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"From Sciences to Nutrition Security"

SAN
Sociedad Argentina de Nutrición

IUNS
INTERNATIONAL UNION OF NUTRITIONAL SCIENCES

Buenos Aires, Argentina, 15-20 October 2017

SMOKE FREE EVENT

Conflict of Interest Disclosure

I have no personal conflict of interest to report in relation to this presentation and my data.

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Nutrition for the Aging Brain: Functional Aspects and Strategies

ILSI Europe
International Life Sciences Institute

Alteration of Neurogenesis during Ageing: Implications for Dietary Interventions

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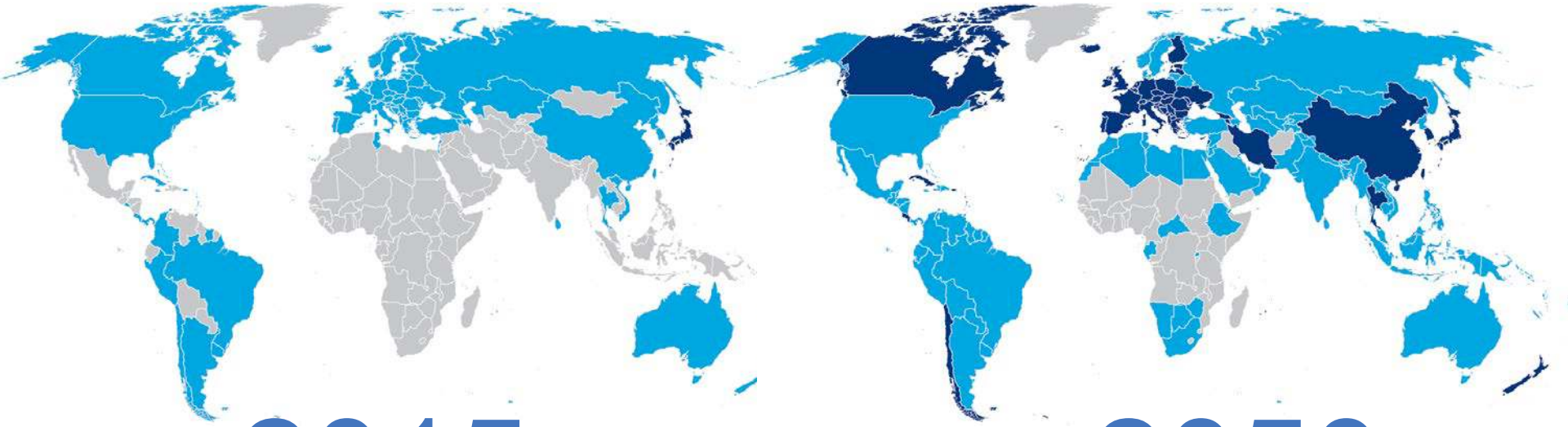
King's College London
@thudrine

