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RESEARCH ARTICLE

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Centrality of positive and negative autobiographical memories across adult life span

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Abstract

Previous studies have found that in nonclinical samples centrality of positive events is usually higher than centrality of negative events. In this study, we investigated the centrality and its relation to valence by considering additional predictor variables (i.e., intensity, time since event, self-concept clarity) as well as age group differences. A total of 365 participants aged between 18 and 89 reported up to 10 positive and up to 10 negative autobiographical memories. We used multilevel analysis to account for the hierarchical structure of the data. The results confirmed the higher centrality of positive events, but only for middle-aged and older adults. Intensity contributed to the centrality of both positive and negative events, whereas self-concept clarity was relevant regarding negative memories of young and middle-aged adults only. Hence, the extent to which memories contribute to identity is not only depending on characteristics of memories but on the remembering person as well.

KEYWORDS
autobiographical memory, centrality of event, emotional valence, individual differences, multilevel analysis

1 | CENTRALITY OF POSITIVE AND NEGATIVE AUTOBIOGRAPHICAL MEMORIES ACROSS ADULT LIFE SPAN

Autobiographical memories are memories of "the events of one's life" (Conway & Rubin, 1993, p. 103) and are closely related to processes of identity formation (Habermas & Bluck, 2000). Autobiographical memories can differ however, in the extent of which they contribute to an individual's identity, which is known as the *centrality of an event* to one's identity.[1] For instance, research has repeatedly shown that positive events are more likely to become central to one's identity than negative events (e.g., Berntsen et al., 2011). While emotional valence represents a characteristic of the event, the centrality of an event may also be affected by characteristics of the person who is remembering the event. This has frequently been demonstrated with respect to negative events: Negative health outcomes such as post-traumatic stress disorder (PTSD) or depression may boost the perception of a negative event as being central to identity (see Gehrt et al., 2018 for a review). Consequently, the extent to which a memory is perceived as central depends on both the characteristics of the event, such as its emotional valence (e.g., Berntsen & Bohn, 2010), and the characteristics of the person remembering the event, such as mental health (e.g., Berntsen & Rubin, 2006) or age (Zaragoza Scherman et al., 2020).

In the present study, we take a closer look at what affects the centrality of positive and negative events. More specifically, we examined whether the intensity of a memory as well as the time since event are differently related to the centrality of positive and negative events. Apart from memory characteristics, we also investigated how individual differences in age and self-concept

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clarity (SCC) influence the centrality of positive and negative memories.

1.1 | Centrality of event and memory characteristics

Valence of autobiographical memories is the most often examined characteristic in the emotional autobiographical memory literature—and regarding centrality of events in particular. Previous research has demonstrated that individuals who rated a negative event as central to their identity reported higher levels of negative health outcomes such as depression (see Gehrt et al., 2018 for a review). Studies that compared the centrality of positive and negative events in nonclinical populations, however, concluded *almost unanimously* that positive events are more central to identity than negative ones (Berntsen et al., 2011; Rubin et al., 2019; Zaragoza Scherman et al., 2015; Zaragoza Scherman et al., 2020).

That positive memories are typically perceived as more central to one's identity can be explained by a self-enhancement motive, which describes "the desire to maintain or increase the positivity of one's self-concept" (D'Argembeau & Van der Linden, 2008, p. 534). One-way to maintain or increase a positive self-view is to focus on positive information about oneself and to narrate one's life story in a positive light (Skowronski, 2011). Therefore, self-enhancement may represent an inbuilt motive to focus on positive aspects about oneself (Rubin et al., 2019; Zaragoza Scherman et al., 2015), which, in turn, may explain why negative memories are typically perceived as less central to identity. It is possible, however, that the centrality of an event and its valence interplay in a more complex manner, especially when other influences are considered simultaneously, such as the emotional intensity or the time since event.

With respect to emotional intensity, some researchers suggested that intensity relates to centrality independently of emotional valence: Both highly intense positive memories and highly intense negative memories are perceived as more central than their less intense counterparts (Boals, 2010; del Palacio Gonzalez & Berntsen, 2017; Gehrt et al., 2018). This could be explained by the intensity principle, which suggests that people process emotionally intense information more efficiently than neutral information (Matlin & Stang, 1978). Holland and Kensinger (2010) emphasized that intensity is related to personal involvement in autobiographical memories, which, in turn, may correspond to the centrality of a particular event to one's identity. Keeping this in mind, it seems relevant to examine both the valence of autobiographical memories and the intensity associated with the according positive and negative memories.

With respect to the time since event, events that happened a longer time ago are considered more central to identity than recent memories (Berntsen & Bohn, 2010; Rubin et al., 2019, Study 3). One of the explanations why older memories are more central to identity is because they may be high-construal memories (Rubin et al., 2019; Trope & Liberman, 2003). In high-construal memories, people focus on abstract memory details and the meaning of the memory. As a result, these memories mainly include essential information about an event and present with a higher centrality to identity. Low-construal memories, on the other hand, are more recent and represent contextual details without giving them a profound meaning and hence are less likely to be central to identity (Trope & Liberman, 2003). Regarding the time since event, it is important to not only consider the time elapsed since an event, but also take into account from which life period memories are recalled. For instance, adolescence and young adulthood are associated with identity-formation (e.g., Erikson, 1950), research on the reminiscence bump phenomenon (e.g., Zimprich & Wolf, 2016, 2018) showed that memories from these life periods continue to contribute to the life story and identity even in older age (Rathbone et al., 2008; Wolf & Zimprich, 2016).

Contrary to intensity, which seems to be equally related to the centrality of positive and negative events, the association between temporal distance and centrality might show different trajectories: Negative memories can be central even from the recent past, while positive memories are more likely to remain central long time after the event. For instance, a phenomenon such as the fading affect bias (FAB; Walker et al., 1997) underpins the differences between positive and negative autobiographical memories. The FAB is especially relevant regarding time since event, because it describes the phenomenon that the intensity of negative memories typically fades faster over time than the intensity of positive ones. This, in turn, could affect the higher centrality of positive and distant memories, whereas negative memories that remain central are expected to be more recent. In addition, there is a general bias towards (more) positive information (i.e., *pleasantness* or *positivity* bias; Rasmussen & Berntsen, 2009; Walker et al., 2003). To sum up, the centrality of an event is related to both intensity and time since event—and for time since event this relationship can differ between positive and negative memories. What is more, Gehrt et al. (2018) acknowledged that the centrality of events notion would benefit from not only focusing on memory-level explanations, but also considering explanatory variables at the individual level.

