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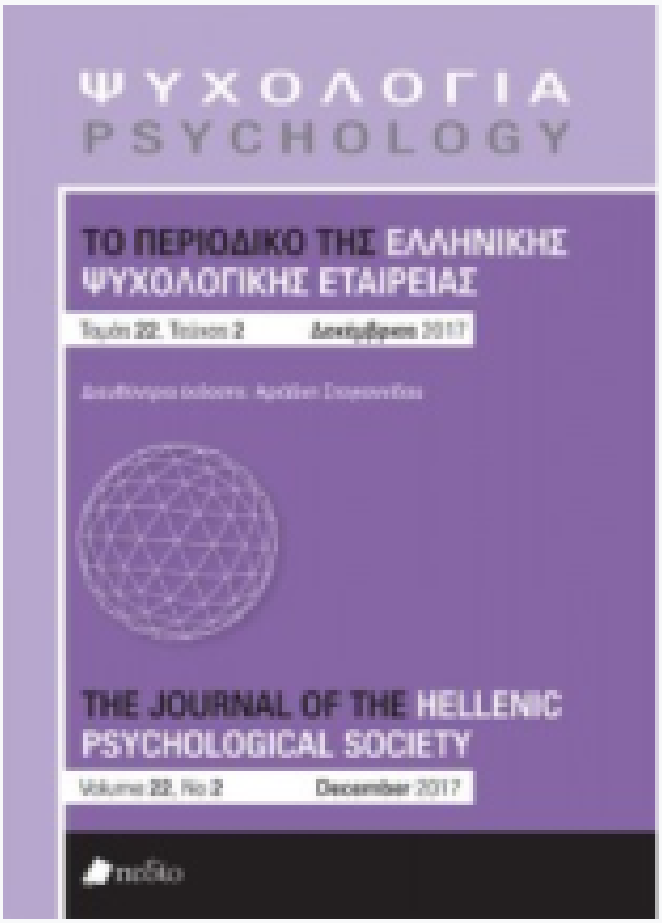

Online social networking and cognitive performance in older adults: A Greek-Canadian study

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Online social networking and cognitive performance in older adults: A Greek-Canadian study

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ABSTRACT

The present study examined the relation between cognitive performance and social networking in older adults from Canada and Greece. The two groups were matched on age, gender, education level, and MMSE scores. Participants reported the amount of both off-line and online networking, as well as the social support received in these contexts. Immediate and delayed recall, speed of processing, and executive functioning were also assessed. Online networking was associated with executive functioning. Interestingly, country context didn't moderate the relationship, despite differences observed between Greeks and Canadians in executive functioning and online networking. Our findings suggest that online social participation could serve both as a source of social support and as cognitive training, benefiting older adults' cognitive vitality. The findings are discussed in relation to the characteristics of the specific countries, stressing the need to explore the effects of online social networking and participation on cognitive function in the aging population.

Keywords: Social networking, Online networking, Executive control, Cognitive functions, Older adults.

According to the World Health Organization (2010), one of the key factors for older adults' successful integration in society is social engagement. Research suggests that older age is associated with a higher risk of social isolation, which may result in heightened feelings of loneliness (Cattan, White, Bond, & Learmouth, 2002) and increased depressive symptoms (Beekman et al., 1995, 2000). In turn, loneliness and depressive symptoms have been found to be related with decreased performance in cognitive tasks (Cacioppo, & Hawkley, 2009).

The relationship between social participation and cognitive performance in older age has received significant attention in the last years, mostly in the context of studies investigating off-

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line (face-to-face) social interaction (Cattan et al., 2002; Krueger, Bennett, Bienias & Barnes 2009; Yeh & Ying Li, 2003). In a review, Hertzog, Kramer, Wilson, and Lindenberger (2008) stated that lower levels of social participation relates consistently with worse cognitive vitality, where longitudinal studies depict that greater social participation, social support and networking function as a buffer for cognitive decline (see Christelis & Dobresku, 2012). In the same respect, James, Wilson, Barnes, and Bennett (2011) found that the rate of cognitive decline was reduced by 70% in more socially active seniors. The latter results also showed that social participation was not driven by initial cognitive status.

