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Using a Reminiscence-based Approach to Investigate the Cognitive Reserve of a Healthy Aging Population

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ABSTRACT

Objectives: The concept of Cognitive Reserve (CR) has been used to account for brain plasticity in older adults that may underlie the resilience against the effects of aging or pathology on cognitive abilities. This study aims at exploring the proxies of CR in a sample of healthy older adults by analyzing their spontaneous reminiscence through a discourse analysis approach.

Method: Fifteen community-dwelling older adults were asked to participate in a video-recorded, spontaneous reminiscence interview. Interviews were transcribed according to Conversation Analysis, and two judges classified the interview content identifying five main markers of CR: enriched environment, cognitively stimulating activities, education, physical activity, and social interaction.

Results: Reminiscence allowed to identify markers of CR. Sharing stories that are linked to CR markers promote positive emotion, coherent sense of self, and cognitive evaluation of the importance of the social network.

Conclusions: Reminisce looks like a possible approach not only to indirect evaluate the CR, but also to promote it.

Clinical Implications: The reminisce approach can be used as a clinical tool to assess and increase the CR, help the clinical population to experience more positive emotions, maintain a more defined sense of self, and value more the social resources available.

Introduction

Data derived from observation of the aging brain in different populations has shown no evidence of a direct relationship between a given form of brain damage and its clinical manifestation (Herrup, 2015): Several studies have observed that some individuals continue to function clinically despite brain pathology (e.g., Crystal et al., 1988; Davis, Schmitt, Wekstein, & Markesbery, 1999; Katzman et al., 1988; Riley, Snowdon, & Markesbery, 2002). Starting from this evidence, Stern (2002, 2003) introduced the concept of *cognitive reserve* (CR), which can be defined as "the ability to optimize or maximize performance through differential recruitment of brain networks, which perhaps reflect the use of alternate cognitive strategies" (Stern, 2002, p. 451). This concept has been advanced to account for brain plasticity in older adults that may underlie the resilience to the effects of aging or brain pathology such as Alzheimer's disease on cognitive

abilities (Tucker & Stern, 2011; Whalley, Deary, Appleton, & Starr, 2004).

The study and application of CR come with certain levels of complexity. The first is that different models of brain functioning could explain the concept of "reserve." In his reviews, Stern (2002, 2003) has distinguished between two types of reserve models. On the one side, 'passive' models (e.g., Katzman, 1993; Satz, 1993) assume that individuals differ in their *brain reserve capacity* (BRC), indexed by measures such as brain size or neuronal count. The core idea is that there is some critical, fixed threshold of BRC, which predicts the amount of damage that can be sustained before the clinical expression of a disease (i.e., functional impairment) is recorded or noticed. Individuals with greater BRC—consisting in a higher number of synapses or higher head circumference—would require more pathology to reach this threshold (Steffener & Stern, 2012).

The 'active' models, on the other hand, suggest that the brain tries to cope with or compensate for brain pathology. Within these models, CR describes how flexibly and efficiently the individual can make use of available brain reserve (Tucker & Stern, 2011). Stern (2002) has argued that CR enables individuals to compensate for any form of brain damage and still operate efficiently: When the approach used to face a specific task is no longer available because of any form of damage, a higher CR will allow individuals to use alternative paradigms to get the same or similar results. Thus, according to the CR hypothesis, reserve is defined in terms of differences in how cognitive or functional tasks are processed rather than in terms of brain's structures per se. In other terms, people with higher CR levels do not differ from individuals with lower CR regarding brain anatomy (e.g., the number of synapses), but are able to use more efficient cognitive processing mechanisms. Although passive and active models seem to focus either on the "hardware" or on the corresponding "software" of reserve, they should not be considered as mutually exclusive, but rather as reflecting two different approaches aiming at explaining the same phenomenon - namely individual differences in brain plasticity in older adults (e.g., Mortimer, Snowdon, & Markesbery, 2003).

The concept of CR has been used to explain why individuals with higher education (e.g., Davis et al., 1999; Stern, Alexander, Prohovnik, & Mayeux, 1992), intelligence (Alexander et al., 1997), occupational attainment (Richards & Sacker, 2003; Stern et al., 1994), as well as engagement in leisure actives of an intellectual and social nature (Scarmeas et al., 2003) can sustain significantly larger brain damage before showing functional impairment. Aspects of life experience like educational or occupational attainments are thought to supply reserve in the form of a set of skills or repertoires that allows some people to cope with progressing pathology better than others (Scarmeas & Stern, 2003). For example, taking the level of education into account, Stern and colleagues (1992) found that well educated patients showed a higher degree of disruption of cerebral metabolism and blood flow for a given level of dementia than patients with lower levels of education. This apparently paradoxical result suggests that—although Alzheimer pathology is relatively more advanced in patients with higher levels of education—these patients can cope more efficiently with neuropathological changes. Likewise, other studies have found that people with higher intelligence, more education, or engaging in leisure activities decline more quickly and die sooner once Alzheimer's pathology is diagnosed (Scarmeas, Albert, Manly, & Stern, 2006; Stern, Albert, Tang, & Tsai, 1999): By the time deficits are clinically evident, the disease has reached a more advanced stage in individuals with high CR. Finally, there is evidence that education and engagement in leisure activities are related to lower risk of functional decline in healthy, non-demented elderly (Scarmeas & Stern, 2003; Snowdon, Ostwald, & Kane, 1989).

