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Shaping our personal past: Assessing the phenomenology of autobiographical memory and its association with object and spatial imagery

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A new instrument has been developed that allows a comprehensive assessment of the relevant dimensions of the phenomenology of autobiographical memories (Assessment of the Phenomenology of Autobiographical Memory, APAM), and their association with visual object and spatial imagery has been examined. An initial version of APAM consisting of 30 items (the first 28 measured on a seven-point Likert-type scale) was developed and administered to a sample of 138 undergraduates. To test whether each item consistently measured the same dimension across different memories, all questions were rated for 12 cues. Results showed that 25 Likert-type items possessed adequate levels of internal consistency and unidimensionality across cues. We also found that higher levels of visual object imagery were associated with more sensory details and recollective qualities of memory, and with stronger experience of sensory and emotional reliving. The theoretical and practical usefulness of APAM as well as the relevance of visual object imagery in the phenomenology of autobiographical memory are discussed.

Key words: Autobiographical memory, phenomenology, visual object imagery, visual spatial imagery, mental imagery, individual differences.

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INTRODUCTION

"As I remember it, I can see it in my mind and I can feel now the emotions that I felt then. This memory is significant for my life." When talking about relevant personal events, we frequently use expressions that refer to the quality of the remembered material and to the subjective experience associated with our remembering, namely, to its phenomenology. Phenomenological qualities of memories are multiple, including vividness and richness of sensory details, emotional valence and intensity, specificity and coherence, personal relevance, and belief in the accuracy of the memory. The configuration of phenomenological qualities of memories that are experienced while remembering gives rise to the feeling of re-experiencing the past (*autonoetic* awareness), which characterizes autobiographical memory (ABM; e.g., Conway, 2005; Tulving, 2002).

In the present study we aimed to present a new comprehensive measurement tool of the phenomenology of ABMs and to investigate whether and how individual differences in visual object and spatial imagery, such as a cognitive style, are associated with the phenomenology of ABMs.

Phenomenology of autobiographical memory

Phenomenological dimensions are quite relevant in distinguishing between different kinds of memory and in identifying memory changes related to aging and memory alterations associated with clinical disorders. For example, false memories tend to be less emotionally intense and less vivid compared to true memories (Heaps & Nash, 2001; Johnson, Foley, Suengas & Raye, 1988). Compared to young adults, older adults recall more general than specific events and their memories are poorer in sensory/contextual details and more positive (e.g., Anderson, Cohen & Taylor, 2000; Rubin & Schulkind, 1997). Alterations in the phenomenology of ABMs have been also reported in the clinical domain, such as depression (i.e., overgeneral memories, see Williams, 1996, for a review) and post-traumatic stress disorder (PTSD; McNally, Lasko, Macklin & Pitman, 1995; Rubin, Dennis & Beckham, 2011).

The phenomenology of ABM is also modulated by individual differences in personality and cognition. For example, Rubin and Siegler (2004) showed that openness to feelings correlated strongly and positively with sense of recollection, amount of sensory details, measures of belief in the accuracy of memories, and feeling of emotions while remembering. D'Argembeau and van der Linden (2006) found that higher levels of emotion suppression strategy correlated with lower ratings of autonoetic consciousness, visual details, spatial context, emotional intensity, and story coherence. They were also associated with a reduction in the use of words in representing events.

In contrast with this well documented importance of the phenomenological characteristics of ABM, in most published studies the evaluation of phenomenological experiences has been limited to a relatively small number of potentially relevant dimensions. Moreover, only in some studies these dimensions have been measured by standardized instruments, such as the Memory Characteristics Questionnaire (MCQ, Johnson *et al.*, 1988) and the Autobiographical Interview (AI, Levine, Svoboda, Hay, Winocur & Moscovitch, 2002), while in many other

instances the assessment has been done by simply creating ad hoc items or by taking single items from existing instruments (e.g., Aydin, 2018).

