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Research Article

Emotion Evaluation from Young Adults to Old Seniors using Films Emotionally Labelled

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Abstract

Objectives: Investigation of facial expressions related to emotional reactions from four age ranges, including both non pathological women and men, when viewing successive film clips emotionally-labeled as neutral, happy, surprised, angry, scared, disgusted, and sad reactions. **Method:** Emotions were evaluated by having different age groups view a video composed of a succession of short, emotionally-labeled film clips to elicit neutral, happy, surprised, angry, scared, disgusted, and sad reactions. The groups consisted of young adults (YA) ranging from 20 to 39 years old, older adults (OA) ranging from 40 to 59 years old, young seniors (YS) ranging from 60 to 79 years old and older seniors (OS) ranging from 80 to 91 years old. **Results:** Viewing emotions by age group revealed that the first emotion declining significantly with aging is happiness. A high level of happiness seems to be a signature of younger adults. From age sixty to eighty, the amount of emotion increased significantly, specifically anger. No significant difference was seen in arousal between the four groups. A highly significant difference was observed in the valence between the adults and the seniors. **Conclusion:** This study allowed us to discriminate by each group's respective amounts of emotion and the normal evolution of emotions at different ages. This testing method, which is easy to apply, could allow us to distinguish normal processes occurring during aging from pathological processes occurring in neurological diseases.

Keywords: Aging emotions; Young adult emotions; Old adult emotions; Young senior emotions; Old senior emotions

Introduction

With increasing age, basic cognitive functions, attention, and memory, are affected. Similarly, the decline in sensory capacities was also affected by age, which was related to a decrease in perception. These age-related changes are now well documented in normal human aging [1-3]. Conversely, little is known about age-related changes occurring in facial expression when perception and cognition decline in normal aging [4]. Indeed, facial expressions are conceived as biologically prepared responses to emotional external signals involved in communication, but now, it is well known that the response to these external signals is modulated in aging [5]. Surprisingly, although physical health and strength typically decline in old age when added to the accumulating vicissitudes of life, emotional well-being is somehow maintained or even improved [6]; this is called the paradox of emotional well-being in aging [7]. Indeed, older adults are better than younger adults at regulating their emotions and can more easily defuse negative feelings and situations when a choice has to be made between neutral or negative stimuli by looking away from the negative

image [8-11]. However, compared to younger adults, older adults will more successfully avoid distraction by neutral stimuli [12,13]. Thus, it seems that older adults' superior distraction avoidance is specific to negative stimuli because this behavior is not observed with positive stimuli [14,15]. As an explanation, the brain regions necessary for resolving interference for emotional stimuli may decline less with age than other brain regions. Indeed, older adults are therefore more likely to recruit prefrontal resources to regulate emotion than younger adults [16]. All the above studies were performed with static images requesting an active response by the subject.

To better understand what happens in real life, the current study investigates facial expressions as they relate to emotional reactions from four age ranges, including both women and men, when viewing successive film clips emotionally-labeled as neutral, happy, surprised, angry, scared, disgusted, and sad reactions. The facial expression images, captured by a camera, were coded by software (Face Reader) providing emotional responses more quickly, and equally as reliably when compared with human raters [17]. In this system, the facial analysis includes three successive stages. First, it can track the face of the subject that remains free to move within certain limits. The software is then able to accurately represent the face by a 500-point mesh. Finally, using an artificial neural network [18], the face is ranked into six facial expressions for basic emotions: happy, sad, angry, surprised, scared, or disgusted completed by a neutral class [19]. This classification is widely used, and the categories represent clear concepts [20]. In addition, arousal and the global positive or negative valence were also evaluated knowing that aging could have a significant effect on it. Indeed, prominent models of emotion identify valence and arousal as fundamental components of emotion [21]. Valence refers to the direction of an emotional response (negative or positive), whereas arousal refers to the magnitude of the response (exciting, agitating, calming, subduing) [22]. Empirical evidence shows that these two emotional dimensions are not independent of each other [23-25]. Quantification of facial expressions triggered by emotional reactions is expected to match the watching of categorized films. The expected difference in emotional expression by age range could pave the way to detect early possible incoming neurological diseases and, more specifically, the earliest stage of neurodegenerative diseases, such as Alzheimer's disease, without adding additive testing stress caused by conventional approaches.

