MEMOA: Introducing the Multi-Modal Emotional Memories of Older Adults database

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Abstract—In order to contribute to the need of spontaneous multi-modal affective databases for the automatic recognition of emotions in older adults, this paper presents a novel Dutch multi-modal database consisting of emotional memories of older adults. The data consists of positive and negative memories of older adults eliciting through two emotion reliving tasks: autobiographical memory recall in the first session and life story books to discuss these memories in depth in the second session. Data collection was carried out at the participants' home or at a place comfortable to them. Audio was recorded for the first session whereas audio, video and physiological data were recorded for the second session. As this database introduces a novel way of using autobiographical memories to study emotional expressions in older adults, a first step of the complex coding of emotions is presented in this paper. We reflect on the challenges encountered in the database and propose ways to address these issues.

Index Terms—aged, emotions, older adults, spontaneous, database, annotation, autobiographical memory recall, life events, valence, multi-modal

I. INTRODUCTION

In recent years, a shift is notable towards multi-modal databases that consist of induced or spontaneous emotional expressions. These databases mostly include emotional data of (young) adults or children [4]. There are few static databases with young people and older adults such as [47]. There is, however, still a lack of diversity in the populations of these databases as Wang et al. [4] point out. As the current society is aging rapidly, it is important to include vulnerable groups such as older adults or people with dementia in order to understand their emotions and create automatic recognition models for these groups. Importantly, some studies have shown that older adults differ from younger adults in their emotional experiences, regulation and expressions [7]. For example, older adults experience more complex emotions, express an increased positive affect or have a greater emotional control [7].

A contribution to these gaps can be made by having more accurate and comprehensive research that focuses on eliciting, understanding and representing expressions of spontaneous, natural emotions in real-life environments for older adults. We therefore collected a Dutch spontaneous multi-modal affect database, consisting of emotional memories of older adults.

When collecting emotional memories of older adults in natural settings, several annotation challenges arise inadvertently. Emotional expressions in spontaneous data are often ambiguous, short-lived or dynamic making it difficult to fully understand and interpret the emotions. In addition, the perception of emotions is subjective and hard to validate. Although eliciting emotions in social interactions can result in strong spontaneous, complex emotions, it can also result in more variability in the responses, co-occurrence of different emotions or evoke non-targeted emotions [1], [5], [6].

In this paper, a first step towards developing an emotion annotation scheme for emotional memories is presented alongside the introduction of a novel spontaneous multi-modal database of older adults' emotional memories. The database consists of specific positive and negative memories that were elicited via autobiographical memory recall which were then discussed in depth via life story books at the participant's home. As coding and interpreting spontaneous emotions is complicated, examples of the valence annotated memories are presented in this paper to accentuate this complexity in these emotional memories as they can differ between- and within older adults in terms of valence. With this in mind, emotional intensity is explored as a possible explanation for the differences found and is suggested as a potential future dimension to investigate.

II. RELATED WORK

A. Age and Emotional experiences

Older adults have different emotional experiences than younger adults [7], [12]. Research found that the emotional complexity of a person's emotional experience changes with age as a wider range of emotions or blends or overlaps between positive and negative emotions can occur with age [2], [3], [8], [9]. Older adults related more to bittersweet emotional experiences than younger adults. Magai et al. [10] found in their study that emotions became more complex with age when targeted emotions were elicited as their emotion experiences did not often occur in isolation. Also, the expressions of emotion were not typically "pure" suggesting that other positive and negative emotions were also elicited besides the targeted emotions [10]. Schneider and Stone [11] found a slight increase of the experience of mixed emotions (i.e., co-occurrence of positive and negative emotions) and age.

It is important to take these aging effects on emotional experiences into account when developing automatic emotion recognition models to interpret emotions of older adults automatically.

B. Autobiographical memories

Autobiographical memories consist of past experiences, encounters with other individuals or facts about oneself and can thus be defined as memories of a person's life. When recalling autobiographical memories, mental representations of these past events are constructed in a complex way by attaching a history of emotional reliving of the events and details to the recalled memory [31], [32]. An important dimension in autobiographical memories is valence, as it indicates to what degree a memory is recognized as negative or positive [33]–[35]. To structure autobiographical memories, life scripts can be used as they represent various life events that embody a prototypical life experience in a specific culture and in a certain order [36]. In autobiographical memory research, life events are often categorized into positive and negative events with attributed normed valence scores that were derived from younger and older adults when asked to rate these prototypical life events. Examples of life events are "death" or "birth" in which "death" has a lower valence score than "birth".

