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► **To cite this version:**

Sarah Le Vigouroux, Bruno Dauvier, Anne Congard. Development of affect and affective stability in adulthood: Nonlinear age-related differences in daily life. *Current Psychology*, 2020, 10.1007/s12144-020-00743-y . hal-02551699

**HAL Id: hal-02551699**

**<https://hal.science/hal-02551699v1>**

Submitted on 26 Sep 2023

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## Development of affect and affective stability in adulthood: Nonlinear age-related differences in daily life

Sarah Le Vigouroux<sup>1</sup> · Bruno Dauvier<sup>2</sup> · Anne Congard<sup>3</sup>

<sup>1</sup> EA 7352, CHROME, Team APSY-v, Nîmes University, rue du Dr G. Salan 30021, Nîmes Cedex 01, France

<sup>2</sup> PSYCLE, Aix-Marseille University, Aix-en-Provence, France

<sup>3</sup> Laboratoire de Psychologie des Pays de la Loire, LPPL, EA 4638, Nantes University, F-44000 Nantes, France

### Abstract

Our objective was to highlight age-related differences in subjective affect and its variations between adolescence and old age in an ecological environment, running generalized additive models to look for nonlinear relationships between age and affect. The originality of this research lay in its consideration of the levels of both affective valence and affect activation. Over a 2-week period, 209 participants aged 13–80 years completed a daily survey based on the experience sampling method, each providing an average of 60 observations. Results revealed 1) two nonlinear patterns of age-related differences in affective valence during the first (declines in deactivated negative affect and deactivated positive affect) and second (continuing decline in deactivated negative affect and increase in deactivated positive affect) halves of adulthood, and 2) one linear pattern of age-related differences in affect variation in the shape of a two-step reduction in the amplitude of variation, with a more marked reduction in the second half of adulthood. Results are discussed in the light of age differences in motivation and affect regulation expertise.

**Keywords** Circumplex structure of affect . Affect variability . Affective inertia . Motivation change . Generalized additive model

### Introduction

Many studies have reported age-related affective differences, showing that the quality of affective experience improves during adulthood, and can be maintained in aging (e.g., Carstensen et al. 2011; Charles et al. 2001). Lifespan theories such as Socioemotional Selectivity Theory (SST; Carstensen 1995), Strength And Vulnerability Integration (SAVI; Charles 2010), and Selection, Optimization and Compensation in Emotion Regulation (SOC-ER; Urry and Gross 2010) explain this improvement in terms of age-related motivational changes and the acquisition of expertise in affect regulation. They suggest that as individuals age, they become not only increasingly motivated to regulate their emotions, but also increasingly capable of doing so, potentially leading to reduced negative affect (NA) and increased positive affect (PA) (Kunzmann et al. 2014). NA does indeed decrease across adulthood, while PA and wellbeing generally increase (e.g. Carstensen et al. 2011; Charles et al. 2001). Moreover, affects differ with age not only according to their valence (positive vs. negative), but also according to their degree of activation (activated vs. deactivated) (e.g., Kessler and Staudinger 2009). After explaining the circumplex model of affect on which the present study was based, we identify the different types of affect variation, and describe studies highlighting age-related differences in affect and affect variation.

## Contribution of the Circumplex Approach

Affects are traditionally regarded as the subjective aspect of emotions, as opposed to the somatic aspect. They are the reflection of events perceived through the filter of regulation processes, and can refer not only to emotions, but also to stress responses and moods (Gross 2015). Different studies have attempted to define and count affects. According to Russell (1980), affects are interrelated, rather than being completely independent of each other. The value of Russell and Barrett (1999)'s circumplex model is that it is organized in the form of a circle in a two-dimensional space with two bipolar orthogonal axes: valence (pleasant vs. unpleasant) and activation (or arousal; activated vs. deactivated). This consensual model has made a major contribution to research on affect structure, providing new opportunities for analyzing changes in the different affects during aging. This approach allows for a more detailed understanding of affects in terms of valence and activation in the different octants of the circumplex. This circumplex pattern has become the most widely used structural representation of affect in studies of individual differences (e.g., Erbas et al. 2015; Kuppens et al. 2013; Wilt et al. 2011). Yik and Russell (2003) showed that the circumplex approach is also useful for identifying the links between affects and other variables, particularly age.