This automated recording of emotions at different ages seems to be more reliable since, in the past, it was demonstrated that the emotional reactions of seventy-year-old subjects were poorly recognized by younger subjects [26]. In addition, it seems that well-recognized emotions must be evaluated by subjects close in age [27]. Both of these studies revealed an age bias in identifying the emotions related to the age examiners. To observe the eventual behavioral changes as early as possible using this automated method with the increasing age of specific emotion(s), we created groups of only ten subjects hoping to observe significant changes resulting from homogeneous results.

Methods

Participants

The four groups of ten participants were composed of four age groups. The first group, called young adults (YA), ranged from 20 to 39 years (M. age=28.3, ±SEM= 2.08); the second group, called older adults (OA), ranged from 40 to 59 years (M. age=51.9, ±SEM= 1.32); the third group, called young seniors (YS), ranged from 60 to 79 years (M. age=69.7, ±SEM= 2.17); and the fourth group, called older seniors (OS), ranged from 80 to 91 years (M. age=84.89, ±SEM= 1.44). The YA group was comprised of students at the University Aix-Marseille with an education level greater than 16 years. The level of education was 8 superior or equal to 16 and 2 equal to 11 years for the OA group. For the YS group, it was 2 equal 16, 4 equal 11, 3 equal 7 years, and 1 without scholar education. For the OS, it was 2 equal 11, 4 equal 7 years, and 4 without scholar education.

All the participants were native French speakers, and exclusions were made for those with a neurological disease or a history of psychiatric diseases. Participants were not taking neurological medication and did not have significant apparent cognitive assigned pathology. Indeed, in the following the emotion evaluation, all subjects submitted to the Mini-Mental Score Evaluation (MMSE) and, in agreement with the recommendations of Tombaugh and McIntyre [28], only the results of the subjects with no cognitive impairment were considered. Subjects were recruited voluntarily and were debriefed following the study. All the participants with significant sensory impairments (visual and hearing) were corrected.

Materials

An HD camera from the HP computer, with the red LED "on" light masked by a tape to not disturb the viewing, allowed us to record the experiments with the consent of the participants. In front of the camera, the participant's emotions were filmed and later analyzed by Face Reader v7 software. Once the analyses were performed, the evoked emotions of neutrality, happiness, surprise, anger, fear, disgust, and sadness, were averaged and reported in a summary table for each film extract. The average of the positive (happy) or negative valence (which is the average of happy minus the averages of the sum of anger, disgust, fear, and sadness) was also reported as well as the average of the estimated arousal.

Procedure

The four generations were tested in their living home except for the student group (YA), which was tested in a quiet office at Aix-Marseille University. For a total of 10 minutes, all participants were asked to watch seven video extracts that were emotionally directed in succession as follows: neutral - 60 seconds, happiness - 160 seconds, surprise - 60 seconds, anger - 80 seconds, fear - 90 seconds, disgust - 60 seconds, and sadness - 90 seconds. The extracts related to happiness, anger, and sadness were different depending on the range of age to elicit emotion corresponding to

the time they lived. Consequently, the four specific movies related to the age range are reported in (Table-1) and the supplementary data. The definitive choice of all the extracts resulted from preliminary testing and could be changed as a function of the subject's nationality.