1.2 | Centrality of event and individual differences

Centrality of events may not only differ for different types of memories. Individuals may also show systematic differences in the tendency to judge their memories as more (or less) central. Because individuals do not look at events in isolation, it is likely that individual differences influence the perceived centrality of memories (Gehrt et al., 2018; Rubin et al., 2019). Rubin et al. (2019) suggested that centrality is not only a memory characteristic but possibly also an individual's characteristic: Some individuals show a more pronounced tendency to judge their autobiographical memories as overall central—regardless of other event characteristics. The majority of studies that investigated individual differences in event centrality focused on emotional disorders (PTSD, depression, anxiety). These studies found, for instance, that the tendency to rate positive events as more central to identity can be disrupted in people with emotional difficulties (e.g., Berntsen et al., 2011; Berntsen & Rubin, 2007). Emotional distress may be one of the reasons to rate

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negative events as central. Research on individual differences and event valence (positive and negative) is, however, limited and other individual differences variables might also come into play.

There is emerging evidence showing that demographic characteristics such as age influence the centrality of events (Gehrt et al., 2018). Until recently, studies have mostly examined either young *or* older adult age groups (Berntsen et al., 2011) but did not compare them directly. The study by Zaragoza Scherman et al. (2020) compared young adults (18–30) and middle-aged adults (45–64). Centrality of negative events did not differ between age groups; however, younger adults reported a lower centrality of positive memories than middle-aged adults. The authors argued that this might be due to the fact that young adults did not have the chance yet to experience a broader variety of important life events. An alternative explanation could be that adolescence and young adulthood are the life periods associated with identity-development (e.g., Erikson, 1950). It is not until adolescence that individuals have fully developed the cognitive abilities to integrate events into a coherent life story or identity (Habermas & Bluck, 2000). Thus, younger adults may need more time to evaluate which life events are important or central to their identity.

The age differences in the centrality of positive events as reported by Zaragoza Scherman et al. (2020) might become even more pronounced with increasing age. Previous research has shown that older adults, in particular, are more likely to focus on positive information. Compared with younger adults, older adults draw more attention towards positive than negative cues (Mather & Carstensen, 2005), relive positive events to a greater extent (Pasupathi & Carstensen, 2003), and reappraise negative experiences in a more positive light (Comblain et al., 2005). This age-related positivity effect can be explained by an age-related change in time perspective and can be considered as a type of adaptive emotion regulation (see Carstensen et al., 1999). To the best of our knowledge, there is no study comparing the centrality of positive and negative events in a sample that covers the entire adult life span.

Age differences are but one perspective on individual differences in the centrality of events. There are also studies considering the association between centrality of negative events and personality characteristics (e.g., neuroticism) or measures of maladaptive psychological functioning. Associations between negative health outcomes and centrality of negative events do not automatically imply, however, that perceiving positive events as central is significantly associated with positive (or adaptive) aspects of mental health. Demblon and D'Argembeau (2017) showed that identity motives such as self-esteem, meaning, distinctiveness, and continuity—concepts tightly related to self-concept—influenced the centrality of events.

In what follows, we focus on a relatively stable personality trait—Self-Concept Clarity (SCC;Campbell et al., 1996). It represents "the extent to which the contents of the self-concept are clearly and confidently defined, internally consistent, and temporally stable" (Campbell et al., 2003, p. 122). The authors found that SCC is positively related to self-esteem and negatively correlated with negative affect, neuroticism, and rumination. Having a clear and stable self-concept is considered an interpersonal resource that directly relates to psychological well-being. Moreover, SCC mediates the relationship between stressful life events and aversive perceptions of life (e.g., meaninglessness) and life satisfaction: SCC buffers the adversity impact on life satisfaction (Ritchie et al., 2011). Given its positive associations to well-being and life satisfaction, a clear and stable self-concept might also be associated with a more positive view of the past. For instance, Holm and Thomsen (2018) asked young adults to identify life story chapters and to rate their emotional tone. They found SCC to be related to a higher positive and lower negative emotional tone of life story chapters. Similarly, Ritchie et al. (2014) argued that a person with a clear self-concept would aim at maintaining the impact of positive events and try to diminish the impact of negative experiences. Therefore, SCC may contribute to a higher centrality of positive and a lower centrality of negative events.

To the best of our knowledge, only one study directly examined the relation between centrality of events and SCC (Boelen, 2017). The sample comprised bereaved individuals and considered the loss of a close person as a central event. The findings confirmed that SCC negatively correlated with the centrality of the negative event (i.e., the loss): The higher the SCC, the lower was the centrality of the negative event. This strengthens the assumption that a higher SCC can buffer the impact of aversive life events (Ritchie et al., 2011). A less clear self-concept, in contrast, might be associated with perceiving negative events as more central. While there is some evidence showing that SCC is associated with a lower centrality of negative events (e.g., Boelen, 2017), we know even less about the relation between SCC and the centrality of positive events.

1.3 | The present study

The purpose of the present study was threefold. Our first aim was to address the question whether the centrality of events differs between different types of memories, that is, whether intensity and the time since event are differently related to the centrality of positive and negative memories. Although previous studies have also considered these variables, we aimed to replicate their findings based on a different methodological approach. First, the multivariate approach allowed us to examine different predictor variables simultaneously. Second, participants recalled up to 10 positive and up to 10 negative memories, which resulted in a larger sample of memories per person than was used in previous studies (e.g., Boals, 2010). Consequently, we used a multilevel modeling approach to consider that memories were nested within participants. Third, we recruited a nonclinical sample that covered the entire adult life span.

Apart from replicating previous research based on a different methodological approach, the present study complements previous findings by focusing more closely on individual differences in the centrality of positive and negative events. For instance, Rubin et al. (2019) reported a relationship between the centrality of event and individual characteristics, demonstrating that the overall centrality of event ratings serves as an individual characteristic. Hence, not only other memory characteristics but also individual characteristics could predict the extent to which positive and negative memories are perceived as central. Our second goal was therefore to test whether individual differences in the centrality of positive and negative events can be

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explained by age and SCC, while controlling for gender differences (see also Boals, 2010; Sotgiu, 2019).