In its most advanced version (Yik et al. 2011), the circumplex is composed of 12 points: 1) pleasant activation (e.g., energetic, excited), 2) activated pleasure (e.g., enthusiastic, elated), 3) pleasure (e.g., satisfied, pleased), 4) deactivated pleasure (e.g., serene, peaceful), 5) pleasant deactivation (e.g., placid, tranquil), 6) deactivation (e.g., quiet, still), 7) unpleasant deactivation (e.g., sluggish, tired), 8) deactivated displeasure (e.g., sad, gloomy), 9) displeasure (e.g., unhappy, dissatisfied), 10) activated displeasure (e.g., distressed, upset), 11) unpleasant activation (e.g., frenzied, jittery), and 12) activation (aroused, activated). This representation has the advantage of going further than the traditional methods of investigation featuring just PA and NA, as it gives more precise meanings on two consensual dimensions (i.e., valence and activation). It therefore allows the overall affective experience to be represented (Barrett and Russell 1998). Although individuals have an ideal emotional state or at least a state of balance, also called a core affect, toward which they tend to return, affects vary greatly around this point, and do not always reach it. These intra-individual changes are relatively rapid and can be more or less reversible. One characteristic of affects is therefore that they change all the time. These variations serve to inform individuals about their environment, so that they can modify their behavior and adapt to the situation accordingly. Russell (2003) emphasized that affective experiences (i.e., subjective feelings) only reach consciousness when they undergo change. It is therefore necessary to consider fluctuations and not just the mean level of affects.

## Affective Variations

Kuppens et al. (2007) investigated intra-individual differences in affect variability. Affective states change over time, and these transitions can take different forms, being of greater or lesser magnitude and remaining more or less in the same area. To consider this intra-individual variability in the regulation of affects, Kuppens et al. (2010) developed a model of affect dynamics called DynAffect. Based on this model, individuals can be characterized according to three individual processes or characteristics that subtend changes in daily affective experiences: 1) home base, corresponding to the core affect; 2) fluctuations in affect around this point (i.e., affect variability), and 3) attractor strength, corresponding to the force of attraction exerted by the core affect. Thus, fluctuations in affect result from internal or external processes to which an individual is more or less sensitive and which are linked to the core affect by attractor strength.

We were interested in two types of fluctuations in affect: affect variability and affective inertia (Kuppens and Verduyn 2015). Affect variability refers to the range over which affects fluctuate across time (often captured by the standard deviation of emotion scores across time). Affective inertia refers to the tendency of emotions to carry over from one moment to the next, reflecting a resistance to change (often captured by the autocorrelation of affect scores across time; Koval et al. 2015; Kuppens et al. 2012). High inertia occurs when an individual's affective fluctuations closely resemble those that occurred in the previous affective state. It differs from variability, which concerns the magnitude of affective fluctuations. An individual can therefore have high variability and high inertia. In short, affective inertia refers to the speed of change, while variability refers to the dispersion of change.

A high level of inertia may be a sign that the individual's particular environment has the effect of dramatically height- ening his or her affective state. Then again, it may reflect maladjustment, notably indicating that the individual's affects are less sensitive to external (e.g., influence of lived events) or internal (e.g., voluntary regulation) influences, and therefore capturing both blunted reactivity and weakened regulatory skills. High inertia is a key characteristic of affective dynamics in depression, especially in adolescents (Kuppens et al. 2012).

## Age-Related Differences in Affect and Affect Variability

Affective experience (relative to core affect and affect vari- ability) changes with age. Regarding age related-differences in core affect, Charles et al. (2001) observed an NA decrease in a longitudinal study over 23 years including participants aged 17–101 years. For their part, Mroczek and Kolarz (1998) found that NA decreased until about age 60 years, then stabi- lized, while the frequency of PA increased slightly, in a sample of 2727 participants aged 25–74 years. Regarding age-related differences in PA, results are contradictory. Most studies indi- cate that the frequency of positive versus negative experiences increases and then levels off, before undergoing a slight de- crease in extreme old age (Carstensen et al. 2011; Gana et al. 2015). In a German socio-economic panel study Kunzmann et al. (2013) found that happiness decreased, but only in old age. When activation was taken into account, older partici- pants reported a higher level of deactivated PA (e.g., serenity) than younger participants did, while activated PA (e.g., enthu- siasm) remained stable (Kessler and Staudinger 2009; Scheibe et al. 2016). Regarding NA, older adults reported a lower level of activated NA (e.g., anger) than younger participants did, while deactivated NA (e.g. sadness) remained stable (Charles and Carstensen 2008; Kunzmann et al. 2013; Tassone et al. 2019). In an occupational context, in a sample of 95 healthcare sector employees aged 17–64 years, activated NA decreased after a day of work, while deactivated NA remained stable (Scheibe et al. 2016).

Most studies, including the above-mentioned ones, have taken a linear approach to age-related affective differences. However, affects are, by definition, dynamic, and a linear approach makes it impossible to highlight this aspect (McKeown and Sneddon 2014). When Kunzmann et al. (2013) studied age-related affective changes and stability, they therefore concluded that age-related improvements in the quality of affective experiences across the entire adult lifespan cannot be studied using a uniform and linear approach.