- Neutral - River- https://www.youtube.com/watch?v=c2NmyoXBXmE
- Happy -
YA: Sketch.-. Gad Elmaleh Le restaurant d'altitude https://www.youtube.com/watch?v=Zztzjr7QbU8
OA: Intouchables is a French film made by Olivier Nakache and Éric Toledano, released in 2011.
YS: Le père Noël est une ordure is a French film made by Jean-Marie Poiré, released in 1982.
OS: The count Charlie Chaplin https://www.youtube.com /watch?v=uJzBT-ZQ6bE
- Surprise - Snake- https://www.youtube.com/watch?v=IeVL6UgfgzY
- Crocodile https://safeshare.tv/x/KkkEFRtyiS
- Angry -
YA and OA: Battered child http://www.letribunaldunet.fr/videos/choc-babysitter-bat-bebe-ascenseur-video.html
YS and OS: Roundup La Rafle is a dramatic and historic french Written and made by Roselyne Bosch, released in 2010.
- Scare - Lights Out- Who's There Film Challenge (2013) from David F. Sandberg on Vimeo. https://www.youtube.com/watch?v=vF8keYfncN4
- Disgust - Scorpio https://www.gamaniak.com/video-7440-manger-scorpion-geant-vivant.html
- Baby vomit https://www.dailymotion.com/video/x12ab
- Sad - YA and OA: Dog euthanasia Marley et moi (Marley and Me) is an American film made by David Frankel, released in 2008
YS and OS: Elderly alone- https://www.notretemps.com/famille/dependance/personnes-agees-seules-noel-video-choc-reagir,i100467
Supplementary Material
-1 Film 20 39 years.wmv
-2 Film 40 59 years.wmv
-3 Film 60 79 years.wmv
-4 Film equal or superior to80 years.wmv

Table 1: Corresponding film clip to elicit emotions in Young Adult (YA), in Old Adult (OA), in Young Senior (YS), and in Old Senior (OS) with all the videos origin to make the specific film clip to the range of age.

Data Analysis

Statistical analyses were performed with SPSS/PC+ statistics 11.0 software marketed by SPSS, Inc. All data are presented as the means ± SEM. The performance was analyzed using a repeated-measure MANOVA. Then, subsequent ANOVAs for each session were computed. Linear regression was attempted considering the valence obtained by all the participants. The threshold for significance was set at $p \leq 0.05$.

Results

Facial expressions

No significant arousal was observed (Figure 1) between the four groups [ANOVA: $F(3, 36) = 0.65$; NS] inversely to the valence (Figure 2A), where a highly significant difference appeared [ANOVA: $F(3, 36) = 16.7$; $p<0.001$]. This difference resulted from a significant difference between the YA group and the YS and OS groups [ANOVAs: $F(1, 18) \geq 23.52$; $p<0.001$] and between the OA group and the YS and OS groups [ANOVA: $F(1, 18) = 16.68$; $p<0.001$].

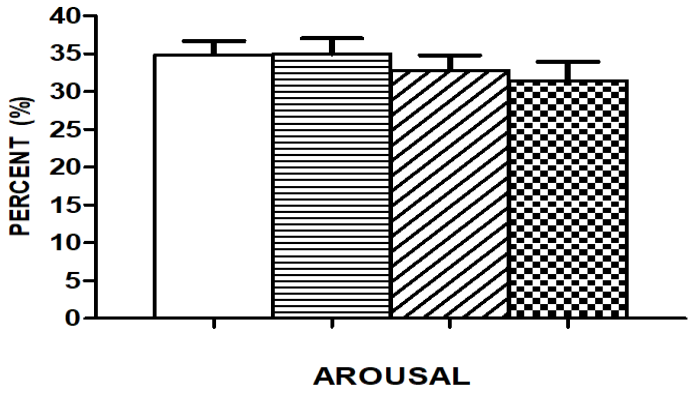


Figure 1: Mean±SEM of the percentage of arousal in Young Adult (YA), Old Adult (OA), Young Senior (YS), and Old Senior (OS) during the 10 minutes of the broadcasting film clip.

In addition, a negative correlation was found between age and the decrease in the positive valence (Figure 2B), (correlation coefficient: r=0.57; p<0.001)] with a switching point at 45 years of age.

