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The association of leisure activities in middle adulthood with cognitive performance in old age: Social capital mediates cognitive reserve effects

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Running head:

Cognitive reserve and social capital

Abstract

One of the fundamental challenges for neuropsychological aging research is how to maintain and promote cognitive functioning in old age. Previous research revealed that an active lifestyle, social participation, and emotional support during adulthood seem to be protective against cognitive decline in old age. However, up to now, a detailed examination of the interplay of these relations based on a broader variety of past activities and considering the individual's available social capital is missing. The present study seeks to extend the literature by investigating the interactions of family based social capital as a mediator between the build-up of cognitive reserve (via the engagement in a broad variety of past leisure activities) and old age cognitive functioning in a large sample of older adults with a wide age range. A total of 2,788 older adults (aged 65–101 years) served as the sample for the present study. A test on verbal abilities, one on processing speed and one on cognitive flexibility were applied. In addition, individuals were retrospectively interviewed regarding their family network and regarding received and given support within it, as well as regarding 18 leisure activities (carried out at age 45). Present results suggest that network size as well as the given support within the family network mediate the relation between having an active lifestyle during middle adulthood and better cognitive functioning in old age. These findings are discussed with respect to models of cognitive reserve and cognitive aging.

Key words: cognitive functioning; cognitive reserve; leisure activities; social capital; older adults

Introduction

Leading an active lifestyle, in terms of intellectual activities and social participation is substantial to maintain high levels of cognitive functioning in old age (Anstey & Smith, 1999; Fritsch et al., 2007). According to the cognitive reserve account, a buffer against cognitive decline can be built up across the life span depending on early stimulation of cognitive resources, for example, through formal school education as well as cognitive activities during later life (Stern, 2017; Stern, 2002). Over the last decades, there has been increasing evidence detailing the beneficial roles of intellectual leisure activities such as learning a new language or the cognitive level of job for explaining interindividual differences in cognitive functioning in old age (Aartsen, Smits, Van Tilburg, Knipscheer, & Deeg, 2002; Bielak, Cherbuin, Bunce, & Anstey, 2014; Ihle et al., 2015; Ihle et al., 2015; Ihle, Gouveia, Gouveia, Freitas, Jurema, Machado, et al., 2017, 2017; Ihle, Gouveia, Gouveia, Freitas, Jurema, Ornelas, et al., 2017; Ihle, Gouveia, Gouveia, Linden, et al., 2017, 2017; Ihle, Oris, et al., 2017; Ihle, Oris, Fagot, & Kliegel, 2016).

Amongst those cognitive life course factors, more attention has recently been given to social mechanisms. It has been suggested that leading a socially active life is at least as important for the build-up of cognitive reserve as being engaged in cognitively demanding leisure or professional activities (Stern & Munn, 2010; Wang et al., 2013; Wang, Karp, Winblad, & Fratiglioni, 2002). For example, many activity lists that have been used to measure the participation of individuals in leisure activities include activities that have important social components such as doing sports, going to the theater, or even more clearly participating in associations or clubs, or playing party games (cards, board games, etc.) (Ihle et al., 2015). Those interactive leisure activities represent one origin of the individual's social capital, from which emotional or practical support can be drawn when needed by the elderly. Social capital has been shown to be crucial to cognitive functioning in old age (Hall & Wellman, 1985; Wang et al., 2002). Having a supportive personal network with various types of relationships (e.g., kinship,

friends, neighbors, etc.) may have significant positive effects on cognitive functioning of older adults (Bennett, Schneider, Tang, Arnold, & Wilson, 2006; Crooks, Lubben, Petitti, Little, & Chiu, 2008; Ellwardt, Van Tilburg, & Aartsen, 2015).

The link between personal relationships and leisure activities has recently received increasing attention (for instance, Glover & Hemingway, 2005; Putnam, 2000; Warde & Tampubolon, 2002). Such research has shown that individuals actively participating to a variety of leisure activities have larger personal networks, a higher frequency of interactions with network members and fewer occurrence of loneliness (Toepoel, 2013). Yet, the interplay of the pathways of cognitive reserve associated activities and social capital is virtually unknown so far.

In that context, we argue that the link between personal networks and leisure activities in later years may depend to a significant extent on leisure activities in younger adulthood. Individuals active in leisure in middle adulthood may have greater chances to preserve a stronger continuity of their personal ties throughout their life course by maintaining sociability and support exchanges with significant others (Ingen & Eijck, 2009; Toepoel, 2013). This continuity does not only or mainly concern friends but also family members, as family members play a critical role in leisure activities both in young and old adulthood (Siegenthaler & O'Dell, 2000; Townsend, Puymbroeck, & Zabriskie, 2017). Therefore, we expect that individuals actively involved in leisure activities earlier in life to have more social capital in their family in later years.