The accounts proposed to explain the effect of enriched social participation in cognitive vitality are based on the *Use it or lose it* hypothesis (Hultsch, Hertzog, Small, & Dixon, 1999) and the Cognitive-Enrichment theory (Hertzog et al., 2008). Both theories build upon the assumption that social interaction and participation requires a certain amount of cognitive activity, and thus, social participation and interaction would function as cognitive training in a naturalistic environment. However, our ever-growing digitalized society depends increasingly on digital means for communication, civic participation and information retrieval (Eurostat, 2014). As such, being digitally illiterate constitutes a form of social exclusion and may contribute to social isolation (Xie, 2003). In this respect, older individuals could be considered a group at risk for a technology mediated social isolation, since they have the lowest rates of internet use, compared to other age groups (Statistica, 2014). Based on the research discussed above, one may logically assume that older adults' cognitive vitality may benefit from enriched online social participation as well.

In this vein, Small, Moody Siddarth, and Bookheimer (2009) reported that the dorsolateral prefrontal cortex (an area of the brain that is related with executive function) had a greater activation in older adults who were active users of the Internet, suggesting that Internet use may work as a form of cognitive training. Internet use and online social networking levels have been found to correlate with increased feelings of social inclusion (Wellman, Haase, Witte, & Hampton, 2001) and reduced depressive symptoms in the silver years (Houston, Cooper, & Ford, 2002). In a related study, Sum, Mathews, Pourghasem, and Hughes (2009) showed that Internet use provided Australian seniors with a sense of community, strengthening not only their online, but also their off-line social engagement and networking levels. In contrast, the absence of a sense of community was related to feelings of loneliness in the elderly.

In relation to this research, it is interesting to note that the rates of Internet use among older adults differ among countries. For instance, survey data collected in 2009 showed that 72 % of older adults were online users in Canada (Government of Canada, 2010; see also Goodman, Syme, & Eisma, 2003), whereas the percentage in 2011 for Greece was approximately 20% (UNECE, 2011). This difference can be partly explained by dissimilar political and social policies in Greece and Canada. In Canada, the health system and the local communities encourage actions for healthy ageing, with digital literacy being one of them (Canadian Public Health Association, 2010). In this context, the government provides several programs at local community centers (Social participation – Social networks, 2003). To our knowledge, no such political initiatives have recently taken place in Greece.

Despite the benefits that online social networking might have for older adults' cognitive vitality, relevant findings are scarce. The present study set out to examine the relation between off-line, as well as online social networking and cognitive performance in older adults, taking into account country-specific differences in Internet use. In doing so, we included participants from two distinct, in this respect, contexts: Greece and Canada. We expected positive associations between social networking (online and off-line) and older adults' performance in cognitive tasks, which would be independent of their country of origin and residence.

1. Methods

Participants

Thirty five Canadian and 46 Greek adults were selected from community-based centers in Toronto (Canada) and Thessaloniki (Greece) respectively. Inclusion criteria were: i) age over 55 years ii) having been raised in and being residents of each country, and iii) Greeks scoring 23 and above (Fountoulakis, Tsolaki, Chantzi, & Kazis, 2000), and Canadians scoring 27 and above (Folstein, Folstein, McHugh, & Fanjiang, 2001) on the *Mini Mental State Examination* (*MMSE)*. Among the 32 Canadians and the 44 Greeks who met the inclusion criteria, 29 Canadians (90.63%) and 22 Greeks (50%) were involved in online social networking. For the final analysis, the 22 Greeks who engaged in online social networking were carefully matched with 22 of the Canadians on age, gender, education (1 = did not finish elementary school, 2= finished elementary school, 3 = high-school graduate, 4 = technical school graduate, 5 = university graduate, 6 = completed post-graduate studies), and the MMSE score (see Table 1 for demographic details).

Measures

Cognitive performance measures. The English and Greek versions, for Canadian and Greek participants respectively, of the *Trail-Making Test* (*TMT*; Reitan, 1958; Vlahou and Kosmidis, 2002) were used to assess participants' speed of processing and executive functioning (Arbuthnott & Frank, 2000). The test consists of two sub-tests: *TMT-A* requires the participant to connect series of numbered circles in ascending order (e.g., 1 - 2 - 3). The specific measure is seen as an indicator of individuals' processing speed; see Arbuthnott & Frank, 2000; McGint, Podell, Franzen, Bairdand,Williams 2002). The *TMT-B* requires the participant to alternate between numbered and lettered circles (e.g. 1 - A - 2 - B -3 - C etc.), considerably differing from *TMT-A* in terms of its cognitive processing and executive control demands (see also Arbuthnott & Frank, 2000). Specifically, *TMT-B* constitutes a complex executive functioning task, since it assesses the coordinated, controlled use of inhibition, task switching (or cognitive flexibility) and updating processes (see Bowie & Harvey, 2006; Miner &