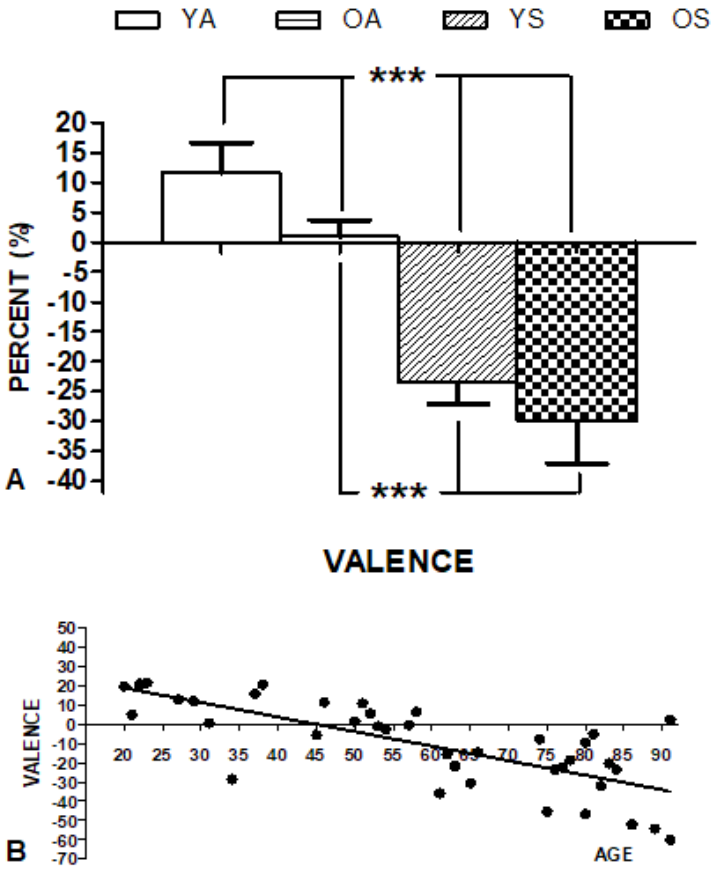
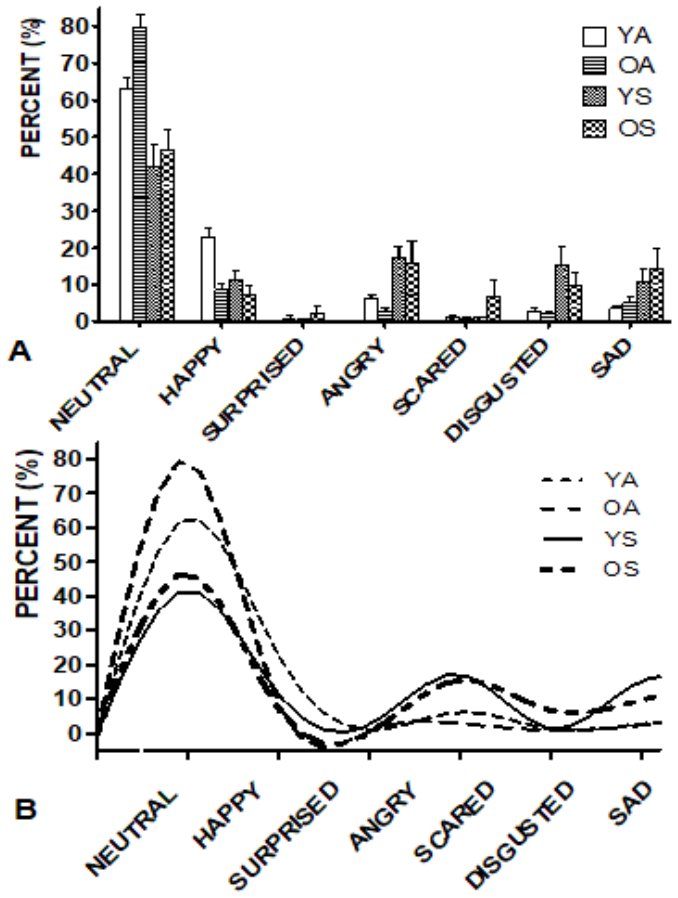


Figure 2: (A) Mean±SEM of the percentage of the valence in Young Adult (YA), Old Adult (OA), Young Senior (YS) and Old Senior (OS) after viewing the broadcasting entire film clip composed of successive short film clips (1 to 2 minutes) emotionally labelled. (B) Linear regression with all the percentages of the articipants' valences related to their respective ages revealed an inflection point at 45.

