Interaction between BDNF polymorphism and physical activity on general cognition in the elderly

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Anne Canivet[1], Cédric Albinet[1], Nathalie André[1], Jean Pylouster[1], Montserrat Rodríguez Ballesteros [2], Alain Kitzis[2] & Michel Audiffren[1,3]

anne.canivet@univ-poitiers.fr ; [1]*Centre de Recherche sur la Cognition et l'Apprentissage - CeRCA (UMR CNRS 7295). University of Poitiers, France.*

[2]*Laboratoire CiMoTheMA – EA 3808, Groupe « Génétique des maladies rares », University of Poitiers and Laboratoire de Génétique, CHU de Poitiers, France*

3 Maison des Sciences de l'Homme et de la Société (USR CNRS 3565), University of Poitiers, France

INTRODUCTION

During the aging process, several brain molecular and cellular mechanisms such as synthesis of neurotrophic proteins progressively decline (Grady, 2008). In other respects, studies demonstrate the positive effects of regular physical activity (PA) on cognitive function in elderly populations (Carvalho, Rea, Parimon, & Cusack, 2014). According to the neurotrophic hypothesis, PA enhances the release of brain-derived neurotrophic factor (BDNF) and then promotes brain health. Nevertheless, the BDNF gene (BDNFVal66Met) regulates the amount of BDNF released in the brain and seems implicated in the deleterious effect of brain aging (Miyajima et al., 2008). The deleterious variant of this gene (Met allele) decreases the BDNF level in the brain and predicts lower hippocampal volume. So, the positive effect of PA could counteract the deleterious effects of this polymorphism on cognition in elderly (Raz, Rodrigue, Kennedy, & Land, 2009). We hypothesize that Met carriers who practice exercise will be better on general cognition than their sedentary counterpart.

METHOD

240 volunteers with MMSE ≥ 24, older than 54 years, took part in the "PRAUSE" survey (Poitou-Charente, France). We established 4 groups of participants as a function of physical activity level (above and below 7.5 METs-h/week, recommendation from the world health organization) and polymorphism BDNF profile (Met Carriers vs. Val Homozygous)

Table 1: Characteristics of the participants

GROUPS	Inactive Met Carrier	Inactive Val/Val	Active Met Carrier	Active Val/Val	Total	PA / BDNF effects
Participants	49	79	51	61	240	
Age (SD)	75.15 (10.11)	78.64 (9.86)	70.07 (7.53)	70.80 (8.64)	74.11 (9.81)	P*
Gender (M/F)	19/30	19/60	33/18	27/34	98/142	P*
Education years (SD)	10.37 (4.00)	9.52 (3079)	10.96 (3.56)	10.31 (3.32)	20.20 (3.69)	
Depression (SD)	8.87 (5.66)	9.38 (5.05)	5.88 (4.68)	6.73 (5.39)	7.85 (5.36)	P*

Note: P* = significant main effect of PA

ASSESSMENT OF PHYSICAL ACTIVITY

The level of contemporary PA was evaluated with the Historical Leisure Activity Questionnaire. Participants were asked to report the number of hours per week for each physical activity they practiced during the present year. Using the Compendium of Physical Activities Tracking Guide (2008), we established the mean energy expenditure (Mets-h/week) of each participant.

ASSESSMENT OF GENE

DNA of each participant was collected with buccal swabs.

ASSESSMENT OF GENERAL COGNITION

General cognition has been evaluated with the Mini Mental State examination.

STATISTICAL ANALYSES

To examine whether there is an interaction between age and PA on episodic memory performance, We conducted an analysis of variance (ANCOVA) with PA level and BDNF polymorphism as between-subjects factors and gender, age, level of education and depression as covariates.

RESULTS

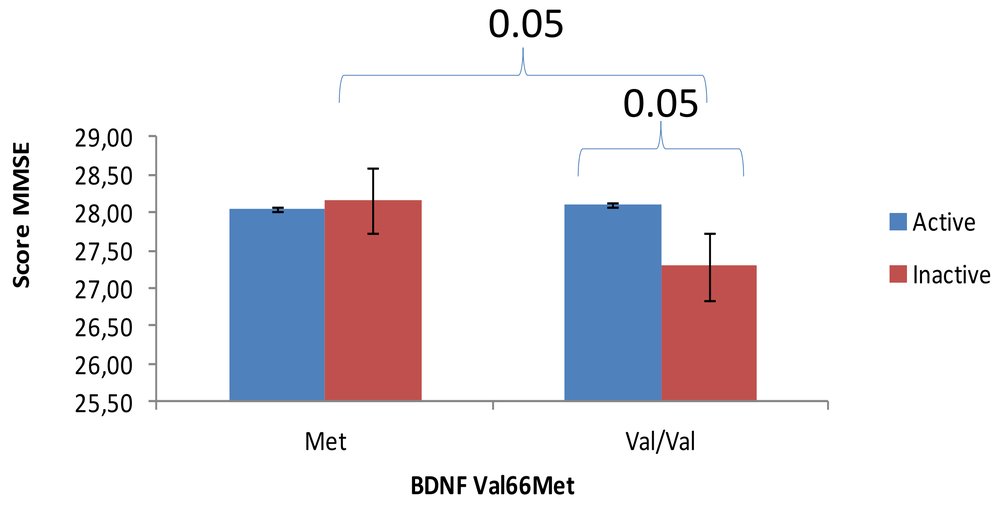

***Fig 1*: Interaction between PA and BDNF Val66Met on general cognition.**

As expected, PA level interacted with BDNFVal66Met on general cognition ($F(1, 228) = 4.640$, $p < .05$) (see Figure 1). A post-hoc Scheffé test showed that there was a significant difference between Inactive and Active Val homozygous. This post-hoc found also a significant difference between Inactive Met carriers and Inactive Val which could be explained by difference of age and depression between these 2 groups.

DISCUSSION

This interaction strongly suggests that PA and BDNF polymorphism share a common mechanism influencing cognition but the nature of the link remains unclear. According to Brown *et al.* (2014), PA seems more favorable to brain health for participants with Val/Val genotype profile. According to Gertzmann *et al.* (2013), the BDNF polymorphism could impact differently brain areas involved in different cognitive functions. In the future, it could be interesting to examine if the relationship between physical activity and each BDNF phenotype change according to different cognitive functions.

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