

<b>Institution:</b> University of Northumbria at Newcastle		
<b>Unit of Assessment:</b> 4 (Psychology, Psychiatry and Neuroscience)		
<b>Title of case study:</b> The commercial impact of research into dietary supplements for brain function and behaviour		
<b>Period when the underpinning research was undertaken:</b> 2006 – 2020		
<b>Details of staff conducting the underpinning research from the submitting unit:</b>		
<b>Name(s):</b> (All at BPNRC)	<b>Role(s) (e.g. job title):</b>	<b>Period(s) employed by submitting HEI:</b>
David Kennedy	Director of BPNRC	10/1998 – present
Philippa Jackson	Associate Professor	02/2005 – present
Emma Wightman	Senior Research Fellow	07/2008 – present
Crystal Haskell-Ramsay	Associate Professor	02/2003 – present
Fiona Dodd	Research Fellow	05/2007 – present
Jonathon Reay	Principal Lecturer	09/2007 – 11/2012
Andrew Scholey	Professor	01/1998 – 01/2007
Joanne Forster	Senior Research Assistant	01/2008 – present
Rachel Veasey	Senior Research Assistant	01/2014 – 05/2017
Julie Khan	Research Assistant	12/2009 – present
Bernadette Robertson	Research Assistant	03/2006 – 09/2011
Sarah Dunn	Research Assistant	04/2011 – 05/2013
Alexandra Carne	Research Assistant	05/2012 – 01/2013
<b>Period when the claimed impact occurred:</b> 2013 – 2020		
<b>Is this case study continued from a case study submitted in 2014?</b> N		
<b>1. Summary of the impact</b> (indicative maximum 100 words)		
<p>The market for brain health supplements is estimated to be worth up to EUR1,000,000,000 in the European Union and at similar levels in the USA. Research is essential to support the development and promotion of these products. The Brain, Performance and Nutrition Research Centre (BPNRC) at Northumbria University conducts trials evaluating the effects dietary supplements and their component parts have on brain function and behaviour. The leading international manufacturers of nutritional and dietary ingredients and supplements use Northumbria's research to learn about the nature and extent of the effects of their products, to develop new products and ingredients, and to support marketing and sales. Specific examples include: [text removed for publication] (iii) establishing the efficacy and effective dose of International Flavors and Fragrances Inc's (IFF) popular Neuravena® product; and (iv) Bayer HealthCare's use of research to support claims, and sales growth, for its Supradyn™ product.</p>		
<b>2. Underpinning research</b> (indicative maximum 500 words)		
<p>Northumbria University's Brain, Performance and Nutrition Research Centre (BPNRC) conducts research evaluating the effects of dietary components on brain function and behaviour. These include micro- and macronutrients, bioactive phytochemicals, whole foods (e.g., nuts), and dietary supplements (e.g., herbal extracts). All studies, including those cited here, are conducted to the rigorous standards of human clinical trials, including pre-registration, the adoption of randomised, placebo-controlled, double blind-designs, and the use of sensitive study outcomes. Parameters such as cognitive function (e.g., attention, working memory, episodic memory, and executive function) and mood are assessed using Northumbria University's Computerised Mental Performance Assessment System (COMPASS), a flexible software framework designed by Northumbria to deliver customised cognitive assessments [R1].</p> <p>[Text removed for publication]</p> <p>[Text removed for publication]. Similar results were found for Neuravena®, a product containing <i>Avena sativa</i> extract and made by IFF Health, a manufacturer of functional natural health and nutrition ingredients. Repeated assessment using COMPASS across a single testing visit</p>		

following acute doses (800mg and 1600 mg) of Neuravena® revealed broad cognitive benefits of the 800mg dose. Benefits included improved working memory, episodic memory, executive function, and speed of performance across all tasks, evident from one-hour post-dose in healthy adults (n=42, repeated measures). As such, this study established that the optimal dose of *Avena sativa* is lower than previously thought, at 800mg or less [R4].