This resulting difference between YA and OA, and YS and OS, was precisely explained in regard to the detailed facial expressions (Figure 3A and 3B). Indeed, facial expressions, excluding neutral expressions, revealed a significant difference between the 4 groups [Fig 3A, (MANOVA: F (3, 36) =12.8; p<0.001)] as well as the ratio of the successive emotions elicited during the video projection by the 4 groups [Fig 3B, MANOVA: F (5, 180) =2.85; p = 0.001].



(Figure 3: (A) Mean±SEM of the percentage of specific facial expressions that were observed when broadcasting in succession, neutral, happiness, surprise, angry, scare, disgust, and sad film clips. (B) The ratio of the successive emotions elicited during the video projection by the 4 groups.

From the starting video projection, both adult groups (YA and OA) demonstrated much more neutral emotion (Figure 4A) than both senior groups (YS and OS) [ANOVA: F (3, 36) =12.8; p<0.001]. Selected ANOVAs revealed an equivalent difference between the YA or OA groups and YS or OS groups [ANOVAs: F (1, 18) ≥ 5.26; p≤0.05]. Notably, the OA group was much more indifferent than the YA group [ANOVA: F (1, 18) =12.67; p<0.01]. Chronologically, the first evoked emotion, after the neutral emotion, was the happy emotion (Fig 4B). All the groups showed this emotion but at a different level [ANOVA: F (3, 36) = 8.68; p<0.001). While the OA, YS, and OS groups reacted at a quite similar level, approximately 10±3%, without significant difference between them [ANOVAs: F (1, 18)≤1.7; NS], the younger group (YA) demonstrated two times the amount of happiness (22.63%) with a significant difference with the OA group [ANOVA: F (1, 18)=16.34; p<0.001], the YS group [ANOVA: F (1, 18)= 9.4; p<0.01] and the OS group [ANOVA: F (1, 18)=17.04; p<0.001]. Then, for the surprise emotion (Fig 3C), no significant difference was seen between the four groups [ANOVAs: F (3, 36) =1.04; NS]. Again, a significant difference was found for the angry emotion [Fig 3D, ANOVA: F (3, 36) = 4.12; p<0.05)]. Indeed, the adult groups were less sensitive to film footage related to anger than the senior groups. The YS group reached a much higher ratio than the YA group [ANOVAs: F (1, 18) =8.7; p < 0.01]. A lower ratio was observed in OS subjects and consequently was different from both S subjects (YS and OS groups) [ANOVA: F (1,18) ≥ 5.06; p≤0.05]. All the groups had low sensitivity to the fear portion of the video (Fig 3E), with no significant difference between them [ANOVAs: F (3, 36) = 1.17; NS]. The higher level (6.56%) observed in the OS group comes mainly from one patient who was particularly scared (46.4%) during all video projections. A significant difference was observed in the disgust emotion [Fig 3F, ANOVA: F (3, 36) = 4.1; p<0.05)], particularly in patients from the YS group in comparison to both adult groups (YA and OA groups) [ANOVAs: F (1, 18) ≥6.86; p < 0.05]. Finally, although a progressive increase in the ratio was seen from YA to OS in sadness (Figure 4G), no significant difference was reached (ANOVA: F (3, 36) = 1.67; NS) due to intragroup variability increasing with age.