Table 1
Gender distribution and descriptive statistics (mean, standard deviation and range) for the matching variables (age, education level and MMSE performance) per country group (Greeks/ Canadians)

	***Canadians* (9 female, 13 male)**			***Greeks* (10 female, 12 male)**		
Matching Variables	M	*SD*	Range	M	*SD*	Range
Age[a]	65.09	4.92	58 - 74	64.71	5.01	57 - 73
MMSE score[a]	29.68	0.57	28-30	28.95	1.21	25-30
Education level (frequency)	*Canadians*			*Greeks*		
Elementary	1			1		
Junior High-school	1			1		
Senior High-school	7			7		
University-Master's	13			13		

[a] $p > .05$

Ferraro, 1998; Reitan & Wholfson, 1993). The time taken to complete Trails A and B (in seconds) was measured, and the test was discontinued if the participant exceeded 75 seconds in *TMT-A,* and 273 seconds in *TMT-B* (Vlahou & Kosmidis, 2002).

Moreover, the English (Delis, Kramer, Kaplan, & Ober, 1987; see also Delis, Freeland, Kramer, & Kaplan, 1988) and Greek (Vlahou et al., 2012) version of the *California Verbal Learning Test* (*CVLT*), were given to the Canadian and Greek participants, respectively. This is a widely used measure of verbal learning and memory skills. Among the measures provided, only the immediate free recall and the long delay free recall were used for the purposes of the study. The maximum score for immediate free recall is 80, and for long delay free recall is 16.

Social Networking measures. The *Lubben Social Network Scale* (LSNS; Lubben, 1988; see also Lubben et al., 2006) was translated and back translated to Greek for the purpose of this study. This 9-items scale provides information about an individual's (off-line) social networking, and more specifically, the frequency and amount of contact a person has with family and friends, as well as the perceived level of social support received by them. The original scale includes ten items in total and participants are required to rate the frequency and amount of contact they have with family and friends on a 6-point Likert scale. However, the last question in the original questionnaire "*Do you live alone or with other people?"* was withdrawn, since it was not possible to adapt the specific question in order to include it in an online networking version of the scale.

To the best of our knowledge, there are no scales measuring frequency of contacts, closeness with family and friends and support levels provided or received via electronic, online social networking platforms (e.g. Facebook, twitter, electronic mail, Skype etc.). We thus developed a relevant measure, using the questions in the above mentioned off-line social networking scale and simply adding the word "online" to each question. For example, the question "*How often do you see or hear from relatives?"* was re-formulated as follows: *"How often do you see or hear from relatives online?".* The internal consistency reliability coefficients for the off-line (a = .715) and the online (a = .856) social networking scales indicate that they constitute reliable measurements of the underlying constructs.

Procedure

The study was approved by the University of Sheffield Ethics Committee. Each participant was informed about the aim of the study, about anonymity and confidentiality being preserved, as well as about his/her rights (e.g., to withdraw at any point). Participants who provided written consent were involved in the screening phase (see Participants section). If the inclusion criteria were met (see Participants section), participants took part in the main assessment phase (lasting 35-50 minutes, during morning hours). The researcher met with each participant in a quiet room to eliminate possible disruptions or distractions. The order of the tests and scales was counterbalanced across participants.

2. Results

The descriptive statistics are provided in Tables 2 and 3 for the whole sample and each country context respectively. In the overall sample, Pearson correlation analyses (see Table 4) revealed statistically significant negative correlations between the online networking measures and both the *TMT-A* ($r(44) = -.330$, $p = .028$), and *TMT-B* scores ($r(44) = -.455$, $p = .002$) . There were no such correlations for the off-line networking measure, nor between the memory scores (immediate, and long delay free recall) and either social networking measure (on-/off-line).