A second level of complexity linked to the concept of CR concerns the different and varied proxies that research has used to assess it. A recent meta-analysis involving 135 cross-sectional studies (Opdebeeck, Martyr, & Clare, 2016) has highlighted the variety of methods and proxies used by different researchers to measure CR: Education was the most common proxy of CR (109 studies); occupational attainment was considered in 19 studies, while 31 studies measured CR by the engagement in cognitively stimulating activities. Finally, only six studies used a combination of more than one proxy measure. As a limitation the authors stressed how the reported associations were modest. The authors highlighted the need for further studies to more comprehensively investigate the relationship between the CR and specific, well defined, cognitive functions in healthy and clinical populations. For this reason, finding a way of exploring to a deeper extent which proxies might play a major role in promoting healthy aging, by adopting a form of ecological and comprehensive approach that considers several aspects of individuals' lives, would possibly add some important and relevant information to the study of the CR.

In this work, we suggest that a promising way of doing this is using a reminiscence-based approach to elicit spontaneous memories in the aging population. Reminiscence is a practice common at all ages (Webster & Gould, 2007), and it is defined as the process of thinking or telling someone about personally significant past experiences, both successful and unsuccessful (Satorres, Viguer,

Fortuna, & Meléndez, 2017). This process entails an awareness of life experiences that may be re-examined and reintegrated (Biassoni, Cassina, & Balzarotti, 2017). In the past few years, several studies have been exploring the effect of reminiscence on various cognitive, social, behavioral, and health outcome measures and recent meta-analyses have documented significant effects on older adults' well-being (Bohlmeijer, Roemer, Cuijpers, & Smit, 2007; Pinquart & Forstmeier, 2012).

Four processes underlying reminiscence are often mentioned to explain the positive relationship between reminiscence and successful aging: identity-forming and self-continuity; enhancing meaning in life and coherence; preserving a sense of mastery; promoting acceptance and reconciliation (Bohlmeijer et al., 2007). Notably, high levels of CR could (and should) foster all these processes, by allowing individuals to deal with tasks affected by each of the mentioned processes in a more efficient way. If this line of reasoning is true, then one should be able to identify clear markers of CR by analyzing spontaneous reminiscence of healthy elderly. The reminiscence approach would enable to identify not only which proxies of the CR are used, but also to better understand how they may help the older adult to cope with different tasks linked to aging by the way of understanding to which extent each type of tasks (e.g., social, cognitive, physical, etc.) play a role in promoting the CR. Finally, analyzing spontaneous narrations would also allow taking into consideration all the CR proxies at the same time, avoiding the aforementioned limitations highlighted by Opdebeeck and colleagues (2016).

To be able to analyze the data derived from a reminisce activity reliably, we chose to adopt a Discursive Psychology-inspired perspective. Discursive Psychology (DP) links "psychology" and "discourse": Psychology is intended as something that is displayed, and can hence be studied, in talk and dialogical interactions (Potter, 2005). Within DP, psychology is considered from the perspective of the participants of the dialogical interaction (Potter & Wetherell, 2001). This is possible because language is intended both as constructed and constructive: People when talking "act," using language as a fundamental tool to construct the social world. Language is also intended as informative: This

means that people's conduct during a conversation has to be treated not as a simple behavior, but as an action (i.e., an intelligent activity; Pomerantz & Fehr, 1997). From this perspective, language involves a series of procedures that are shared among people, which help individuals to coordinate with others in everyday life. This perspective opens the possibility of examining utterances as objects which speakers use with awareness to pursue specific goals while interacting with other people (Wooffitt, 2001).

A standard method used within Discourse Analysis to analyze the transcripts is Conversation Analysis (CA). Conversation Analysis derives from Sack's work (with the cooperation of Schegloff and Jefferson)—aimed at exploring language and its organization in everyday use. Their main aim was to define a new sociological method to analyze natural occurring interactions (that is to say data-driven and not theory led), starting from the assumption that language use can be seen as an informative site to explore social actions (Wooffitt, 2001). Starting from these theoretical and methodological assumptions, we designed and ran our study aimed at exploring proxies of the CR in a sample of healthy older adults.

Methods

Participants

We recruited 15 participants (age range: 72–85 years, mean age: 79.13 years, SD = 3.61) by way of advertising the project at local senior centers. We excluded participant with a diagnosis of any form of dementia or cognitive impairment. Exclusion was based on information self-reported by participants. When an individual expressed interest in being involved in the research, they were asked about any diagnose or about cognitive difficulties they have been experiencing. Participants were balanced by gender (F = 8).