Enduring personal connections to a large extent can be seen as translating into social capital, that is “actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance or recognition” (Bourdieu, 1985, p. 248). The more connections people have to other individuals, the more likely they have access to such individual’s (so called “alters”) resources, be they instrumental (financial support, domestic support), informational (exchanges of knowledge and key information) or emotional (companionship, positive interactions, emotional support). Such increases in resources have

been shown to have positive consequences for personal adaptation in old age (Cornwell, 2009b, 2009a, 2011).

Taken together, the present study aimed to extend the literature by investigating in more detail the interplay of engaging in cognitively stimulating leisure activities, social capital, and cognitive performance in a large cross sectional sample of older adults. To overcome the possible limitation of a cross sectional setting, in the present analyses we focused on activity participation in middle adulthood (at age 45), the current cognitive status at time of testing (age ranged from 65 to 101) and the social capital in the recent past before testing time. This allowed to approach the role of individual differences in social capital as possible consequence of social participation in earlier lifespan phases and test for their respective direct and indirect effects on cognitive health in old age. Specifically, our goal was to examine whether higher levels of available social capital (and here which dimensions especially) may *mediate* the relation between midlife leisure activity profiles and current cognitive functioning in old age. This will advance the understanding of key mediators of the cognitive-reserve-cognition relation in old age, which is of major importance to foster theorizing in cognitive reserve research (see e.g. Ihle, Oris, et al., 2017; Ihle et al., 2016).

Methods

Participants

We used data from the *Vivre-Leben-Vivere* survey, an ongoing project started in 2011 on life conditions of elderly people living in five different cantons (Geneva, Valais, Bern, Basel, Ticino) of Switzerland. The regions were selected based on the representativeness of the linguistic and urban/rural areas and to capture the effects of different social policy systems in Switzerland. The main sample (N=3080) was randomly selected in the cantonal and national population records and stratified by age (65-69, 70-74, 75-79, 80-84, 85-89, 90 and older), gender and canton. For the sample of the present study, we only retained participants who were cognitively healthy and who had answered the questions about their personal networks, which

led to a sample of 2788 individuals (mean age = 77.87 years, $SD = 8.22$, range 65-101; see Table 1 for detailed sample characteristics).

Materials

Cognitive Performance

Verbal Abilities. We administered the Mill Hill Vocabulary Scale (Deltour, 1993) measuring verbal abilities. For each item, participants had to underline the word, which was intermixed with five distractor words, that semantically matched the target word. After one exercise item, participants were presented with ten of those vocabulary items, without any time limit. The verbal abilities score was the proportion of correctly completed items.

Processing Speed. We assessed the Trail Making Test Part A (Reitan, 1958) measuring processing speed. After seven exercise trails, participants had to correctly connect the numbers 1-25 as fast as possible in the ascending order. The TMT A completion time was the time in seconds needed to correctly connect the 25 numbers.

Cognitive Flexibility. In order to measure cognitive flexibility, we assessed the Trail Making Test Part B (Reitan, 1958). After seven exercise trails, participants had to connect the numbers 1 to 13 in ascending order and the letters A to L in alphabetic order while alternating between numbers and letters (i.e., 1-A-2-B 3-C ... 12-L-13) as fast as possible and without error. The TMT B completion time was the time in seconds needed to correctly connect the 25 numbers/letters.

Leisure Activities at age 45

Participants were interviewed about the following 18 leisure activities, covering a large variety of leisure activities: (1) going for a walk; (2) gardening; (3) gymnastics or other physical exercises; (4) other sports; (5) going to a café, restaurant, etc.; (6) going to the cinema, theater, etc.; (7) excursions of 1 or 2 days; (8) journeys of at least 3 days; (9) playing a musical instrument; (10) other artistic activities; (11) taking courses, going to conferences, etc.; (12) party games (cards, scrabble, etc.); (13) crossword puzzles, Sudoku, etc.; (14) needlework

(knitting, sewing, etc.); (15) handicrafts, repair, carpentry, pottery, etc.; (16) participation in political or labor union activities; (17) participation in municipality or district activities, and (18) participation in sporting events (e.g. visit a football match, etc.). For each of these 18 activities, participants reported whether they had carried out the respective activity at age 45 or not. Activities were summed up for each individual to calculate the overall number of mid-adulthood activities (see Ihle et al. 2015 for a similar procedure).