Research on the phenomenological features of ABMs focused on the development of measures of relevant dimensions (e.g., vividness, sensory and contextual details, thoughts/feelings). The first comprehensive tool for the evaluation of the ABMs was the Autobiographical Memory Questionnaire (AMQ, Rubin, Schrauf & Greenberg, 2003; Talarico, LaBar & Rubin, 2004), which asks respondents to answer a set of around 20 questions (depending on the version) about the memory elicited by a set of cue words (30 in the seminal paper). Each dimension of the ABM is measured by a single item and the participant's score on this dimension is computed averaging the ratings on the same item across all cues. Several studies criticized this single-item approach (apparently overlooking that the score on the dimension is actually a composite measure of the same item rated about multiple cues) and developed measures in which each dimension was measured by more items (Luchetti & Sutin, 2015; Sutin & Robins, 2007). Examples of such approach are the Memory Experiences Questionnaire (MEQ, Sutin & Robins, 2007; short version of MEQ, Luchetti & Sutin, 2015), and the more recent Autobiographical Memory Characteristic Questionnaire (AMCQ, Boyacioglu & Akfirat, 2015), that also extended the range of dimensions assessed by the instrument. These multi-item measures of the dimensions maximize the reliability of the scores (as opposed to single items) for a single cue, but their supporting evidence is somehow limited to the specific cue on which they were validated (general and early memories for the MEQ, and childhood memories, autobiographical memories related to romantic relationships, and self-defining memories for the AMCQ). As a result, this makes them more suitable when the assessment of phenomenological characteristics is limited to one or very few ABMs. However, this approach does not seem to be adequate when one wants to assess such characteristics as a stable disposition of the individual, in order to investigate their association with other dispositions or traits. In these cases, it seems more methodologically appropriate to assess the phenomenological characteristics of ABMs on (relatively) larger set of memories, in order to control for the effect of the unique content of a specific memory (e.g., childhood memory vs a memory of a romantic relationship). In these cases, the use of the MEQ or the AMCQ is impractical, given the long administration time implied by the procedure.

In the present study we adopted the Rubin *et al.*'s (2003) approach of asking participants to rate single items on memories elicited by multiple and diverse cues. It should be noted, however, that the AMQ was developed with the aim of identifying "what properties predict the degree to which a memory will be recollected and believed" (Rubin *et al.*, 2003, p. 887), and not as a measure of individual differences in the phenomenology of memory. Moreover, it measures a limited range of dimensions (recollection and belief in the accuracy of the memory [e.g., reliving, real/imagined], component processes [e.g., sight, hear], and reported properties of events or memories [e.g., importance, rehearsal]), dimensions such as visual perspective and back in time, rehearsal/thinking and rehearsal/talking, type of sensory detail are merged and not assessed separately, and other important phenomenological dimensions such as self-distancing, memory accessibility, or emotional intensity of the event and memory are not measured.

In order to address these limitations, in this study we capitalized on the more comprehensive set of dimensions from Sutin and Robins (2007) and Boyacioglu and Akfirat (2015) and developed a measure of the relevant dimensions of the phenomenology that allows the assessment of the general phenomenological characteristics of an individual's ABMs with single items rated on multiple cues. Being the score on the single item the average of the scores across all memories elicited by the cue, it is possible to compute its reliability and thus obtain a reliable and more representative estimate of how the specific characteristic assessed by the item is usually experienced by the participant. This measure, in turn, can be correlated with other stable characteristics.

Individual differences in visual imagery

The second purpose of this study was to examine the association between the phenomenological properties of ABMs and individual differences in a stable characteristic such as visual imagery. Behavioral and neuroimaging studies on healthy subjects as well as lesion studies have shown that the visual modality plays a crucial role in voluntary retrieval of ABMs (e.g., Conway, 1988, 1990; Daselaar, Rice, Greenberg, Cabeza, LaBar & Rubin, 2008; Greenberg, Eacott, Brechin & Rubin, 2005; Ogden, 1993; Svoboda, McKinnon & Levine, 2006). Moreover, visual imagery contributes to several aspects of ABM, including subjective reliving of autobiographical memory (e.g., El Haj, Kapogiannis & Antoine, 2016; Greenberg & Rubin, 2003; Rubin, 2005, 2006), their vividness (e.g., D'Argembeau & Van der Linden, 2006), as well as the easiness (e.g., lower retrieval times) of retrieval (Rasmussen & Berntsen, 2014; Williams, Healy & Ellis, 1999). In addition, emotional autobiographical memories have been found to be experienced with more visual imagery than neutral ones (e.g., El Haj, Nandrino, Antoine, Boucart & Lenoble, 2017).

Evidence for a role of visual imagery in the retrieval of ABMs also comes from the studies on eye-movements during autobiographical recall (El Haj *et al.*, 2014, 2107; El Haj & Lenoble, 2018; Lenoble, Janssen & El Haj, 2019). For example, El Haj *et al.* (2014) found that autobiographical recall triggered a higher number of saccades, with higher duration and amplitude compared to a control condition, suggesting that the retrieval of ABMs is associated with visual exploration and generation of visual mental images of the remembered event. Moreover, a very recent work by Lenoble *et al.* (2019) has shown that maintained fixation during the retrieval can also affect the characteristics of ABMs: ABMs retrieved during a maintained fixation condition were less detailed and accompanied with less visual imagery, and they were retrieved slower compared to those retrieved during a free-gaze condition.

However, surprisingly, the evidence regarding the association between the phenomenology of ABMs and individual differences in vividness of visual imagery is mixed. On the one side, D'Argembeau and van der Linden (2006) have shown that vividness of visual imagery predicted richness of sensory details in memory and the clarity of representation of temporal

information. On the other, Greenberg and Knowlton (2014) reported no significant association between individual differences in vividness of visual mental images and the richness of sensory details in memory and the experience of reliving. Some more recent studies (Sheldon, Amaral & Levine, 2017; Vannucci, Pelagatti, Chiorri & Mazzoni, 2016) suggested that the inconsistent results could be due to the fact that: (1) visual imagery is treated as a unitary construct; and that (2) individual differences are referred to a limited dimension, namely the *ability* to generate vivid mental images.

