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COGNITIVE HEALTH AND AGING RESEARCH LAB

UNIVERSITÉ Concordia UNIVERSITY
Centre PERFORM Centre

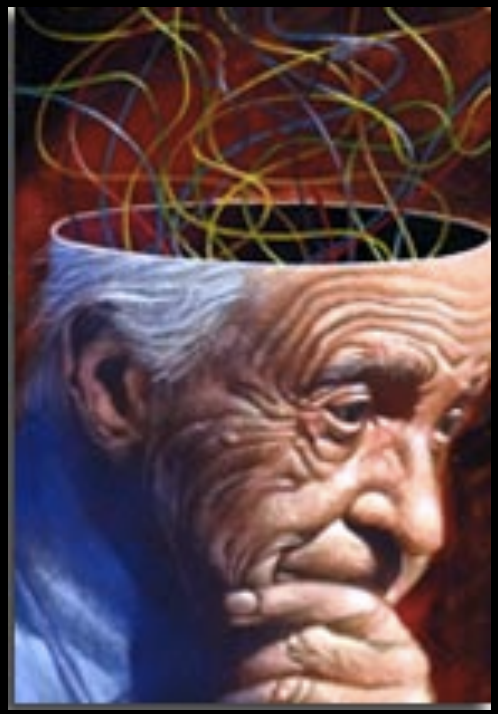
Activité physique et exercice pour le cerveau vieillissant….

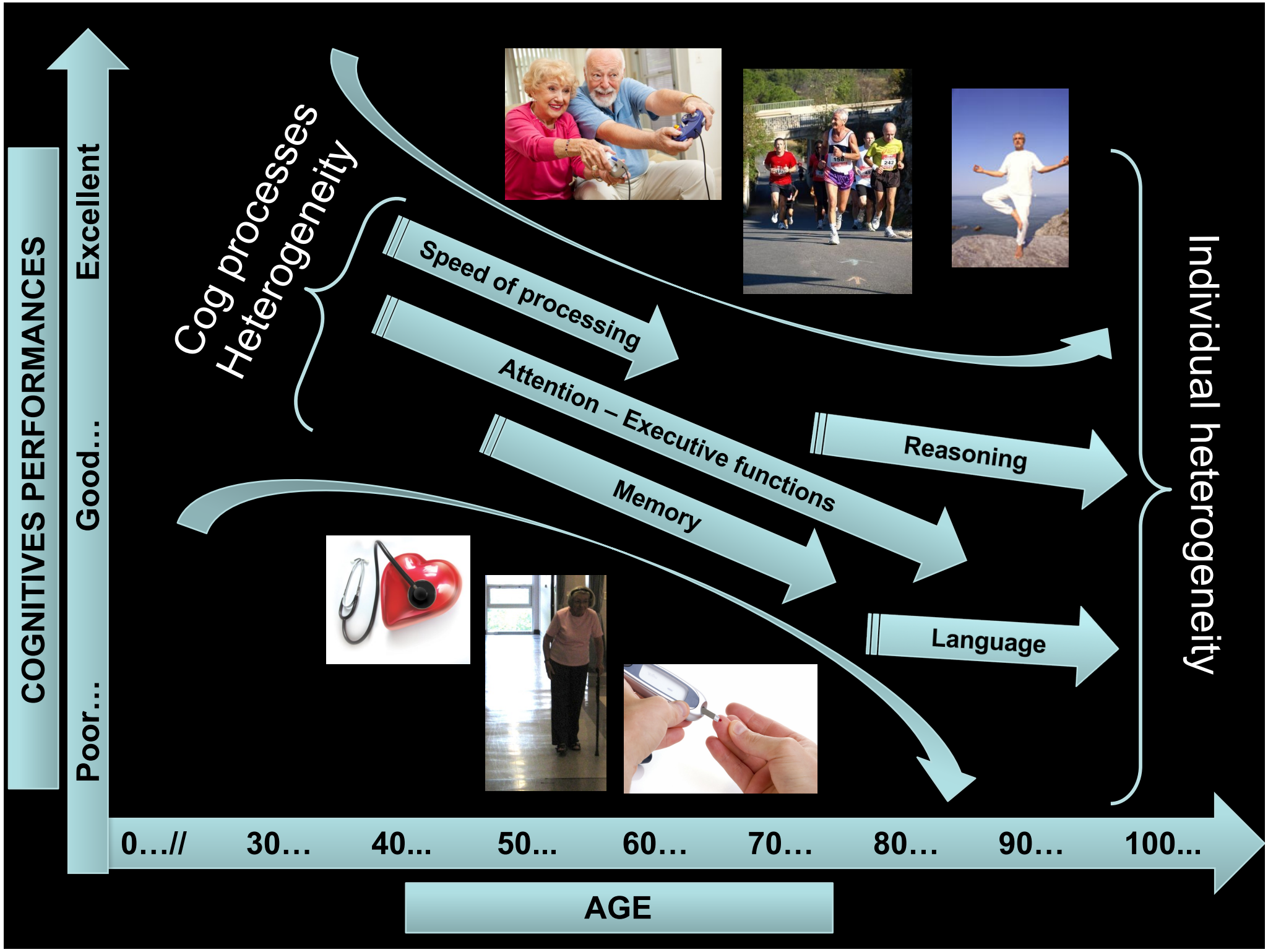
dans un monde numérique ?

Louis Bherer, Ph.D.
PERFORM Centre, Concordia university
Institut universitaire de gériatrie de Montréal

CREGES, UdM
6 mai 2016

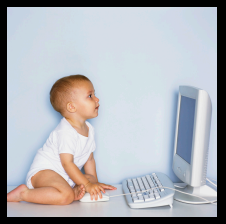
Le vieillissement du cerveau est un processus hétérogène sur lequel on peut agir !




COGNITIVES PERFORMANCES
Excellent
Good…
Poor…
Cog processes Heterogeneity
Speed of processing
Attention – Executive functions
Memory
Reasoning
Language
Individual heterogeneity
0…//
30…
40…
50…
60…
70…
80…
90…
100…
AGE

Influences du style de vie sur le vieillissement cognitif

-Stimulation cognitive



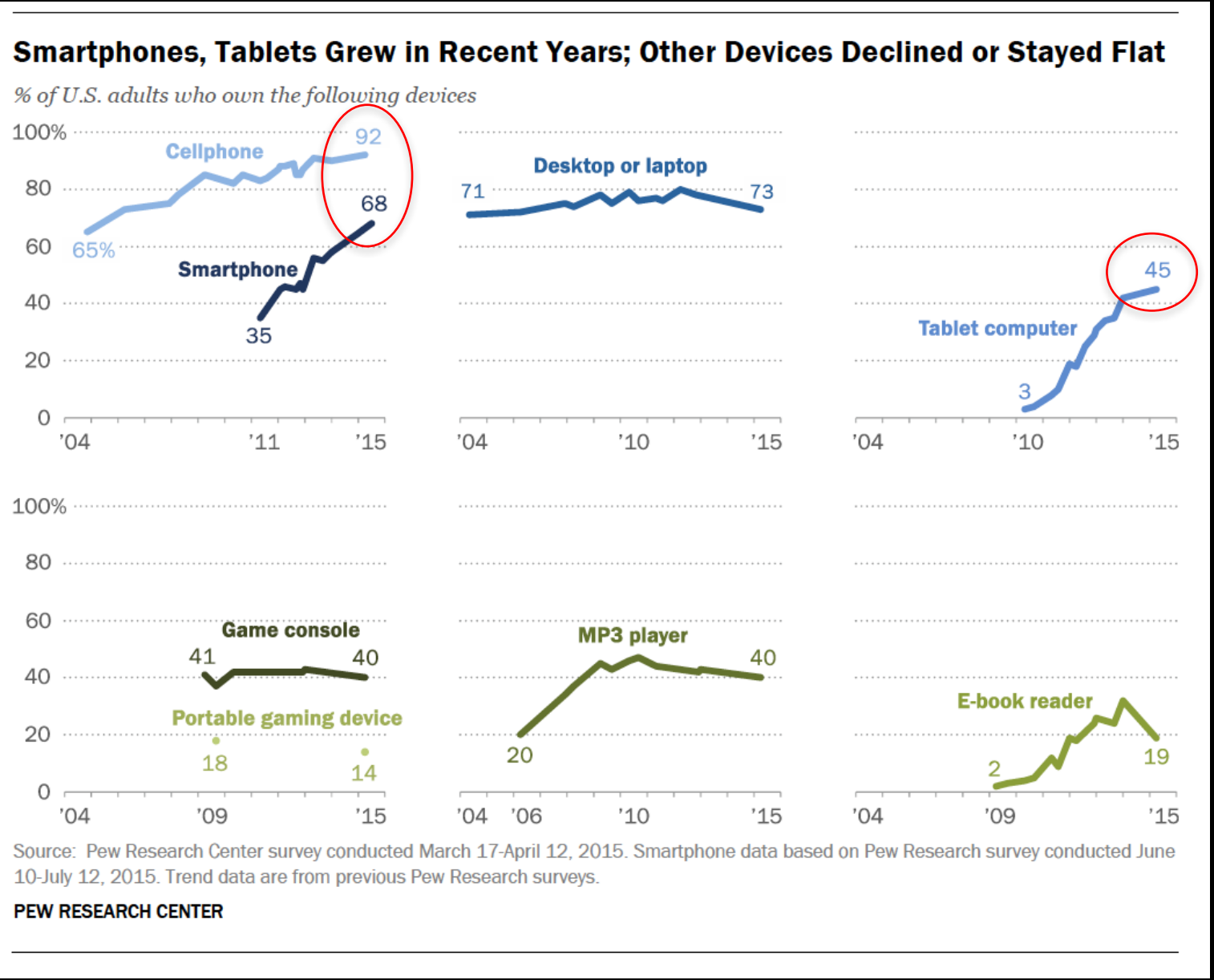
-Activité physique

-Interaction sociale

-Alimentation

Technologies numériques

Quelles technologies ?