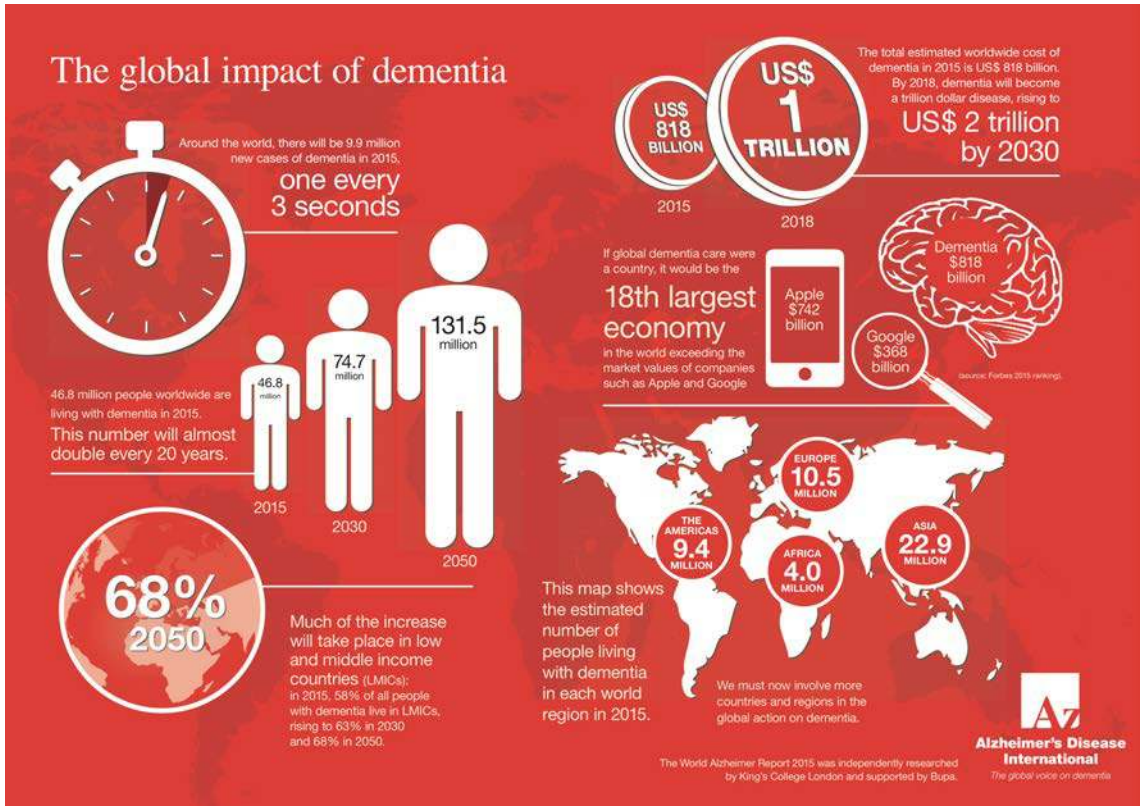
Populations are getting older

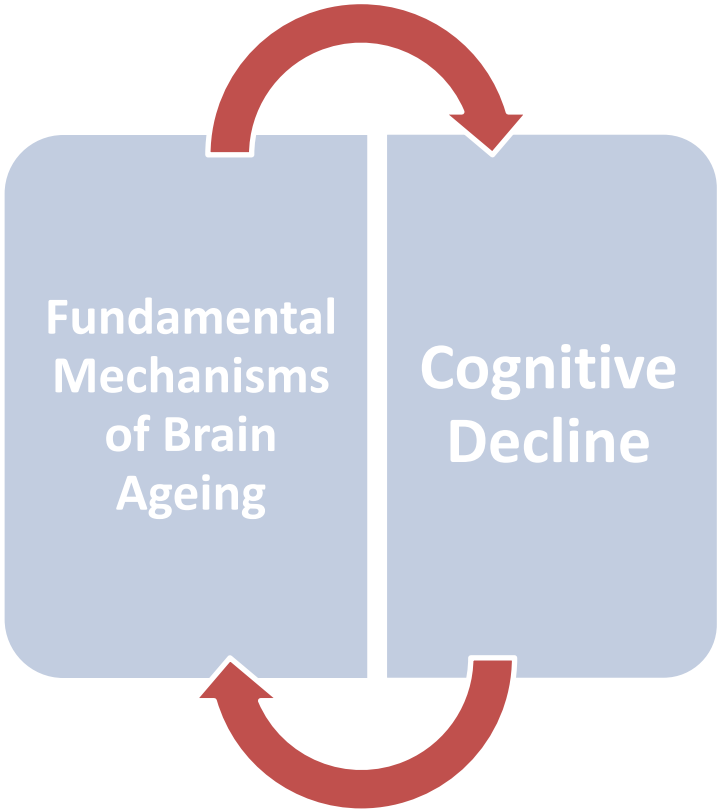


>65: Risk of dementia doubles every 5 years

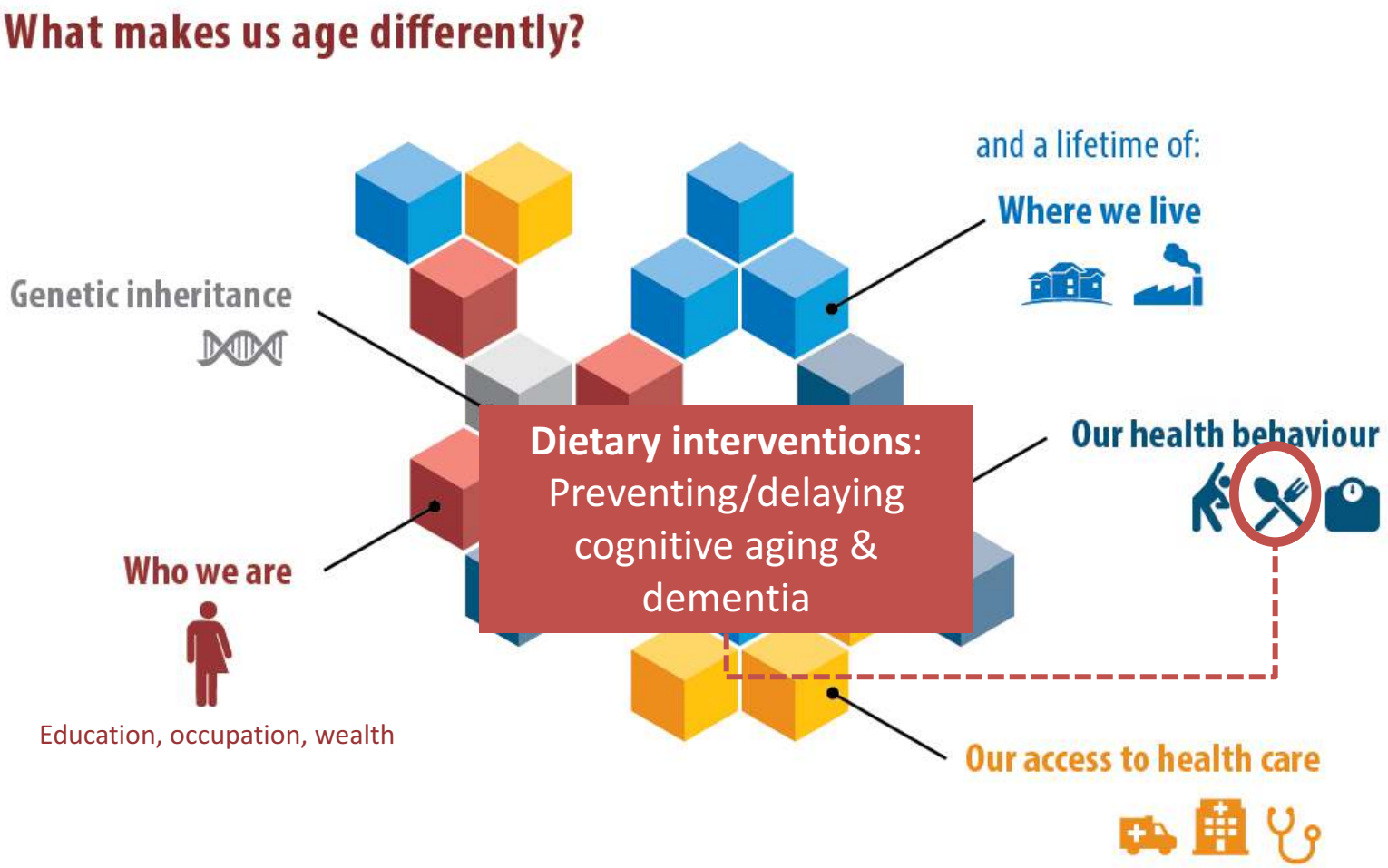
World Health Organization

Global Impact of Dementia



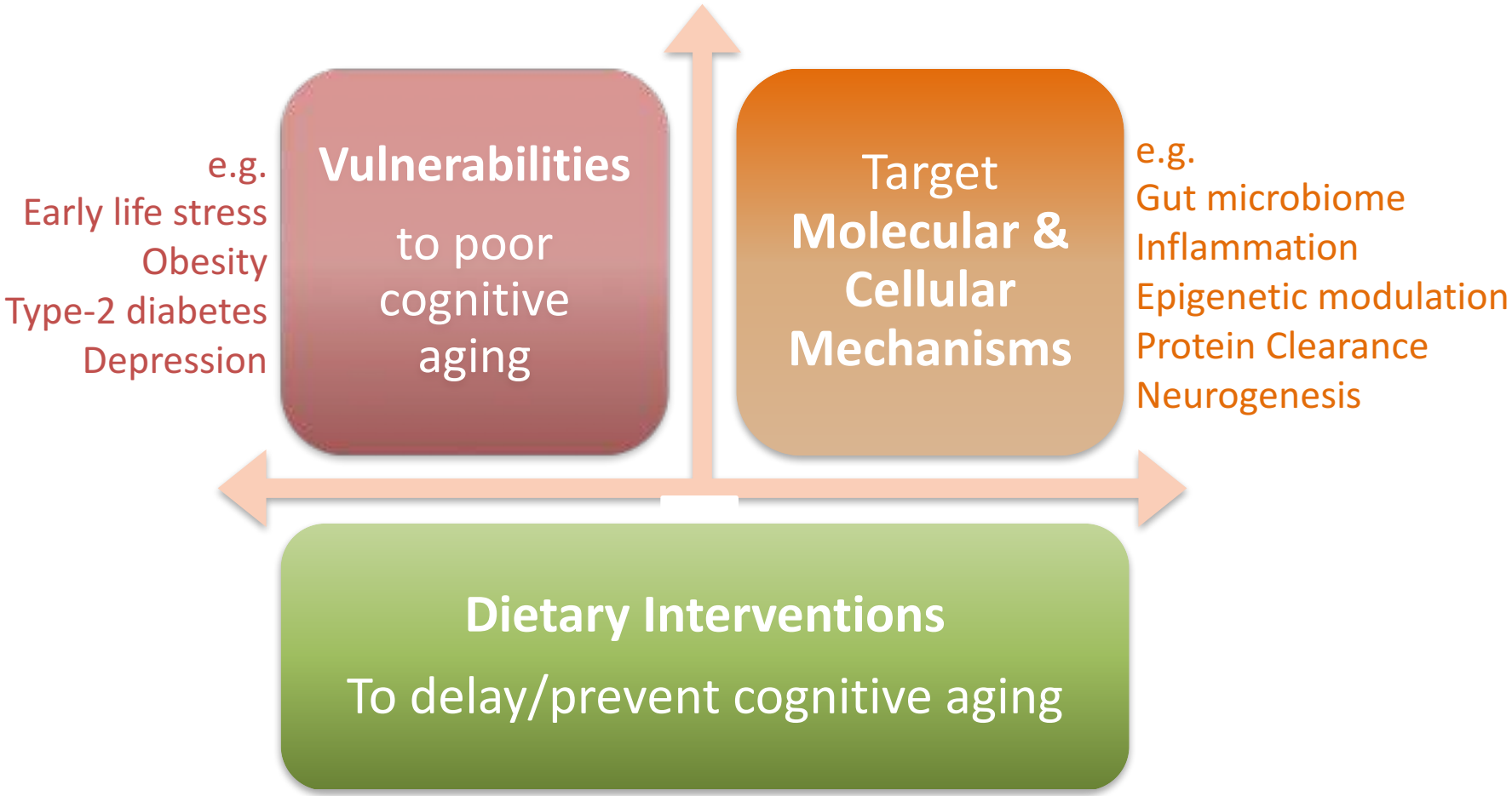


Not all equal in front of (brain) aging



World Health Organization

Efficient Dietary Interventions Strategies: Need to identify Vulnerabilities and Mechanisms



Miquel et al. ILSI Nutrition and Mental performance task Force, in revision

Poor cognitive ageing: Vulnerabilities, mechanisms and the impact of nutritional interventions