In this regard, over the last two decades a number of behavioral and neuroscientific studies revealed that the visual imagery system consists of two distinct subsystems, namely object and spatial imagery: the object imagery system processes information about the visual appearance of objects and scenes (i.e., shape, color information, and texture) while the spatial imagery system processes information about spatial relations, object's locations in space and spatial transformations (e.g., Farah, Hammon, Levine & Calvanio, 1988; Kosslyn, Ganis & Thompson, 2001; Kosslyn & Thompson, 2003; Mazard, Tzourio-Mazoyer, Crivello, Mazoyer & Mellet, 2004).

In addition, a great body of evidence demonstrated that this dissociation also holds at the individual differences level, and specifically in dimensions of cognitive style (e.g., Kozhevnikov, Hegarty & Mayer, 2002; Kozhevnikov, Kosslyn & Shepard, 2005; Vannucci & Mazzoni, 2009). Object imagery and spatial imagery measured as visual cognitive styles refer to the tendency/preference and frequency of use of these two types of visual imagery. Specifically, individuals with high levels of visual object imagery (i.e., Object Imagers) prefer to generate concrete, pictorial, high-resolution images of individual objects and they enjoy visual pictorial representations (e.g., paintings), whereas individuals with high levels of spatial imagery (i.e., Spatial Imagers) prefer to use imagery to schematically represent location, spatial relations, and objects' movements (e.g., Kozhevnikov, Hegarty & Mayer, 2002; Kozhevnikov *et al.*, 2005). Moreover, Object Imagers are good in visual object recognition tasks (e.g., filtered pictures task, Vannucci *et al.*, 2008), whereas Spatial Imagers perform well in complex spatial transformation tasks (Blazhenkova, Kozhevnikov & Motes, 2006; Kozhevnikov *et al.*, 2005). Recently, Blazhenkova (2017) has shown that individuals with high levels of visual object imagery reported higher levels of vividness of imagined emotional expressions, higher levels of emotional complexity (i.e., having emotional experiences that are broad in range and well-differentiated), and they were also better in recognizing emotional states (conveyed by facial expressions and voice) compared to individuals with low levels.

To the best of our knowledge, only two studies (Aydin, 2018; Vannucci *et al.*, 2016) investigated the relationship between the phenomenology of ABMs and individual differences in visual imagery as a cognitive style. In the study by Vannucci *et al.* (2016) individuals with high levels of object imagery remembered more personal memories and with shorter retrieval times compared to individuals with low levels and they also rated their ABMs as more detailed and mainly recalled as visual images.

Recently, Aydin (2018) extended the investigation to individual differences in spatial imagery (see also Sheldon *et al.* (2017) for the association between accuracy of episodic memory and spatial imagery). In the study participants generated two past and two future personal events from different time frames and twelve phenomenological characteristics of the events, as well as the episodic specificity (i.e., number of internal and external details), were assessed. Object imagery scores were positively correlated with the amount of visual details, the emotional intensity of the event and the story coherence. Spatial imagery was not significantly related to any of the phenomenological ratings. However, spatial imagery contributed to the level of episodic specificity of both past and future autobiographical events.

In the present work we aimed to capitalize on these promising findings and to extend them further, by assessing a more comprehensive set of phenomenological characteristics and obtaining more reliable scores for each of them. Specifically, we hypothesized that higher levels of visual object imagery were associated with a more intense *autonoetic* experience, that is, with a larger amount of sensory details in memory but also with a stronger experience of both sensory and emotional reliving, and with a tendency to rate memories as remembered as opposed to known. We also aimed at testing whether and how individual differences in object and spatial imagery were also related to phenomenological dimensions related to a basic feature of ABMs, for example, belief in memory accuracy, that have not been investigated in previous studies.

METHODS

Participants

One hundred and thirty-eight psychology undergraduates (78.3% females; age range: 18–32 years) at the University of Florence participated in the first session (scale assessment). A subgroup (n = 90, 77 females; age range: 18–31 years) agreed to take part also in the second session (visual imagery), 2 weeks later.

Material

Assessment of the Phenomenology of Autobiographical Memory (APAM). In the context of APAM, participants were asked to retrieve an autobiographical memory associated with each of the 12 cue words. The cue words were *city*, *dress*, *sickness*, *sea*, *love*, *mother*, *party*, *plant*, *poetry*, *fire*, *mountain*, and *wine*. The cue words were derived from Rubin *et al.* (2003) and we selected words familiar[1] to Italian people and we did not use opposite words (e.g., health and sickness).