C. Existing databases

Databases containing spontaneous multimodal affective interactions with older adults for the purpose of automatic emotion recognition are sparse. An example is the multimodal CorpAGEst corpus focused on developing multi-modal annotations of spontaneous emotions of older adults in everyday interactions to detect age-related changes in the competence of older adults. Their aim was to reconstruct the attitudinal and emotional profile of older adults allowing a better understanding how older adults express themselves emotionally in naturalistic settings [29]. Other multi-modal databases including older adults often used acted emotions or was more task-oriented [30], [44]–[46].

III. DESIGN OF THE DATABASE

A. Elicitation Methods

For the database, different methods to elicit emotional expressions in older adults have been used. The study first used emotion reliving tasks to elicit spontaneous emotions as higher ecological validity can be achieved by having strong interactions and meaningful emotional stimuli that are relevant to the participant [2], [6]. The emotion reliving tasks in this study consisted of autobiographical memory recall (session 1) and life story books (second session). Lastly, a standardized set of pictures to evoke emotions were used in the second session after the life story books to compare the emotional expressions by different elicitation methods. A summary of the database can be found in Table I.

Autobiographical Memory Recall: A revised version of the Autobiographical Memory Test (AMT, [18]) was used to recall emotionally laden autobiographical memories. The AMT is a word association task and has often been used to recall specific memories in response to cue words in which participants are instructed to recall specific memories that happened on a specific day, place and only happened once and did not last longer than a day [18]. The current AMT consists of two practice words (grass and bread). Then, two emotional cue words (sad and happy) were presented to which three specific emotional memories had to be recalled by the participant. The cue words were always in the fixed order of 'grass, bread, sad and happy'. The AMT was carried out in the first session and participants were asked to provide a photograph or document for each emotional memory to be included in the life story book in the second session.

Life story book: Life story books (LSB) are often used in reminiscence and life review research to enhance quality of life of older adults or persons with dementia [15]–[17]. In the current study, a personalized digital life story book was constructed for each participant that contained the pictures and verbal prompts from the recollected positive and negative memories in the first session. These life story books were used in the second session to stimulate conversations and thereby eliciting again positive and negative emotions and their expressions about the emotional memories in greater detail.

IAPS: The International Affective Picture System (IAPS) is a set of standardized pictures for studying emotions [13]. It has previously been used as emotion-evoking stimuli in different age groups [2]. In the current study, the IAPS is used to examine possible differences between standardized elicitation methods such as the IAPS and emotion reliving tasks. Six pictures (three sad and three happy) were chosen based on their normed rating by scoring either high on sadness or happiness and low on other dimensions. [14].

B. Multi-modal Recording Setup

All sessions of the study were conducted at the participants home or at a location where they felt comfortable. Video, audio and physiological data was collected to be used for multi-modal analysis of facial and vocal expressions, and physiological measurements of emotions in older adults.

	Session 1	Session 2
Participants in the study	23	23
Participants in the database	19	19
Hours of videos/audio	audio only: 10h55m	26h18m
Elicitation method	AMT	LSB, IAPS
Questionnaires	TAS-20	TOPICS-MDS
	IPIP-5-50, MOCA	
Self-report ratings	n.a.	Valence, Arousal
Recorded signals	Audio	Audio, Video
		ECG, HR
		movement

Video: The raw video data was collected using three Panasonic camcorders (HC-V180 and HC-V720) in recording mode of 1080/50p and format AVCHD. The first camera was placed in front of the participant's face for frontal view. The second camera was focused on the body of the participant and the third camera was focused on the interviewer.

Audio: Audio information was gathered through the use of two wireless close talk lavalier microphones for the participant and interviewer. The microphones were connected to the SHURE wireless transmitter packs. One shotgun microphone was placed between the participant and interviewer. This resulted in three mono audio channels recorded with the ZOOM H6 and Audacity at sampling size 16-bit and rate 44.1 kHZ. The audio files are in .wav format and re-sampled to 16kHz.

Physiological: Three wireless Shimmer sensors were used to record the galvanic skin response (GSR), heart rate (HR) and movement (accelerometer). The HR sensor was attached to the body whereas the GSR sensor was attached on the non-dominant wrist and the movement sensor on the dominant wrist.