Finally, we aimed to take a closer look at potential age group differences in the centrality of event. To the best of our knowledge, the present study is the first one to date to examine the centrality of positive and negative events in a sample that covers the entire adult life span. To test for the possible age group differences, we presented the goal-related analyses as described above—and subsequently results—according to three age groups (i.e., young, middle-aged, and older adults). Taken together, in this study, we aimed to replicate previous findings regarding the centrality of event (e.g., time since event), but also to extend them by using a different methodological approach that allows to examine different predictor variables simultaneously and to consider both characteristics of the event (i.e., intensity, time since event) and individual (i.e., age groups, SCC).

2 | METHOD

2.1 | Participants

The sample comprised 365 adults aged between 18 and 89 years (M = 49.58, *SD* = 17.05). The majority of the sample was female (67.1%). Participants were mostly married (58.6%) or single (28.8%). Almost half of the sample had graduated from university (45.2%). Sixty-two participants were university students (17%). Most of them belonged to the group of young adults (*n* = 60). The majority of the sample reported being employed, but occupational status differed considerably with age. Overall, subjective health was rated as good (M = 2.23, *SD* = .88). Table 1 provides a more detailed overview of demographic characteristics per age group. The grouping of age was based on previous studies from both the autobiographical memory and the developmental psychology literature. Typically, the adult life span is divided into three age groups: young, middle-aged, and older adults (e.g., Bohn, 2010; Chopik et al., 2018; Comblain et al., 2005; Fitzgerald & Lawrence, 1984; Fung et al., 2010, Study 2; Hamilton & Allard, 2021; Rohr et al., 2017; Wang & Conway, 2004).

Participants were recruited through promotional flyers, e-mail, and word of mouth. To participate in the study, individuals had to be 18 years of age or older and have a working knowledge of German language. After finishing the study, they could take part in a lottery to win a gift voucher (worth 15 Euros). For students, there was an option to get course credit (instead of lottery).

2.2 | Procedure

We collected the data online via the www.soscisurvey.de platform. After giving their informed consent, participants provided demographic information (e.g., age, gender, marital status, education) and rated their subjective health. Next, participants were asked to recall up to 10 positive memories. They were instructed to briefly describe a memory that came to their mind. The memories did not have to be extraordinary, but refer to a specific and distinct event from their personal past. In addition, the events recalled had to be older than 1 year. Each memory had a separate page where participants could enter a brief description of the event and proceed to the next memory once they were finished. In the next step, participants were asked to recall up to 10 negative memories. The instruction and the procedure were identical to the one for positive memories. If participants had no more memories to report, they could proceed to the next page leaving it blank. The order of the procedure was the same for all participants.

After having described positive and negative memories, participants completed a personality questionnaire including the SCC Scale. Subsequently, participants were presented with their description of positive and negative memories and were asked to answer several questions concerning the events described (see below). Memories were presented in the order in which they had been recalled (again, starting with positive and then negative memories).

2.3 | Measures

2.3.1 | Memory characteristics

For each memory, participants provided their age at the time when the event had happened and rated how they currently judge its emotional *intensity*. Intensity responses were made on a five-point Likert-scale

TABLE 1 Individual characteristics of the sample for each age group

	Young adults	Middle-aged adults	Older adults
N (% of sample)	91 (25)	178 (49)	96 (26)
Mean age (*SD*)	24 (5.39)	52 (4.74)	69 (6.76)
Age range	18–39	40–59	60–89
% Female	82.4	65.7	55.2
% Single	83.5	13.5	5.2
% Married	16.5	71.9	74.0
% A-levels	92.3	67.4	55.2
Main occupational status	Student (66%)	Employed (85%)	Retired (64%)
Mean subjective health (*SD*)	2.01 (.81)	2.22 (.87)	2.46 (.93)
Self-concept clarity (*SD*)	3.24 (.51)	3.39 (.55)	3.53 (.48)

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ranging from *not at all intense* (1) to *very intense* (5). We created a variable covering the *time since event* by subtracting participant's age at the time of the event from the participant's current age.

2.3.2 | Centrality of event

Participants rated the event centrality for each reported memory. We used the seven-item short version of the centrality of event scale (CES; Berntsen & Rubin, 2006) to assess how central an event is to a person's identity and life story. Responses were made on a 5-point Likert-scale ranging from *totally disagree* (1) to *totally agree* (5). The seven items were combined into a mean score. The German version of the questionnaire was created following translation guidelines: Forward and backward translation by native speakers, followed by an expert confirming the equivalence. Cronbach's α in the current sample was .92, which is in line with the original scale properties and shows good internal consistency (Berntsen & Rubin, 2006).

2.3.3 | SCC

SCC was measured using the twelve-item scale developed by Campbell et al. (1996). Each item contains a statement (e.g., "In general, I have a clear sense of who I am and what I am.") the participant is asked to answer on a 5-point Likert-type scale ranging from *strongly disagree* (1) to *strongly agree* (5). Higher scores indicated higher SCC. The German version of the questionnaire was created following translation guidelines: Forward and backward translation by native speakers, followed by an expert confirming the equivalence. Cronbach's α in the current sample was .79, similar to the original scale showing good internal consistency (Campbell et al., 1996).

2.4 | Statistical modeling

Let y_{ij} denote the CES rating given by individual i ($i = 1,\ldots, N$) for the autobiographical memory j ($j = 1,\ldots, n_i$). Because CES ratings are nested within individuals, we used mixed-effects models to predict an event's centrality (e.g., Hedeker & Gibbons, 2006). While one group of predictors entered the model at Level 1 (the level of autobiographical memories or level of within-person differences), for instance, valence, other predictors were relevant only for Level 2 (the level of individuals or between-person differences), for instance, SCC. Because positively and negatively valenced memories were treated separately, we defined two indicator variables as follows:

$$I_p(y_{ij}) = \begin{cases} 1 & \text{if the valence of } y_{ij} \text{ is positive} \\ 0 & \text{otherwise} \end{cases} \quad \text{and}$$

$$I_n(y_{ij}) = \begin{cases} 1 & \text{if the valence of } y_{ij} \text{ is negative} \\ 0 & \text{otherwise} \end{cases}.$$