Then, the phenomenological features of each retrieved memory were rated on 30 items. The 30 items were taken and adapted from the Memory Characteristics Questionnaire (MCQ, Johnson *et al.*, 1988), the AMQ (Rubin *et al.*, 2003), and the MEQ (Sutin & Robins, 2007). Items taken from the MCQ were: clarity of memory (item 1 in APAM), color (item 2), vividness (item 3), richness of visual details (item4), sound (item 5), smell (item6), taste (item 7), and touch (item 8). Items taken from AMQ were: sensory (item9), auditory (item 10), visual (item 11), spatial reliving of the event (item 12), remember/know (item 13), formulation in words (item 14), coherence (item 15), confidence in the accuracy of the memory/testify (item 16), emotional reliving of the event (item 21), personal importance (item 26), imagined/real (item 27), confidence in the accuracy of the memory/persuade (item 28), specificity (item 29), age of memory (item 30). Rehearsal in the AMQ it is measured by a single item ("I have thought or talked about this event"), while we included two distinct items, intended to assess separately thinking (item 24) and talking (item 25). Items taken from the MEQ were about accessibility (item 17), visual perspective-first person (item 18), visual perspective-third person (item 19), emotional intensity

(event – item 20; memory –item 22), self-distancing (item 23). Of these items, the first 28 were measured on a seven-point Likert-type scale. Item 29 included three choices: whether the memory was for an event that occurred once within a single day (item 29a), whether it was a summary or merging of similar events (item 29b), or whether it was for an event that extended for a period greater than 1 day (item 29c). Item 30 was an open question, with request to date memory. The list of items of APAM is reported in the online Appendix S1.

Object–Spatial Imagery Questionnaire (OSIQ, Blazhenkova *et al.*, 2006*).* The OSIQ (Italian adaptation in Vannucci, Cioli, Chiorri, Grazi & Kozhevnikov, 2006) assesses individual differences in cognitive style, namely in the frequency of use, preference and ability to imagine objects (Object Imagery Scale, OSIQ_OI) versus spatial relations and layouts (Spatial Imagery Scale, OSIQ_SI). Participants rated the questionnaire items on a five-point Likert-type scale (from 1 = *totally disagree* to 5 = *totally agree*). The mean score of the OSIQ_OI scale is considered to be an index of the object imagery level and the mean score of the OSIQ_SI scale is considered to be an index of the spatial imagery level. Previous studies reported adequate reliability and convergent validity (Blazhenkova *et al.*, 2006; Vannucci *et al.*, 2006). The OSIQ was administered to a subsample of participants (n = 90).

Procedure

In session 1, APAM was administered to whole sample in small group sessions. Participants were briefly introduced to the research project, presented as a study examining individual differences in autobiographical memory. Participants received a page of instructions, followed by the sample cue word "tree" followed by the 30 questions about the memory it cued (practice trial), and then 12 small numbered booklets, each one with a blank cover page, followed by the cue-word and the 30 questions. The order of cues was reversed in half of the participants. The task was self-paced and it lasted between 60 and 90 minutes.

Session 2 took place 2 weeks after session 1. Participants were tested in small groups and they were administered the questionnaire on individual differences in visual object and spatial imagery (OSIQ). At the end, participants were debriefed about the questionnaire and the association between the two sessions.

RESULTS

Psychometric properties

The reliability of each item was indexed as the internal consistency of scores (Cronbach's α) across the 12 cue conditions. One hundred and thirty-three participants (96.4%) retrieved a memory for each cue-word (i.e., 12 memories), four participants could generate 11 memories, and one participant retrieved ten memories. Overall, missing data represented 0.85% of the complete dataset. Since we could not detect a clear pattern of systematic missingness, we considered these missing data as completely at random and carried out the subsequent correlational analyses using full information maximum likelihood estimation (Collins, Schafer & Kam, 2001). Item 29 (nominal scale) and 30 (open question) were excluded from these analyses. The level of internal consistency was adequate ($\alpha \geq 0.70$) in all but four items (item 20, 24, 25, 26), in which it was lower but still acceptable ($0.60 \leq \alpha \leq 0.69$, see Table 1).