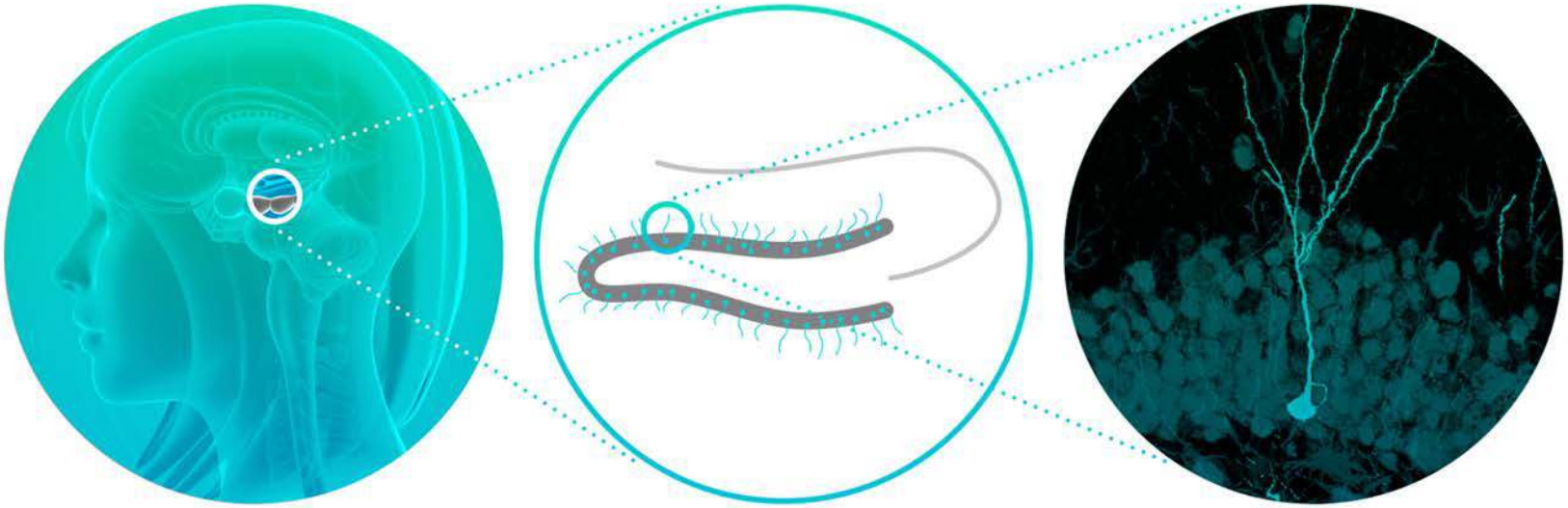
Adult Neurogenesis?

"Once development was ended, the fonts of growth and regeneration of the axons and dendrites dried up irrevocably. In the adult centers, the nerve paths are something fixed, and immutable: everything may die, nothing may be regenerated."

Santiago Ramon y Cajal, 1928

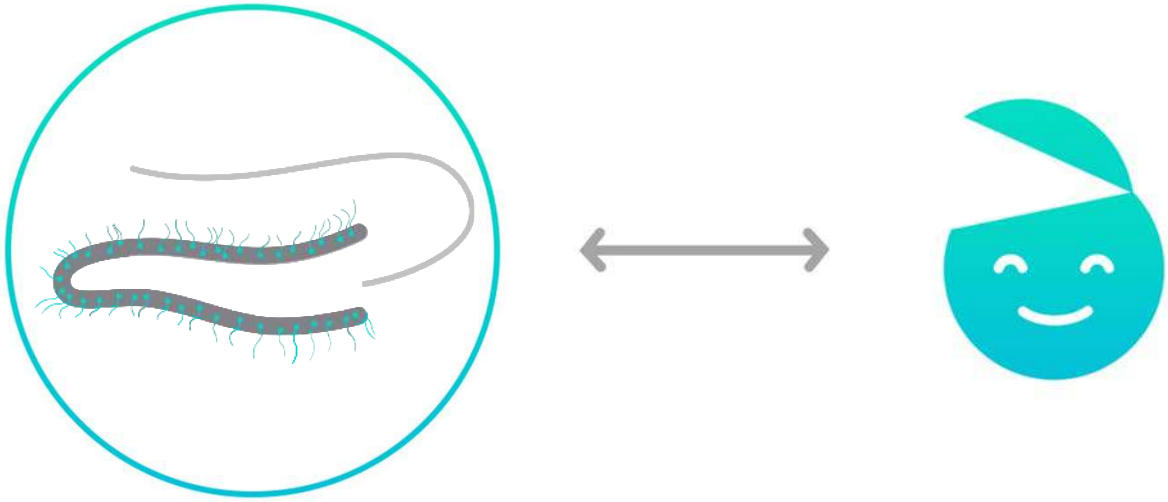
Altman and Das, 1965

Human Hippocampus: Adult Neurogenesis



Functional Relevance of Adult Hippocampal Neurogenesis

Functional Relevance of Adult Neurogenesis: Learning & memory



Level of Neurogenesis is positively correlated with hippocampal dependent learning tasks