A mixed-effects model for CES ratings that differentiates between AMs with positive versus negative valence can then be written as

$$y_{ij} = I_p(y_{ij})\left(\beta_0 + u_i + \mathbf{x}_i'\boldsymbol{\beta} + e_{ij}\right) + I_n(y_{ij})\left(\gamma_0 + w_i + \mathbf{x}_i'\boldsymbol{\gamma} + e_{ij}\right)$$

where β_0 is the fixed CES intercept for positive events, u_i is the random deviation of individual from the fixed intercept, $\mathbf{x}_i$ is a vector of covariates, $\boldsymbol{\beta}$ is a vector of regression coefficients linking the covariates and the CES (for positive events), and e_{ij} is a residual. Analogously, γ_0 is the fixed CES intercept for negative events, w_i is the random deviation of individual from the fixed intercept, $\mathbf{x}_i$ is a vector of covariates, $\boldsymbol{\gamma}$ is a vector of regression coefficients linking the covariates and the CES (for negative events). The random CES intercepts for positive and negative are assumed to be normally distributed with a mean of zero and covariance matrix $\mathbf{G}$, that is

$$\begin{pmatrix} u_i \\ w_i \end{pmatrix} \sim N(\mathbf{0}, \mathbf{G}) \quad \text{with } \mathbf{G} = \begin{pmatrix} \sigma_u^2 & \sigma_{uw} \\ \sigma_{uw} & \sigma_w^2 \end{pmatrix},$$

where σ_u^2 is the variance of positive CES random intercepts, σ_w^2 is the variance of negative CES random intercepts, and σ_{uw} is their covariance. Comparable to the random effects, the residuals e_{ij} are assumed to be normally distributed with a mean of zero and (constant) variance σ_e^2.

For the analyses to be presented below, gender was dummy-coded (0 = male, 1 = female) and age was divided into three age groups (younger, middle-aged and older adults, see Table 1). The age group variable was also dummy-coded. A first dummy variable coded the difference between younger (= 1) and middle-aged participants (= 0), whereas a second dummy variable coded the difference between older (= 1) and middle-aged participants (= 0). The group of middle-aged adults thus served as the reference category. Level 2 predictors (age group dummy variables, gender, and SCC) were centered around their respective sample means. Level 1 predictors (intensity and time since event) were centered around their respective group (i.e., the individual's) mean.

All analyses were conducted using SAS Proc Mixed procedure (SAS Institute Inc., 2014). As indexes of model fit we report −2 × the log-likelihood (−2LL) and Akaike's Information Criterion. For both statistics, lower values indicate a better model fit. In addition, we report the difference in −2LL, which is approximately chi-square-distributed and allows for testing significant differences in model fit between models using the difference in numbers of parameters estimated as degrees of freedom. Finally, the amount of (total) variance accounted for by the respective model is provided by an R^2 statistic on both levels of analysis (Recchia, 2010; Snijders & Bosker, 1999).

3 | RESULTS

The 365 participants reported a total of 5101 memories: 2721 positive and 2380 negative memories. On average, participants retrieved 14.01

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TABLE 2 Descriptive memory characteristics based on valence and age categories

	Young M (*SD*)	Middle M (*SD*)	Older M (*SD*)	Total M (*SD*)
Positive				
Centrality	2.86 (1.07)	3.2 (1.19)	3.17 (1.15)	3.11 (1.16)
Intensity	4.17 (.89)	4.46 (.85)	4.45 (.83)	4.39 (.87)
Time s. event	6.84 (6.88)	24.26 (13.67)	39.08 (17.95)	23.89 (17.86)
Negative				
Centrality	2.84 (1.18)	3.01 (1.19)	2.88 (1.17)	2.94 (1.18)
Intensity	4.36 (.87)	4.51 (.78)	4.54 (.77)	4.48 (.80)
Time s. event	7.77 (6.94)	23.24 (15.44)	37.49 (21.34)	23.09 (18.83)

Note: $N_{positive} = 2721$, $N_{negative} = 2380$. The intraclass correlation for each memory variable shows the between person variation: $ICC_{centrality} = .287$; $ICC_{intensity} = .230$; $ICC_{time} = .544$. 28.7% of the variation of centrality is between persons, whereas 71.3% is within person; 23% of intensity variation is between individuals, and 54.4% of time since event variation is also between individuals.

memories: 7.45 positive and 6.52 negative ones. We conducted a repeated measures analysis of variance (ANOVA) to test whether the frequency differences between positive and negative memories recalled depended on age, gender, or their combination. The difference in the number of positive and negative was significant with participants reporting on average more positive than negative memories, $F(1,358) = 55.90$, $p < .001$. The ratio of positive and negative memories was not dependent on age, gender, or their interaction. There was, however, a significant main effect for gender: Overall, men reported a lower number of both positive ($M_{positive} = 7.12$) and negative memories ($M_{negative} = 6.05$) than women ($M_{positive} = 7.65$, $M_{negative} = 6.78$), $F(1, 358) = 10.37$, $p < .001$. Regarding age, middle-aged adults reported the highest number of both positive and negative memories ($M_{positive} = 7.64$, $M_{negative} = 6.87$) and younger adults reported the lowest number of positive memories ($M_{positive} = 7.24$, $M_{negative} = 6.27$), $F(2, 358) = 3.96$, $p < .05$. However, post hoc comparisons did not reveal any significant age group differences.

The average CES rating was 3.03 ($SD = 1.18$). The average intensity rating for all memories was 4.43 ($SD = .84$). Time since event ranged between 0 and 79 years old, the mean being 23.55 ($SD = 18.35$). In Table 2, CES ratings and memory characteristics subdivided by valence and the three age groups are shown. Positive memories were rated as more central than negative ones. In addition, age groups differed significantly regarding SCC (see Table 1): $F(2, 361) = 7.2$ ($p < .05$), Tukey's post hoc analyses showed that the significant difference ($p < .05$) was between young and older adult groups: Older adults reported higher scores of SCCS, on average.

3.1 | Multilevel modeling results

3.1.1 | Model 0

In the baseline model, we estimated the fixed and random effects model for all three age groups together. The overall intraclass correlation was .287 implying that 28.7% variance was between individuals. This shows that individuals differ reliably in their (mean) CES ratings, which confirms the need for a multilevel analysis. The fixed intercept for positive memories was 3.13 ($p < .001$), for negative memories it was 2.98 ($p < .001$). The estimated means were significantly different from each other ($p < .001$). Random variance for positive memories was .41 ($SE = .04$, $p < .001$), random variance for negative memories was .57 ($SE = .05$, $p < .001$) and residual variance .89 ($SE = .02$, $p < .001$). −2LL model fit statistic was 14,909, and AIC amounted to 14,917.

3.1.2 | Model 1

In the next step, we included the three age groups (see Table 3). Regarding positive events, we found age differences in the sense that young adults rated their positive memories, on average, as less central than the groups of middle-aged and older adults. No age differences were found regarding negative memories. The younger age group did not show significant differences between positive and negative CES ratings, middle-aged and older adults, however, rated the centrality of positive memories as higher than the centrality of negative ones. Compared with Model 0, classifying the results based on age groups led to an increase in the model fit as judged by the −2LL and AIC values: 14,903 and 14,811 respectively (see Table 4).