To assess whether the items measured the same dimension regardless of the cue presented, we performed a principal component analysis of each item score across the 12 cue conditions. An item was considered as (acceptably) unidimensional

Table 1. *Mean, standard deviation, skewness, kurtosis, alpha and % of variance explained and average loading of each item*

Item	Mean (SD)	Skewness	Kurtosis	α	Variance Expl. (%)	Average loading (min.–max.)
Item 1	4.85 (0.85)	−0.23	−0.03	0.70	23.63	0.48 (0.32–0.61)
Item 2	5.51 (1.13)	−1.47	3.59	0.88	43.77	0.66 (0.49–0.75)
Item 3	4.48 (0.94)	−0.26	−0.12	0.77	28.60	0.53 (0.39–0.64)
Item 4	5.49 (0.81)	−0.64	0.54	0.78	29.95	0.54 (0.36–0.72)
Item 5	3.93 (1.06)	−0.19	−0.48	0.75	27.60	0.51 (0.26–0.66)
Item 6	2.56 (1.12)	0.41	−0.82	0.81	32.77	0.56 (0.25–0.75)
Item 7	2.28 (0.88)	0.87	0.56	0.71	24.27	0.48 (0.32–0.61)
Item 8	3.09 (1.11)	0.2	−0.5	0.77	28.98	0.53 (0.40–0.70)
Item 9	4.31 (0.89)	−0.18	−0.16	0.73	26.33	0.50 (0.25–0.70)
Item 10	3.45 (0.99)	0.36	−0.31	0.73	26.03	0.50 (0.32–0.69)
Item 11	5.01 (0.79)	0.1	−0.32	0.72	25.59	0.50 (0.37–0.64)
Item 12	4.12 (0.90)	−0.1	−0.14	0.71	24.08	0.49 (0.35–0.62)
Item 13	5.56 (1.12)	−1.52	2.8	0.88	43.92	0.66 (0.55–0.81)
Item 14	2.65 (1.15)	0.61	−0.17	0.86	41.42	0.64 (0.38–0.75)
Item 15	3.95 (1.11)	0.07	−0.39	0.76	28.17	0.52 (0.35–0.64)
Item 16	4.85 (0.98)	0.27	−0.44	0.75	26.85	0.51 (0.37–0.64)
Item 17	4.90 (1.23)	−1.42	2.26	0.85	38.07	0.61 (0.48–0.70)
Item 18[a]	4.46 (1.24)	−0.52	−0.19	0.79	–	–
Item 19	3.58 (1.35)	0.18	−0.8	0.83	36.10	0.59 (0.44–0.73)
Item 20	4.77 (0.82)	−0.28	−0.49	0.66	22.09	0.46 (0.30–0.58)
Item 21	3.95 (1.01)	0.22	−0.29	0.76	28.60	0.53 (0.30–0.66)
Item 22	3.85 (1.01)	0.02	−0.45	0.77	29.12	0.54 (0.45–0.65)
Item 23	3.31 (1.14)	0.25	−0.54	0.76	28.67	0.52 (0.28–0.69)
Item 24[a]	4.05 (0.75)	−0.24	−0.65	0.60	19.15	0.43 (0.30–0.60)
Item 25	3.38 (0.86)	0.08	−0.42	0.66	21.29	0.45 (0.19–0.66)
Item 26	3.42 (0.89)	0.36	−0.28	0.64	21.65	0.45 (0.26–0.63)
Item 27	5.60 (0.79)	0.09	−1.01	0.79	31.01	0.55 (0.41–0.71)
Item 28[a]	2.94 (0.95)	−0.07	−0.65	0.78	–	–

[a]Item excluded from the analysis.

across cues if the variance accounted for by the first component was higher than 20%, the scree-plot suggested an optimal number of factors to extract equal to 1 and all component loadings were higher than 0.25. All items except item 24 (which was therefore excluded from the final pool) met these criteria, suggesting that they were measuring the same dimension regardless of the cue presented (Table 1).

Given the previous results, we computed scores for each item as the mean rating per participant across the 12 cues. Means, standard deviations, skewness, and kurtosis of all items are reported in Table 1. In item 29 the mean number of single events remembered across the 12 cues was 7.88 ± 2.02 (range 3–12), the mean number of multiple events remembered was 2.39 ± 1.71 (range 0–7), whereas the mean number of extended events was 1.66 ± 1.39 (range 0–6).

As for item 30, exact dates were reported in 22.30% of cases and the mean time distance for these memories was 2,113 ± 1,082 days.

Since we aimed at developing a parsimonious pool of items that could adequately map the phenomenological characteristics of ABMs, we checked for redundancies in the inter-item correlation matrix, defined as a high correlation ($r \geq |0.65|$) between two or more item scores supposed to measure distinct dimensions. When this was the case, we kept in the pool only one item and excluded the other(s) on the basis of three criteria: (1) the reliability was higher; (2) the amount of information provided was higher (indexed by its standard deviation); (3) the distribution was less skewed and/or kurtotic. The application of these criteria had led to the exclusion of two item s, item 18 (visual perspective, $r = -0.76$ with item 19), and item 28 (confidence in the accuracy of one's own memory/ persuade, $r = -0.66$ with item 16).

We also tested gender differences in item scores. Independent-sample *t*-tests (Welch's method) showed small differences (effect size $0.20 < r < 0.30$) in item 20 (M > F), 21 and 30 (F > M), which however were no longer significant after controlling for false discovery rate with the adaptive Benjamini and Hochberg (1995) step-up procedure. As a result, gender was not considered in subsequent analyses.

