The measurement of **diet-induced changes in cognition:** methodological aspects

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GENERAL OBJECTIVE

To advance the understanding of the effects of diet and food components on mental performance.

Specifically:

- To review methodologies that assess mood and cognitive functioning
- To suggest approaches that should be taken
- To ensure that these methodologies can be used in all European countries
- Whenever possible the underlying physiological effects on brain metabolism and mental functions will be addressed
- To review how current methods are applied to sub-groups of the population (e.g. children, adults, the elderly), in particular in daily life and the free-living situations.

MEMBERS

Barilla G.&F. Fratelli, Coca-Cola European Union Group, DSM, Groupe Danone, Kraft Foods, Nestlé, Südzucker, Unilever, Wild Flavors Berlin

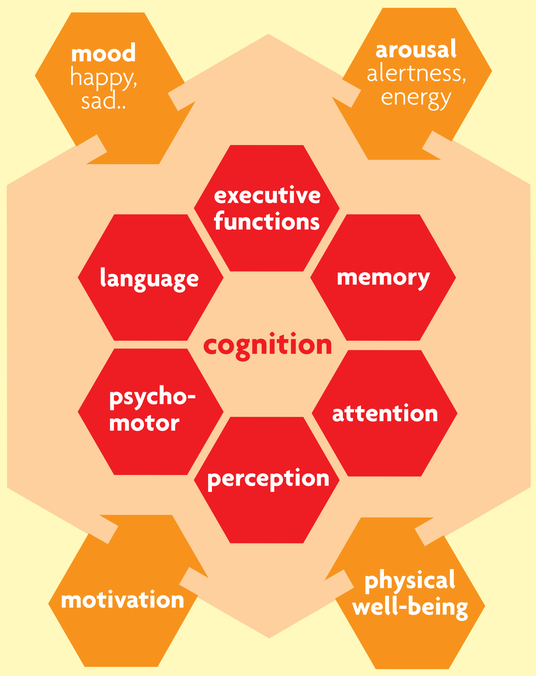
OUTPUT

Schmitt JA, Benton D & Kallus KW (2005). General methodological considerations for the assessment of nutritional influences on human cognitive functions. *European Journal of Nutrition,* 44, 459-464

Kallus KW, Schmitt JA & Benton D (2005). Attention, psychomotor functions and age. *European Journal of Nutrition,* 44, 465-484

Benton D, Kallus KW & Schmitt JA (2005). How should we measure nutrition-induced improvements in memory? *European Journal of Nutrition,* 44, 485-498

cognitive functions: basic concepts



Cognition is a general term that includes the processes by which we perceive, evaluate, store and manipulate information.

It can be clustered in to six main domains (see figure). Each area can be further divided.

In turn cognition is influenced by other aspects of psychological functioning, mood, motivation and alertness.

The approach that needs to be taken is illustrated by the example of memory, an aspect of cognition that is susceptible to dietary influences.

Schematic representation of the interaction between the cognitive functions (in red) and the factors that may modulate the efficiency of cognitive processing (in orange).

aging – an example of the potential influence of nutrition

Amongst the first signs of both healthy aging and Alzheimer's disease are problems of memory and attention.

There are a number of ways in which nutrition has been suggested to influence memory in the elderly. Although data are preliminary it is suggested that:

- The aging process reflects the action of free radicals and can benefit from anti-oxidant micronutrients or particular foods with these properties
- As poor glucose tolerance is associated with poor memory, a low glycaemic load diet may be beneficial
- A high level of homocysteine in the blood is a risk factor for Alzheimer's disease and can be decreased by folate and vitamin B_{12}
- Dietary induced changes in acetylcholine synthesis may improve memory
- The intake of fatty acids may help those in the early stages of Alzheimer's disease.

MEMORY

Memory is not a single entity that can be summarized in a one number from a single test.

1) There are a number of stages at which potentially diet can be influential:
a. Initial storage
b. Maintaining the memory
c. Retrieval.

2) The type of information is important. Is it verbal or non-verbal?

3) Are you assessing short-term or long-term memory?

4) There are different types of long-term memory. A basic distinction is between:
a. Nondeclarative memory – something that cannot be put into words such as riding a bicycle
b. Declarative memory – something that can be put into words that is further divided into:

Semantic memory: general facts such as Paris is the capital of France.