Social capital in families

Applying standard procedures for collecting information on family networks (Widmer, Aeby, & Sapin, 2013), respondents were asked to name their five most significant family members. In order to keep responses as broad as possible, participants were asked to use their own definition of who is a member of their family (Girardin & Widmer, 2015). Participants were told that the term significant referred to people in their family who have played an either positive or negative role during the past year. This kind of open question allowed to capture supportive but also ambivalent relationships that occur within family networks. Participants were then asked a set of questions about support among listed family members. Emotional support was defined as the ability to provide guidance and moral comfort. It was investigated with the following question: “Who would give emotional support to X [i.e. each individual included in the respondent’s family configuration, considered one by one] during routine or minor troubles?”.

Based on responses provided, we assessed a variety of network indexes to measure social capital in egocentric networks. Size of the family network was used as a general indicator of social capital, the greater the number of family members, the higher the potential support providers. Size measured the number (varying from 0-5) of family members included in the respondent’s network (see Table 2 for means and standard deviations). Density, and reciprocity are classical indicators for the bonding dimension of social capital. Bonding social capital refers

to situations in which a majority of network members are interconnected. Such situation enhances expectations, claims, obligations and trust for the focal individual because of the larger collective nature of normative control and support (Coleman, 1988; Putnam, 2000). Density indicated the interconnectivity of all network members. This indicator, which varies from 0 to 1, was measured by dividing the number of existing ties by the number of potential ties. A density of 1 indicated that all family network members were interconnected. Reciprocity designated the extent to which support was exchanged reciprocally among network members. Therefore, it referred to the ratio of reciprocal ties to all existing ties between family network members. Like density, this index varies from 0 to 1 with 1 meaning that all ties within the network are reciprocal. Three different indexes (the in- and out-degree and betweenness centrality) were assessed to measure other dimensions of social capital, referring to its bridging potential (Cornwell, 2009b, 2011). The in-degree and the out-degree of respondents were computed to measure the intensity of the support exchanges with network members. The in-degree indicates the number of family members for whom respondents provided support. This index varies from 0 to 5, with 5 indicating that all mentioned network members received support by the respondent. Respondent's out-degree reflected the number of family members providing the respondent with support. This index captures the capacity of respondents to mobilize support among their network members. Like the in-degree, the out-degree index varies from 0 to 5, with 5 indicating that the respondent received support from all family network members. The third index is the respondent's betweenness centrality, which indicates if respondents were intermediaries between their significant family members. This index was computed as the ratio of all the shortest paths between any two family members that went through the focal individual (Hanneman & Riddle, 2005). Focal individuals are considered central if they are lying between all, or almost all, of their family members' connections. Betweenness centrality varies from 0 to 1, with 1 indicating that all the family members went through the respondent to reach each other.

In summary, the variety of the network indices we dispose of allows us to have a multidimensional assessment of family based social capital.

Control Variables

We considered gender (1= male, 0=female) and age of individuals (1=65-69, 2=70-74, 3=75-79, 4=80-84, 5=85-89 and 6=90 and above) as well as their level of education as control variables. In addition, we controlled for having a partner, having siblings and having children (all three measurements: 1=yes; 0= no). Furthermore, we controlled also for number of living siblings and number of living children as control variables to our analysis.

Statistical Analyses

We inspected relations between performance in verbal abilities, processing speed and cognitive flexibility, leisure activities in mid-adulthood, and the different indexes for bonding and bridging social capital (by calculating Pearson's correlation coefficients r for relations between all variables).

Regarding our specific goal, we investigated whether the relation of leisure activities at age 45 to performance in verbal ability/processing speed/cognitive flexibility was mediated via the social capital indexes. For these mediation analyses, we used a path model approach, with an individual mediation model for each cognitive measure, and for each social capital index. These models contained three paths (see Figure 1 for an illustration): path a, the social capital indexes regressed on leisure activities in mid-adulthood; path b, performance in verbal ability/processing speed/cognitive flexibility regressed on the social capital indexes; and path c, performance in verbal ability/processing speed/cognitive flexibility regressed on leisure activities at age 45. Importantly for evaluating mediation, the applied path model approach allowed simultaneously estimating the direct relation of leisure activities at age 45 to performance in verbal ability/processing speed/cognitive flexibility (i.e., the coefficient of path c) and the indirect relation via the social capital indexes (i.e., the product of the coefficients for paths a and b), including their significance. The proportion of the size of the mediated relation and the total

relation (i.e., the sum of the mediated and the direct relation) allowed quantifying the portion of the relation of leisure activities in mid-adulthood to performance in verbal ability/processing speed/cognitive flexibility that was explained indirectly via the social capital indexes as mediators.

