating shame throughout the interview in a way that, after experiencing one or two shame-eliciting situation, the following situations elicited less shame. Two example explanation about the third situation are as follows: ”I was less ashamed, because I already created a distance towards the interviewer. That’s why I was not ashamed for long. It was not so perceptible.” (participant 11), ”The feeling was weaker than in the previous situations because one already knew it. But I was anyway ashamed” (participant 13). Those cases hint toward applied shame regulation strategies that prevented participants to consciously experience shame. If participants did not mention shame, the interviewer asked them whether they experienced shame. When participants confirmed, they often used different formulations involving, for instance, embarrassment. An example for this is the quote ”Yes, it was unpleasant. It immediately put you into a lower position than the other.” (participant 5, situation 1). Such descriptions highlight that in everyday language, shame is often not addressed directly but rather by synonyms. As such, one of the difficulties of the applied approach lies within the differences between common and scientific language. Interviews with participants, which are held in common language, must be interpreted in a scientific way.

To conclude, according to statistical questionnaire analysis, shame was successfully elicited. Those results could be partly confirmed by qualitative content analysis. Some problems have to be taken into account: Talking about shame can be difficult for participants – firstly, as it is a highly unpleasant emotion and secondly, as a possible regulation process could limit their conscious access to internal states (Gross, 2013). Also, scientifically interpreting content in common language that uses various synonyms and indirect descriptions of psychological phenomena is challenging. Those difficulties apply to the analysis of functions of smiles in the context of shame, which will be addressed in the following, as well.

6.2 Functions and smiles and their interrelation with morphology of smiles

The first research question (RQ1) aimed at finding whether smiles and laughter serve different functions in shame-eliciting situations as captured in the post-interview. The qualitative content analysis of the post-interviews’ function sub-sections revealed that nearly every smile

instance served a certain function in the shame-eliciting situation. The discovered functions could be classified into three main categories. Most of smiles were described to serve interpersonal functions, which included regulating the social status in the current social interaction, supporting the relationship with the interviewer (for example by signaling appeasement, showing courtesy or self-confidence) and masking internal (mostly negative) emotions so that the interviewer would not notice them. Further functions of smiles represented the other two main categories in equal shares. As opposed to interpersonal social functions, some smiles served intrapersonal functions. This included devaluating the negative situation to alter its perceived significance and a row of positive self-focussed processes that mainly aimed at enhancing the own well-being and maintaining a positive self-image. In some cases, smiles were described to be a sign of an internally experienced emotion (sign function). Those were mostly negative emotions described as insecurity, anger, or shame. Few smiles were described to be a sign of amusement. That is, besides inter- and intrapersonal, smiles can also have representative functions. As such, RQ1 could be affirmed. An overview over the three discovered main categories of smile functions including their sub-categories and example quotes from participants can be found in table 3.

The functions of smiles were investigated in an explorative inductive way, that is, they were generated from participants' descriptions independently of existing theories and without a pre-defined category system. Despite this, the discovered categories partly reflect existing theories (see section 2.3.1), which could therefore be confirmed by the present study. However, there was no coherent theory on functions of smiles for the specific context of shame. In the present study, functions of smiles specifically relevant in this context were found, some of which were not yet specifically described by other authors. The results of this study provide a unified theoretically and empirically based picture of functions of smiles in the context of shame. Additionally, the second research question (RQ2) concerned whether functions and morphology of smiles are interrelated. The morphological aspects of smiles that occurred during the shame-eliciting situation were analyzed using techniques of qualitative content analysis, as well. A descriptive analysis revealed that some morphological aspects co-occurred more frequently with certain smile functions than with others. Some morphological aspects, however, seemed to occur rather independently of the function a smile served. The connection between the

exploratively discovered functions with their respective morphological appearance and existing theories on smile and shame will be discussed in the following.

Different functions of smiles found in the scientific literature were presented in section 2.3.1. The sign functions of smiles found in the present analysis were previously addressed as representative functions and referred to eleven smile types by Ekman and Wiltschek (1989). The present analysis found smiles to be a sign of negative emotions such as insecurity, anger and shame. Insecurity was not mentioned by Ekman and Wiltschek (1989). Participants mentioned that they smiled because they felt insecure or in order to mask their insecurity. That is, insecure smiles do not only have a representative function but are often connected to the interpersonal function *mask internal emotions* (level 3), as well. Also Ekman and Friesen (1982) use the term masking smiles for smiles that feign positive emotions in front of others while negative emotions are experienced. John and Gross (2013) refer to emotion regulation strategies that suppress emotional expressions as Response Modulation. The contempt smile described by him could be associated with anger. His enjoyable-anger smile appears to be related, however, participants of this study did not report any enjoyment connected to the anger reflected in the smile. Instead, experienced anger might be connected to the shame regulation strategy Attack Other, which is characterized by negative emotions directed at the other (Nathanson, 1994). As such, those smiles might be a signal of emotion regulation processes. Smiles as a signal of shame were described by Ekman and Friesen (1982) as embarrassment smiles. Openly signaling that one is ashamed, in this case by smiling, can help to restore or sustain social reputation and thus to avoid rejection (Fessler, 2007). That is, participants might have used this smile to show that they are aware of having committed a mistake to increase their chances of getting the job, despite. This is associated with the general emotion regulation strategy Situational Modification that is used to modify a situation to increase chances of experiencing desired emotions (John & Gross, 2013), which would result from a positive feedback by the job interviewer. As such, smiles that are a display of shame can be interpreted as serving a social function. This study found few smiles as signs of amusement in the context of shame. They could be viewed as related to Ekman's felt smiles which occur due to uncontrollable genuine positive emotions. However, he did not describe felt smiles and positive emotions to occur in situations that are inherently unpleasant. Participants experiencing amusement in the shame-eliciting context could hint that they regulated