We asked each participant to report the total number of years of completed formal education, as well as to list the most frequent leisure activities they have been practicing regularly for the last 10 years. All demographic data are reported in Table 1. Research assistants recorded the interviews at a location chosen by each participant: either the senior center or their own house.

Champlain College's IRB approved the research project.

Table 1. Demographic information.

Participant	Age, y	Gender	Years of Education	Number of Leisure Activities	Use of Prompts	Interview Length
1	81	M	12	9	Picture	6'50"
2	78	F	14	7	None	10'53"
3	75	M	15	6	Picture	5'56"
4	78	F	20	7	None	10'58"
5	85	M	18	7	None	5'50"
6	77	F	20	10	None	34'20"
7	83	F	16	4	Picture	5'00"
8	75	M	18	8	Picture	25'55"
9	76	F	20	4	None	13'04"
10	79	M	22	5	None	6'32"
11	83	M	16	10	None	5'41"
12	74	F	12	12	None	5'15"
13	77	F	12	8	Song	5'46"
14	84	M	15	7	None	5'28"
15	82	F	22	5	Picture	5'47"

Table 2. Mean scores and standard deviation of CR markers.

Marker	Mean	SD
Enriched Environment	.56	.35
Cognitive Activities	.72	.47
Education	.36	.28
Physical Activity	.21	.29
Social Interaction	1.32	.40

Table 3. Mean difference among CR markers.

CR Markers	CRMarkers	Mean Difference	SE	p-Value
Enriched Environment	Cognitive Activities	−.16	.16	1.00
	Education	.20	.12	1.00
	Physical Activities	.35	.11	.06
	Social Activities	−.76	.13	.001
Cognitive Activities	Enriched Environment	.162	.16	1.00
	Education	.36	.15	.269
	Physical Activities	.51	.17	.10
	Social Activities	−.60	.19	.06
Education	Enriched Environment	−.20	.12	1.00
	Cognitive Activities	−.36	.15	.27
	Physical Activities	.15	.12	1.00
	Social Activities	−.97	.15	.00
Physical Activities	Enriched Environment	−.35	.11	.06
	Cognitive Activities	−.51	.17	.10
	Education	−.15	.12	1.00
	Social Activities	−1.11	.11	.00
Social Activities	Enriched Environment	.76	.13	.001
	Cognitive Activities	.59	.19	.06
	Education	.96	.15	.00
	Physical Activities	1.11	.11	.00

Interviews

After reading and signing the consent form, participants were asked to report a significant memory from their past. They were offered the possibility of using prompts (pictures and songs) as a trigger for the reminisce activity. Six participants decided to start their interview using a prompt, five chose a picture representing a landscape, one picked a song.

We collected 170 minutes of video recordings (range: 5 minutes to 34 minutes 20 seconds; average length: 9 minutes 30 seconds).

Discourse Analysis

To be able to rely on more solid data, and to develop a model to explain our result, we also analyzed the transcripts of the 15 interviews using CA.

Interviews have been transcribed according to the convention suggested by Jefferson (2004) by two independent judges. Inter-rater reliability was calculated and found to be .87. Transcripts were divided into sections, which have been classified and analyzed according to the topics of interest (i.e., CR markers, see below) by the two judges, who discussed the interpretation/reading.

We identified the CR markers to look for starting from an analysis of the literature. We listed the proxies that we constantly used in studies aiming at assessing the CR (see Opdebeeck et al., 2016) and excluded those that were not well defined or only rarely used. Following these guidelines, we were able to identify five main markers: (1) Enriched environment (EE), e.g., engaging community, active natural environment, cultural/educational opportunities, etc.; (2) Cognitive stimulating activities (CA), e.g., reading, theatre, organizing events, teaching, challenging conversation, etc.; (3) Education (Edu), e.g., formal education, professional training, learning by

doing; (4) Physical activity (PA), e.g., sports, gardening, walking, horse-riding, etc.; and (5) Social interaction (SA), e.g., with family members, relevant others, community. For each marker, we derived specific examples from previous studies, and we compiled a codebook to be used when analyzing the interviews. Two independent researchers analyzed the interviews by referring to the codebook and identified all the occurrences of the 5 CR markers described above. Inter-rater reliability was .82. Any disagreement was discussed between the two judges until an agreement was reached.

Results

Overall Incidence of CR Markers

As the first step to compare occurrences of CR markers through interviews with different lengths, an index for each marker has been computed using the following equation:

$$\text{TOT}_{\text{NWords}}: \text{Occurrence}_{\text{NCRMarker}} = 100: X$$

A Repeated Measures GLM ANOVA on the corrected data highlighted a main effect of the type of markers: $F_{4;\ 56} = 17.91$, $p < .001$, $\eta^2 = .56$ (mean scores and standard deviations are reported in Table 2).