Regarding age related-differences in affect variation, some studies suggest that PA and NA variability dwindles in old age(e.g., Brose et al. 2013; Röcke et al. 2009). Older adults experience fewer day-to-day fluctuations in PA and NA than young adults do, but with no distinction in terms of activation. These age differences are more apparent in PA than in NA (Röcke et al. 2009). For example, compared with younger adults (20–31 years), the older adults (65–80 years) in Brose et al. (2013)'s study reported that stressors had less impact on their affect. The results of Brose et al. (2015), based on data collected over 100 days in everyday life situations, showed that older (65–80 years) adults' affective experiences were less complex and therefore less variable than those of younger (20–31 years) adults. To our knowledge, no study has yet examined age-related differences in affect variations (ampli- tude and inertia) by considering both valence and activation. We can draw two main conclusions from the various theories that have been developed to explain age-related differences in affect. First, there is a change in life objectives, as the goal of emotion regulation and immediate wellbeing becomes more and more of a priority with age (Carstensen 1995; Charles 2010). Second, affect regulation skills improve through the development of expertise in the use of regulation strategies (Charles 2010; Urry and Gross 2010).

SST (Carstensen 1995) and SAVI (Charles 2010) postulate that these differences can be accounted for by the interaction between affect and social factors, including changes in life priorities. With aging, people become more aware of their future time perspective, which changes their fundamental ob- jectives. Thus, when time limitations make themselves felt, older people tend to avoid negative experiences that have become less necessary and are viewed as short-term sacrifices motivated by long-term objectives (Löckenhoff and Carstensen 2004, 2007). These two patterns.

SAVI (Charles 2010) and SOC-ER (Urry and Gross 2010) suggest that age-related differences can be explained by the development of expertise in the use of emotion regulation strategies. According to SAVI, age-related differences are marked by increased use of regulatory strategies to avoid or limit exposure to negative stimuli, but with some vulnerability related to physiological aging under conditions where there is a high level of affect

activation (Charles 2010). Time lived is conceived of here as an important mechanism by which people acquire practice and experience in their encounters with everyday problems (e.g., Blanchard-Fields 2007). Previous experiences increase exposure to and assimilation of cultural norms and roles. SOC-ER explains that people select and optimize particular regulation strategies according to their available resources, thereby highlighting how expertise in affect regulation is acquired with aging. Moreover, Fredrickson (1998) suggest that affects, especially PA, serve as regulation resources.

## Objectives

The present study was intended to pin down age-related differences in the experiences and emotional dynamics of adolescents and adults in ecological environments. It had a twofold aim. First, as affects do not follow linear trajectories across the lifespan (Kunzmann et al. 2013), we investigated the nonlinear aspect of age-related affective differences in two components of the DynAffect model (core affect and affect variability) in an ecological environment using the experience sampling method (ESM). Second, we investigated age-related differences in 12-point circumplex affects (Yik et al. 2011) and affect variations not only according to the valence (positive vs. negative) of the affects being considered, but also according to their degree of activation (activation vs. deactivation; e.g., Kessler and Staudinger 2009). Our overall objective was to demonstrate the nonlinearity of affective differences, characterized by a change in PA dynamics in middle adulthood, by collecting data in an ecological environment via daily surveys, as other studies have done (i.e., Carstensen et al. 2011; Scheibe et al. 2013). We formed the general hypothesis that age-related differences (from adolescence to old age) in affects (core affect and affect variation) depend on the latter's valence and activation, and follow nonlinear patterns. We assumed that:

- 1) During the first part of adulthood, individuals focus on reducing NA, especially deactivated NA (i.e., unpleasant deactivation and deactivated displeasure), as suggested by Scheibe et al. (2016);
- 2) At the same time, individuals experience less and less deactivated PA (i.e., deactivated pleasure and pleasant deactivation), owing to the nature of their lived experiences (education/training, entering the world of work, starting a family, etc.) and the fact that their capacity for emotional regulation is still developing, as suggested by Löckenhoff and Carstensen (2007), and Urry and Gross (2010). Activated PA (i.e., pleasant activation and activated pleasure) increases, however, owing to the energy required to carry out activities related to their life projects (Fredrickson 2000);
- 3) During the second half of adulthood, individuals focus on increasing deactivated PA (Carstensen 2006). This results in the continued reduction in NA (both activated and deactivated) and, above all, an increase in PA (especially deactivated PA);
- 4) Given that high variability and high inertia are markers of psychological maladjustment (e.g., Koval et al. 2016; Kuppens et al. 2012), variations in affect (especially NA) and affective inertia decrease with age.