Figure 1a depicts estimated CES ratings and their differences between age groups for positive and negative memories. Note that age groups differed in size. Therefore, age group differences are presented in effect sizes (Cohen's d). For positive memories, the young adult age group was different from the other two age groups; however, the effect size was small: .26 compared with the middle-aged and .24 compared with the older adult age group. Regarding negative memories, the group of middle-aged adults differed more strongly from young and older adults, than the young and older adults from each other ($d = .02$). Figure 1b depicts the differences of CES estimated means between positive and negative memories within each age group. Older adults showed the largest effect size,

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TABLE 3 Multilevel regression parameter estimates including fixed effects only

	Young			Middle-aged			Older		
	Positive	Negative	Sig. Δ	Positive	Negative	Sig. Δ	Positive	Negative	Sig. Δ
Model 1									
Fixed effects									
Intercept	2.87*	2.90*	.716	3.22*	3.06*	.005	3.19*	2.91*	< .001
Model 2									
Fixed effects									
Intercept	2.92*	2.88*	.627	3.24*	3.04*	< .001	3.22*	2.88*	< .001
Intensity	.49*	.45*	.624	.59*	.39*	< .001	.56*	.35*	.006
Time s. event	−.02*	−.01	.493	.002	−.005*	.019	−.002	−.005*	.444
Model 3									
Fixed effects									
Intercept	2.89*	2.78*	.184	3.24*	3.04*	< .001	3.23*	2.88*	< .001
Intensity	.49*	.45*	.638	.59*	.39*	< .001	.56*	.35*	.006
Time s. event	−.02*	−.01	.482	.002	−.005*	.016	−.002	−.005*	.445
Gender	−.12	−.34	.293	−.25*	−.33*	.465	−.03	.07	.521
Self-concept clarity	−.05	−.32**	.069	−.06	−.41*	< .001	−.07	−.06	.919

Note: Sig. Δ stands for significant difference between centrality of positive and negative memories for the respective age group; the *p*-values are presented.
*$p < .05$, **$p < .10$.

TABLE 4 Multilevel regression parameter estimates including random effects only

	Model 1	Model 2	Model 3
Random effects			
Pos Intercept variance	.39 (.04)*	.39 (.04)*	.39 (.04)*
Neg Intercept variance	.56 (.05)*	.57 (.05)*	.53 (.05)*
Correlation Pos Neg Intercept	.67*	.71*	.71*
Residual variance	.89 (.02)*	.77 (.02)*	.77 (.02)*
Model Fit			
−2LL	14,903	14,146	14,141
Δ(−2LL)		757*	6
AIC	14,911	14,154	14,149
R^2 Level 1	1%	10%	12%
R^2 Level 2	1%	1%	4%

*$p < .05$.

though it can still be considered as small (Cohen's $d = .21$), exhibiting the greatest difference between positive and negative memories' centrality.

3.1.3 | Model 2

In the following model we included level-1 predictors, namely intensity and time since event. Regarding positive memories, we observed a positive association between intensity and CES rating in all three age groups, implying that more intense memories are also perceived as more central. This effect was stronger in the groups of middle-aged and older adults than younger adults. With respect to negative memories, we also found a positive association between intensity and CES rating implying that more intense memories were also rated as more central. The magnitude of this effect did not differ between age groups. We did, however, find differences within the middle-aged and older age groups: The effect of intensity on the CES rating was stronger for positive than for negative memories (see Figure 2a). Overall, intensity significantly and positively predicted the centrality of both positive and negative memories.

Time since event had less consistent effects on CES rating. Note that the time since event was scaled as years from the present, hence the higher the value the older the memory was. Regarding positive memories, we found a significant association between time since event and CES ratings only in the younger age group: The older a memory was, the lower it was rated on the CES scale. This effect differed from the middle-aged and older age groups. Regarding negative memories, we found a significant and negative association between time since event and CES ratings, this held for middle-aged and older age groups only. This implies that the longer the time since event, the less central participants rated the event. The effect of time since event on CES rating between positive and negative events was statistically different for the middle-aged group.

In this model random effects remained significant, which implies significant individual differences in the CES ratings for both positive and negative memories. After including the level-1 predictors, the model fit increased substantially as can be seen from lower −2LL and AIC values (see Table 4). The correlation between

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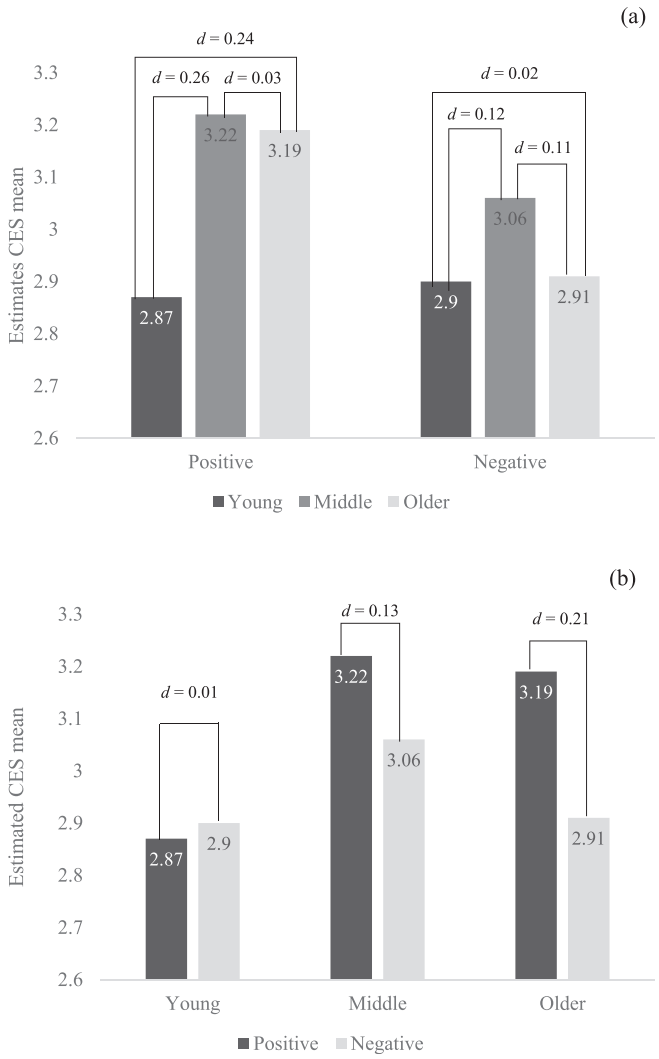


FIGURE 1 Differences of centrality of event scale (CES) between age groups within positive and negative memories category (a) and differences of CES within age groups between positive and negative memories (b). (a) Depicts the CES ratings for positive and negative memories and presents the differences between age groups within positive and negative centrality. (b) Depicts the CES ratings for age groups and presents the differences between positive and negative centrality within the age groups. The Cohen's d effect sizes are presented for each comparison.