Pairwise comparisons confirmed that markers linked to social interactions were used significantly more than all other markers ($\text{MD}_{\text{EE}} = .76$; SE = .13; $p = .001$; $\text{MD}_{\text{Edu}} = .96$; SE = .15; $p < .001$; $\text{MD}_{\text{PA}} = 1.12$; SE = .11; $p < .001$), other than the ones referring to Cognitive Activities ($\text{MD}_{\text{CA}} = .60$; SE = .19; $p = .06$). No other difference was significant (see Table 3).

Relationship between CR Markers and CR Proxies

A second step was to explore a possible correlation between the CR markers as they emerged from the interviews' analysis and the self-reported data that we collected from our participants and that represent proxies of the CR: years of formal education and number of leisure activities. Leisure activities were divided into three categories: social, cognitive, and physical.

Given our small sample, a parametric test wouldn't be adequate. For this reason, we ran a non-parametric correlation, among self-report data (years of formal education completed, number of self-reported leisure activities) and the CR markers derived from the interviews. We selected Kendall's tau-b (τ_b) correlation coefficient, which is recommended when working with small samples.

Results highlighted a significant positive correlation between the number of years of completed education and the occurrence of CR markers linked to education emerging from the interviews ($\tau_b = .72$; $p < .001$). The total number of leisure activities reported by participants were significantly correlated with the CR markers for cognitive activities ($\tau_b = .56$; $p < .01$). The specific number of cognitive leisure activities reported by participants correlated positively with the CR markers for cognitive activities ($\tau_b = .80$; $p < .001$). The number of self reported social leisure activities correlated significantly with the CR markers for social interaction ($\tau_b = .47$; $p < .05$). No other significant correlation emerged.

Discourse Analysis

Enriched environment

When focusing on CR markers linked to the presence of cognitive environment, we were able to highlight how individuals actively constructed their memories about this topic and also worked at the reconstruction of their sense of self (see Extracts 1, 2, and 3).

47	J:	=(___), in there. So uhm- we (.) dried her off as much as we could (.) GOT her headed towards
48		shore (.) and I sent my da:d with a: ICE pick along because (.) he was an o°lder (1.5) person
49		at the time and I wanted to get him °off the °lake- THE LAKE. Uhm-
50	Interviewer:	=>Good for understanding, it was ↑dangerous.<
51	J:	=Yeah. And ↑so at the SAME TIME (.) they were (1.2) shutting >down and trying to get the
52		Governor< (.) °off the lake. And °a number of >people who were out there<. .hh I happened
53		to have a COUple of friends from Middlebury, .hh younger boys who were in business here
54		in Middlebury and they came over to (.) help me tie down the shanty and uh- so on, and
55		then (1.7) I went ashore uh- from there and we .got out of the STORM (.) on there, but uh-
56		↑she had VOWED >never to go ice fi(h)shing< ((laughter))=
57	Interviewer:	((laughter)) I can [only ima:gine, yeah, that's crazy].

Extract 1. In Extract 1, where the person reminiscing is sharing a memory linked to learning to fly at their farm, we can see a few clear examples of how this memory is used to foster a personal and social construction of self through memory.

On line 75 the speaker stresses the high point of the narration with an emphasis on the word *WE* - reference to the social aspects of this memory. If the memory starts with a social aspect, then it brings to something relevant for the sense of self of the speaker - and this transition is clearly marked (line 76) by the stress on the word "*me.*" How the social and personal aspects linked to the memory contributed to the formation of the identity of the speaker is highlighted later (line 79) when after hesitating for a few seconds, possibly to refocus attention (*uhm-*) the narrator stresses the word *THAT*.

The cognitive part of memory construction is evident by the stress on the word *reMINds* (line 2) followed by a pause. Moreover, when asked to expand on the memory, the speaker takes time to recall and construct the memory (line 5: *Uhm - SURE -Uhm*). On line 3, we can also detect the influence of emotions in shaping this specific memory: the speaker stresses the word *attached*, and then add a laugh as a marker of emotional connection

Extract 3. Extract 3 offers another good example of active constructions of memory, linked with positive emotions.

The speaker's enthusiasm is noticeable on line 28 (increased intonation before starting the narration of this new memory and the emphasis on the action of narrating, conveyed by the world *tell*)

32	Joyce:	RIGHT. And the FIRST place, it was a ↑time when u͟h͟h- things were tight with money and
33		everything and my f͟a͟t͟h͟e͟r said- and I ↑had- I had a wonderful grandfather .hh that lived
34		with us an͟:d͟ >grandpa got sick<, an͟:d͟ so my father said, "I can't send you to college now
35		because we don't have the ↑money, and if you s͟t͟a͟y home with your (.) grandfather for a
36		year we'll just see >what we can do to get you back into school"<, bec͟a͟u͟s͟e I ALREAd͟y had
37		b͟e͟e͟n allowed to (.) enter [the college.
38	Interviewer:	[So you were already- you were already in college whe͟:n͟ (.) your
39		g͟r͟a͟n͟d͟f͟a͟t͟h͟e͟r got s͟i͟c͟k so you had to go home?
40	Joyce:	I͟ ↑wasn't in college↓ when u͟h͟m- in college when he got sick, it was JUST before that.
41		And so I stayed home for a ye͟:a͟r and then when that y͟e͟a͟r was up u͟h͟m- I did go to °college,
42		a͟n͟d then that's what (.6) went on. And my grandfather went to a: nursing ↑home an͟:d͟ for
43		two years uhm- I was at UVM [because] that was a two year course.