## Methods

### Participants

The sample consisted of 209 French individuals (131 women) aged 13–80 years ( $M = 38.50$ ,  $SD = 17.56$ ). The sample's age distribution is shown in Fig. 1. There were no sex differences in participants' age distribution ( $t = -.88$ ,  $p = .38$ ) or affective experience (Table 1). Participants were mostly recruited through the investigators' networks or through word of mouth, with the remainder being recruited on social media. Participants came from various regions of France. All participants signed an informed consent form that outlined the conditions for taking part, as well as for withdrawing from the study, if desired. The study met local ethical rules on noninvasive protocols involving healthy participants, and did not require formal ethics committee approval.

## Procedures and Metrics

The ESM provides an opportunity to analyze affects in a relatively ecological way and to study their short-term fluctuations

Fig. 1 Distribution of participants according to age

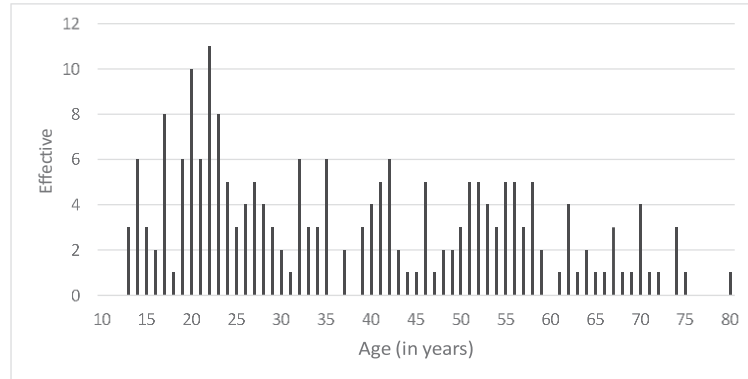


Table 1 Sex differences in sample

	Mean		Standard Deviation	
	<i>t</i>	<i>p</i>	<i>t</i>	<i>p</i>
Pleasant activation	-2.48	.01	.99	.32
Activated pleasure	-1.60	.11	-.47	.64
Pleasure	-2.17	.03	.99	.32
Deactivated pleasure	-1.63	.11	1.85	.07
Pleasant deactivation	-1.41	.16	1.59	.11
Deactivation	.92	.36	.73	.47
Unpleasant deactivation	1.78	.08	1.75	.08
Deactivated displeasure	1.30	.20	1.82	.07
Displeasure	1.18	.24	1.63	.11
Activated displeasure	1.32	.19	.87	.39
Unpleasant activation	1.81	.07	1.34	.18
Activation	-.30	.76	.27	.79

(Wilt et al. 2011). This procedure has become the norm in this area (McKeown and Sneddon 2014; Wilt et al. 2011), as it is a unique method that records participants' responses as they experience the affective state of interest. We used the mean level of affect ratings over a 2-week period. We assumed that these assessments were more ecological and reliable.

First, a psychologist conducted a structured face-to-face or telephone interview with each participant. The purpose of this interview was to establish a list of 12 items corresponding to the 12 affects identified by Yik et al. (2011). A definition of each affect was read out to the participant, who then had to indicate the most prototypical adjective for that definition. Once the 12 affects had been listed, the experimenter gave the list to the participant, in order to correct any misunderstandings. This procedure limited the risk of the same term meaning different things to different participants (Nesselroade et al. 2007). There were no age-related differences in the choice of adjectives for each affect. These 12 items were then printed on a memo card (see Fig. 2) that was sent to participants to allow them to complete the daily survey.

Second, participants underwent a daily survey with five observations per day for 14 consecutive days (ESM phase). For each observation, participants had to respond within 30 min to alerts sent automatically to their mobile phones from a central server. Referring to their memo card, they had to indicate the intensity with which they currently felt each of the 12 affects listed on a 5-point scale ranging from 1 (Not at all) to 5 (Very) (e.g., 414,131,212,415). Alert messages were sent about every 3 h from 9 am onwards (participants could request an adjustment of more or less 15 min). The participation rate in the daily survey was 86%, or an average of 60 observations (out of 70) for each participant.

## Statistical Analysis

We used generalized additive models (GAMs) to study age-related differences (gam function of the mgcv package in R; Wood 2016). The term additive refers to the additivity of the spline transformations of the explanatory variables. It is easier to analyze nonlinear interactions between numerical explanatory variables with GAMs than with polynomial transformations in generalized linear models (Marx and Eilers 1998; Wood and Augustin 2010). GAMs also provide the flexibility needed to describe what are often nonlinear age-related differences in affective states (McKeown and Sneddon 2014). Another advantage of GAMs is that during the estimation process, the various possible models are automatically compared, in order to directly find the one that best fits the data. To indicate the nature of the relations, the predictions were calculated and displayed in graphic form. The GAMs were estimated from standardized data, allowing us to graphically estimate effect sizes.