Démographie

Cellphone Ownership Is Common Across All Major Demographic Groups

% of U.S. adults who own a cellphone

U.S. adults	92
Sex	
Men	92
Women	92
Race/ethnicity	
White	91
Black	94
Hispanic	92
Age group	
18-29	98
30-49	96
50-64	90
65+	78
Household income	
<$30K	86
$30K-$49,999	94
$50K-$74,999	91
$75K+	98
Educational attainment	
Less than high school	86
High school	90
Some college	93
College+	95
Community type	
Urban	94
Suburban	92
Rural	87

Source: Pew Research Center survey conducted March 17-April 12, 2015. Whites and blacks include only non-Hispanics. N=1,907

PEW RESEARCH CENTER

FOR FURTHER INFORMATION ON THIS REPORT:

Monica Anderson, Research Analyst

Lee Rainie, Director Internet, Science and Technology Research

Dana Page, Senior Communications Manager

202.419.4372

www.pewresearch.org

Smartphone Owners More Likely to be Younger, More Affluent and Highly Educated

% of U.S. adults who own a smartphone, e.g. iPhone, Android, Blackberry or Windows phone

U.S. adults	68
Sex	
Men	70
Women	66
Race/ethnicity	
White	66
Black	68
Hispanic	64
Age group	
18-29	86
30-49	83
50-64	58
65+	30
Household income	
<$30K	52
$30K-$49,999	69
$50K-$74,999	76
$75K+	87
Educational attainment	
Less than high school	41
High school	56
Some college	75
College+	81
Community type	
Urban	72
Suburban	70
Rural	52

Source: Pew Research Center survey conducted June 10-July 12, 2015. Whites and blacks include only non-Hispanics. N=2,001.

PEW RESEARCH CENTER

Tablet Owners More Likely to be Younger, More Affluent and Highly Educated

% of U.S. adults who own a tablet computer, e.g. iPad, Samsung Galaxy Tab, Google Nexus or Kindle Fire

U.S. adults	45
Sex	
Men	43
Women	47
Race/ethnicity	
White	47
Black	38
Hispanic	35
Age group	
18-29	50
30-49	57
50-64	37
65+	32
Household income	
<$30K	28
$30K-$49,999	44
$50K-$74,999	51
$75K+	67
Educational attainment	
Less than high school	19
High school	35
Some college	49
College+	62
Community type	
Urban	42
Suburban	50
Rural	37

Source: Pew Research Center survey conducted March 17-April 12, 2015. Whites and blacks include only non-Hispanics. N=959

PEW RESEARCH CENTER

International Journal of Medical Informatics 85 (2016) 17–26

Contents lists available at ScienceDirect

International Journal of Medical Informatics

journal homepage: www.ijmijournal.com

Investigating the effectiveness of technologies applied to assist seniors: A systematic literature review

Pouria Khosravi [a], Amir Hossein Ghapanchi [a,b,*]

[a] School of Information and Communication Technology, Griffith University, Gold Coast, Queensland 4222, Australia
[b] Institute for Integrated and Intelligent Systems, Gold Coast, Queensland 4222, Australia

[redacted]

Table 1
Criteria to evaluate the effectiveness of the technologies in the studies.

Subjective effectiveness score	Criteria
3	Findings were supported by the results of an RCT study or equivalent fair quality study with a control group Technology intervention was directed to significant improvement in the outcome measures or significant improvement in the intervention group compared to the control group
2	The findings were supported by a non- randomised controlled trial study with a fair quality Technology intervention was directed to improvement in the outcome measures
1	Technology intervention showed no improvement in the outcome measures or no improvement in the intervention group compared to the control group

[redacted]

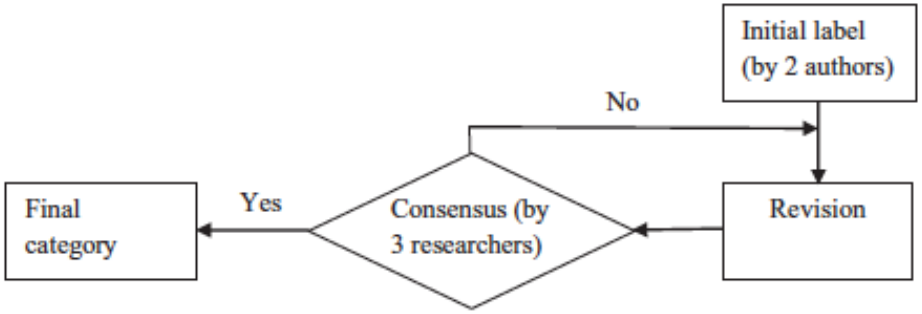


Fig. 4. Consensus process.

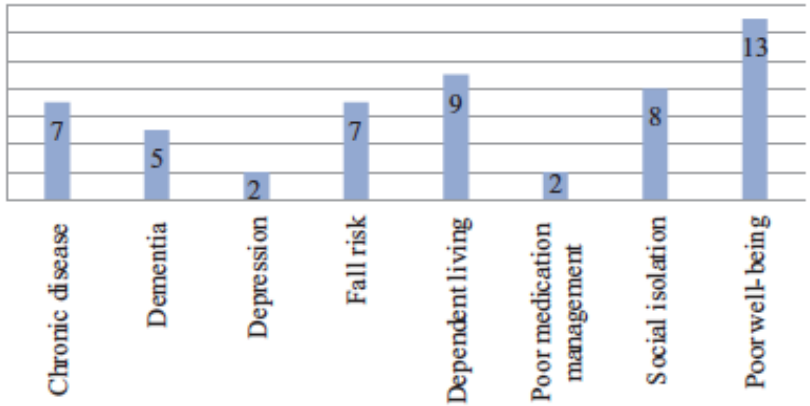


Fig. 5. Seniors' problems targeted by researchers from different disciplines (and number of publications).

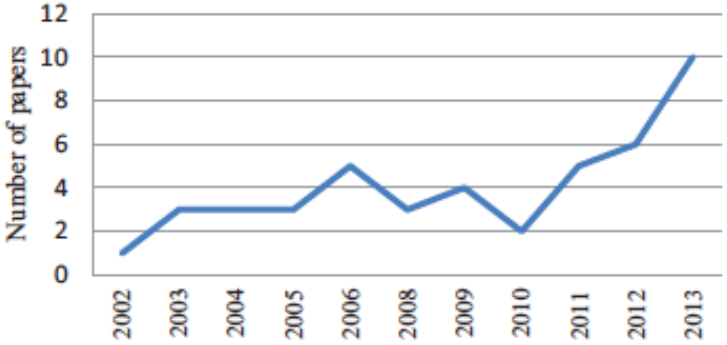


Fig. 2. Frequency of publications per year.

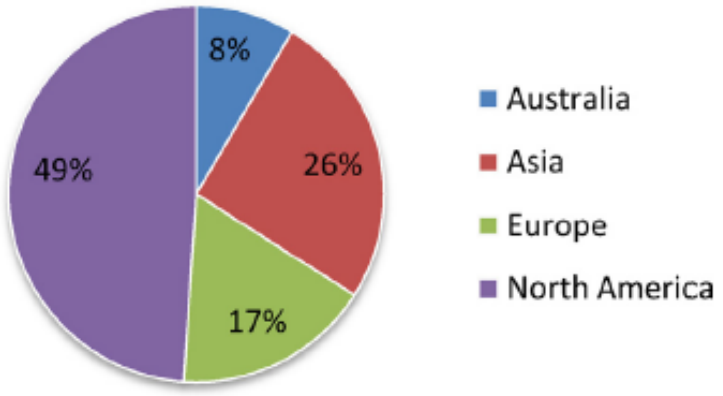


Fig. 3. Number of publications per continent.

Table 12
Comparative analysis of effectiveness of various assistive technologies.

	Chronic disease	Dementia	Depression	Fall risk	Independent living	Medication management	Social isolation	Wellbeing
Robotics			2		2		1.8	2
General ICT		2	3				2	2.4
Sensor technology		2		2	2.4			
Telemedicine	2.5				2			
Medication dispensing device						1		
Videogame				3				

Technologies numériques et santé cognitive ?

1- Mieux évaluer la cognition

2- Favoriser la réserve cognitive

3- Pour motiver à bouger

What to expect from cognitive training

Brain plasticity mechanisms ?

Improved dual-tasking ability (transfer) ?

Functional impacts (mobility and gait) ?

frontiers in
HUMAN NEUROSCIENCE

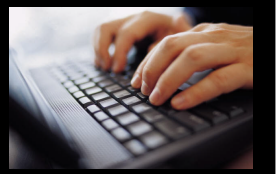
ORIGINAL RESEARCH ARTICLE
published: 18 May 2012
doi: 10.3389/fnhum.2012.00129

An investigation of response and stimulus modality transfer effects after dual-task training in younger and older

Maxime Lussier [1,2] ****, Christine Gagnon*** [1,2] ***and Louis Bherer*** [1,2]

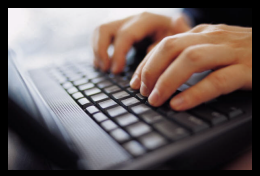
[1] *Department of Psychology, Université du Québec à Montréal, Montréal, QC, Canada*
[2] *Centre de Recherche de l'Institut Universitaire de Gériatrie de Montréal, Université de Montréal, Montréal, QC, Canada*

DT-Training Condition



Response modality Transfer

Stimulus modality Transfer



S-R modality transfer

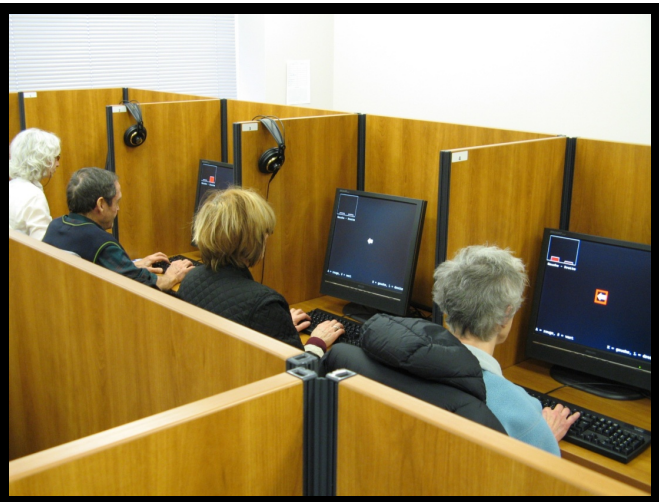
Training benefits equivalent among OA and YO and transferred to all task combinations…..but !!!