Extract 2. In Extract 2, where the speaker talks about her attachment to the working landscape of Vermont and how that played a role in her working life, we can see again the process of construction of memory, linked both to a cognitive and an emotional effort.

and 33 (emphasis on *JUST THAT*, to stress how much more interesting/articulated the memory was). The speaker also stresses several times the importance of the narration; line 28: stress on the world *tell*; line36: emphasis on the world *LOOK*,

28	Speaker 3:	One ↑other thing I want to t͟e͟l͟l you before I forget, uh- when we bought our house in East
29		*******, k͟i͟d͟s were little, (.) and I was in the back s͟h͟e͟d (shaking there was) the lady that
30		had lived in the house she was quite a BOOK collector .h͟h so she had all of these (.) stacks of
31		e͟m͟p͟t͟y boxes there, books [( ).
32	J:	[She's seen a lot of Na°tional G͟e͟o͟g͟r͟a͟p͟h͟i͟c͟s.
33	Speaker 3:	=Well ↑it wasn't JUST THAT. (She had this) And so I was in ↑there >shaking everything and
34		w͟h͟a͟t do I find?< Robert Frost.
35	Interviewer:	<°Oh my go[o͟d͟n͟e͟s͟s>.
36	Speaker 3:	[LOOK, this is ((murmur)) what I fo͟:u͟n͟d, **********'s Memorial from ****
37		Vermont 194:6. AND [THAT WAS] I͟N THE BOX.
38	Interviewer:	[O͟:h͟ w͟o͟:w͟] <That's s͟o [crazy>.
39	Speaker 3:	[And it SAYS-
40	Interviewer:	=It s͟a͟y͟s ROBERT FROST right ↑on it.
41	Speaker 3:	Yes, he ↑signed it. It says, "I h͟e͟a͟r the world reciting the mistakes of ↑ancient men, the

which also overlaps with the interviewer's remark. Enthusiasm and importance of the shared memory are also linked to a strong sense of presence of the narrator of the memory, that we can derive from the raising intonation before *there* on line 33 and stretch of the world *fo:ound* (line 36).

This memory that is clearly presented as important, also appears to be co-constructed between the two speakers who are taking part in the interview, as we can derive from the overlapping utterances on lines 32 and 33.

Cognitive activities

When reminiscing about cognitive activities, the interviews appear to work also at the definition of the sense of self, especially from a social standpoint.

lapping utterance; she also stress and highlight their group name *FA:Bulous*). The participant (line 30) also stresses the link between cognitive activity (*teaching*) and social life (*my granddaughter*).

Extract 5. In Extract 5, we can see (lines 72–74) the participant building a sense of self through memory (reiteration of *I did*, attention drawn to *myself* through the use of intonation) and emotions (use of *laughter*).

Extract 6. In Extract 6, we see how the narrator indirectly builds a sense of self by comparing her own identity with the life story of the person she met in the memory that she is sharing (e.g., line 14,

21	Woman 1:	(1.1) Well, you said you ↑DON'T cook. (Is [that it?)
22	Woman 3:	[N- no, no, no. That's why we're FA:Bulous because
23		(.) .none of us know how to cook for 56 .people .hh so we (did), we had an- (and) with my
24		son, HE would ( ) the SOUP or vegetable he ma:de >so we will just have to heat it up< .hh
25		then we go to COSTco and get the salad and then SEARCH and yeah, the (BREAD) and we just
26		GET THAT ready so by 10:↑30, .hh we can just sit down, have a CUP of coffee and gab ( ) and
27		then ( ) once a ↑month.
28	Woman 1:	=So GREAT, what kind of things did <you like> to cook?
29	Woman 3:	=O:h anything. (1.4) Anything. .hh I: ALWAYS cook. It ALWAYS has to be as fresh as possible
30		(1.3) an:d UH- NOW I'm teaching my granddaughter. And we started like somewhere like
31		the HERBS that grow on °( ) and we're going to make chicken soup (.) out of the chicken
32		carcass and .hh (here she is by herself ( ) ALRIGHT. ( )) and this is now, we take the
33		sea:soning, Wha- what- what do I do? I said "I want you to use your no:se, Smell ( ). Here's
34		what you think would go" It was the best as possible.

Extract 4. In Extract 4 we can see how the person being interviewed starts by stressing the importance of precisely define who she is within her group of friends (line 22: she corrects the interviewer, and her urgency is conveyed by the over-

emphasis on *parents*, line 16, emphasis on *realize*; line 17 emphasis on *LEFT*). This is also closely linked to a sense of agency from the narrator, which we can derive from the emphasis on *called* (line 9) and on *THAT* (line 19).