Functional Relevance of Adult Neurogenesis: Learning & memory

New hippocampal neurons:

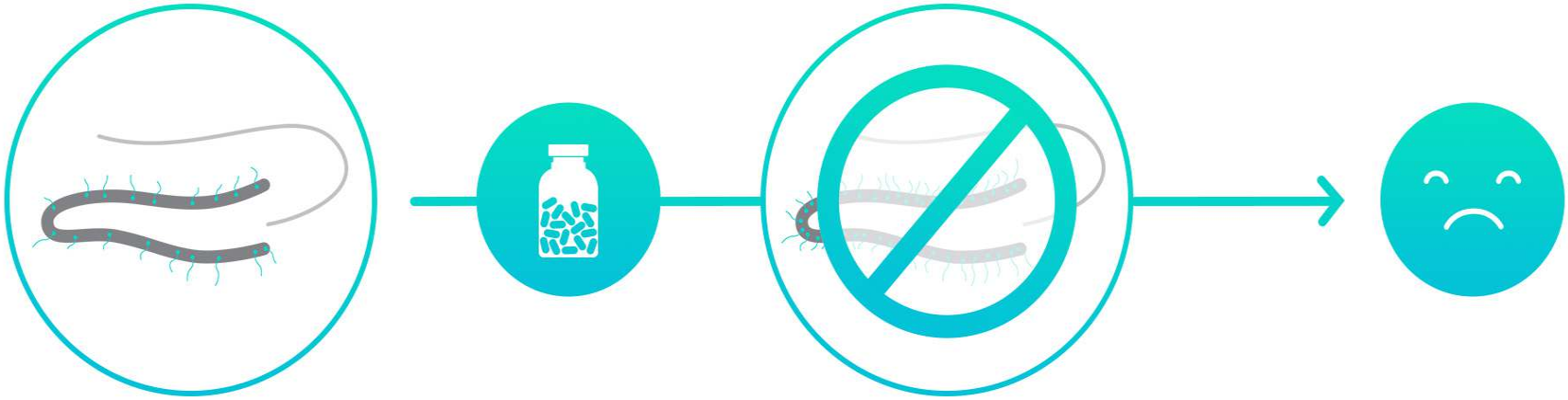
- Increase spatial memory capacity
- Reduce interference between memories (pattern separation)
- Add information about time to new memories
- Are involved in forgetting of established context-memories.

Functional Relevance of Adult Neurogenesis: Mood & Depression

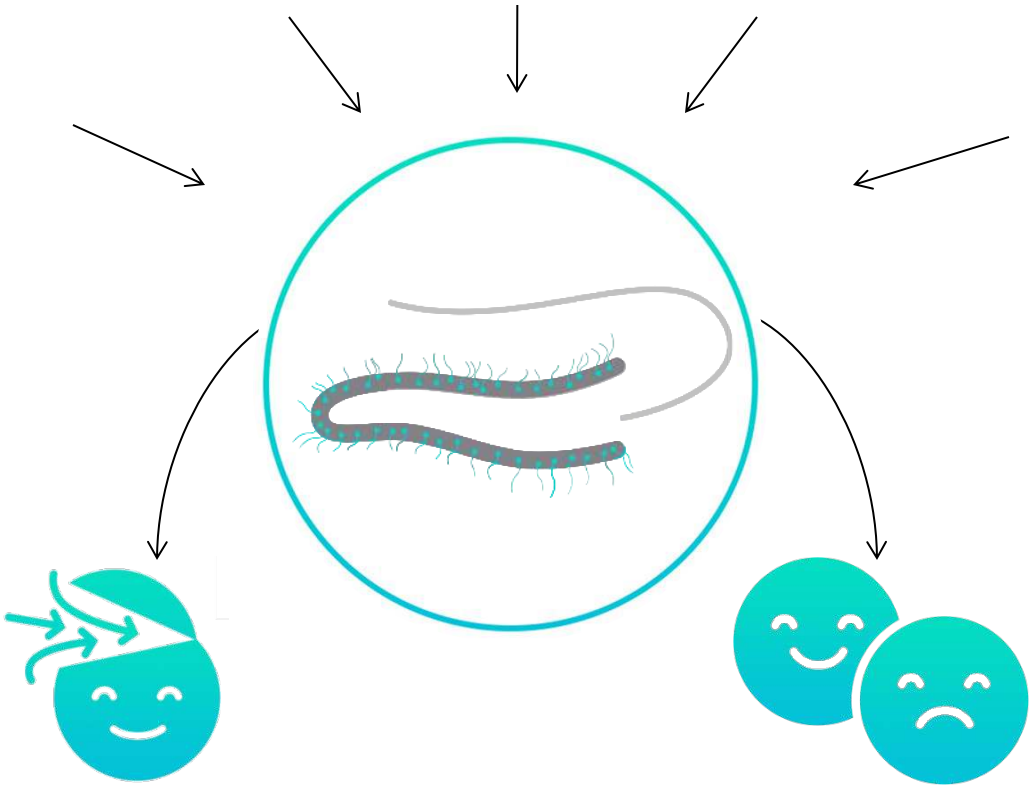
- Adult Hippocampal Neurogenesis is reduced in some animal models of depression.

- Many treatments for depression promote Adult Hippocampal Neurogenesis and are dependent on functional neurogenesis.