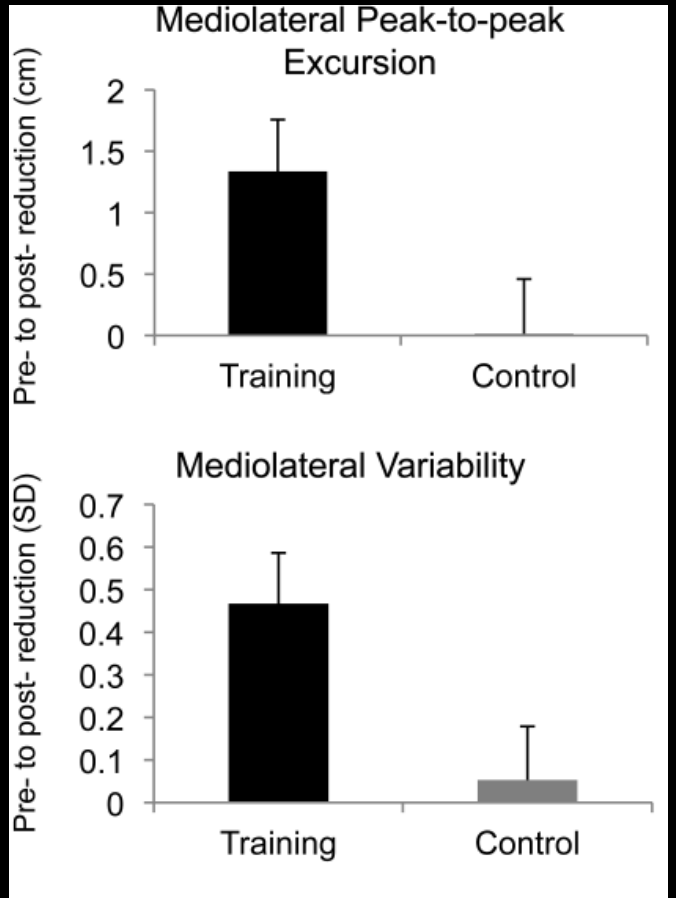
Functional benefits ?

Journal of Gerontology: MEDICAL SCIENCES
Cite journal as: J Gerontol A Biol Sci Med Sci
doi:10.1093/gerona/glq151

Benefits of Cognitive Dual-Task Training on Balance Performance in Healthy Older Adults

Karen Z. H. Li,[1] E. Roudaia,[2] M. Lussier,[3,4] L. Bherer,[3,4] A. Leroux,[5] and P. A. McKinley[6]





Cognitive training as a therapeutic

The benefits of cognitive training after a coronary artery bypass graft surgery

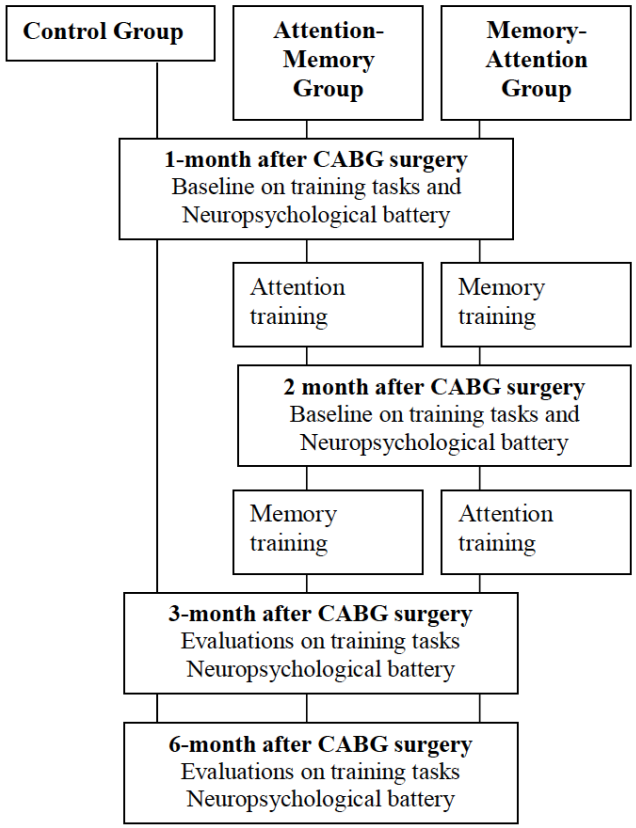
Emilie de Tournay-Jetté · Gilles Dupuis · André Denault · Raymond Cartier · Louis Bherer

INSTITUT DE CARDIOLOGIE DE MONTRÉAL

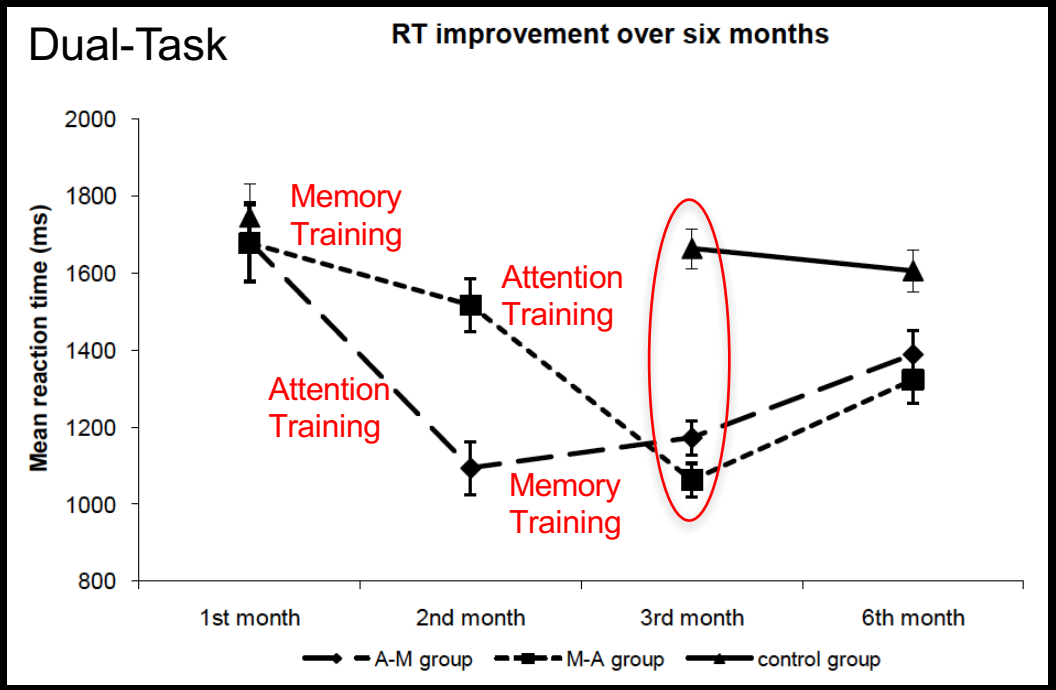
UQÀM

Figure 1

N=51



Dual-Task



Transfer effects ?

Training related benefits were observed in clinical neuropsychological tests

de Tournay-Jetté et al. (2012) *Journal of Behavioral Medicine*

Évaluation et stimulation cognitive

Neurosciences of exercise

Bherer, Erickson & Liu-Ambrose (2013). *A review of the Effects of Physical Activity and Exercise on Cognitive and Brain Functions in Older Adults.* **Journal of Aging Research**

Annals of Internal Medicine | ARTICLE

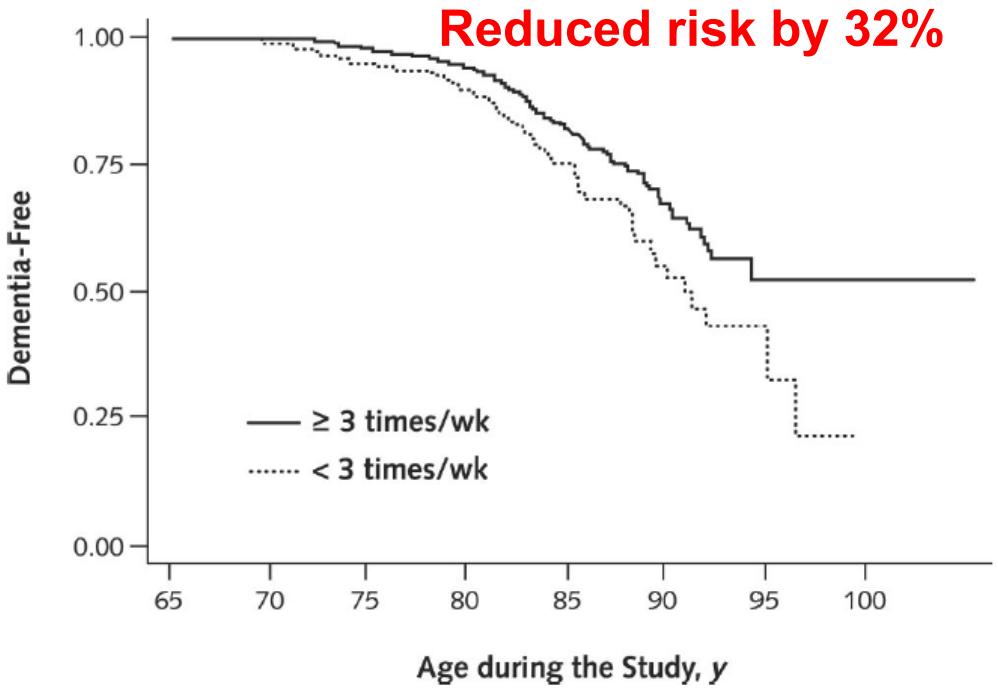
Exercise Is Associated with Reduced Risk for Incident Dementia among Persons 65 Years of Age and Older

Eric B. Larson, MD, MPH; Li Wang, MS; James D. Bowen, MD; Wayne C. McCormick, MD, MPH; Linda Teri, PhD; Paul Crane, MD, MPH; and Walter Kukull, PhD

- 1,740 of 65 years and +
- Without MCI or Dementia
- Follow-up 6.2 year

- ≥3/wk = 13/1000 / year
- <3/wk = 20/1000 / year

Figure 1. Kaplan–Meier survival estimates for the probabilities of being dementia-free.



Persons who exercised 3 or more times per week were more likely to be dementia-free than those who exercised fewer than 3 times per week.

Association of Muscle Strength With the Risk of Alzheimer Disease and the Rate of Cognitive Decline in Community-Dwelling Older Persons

Patricia A. Boyle, PhD; Aron S. Buchman, MD; Robert S. Wilson, PhD; Sue E. Leurgans, PhD; David A. Bennett, MD

-Followed 900 healthy seniors (3,6 years)

-Tested 9 muscle groups

-Association between muscle-strength and the risk of cognitive decline (and MCI or AD) persists after controlling for body mass index, vascular risk factors and disease and APOE status.