64	Interviewer:	That's so crazy, foods are such (.) simple things that anyone can go [get today at the grocery
65	D. P:	[exactly]
66	Interviewer:	=store. it's so interesting looking back how that was not accessible [at all.
67	D. P:	[Yeah, it changed your
68		cooking habits, [of course you have to find other ways to- uhmm BUTter was not in=
69	Interviewer:	[Yeah.]
70	D. P:	=existence uh- that's when margarine started to come in of course as a substitute.
71	Interviewer:	Is that what yo:u would use?
72	D. P:	OH I grew up on margarine ((laughter)) yes I did. And I >did a lot of coloring of it< myself, it
73		came as a white ↑substance in a uh- bag that you- you would squeeze a little .hh pill like in
74		the ba- bag which uh- would spray out the yellow coloring and you'd flex it and=

8		got >°to do that<. So (.) one of the stories that I wanted to sha:re was I was working for a
9		non-profit, I ca↑lled this person up and said, "Can I come and (1.1) talk to you about what
10		>I'm doing?", and °she said, sure<. So I (.) went to her ↑house, (1.9) sat in this beau:tiful
11		room overlooking this beautiful valley with mountains all around and I said, "°Gosh, this is
12		really- really quite something", and she said, ">Do you want to know< why I'm he:re?",
13		and I °said, "Sure, why are you here?" She said, (.) "I grew up in a little village in Vermont.
14		M:y par↑ents were (.5) dysfunctional, my dad was an ↑alcoholic, my mom was ↑afraid
15		and I just had noth:ing I was just there. And after I got a certain age I went out (.) and I saw
16		the library (1.1) ↑and I went °into the library° and I began to re:ad and I began to realize
17		this didn't have to be my life. I LEFT that home and went on to school, I had a good jo:b, >I
18		married, I had family< my son is in the Peace Corps and my life is just totally different
19		because of that °library. THAT's the kind of things that I would run into in my (.) travels

Education

While reminiscing about education, the interviewees use the memory to convey a more defined sense of self. They also tend to link these specific memories the use of emotions.

moments for her personal story: line 86 (*top person*), line 90 (*they looked down on me*) and line 91 (DO). This process is also supported by the use of emotions: line 87 (*laughter*) and line 93 (*very uhm: anxious*).

83	IMG_0149.MOV:	[Oh, okay. SO uhm- I went away to >Michigan State, I had been saving< my money,
84		but I uhm- (.9) was from a class of 32 people.
85	Interviewer:	=No kidding?
86	IMG_0149.MOV:	=And I wasn't the ↑top person↓ but I was third >at the time< because I never uhm-

87		stu:died hard enough ((laughter)) I had too many things going on. ((laughter)) .hh But uhm-
88		it was: VERY DIFficult for me that first year, there were no ↑counselors, uhm- the- the girls
89		that I met in- in the dor↑ms (you know, were) at the time I thought they were rather
90		sno:oty, that was the word we used .hh uhm- but they looked down ↓on me because I was
91		a farmer':s daughter (you know) and, "What do you DO in the country?" (you know) I- and
92		they'd say, "Well we took a trip to the country one ↑time .hh and it seemed like it was
93		awful there". (you know) I became very, very uhm: anxious about telling >where I was from

Extract 7. In Extract 7 we can see how the interviewee takes the opportunity to build her sense of self while narrating about her educational experience. She takes time to form and organize the memory (line 84 *uhm- (.9)*) and uses emphasis to highlight some defining

Extract 8. In Extract 8 we can observe the same mechanism highlighted when discussing Extract 7. The interviewee takes the opportunity to build his sense of self while narrating about his educational experience. He takes time to form and organize the memory (Line 1 *I uh- (2.7)*) and *as a uh- (1.4)*) and

1	Man:	No, I uh- (2.7) I worked back as a uh- (1.4) adult student (2.1) and uh- (1.2) actually, I th↑ink
2		I went through (2.1) two years, never had an instructor older than I was (.) or a couple was
3		close.
4	Woman:	(2.1) What did you STUdy?
5	Man:	Uh- Well, ONE of my favorite courses (.) was Accounting with uh- (T*** B***) .hh and I
6		think she is since retired (1.2) but what a fantastic Accounting °teacher. Oh, I was (1.4)
7		reQUESted to uh- participate by Miraculou:s Center because (1.4) I lived in [*State Name*] (.6) for
8		first gra↑de and up 'til first grade, .hh (.9) about a ↑mile from here↓ (.9) and I went to
9		scho:ol uhh- where up here (.) by the brick store, you take a LEFT and about four, five
10		buildings down ON the left (.) was a two-room school house. .hh And that- (.) that was uh-
11		taught by a >lady by the name of Mrs. WA***,< who was my first grade TEAcher. And of

uses emphasis to highlight some defining moments in his narration: line 1 (*student (2.1)*, and *I think*); line 7 (*reQUESted*) and line 11 (*TEAcher*).

Social activity

When reminiscing about social activities, our participants kept asking for joined attention from the interviewer to stress the relevance of the communication. Something that rarely happened while they were reminiscing about other topics. The importance of social network to help to construct and define the sense of self also emerged.