For all analyses, to achieve that higher values represented better performance across all variables, for processing speed and cognitive flexibility the distribution of completion time of all participants was reversed based on the sample mean so that interindividual differences remained identical. For all analyses, SPSS was used, for the mediation analysis we used the PROCESS Macro, and the standard error estimation was estimated using bootstrap methods (Hayes, 2013).

Results

Descriptive Statistics

Mean performance in verbal ability was 59.4 percent correct ($SD = 25.7$). Mean completion time in processing speed was 66.20 seconds ($SD = 30.61$). Mean completion time in cognitive flexibility was 127.3 seconds ($SD=53.1$). Mean number of leisure activities at age 45 was 11.2 out of 18 activities ($SD=2.9$). The highest participation rate over all age groups was in social activities. Only 17 participants (0.6% of the sample) indicated having done no social activity at all at age 45. Regarding the social capital indexes, the mean network size was 3.4 ($SD=1.5$), mean density was .43 ($SD=.29$), mean reciprocity was .45 ($SD=.35$). The mean in-degree was 2.1 ($SD=1.5$), the mean out-degree was 1.5 ($SD=1.3$), and the mean betweenness centrality was .13 ($SD=.21$).

Correlations between measures

Larger network sizes, higher in-degrees and higher out-degrees were significantly correlated with better performance in verbal ability, processing speed and cognitive flexibility. Density, reciprocity and betweenness centrality did not show any significant correlation with cognitive performance. A higher number of leisure activities at age 45 were significantly

correlated with the network size, the in-degree and the out-degree (see Table 1 for the full correlation matrix).

Mediation analyses

To test the potentially mediating effect of social capital between leisure activities and cognitive processes we estimated several mediational models. First, we applied a model in which the relation of leisure activities at age 45 to performance in verbal ability, processing speed and cognitive flexibility was mediated via the social capital indexes (each index that was significantly correlated to the cognitive tests and the leisure activities at age 45 (see Table 1) was entered separately as mediator). Results showed that the relation between leisure activities at age 45 and verbal abilities was mediated by the network size and the in-degree (see Table 3). 2.6% of the relation of activities to verbal ability was explained indirectly via the network size (Direct effect = .56, total effect = .59, $p < .001$). The mediation effect of the in-degree was 5,6% (Direct effect = .53, total effect = .59, $p < .001$). Even though the out-degree was significantly correlated to both activities at age 45 and verbal ability, we found no mediation effect in this case (see Table 3 for all mediation effects on verbal ability). As for processing speed and for cognitive flexibility, no mediation effects were found for each of the social capital indexes that were significantly correlated.

Discussion

The aim of this study was to investigate the role that current social capital may have in mediating the relation between leisure activities carried out in mid-adulthood and cognitive functioning in old age, using data from a large sample of older adults with a wide age range (65-101 years), covering rich information on family networks, retrospective information about leisure activities in middle adulthood and current cognitive functioning.

In line with previous literature (e.g. Hertzog, Kramer, Wilson, & Lindenberger, 2008; Ihle et al., 2015; Ihle, Oris, Fagot, Maggiori, & Kliegel, 2016), the current study confirmed that cognitive functioning indeed relates to activities at an earlier age. This extends studies with a

large variety of activities that focused only on current activities or a narrow age range of older adults (Karp et al., 2006; Paillard-Borg, Fratiglioni, Xu, Winblad, & Wang, 2012; Wang et al., 2013, 2002). The results of our study with a large variety of activities being assessed reflect the crucial importance of leisure activities for building up cognitive reserve over the life course.

Furthermore, and perhaps more importantly, our study shows that current family based social capital is indeed positively related to cognitive functioning in old age. Interestingly, it is not mainly the support provided by family networks that matters, but rather the role of aging individuals as active supporter. Being an active agent in one's own family (e.g. having larger number of family members, as well as supporting them) is thus significantly related with enhanced cognitive performances. This suggests that active participation in social and relational tasks requires cognitive abilities but is also promoted by them. In other words, the impact of activities has a strong relational dimension (it is not something one mainly does one one's own). Our results nicely dovetail with reports showing the beneficial effects of social participation on cognition in older adults (Crooks et al., 2008; Gow, Corley, Starr, & Deary, 2013; Ingen & Eijck, 2009; Shankar, Hamer, McMunn, & Steptoe, 2013).