Functional Relevance of Adult Neurogenesis: Mood & Depression

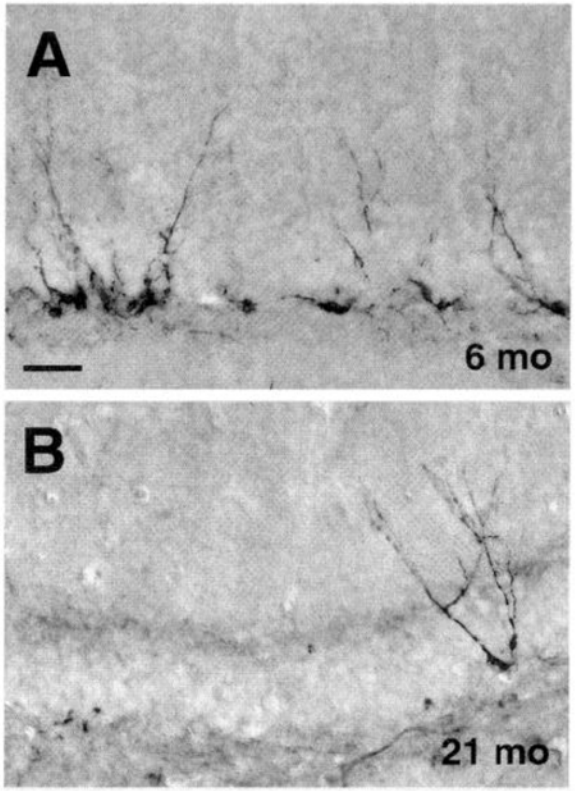


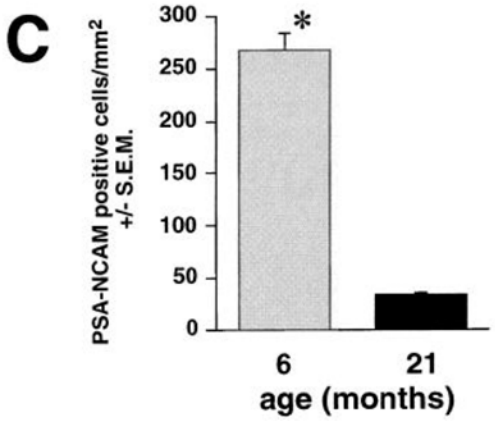
Adult Hippocampal Neurogenesis emerging as Target of choice?

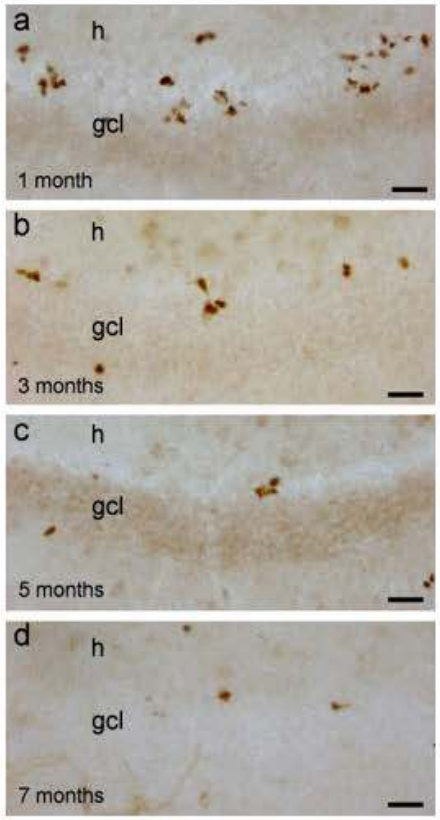


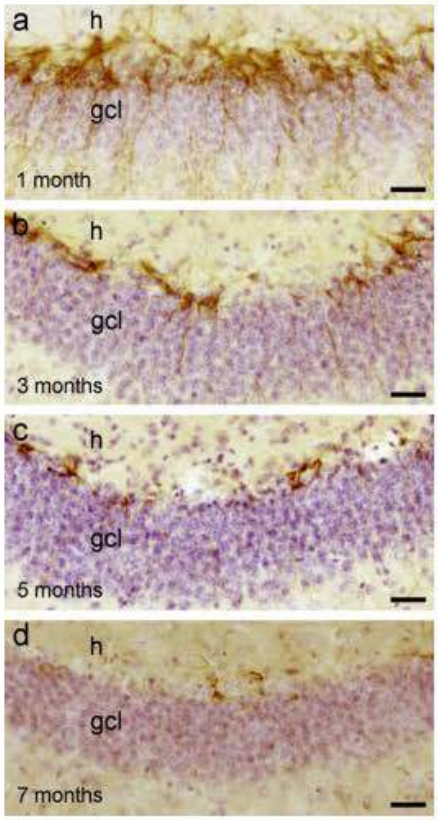
How is Adult Hippocampal Neurogenesis altered during **Aging**?

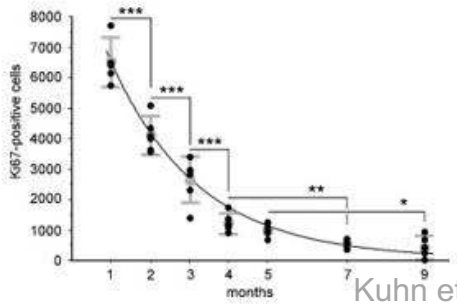
Adult Hippocampal Neurogenesis **decreases with age in rodents**