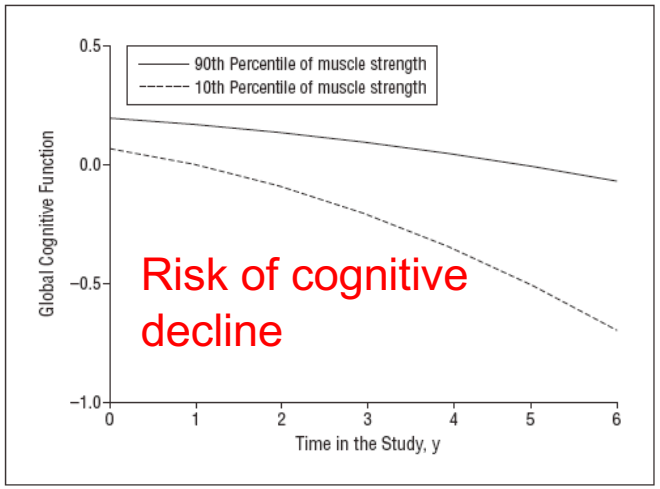


Figure 2. Decline in global cognitive function for participants with low muscle strength vs those with high muscle strength.

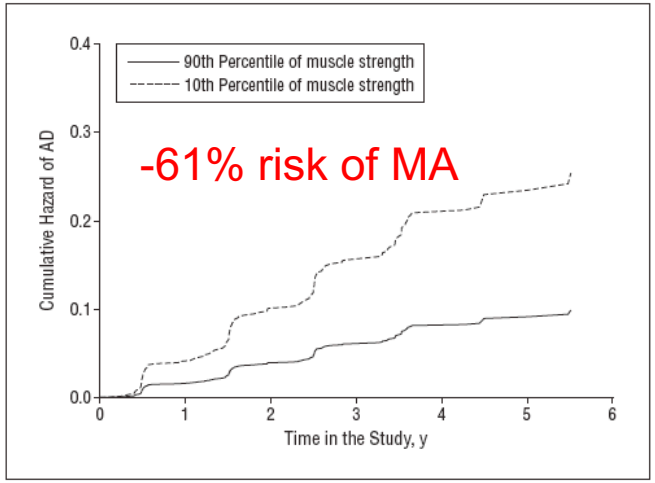


Figure 1. Cumulative hazard of Alzheimer disease (AD) for participants with low muscle strength vs those with high muscle strength.

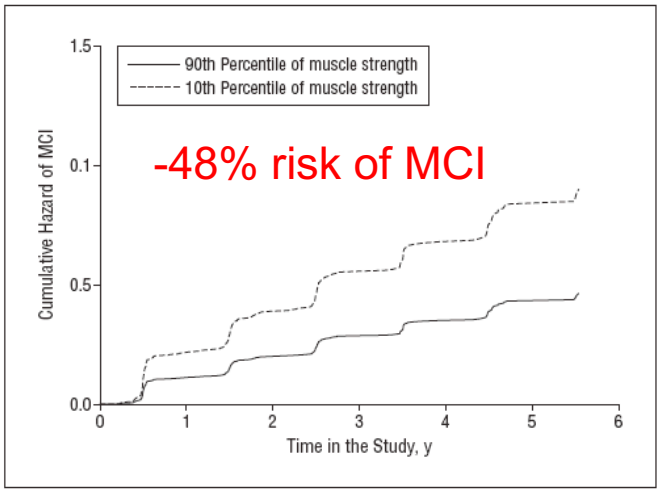


Figure 3. Cumulative hazard of mild cognitive impairment (MCI) for participants with low muscle strength vs those with high muscle strength.

Arch Neurol. 2009;66(11):1339-1344

Renaud, M., Bherer, L., & Maquestiaux, F. (2010). A high level of physical fitness is associated with more efficient response preparation in older adults. *Journal of Gerontology: Psychological Sciences*, 10.1093/geronb/gbq004

A High Level of Physical Fitness Is Associated With More Efficient Response Preparation in Older Adults

Mélanie Renaud,[1,2] Louis Bherer,[1,2] and François Maquestiaux[3]

[1]Department of Psychology, University du Québec à Montréal (UQÀM), Montréal, Québec, Canada. [2]Centre de recherche, Institut Universitaire de Gériatrie de Montréal, Montréal, Québec, Canada. [3]UFR STAPS, Université Paris-Sud, Orsay, France.

Older adults in an aerobic training session in Montreal.

110 Community dwelling older adults

Lower Fit (N=55)
60-69 yrs vs. 70-79 yrs

Higher Fit (N=55)
60-69 yrs vs. 70-79 yrs

Physical fitness is associated with better response preparation and have a protective effect on motor speed

Figure 1: Mean initiation time (ms) in the Low fit (- - - -) and the High fit groups (——) as a function of PI for each duration condition.

Figure 2: Mean execution time (ms) for the 60-69 (- - - -) and the 70-79 groups (——) as a function of fitness level.

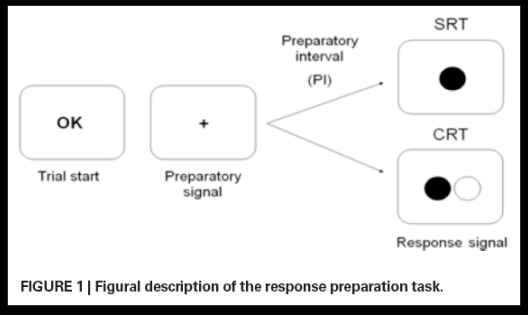
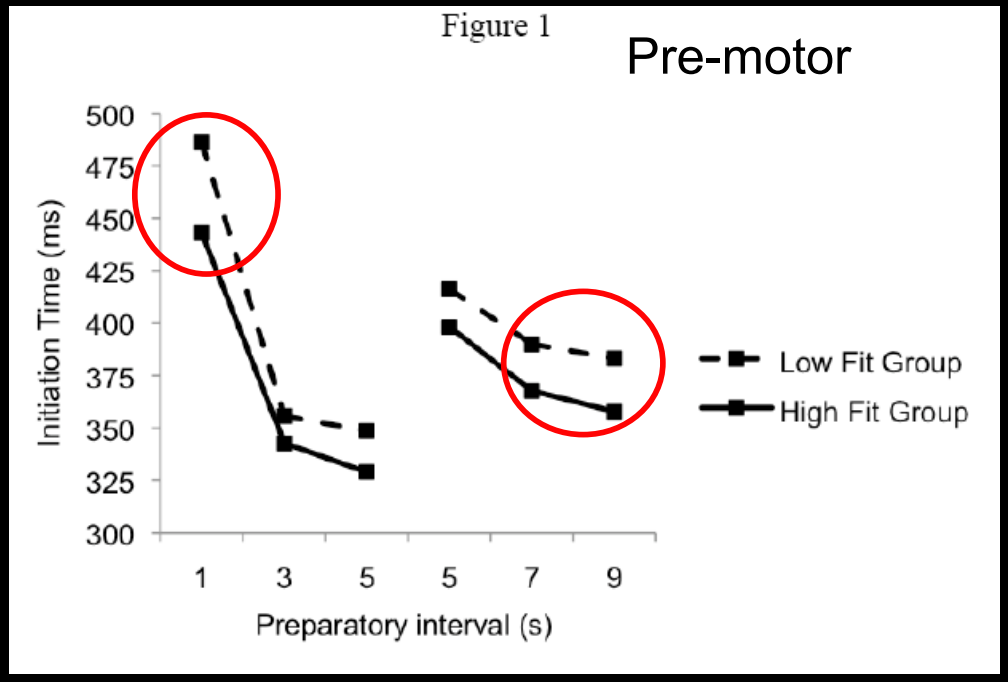
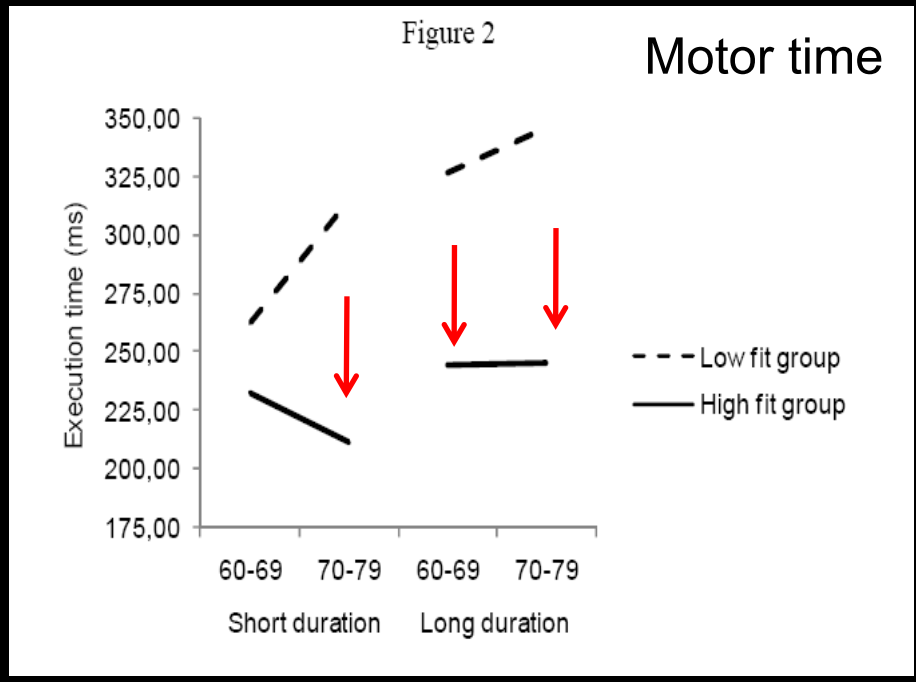


FIGURE 1 | Figural description of the response preparation task.





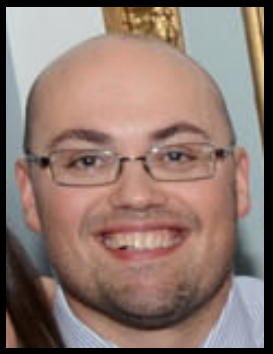
Renaud, Bherer & Maquestiaux (2010)
Journal of Gerontology: Psych. Sciences.