their negative emotions by replacing it with a positive emotion (Nathanson, 1994). Also John and Gross (2013) describe the regulation strategy Attentional Deployment, which redirects attention to a desired emotion. Also, this phenomenon can be explained with the undoing hypothesis, which assumes that inducing positive emotions compensates the negative physiological and psychical effects of experienced negative emotions (Fredrickson et al., 2000), which could happen automatically as a self-protection mechanism. It is possible that positive emotions are evoked through smiling or laughing, as stated by the facial feedback hypothesis (Foley et al., 2002; Morreall, 1982; Neuhoff & Schaefer, 2002). However, participants presented their amusement to be genuine and not induced by voluntary positive expressions. Participants could mostly not give a precise answer when asked why they were amused (e.g., ”I somehow found it funny”, participant 14 situation 1). Humor, which is related to amusement, is described to allow a re-appraisal of and creating an emotional distance to negative situations (Keltner & Bonanno, 1997; Lefcourt et al., 1995). This is in line with the Cognitive Change regulation strategy (John & Gross, 2013). Those interpretations lead to the conclusion that smiles that were reported to be signs of amusement could be also be categorized as serving intrapersonal functions. Like other smiles associated with internal emotions presented above, smiles connected to amusement that occur in a negative situation can be interpreted as indicators of emotion regulation processes. Due to the relatively low frequency of smiles that were categorized to function as a sign of internal emotion, existing theories about the morphology of smiles reflecting those emotions could not reliably be confirmed. In the present study, smiles categorized as signs of internal emotions were predominantly classified as non-Duchenne. As those smiles reflected mainly negative emotions, this finding is in line with the general assumption that Duchenne smiles are associated with positive emotions. Also, non-Duchenne smiles are mostly assumed to have social functions (Ekman & Friesen, 1982; Ekman & Wiltschek, 1989). This supports the assumptions introduced above that some smiles categorized as having sign functions may serve interpersonal functions, as well. Laughter showed the highest relative co-occurrence rate with the sign function. That is, when a smile represented an internal emotion, it was more often associated with laughter than when they served other functions. Laughter is assumed to help to cope with unpleasant situations (Ruch & Ekman, 2001). Thus, it might be employed to regulate negative internal emotions. In sum, smiles that were described by participants as occurring due to

internally experienced emotions might in fact be signs of an unconscious emotion regulation process.

Intrapersonal functions discovered in the analysis of this study included negating or devaluating the negative situation, which reflects the Cognitive Change regulation strategy (John & Gross, 2013). This function category involves also positive self-focused processes that help to enhance the own well-being, promote internal self-regulation processes and reflect self-satisfaction. As such, it seems more directly connected to emotion regulation. Participants even described the smiles specifically being used to regulate themselves and to make themselves feel better (for example quotes, see table 3). Like smiles that were reported to be signs of amusement (described above), those self-regulative smiles can be described with the undoing hypothesis (Fredrickson et al., 2000) and the facial feedback hypothesis (Foley et al., 2002; Morreall, 1982; Neuhoff & Schaefer, 2002).

Interestingly, smiles serving intrapersonal functions had the highest co-occurance rate with Duchenne smiles as well as intense smiles with teeth showing. Duchenne smiles and more intense smiles are typically associated with positive emotions. Consequentially, taking into account the facial feedback hypothesis, this results could indicate that when smiling in a negative situation, not in order to influence the social interaction or the relationship but to influence the self in a positive way, intense and Duchenne smiles are employed to induce positive emotions more effectively. Also, it could indicate that intense and Duchenne smiles that occur in unpleasant social situations are more often directed at the self than at the other person, which, like in the present case, caused the unpleasant situation. On the other hand, this category is also marked by a relatively high rate of non-Duchenne smiles. Within the category, Duchenne smiles show even more often than non-Duchenne smiles. This can stand in contrast to the previously drawn conclusion. However, it can also simply emphasize that Duchenne and non-Duchenne smiles often merge into one another. This phenomenon was generally observed throughout the situations. Another contrasting result is that smiles with intrapersonal functions were rather often asymmetric. This does not match previous interpretations for this category as asymmetric smiles are typically associated with negative emotions such as contempt, with false smiles and with smiles that serve social functions (Ekman & Wiltschek, 1989). Those contradicting aspects could reflect that, on the one hand, negative emotions are elicited due to an unpleasant social situation

and, on the other hand, an internal effort is made to regulate those negative emotions by re-appraising the situation or by keeping a positive self-focus.