Other items: A 10.1" tablet was used to present the life story book and the IAPS pictures. The tablet was also used to fill in the self-report questionnaires. The tablet was placed in front of the first camera that was in front of the participant.

Fig. 1. Multi-angle view in the database consisting of a frontal and side view of the participant as shown at the top and view of the interviewer at the bottom.

C. Data collection

Participants: Twenty-three (11 male, 12 female) older adults were recruited through advertisements in local newspapers. They were aged between 65 and 85 years old (M= 74, Sd= 5.86). Participants were excluded if they had memory problems, a pacemaker or traumatic experiences. Inclusion criteria were: normal or corrected vision and/or hearing, minimal age of 65 years old and speaking and reading Dutch fluently. The first and second authors collected the data in which the first author always acted as the interviewer in both sessions. The sessions were either recorded at the participants home or at a location where they felt comfortable and lasted approximately 2.5 hours. 19 of the total 23 participants agreed to be included in the database.

Questionnaires: A selection of the The Older Persons and Informal Caregivers Survey Minimum DataSet (TOPICS-MDS) questionnaire was used [22]. Eight questions on demographic information and four questions on emotional well-being and quality of life were asked. The personality tests TAS-20 and IPIP-5-50 were used in this study [20], [21] to examine individual differences such as alexithymia or extraversion. In order to assess cognitive deterioration and to check the exclusion criteria, the Dutch version of the Montreal Cognitive Assessment (MOCA, [19]) was used as screening instrument for cognitive impairments.

Self-report ratings: Self-report questions on the dimensions of valence and arousal regarding the emotional memories were presented in order to study the difference in elicitation methods of emotion reliving tasks and the IAPS. The self-report ratings were filled in on a continuous scale together with the Self-Assessment Manikin (SAM) scale for valence (ranging from negative to positive) and arousal (ranging from calm to aroused). The valence questions asked how they felt when the emotional experience happened, how they felt when discussing it and how they felt now. For arousal, questions regarding how they experienced the feeling when the emotional event happened, when they were discussing it and how they experienced it now were asked. Lastly, four self-report questions on valence and arousal were asked for the IAPS pictures regarding how they felt when viewing the pictures and how they felt now (ranging from negative to positive) as well as how they experienced that feeling while viewing the pictures and how they experienced it right now (ranging from calm to aroused).

Transcripts: All audio files from the database were transcribed with the automatic speech recognizer NLSpraak and manually corrected. [1]

Procedure: The study was approved by the Ethics Committee of the University of Twente (Nr 107426). Informed consent was obtained prior to the study. The study consisted of two sessions that were scheduled with minimally a week apart. In the first session, participants were asked to fill in the TAS-20 and IPIP-5-50. Then, the AMT was conducted in which

[1] The automatic speech recognizer can be found on https://github.com/opensource-spraakherkenning-nl/Kaldi_NL

participants first received the two practice cue words (grass and bread). Then, participants received the two emotional cue words (sad and happy) in which they were instructed to recall three specific memories provide a photograph or document. After completing the AMT, participants filled in MOCA. Audio data was recorded in the first session and is included in the database.

In the second session, participants first completed the demographic questionnaire. Then, the LSB was presented on a tablet that consisted of short verbal prompts of their emotional memories accompanied by a photo based on the first session. Participants were interviewed in depth about each emotional memory. They self-rated each memory on three valence questions and three arousal questions on a continuous SAM scale as previously described. After the LSB, participants were asked to react to the IAPS pictures and rated them on four valence and arousal questions as previously described. Afterwards, participants received a small gift for their participation. Video, audio and physiological data was recorded in the second session and are included in the database.

IV. Coding emotions in autobiographical memories

As discussed in section I, the coding of memories into meaningful categories of emotions is complex. With the database in mind, the need for a new annotation scheme specifically for emotional memories of older adults grew in order to understand and interpret the emotional expressions. Developing the annotation scheme for emotional memories based on previous research on autobiographical memories and observations in the database, several challenges arose which will be discussed with transcripts of memories of the database. For that purpose, all transcripts were translated into English.

Challenge 1. How do we establish meaningful fragments in memories for units of coding while coping with the dynamic and spontaneous structure of emotions?