Right now, I'm feeling:
1. Dynamic
2. Weary
3. Enthusiastic
4. Depressed
5. Happy
6. Dissatisfied
7. Serene
8. Distressed
9. Relaxed
10. Tense
11. Numb
12. Overexcited

Fig. 2 Example of a memocard

We used GAMs to simultaneously model variations in all 12 circumplex affects according to age. These models explained the respondents' mean ratings of the 12 items in terms of the interaction between age and the sine and cosine of the angular position of each affect on the circumplex, thereby allowing us to respect the latter's circularity. In order to be able to consider the circumplex nature of the affects, the scores used in the model were the mean scores for each of the 12 affects over the 2-week period. This model made it possible to separately consider nonlinear variations in each of the 12 affects, all the while taking advantage of their proximity on the circumplex.

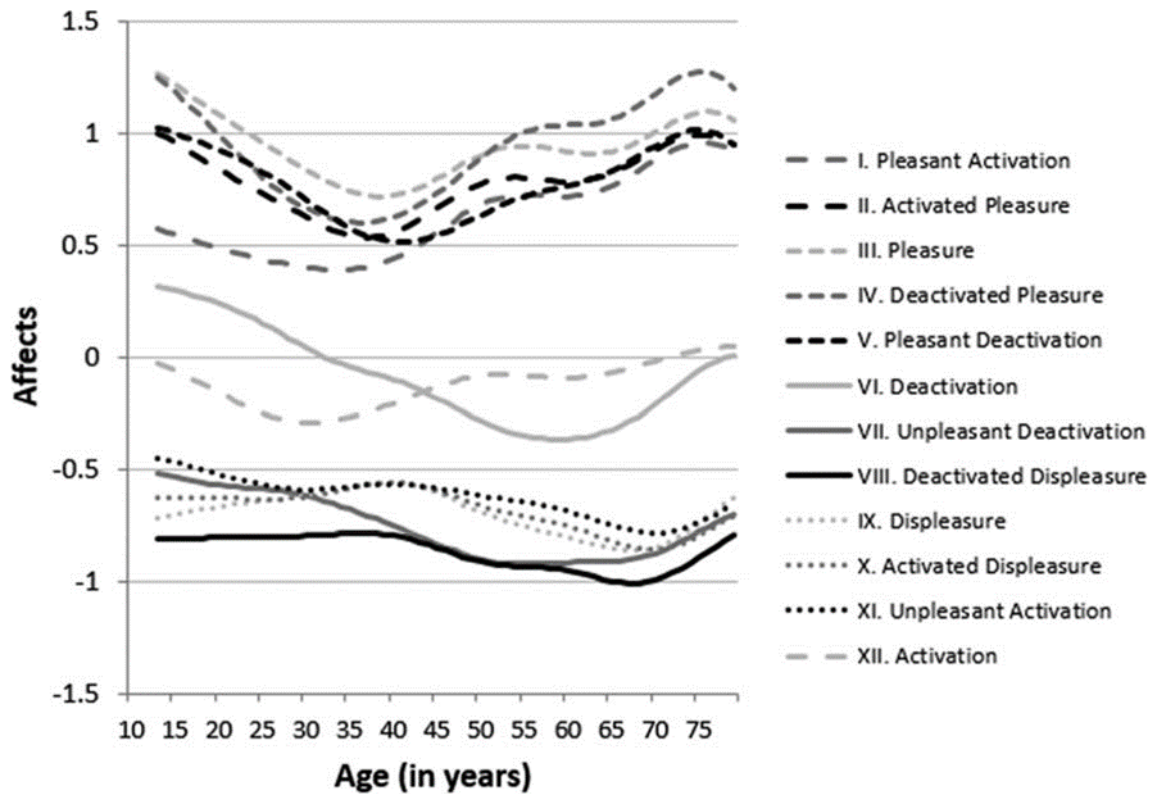
Affect variability was operationalized by the intra-individual standard deviation for each of the 12 affects, and affective inertia by the autocorrelation between two measurement timepoints for the same affect (Kuppens and Verduyn 2015).

## Results

### Age-Related Differences in Affects

The estimated models of age-related differences in circumplex affects explained 50.1% of the total deviance (edf = 49.33), while the model2 that did not take age-related differences into account explained 44.8% of the variance. The GAM-predicted age-related differences in affect level (Fig. 3) concerned both the valence and activation of each affect. The relationships revealed by the GAMs appeared to be a little more complex than those generally described in the literature, as none of the 12 affects varied linearly with participants' age.