Interpersonal functions represented the major part of smile functions found in this study. Smiles related to interpersonal functions were generally found to be mostly associated with non-Duchenne smiles. This goes in line with traditional assumptions (Ekman & Friesen, 1982). A study by Hess and Bourgeois (2010) showed that Duchenne smiles occurred more frequently in social interactions with status differences, also in a negative emotional context. The present study took place in a similar context, as a job interview situation is also marked by a status difference of the interaction partners and as participants experienced unpleasant situations. Nevertheless, the present study's results contradict Hess and Bourgeois (2010). The level 4 category interpersonal functions was the strongest related to asymmetry, which supports existing assumptions that asymmetric smiles often serve social functions (Ekman & Wiltschek, 1989). Also, it was found to be the most often associated with smile controls. That means, smiles were often controlled respectively suppressed, for example, by pressing or pursing the lips or by depressing the lip corners. That indicates that in critical social situations such as job interviews or shameful situations, smiles or laughter are often not fully expressed or suppressed entirely. For example, participants describe that they had the urge to smile or laugh in a shame-eliciting situation but suppressed it because "I do not want to look like I'm having too much fun" (participant 7, situation 3) and "I think that it is more fitting to reply seriously in this situation" (participant 14, situation 3). That is, they had to suppress smiles or laughter which they deemed inappropriate for the situations. Those reports are in line with Gross (2013) which states that positive emotions may be regulated, as well. In the case of the mentioned participants, their internalized socio-cultural rules informed them that intense smiles or laughter are inappropriate in the situation at hand.

Interpersonal functions were sub-divided into four level 3 categories. One of them is social status regulation, which involves smiles that were used to show dominance, signal social status changes or differences or to maintain one's social status. According to Hess et al. (2002), dominance is one of the most prominent functions of smiles. Dominance laughter can be used to signal disapproval and status superiority without directly harming the relationship (Boxer & Cortés-Conde, 1997; Grammer & Eibl-Eibesfeldt, 1990). In job interview situations, it can be

useful to maintain a positive relationship with the interviewer even when a conflict arises, in order to keep the chances of getting the job. Signaling dominance in job interview situations might be useful if the applicant strives for a leading position that requires self-esteem. In the job interview role play of this study, participants were free to imagine a position that would fit their own situation best. As some participants were already older and already have more job experience, some might have imagined applying for a job in a higher position. According to the dominance theory by Barkow (1980), self-esteem evolved from the drive for dominance. Dominant behaviors are associated with higher social status (Barkow, 1980). Considering the PAD model of emotional states, dominance is related to maintaining or gaining control over a situation (Mehrabian, 1996). This also reflects in some participants' descriptions, for example, dominance smiles were described as used "to gain back the control" (participant 20, situation 3). Furthermore, displays of dominance can help to cope with situations of social discomfort, such as shameful situations. Signaling dominance in shameful situations is plausible, considering Nathanson's shame regulation strategies. Dominant behavior can be related to the Attack Other strategy. As a reaction to a shameful social situation, it aims at placing the other in a lower social status position than oneself (Nathanson, 1994). It seems consistent with Nathanson's theory that a depreciating smile or laughter could be a part of the Attack Other shame regulation strategy. Accordingly, participants that described smiles to serve social status regulation also often described Attack Other strategies and negative emotions directed at the interviewer, characteristic for Attack Other. Social status regulation was highly and more often than any other function category associated with asymmetric smiles. This supports Ekman's assumption that asymmetric smiles are commonly associated with negative emotions directed at the other, like contempt, and with social functions (Ekman & Wiltschek, 1989).

Relationship supporting functions represent the most found level 3 sub-category of interpersonal functions. Those include for example signaling appeasement, showing courtesy or a positive self-representation in front of the other. It appears logical that smiles in job interviews serve functions that influence the relationship with the interviewer positively, as this would raise the chances of getting the job. Especially in shameful situations that highlight a faux-pas of the interviewee, as was the case in the present study, it can be expected that additional efforts are made to maintain or restore the social reputation. As already mentioned, this can be achieved by

displaying shame openly (Fessler, 2007). In this context, a smile might in some cases be an open signal of shame. The relationship supporting functions of smiles are related to the emotion regulation strategy Situational Modification, as they aim at modifying the job interview situation so that it more likely leads to a positive outcome and emotions (John & Gross, 2013). This is supported by participants' descriptions stating that they smiled because they still wanted the job or because the job interview situation required courtesy and a positive self-representation (for example quotes, see table 3). Next to signaling dominance, signaling appeasement is viewed as one of the most important functions of smiles (Hess et al., 2002). Appeasing smiles may be used in job interview situations in order to enhance the interviewer-interviewee relationship, especially if a disagreement or a mismatch of values or expectations appears, which can in turn elicit shame in interviewees. Smiling can help interviewees to make a positive impression and thus enhance their chances to get the job. As appeasement smiles can be viewed as submissive behavior, they might help to signal that the applicant is willing to follow orders and rules of superiors. This can especially apply if the participants imagined applying for a staff position and not a leadership position, which could be more likely for younger participants with less work experience. Shameful situations may be viewed as conflict situation – they are a result of unmet social expectations and are accompanied by a fear of rejection and loss of social status (Hahn, 2001). An appeasing smile can help to ease the conflict and maintain a positive relationship. Also, appeasement smiles can be interpreted as related to the shame regulation strategy Attack Self (Nathanson, 1997). They could signal appeasement to others by showing that one accepts the blame for the unpleasant social situation.