The database consists of memories that are associated with the emotions sad and happy. However, within these memories, emotions can fluctuate due to their dynamic nature throughout a memory. We therefore have to cope with this fluctuation when annotating emotions in this type of data. In order to meaningfully segment the data so that it can be interpreted in the context of the memory of the older adult, the units of coding have to be established. Based on the emotional memory of participant A that was recalled in Session 1 with the cue word "sad" as seen in Table II, it appears that two different memories were shared that the participant compared to each other regarding the emotional experience.

In the beginning, participant A described the death of a parent in which the parent wanted the participant to 'celebrate'. The participant mentions that this death was experienced in 'a different way' whereas the participant explains that with the other parent, it was 'a different story' and 'abnormal', implying that the emotional experience was very different than the first. A clear distinction is found between these events in

the participant's life so a meaningful segmentation would be based on the same thematic coherence. In this case, death of mother and father could be chosen as unit of coding. This would then result in a segmentation of units that we call meaningful fragments.

As described before in section II, life events provide structure in autobiographical memories and could therefore be used to annotate the meaningful fragments in the memories for emotions. As described in section II, valence is an important dimension in memories and is therefore the focus of the annotation scheme. By constructing a list of life events and their associated valence scores based on previous research, the basis can be created for the novel valence annotation scheme for emotional memories of older adults.

Challenge 2. Identifying life events and giving emotional interpretation to them. How do we identify whether a meaningful fragment is a life event or not?

We propose the Valence of Emotional Memories scale (VEM), which consists of a list of life events with corresponding mean valence scores that range from 1 (negative) to 7 (positive) compiled from previous research described in section II. The VEM can be used to annotate the meaningful fragments in an emotional memory. For example, the life event of "death of parent" has a valence score of 1.4 and "birth child" has a valence score of 6.6. In our previous research [43], the VEM was used as a first attempt to annotate a part of session 1 in which memories were first transcribed, segmented on the same thematic coherence and then if possible identified as life events with the normed valence scores using the VEM.

However, it appeared that not all fragments could be coded as a life event. Sometimes, they contained a participant's thoughts about the targeted emotion during the autobiographical memory recall or it gave more insight how a participant interpreted emotions. Although these fragments did not discuss any life events (thus were not scored on valence), they contained reflections about the participants own emotions which could give insight how emotions are interpreted by older adults. Examples of such fragments are shown in Table III.

For participant B, the fragment was both identified as a life event ("Birth child") and a reflection. Here, the participant wonders if the event was a happy memory or if another

TABLE II
Session 1: Transcript of Life event

Participant A   Transcript of Emotional memory
"Well, enough things, but I'm just not that sad about those things. You just think this happened and now it is over. And, yes, my [parent] has also passed away, but yeah, we all go right. Of course, you are sad when she passes away but in a different way. I don't know why, he/she was also very contented as in give me that injection. And that becomes easy. So, it goes down a bit easier. You have tears in your eyes for a brief moment, when he/she was laid to rest then you look on with tears in your eyes but I find that a different kind of sadness. When that person wants you to celebrate instead of the other way around. But it was a very different story with my [parent]. That was so significant, abnormal. You cannot understand it."

TABLE III
SESSION 1: TRANSCRIPT OF LIFE EVENT AND REFLECTION

Participant B   Transcript of Life event and Reflection
"Yes. And so on. Yes, it is, of course also the birth of your first child. Is also very special. I, hmm, I'm not sure if happy is relevant? I don't know, it's more proud. But happy? I'm not sure actually. Well, I will just continue with my story. Well, eventually, it shows that you're pregnant. But in my case it took a long time. That's something that I remember, but no, I wasn't specifically happy? Weird right, that I wasn't, that the emotion of happiness wasn't that strong actually. But when am I happy then?"

Participant C   Transcript of Reflection
"Sadness. Then it has to be that people passed away, but nobody has passed away in my childhood. I did not know my [grandparent], so, barely. Sadness means more that you're at school or something. Yes, sadness. You mean that you have to cry? Then you are sad, right? Yes. Yes. Or silent sadness. No, nothing comes to mind. I'm thinking about it right now."

emotion was more relevant. The participant is noticeably reflecting on the definition of "happy".