Importantly, our results critically extend those studies by using the social capital approach on families (Widmer, 2010). Its focus on potential or "perceived" support, rather than on activated support, provides an operationalization of personal relationships as relational reserves and makes the connection with cognitive reserves conceptually more direct. In details, present data revealed that family based social capital mediates to some extent the relation between leisure activities and cognitive functioning. While these mediation effects were reliable, it was also clear that they only concern a relatively small share of variance in cognitive reserve effects. The association was robust to adjustment for a wide array of potentially confounding variables including level of education, age, gender, the type of family configuration, as well as having a partner, siblings and children. Yet, it has to be underlined that the mediation effects concern pathways of 20 to 40 years of age (between 45 and the individual target age of

participants at time of cognitive testing). Thus, it seems remarkable to detect those effects even with these time scales. Therefore, our results add to the explanation of the interindividual difference in cognitive functioning in older adults from a true lifespan perspective (Antonucci, Fiori, Birditt, & Jackey, 2010). They suggest that both network size and given support are mediators in the relation between leisure activities at age 45 and cognition in old age. Our findings confirm evidence from the literature that underlines the importance of social support for the maintenance of cognitive abilities in old age (Cornwell & Schafer, 2016; Gow, Corley, Starr, & Deary, 2013). Cornwell & Schafer (2016) underline the importance of support pathways through which social networks are beneficial for physical and psychological health aspects. In line with this pathway perspective, we argue that our findings also show how pathways linking social activities and social networks have a positive impact on cognition and cognitive reserve in old age. We acknowledge that this research focuses on family based social capital, but it may also be true for friendship. For future research, social capital provided by friends should therefore be considered and their relation to cognition should be further explored.

In summary, present results underline the important interplay of social capital occurring in family networks with cognitive reserve effects built-up during mid-adulthood in their association with cognitive performance in old age. These findings on the mediating role of social capital add up to the explanation regarding the mediating variables of the association between activity engagement during adulthood and cognitive functioning in old age. Furthermore, our results stress the importance of social mechanisms in general terms for the enhancement of cognitive abilities in older adults, which is also confirmed by existing literature (Bassuk, Glass, & Berkman, 1999; Ertel, Glymour, & Berkman, 2009; James, Wilson, Barnes, & Bennett, 2011; Lövdén, Ghisletta, & Lindenberger, 2005; Zunzunegui, Alvarado, Del Ser, & Otero, 2003). Thus, while not all studies are consistent with these inferences (Aartsen et al., 2002), a substantial and still developing body of literature supports the idea that social activity may help to prevent or delay cognitive decline in old age.

We acknowledge that the present study is retrospective and limited by its cross-sectional design. Analyses of the present study give only information about interindividual differences in cognitive status but do not allow drawing conclusions regarding cognitive decline with age. This would be of particular importance to understand if cognitive decline is a cause or a consequence of change or decline in the levels of available social capital in the individual's family network. However, at least for our results on the positive effect that leisure activities at age 45 have on social capital it is most likely that the direction of causation is right, as present family networks cannot influence activities carried out in the past.

Moreover, present data do not allow drawing conclusions regarding the effect of social capital earlier in life on leisure activities in following life phases, as social capital was measured in old age (65 years and beyond) and leisure activities concerned mid-life (age 45). We further acknowledge that future research will have to address this issue.

With regards to the measurement of the social capital, we acknowledge that our data provide a dichotomous evaluation of relationships (support exists / does not exist). This dichotomous method was chosen in our survey due to the time constraints (questionnaire length) stemming from a network approach of relationships, in which a large number of dyads has to be estimated by each respondent. Therefore, quality of relationships was not estimated in this study. We acknowledge that further research is needed in this regard.

Moreover, we acknowledge that further measurement of family based social capital (especially in terms of extensive family networks, not as in our case limited to five network members) and cognitive abilities would be needed to have a better understanding of their actual interplay. It is therefore necessary to apply our model to longitudinal data.

This study has several implications for future research. As mentioned, there has been little research explaining cognitive functioning by using the social capital framework. Therefore, this is still a field that needs further investigation and study. Particular attention should be paid to the role as active agents that individuals unequally play within their family networks, as our

results show that the support that the focal individuals gives to the network members is associated with greater cognitive abilities in old age. More research is needed to assess the extent to which other characteristics of the family network can preserve cognitive capabilities and postpone the onset of normal or pathological cognitive decline in older age.