56	IMG_0146.MOV:	(Oh) We did at times, we had >Morgan horses but (there were)< (mainly uh-) it was MAInly
57		[work horses ( ) >there °was other farmers around, however<, my brother and I: we both
58	Interviewer:	[hmm mm]
59	IMG_0146.MOV:	=had a- ((small banging noise)) it was a cro:ss- it- it was kind of a pinto- pinto, a pair of
60		°pinto horses. Mine was named FLICKER and his was named Zev, ((laughs)) and that was
61		what we rode to school. ((laughs))

Social activity

Extract 9. In Extract 9, we can notice how the interviewee, when referring to the brother, stresses the relevance and importance of this part of the memory by "framing" the introduction of the two of them as the main actors of the shared memory (slowing down before *my brother*—line 57—and emphasizing the word *I*). Slowing down when introducing the brother and himself also signaled the need for showing shared attention from the interviewer, who perceived the signal and confirmed her attention (line 58). The memory is also supported and enriched by positive emotions (*laughs*, lines 60 and 61), and by adding non-

verbal communication aids to increase effectiveness and relevance of communication (line 59 *((small banging noise))*).

Extract 10. In Extract 10 we can see the same use of positive emotions (*laughter* lines 56 and 57) to stress the relevance of the shared memory, and also to ask for confirmation of joint attention from the interviewer (lines 56 and 57). Throughout the extract, the narrator stresses the importance and relevance of good social support: line 48 (*sent my da:d* and *older(1.5)*), line 53 (*a COUple of friends*) and line 54 (*(.) help me*)

Extract 11. In Extract 11, we can see how the narrator uses the social network involved in the memory she is sharing as a way of better define her sense of self at the time the memory occurred (e.g., line 33 *my father said- and I had - I had a wonderful grandfather .hh*), and she makes evident how her social interactions helped shaping her sense of self (line 40 *I wasn/t in college uhm- in college when he got sick* and line 41 *so I stayed home for a ye:ar and then when that year was up uhm- I did go to*college*)

Extract 12. In Extract 12, we notice the same use of positive emotions so promote memory and

47	J:	=(__), in there. So uhm- we (.) dried her off as much as we could (.) GOT her headed towards
48		shore (.) and I sent my da:d with a: ICE pick along because (.) he was an o°lder (1.5) person
49		at the time and I wanted to get him °off the °lake- THE LAKE. Uhm-
50	Interviewer:	=>Good for understanding, it was ↑dangerous,<
51	J:	=Yeah. And ↑so at the SAME TIME (.) they were (1.2) shutting >down and trying to get the
52		Governor< (.) °off the lake. And °a number of >people who were out there<. .hh I happened
53		to have a COUple of friends from Middlebury, .hh younger boys who were in business here
54		in Middlebury and they came over to (.) help me tie down the shanty and uh- so on, and
55		then (1.7) I went ashore uh- from there and we .got out of the STORM (.) on there, but uh-
56		↑she had VOWED >never to go ice fi(h)shing< ((laughter))=
57	Interviewer:	((laughter)) I can [only ima:gine, yeah, that's crazy].

32	Joyce:	RIGHT. And the FIRST place, it was a ↑time when uhh- things were tight with money and
33		everything and my father said- and I ↑had- I had a wonderful grandfather .hh that lived
34		with us an:d >grandpa got sick<, an:d so my father said, "I can't send you to college now
35		because we don't have the ↑money, and if you stay home with your (.) grandfather for a
36		year we'll just see >what we can do to get you back into school"<, because I ALREAdy had
37		been allowed to (.) enter [the college.
38	Interviewer:	[So you were already- you were already in college whe:n (.) your
39		grandfather got sick so you had to go home?
40	Joyce:	I ↑wasn't in college↓ when uhm- in college when he got sick, it was JUST before that.
41		And so I stayed home for a ye:ar and then when that year was up uhm- I did go to °college,
42		and then that's what (.6) went on. And my grandfather went to a: nursing ↑home an:d for
43		two years uhm- I was at UVM [because] that was a two year course.

11	Woman 1:	Okay uhm-, (3.3) the first time I saw Neil Diamond (.) was in ***↑***, North ↑Carolina
12		back in 19↑77. <An:d my husband, and a very dear friend> and HER husband went to the very
13		FIRST concert of Neil Diamond in 1977. Uh- Mary and I were BOTH in (.) nursing schOOL an:d
14		getting ready to grad↑uate <and so for> the next (3.1) probably hhh uh- 15 (.) years, every
15		time Neil Diamond came t:o (1.2) ******, the four of us would go. And the words in for
16		Eugene's are jus:t beautiful words and very (.) dear to my heart. (1.1) Okay? ((laughs))
17	Woman 2:	How many times have you seen ↑Neil Diamond↓?
18	Woman 1:	OH hhh I'VE- I'VE to be HONest with you, I've LOST count but one thing I can say is (.) uhm-
19		April 28th this year, I'm FLYing to ***** and I'm going to see (.) Neil Diamond with Ma:ry
20		and both of our husbands are dece:ased BUT we're going anyway °and so that's Neil Diamond
21		(.) for me. ((laughs))

support its relevance (lines 16 and 21 *((laughs))*). The narrator also uses references to her social network to convey a better-defined sense of self while reminiscing (line 12 - *<An:d my husband - a very dear friend> and HER husband*; line 13 - *Uh-Mary and I were BOTH in (.) nursing schOOL*).