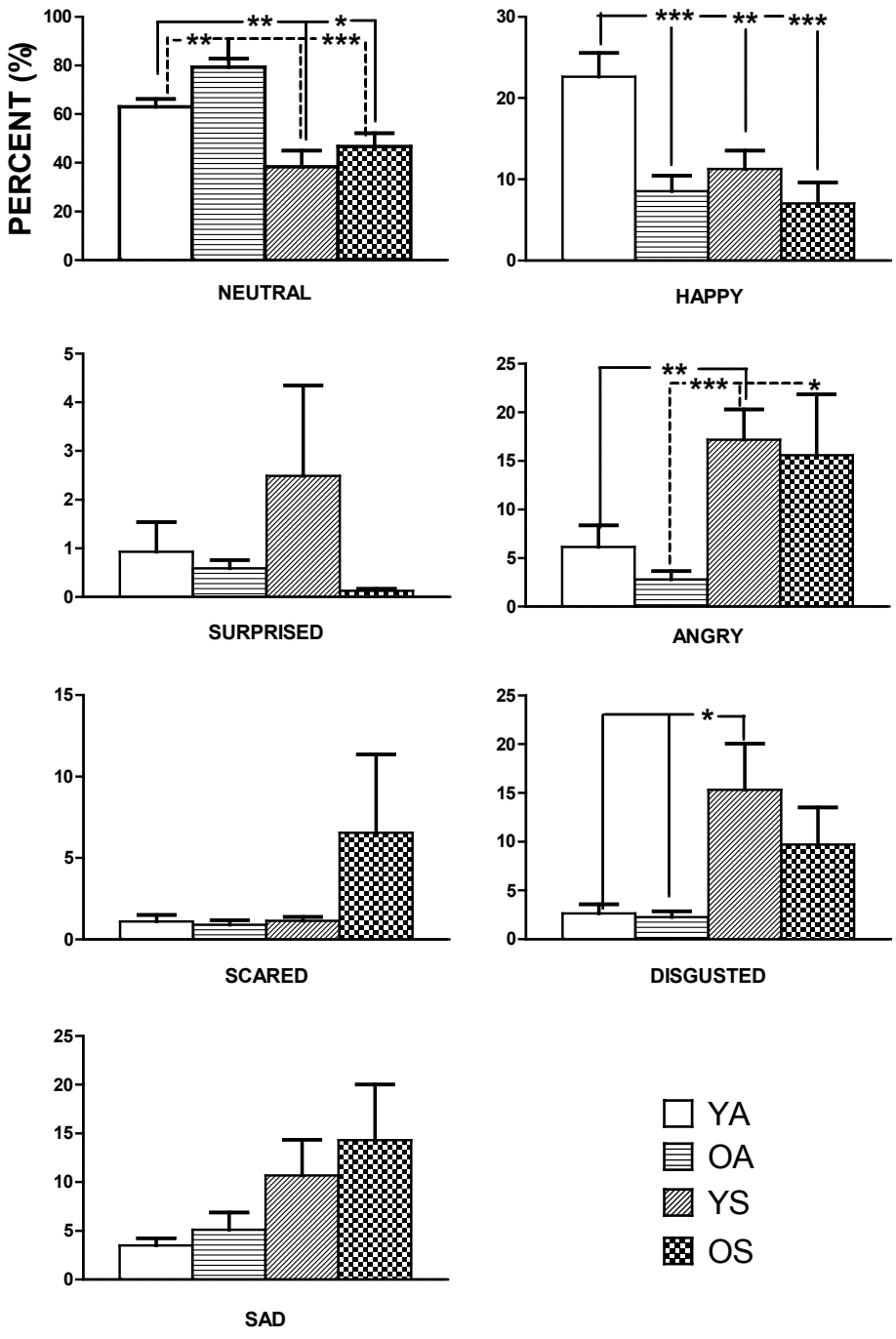


Figure 4: Mean±SEM of the percentage of specific emotions. Significant differences were mainly seen between groups in the amount of neutral, happy, and angry emotions.