For participant C, a reflective fragment of sadness is described in which the participant reflects what sadness means to him/her. Shown in Table III, participant C distinguishes different kinds of sadnesss: sadness where you have to cry or "silent sadness". It thus appears that people find it difficult to define emotions and reflect what it means to them when recalling memories. This highlights the complexity and ambiguity of emotions, as different interpretations are possible. The memory of participant B also shows that it can evoke non-targeted emotions even though sad and happy were the targeted emotions or have variability in responses as participant C associated sadness with crying or "silent sadness".

Challenge 3. When emotional experiences deviate from the normed valence found in previous literature, how do we express differences in valence when it is clear that not all life events are experienced in the same, emotional way? In addition, what if the memories cannot be categorized in the life events established in the valence annotation scheme?

At the moment, the VEM has been used to identify and code life events with the associated valence score for session 1 partly. Based on observations from the database, the normed valence score in the VEM did not always reflect the correct valence of an emotional memory when comparing it to other memories of the same life event. As the previous memories of Participant A show: the death of one parent was experienced very differently in an emotional way than the death of the other parent. Although life event "death of parent" has a certain normed valence score according to the VEM (valence score 1.4), the events of the death of the two parents for participant A differed a lot, suggesting that they should not receive the same valence score.

Due to highly personal circumstances, not every life event will be experienced in a same way. In order to allow for this flexibility in the annotation scheme, we expanded the VEM with a subjectivity score of +1 or -1 that can be administered to decrease or increase the valence score of a life event. So the total valence score of a life event can be amplified or weakened in the VEM. In addition, we also observed in the database that life events were missing from the VEM as some memories did not fit the life events in the list. As the list is not final, the

missing events were added when it was necessary and their valence scores were established by choosing relevant various key words based on [39] and average the valence scores. As a result, the VEM contained 47 life events with valence scores.

Challenge 4. Interpreting the emotional memories, participants express differences between the emotional experiences during or between life events, as some felt more intense than others. Is there another dimension of emotion that plays a role in emotional memories besides valence, such as emotional intensity?

The fragments that received the subjectivity scores or were identified as reflective fragments are interesting as it appears that the memories differed not only in valence as a negative memory could be increased or decreased and still be negative. It implies that the way participants experienced the emotion in the same life events is different with regards to their intensity or how strong they felt this emotion. Again, it also shows the ambiguity and complexity of spontaneous emotions to interpret as even participants reflect and contemplate their interpretations of the targeted emotions. The subjectivity scores and reflective fragments demonstrate that the elicited emotions are sometimes non-targeted due to their different interpretations and reflections, suggesting that blends or mix of emotions appear when discussing emotional memories. This can be seen in the Table II where participant A distinguished two life events as the first event "death parent" was "a different kind of sadness" and the second event "death parent" was a "different story; abnormal; so significant". It implies a difference in emotional valence that can possibly be explained by emotional intensity. That the intensity of an emotion can differ is also exemplified by participants B and C in Table III. For participant B, the emotional memory can be identified as both a life event ("birth child") and a reflective fragment on the emotion of "happy". Participant B mentions that the "emotion happiness was not that strong actually",and that "proud" was more relevant for the life event. It suggests that, although both positive valence event, the intensity differed for this specific memory. Participant C reflected on "sadness" is and what it means to him/her. According to the transcript, participant C distinguishes different kinds of sadness in events: sadness where you have to cry or "silent sadness". Although both kinds of sadness would fall into the same side of the valence dimension (i.e., negative), there is a difference in the expression of sadness regarding the intensity of sadness. Examining the second session, a specific emotional memory from the life story book of participant D is shown in Table IV.

TABLE IV
PARTICIPANT D : SESSION 2 : LIFE EVENT "DEATH PARENT"

Speaker   Transcript of emotional memory
Interviewer: "How did you experience the funeral of your parent?"
Participant D: "I found it, it's also emotional. We carried the coffin into the church and out of the church with seven people. And yeah, the funeral alone, it was also an emotional event but personally, I found it less intense than the operation and what happened there. That he/she passed away, that was pretty intense"

Although the emotional memory in the life story book focused on the life event "Death parent" from the first session, it could be further chunked into other life events when discussing the life event in depth during the second session. The participant was asked to elaborate on the death of the parent in which the participant elaborated the above event in the context of death. In this life event, participant D explains how the emotional experience of the funeral was different from the emotional experience during the operation of the parent. The participant explains that the experience of the former was "less intense" than the latter ("pretty intense"). In other words, the intensity in emotional experiences differed for these negative life events, suggesting that it is plays a role in emotional memories besides the valence dimension.