The second most found level 3 sub-category of interpersonal functions is relationship rejection/harm. These functions seem to be strongly associated with the Attack Other strategy in which discontinuing a relationship is accepted or desired (Nathanson, 1997). Some level 1 sub-categories, formed based on participants' descriptions, highlight this connection. They include for example rejecting, depreciating and attacking the other (e.g., "kiss my ass-smile", participant 10, situation 2). Surprisingly, in addition to non-Duchenne, they were relatively often marked by Duchenne smiles. Next to intrapersonal functions, this level 3 category was the most often associated with Duchenne smiles. Conversely, this was not the case for the general level 4 category of interpersonal functions, which was, in line with common assumptions, associated

with non-Duchenne smiles (Ekman & Friesen, 1982). This sub-section is an exception. It supports results of Hess and Bourgeois (2010) which showed that Duchenne smiles occur in interactions between individuals of different status. As such, in some contexts, Duchenne smiles can be used to influence social interactions. Mostly, social smiles, whether Duchenne or non-Duchenne, were associated with a positive influence on social interactions (Ekman & Wiltschek, 1989; Mauersberger & Hess, 2019; Mehu et al., 2007, e.g.). The existence of smiles that serve a relationship rejecting or harming function shows that social smiles can also have a negative impact on social relations. On the other hand, those smile types could form a new category independent of (positive) social smiles. According to Samson and Gross (2012), negative or aggressive humor, compared to positive humor, is relationship harming and does not promote emotion regulation. This type of humor can show in sneering or laughing at somebody. Laughter co-occurred only seldom with relationship harming function. Sneering smiles were not specifically categorized in the present study, as they do not have a clear morphological appearance. It is possible that they would show in other included morphological aspects. Smiles of the relationship rejection/harm category were also more often than any other level 3 or 4 category accompanied by smile controls. Participants described that they suppressed smiles because they did not want to be friendly towards the interviewer that shames them (e.g., ”She criticized me, so I did not want to make the impression that this was ok and that I just accept it but I wanted to show that she hurt me.”, participant 15, situation 3). In those cases, it seems that participants trade a positive relationship with the job interviewer for self-protection. With the shame-eliciting statements, the interviewer possibly attacked participants' self-concept (Nathanson, 1997). In order to protect their self-concept, they may have chosen to distance themselves from the person inducing the shame. This implies that smiles of this category can serve an emotion regulating function.

Another sub-category of interpersonal functions refers to smiles that mask internal emotions. This function was already addressed by Ekman and Wiltschek (1989). The present results could confirm their theory. Masking smiles showed the strongest association with non-Duchenne smiles among all level 3 and 4 functions. This goes in line with existing assumptions (Ekman & Friesen, 1982). Besides no involvement of the Duchenne marker, masking smiles are assumed to often be asymmetric (Ekman & Friesen, 1982) and accompanied

by the cheek puffer or dimpler (Ruch, 1997), which were included in the present analysis. These assumptions could be supported only to some extend. They showed a relatively low co-occurrence rate with masking and other functions. Cheek puffer has the highest co-occurrence rate with masking smiles compared to other categories, although it is still rather low (21%). Smiles' functions of masking internal emotions reflect the emotion regulation strategy Response Modulation (John & Gross, 2013), which refers to suppressing emotional expressions.

In sum, the interpretation of the findings indicates that not only smiles serving intrapersonal functions are connected to internal emotion regulation. As elaborated in the previous sections, interpersonal functions seem to promote internal emotion regulation, as well. Also smiles that were described to have occurred due to a certain internal emotional state can in fact be connected to emotion regulation processes. In addition to functions of smiles and their connection with the morphology, some results are generally connected to the morphological appearance. Gaze aversion and body adaptors (touching face or body) were described as typical shame signals (see section 2.2.2). Ekman and Wiltschek (1989) characterize embarrassment smiles by gaze aversion. In this study, gaze aversion co-occurred with all function categories on a moderate to high level. Body adaptors generally occurred rarely. Due to those inconclusive results, the previous assumptions about gaze aversion and body adaptors could not be confirmed.

As described in section 2.3.1, there are conflicting theories and results on Duchenne an non-Duchenne smiles. Generally, Duchenne and non-Duchenne smiles were often observed to merge into one another in this study. This indicates that Duchenne and non-Duchenne smiles do not often occur independently. Some of the present results support traditional assumptions that Duchenne smiles are associated with positive emotions and non-Duchenne smiles often serve social functions (Ekman & Friesen, 1982; Ekman & Wiltschek, 1989). Specifically, smiles categorized as signs of negative internal emotions were predominantly classified as non-Duchenne, smiles serving interpersonal functions were found to be mostly associated with non-Duchenne smiles and masking smiles showed the strongest association with non-Duchenne smiles. However, also contradicting results were found. They indicate that Duchenne smiles can also be used to influence social interactions. This influence can be positive or negative. Relationship rejecting or harming smiles often involved the Duchenne marker. A remarkable result was that smiles serving intrapersonal functions were strongly associated with Duchenne

and intense smiles. This connection could be interpreted as Duchenne smiles serving an emotion regulating function by inducing positive emotions. Due to those inconsistent results, the traditionally assumed role of the Duchenne marker has to be reconsidered, as already suggested for example by Krumhuber and Manstead (2009).