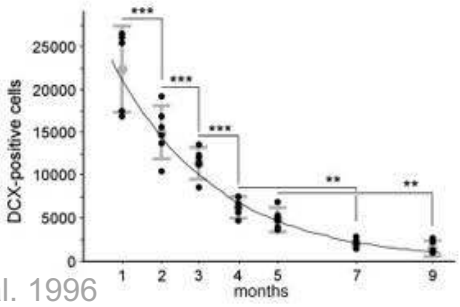










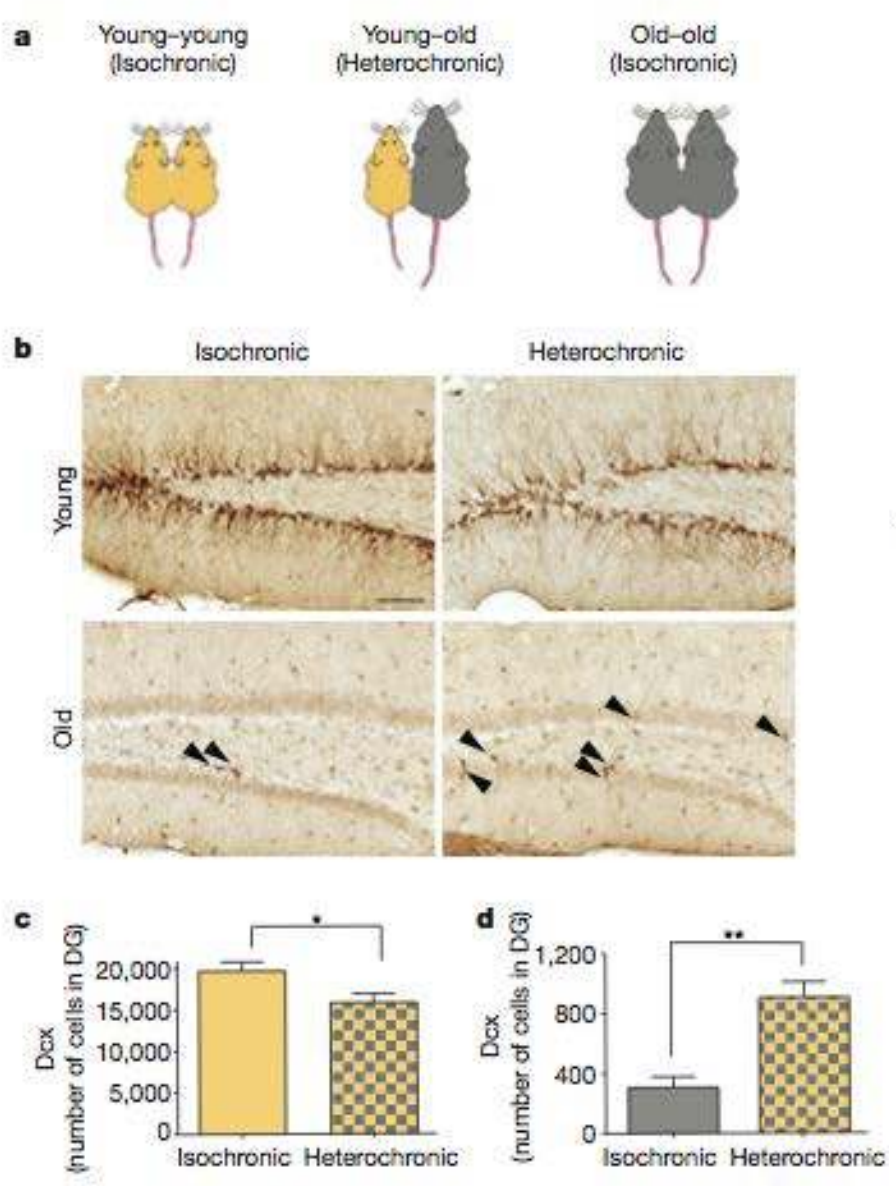


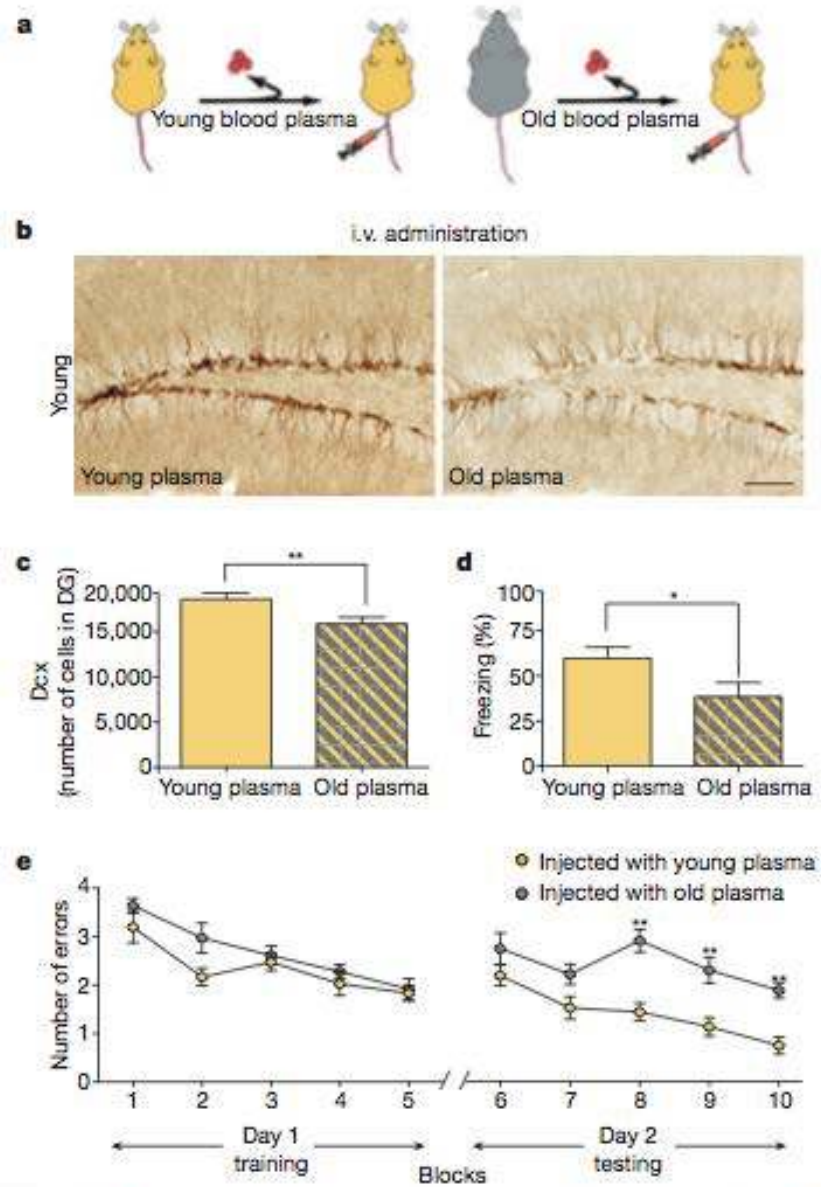
Kuhn et al. 1996

Ben Abdallah et al., 2010

For Review, Klemplin and Kempermann 2007

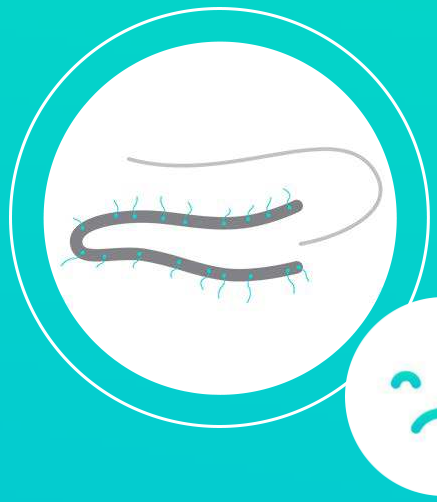
Neurogenesis decline with age: **Parabiosis** and the **Systemic Milieu**





Villeda et al., 2011- Nature

Can life style modulates Adult Hippocampal Neurogenesis?