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Table 1

Sample characteristics (n=2788)

		N	%
Age group	65-69	581	20.8
	70-74	557	20
	75-79	533	19.1
	80-84	455	16.3
	85-89	392	14.1
	90+	270	9.7
Gender	Female	1319	47.3
	Male	1469	52.7
Canton	Basel	589	21.1
	Berne	659	23.6
	Geneva	521	18.7
	Ticino	497	17.8
	Valais	522	18.7

Table 2

Full correlation matrix of measures

Variable	1	2	3	4	5	6	7	8	9	10
1. Verbal ability	---									
2. Processing speed	.24***	---								
3. Cognitive flexibility	.28***	.63***	---							
4. Leisure activities at 45	.13***	.13***	.06***	---						
5. Network Size	.11***	.09***	.04 NS	.09***	---					
6. Network Density	.00 NS	-.04 NS	.01 NS	.03 NS	-.15***	---				
7. Network Reciprocity	.02 NS	.00 NS	.02 NS	.02 NS	-.02 NS	.71***	---			
8. Network In-degree	.14 ***	.13***	.10***	.11***	.56***	.37***	.26***	---		
9. Network Out-degree	.06 **	.01 NS	-.00 NS	.05**	.39***	.45***	.45***	.47**	---	
10. Network Centrality	.04*	.02 NS	-.02 NS	.01 NS	.12***	.03 NS	.17***	.33**	.39***	---

Note: Correlations between performance in verbal abilities, processing speed, cognitive flexibility, leisure activities at age 45 and the six social capital indexes.

*** $p < .001$; ** $p < .01$; * $p < .05$.

Table 3

Mediation effects of network size and in-degree on the effect of activities at age 45 on Verbal Abilities

	Network Size				In-degree			
	B	SE	p	CI95%	B	SE	p	CI95%
(a) Activities->Mediator	0.02	0.01	*	[0.003 - 0.04]	0.04	0.01	***	[0.02 - 0.06]
(b) Mediator->Verbal ability	1.17	0.32	***	[0.54 – 1.81]	1.47	0.31	***	[0.86 – 2.08]
(c) Indirect Effect	0.03	0.01	**	[0.004 – 0.06]	0.06	0.02	***	[0.02 – 0.1]
(d) Direct Effect	0.56	0.16	***	[0.25 - 0.88]	0.53	0.16	***	[0.22 – 0.85]
(e) Total Effect	0.59	0.16	***	[0.27 – 0.90]	0.59	0.16	***	[0.27 – 0.90]

Note: Results of mediation analyses to investigate whether the relation of leisure activities at age 45 to performance in verbal ability was mediated via the network size and the in-degree

***p<.001; **p<.01; *p<.05.

B=beta value estimated by robust linear regressions for continuous variables; SE=Standard Error; CI95%= Upper and lower bounds of confidence intervals at 95%.

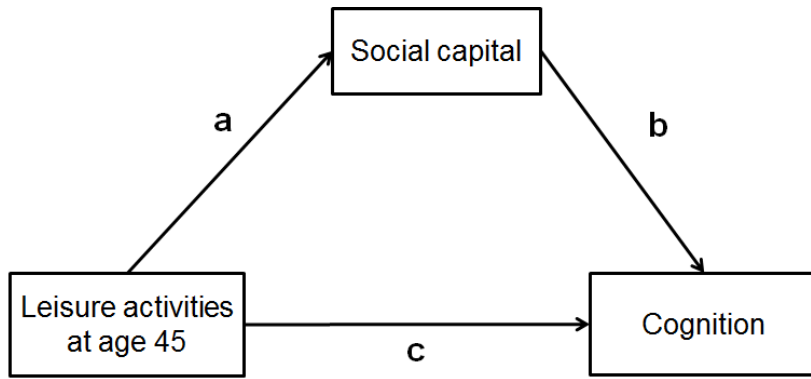


Figure 1. General structure of the path models applied to investigate whether the relation of leisure activities at age 45 to performance in verbal ability, processing speed and cognitive flexibility in old age was mediated via the six social capital indexes. These models allowed simultaneously estimating the direct relation of leisure activities at age 45 to performance in verbal ability/processing speed/cognitive flexibility (c) and the indirect relation via social capital measured by the six social capital indexes (a*b).

Figure