Overall, results showed that the reported level of PA was higher than that of NA. Deactivation and unpleasant deactivation decreased between the ages of 13 and 60 years, then underwent an increase equivalent to half the initial reduction over the subsequent 20 years. Deactivated displeasure, displeasure, activated displeasure, unpleasant activation and activation differed relatively little across the age range we studied. Regarding differences in activated pleasure, pleasure, deactivated pleasure and pleasant deactivation, these affects decreased until about 35–40 years of age, then increased by the same amount until 70–75 years of age, after which there was a slight decrease. The GAMs predicted that age-related differences in PA would follow an S-shaped curve. Interestingly, we found that during the first half of life (up to the age of 35–40 years), adolescents and young adults simultaneously felt less and less PA, and less and less NA.



<sup>1</sup>  $M = \text{gam}(\text{affect} \sim s(\text{age}, \cos C, \sin C), \text{data} = \text{standardized data})$ , where  $C = \text{position in the circumplex} / 12 * 2\pi$ .

<sup>2</sup>  $M0 = \text{gam}(\text{mean affect} \sim s(\cos C, \sin C), \text{data} = \text{standardized data})$ .

Fig. 3 GAM-predicted z scores for the 12 circumplex affects between 13 and 80 years

The initial analysis revealed two main patterns of age-related affective differences (Fig. 4), depending on the valence of the affects. To explore these differences in greater depth, we conducted a principal component analysis of the GAM predictions. This analysis revealed two patterns of affect differences (proportions of variance: .47 and .45) with age (Fig. 3). With loadings above .90, the first one concerned activated pleasure (.97), pleasure (.96), deactivated pleasure (.95), and pleasant deactivation (.97). The second one concerned deactivation (.94), unpleasant deactivation (.96), displeasure (.92), and activated displeasure (.92). Thus, the former could be identified as the difference component of deactivated PA, and the latter as the difference component of deactivated NA. Their representation confirmed what we had observed earlier at the circumplex level.



## Age-Related Differences in Affect Variability

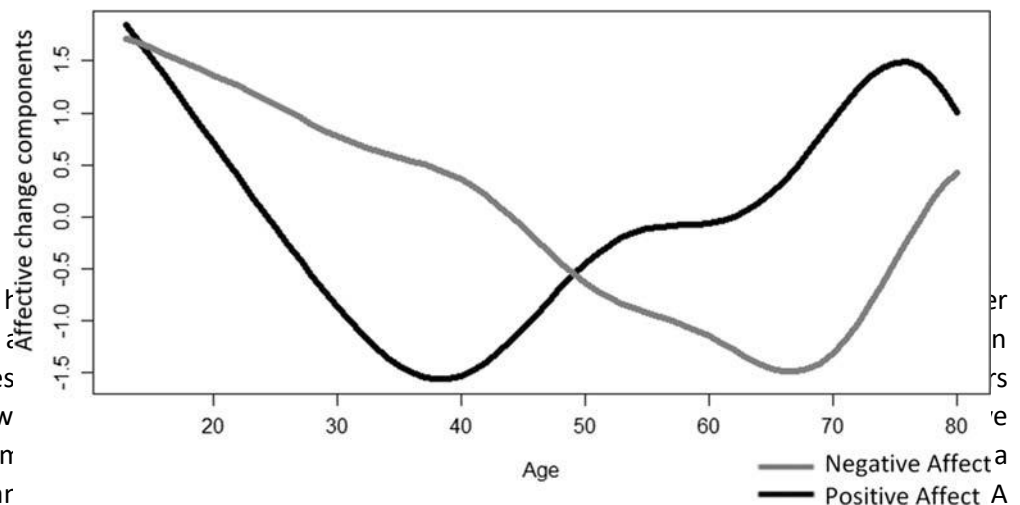
The estimated models of age-related differences in circumplex affect variations explained 10.8% of the total deviance (edf = 30.97), while the model<sup>1</sup> that did not take age-related differences into account explained 4.86% of the variance. The GAM-predicted data are provided in Fig. 5. Results showed that the older the participants, the less their affects varied, with reduced amplitude whichever affect was considered. There were two reductions in affect variation, one before 30 years and one after 40 years, the second reduction being greater than the first (Fig. 6). By contrast, there were no age-related differences in affective inertia. The estimated models of age-related differences in circumplex affective inertia explained 1.66% of the total deviance, and the model<sup>2</sup> that did not take age-related differences into account explained 0.69% of the variance.