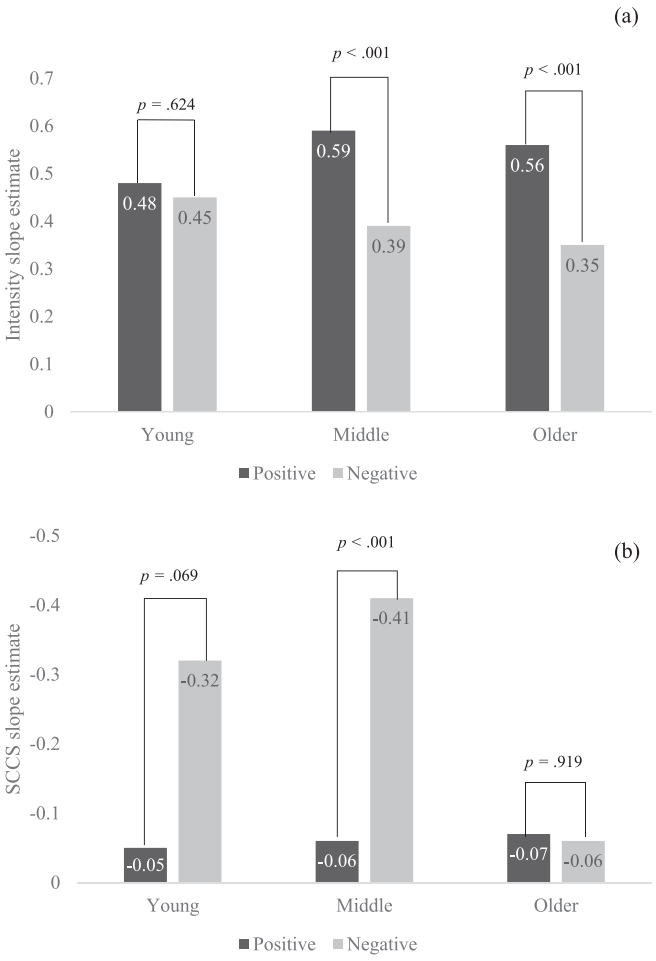


FIGURE 2 Differences of predictors' influence on centrality of event scale (CES) within age groups between positive and negative memories category. (a) Depicts the slope sizes of intensity on CES rating. The differences of these ratings between positive and negative memories are presented for each age group. (b) Depicts the slope sizes of SCCS on CES rating. Similarly, the differences of these ratings between positive and negative memories are presented for each group. In (b) the values are negative, the reversed depiction is chosen for clarity purposes. The *p*-values are presented for each comparison.

random intercepts for positive and negative memories was significant ($r = .71$, $p < .05$).

3.1.4 | Model 3

In the final model, we added level-2 predictors, namely gender and SCCS. Gender served as a control variable. Regarding CES, we found only small gender differences and only in the middle-aged group: Women in the middle-aged group rated the centrality of positive and negative memories as lower than men. The same tendency applied for negative memories.

Regarding SCCS, we found no significant association with the CES ratings of positive events. We found a negative association between SCCS and centrality of negative events in the group of middle-aged adults. A higher SCC contributed to the lower CES ratings of negative memories. A similar pattern occurred in the younger adults age group but the estimate was only marginally significant (see Figure 2b). There are also potential differences between the middle-aged and older age group in the association between SCCS and centrality of negative memories.[2]

The random intercepts variance remained significant, showing a substantial between person variation in the CES ratings for positive and negative memories. We see a significant correlation ($r = .71$, $p < .05$) between positive and negative intercepts. After including between-person variables such as gender and SCC, the model fit was better than Model 2 as indicated by a change in −2LL and AIC yet

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marginally. We observed that throughout the models CES rating for positive memories remains largely higher than for the ones of negative memories.

4 | DISCUSSION

In this study we investigated how the centrality of an event differs among individuals and among memory characteristics. Results were presented for positive and negative memories separately, as well as for three age groups (young, middle-aged, and older adults). We used a multivariate approach that allowed us to account for more than one explanatory variable at the same time, and to test for individual differences in the centrality of positive and negative events. The results showed significant and consistent centrality of event variation between individuals. Centrality of event was associated with positive and negative memories, but positive memories were considered as more central. While the centrality of positive memories increased with age, centrality of negative events did not show significant age group differences. The effects of other memory and individual characteristics such as time since event, intensity, and SCC differed marginally between age groups. In the following we describe the abovementioned results in detail, their (in)consistency with previous research as well as their implications. Finally, we consider study limitations and outline possible future directions.

4.1 | Memory valence and age-related differences

The finding that participants rated positive memories as more central than negative ones is in line with previous research, especially in nonclinical samples (Gehrt et al., 2018). Although in our study, positive memories were perceived as more central than negative ones, the effect size was comparatively small. We observed some age group (non)differences for the centrality of positive and negative events. Higher centrality of positive memories became more pronounced with age, whereas the centrality ratings of negative memories did not show significant age group differences. In the current study, young adults rated their positive memories as less central than middle-aged and older adults. Identity development processes (e.g., Erikson, 1950) could explain this finding (Zaragoza Scherman et al., 2020). Young adults are at the beginning of their adult life and highly impactful events may require more time to be integrated properly, respectively to be perceived as central for one's life and identity (Comblain et al., 2005). Additionally, in our study younger adults showed higher centrality of positive events for more recent memories. This might be in line with the identity development explanation (Erikson, 1950) postulating that young adults are still in the life period in which more impactful life events are being experienced.

Furthermore, we observed that middle-aged and older adults rated their positive memories as more central than negative ones and this difference was greater within the older age group. This is also supported by the temporal distance findings. These results are in line with prior research (Berntsen et al., 2011; Rubin et al., 2019) such as that recent positive events are less likely to be considered central, but recent and negative events can be central. Positivity effect, the phenomenon known to be more pronounced in older age, possibly explains the increased importance of positive centrality with age (Comblain et al., 2005; Mather & Carstensen, 2005). We return to the positivity effect explanation later.