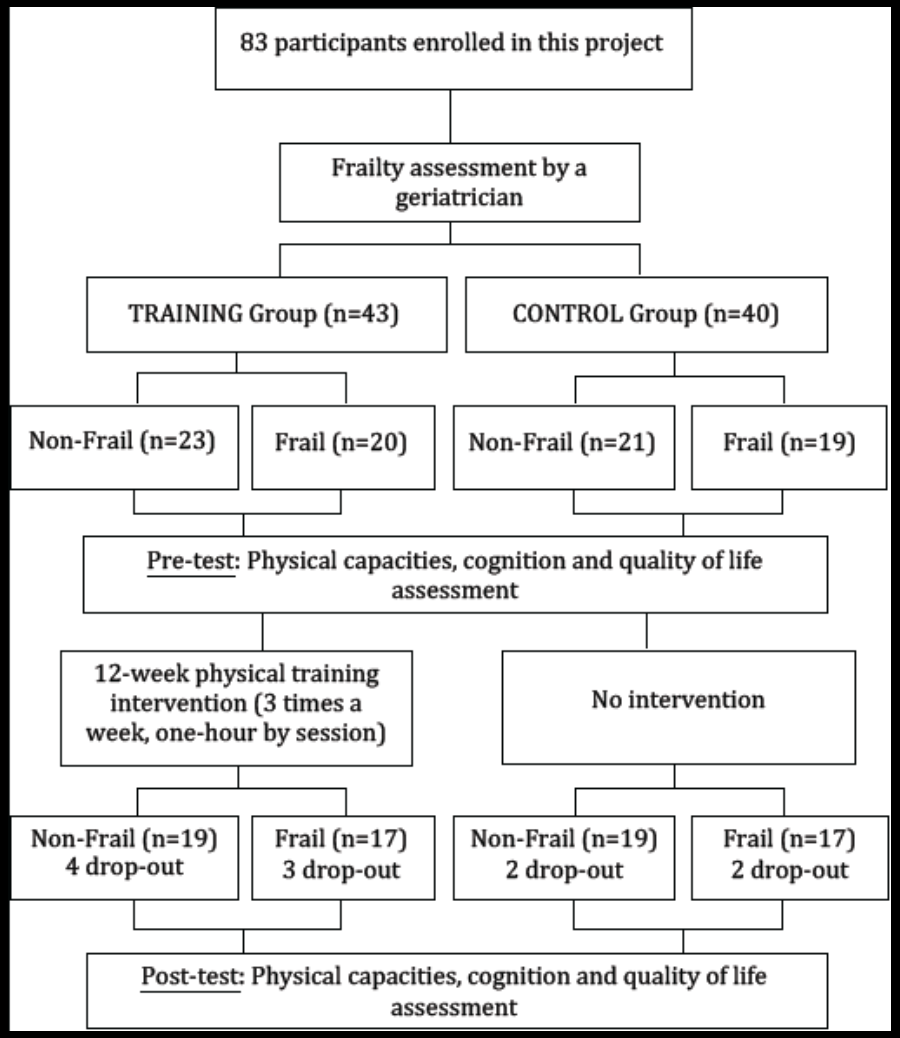
INTERVENTION !

Journal of Gerontology: Psychological Sciences, 2013

Benefits of Physical Exercise Training on Cognition and Quality of Life in Frail Older Adults

Francis Langlois,[1,2] Thien Tuong Minh Vu,[2,3] Kathleen Chassé,[2] Gilles Dupuis,[1,4] Marie-Jeanne Kergoat,[2] and Louis Bherer[1,2]

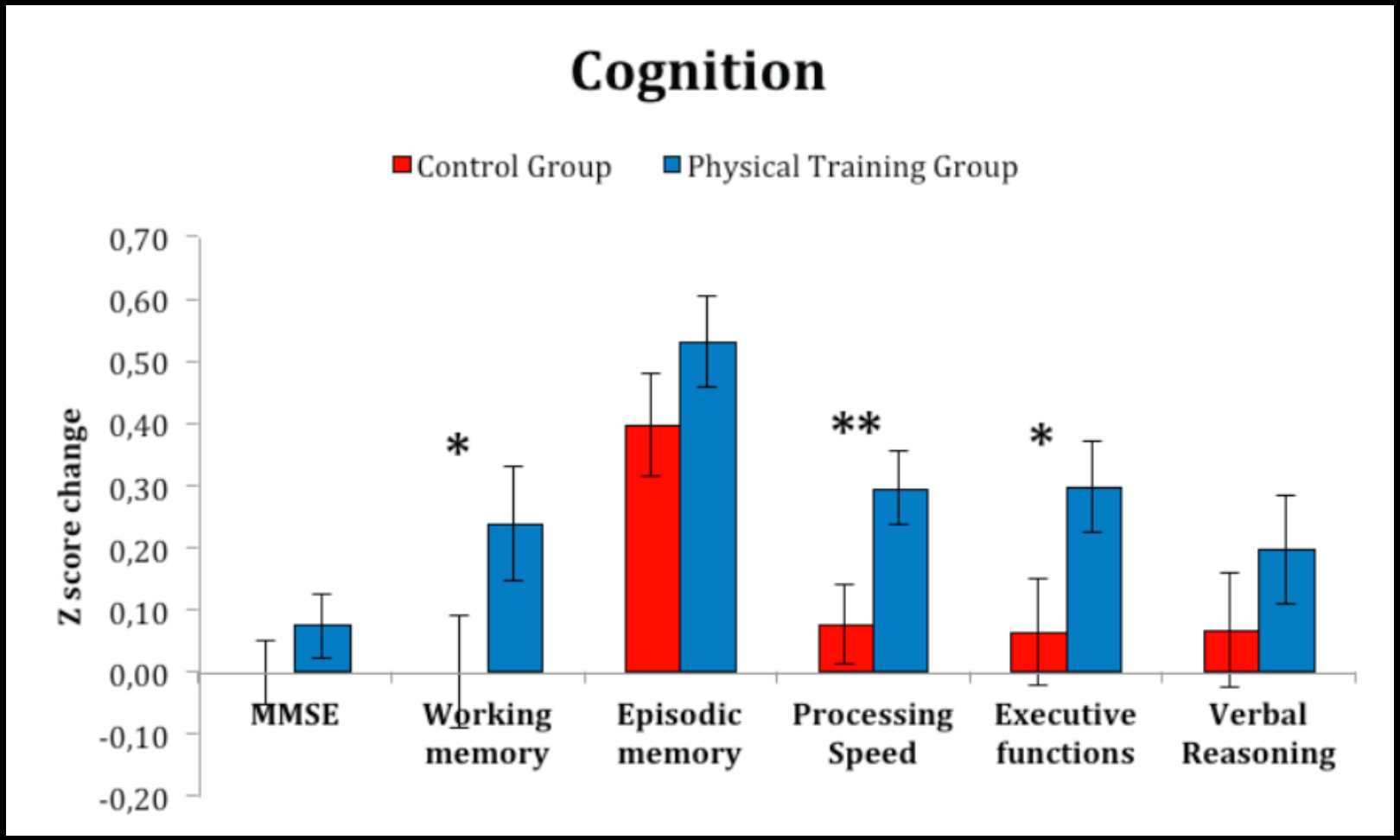




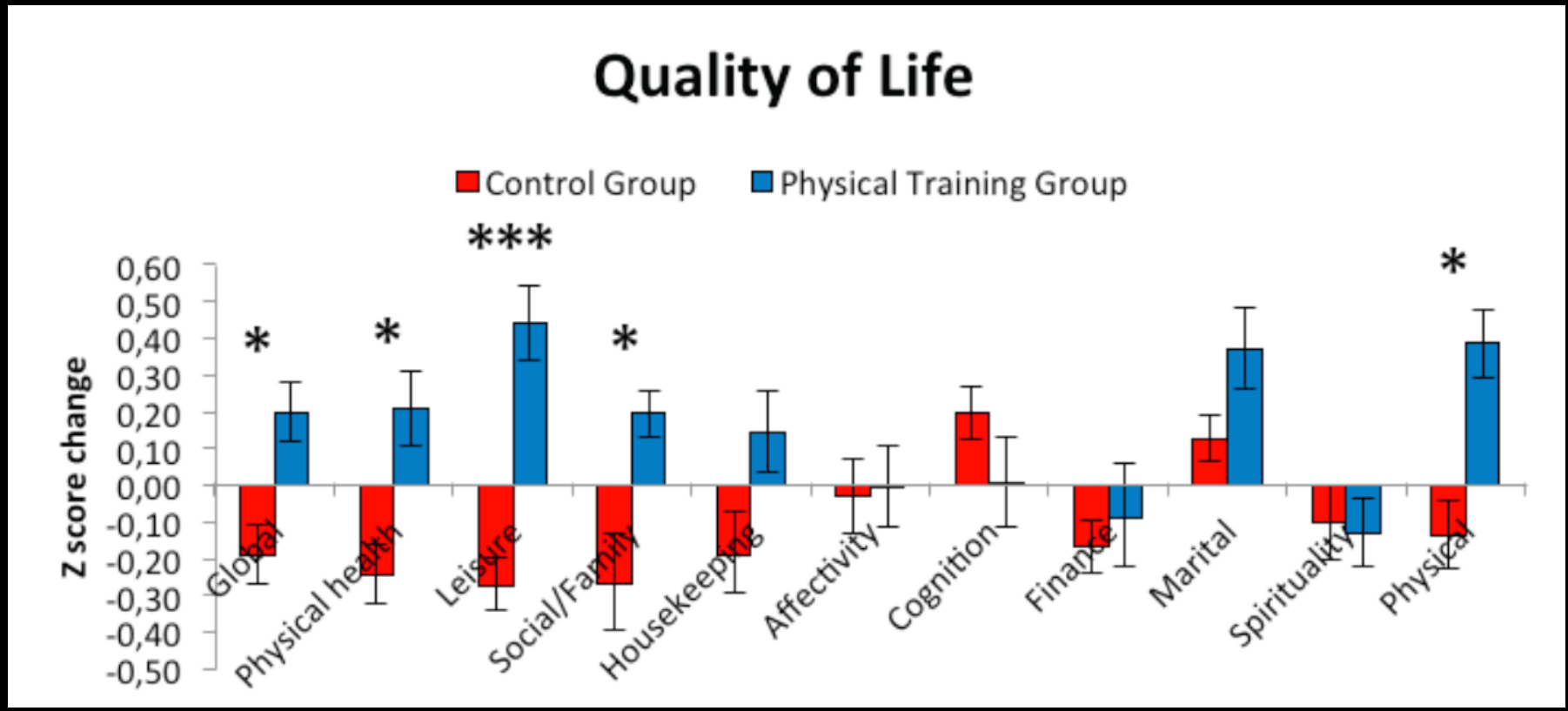
3/week x 12 weeks

Combined training exercises

Equivalent improvement in frail and non-frail older adults after 3 months



Equivalent improvement in frail and non-frail older adults after 3 months



RESEARCH ARTICLE

Effects of Physical Activity Training in Patients with Alzheimer's Dementia: Results of a Pilot RCT Study