## Discussion

The present study examined age-related differences (from adolescence to old age) in affect and affect variation in an ecological environment. Affects differ in a nonlinear way between adolescence and old age, and it seems that age-related differences in affective experience and affect variations cannot be reduced to a simple linear trend between 20 and 30 and 60–80 years (Carstensen et al. 2000; Diehl et al. 2011). For core affect, our results showed that age-related differences in PA followed a moderate S-shaped curve. Furthermore, we identified two nonlinear patterns of age-related affective differences. These two patterns were differentiated by valence,

Fig. 4 Age-related differences in deactivated NA and PA from adolescence to old age. *Note.*

These are the factor scores of the first two components of the principal component analysis based on GAM predictions of age-related affective differences



and not by activation as we deactivated and unpleasant affect in adolescents. The differences corresponded to a period when experience may explain the nonlinear period when goals are characterized by a subsequent decrease, albeit smaller than the first one, corresponded to a period when the acquired strength and expertise in affect regulation are diminished by the vulnerabilities associated with aging. Thus, up to the age of 35–40 years, individuals feel less and less NA and PA, and after 35–40 years, they continue to feel less and less NA, but more and more PA.

The complexity of age-related differences in PA can be linked to results in the cognitive field. Some studies have shown that older people focus more on positive stimuli to compensate for the decline in executive functions, notably autobiographical recall (Holland et al. 2012; Piolino et al. 2010). The meta-analysis by Reed et al. (2014) indicated that older people have a significant information processing bias toward positive information over negative information, whereas young adults show the opposite bias (i.e. positivity effect). It therefore seems that individuals specifically target NA and its reduction, and initially abandon PA, thereby partly explaining the double reduction in PA and

<sup>1</sup> MO = gam(affect standard deviation ~ s(cosC, sinC), data = standardized data).

<sup>2</sup> MO = gam(affective inertia ~ s(cosC, sinC), data = standardized data).

Fig. 5 GAM-predicted z scores (standard deviation) for the 12 circumplex affects between 13 and 80 years

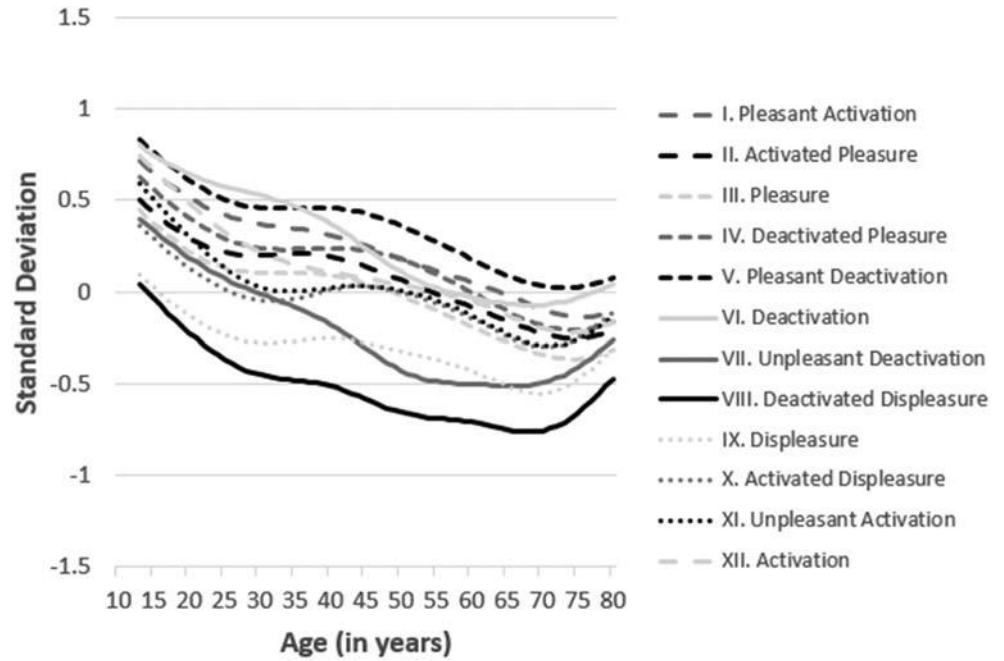
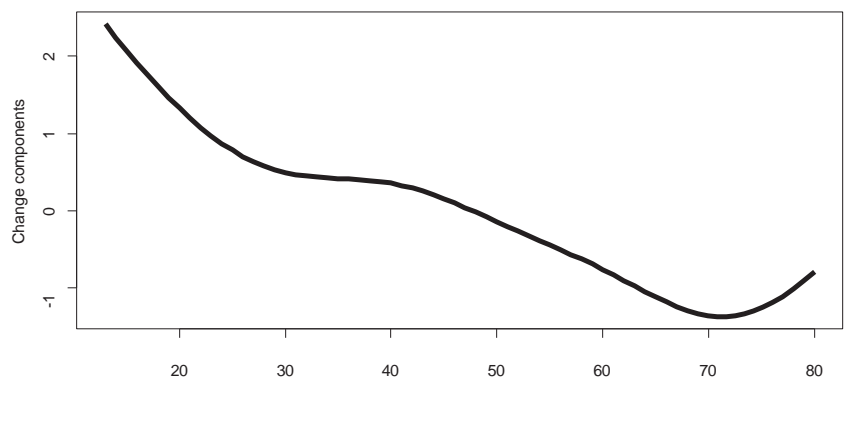