Diet modulates Adult Hippocampal Neurogenesis

Diet	Effect on AHN	Study Models	References
Calorie Restriction	Increased survival	Mouse	68-70, 125-127
Omega 3 fatty acids	Increased	Rat	77, 87, 128-130
Flavonoids	Increased proliferation	Rat chronically stressed	88
	Increased proliferation	Mice	131, 132
Blueberry	Increased proliferation	Rat	133
Curcumin low concentrations	Increased proliferation	Mouse	91, 93-95
Retinoic acid excess	Decreased proliferation	Mouse	106
Vitamin A deficiency	Decreased proliferation (rescued with retinoic acid)	Rat	108
Thiamine deficiency	Decreased proliferation/ survival	Mouse	134, 135
Zinc deficiency	Decreased proliferation/survival	Rat male	100, 103, 136
Folic acid	Increased proliferation	Rat	137
Folate deficiency	Inhibited proliferation	Mouse	138
Increased Homocystein	Inhibited proliferation	Mouse	139, 140
High fat	Decreased proliferation	Rat male	115, 116
	No change	Rat female	
Soft diet	Decreased proliferation	Rat	73, 76
Caffeine at physiologically relevant doses	Decreased proliferation	Mouse	114
Caffeine at supraphysiological doses	Increased proliferation/ Decreased survival	Mouse	113
Caffeine low doses chronically	Decreased proliferation	Rat	
Ethanol	Decreased proliferation	Rat	141, 142
	Decreased proliferation	Mouse	143
Capsaicin	Decreased proliferation	Mice	144
Resveratrol	Increased proliferation	Mice	97, 98
High sugar (fructose)	Decreased proliferation	Male Rat	117
Vitamin E deficiency	Increased proliferation	Rat	145-147
Vitamin E high doses	Increased survival	Rat	148

Zainuddin and Thuret, 2012

Diet, cognition and mood

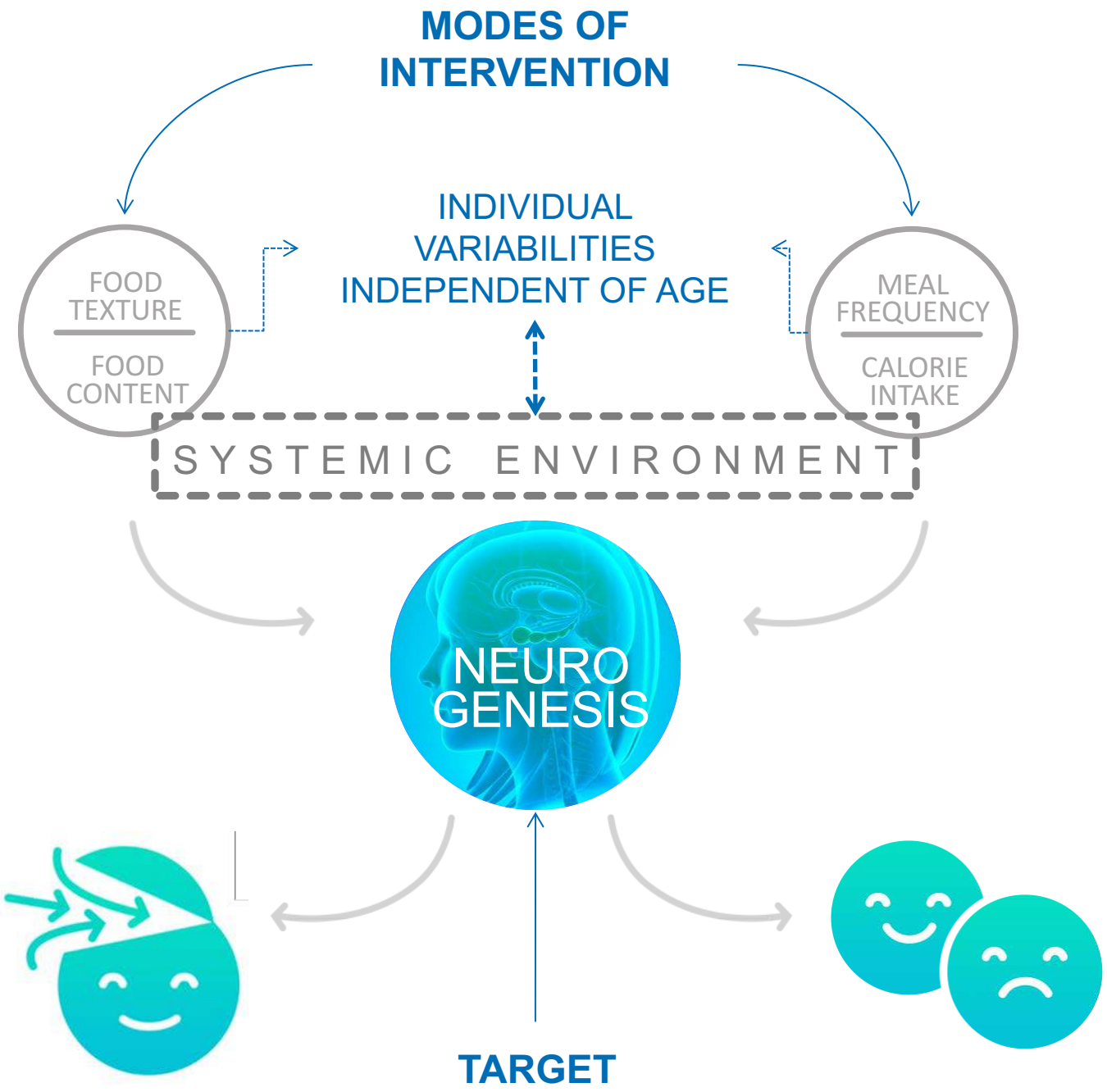
Diet	Effect on Depressive Behaviour	Effect on Learning and Memory	Study Models	References
Caloric/Dietary Restriction Intermittent Fasting		Enhanced spatial learning	Rat (aged)	149
		Increased learning and motor performance	Mouse	150
		Increased learning consolidation	Mouse	151
		Enhanced verbal memory	Human (Healthy Elderly)	71
		Improved spatial learning	Rat (traumatic brain injury)	152
	Improved		Mice (depression model)	153
Omega 3 fatty acids	Improved		Human (bipolar)	85, 86
	Delayed onset		Human (bipolar)	154
	Improved		Human (bipolar)	155
	No benefit		Human (bipolar)	156
		Improved spatial memory	Mouse (Alzheimer model)	157
		Improved acquisition and retention	Mouse (Aged)	158
		Improved learning performance	Rat (Diabetic)	159
	Small effect	No effect	Human (recovered from depression)	160
Flavonoids	Improved		Rat	89
		Improved	Various Species	For review 161, 162
		improved	Rodent Species	For review 162-164
		improved	Rat	165-169
Blueberry		Increased spatial memory	Rat	90
		Improved	Human (old age)	170
		Improved	Mice	171
Curcurmin		Improved cognitive performance	Human	92
		Improved cognitive performance	Rat	94, 172
		Improve spatial memory and learning	Rat	173, 174
		Improved	Mice	175, 176
		Improved	Rat (Alzheimer's disease)	177
	Improved		Rat	96, 178-180
	Improved		Mice	181