Vjera A. Holthoff[1,2]*, Kira Marschner[2], Maria Scharf[2], Julius Steding[1], Shirin Meyer[1], Rainer Koch[1], Markus Donix[1,2]

1 Department of Psychiatry and Psychotherapy, Division of Old Age Psychiatry and Cognitive Neuropsychiatry, Faculty of Medicine Carl Gustav Carus, Technische Universität Dresden, 01307, Dresden, Germany, **2** DZNE, German Center for Neurodegenerative Diseases, Dresden, Germany

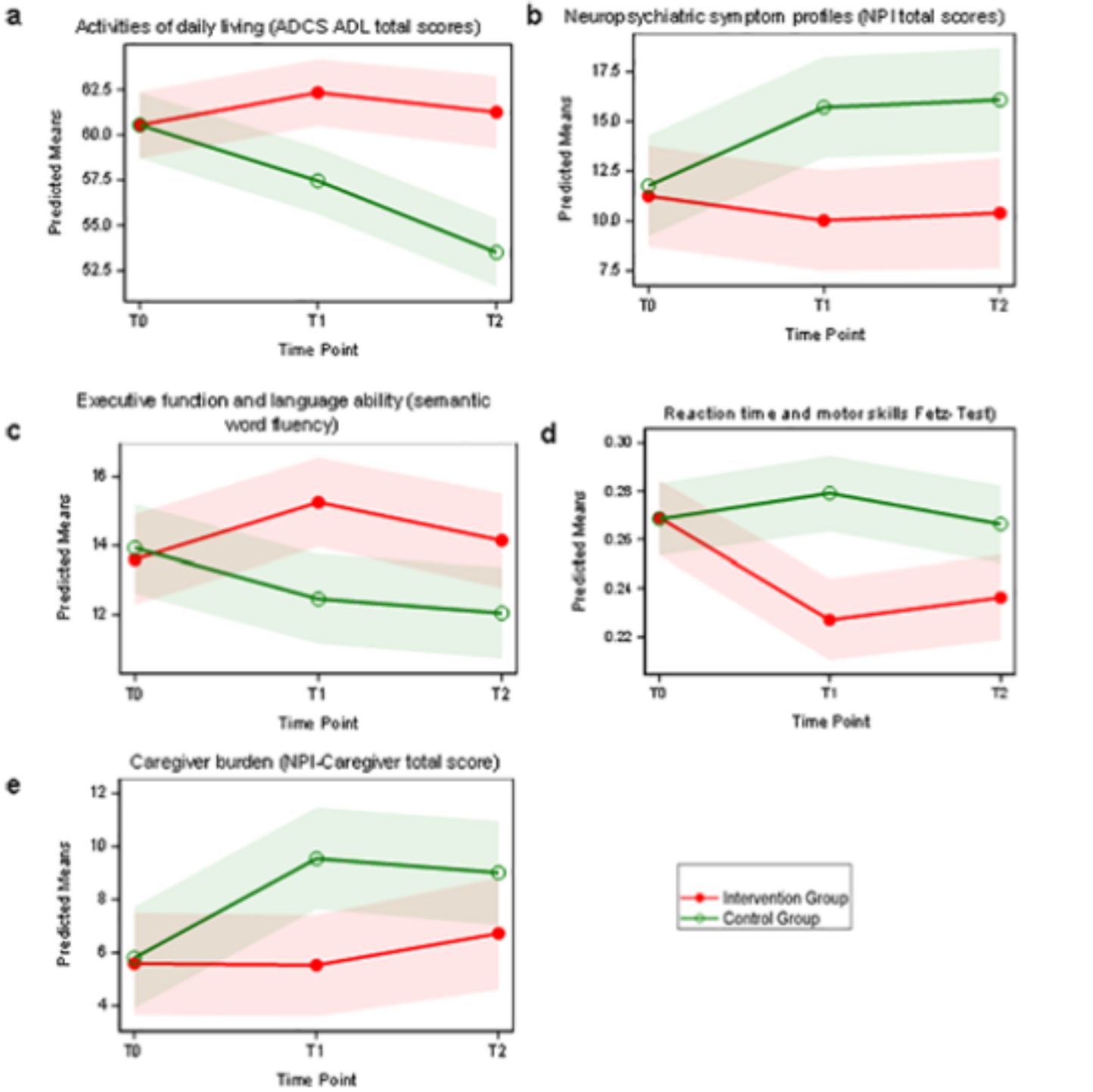
* v.holthoff-detto@alexius.de

Table 1. Demographic and clinical characteristics.

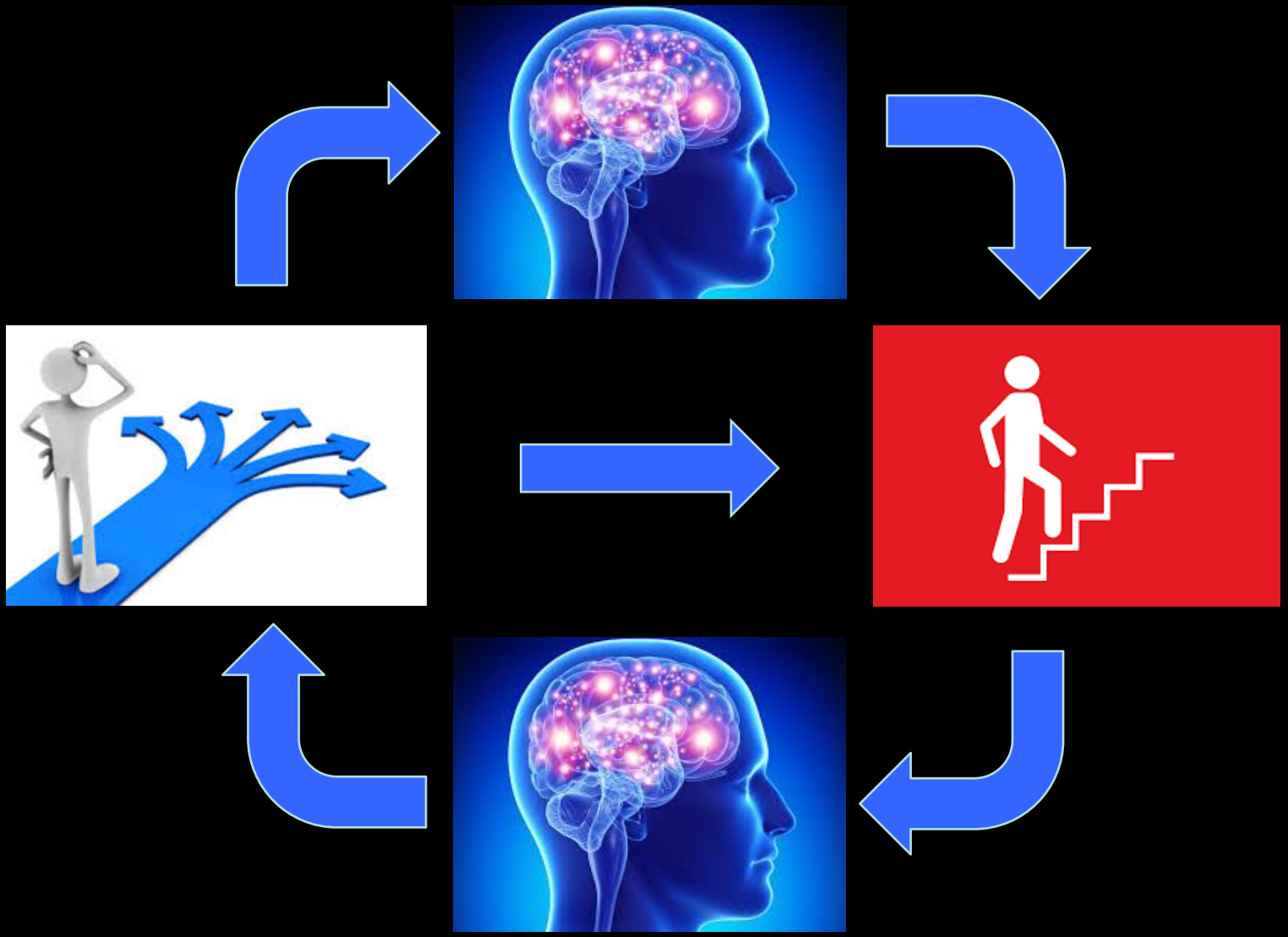
	Intervention group		Control group		
	N = 15		N = 15		*p
Age, mean (SD) in years	72.40	(4.34)	70.67	(5.41)	0.34
Female, N (%)	8	(53.3)	7	(48.7)	0.71
Age of onset, mean (SD) in years	68.27	4.98	67.87	6.35	0.85
Education, mean (SD) in years	12.33	2.13	13.13	2.70	0.07
Number of steps, N (SD)	5818	4180	6662	4986	0.62
BMI, N (SD)	23.43	2.75	24.12	4.06	0.59

*p-values (chi-square and t test)

doi:10.1371/journal.pone.0121478.t001


a
Activities of daily living (ADCS ADL total scores)
Predicted Means
62.5
60.0
57.5
55.0
52.5
T0
T1
T2
Time Point
b
Neuropsychiatric symptom profiles (NPI total scores)
Predicted Means
17.5
15.0
12.5
10.0
7.5
T0
T1
T2
Time Point
c
Executive function and language ability (semantic word fluency)
Predicted Means
16
14
12
T0
T1
T2
Time Point
d
Reaction time and motor skills Fetz-Test)
Predicted Means
0.30
0.28
0.26
0.24
0.22
T0
T1
T2
Time Point
e
Caregiver burden (NPI-Caregiver total score)
Predicted Means
12
10
8
6
4
T0
T1
T2
Time Point
Intervention Group
Control Group

How to “enter” into the circle ?