Since 2008, Northumbria has collaborated with Bayer Consumer Care AG (Basel), an international enterprise that manufactures several leading global brands of multi-vitamin/mineral (MVM) supplements. The original research demonstrated that Bayer's Berocca™ and Supradyn™ MVM supplements were associated with improved cognitive function and mood in healthy adults. A subsequent series of studies carried out during 2012-2018 expanded this research base by assessing updated formulations and novel applications for these products. The aim of this body of research was to explore whether the metabolic effects of water-soluble vitamins underpinned changes in physiological or psychological function during physically or cognitively-demanding activities. In one study, research assessed the impact of acute doses of Berocca Boost™, an MVM supplement also containing guarana, an extract with stimulant properties derived from the seeds of the Amazonian *Paullinia cupana* plant. In the study, the consumption of Berocca Boost™ prior to a bout of moderate-intensity exercise resulted in performance benefits in terms of lower perceived exertion during exercise in active males (n=40, repeated measures) [R5]. Furthermore, performance on working memory (accuracy) and episodic memory (speed) tasks – assessed before and after exercise, using the assessment tool COMPASS – was also significantly improved [R5]. Another study combined multiple methods: metabolic (measuring O<sub>2</sub> consumption and CO<sub>2</sub> production), cognitive (using COMPASS), and cerebral blood flow (NIRS). The study focused on the metabolic effects of single doses and also chronic (over a period of 56 days) supplementation with Supradyn™ in healthy females (n=120) [R6]. This research found that (a) acute supplementation modulated metabolic parameters, increasing energy expenditure and cerebral blood flow during cognitive task performance following a single dose, and that (b) these metabolic consequences were sustained during chronic supplementation [R6].

### 3. References to the research (indicative maximum of six references)

**R1. David Kennedy, Fiona Dodd, Bernadette Robertson, Okello, E.J.\*\* , Jonathon Reay, Scholey, A. B.\*\*, and Crystal Haskell (2011)** Monoterpenoid extract of sage (*Salvia lavandulaefolia*) with cholinesterase inhibiting properties improves cognitive performance and mood in healthy adults. *Journal of Psychopharmacology* **25**(8): 1088-1100  
<https://doi.org/10.1177/0269881110385594>

**R2. David Kennedy, Pace, S.\* , Crystal Haskell, Okello, E.J.\*\* , Milne, A.\* , and Andrew Scholey (2006)** 'Effects of cholinesterase inhibiting sage (*Salvia officinalis*) on mood, anxiety and performance on a psychological stressor battery' *Neuropsychopharmacology* **31**(4): 845-52  
<https://doi.org/10.1038/sj.npp.1300907>

**R3. Emma Wightman, Philippa Jackson, Julie Khan, Joanne Forster, Heiner, F.\*\* , Feistel, B.\*\* , Suarez, C.G.\*\* , Pischel, I.\*\* , and David Kennedy (2018)** 'The Acute and Chronic Cognitive and Cerebral Blood Flow Effects of a *Sideritis scardica* (Greek Mountain Tea) Extract: A Double Blind, Randomized, Placebo Controlled, Parallel Groups Study in Healthy Humans' *Nutrients* **10**(8): 955 <https://doi.org/10.3390/nu10080955>

**R4. David Kennedy, Philippa Jackson, Joanne Forster, Julie Khan, Grothe, T.\*\* , Perrinjaquet-Moccetti, T.\*\* , and Crystal Haskell-Ramsay (2017)** 'Acute effects of a wild green oat (*Avena sativa*) extract on cognitive function in middle-aged adults: a double-blind, placebo controlled, within-subjects trial' *Nutritional Neuroscience* **20**(2): 135-151  
<https://doi.org/10.1080/1028415X.2015.1101304>

**R5. Rachel Veasey, Crystal Haskell-Ramsay, David Kennedy, Wishart, K.\*\* , Maggini, S.\*\* , Fuchs, C.J.\* , and Stevenson, E.J.\* (2015)** 'The Effects of Supplementation with a Vitamin and

Mineral Complex with Guaraná Prior to Fasted Exercise on Affect, Exertion, Cognitive Performance, and Substrate Metabolism: A Randomized Controlled Trial' *Nutrients* 7: 5272  
<https://doi.org/10.3390/nu7085272>

**R6. David Kennedy**, Stevenson E.J.\*\*, **Philippa Jackson**, **Sarah Dunn**, Wishart, K.\*\*, Bieri, G.\*\*, Barella, L.\*\*, **Alexandra Carne**, **Fiona Dodd**, **Bernadette Robertson**, **Joanne Forster**, and **Crystal Haskell-Ramsay** (2016) 'Multivitamins and minerals modulate whole-body energy metabolism and cerebral blood-flow during cognitive task performance: a double-blind, randomised, placebo-controlled trial' *Nutrition and Metabolism* 13:11  
<https://doi.org/10.1186/s12986-016-0071-4>

\*Internal collaborators: C. Fuchs and E. Stevenson – Department of Sport, Exercise and Rehabilitation (UoA24); S. Pace – employed at Northumbria until 02/2005; A. Milne – technical support within BPNRC since 2013

\*\*External collaborators: E. J. Okello – Newcastle University; A. B. Scholey – Swinburne University, Australia; F. Heiner, B. Feistel and C. G. Suarez – Finzelberg GmbH & Co.; I. Pischel – consultant; T. Grothe and T. Perrinjaquet-Mocchetti – Frutarom, Switzerland; K. Wishart, S. Maggini, G. Bieri and L. Barella – Bayer HealthCare, Switzerland

#### 4. Details of the impact (indicative maximum 750 words)

BPNRC's research on the effects of dietary components has had impact in three distinct areas, in relation to (1) bringing to market new dietary supplements, including [text removed for publication], (2) improving dose recommendations for *Neuravena*, and (3) supporting the international marketing initiatives of one of Europe's biggest-selling supplements.