One-way MANOVA using Pillai's Trace, with country context (Canadian vs Greek) as the between subject factor, and the two social networking measures (online and off-line) as the dependent variables, revealed a statistically significant main effect of country context on social

Table 2.
Means standard deviations and range for all measures on the whole sample (22 Greeks and 22 Canadians)

Measures	Whole sample		
	M	***SD***	**Range**
Trail Making A	32.70	13.83	12 - 71
Trail Making B	75.70	31.00	28 - 180
Immediate Free Recall	46.95	8.48	20 - 64
Long Delay Free Recall	10.20	2.73	5 - 15
Online Networking	16.66	10.03	1 - 36
Offline Networking	29.59	7.63	9 - 41

Note: Maximum score for immediate free recall is 80 and for long delay free recall, it is 16. Maximum score for the online and the off-line social networking measures separately is 45. Performance in the trail making sessions (A and B) corresponds to the seconds required for participants to complete each task.

Table 3
Means, standard deviations and range for all measures per group of participants

Measures	*Canadians*			*Greeks*		
	M	***SD***	**Range**	***M***	***SD***	**Range**
Trail Making A	28.64	13.58	12 - 68	36.77	13.13	21 - 71
Trail Making B	57.68	20.76	28 - 120	93.73	29.26	52 - 180
Immediate Free Recall	48.50	6.70	40 - 64	45.41	9.86	20 - 57
Long Delay Free Recall	9.77	2.62	5 - 14	10.64	2.84	6 - 15
Online Networking	22.32	8.80	7 - 36	11.00	7.85	1 - 26
Offline Networking	30.86	7.64	11 - 40	28.32	7.58	9 - 41

Note: Maximum score for immediate free recall is 80 and for long delay free recall, it is 16. Maximum score for the online and the off-line social networking measures separately is 45. Performance in the trail making sessions (A and B) corresponds to the seconds required for participants to complete each task.

networking measures, $V = .34$, $F(2, 41) = 10.54$, $p < .001$, $\eta^2 = .34$. Separate one-way ANOVAs showed significant differences between the Greek ($M = 11$, $SD = 7.85$) and the Canadian ($M = 22.32$, $SD = 8.80$) participants only on the online social networking measure $F(1, 42) = 20.28$, $p <. 001$, $\eta^2 = .326$.

One-way MANOVA using Pillai's trace with country context as the between subject factor and the four cognitive measures (*TMT-A, TMT-B*, immediate and delayed recall) as dependent variables revealed a statistically significant main effect of country context on cognitive performance as well, $V = .38$, $F(4, 39) = 6.02$, $p = .001$, $\eta^2 = .38$. Separate one-way ANOVAs on the outcome variables revealed that significant main effects of country context on the *TMT-A* and *TMT-B* scores, $F(1, 42) = 4.08$, $p = .050$, $\eta^2 = .089$, and $F(1, 42) = 22.21$, $p < .001$, $\eta^2 = .346$, respectively. That is, Canadian participants ($M_{TMT\text{-}A} = 28.64$, $SD = 13.58$;

Table 4
Pearson correlation coefficients between all measures in the whole sample

	1	2	3	4	5	6	
1. Trail Making A	-	.661**	-.084	.085	-.330*		-.195
2. Trail Making B		-	-.208	.145	-.455**	-.176	
3. Immediate Free Recall			-	.556**	.236	.194	
4. Long Delay Free Recall				-	-.064	-.017	
5. Online Networking					-	.478**	
6. Offline Networking						-	

Note *$p < .05$, **$p < .01$

Table 5.
The moderating effect of country context on the relationship between the TMT- B score and online

		Criterion variable: *TMT-B*	
Step	**Predictors**	***β***	***R*²**
1	Online networking	-.177	.367***
	Country	.487**	
2	Online networking	-.168	.004
	Country	.492**	
	Online networking × Country networking	-.063	

Note: **$p < .01$, ***$p < .001$

M_{TMT-B} = 57.68, *SD* = 20.76) were faster than Greek participants (M_{TMT-A} = 36.77, *SD* = 13.13; M_{TMT-B} = 93.73, *SD* = 29.26).

In order to examine the potential moderating effect of country of origin-residence on the significant relationships between the online networking measure and both *TMT* measures, we proceeded with two moderated regression analyses (one with *TMT-A* and another with *TMT-B* as the criterion variable), following the recommendations of Aiken, West, and Reno (1991). The predictor variables in each analysis were mean-centred. Specifically, in centering the online networking variable, the mean score was subtracted from every value of the variable. In the case of the country variable (two groups of equal size), effect coding was used: the Canadian group was coded as −1 and the Greek group coded as +1 (this way, the variable's mean was 0, thus, not differentiating each variable's value when subtracted from it). Subsequently, an interaction term was computed (e.g., online networking × country) reflecting the interaction between the two predictor variables.