Interestingly, we did not find significant age group differences for the centrality of negative memories. Theories usually focus on how positive information is evaluated in different age groups, but does it automatically mean that negative experiences are appraised the same? That age groups do not differ regarding the centrality of negative events is in line with previous work (Zaragoza Scherman et al., 2020) but somewhat surprising, especially when considering that age groups differ in their emotional regulation strategies (Hamilton & Allard, 2021; Mather, 2004). One of the explanations of why we did not find age group differences for centrality of negative events could be that individuals in general tend to maintain their positive self-view and are prone to self-enhancement (e.g., Skowronski, 2011), hence negative events are not considered central. The self-enhancement, in fact, could serve as an overarching notion for all people, regardless of their age. The underlying processes, however, may differ between age groups.

From the prior findings regarding aging and positivity we see that older adults live a happier life (e.g., evaluate their well-being as higher). This could also be referred to as age-related positivity effect, which in turn is influenced by emotion regulation. Hamilton and Allard (2021) examined how negative autobiographical memories are reappraised differently between age groups. The authors suggested an interpretation that older adults insert positive meaning, whereas young adults focus on how to diminish negative emotions. The authors found that while younger adults demonstrated a decrease in negativity, older adults increased the positivity of negative autobiographical memories. Note that negativity for older adults did not decrease, the authors used two separate independent scales for positivity and negativity. This shows that acknowledging negative aspects in life does not necessarily impact the positive meaning of the significantly impactful events (Ford et al., 2018; Hamilton & Allard, 2021). Overall, younger adults focus on diminishing the effect of negative memories, whereas older adults would focus on seeing positive in negative. This explanation may also be relevant to the finding of the higher positive centrality ratings as well as the differences between positive and negative centrality ratings and their increase with age. Note, however, that this could not be tested within the present study. Future studies might consider including emotion regulation strategies to test whether differences in the centrality of positive and negative events can be explained by differences in emotion regulation strategies.

In our study, the events central to identity were also rated as intense. Contrary to the abovementioned age group differences in the centrality of positive events but not the negative ones, intensity did not show substantial differences between age groups and was positively related with centrality for both types of memories (positive and negative). Boals (2010) found similar results in the sense that higher intensity was associated with both centrality of positive and negative

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events, though the study had one event per category (positive and negative). While intensity did not exhibit significant between age group differences, within age group differences regarding positive and negative categories emerged. The intensity effect was stronger for positive than negative memories in both middle-aged and older adult groups. That is, the findings are similar to the aforementioned higher centrality of positive memories in older age.

The intensity is relevant for both positive and negative memories, which is in line with Talarico et al. (2004)—stating that intensity could explain more characteristics than valence alone—but stronger for positive than negative ones, which is in line with the diminished negative affect explanation (Walker et al., 1997). The emotion regulation account could provide the additional explanation as older adults do not necessarily try to diminish the negative affect but rather increase the positive one (Hamilton & Allard, 2021), hence the stronger impact of positive intensity than the negative one (Ritchie et al., 2014). Especially for middle-aged and older adults, the groups for which the aforementioned positivity effect was present.

The diminished negative affect is one of the explanations for a stronger impact of intensity on the centrality of positive events. It could also be that positive memories stay more intense over time because they are central to identity more than negative ones, but it might also be that positive memories are central to identity because they do not lose their intensity (Rubin et al., 2019; Zaragoza Scherman et al., 2020), something that is frequently supported by the FAB phenomenon (Ritchie et al., 2006; Walker et al., 1997). The strong relationship between centrality and intensity adds to the assumption that CES is a memory accessibility measure (Gehrt et al., 2018). The influence of intensity may be related to a better accessibility of positive memories than negative ones. While the negative events accessibility relates to emotional difficulties, the higher accessibility of positive memories points to less emotional difficulties and hence the results relevant in nonclinical samples.

4.2 | Individual characteristics

We found that centrality is not only a memory characteristic but is also an individual's characteristic. The findings are in line with Rubin et al. (2019) and Rubin (2021), though the methodological approach we used was different. We applied multilevel regression analysis, which allowed us to consider not only fixed effects, representing memory characteristics and centrality of event itself as a memory characteristic, but also random effects, representing centrality of event as individual's tendency to rate the events as more (or less) central overall. The significance of the random effects, as well as the intraclass correlation demonstrated that this individual's characteristic differs reliably among people. We also found that this tendency is associated with other individual characteristics, as Rubin et al. (2019) suggested. Despite the abovementioned age group differences showing individual differences in the centrality of (positive) events, we considered how SCC is associated with the centrality of positive and negative events.

Considering mediating properties of SCC between well-being and adversity (Ritchie et al., 2011), as expected SCC was associated with the centrality of event ratings. In line with Boelen (2017), SCC was associated with centrality of negative events. Most previous studies focused on the outcomes of severe negative events (e.g., stressful, traumatic) and looked at its outcomes in relation to centrality, for instance, PTSD or Posttraumatic growth (PTG). In fact, the same (negative) event can be related to not only negative outcomes but positive outcomes as well (not only PTSD but PTG too) (Boals & Schuettler, 2011). SCC is something that does not require a highly impactful event. It can be stronger or weaker but it is a measure that can be used in any sample, which we believe contributes to a more complete picture of centrality and individual differences.

We found that a clearer self-concept was related to lower ratings of the centrality of negative memories, pointing to SCC's adaptability. People usually tend to diminish the effect of negative events (Ritchie et al., 2014) as it is an adaptive outcome in life (Skowronski, 2011). They could do so by, for instance, maintaining the clear self-concept. Based on our findings, we see just that in the middle-aged group and possibly for younger adults as well. SCC was not significantly associated with centrality of events in the older age group. We could speculate that in this age group the self-concept is not of that much importance anymore as other characteristics such as emotion regulation are more important in relation to event's centrality (Hamilton & Allard, 2021). In older adulthood the self is assumed to be established, which would manifest itself in high SCC ratings for older adults. Indeed, we found that SCC increased across age groups, and differed significantly at least between younger adults compared with older. As such, the higher levels of SCC could explain why we found no effects of SCC in the group of older adults. The SCC effects for both young and middle-aged adults were noteworthy which implies the importance of a clear SCC in diminishing the effect of negative memories to one's identity (Ritchie et al., 2014). SCC and its components would need further attention regarding age differences but also its association with emotion regulation.