Discussion

In agreement with several other previous reports on emotions, the video montages that we did allow us to observe emotional evolution [29-31] at different ages [32]. Additional supplementary statements can be made from the present results. A first dichotomy has been seen among the amount of emotion, as revealed by the respective neural emotion percentage resulting from the entire video. Indeed, from forty to sixty years, taken as a whole, it is during this age range that the lower amount of emotion was seen, as demonstrated by the higher percentage of neutral emotion. Then, looking more precisely into emotions by group age categories, it appeared that the first emotion declining significantly with aging is happiness. A high level of happiness seems to be the signature of younger adults under forty years of age. In addition, from sixty to eighty, the amount of emotion increased significantly more, specifically in the angry emotion, and associated with a high but not significant level in the disgust emotion, which distinguished the subjects of this age range. this last emotion, it should be noted that a significant difference was seen between the adult groups and the YS group, as was already reported by Calder et al in 2003[4]. The sad emotion increased from age ranges without reaching a significant level between them, demonstrating a high level of variability in intra-ranges of a specific emotion. No significant difference throughout the developing age was observed in the surprised and scared emotions. While no significant difference was seen in arousal from the YA to the OS subjects, a notable difference was observed in the valence between the adults and the seniors. Indeed, with increasing age, a significant switch from a positive valence to a deep negative valence appeared. The attempted linear regression revealed that the inflection point was at the age of 45. These specific behavioral changes appearing with increasing age were seen, as we suspected, by testing only groups of 10 subjects. Indeed, almost all the emotions were differentially expressed in the age range, but only happiness, anger, and at a lower level, disgust, reached a significant difference. The intragroup variability did not allow the other emotions to reach a significant level and consequently cannot be considered an early homogeneous marker of aging. However, emotion regulation in normal aging demonstrated in past studies that the effect of age on emotional processing is mainly characterized by an attempt to avoid unpleasant situations rather than a clear tendency to prioritize the processing positively [11, 33-35]. One explanation could be found in what is called an attentional bias [11]. Indeed, in this study, the authors proposed that it is older adults' increased emphasis on one emotional goal: direct attention away from information that is not emotionally gratifying. This attentional bias was not observed in YA [34] and was interpreted by a negativity bias resulting from the salient effect of negative attention in comparison to positive stimulation, which decreased significantly with older age. This striking difference in regard to our present results can be explained as follows: in our study, participants were only asked to watch the ongoing successive film clip without demand in turn. The participants were not passive, as demonstrated the equivalent level of arousal through the age ranges, but were trying to figure out what's going on and did not have to make a choice like in the Mather and Carstensen studies [11], thus the negative developing emotion with age cannot be due to on arousal bias. Consequently, when a choice has to be made, old adults do not choose negative information and can demonstrate a positive valence. Conversely, when the information cannot be chosen or avoided, the valence becomes negative with age, which is the case in your study. Overall, we observed that emotion is a domain in which older adults fare surprisingly well, as previously reported [7, 36]. Emotions depend on a complex circuitry of brain regions interacting with the neurotransmitter system and stress and hormones [37, 38]. Thus, from our observations, deficits in seniors are not the result of a decrease in emotion but a modulation in their expression with a significant decrease in happiness and an increase in anger. The ongoing emotion in our study requires a cognitive effort to figure out what is going on as we wrote above. These cognitive capacities, excluding arousal, are well known to be affected in aging. Actively watching a film requires many different brain regions to be active. Obviously, the visual cortex in the occipital lobe can interpret visual information from viewing the screen as well as most of the temporal lobe due to the need for object recognition by sensory integration. Age-related shrinkage occurs in the medial temporal lobes of healthy adults with significant hippocampal decline and minimal entorhinal changes [39, 40]. These changes could be suspected to be one hallmark in healthy aging of relational memory [41-43] requested to understand the watching ongoing story. Thus, with advances in age in healthy adults, the lack of understanding of the film clips will be translated by an increase in anger. In summary, broadcasting selected film clips that have been emotionally-labeled, without testing demand, in turn, will allow us to distinguish normal older-adult behavior, in which arousal and specific emotions are still present, even if they are expressed differently. Currently, patients with neurological diseases, such as depression, or patients with degenerative diseases, such as Alzheimer's disease, will be tested to assess how these emotions will be modulated or transformed by the disease. Thus, this non-stressful procedure of broadcasting film clips without demand in-turn in patients could be useful as an early first approach for suspected incoming diseases.

Conclusions

This study allowed us to discriminate by different age group's respective amounts of emotional stimulation and the normal evolution of emotions at different ages. This study should be reproduced with patients in which specific diseases were diagnosed and, more specifically, in Alzheimer patients at different stages of the disease to determine whether this method can detect incoming disease earlier by observing the emotional state of the patient presenting for a suspected disorder. This testing method, which is easy to apply, could allow us to discriminate between normal processes occurring during aging from pathological processes occurring in neurological diseases.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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