From the initial pool of 30 item s, 3 item s (18, 24, 28) were removed given their inadequate psychometric properties. The subsequent analyses were carried out on the final 27-item version of APAM.

Visual object and spatial imagery and the phenomenology of memory

For each APAM item we specified a multiple regression model in which the scores on OSIQ_OI and OSIQ_SI were entered as predictors. This analysis allowed us to the test the association of the score on APAM item s with one cognitive style over and above the association with the other. The results are reported in Table 2 and show that, after adjusting the *p*-values for false discovery rate, OSIQ_OI was significantly predicted by item 1 (sharpness), item 6 (smell), item 9 (reliving), item 11 (seeing in mind), item 21 (feeling the same emotions again), and item 22 (intensity of feelings). No APAM item score was significantly predicted by OSIQ_SI.d

Table 2. *Multiple regression analyses of the APAM item scores on measures of visual imagery*

	Standardized β (effect size η^2)		
Item	OSIQ-object	OSIQ-spatial	Adjusted R^2
Item 1	0.29[a] (0.08)	0.02 (0.00)	0.06
Item 2	0.17 (0.03)	0.03 (0.00)	0.01
Item 3	0.24 (0.06)	−0.01 (0.00)	0.04
Item 4	0.26 (0.06)	0.01 (0.00)	0.05
Item 5	0.23 (0.05)	0.00 (0.00)	0.03
Item 6	0.31[a] (0.10)	0.03 (0.00)	0.08
Item 7	0.20 (0.04)	−0.06 (0.00)	0.02
Item 8	0.26 (0.06)	0.04 (0.00)	0.05
Item 9	0.29[a] (0.08)	−0.03 (0.00)	0.06
Item 10	0.25 (0.06)	0.08 (0.01)	0.05
Item 11	0.31[a] (0.10)	0.07 (0.01)	0.09
Item 12	0.18 (0.03)	0.12 (0.02)	0.03
Item 13	0.04 (0.00)	0.08 (0.01)	0.00
Item 14	−0.08 (0.01)	0.21 (0.04)	0.02
Item 15	0.20 (0.04)	0.22 (0.05)	0.08
Item 16	0.14 (0.02)	0.00 (0.00)	0.00
Item 17	0.06 (0.00)	0.20 (0.04)	0.02
Item 19	−0.04 (0.00)	0.04 (0.00)	0.00
Item 20	0.21 (0.04)	−0.03 (0.00)	0.02
Item 21	0.31[a] (0.09)	0.09 (0.01)	0.09
Item 22	0.28[a] (0.08)	−0.09 (0.01)	0.06
Item 23	0.08 (0.01)	0.02 (0.00)	0.00
Item 25	0.13 (0.02)	−0.07 (0.00)	0.00
Item 26	0.22 (0.05)	−0.15 (0.02)	0.04
Item 27	0.18 (0.03)	0.18 (0.03)	0.05
Item 29a	−0.19 (0.03)	0.00 (0.00)	0.01
Item 29b	0.20 (0.04)	−0.09 (0.01)	0.02

[a]$p < 0.05$, adjusted p-values for the adaptive Benjamini and Hochberg (1995) step-up False Discovery Rate-controlling procedure; for item 29a and item 29b the response variable was the proportion of cues in which a single and a multiple event, respectively, was remembered. Since the proportion in the third category (item 29c) is constrained to add up to one with the proportions of the other two, it was not free to vary and was not included in the analysis.

DISCUSSION

Assessment of the phenomenology of ABMs

The first purpose of the present work was to develop a comprehensive and psychometrically sound measure of phenomenological properties of ABMs, namely the Assessment of the Phenomenology of Autobiographical Memory (APAM). Although some instruments are already available, current measures have some limits (e.g., only a subset of the relevant dimensions are measured, or some of the dimensions are merged together and not assessed separately) and administration time can be rather long.

We began with identifying the phenomenological properties measured by existing instruments (AMQ, MCQ, MEQ) and developed a new list of 30 items, which included all relevant phenomenological characteristics. The assessment of reliability, dimensionality, and redundancy led to the exclusion of three item s because of redundancy (item 18, 28) or inconsistency across cues (item 24).

The final item s showed good to excellent reliability and, importantly, evidenced capability of measuring the same dimension regardless of the cue administered. Compared to the

other instruments, APAM enables to assess a wider range of phenomenological properties in a quick, non-intrusive, and efficient way. These characteristics make APAM a useful and versatile instrument suitable for a broad range of research purposes.