Fig. 6 Age-related differences in affect variation from adolescence to old age. Note. These are the factor scores of the first component of the principal component analysis based on GAM predictions of age-related differences in affect variation



NA. More generally, cognitive development could have a strong influence on PA and NA, through the consequences it would have on the use of emotional regulation strategies (De France and Hollenstein 2019).

For affect variability, the amplitude of NA and PA variations decreased with age. More specifically, the older the participants, the smaller their affect variation. This reduction in the amplitude of affect variation is consistent with the literature, in which affective stability is conceived of as an adjustment characteristic (Röcke et al. 2009), reflecting individuals' enhanced affect regulation skills (Urry and Gross 2010). It is therefore understandable that the most significant reduction in affect variation should occur during the second half of adulthood, when emotion regulation becomes the main goal (Lang and Carstensen 2002). We can attribute the lack of a relationship between affective inertia and participants' age to the fact that other variables, such as personality or emotional competence, can explain this aspect of emotional dynamics.

These two patterns of age-related differences in affect and affect variation from adolescence to old age can also be understood in relation to the priority given first to eudemonic, then to hedonic motivation (Henderson and Knight 2012; Houben et al. 2015; Ryan and Deci 2001). These two motivations are complementary, and exist side by side in all individuals. However, depending on the lifetime period and the situations they encounter, individuals may favor one or the other. Eudemonic motivation emphasizes personal development and self-realization through activities that are part of a life project (e.g., doing well at school, finding a job, building a new relationship, setting up home). Hedonic motivation emphasizes immediate PA.

Adolescents and young adults preferentially adopt a eudemonic motivation at the outset, honing their affect regulation skills in order to reduce NA. This period is characterized by personal construction where individuals can find themselves in challenging situations, leading them improve their emotional skills (for a meta-analysis, see Doerwald et al. 2016). As they primarily seek to achieve psychological wellbeing (through individual development), they do not target immediate feelings of PA. They engage in activities that require a great deal of effort and personal commitment (Lanteigne et al. 2014; Shomaker and Reina 2015), and therefore favor affect regulation that is oriented toward reducing the NA generated by these activities. With advancing age and the attainment or exceeding of previously targeted life objectives, individuals adopt hedonic motivation, where the aim is to experience immediate PA (Löckenhoff and Carstensen 2004; Riediger and Luong 2015), by developing the appropriate emotion regulation skills (Doerwald et al. 2016; Le Vigouroux et al. 2015, 2017).

## Limitations and Future Directions

The present study nevertheless had two major limitations. The first was the cross-sectional nature of the data collection, as a longitudinal study would have been more appropriate for exploring the notion of age-related differences in affect and affect variation. The second was the interpretation of the results in terms of affect regulation motivation, as this variable was not measured in the study. These results will therefore have to be confirmed in a future study that also probes preferences for eudemonic or hedonic motivation among larger samples of participants. In addition, to improve current understanding of affective differences still further, it would be interesting to consider individual differences, particularly in relation to personality profiles. Motivational changes and the development of expertise in affect regulation may not occur homogeneously with advancing age, and there may be different patterns of age-related differences. Another limitation of our study is that although our sample was quite large, a large proportion of participants were aged between 20 and 25 years, and this needs to be balanced by recruiting even more people in the other age groups.

As a continuation of this study, future research could focus on the changing affective dynamics of individuals with mood disorders (e.g. depression, anxiety). It would be interesting to use the results yielded by the present study to enrich therapeutic interventions, particularly in terms of hedonic and eudemonic motivation, and to see whether older people who fail to increase their level of PA are those who do not adopt a hedonic approach to affect.

## Conclusion

In conclusion, our results tend to show that age is an explanatory factor for both core affect and affect variability. Individuals set themselves the goal of feeling less NA at a very early age, but it is only after about 35–40 years of age that they decide to give priority to PA (Scheibe et al. 2013). Beyond 70–75 years, certain vulnerabilities occur that disrupt affective states, causing first NA to increase, then PA to decrease (Charles 2010; Labouvie-Vief 2003), regardless of the activation level associated with the valence. At the same time, affect variation decreases. Our study failed to reveal any age-related differences in affective inertia. Results

are interpreted in the light of studies of emotion regulation motivation and the acquisition of emotion regulation expertise.

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