Challenge 5. Based on observations from the database, emotions can sometimes blend or co-occur in a memory, even when they are opposites on the valence dimension: How to deal with co-occurrence or blends of emotions in memories?

Table V shows a different memory of participant D discussed in the second session regarding the life event "death parent". Here, the participant actually describes an incident that happened during the period after the parent passed away that included the younger children in a funny but very emotional situation.

TABLE V
PARTICIPANT D : SESSION 2 : LIFE EVENT "DEATH PARENT"

Speaker — **Transcript of emotional memory**
Interviewer: "How did you experience the period after your parent passed away?"
Participant D: "Quite chaotic, also, also, you are often together with your siblings to organize things and it has to happen now. [Parent] also lay in state in a separate room at our home. Yeah, I had two children at home and I thought my wife should go home and I should stay there. My sisters did not agree as they argued: you also have children, you should go home with your wife. So, eventually, I also went home. And we returned a day later, together with the children. And, yes, [parent] lay in state in a separate room just close to this room. And. But then again, it was also special, that those young, youngest children were walking in and out and were talking about their grandparent when he/she lay in the coffin and they were looking at him/her: "He/She does not look like the picture or he/she did look like it", those kind of things. On the one hand it was very funny, well yeah, actually funny but on the other hand also very emotional, yes."

This is a particular example of a mix of emotions and demonstrate the complexity of coding emotions with a contextual structure in a life event as it is difficult to label this into an abstract category of emotion without losing the richness of the memory. Although the event of the death of the parent is prototypical negative, the participant mentions that the situation was actually funny, but still very emotional. It seems that the positive valence emotion (i.e., funny) occurred in the context of a negative valence life event (i.e, death of parent combined with the interpretation of the participant's words and contradiction of "but very emotional"). This suggests that there is a mix of a positively and negatively valenced emotion. For this example, it could be that the intensity of the positive valence emotion (i.e., funny) in this context depends on the intensity of the negative valence life event ("death parent").

Positive and negative emotions could co-occur in life events and memories due to coping mechanisms as research show that experiencing these emotions is fitting when coping with difficult life situations [23]. During stressful times, people can benefit of having these two opposite valence emotions as it allows them to feel better or confront the situation [24]. Experiencing mixed emotions is sometimes beneficial in difficult situations as a positive emotion can help alleviate the negative experience in an aversive life event [28]. This can lower the negative feeling in the life event as the positive emotion changes the experience of the negative event [37]. Especially during bereavement, having positive feelings to a negative emotion will reduce grief over time, increases coping efficiency and results in a more healthier process of bereavement as positive memories are experienced besides sadness (e.g., remembering a loved one with joy) [25]–[27]. As older adults reviewed their life to retrieve emotional memories, it is possible that these life events include mixed emotions when thinking about the past due to coping mechanism or reminiscing. This can also affect the emotional experience as feelings over time can change and should therefore be taken into account that the emotion during the event can sometimes differ from the felt emotion during retelling. Mixed emotions complicate the coding emotions in memories and has to be taken into consideration when further developing the VEM.

V. DISCUSSION AND CONCLUSION

Emotional memories were examined to illustrate the complexity of coding spontaneous emotions in autobiographical memories of older adults. Several challenges were presented that complicate the coding of emotions into meaningful, interpretive labels for feature extraction of multi-modalities in the database. To tackle some challenges, a valence coding scheme (VEM) was introduced for emotional memories that is flexible to use considering the dynamic, fluctuating and personalized nature of emotions. For further development, the VEM should be extended to include emotional intensity to cope with the differences in the emotional experiences of life events as well as approaching mixed emotions. In our previous research, we suggested that emotional intensity acted as a possible confounder. Emotional intensity is a dimension often studied in autobiographical memory research and face modality [32], [38], [40], but not much in gestures or speech research as arousal is studied more often [41], [42]. Although arousal is also an important dimension of emotion, emotional intensity describes the subjective assessment of how a person feels whereas arousal describes the more physiological expression [38]. The current database will be made available to the research community. For future research, the same study will be carried out with people with dementia as it is part of a larger project that aspires to explore automatic emotion technology in order to recognize emotional expressions in people with dementia and thus contributing to the need of including vulnerable groups in databases.

VI. ACKNOWLEDGMENT

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