As a whole, the presented results and interpretations show that smiles and laughter can be regarded as key players in emotion regulation in the context of shame. Smiles and laughter were described to be a driving force for promoting emotion regulation and can be a visible signal of emotion regulation. All categories of smile functions in the context of shame show some connection to emotion regulation processes – more or less directly. This finding is in accordance with general assumptions about shame being mostly regulated and not expressed openly (Gross, 2013; Nathanson, 1994). In some cases, the regulation process that happened internally during the shame-eliciting situation was described in more detail, for example a participant's description was as follows: "At first, it felt really negative but then I started questioning her competence. It was first unpleasant, but then it switched. First I was ashamed and then I went for confrontation. It went from being ashamed to being overly confident" (Participant 11, situation 2).

6.3 Interrelation of experienced shame with frequency and duration of smiles

To further analyze the connection between shame and the occurrence of smiles, a potential positive correlation between self-reported elicited shame and the frequency and duration of smiles was tested statistically. The results indicated that experienced shame was not linked to higher frequencies and duration of smiles. However, smiles could be observed in almost all shame-eliciting situation included in this study. That shows that smiles and laughter do play an important role in the context of shame. As concluded from the previous sections, they serve several functions and are connected to emotion regulation strategies that help to cope with the negative emotions elicited in the shameful situations. Yet, the present study could not show that the extent to which smiles occur is related to how strongly shame is experienced. A limitation of testing the connection between frequency of smiles and shame experience was the strong variation in smile duration, ranging from about two to 121 seconds. For instance, a participant that smiled throughout all three situations would have a smile count of three whereas a participant that smiles ten times for one second would have a smile count of ten. Thus,

measures of smile frequency were difficult to compare. The extend of smiles was capture more effectively by the smile duration measure. Conclusively, the duration measure proved to be more practical in this context than the frequency measure.

It is important to note that the sample size of the present study was below the sample size needed to retrieve reliable results from the correlation analysis. As such, the suitability of those results to draw conclusions about the interrelation is limited. In the scope of this study, a higher sample size was not feasible due to the qualitative dominant mixed methods design. The qualitative analysis of functions and morphology of smiles required an extensive time investment incompatible with the high required sample size of statistical procedures such as correlation analyses. The conflicting sample size requirements of quantitative and qualitative approaches can be noted as a restriction of mixed methods approaches in general. As many qualitative methods are very time consuming due to an in-depth investigation of the studied phenomenon, larger sample sizes are often unfeasible. For qualitative studies, a sample of up to 30 participants is common (B. Fridlund & Hildingh, 2000). Qualitative approaches determine the sample size based on the informational need of a specific study (Sandelowski, 2000). Quantitative studies, on the other hand, determine their sample sizes based on assumed statistical effect sizes and the demands of the statistical method.

6.4 General discussion, limitations and future work

There are few discussable limitations of the applied methodological approach in general. Some were already addressed in previous sections. A part of the limitations concerns the job interview role play and the experimental setup. The results indicate clearly that participants experienced mainly negative affects in the job interview. However, it is not entirely evident whether the statements by the interviewer predominantly elicited shame. It is also possible that they elicit a variety of negative affects, including but not exclusively shame. This hints that the functions of smiles and laughter found in this study may be not limited to the context of shame but might be applicable to socially challenging or unpleasant situations in general. Three participants reported lower shame after the job interview than before, which can be interpreted as a highly effective applied regulation strategy. An alternative explanation, however, is that shame was not successfully elicited. As such, revisiting the job interview procedure designed to elicit

shame specifically, initially introduced by Schneeberger et al. (2019), should be considered.

In a study by Ikuta (1999) participants showed fewer smiles during role play compared to real situations in the field. Some participants also mentioned in the post-interviews that they might have reacted differently if they were in a real job interview. As such, the present study might not fully reflect emotions and behavior in their natural condition. However, this is a common problem of experimental studies. A solution are field studies. The present research question might be difficult to investigate in the field, as participants would have to be observed in a specific context that elicits shame. As such, the experimental setup and the controlled induction of shame in a role play is a sensible alternative. Also, in some cases, participants noted that they might have behaved differently if the job interviewer was a human instead of a virtual agent. A previous study showed that virtual agents can elicits shame as humans do (Schneeberger et al., 2019). However, further research is necessary to determine the differences between social interactions with virtual agents and humans in order to enhance human-agent interactions regarding social and emotional aspects. Few participants remarked that the online set up of the study might have impaired the realism and immersivity of the role play. Other participants, on the other hand, mentioned that they could put themselves very well into the situation. The immersivity seemed to depend on individual factors as well, such that some participants prepared themselves conscientiously for the role play as instructed (e.g., by dressing accordingly), while some others did not. Despite this, participants could describe for almost every situation a specific affect that was evoked by the virtual interviewer as well as functions their smiles served in the social situation. In only four out of 60 situations, smiles occurred because participants were aware of the experimental situation. Participants' statements revealed that they generally assumed the virtual agent to interact independently and automatically with them. They assumed the agent to have artificial intelligence. This confirms that the Wizard-of-Oz setup was successfully implemented and that the participants did not suspect the experimenter to monitor the job interview. One participant mentioned that she felt ashamed, not because of the virtual agent but rather because of knowing that she is being recorded and another person will look at the recording later. It is not to be excluded that this effect took place in more cases. To compare, another participant pointed out that she was so immersed in the role play that she forgot that the webcam was turned on. As the study was performed during the COVID-19 pandemic and many participants studied or worked from home, it can be assumed