Episodic memory: Memory for events based in time and place.

MEMORY AND AGING

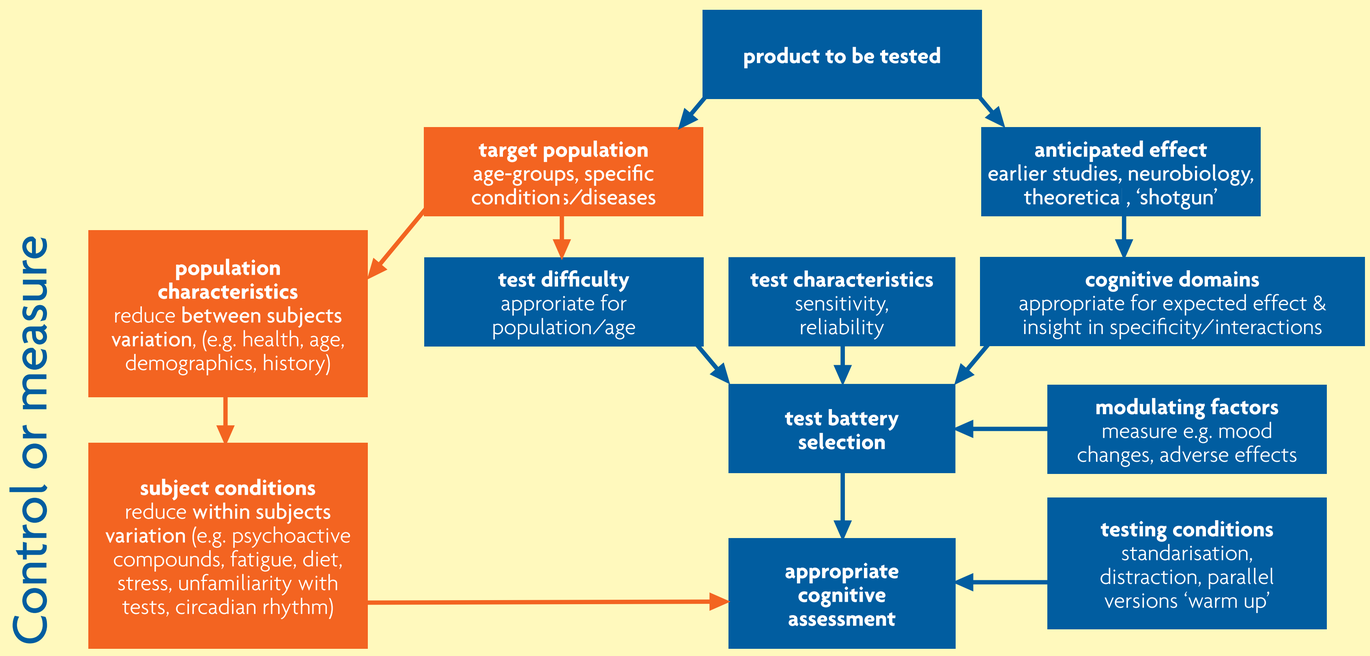
- Although memory declines with age the decline is greater in some tasks than others
- There is only a slight decline in non-declarative memory
- In the early stages of Alzheimer's disease problems of episodic memory are most common. The ability to recall details of past events declines
- There is a relatively large decline in prospective memory; for example the ability to remember to do something next week
- Tests should be chosen that reflect those aspects of memory that are most likely to be compromised by aging.

CONCLUSIONS

- Behavioural assessments are a sensitive and valid means of investigating the effects of nutrition on the functioning of the brain.
- Confounding factors must be controlled such as the population used (e.g age, health) and individual states (e.g. fatigue, motivation).
- Cognition is not a fixed entity that can be assayed with a standard procedure taken from the shelf. The selection of tests will reflect both a theoretical understanding of cognition and an appreciation of the conditions under which a test is administered.
- The approach should never be routine and must be tailored to the characteristics of the product and the target population.

Source: Experimental Psychopharmacology Unit, Maastricht University, NL

methodological considerations



Schematic representation of methodological considerations when designing an experiment to assess the effect of a (nutritional) intervention: appropriate test selection, managing performance variability and ensuring meaningful interpretation of the results.

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