In most published studies on involuntary memories, phenomenological properties have been measured using ad-hoc items and limited to a few dimensions (vividness, rehearsal and specificity in Schlagman & Kvavilashvili, 2008). When a standardized instrument was used (e.g., AMQ in Rubin, Boals & Berntsen, 2008), voluntary and involuntary memories were found to differ in several respects, more than those already observed in the previous studies. APAM measures other neglected but potentially relevant dimensions, such as accessibility of memory, emotional intensity of event and memory, visual perspective, and self-distancing. It could also provide useful information on possible functions of involuntary memories in everyday life, as well as help understand differences and similarities with voluntary memories, in terms of retrieval processes and characteristics of memory traces. The same can be said about comparing true and false memories, as well as memories elicited by different modalities (e.g., perceptual vs. verbal cues). Moreover, APAM could be useful in examining phenomenology across a wider range of mental experiences that are meaningful for the self (e.g., spontaneous thoughts arising during monotonous and boring tasks) and compare them to autobiographical memories.

Some might consider the single-item approach a limitation. Single item measures might have problems in cancelling out random errors in the observed score, and they fail to provide estimates of internal reliability (e.g., a problem for structural equation modeling). However, if measurement error is not random, multiple items can only reduce, but not remove, such bias. It has also been suggested that when measuring established constructs, a deductive approach (i.e., formulating items to assess wider constructs) provides more focused scales and estimates of reliability can be obtained through simple test–retest correlations or, as in our study, through consistency of scores over multiple cues (e.g., Woods & Hampson, 2005).

Moreover, single-item instruments, compared to multiple-item ones, have clear practical advantages, in terms of brevity and ease of administration, important especially when the instruments are to be used for practical purposes. In addition, and more generally, increasing evidence has been reported for complex psychological constructs being effectively assessed by single-item questionnaires, with adequate test–retest reliability, predictive validity, and construct validity (e.g., self-esteem, Robins, Hendin & Trzesniewski, 2001; the Big Five personality traits, Woods & Hampson, 2005). This study does not seem to be an exception. APAM items showed adequate reliability (i.e., consistency of ratings across 12 cues) and internal validity (i.e., ratings of each dimension over the cues loaded substantially on a single component).

In the present study we followed Rubin *et al.*'s (2003) approach and we assessed the phenomenology of ABMs elicited in response to cue-words. Future studies should extend this investigation by using different memory prompts, as for example asking participants to recall self-defining memories, positive or negative academic memories, or memories related to different period of time (e.g., childhood, adolescence) and compare the phenomenology of different types of ABMs. In this regard, a recent study by Luchetti and Sutin (2017) has already shown that memories from reminiscence bump were more positive in valence than events from other time periods and that recent memories had stronger phenomenology than remote memories.

Two other potential extensions of this study are the application of APAM also to elderly people and groups of neuropsychological and clinical patients, in order to evaluate preliminarily its psychometric properties and the examination of the convergent and discriminant validity of the APAM, especially with special populations.

Previous studies have shown that phenomenology of memory varies systematically among these different populations. Compared to young adults, older adults are more likely to recall general than specific past events with less sensory details but positive emotional tone (Anderson *et al.*, 2000; Rubin & Schulkind, 1997). Depressed patients report overgeneral memories (Williams, 1996), a reduced accessibility and a less intense and primarily negative emotional experience in ABMs (Joormann & Siemer, 2004). In PTSD patients, memory is biased toward trauma-related stimuli (Wenzel, Pinna & Rubin, 2004), retrieving specific positive ABMs is difficult (McNally *et al.*, 1995), and ABMs are emotionally intense and vividly relieved (Rubin *et al.*, 2011). Although these patterns are quite consistent, comparisons between groups based on a comprehensive evaluation of phenomenology are still missing, and APAM might be useful and preferable to multi-item scales.

Phenomenology of ABM and visual object and spatial imagery

Besides presenting a new instrument, this study shows that APAM is associated with individual differences in visual object imagery. Visual object imagery predicted the sharpness of the memory, the involvement of smell, the reliving of the original event, the capability of seeing the event in one's mind, the feeling of the emotions that were felt at the time of the memory, and the intensity of this feeling. In short, higher levels of object imagery were associated with stronger *autonoetic* experiences. On the other hand, spatial imagery was not significantly associated with any of the phenomenological properties.

These results provide further evidence for the crucial role played by visual imagery in the retrieval of autobiographical memories (e.g., Conway, 1990; Conway & Fthenaki, 2000; Daselaar *et al.*, 2008; Greenberg & Rubin, 2003; Rubin, 2005, 2006) and specifically for the influence of pre-existing individual differences in visual object imagery style in the retrieval of autobiographical memories, shaping the qualities of the memory retrieved. Our findings are in line and extend the results of a recent study by Aydin (2018), in which object imagery predicted the experience of visual details of ABMs, story coherence, and emotional intensity of the past events, whereas spatial imagery was not significantly associated with any of the phenomenological properties.

Importantly, the present results also show that visual object imagery, as a dispositional trait, makes it easier for individuals to relive their memories, being associated with an enhancement of

the recollective qualities of personal memories, which included both sensory and emotional experience.