that participants were largely accustomed to interacting with others online through a webcam. The awareness of being recorded by the webcam might have been lowered and the realism of the online setup increased due to those circumstances.

Regarding the post-interview, there are few notable issues. Shame is more challenging to talk about than other emotions (Keltner, 1996). As such, participants may have held back some information about their internal states. However, the evaluation of the post-interview indicates that participants spoke openly. It could also be that they themselves did not have uninhibited access to their internal experiences as shame regulation processes are mostly executed unconsciously (Gross, 2013).

As mentioned, people with higher psychological mindedness should be more able to access and talk about experienced internal states. Psychological mindedness was not assessed, though. Instead, the study included psychology students that are assumed to have a higher psychological mindedness, on average (Hall, 1992). However, some participants showed difficulties in accessing their internally experienced states and in verbalizing them. When asked to describe their feelings and emotions in a given situation, some had problems to describe what they actually experienced in the situation. It happened that participants described what they assume people might in general feel in this situation or what they would have felt if the job interview was real. As such, pre-selecting participants according to their psychological mindedness, as it was done by Schneeberger, Hladký, et al. (2021), could improve the data quality. Direct questions about experienced shame might have led to some participants confirming them, although they maybe did not truly experience shame. However, the questioning technique was designed to lower the chance of suggestive effects. Participants were always given enough space upfront to elaborate on their internal experiences freely. The direct question about experienced shame was used in order to clarify previous statements. Also, the question was always formulated considerate of participants individual experiences, for example ”Would you say that what you described so far could be summarized as being ashamed? Please know that this question is about your own subjective experience.”

Some limitations concern the analysis process. The analysis of shame experience and functions of smiles did not reveal in how many situations shame was elicited but how many descriptions referred to shame. This was due to the way qualitative content analysis is

implemented in the program QCAmap. Often, for one situation, multiple affects were described. For example, participant 3 described for situation 3 that it was unpleasant, that he was surprised and then described an Attack Other strategy. As such, the relative frequency of shame and shame-related descriptions reflects how many descriptions in total referred to shame compared to other affects. The description of multiple affects per situation might have underrated the actual shame experience. For future work, it would be recommended to use a different analysis approach that allows to analyze experienced shame per situation or per participant. With regard to the observational analysis of morphological aspects of smiles, differentiating between non-Duchenne and Duchenne smiles was challenging, despite the guidance by the anatomical Facial Action Coding System (FACS) (Ekman & Friesen, 1976). Therefore, the results should be validated by additional raters proficient in FACS. Accordingly, Mayring (2014) recommends the content analytical process to be repeated by a second coder to assess the inter-coder-agreement. This was not feasible in the scope of this work due to the limited time-frame in relation to the time-consuming analysis process and lack of additional coders. As such, the results of the present work should be verified by an independent second rater in future projects. This will be facilitated by the systematic and transparent procedure applied in the present work, which is designed to allow for repetition and evaluation (Flick, 2013; Mayring, 2014).

Despite few limitations, the applied mixed method approach adds great value to the present study. It has several strength that enhance the informational value of the study by allowing mutual validation of results about experienced shame from multiple methods. It allows a more comprehensive picture of the studied phenomenon and investigates different aspects of the phenomena. Differing results can initiate further research (Greene et al., 1989). For example, the statistical analysis of questionnaire data indicated that shame was successfully elicited while the qualitative content analysis revealed that participants do not always mention shame. This gives rise to further questions, for example, about the suitability of the applied setup and about how shame is addressed in everyday language compared to scientific definitions. The qualitative dominant character of the study enabled the investigation of internal processes that are usually not observable from the outside and can hardly be captured in its entirety by questionnaires or other quantitative methods. This approach pointed out the complexity of the emotion shame and the phenomena smile and laughter. It showed that it is difficult to access experiences of shame –

for the person experiencing it and consequentially even more for the researcher. Despite this challenging task, a careful in-depth data collection and analysis approach allowed discovering new knowledge about functions of smiles.