Encouraging Behavioral Change via Everyday Technologies to Reduce Risk of Developing Alzheimer's Disease

Phillip J. Hartin[1], Chris D. Nugent[1], Sally I. McClean[2], Ian Cleland[1], JoAnn T. Tschanz[3], Christine Clark[4], and Maria C. Norton[3, 4]

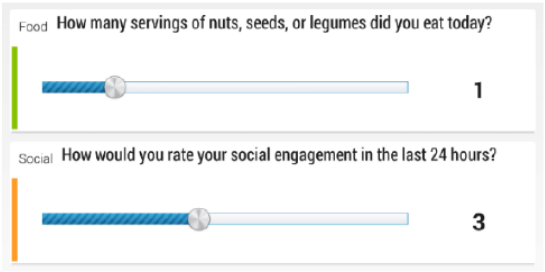
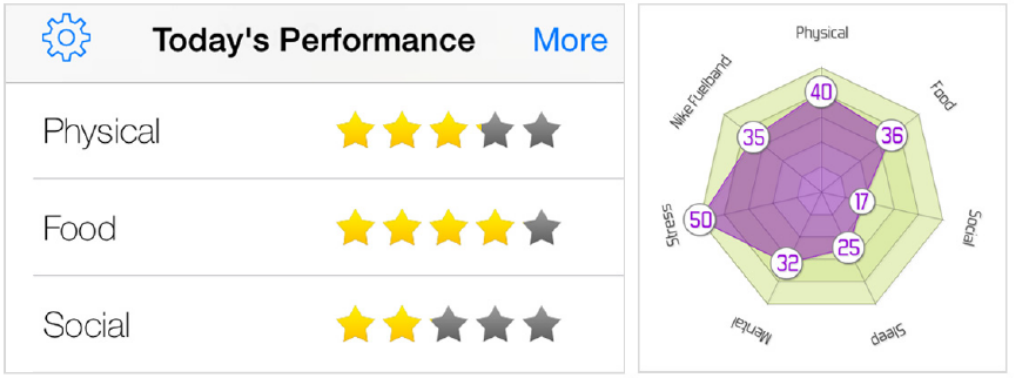


Fig. 1. Custom sliders (android) for user data entry in the log tab view. The length of the bar provides visual feedback to the user on their progress.



(a) (b)

Fig. 2. (a) A snippet of the performance screen on iOS showing the current day's performance in the form of a 5 star rating. (b) A radar chart typically displayed to the user, showing their performance across all domains for the past 7 days.

ACRM
AMERICAN CONGRESS OF REHABILITATION MEDICINE

Archives of Physical Medicine and Rehabilitation

journal homepage: www.archives-pmr.org

Archives of Physical Medicine and Rehabilitation 2015;96:2096-102

ORIGINAL RESEARCH

Effectiveness of Exergaming Training in Reducing Risk and Incidence of Falls in Frail Older Adults With a History of Falls

Amy S. Fu, PhD,[a] Kelly L. Gao, MPT,[a] Arthur K. Tung, DHS,[a] William W. Tsang, PhD,[a] Marcella M. Kwan, PhD[b]

From the [a]Department of Rehabilitation Sciences, The Hong Kong Polytechnic University, Hung Hom, Hong Kong, China; and [b]Rural Clinical School, School of Medicine, The University of Queensland, Brisbane, Queensland, Australia.

In institutionalized older adults with a history of falls, Wii Fit balance training was more effective than conventional balance training in reducing the risk and incidence of falls.

Clinical Interventions in Aging

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ORIGINAL RESEARCH

Does multicomponent physical exercise with simultaneous cognitive training boost cognitive performance in older adults? A 6-month randomized controlled trial with a 1-year follow-up

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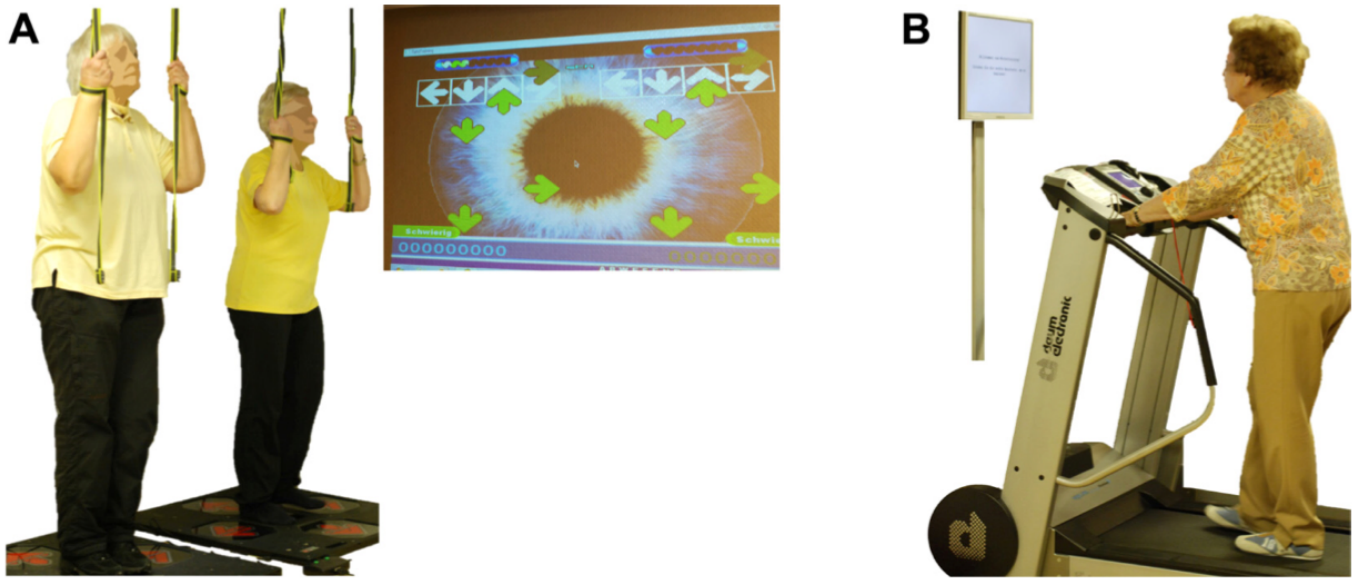

Figure 1 Simultaneous cognitive–physical training components: video game dancing (**A**) and treadmill memory training (**B**). In (**A**) two participants perform steps on a pressure sensitive platform to the rhythm of the music. Step timing and direction is cued with arrows on a screen. In (**B**) a participant is walking on a treadmill while performing verbal memory exercises presented on a computer screen.

Table 1 Baseline demographic characteristics and training compliance

Variable	DANCE	MEMORY	PHYS	*P*-value, two tailed
N	24	22	25	
Sex, female	14, 58.3%	16, 72.7%	16, 64.0%	0.602
Age, years	77.3 (6.3)	78.5 (5.1)	80.8 (4.7)	**0.079**^{t}
MMSE, score	28.4 (1.4)	28.3 (1.2)	28.0 (1.7)	0.533
Education, years	13.7 (1.5)	13.9 (2.1)	12.0 (2.1)	**0.002****
Total training compliance (52 sessions)	84.3% (12.7%)	86.1% (9.1%)	87.1% (7.9%)	0.633
Home-training compliance (eight sessions)	79.9% (23.0%)	90.0% (14.8%)	83.5% (18.4%)	0.201

Notes: Data are means (standard deviation in brackets) or numbers. Bold values indicate significance or trend, $^{**}P<0.01$, $^{t}P<0.10$ trend.

Abbreviations: MMSE, Mini Mental State Examination; DANCE, virtual reality video game dancing; MEMORY, treadmill walking with simultaneous verbal memory training; PHYS, treadmill walking.

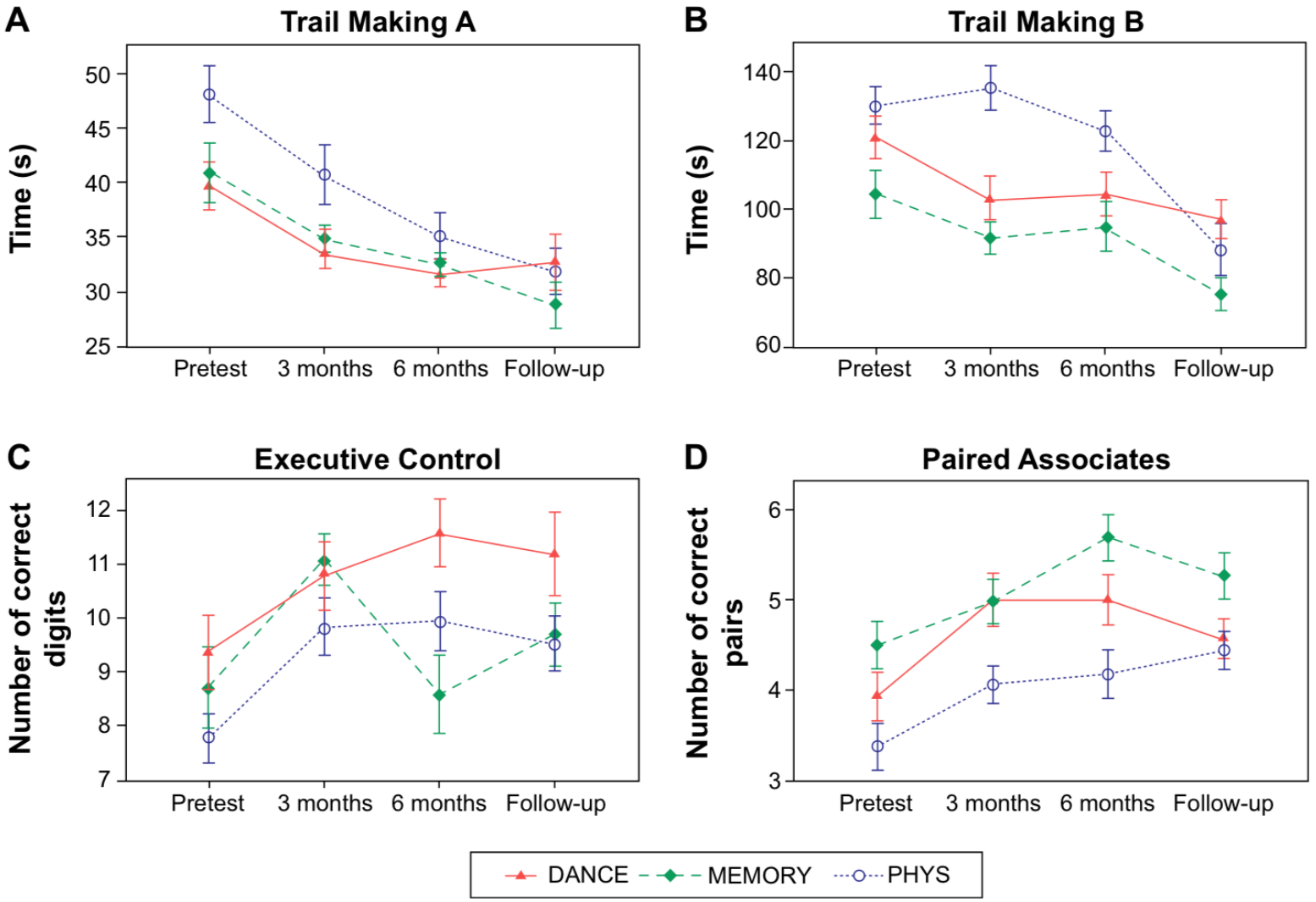

Figure 4 Cognitive performance developments in the four tests that included a 1-year follow-up measurement.