Discussion

This mixed approach aimed at exploring proxies of the CR in a sample of Healthy Aging individuals allowed us to collect some interesting data and gather a better, if preliminary, understanding of how we can identify markers of CR using spontaneous reminiscence.

As a first result, the reminiscence approach was effective in promoting the use of markers linked to the CR that could be easily identified analyzing the interviews' transcripts. It is interesting to notice how, though all markers were present in our interviews, healthy aging population in Vermont appears to be mainly linked to a robust social network. This result confirms data previously discussed in literature, which highlight both the general effects of positive social interaction to promote healthy aging (Cherry et al., 2013; Seeman, Lusignolo, Albert, & Berkman, 2001) and the specific effect of social interaction as a form of prevention of the decline of cognitive functions (Hughes, Andel, Small, Borenstein, & Mortimer, 2008). The other proxies, reported to have a positive influence of the CR of healthy individuals, were all part of the participants' reminiscence, but, interestingly there were mostly associated with references to social interaction. Social activities appear hence to play a role in mediating and promoting the occurrence of other proxies such as cognitive activities or enriched environment. The role of physical activities can be explained differently. Literature explores and reports mainly the effect of cardiovascular activities on cognitive function in the elderly population (for a review, see Angevaren, Aufdemkampe, Verhaar, Aleman, & Vanhees, 2008), while the physical activities reported by our sample were mainly moderate.

Discourse analysis also allowed us to highlight how participants actively engaged in defining their sense of self while reminiscing. This specific

reminisce process can be assimilated to what Wong and Watt (1991) define as integrative reminiscence (aimed at helping an individual is to achieve a sense of self-worth, and coherence about their past), which has been found to be positively associated with successful aging. The fact that reminiscence is helpful to promote a more defined sense of self and that the process is linked to a more positive mood has also been proved with both young and aging individuals (Bryant, Smart, & King, 2005).

It is also interesting to highlight how the most important memories, especially if linked to the relevance of social network, tended to elicit or be linked to positive emotions. This is coherent with data reported in literature (for a review, see Carstensen & Mikels, 2005), where evidence of the fact that elderly tend to show better cognitive performance when dealing with emotional information, if compared to non-emotional. Positive emotions, if not directly mentioned within the reserve model, have been proved to help and foster better coping mechanism in response to stressful situation in aging population (Ong, Bergeman, Bisconti, & Wallace, 2006). It could also be interesting to highlight how a strong correlation between the positive emotional content in early-life autobiographies and longevity 6 decades later emerged from the some of the data reported in the ongoing nun-study (Danner, Snowdon, & Friesen, 2001) aimed at exploring the relationship between emotionally-centered memories and longevity later in life.

If single correlations have been reported in the literature, what is original about this study is the fact that it was able to examine all the proxies linked to the CR and explore how they are used within a spontaneous reminiscence activity. The fact that all the variables that are related to the CR recurred in the spontaneous discourse of our healthy aging population was interesting. First, it stresses and reinforce the link between the markers for the CR discussed in the literature and healthy gaining, and also suggests an ecological approach that can be used to investigate the incidence of these proxies on the life of the elderly. Moreover, our discourse analysis data highlighted how sharing stories that are linked to CR markers promote positive emotion, a coherent sense of self, and cognitive evaluation of the importance of the social network. This implies that being to some

extent more aware of the aspects that influence the CR may promote the CR. We know that CR is not fixed but continues to evolve across the lifespan (Tucker & Stern, 2011), and reminisce looks like a possible approach not only to indirect evaluate it, but also to promote it and enhance its benefits.

Future studies might explore the potentialities of this approach to a deeper level, by using a larger sample derived from a more varied geographical location. Exploring the age of reported memories and the possible effect of the age of the memory on its content could also be relevant to gain a better understanding of the link between the CR and reminiscence.

Clinical Implications

- Key variables to increase Cognitive Reserve (both as a form of prevention and to slow down symptoms of dementia, Alzheimer, and similar pathologies) have been identified and discussed.
- The relevance of reminiscence, as a tool for clinical gerontologists, social workers, and caregivers to assess and improve the CR is highlighted.
- Using reminiscence to bring more awareness of markers linked to the CR can help aging population to experience more positive emotions, develop a more coherent sense of self, and be more aware of the positive aspects of the social networks.
- The approach highlighted in this article can be used as a clinical tool to help the clinical population to experience more positive emotions, maintain a more coherent and defined sense of self, value more the social resources available in their network.

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