Furthermore, the present study supports that a one-to-one mapping of emotions to external expressions is not feasible (Feldman Barrett, 2017). In fact, facial expressions such as smiles and their different morphological appearances seem heavily dependent on context and, more importantly, on how individuals appraise this context. The post-interviews showed that participants interpreted the shame-eliciting situations differently. They had different approaches to cope with them and their smiles served a variety of functions in this context. Yet, the systematic content analytical approach revealed connections between functions described by different participants, which allowed for categorization.

As an outcome, the present work provides an empirically based category system of functions that smiles and laughter serve in the context of the highly unpleasant emotion shame. Also, it provides evidence on the morphological appearances characterizing smiles that serve different functions. The study at hand showed that smiles and laughter are highly relevant phenomena occurring in and contributing to negative situations eliciting shame and shame regulation. There are other research efforts to discover in what contexts, for what reason and in what form do smiles and laughter occur. In addition to representing positive emotions, smile and laughter play a role in various contexts. As such, fully capturing them is difficult and requires a complex research approach. This work contributed to a better understanding of those phenomena by discovering the functions they serve in the context of shame and their morphological characteristics. For example, it added to the emerging discussion that Duchenne smiles are not always a reliable indicator for the internal experience of positive emotions. By showing that smiles and laughter occur in the context of shame and serve emotion regulating functions, this study highlighted that externally displayed emotions do not always match internally experienced emotions. It adds to an understanding that emotion regulation processes have to be taken into account when trying to understand a person's individual experience and how it relates to externally visible expressions. Those findings have a significant value for research and applications in Affective Computing.

Many approaches to computational emotion recognition and generation rely on the

interpretation of observable emotional expression as mapped to basic emotions described by Ekman (1993) (Picard et al., 2001; Soleymani et al., 2012; Valstar et al., 2016, e.g.). Methods of computational emotion recognition and generation as well as computational emotion models are used to create virtual agents that interact with users in a natural, emotionally and socially appropriate way. An important application for virtual agents are training systems that aim at enhancing social skills (DeVault et al., 2014; Gebhard, Schneeberger, André, et al., 2018; Gebhard et al., 2019; Hoque et al., 2013; Schneeberger, Sauerwein, et al., 2021). As highlighted by the present results, a one-to-one mapping of facial expressions to basic emotions is not always appropriate and can easily lead to misinterpretations of a user's internal state, especially when unpleasant emotions like shame are experienced. In the context of social training systems, such misinterpreting can have serious consequences for the well-being of the user and the training success. The present study's results can be applied to 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. It represents a piece of the puzzle that is required to build a computational emotion model that describes how externally observable expressions can be linked to internal emotional experiences, as is the goal of the DEEP project this study is a part of.

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Appendix A

Figure A1

Frequencies of smile functions and their co-occurrence with morphological aspects

Functions of smiles					Co-occurrence frequency of morphological aspects with functions of smiles									
Level 4	**Level 3**	**Level 2**	**Level 1**	**Frequency of function**	**Non Duchenne**	**Duchenne**	**Asymmetry**	**Intense**	**Smile Control**	**Dimpler**	**Cheek Puffer**	**Laughter**	**Gaze Aversion**	**Body Adaptor**
Sign of internal emotion				40	33	14	14	11	23	7	6	11	24	3
				17%	**83%**	35%	35%	28%	58%	18%	15%	28%	60%	8%
	Sign of negative emotion			33	27	10	10	9	19	4	5	8	19	2
				14%	**82%**	30%	30%	27%	58%	12%	15%	24%	58%	6%
			Sign of insecurity	20	17	7	6	6	9	2	3	5	12	2
			Sign of anger	6	4	3	2	2	5	2	1	2	2	0
			Sign of shame/embarrassment	6	6	0	2	1	3	0	1	1	4	0
			Unspecified negative feelings	1	0	0	0	0	2	0	0	0	1	0
	Sign of positive emotion		Sign of amusement	7	6	4	4	2	4	3	1	3	5	1
				3%	86%	57%	57%	29%	57%	43%	14%	**43%**	71%	14%
Intrapersonal functions				42	26	20	17	21	24	3	6	8	27	2
				18%	**62%**	**48%**	**40%**	**50%**	57%	7%	14%	19%	64%	5%
	Negate/devaluate situation		Negate/devaluate situation	2	1	0	1	0	3	1	1	1	1	0
				1%										
	Positive self-focused processes			40	25	20	16	21	21	2	5	7	26	2
				17%	63%	50%	40%	53%	53%	5%	13%	18%	65%	5%
			Enhance own well-being	20	15	10	7	12	11	0	5	5	14	2
			Internal self-regulation	16	9	7	8	7	10	2	0	1	10	0
			Sign of self-satisfaction	4	1	3	1	2	0	0	0	1	2	0

Note. This figure continues on the next page.