The positive association between visual object imagery and the experience of emotional reliving are in line with recent finding on the association between visual object imagery and emotional processing (Blazhenkova, 2017; Blazhenkova & Kozhevnikov, 2010), and they further show that this association is also extended to the retrieval of ABMs.

Future investigations, comparing groups of participants with extreme visual object imagery levels may also help to better understand the emotional profile of the Object Imagers. In this regard, the investigation should be also extended to the physiological measures of emotional activation and arousal associated with the retrieval of ABMs, to provide an objective and covert measure of the subjective experience of emotional reliving.

Finally, another potential extension of this study is the use of objective measure of visual object imagery (e.g., the degraded pictures task, Kozhevnikov *et al.*, 2005) which might provide stronger evidence for the association between visual cognitive styles and the phenomenology of ABMs.

CONCLUSION

Our findings show that APAM is a psychometrically sound measure of phenomenological properties of ABMs and they extend previous investigations on the role of visual imagery in autobiographical memory, by showing that visual object imagery as an individual trait enhance both the sensory and emotional recollective qualities of personal memories.

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NOTE

[1] To assess familiarity (i.e., a subjective frequency measure of how much a word is present in someone's daily life), we asked independent judges to rate the level of familiarity of the cues and only familiar words were selected (e.g. the word "ocean" included in the original pool of words was excluded and "sea" was used).

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article:

Appendix S1. Assessment of the Phenomenology of Autobiographical Memory (APAM).

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Appendix A. Assessment of the Phenomenology of Autobiographical Memory (APAM)

- Item01: My memory for this event is 1= dim; 7= sharp/clear
- Item02: My memory for this event is 1= black and white; 7= entirely colored
- Item03: My memory for this event is 1= vague; 7 = very vivid
- Item04: My memory for this event involves visual detail 1 = little or none; 7 = a lot
- Item05: My memory for this event involves sound 1 = little or none; 7 = a lot
- Item06: My memory for this event involves smell 1 = little or none; 7 = a lot
- Item07: My memory for this event involves touch 1 = little or none; 7 = a lot
- Item08: My memory for this event involves taste 1 = little or none; 7 = a lot
- Item09: As I remember the event, I feel as though I am *reliving* the original event (1= not at all ; 7 = as clearly as if it were happening right now)
- Item10: As I remember the event, I can hear it in my mind (1= not at all ; 7 = as clearly as if it were happening right now)
- Item11: As I remember the event, I can see it in my mind (1= not at all ; 7 = as clearly as if it were happening right now)
- Item12: As I remember the event, I can recall the setting where it occurred (1= not at all ; 7 = as clearly as if it were happening right now)
- Item13: Sometimes people know something happened to them without being able to actually remember it. As I think about the event, I can actually remember it rather than just knowing that it happened (1= completely disagree; 7= completely agree)
- Item14: As I remember the event, it comes to me in words (1= completely disagree; 7= completely agree)
- Item15: As I remember the event, it comes to me in words or in pictures as a coherent story or episode and not as an isolated fact, observation, or scene (1= completely disagree; 7= completely agree)

- Item16: You are confident enough in your memory of the event to testify in a court of law (1= completely disagree; 7= completely agree)
- Item17: This memory just sprang to my mind when I read the instructions (1= completely disagree; 7= completely agree)
- Item18: In my memory, I see this experience through my own eyes (1= completely disagree; 7= completely agree)
- Item19: I view this memory as if I was an observer to the experience (1= completely disagree; 7= completely agree)
- Item20: My feelings at the time of the event were intense (1= not at all; 7 = a lot)
- Item21: As I remember the event, I can feel now the emotions that I felt then (1= not at all ; 7 = as clearly as if it were happening right now)
- Item22. As I remember the event, my feelings are intense (1= not at all; 7 = a lot)
- Item23: I feel like the person in this memory is a different person than who I am today (1= completely disagree; 7= completely agree)
- Item24: Since it happened, I have thought about this event (1= never; 7= very often)
- Item25: Since it happened, I have talked about this event (1= never; 7= very often)
- Item26: This memory is significant for my life because it imparts an important message for me or represents an anchor, critical juncture, or a turning point (1= completely disagree; 7= completely agree)
- Item27: I believe the event in my memory really occurred in the way I remember it and that I have not imagined or fabricated anything that did not occur. (1 = 100% imaginary; 7 = 100% real)
- Item28: If another witness to the event, who you generally trusted, existed and told you a very different account of the event to what extent could you be persuaded that your memory was wrong (1= not at all; 7= completely)

- Item29:To the best of your knowledge, is the memory of :

  -an event that occurred once at one particular time and place

  -a summary or merging of many similar or related events

  -events that occurred over a fairly continuous extended period of time lasting more than a day

- Item30: Please date the memory (month/day/year) as accurately as you can. Please fill in a month, day, and year even if you must estimate. If the memory extended over a period of time, report the approximate middle of the period.