Notes: Significant overall improvements were shown in all tests over the 6-months training period (graphs **A**–**D** all $P<0.05$, one tailed). In Trail Making B (graph **B**), only the two groups with a cognitive training component (DANCE and MEMORY) improved from pretest to 3-months test (trend $P=0.075$, one tailed). In Executive Control (graph **C**), different time courses of adaptation between DANCE and MEMORY were found (trend $P=0.051$, one tailed). From 6-months test to 1-year follow-up test Trail Making B improved significantly (graph **B**, $P=0.015$), while performance was maintained in the three other tests (graphs **A**, **C**, and **D**). Error bars indicate ± standard error of the mean.

Abbreviations: DANCE, virtual reality video game dancing; MEMORY, treadmill walking with simultaneous verbal memory training; PHYS, treadmill walking.

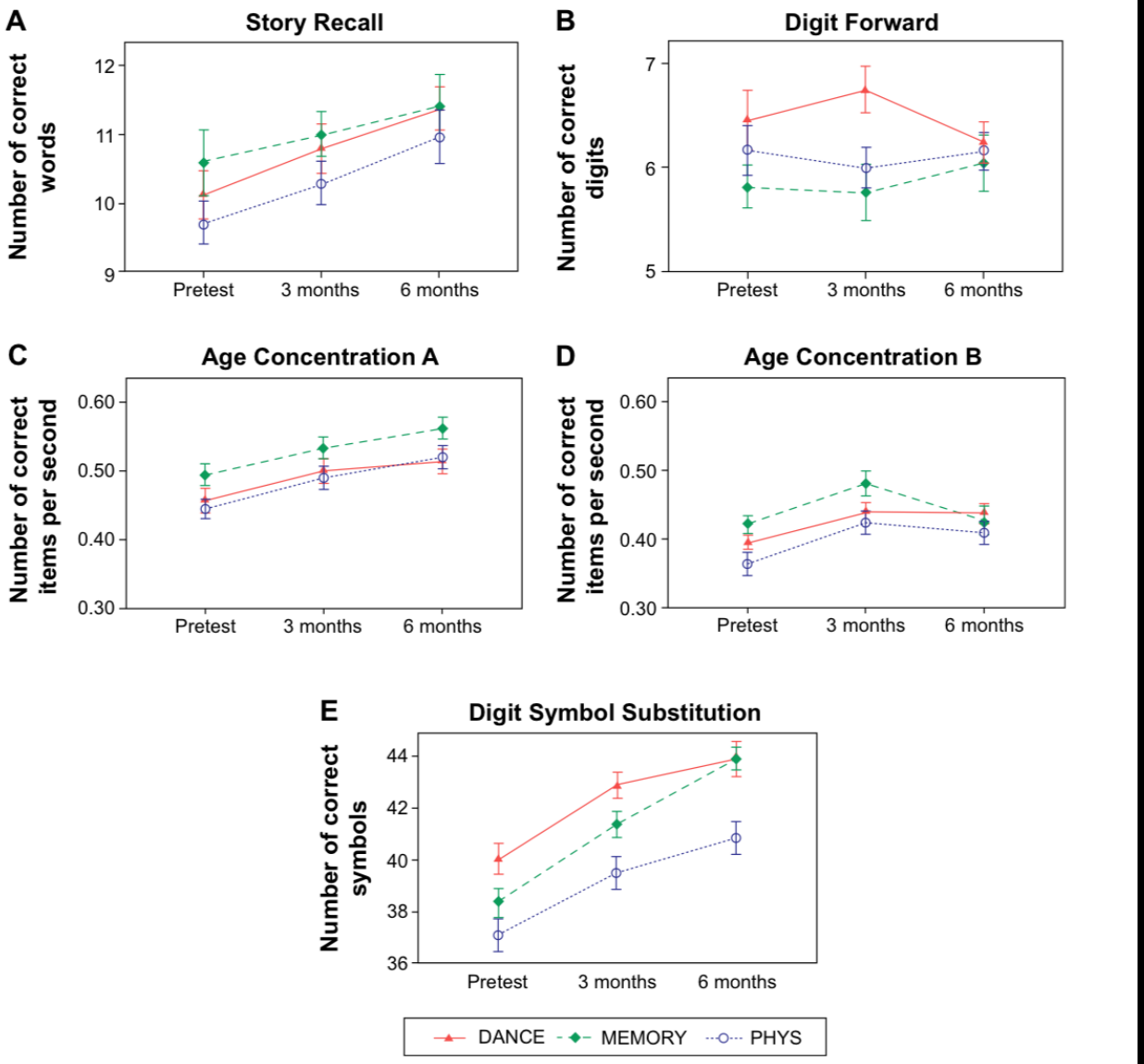

Figure 5 Cognitive performance developments in the five tests that did not include a 1-year follow-up measurement.
Notes: Significant overall improvements were shown in the tests in graphs (**A**, **C**, **D**, and **E**) (all $P<0.05$, one tailed) over the 6-months training period. No improvement was found in Digit Forward (graph **B**). Error bars indicate ± standard error of the mean.
Abbreviations: DANCE, virtual reality video game dancing; MEMORY, treadmill walking with simultaneous verbal memory training; PHYS, treadmill walking.

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Efficacy of a cell phone-based exercise programme for COPD

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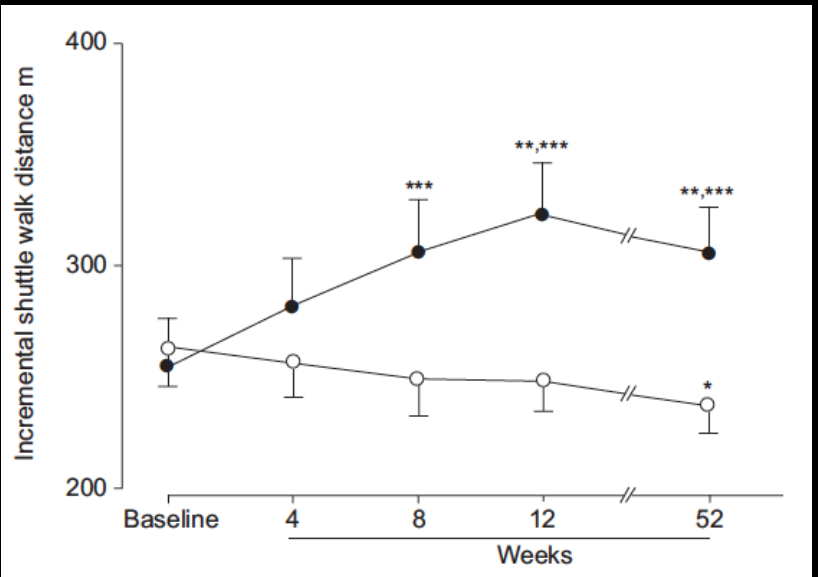

FIGURE 1. Distance covered during the incremental shuttle walk test at baseline and then every 4 weeks for 3 months and after 1 yr. In the cell phone group (●), the distance increased significantly at 8 weeks, 12 weeks and 1 yr compared with baseline. This was greater than that of the control group (○) after 12 weeks and 1 yr. Data presented as mean±SEM. *: $p<0.05$; **$p<0.01$; ***: $p<0.001$; compared with the baseline of the control group.

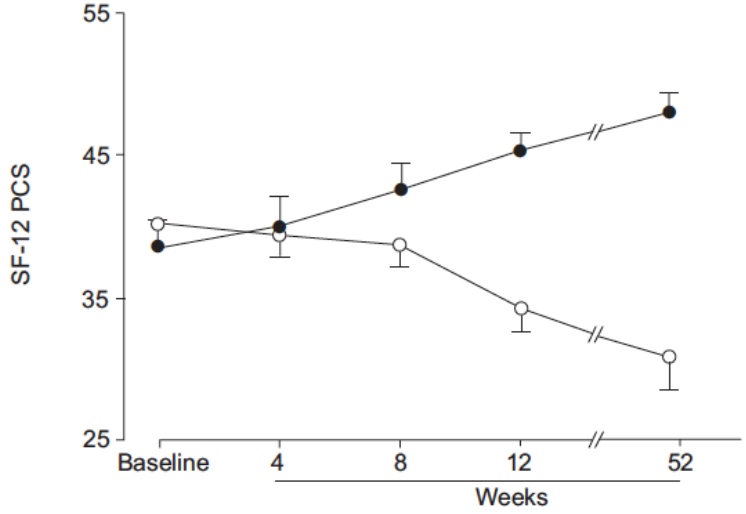

FIGURE 3. Quality of life questionnaire by Short Form-12 (SF-12) physical component summary scores (PCS) at baseline and then every 4 weeks for 3 months and after 1 yr. The SF-12 PCS values in the cell phone group (●) were significantly improved after 8 weeks ($p<0.05$; $n=24$), 12 weeks ($p<0.01$; $n=24$) and 1 yr ($p<0.01$; $n=24$) compared with the baseline, and were significantly greater than those of the control group (○) at 12 weeks ($p<0.001$; $n=24$) and 1 yr ($p<0.001$; $n=24$).

Mieux vieillir dans un monde numérique ?

- Mieux suivre et mesurer les comportements préventifs
- Motiver et encourager le changement de style de vie
- Guider les activités (physiques et cognitives)
- Il nous faut plus d'études de validation et d'impact
- Effet de la nouveauté ? Ou impact durable ?

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