##### 4.1 Bringing new supplements to market

[Text removed for publication]

##### 4.2 Improving dose recommendations for *Neuravena*® (*Avena Sativa*)

IFF Health – a division of International Flavours and Fragrances Inc. – is a leading global natural health and nutrition ingredient manufacturer. IFF Inc. had sales of USD5,100,000,000 in 2019. Northumbria research was used to inform a new lower dose of IFF's *Avena sativa* extract product, *Neuravena*. The research provided new insights by demonstrating that 800mg was sufficient to have a positive effect [R4]. IFF Health states that *'this dose is lower than what was previously used (1250mg), and current dose recommendations are based on the study results'* [E8]. This discovery is also important for consumers as *'a dose of 800mg is more economically viable as well as user friendly (one capsule instead of two, for example)'* [E8]. This further benefitted the company, as it supports *'promoting the ingredient to new markets and new users'* [E8]. In addition, using COMPASS in this study *'enabled us to check for many attributes of the extract at the same time, and is regarded by many in the market as an advanced method for checking effects on cognition'* [E8]. The results revealed improved speed of performance across all the cognitive tasks and these data were used to develop a new concept showing how to use *Neuravena* in products targeting consumers involved with video games [E8, E9]. Finally, the research supports the company to meet regulatory requirements around the world:

*'the study is integral for establishing the efficacy and safety of the extract with regards regulatory processes. Especially in the USA and EU, where we mainly operate and have many customers, the sale of nutraceutical products is governed by strict rules and standards, so the research is very important so that we can meet those requirements'* [E8].

##### 4.3 Supporting international marketing initiatives

Bayer Consumer Care AG (Basel) has used Northumbria's research [R1, R2] to promote its products and recognises the commercial value of the research findings. Bayer states that *'these studies help differentiate the products in the marketplace via the development of more distinctive claims'* and *'play a substantial role in their commercial success'* [E10]. For example, Supradyn™ – which is marketed in Europe, Latin America, Africa, and Asia Pacific, and is worth more than

EUR200,000,000 in annual sales – *'continues to gain further market share since 2 years, proving its stronger equity and execution vs. its competitors in the market; the brand grew globally +7%, vs. the category growth of 4%'* [E10]. In order to achieve this, Northumbria research was used to produce new marketing materials that have been used *'to support claims about product effectiveness (i.e., works from the first intake, clinically/scientifically tested/proven)'* [E10, E11]. The research has also been used *'to train the Bayer medical staff in the company's affiliates around the world, to train the sales forces (targeting pharmacies) and consequently the pharmacy staff'* [E10]. Additionally, the publications are used as *'references in documents submitted to health authorities for claims substantiation'* [E10]. In summary Bayer stated the collaboration with Northumbria University *'is crucial for the continued success of our products'* [E10].

**5. Sources to corroborate the impact** (indicative maximum of 10 references)

Ref.	Corroborating Source	Link to Impact
E1	[text removed for publication]	[text removed for publication]
E2	[text removed for publication]	[text removed for publication]
E3	[text removed for publication]	[text removed for publication]
E4	[text removed for publication]	[text removed for publication]
E5	[text removed for publication]	[text removed for publication]
E6	[text removed for publication]	[text removed for publication]
E7	[text removed for publication]	[text removed for publication]
E8	TESTIMONIAL - Dr. Itay Shafat, Product Manager Cognitive Line and Sports Nutrition, IFF Health	Underwrites all changes/benefits at IFF Health
E9	PRODUCT BROCHURE - IFF Health Neuravena for e-gamers	Cites Kennedy et al. 2017 (R6) study findings
E10	TESTIMONIAL - Silvia Maggini, Global Medical Category Head, Nutritionals and Digestive Health, Bayer Consumer Care AG	Underwrites all changes/benefits at Bayer
E11	<a href="#">PRODUCT ADVERT - Bayer</a> (source: YouTube)	Cites Kennedy et al. 2016 (R2) and uses the phrase 'works from the first time' which was derived from the research findings