The moderated regression analysis was computed in two steps, including the main effects of the predictors, and the interaction term, respectively. A significant moderation effect is indicated if the addition of the interaction term significantly adds incremental variance in the prediction of the criterion variable. In the present study, the cross product of the centered predictors (entered in the second step of each analysis) failed

to significantly increase the predicted variance in the *TMT-B* measure (see Table 5); being Canadian or Greek did not affect the relationship observed between online networking and executive functioning. It is finally noted that, the centered online networking and country variables failed to significantly predict variance in the *TMT-A* (processing speed) measure, when entered in the first step of the relevant regression analysis (R^2= .127, p = .062); we therefore did not proceed with the examination of a moderating effect.

3. Discussion

This study was set to examine the relation between cognitive vitality and online social networking in older adults, taking into account country-specific differences in Internet use. We expected positive associations between the social networking measures and older adults' performance in cognitive tasks, which would be independent of their country of origin and residence: Greece and Canada in our case. The results partially confirmed our hypotheses: online networking was significantly associated with speed of processing and executive functioning, indicating that the more online networking older adults used, the better they were on speed of processing and executive functioning. This is consistent with previous evidence that depict more Internet use (Small et al., 2009) and more social participation (Hertzog et al., 2008) to be related with benefits in cognitive vitality. This is the first study though to show that social networking via online, rather than off-line (face-to-face) means is associated with benefits in cognitive performance in older adults. Our results also showed that country context did not moderate the relationship between online networking (amount and social support received) and executive functioning, despite the significant differences between Greeks and Canadians in both types of measures. This finding suggests that the relation between online networking and cognitive vitality among older adults remains robust, even when comparing countries with different Internet use rates.

Interestingly, in contrast to existing findings (see Hertzog et al., 2008; Seeman, Lusingolo, Albert, & Berkman, 2001), the off-line networking measure failed to correlate with the cognitive measures used in the present study. This inconsistency might be attributed to differences in the theoretical and methodological attempts to define and measure social networking/ engagement levels, as well as cognitive performance across studies. For example, some social activities (e.g., attending church or going to coffee shops) may be popular and meaningful in some cultures, but not in others, making their effect more or less relevant (Christelis & Dobresku, 2012). This methodological diversity and lack of consensus seems to also characterize measurements of cognitive outcomes across studies. For instance, many studies have used general measures of cognitive status, such as the MMSE, which are mostly sensitive to pathological states (Bosma et al., 2002; Glei et al., 2005; Yeh & Liu, 2003). Moreover, most studies have employed large sample size of seniors who are positioned in a broad spectrum of cognitive performance, ranging from pathological levels to healthy ones. This great variability in cognitive performance facilitates the establishment of statistically significant correlations. At the same time however, it would produce the erroneous assumption that more social networking/ engagement levels would also benefit cognitive vitality in those that lie in the higher levels of cognitive performance. Our findings suggest that, in the case of a typical healthy sample, like the present, cognitive stimulation provided via off-line social participation (as tapped here by the frequency and amount of supportive contact a person has with family and friends) might not be enough to produce a significant effect on cognitive performance.

Then why was higher social support from online means associated with better cognitive performance? This finding may be explained in relation to the findings of a relatively recent neuroimaging study. Small and colleagues (2009) reported greater activation in the dorsolateral prefrontal cortex in older adults who were active users of the Internet. The prefrontal cortex has been implicated in exec-

utive functions (cognitive flexibility, inhibition and updating), such as those tapped by the *TMT-B* measure used in the present study. Small and colleagues actually found greater prefrontal activation in older adults with only 7 days of internet use, suggesting that Internet use may work as a form of cognitive training. Since, we did not find a correlation between the same measure of social networking (face-to-face networking) and cognitive performance, we suggest that the positive relationship observed between online social networking and executive functioning might actually reflect the influence of Internet/computer use, rather than an effect social networking and support.