In the present study, SCC did not relate to the centrality of positive memories. The management of negative memories appears to be more important than enhancement of positive ones. Berntsen et al. (2011) also found that centrality of negative memories was better predicted by individual characteristics (e.g., well-being) than centrality of positive memories. Berntsen et al. (2011) suggested that positive events are not related to individual characteristics due to their correspondence to cultural life script events in which people do not differ that much. Negative events, on the other hand, are less common, hence their centrality requires more explanations which would then be represented by the relatedness to SCC. Both positive and negative events can be central but for different reasons: Positive would represent the norm, and negative the deviation from that norm. The findings are in line with the self-enhancement motives, that people would aim at maintaining the positive self-view, specifically by using the SCC to diminish the effect of negative memories.

Based on the current findings, we can see the distinctiveness of middle-aged adults' group. Our study provided additional information

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that having only young and/or older adults groups would conceal. How is the middle-aged group category different from the other two, or the other two are different from the middle-aged category? On the memory characteristics level, this group showed tendencies more similar to older adults than younger, which could be explained by the fact that the motivation to increase/maintain well-being might start at middle-age already, but peaks in older age (Carstensen et al., 1999). Regarding the individual characteristics, middle-aged adults showed distinct patterns such as gender differences. Middle-aged women rated their memories as less central than men, be it positive or negative. We did not find any gender differences in neither younger nor older adult groups. Middle-aged adults showed more similar patterns to younger age group when SCC comes into play. To sum up, for some processes middle-aged adults are more similar to older adults, whereas for others they are more similar to younger adults. This points to the suggestion that we should not necessarily assume the linearity of age differences across the life span as the development might adopt different trajectories (Baltes et al., 1980).

4.3 | Limitations and future directions

4.3.1 | Limitations

Nevertheless, the current study had a few limitations. First, the age group sizes of young, middle-aged, and older adults were unequal. Second, we did not randomize the order in which positive and negative memories were recalled as all participants recalled positive memories first, however, no considerable differences between intensity and quantity of recalled memories were found. Moreover, participants did not rate the valence of the memories but rather reported memories according to the broad categories. Third, the data were collected online. On the one hand, this may reduce (experimental) control. On the other hand, online surveys provide an anonymous setting that may reduce social desirability and make it easier to describe personal memories (Gibbons & Rollins, 2016). Fourth, we only tested for linear effects of intensity, time since event, and SCC. Knowing that positive memories are likely to stem from the reminiscence bump period (e.g., Wolf & Zimprich, 2020), as such, nonlinear relations need to be considered as well. For instance, the question of whether memories from the reminiscence bump show different effects on centrality for young, middle-aged, or older adults and positive and negative memories remains open. Note that the reminiscence bump is challenging to examine in young adults, and for the other age groups it would also not necessarily seem warranted to use the same, specific age boundaries of the bump (Wolf & Zimprich, 2020; Zimprich & Wolf, 2018). Nevertheless, this line of research is worth following up upon in future research.

4.3.2 | Future directions

Even though we replicated previous findings showing that positive memories are typically perceived as more central than negative memories, the direction of the relationship between valence and centrality of event, however, is yet to be defined. Do positive events lead to higher centrality or is the valence evaluated differently because events are perceived as more central (Zaragoza Scherman et al., 2020)? The present findings support the assumption that negative and positive events do require separate investigation—probably due to differences in processing (Banks & Salmon, 2013). While most research considered that higher centrality of negative events will lead to negative (health) outcome, Banks and Salmon (2013) showed that this is not necessarily the case for everybody: People may find positive outcomes in negative but central events (see also Newby & Moulds, 2011). Therefore, independent positivity and negativity scales could provide additional information (Broadbridge, 2018), especially if one is focusing on age-group differences (Ford et al., 2018; Hamilton & Allard, 2021).

Furthermore, in the present study, we considered SCC to be related to the centrality of events. While SCC describes the extent to which the self-concept is perceived as clear and temporarily stable (Campbell et al., 2003), another individual's characteristic such as self-esteem could capture the emotional (e.g., positive or negative) evaluation of one's self-concept. Apart from personality features (i.e., SCC), individual differences in emotion regulation or coping could be relevant with respect to the centrality of positive and negative events as well as age-related differences therein (e.g., reflection-rumination hypothesis) (Broadbridge, 2018; Gehrt et al., 2018).

5 | CONCLUSION

This study provided additional value to the field by considering the entire adult life span. We emphasized the need to consider all three age groups (young, middle-aged, and older adults) in order to provide a more complete picture regarding centrality of event and its relation to valence. We have also confirmed the previous findings that centrality of positive events is higher than of negative ones in the nonclinical sample. Nevertheless, in our study other memory characteristics (e.g., intensity) and individual characteristics (e.g., SCC) provided additional information to the prominent tendencies. Recalling autobiographical memories is a dynamic process and emotional characteristics in particular might depend on individual's characteristics at the time of retrieval. The present study emphasized the importance of considering the centrality of event not only as a memory characteristic but also as a tendency that can vary between individual.

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CONFLICT OF INTEREST

The authors have no conflicts of interest to report.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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ENDNOTES

[1] Note that the concept of centrality of an event to one's identity might come in different names, such as self-defining memories (Boals, 2010; Demblon & D'Argembeau, 2017), or—when centrality is considered a characteristic of an individual—self-narrative focus (Rubin et al., 2019).

[2] An anonymous reviewer suggested treating participant's age as a continuous variable, instead of dividing age into age groups, which can sometimes appear arbitrary. This might be the case especially when the groups in question represent the full adult life span, because the age group boundaries become harder to pronounce. To account for that, we reran our analyses based on a different grouping of age, that is, we excluded the possible transitioning processes between one age group into another: 18–35 years of age represented young adults, 44–60 middle-aged, and 65–89 older adults. While the parameter estimates changed marginally, the conclusions remained the same in terms of the significance of predictor variables. We then executed a number of analyses considering the age of participants as either a linear or a quadratic variable. The three models representing the relationship between variables as shown in Table 3 are depicted in Data S1 (linear) and S2 (quadratic). The results led to similar conclusions in terms of the significance of predictor variables. Nonetheless, the model fit of the models decreased and we argue that a certain amount of information was lost. Using age group analyses allowed us to observe different trajectories that middle-aged adults employ (e.g., regarding SCC).

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