Functions of smiles					Co-occurrence frequency of morphological aspects with functions of smiles										
Level 4	**Level 3**	**Level 2**	**Level 1**	**Frequency of function**	**Non Duchenne**	**Duchenne**	**Asymmetry**	**Intense**	**Smile Control**	**Dimpler**	**Cheek Puffer**	**Laughter**	**Gaze Aversion**	**Body Adaptor**
Interpersonal functions				150	112	54	64	50	91	22	18	30	79	5
				65%	**75%**	36%	**43%**	33%	**61%**	15%	12%	20%	53%	3%
	Social status regulation		Show dominance / status	20	15	6	16	5	12	3	2	4	12	1
				9%	**75%**	30%	**80%**	25%	60%	15%	10%	20%	60%	5%
	Relationship support			54	47	16	20	18	29	5	4	10	27	1
				23%	**87%**	30%	37%	33%	54%	9%	7%	19%	50%	2%
		General relationship enhancement		8	8	3	4	2	5	1	1	1	4	1
				3%										
			Appeasement	5	5	3	3	2	4	1	0	1	3	1
			Enhance relationship	1	1	0	1	0	0	0	1	0	1	0
			Display acceptance of other's opinion	2	2	0	0	0	1	0	0	0	0	0
		Social display rule		17	14	5	3	4	7	0	1	3	8	0
				7%										
			Show courtesy		13	3	3	2	7	0	1	2	6	0
			Disagree in socially accepted manner		1	2	0	2	0	0	0	1	2	0
		Positive social self-presentation		29	25	8	13	12	17	4	2	6	15	0
				13%										
			Display ability to deal positively with negative situation	10	9	3	5	3	8	0	1	5	6	0
			Display professionalism/seriousness	7	4	2	2	2	5	2	1	0	3	0
			Show self-confidence	5	5	0	3	2	3	1	0	0	5	0
			Positive self-presentation in front of other	7	7	3	3	5	1	1	0	1	1	0
	Relationship rejection/harm			45	25	21	17	17	33	11	6	11	24	0
				19%	**56%**	**47%**	38%	38%	73%	24%	13%	24%	53%	0%
			Sign of resignation	5	3	3	1	1	4	0	1	1	1	0
			Depreciation of other	24	12	13	10	11	20	7	3	7	14	
			Reject other/relationship termination	9	6	4	4	4	6	0	1	2	6	0
			Provoke/attack other	4	3	1	2	1	1	2	0	1	3	0
			Highlight faux pas of other/"You hurt me"	3	1	0	0	0	2	2	1	0	0	0
	Mask internal emotions			28	25	11	11	10	17	3	6	5	16	3
				12%	**89%**	39%	39%	36%	61%	11%	21%	18%	57%	11%
			Mask feeling of discomfort	27	24	11	10	10	16	2	5	4	16	3
			Mask true (unspecified) feelings	1	1	0	1	0	1	1	1	1	0	0
				232	171	88	95	82	138	32	30	49	130	10

Note. This is a continuation of figure A1 (see previous page).

Appendix B

Script of the job interview role play

Szene Willkommen

Guten Tag. Mein Name ist Sonja Schneider. Ich bin Abteilungsleiterin und werde mit Ihnen das Bewerbungsgespräch führen. Ich hoffe, Sie sind gut vorbereitet. Haben Sie gut hergefunden? [Antwort des Interviewees]

Szene Scham 1

Bevor wir beginnen, eine kurze Frage. Woher haben Sie denn dieses Outfit? Irgendwie passt Ihnen das nicht wirklich. [Antwort des Interviewees]

Szene Lebenslauf

In Ordnung. Dann wollen wir anfangen. Sie haben sich um eine Stelle bei uns beworben. Als erstes würde ich gerne zu ihrem Lebenslauf kommen. Erzählen Sie mir bitte etwas über sich. Was haben Sie bis jetzt gemacht was für die ausgeschriebene Stelle wichtig wäre. [Antwort des Interviewees]

Szene Scham 2

Was Sie erzählt haben, haben alle anderen Bewerber auch schon gesagt. Sie haben da jetzt nicht gerade herausgestochen. [Antwort des Interviewees]

Szene Stelle

Okay. Jetzt werde ich Ihnen ein paar Dinge zu der Stelle erzählen. Wir suchen einen Mitarbeiter im Projekt Fesus, in dem es um den Einsatz neuer Medien geht. Die Hauptaufgabe ist zunächst die Analyse der bestehenden Literatur. Danach geht es hauptsächlich um Assistenzaufgaben bei der Arbeit im Projekt. Die Einteilung der Arbeitszeiten kann unsererseits flexibel gestaltet werden. Wir sollten jedoch mindestens ein Mal die Woche ein Meeting in der Gruppe haben. A propos Gruppe. Ich werde Ihnen nun eine Beispielsituation aus dem Alltag schildern, und dann würde ich gerne wissen wie Sie in so einer Situation reagieren würden. Stellen Sie sich vor, Sie arbeiten in einem Team mit einigen Kollegen an einem Projekt, jedoch werden Sie von diesen oft ignoriert. Ihre Ideen für das Projekt werden nicht ernst genommen. Was würden Sie tun? [Antwort des Interviewees]

Szene Scham 3

Also diese Antwort war ja mal nichts. Da habe ich von den anderen Bewerbern schon besseres gehört. [Antwort des Interviewees]

Szene Abschluss

In Ordnung, an der Stelle sind wir schon am Ende des Gesprächs angekommen. Ich bedanke mich. Wir werden uns dann bei Ihnen melden. [Antwort des Interviewees]

Szene Abschied

Auf Wiedersehen.