Zainuddin and Thuret, 2012

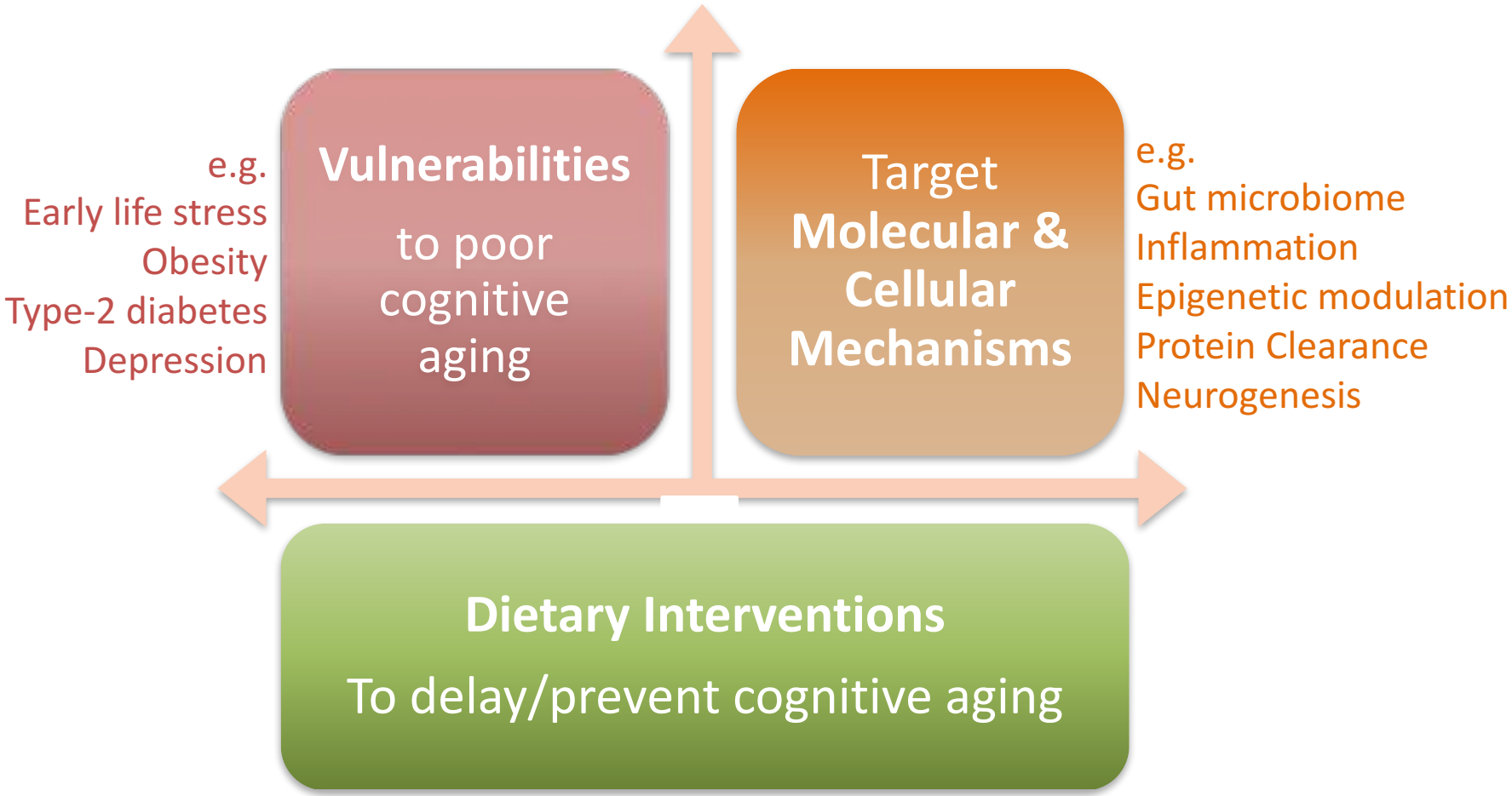
Diet, cognition and mood

Retinoic acid excess	Improved		Mouse	[107]
Vitamin A/retinoid deficiency		Impaired spatial learning and memory	Rat	[182]
		Impaired relational memory	Mouse	[183]
Zinc	Improved		Rodent, Human	For review[102]
High fat		Decreased spatial learning	Rat	[184]
		Decreased learning and memory and Increased risk for dementia	Rat	[185]
		Impair spatial learning	Mice	[186]
	Exacerbates		Rat (depression model)	[187]
		Increased susceptibility to spatial learning deficit	Rat	[188, 189]
		Impair memory	Rat	[190]
High sugar		Impaired spatial learning	Rat	[191]
		Impaired spatial learning	Rat	[192]
		Impaired	Rat	[193]
Low glucose (extracellular)		Impaired memory	Rat (Aged)	[194]
Soft diet		Impaired	Rat (Alzheimer's model)	[74]
		Impaired learning and memory	Aged animals	For review [195]
		Impaired spatial learning and memory	Mice (female albino)	[196]
Caffeine		Improved object recognition	Mouse	[197]
	Reduced risk		Human	[198]
	Reduced risk		Human	[199]
		Improved cognitive function	Rat	[200]
Ethanol		Improved associative learning with moderate chronic consumption	Mouse	[201]
		Impaired	Human	[202]
	Induced depressive behaviour		Rat	[203]
Capsaicin		No effect	Mice (young)	[144]
Resveratrol	Improved		Mice (despair test)	[99]
		Improved cognitive function	Mice	[98]
Vitamin E deficiency	Associated risk		Human (depression)	[204]
	Associated risk		Human (depression)	[205]
	No association		Human (aged adult with depression)	[206]
Vitamin E		Protective effect	Rat (brain injury)	[207]
		Delayed memory loss	Mouse	[99]

Zainuddin and Thuret, 2012


MODES OF INTERVENTION
INDIVIDUAL VARIABILITIES INDEPENDENT OF AGE
FOOD TEXTURE
FOOD CONTENT
MEAL FREQUENCY
CALORIE INTAKE
SYSTEMIC ENVIRONMENT
NEURO GENESIS
TARGET

Efficient Dietary Interventions Strategies: Need to identify Vulnerabilities and Mechanisms



Miquel et al. ILSI Nutrition and Mental performance task Force, in revision

Poor cognitive ageing: Vulnerabilities, mechanisms and the impact of nutritional interventions

ILSI Europe
International Life Sciences Institute

3rd WORKSHOP

Nutrition for the Ageing Brain: Moving Towards Clinical Applications

Save the Date: 30-31 August 2018
Madrid, Spain

Main themes to be addressed:

- Impact of nutrition on brain functions using neuroimaging technologies;
- Microbiome and immune status: impact on brain function;
- Biomarkers of food intake and cognitive health;
- Sleep deprivation: effects on diet and cognitive performance;
- New methodologies applied to dementia and how nutrition could play a role.

Organised by the ILSI Europe
Nutrition & Mental Performance Task Force
More information can be found on www.ilsi.eu.

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