Although, the main purpose of the present study was to investigate the relationship between social networking and cognitive performance, we additionally explored differences between the two groups of participants on the measures employed. Specifically, even when comparing participants from both countries that do have access to internet and are engaged in some form of online social networking (90.63% of the Canadians versus only 50% of the Greeks that passed the screening phase), still the Greeks reported lower levels of online social contact and support than the Canadians. The above mentioned percentages are similar to those provided by the *Social participation – Social Networks* (2003) survey, with regard to Canada (81% use the Internet, whereas 72 % of those older than 55 are also engaged in online social networking) and Greece (53%, one of the lowest Internet use rates among the European countries, use the Internet, with no more than 20% of Greek seniors being active online, UNECE, 2011). In Canada, the health system and the local communities encourage actions for healthy ageing, with digital literacy being one of them (Canadian Public Health Association, 2010). In contrast, older adults in Greece are not as socially active online, as other European seniors, possibly due to the lack of relevant encouragement and support from their local communities.

Results also showed that Canadian participants performed better in the executive function measures, as compared to the Greeks. Differences on several timed neuropsychological assessments, including the *TMT* measures have been observed in other cross-cultural studies (see Agranovich & Puente, 2007, Stanczak, Stanczak, & Awadalla, 2001), with researchers, at least partially attributing the differences in subjective relevance of the tasks to culture-specific experiences and characteristics (e.g. time perception, attitudes towards testing, familiarity with timed assessments, learning patterns). However, this is the first study to compare two matched samples of Canadians and Greeks on cognitive performance and online networking, and one should be cautious on making general conclusions from the current findings, due to the relatively small sample sizes.

To sum up, the present study attempted to shed more light on the unexplored contribution of older adults' online (besides off-line) social networking levels to cognitive vitality. Our findings support that online social networking benefits older adults' executive functioning, independently of the country context. Our study was not able though to disentangle the beneficial effect of online social networking on cognitive performance, from that of Internet use. As such, it is unknown how much of the benefits observed in cognitive performance can be attributed to the use of Internet, and how much due to enhanced social connectivity, an issue that merits further investigation. This line of research has the potential to inform the development of active and healthy ageing interventions, taking into account the interplay between aspects of cognition and the complexity of social networking activities (off-line and online), in light of the increasingly essential role of online social participation in contemporary life.

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Ηλεκτρονική κοινωνική δικτύωση και γνωστική επίδοση στην τρίτη ηλικία: Μια μελέτη με ΄Ελληνες και Καναδούς συμμετέχοντες

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ΠΕΡΙΛΗΨΗ

Η παρούσα μελέτη εξέτασε εάν οι επιδόσεις σε γνωστικά έργα συσχετίζονται με μετρήσεις της κοινωνικής δικτύωσης σε άτομα τρίτης ηλικίας από τον Καναδά και την Ελλάδα. Οι δύο ομάδες συμμετεχόντων εξισώθηκαν ως προς την ηλικία, το φύλο, το επίπεδο εκπαίδευσης και την επίδοσή τους στη δοκιμασία MMSE. Οι συμμετέχοντες εκτίμησαν τα επίπεδα κοινωνικής δικτύωσης και υποστήριξής τους, τόσο μέσω διαδικτύου, όσο και δια ζώσης. Στους συμμετέχοντες δόθηκαν και έργα άμεσης και καθυστερημένης μνημονικής ανάκλησης, ταχύτητας επεξεργασίας και εκτελεστικού ελέγχου. Η μέτρηση της ηλεκτρονικής κοινωνικής δικτύωσης συσχετίστηκε με την επίδοση σε δοκιμασία εκτελεστικού ελέγχου. Δεν προέκυψαν στατιστικά σημαντικά ευρήματα που να δείχνουν ότι η σχέση αυτή ρυθμίζεται από τη μεταβλητή της χώρας προέλευσης - διαμονής των συμμετεχόντων, παρά τις διαφορές που παρατηρήθηκαν ανάμεσα στους Έλληνες και Καναδούς συμμετέχοντες στις μετρήσεις ηλεκτρονικής κοινωνικής δικτύωσης και εκτελεστικού ελέγχου. Συμπεραίνεται πως η κοινωνική συμμετοχή μέσω διαδικτύου μπορεί να συμβάλλει τόσο στην κοινωνική υποστήριξη, όσο και στη γνωστική επίδοση ατόμων τρίτης ηλικίας. Τα ευρήματα συζητούνται σε σχέση με τα χαρακτηριστικά των συγκεκριμένων χωρών, σημειώνοντας την ανάγκη περαιτέρω διερεύνησης των παραπάνω επιδράσεων.

Λέξεις κλειδιά: κοινωνική δικτύωση, ηλεκτρονική κοινωνική δικτύωση, εκτελεστικός έλεγχος, γνωστική επίδοση, τρίτη ηλικία

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