

Institution: Lancaster University		
Unit of Assessment: 4, Psychology, Psychiatry and Neuroscience		
Title of case study: Enabling healthier choices for consumers through sugar reduction in energy drinks and foods.		
Period when the underpinning research was undertaken: 2001-2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Sandra Sünram-Lea	Professor	01/03/2001-present
Period when the claimed impact occurred: 2013 - 2020		
Is this case study continued from a case study submitted in 2014? N		
1. Summary of the impact (indicative maximum 100 words)		
Prof Sünram-Lea's research has: 1) Directly informed development of new lower- and low-sugar versions of products by multi-national companies (GlaxoSmithKline, Suntory, Danone and Nestlé), including Lucozade drinks where these changes have impacted millions of consumers globally with wider availability of healthier low-sugar options (50% reduction in sugar content of Lucozade). 2) Contributed to research development through collaborations with industry (incl. GlaxoSmithKline, Suntory, Danone and Nestlé); enabling evidence-based evaluation of novel products and prototypes designed to create healthier consumer choices. 3) Enriched awareness and understanding of the importance of carbohydrate quantity for healthy nutrition of more than 10,000 healthcare professionals, policy makers and members of the public.		
2. Underpinning research (indicative maximum 500 words)		
Sünram-Lea's research has investigated the effects of sugar (glucose) and carbohydrates on human cognitive performance, and she has published more than 40 papers on this topic. Her work has contributed to the development of a substantial body of literature on the aspects of cognitive performance that are affected by glucose and has advanced our understanding of the psychological consequences of fluctuations in glucose, such as the conditions under which glucose ingestion affects performance. She developed a novel paradigm for investigating the influence of glucose on cognitive performance in healthy young adults, which has been recognized as a prototypical experimental model for research on the nutrition-behaviour axis. She conducted the first empirical demonstration that long fasting periods are not necessary to elicit an effect of sugar on mental performance (3.1) and demonstrated that relatively small variations in central glucose availability can affect human cognitive performance. It successfully challenged the assumption that cognitive effects can only be shown under conditions of low glucose levels, and provided evidence that effects persist under more naturalistic conditions and are not restricted to long fast durations. Sünram-Lea devised experimental strategies to determine the relative effects of glucose on several brain functions such as attention, mood, effort and motivation. This in turn showed that these different functions that underlie cognitive performance were influenced to various degrees by glucose availability (3.4, 3.5, 3.6). Through this work, Sünram-Lea has developed unique expertise in the assessment of sugar content and food components and her collaboration with the global food and drinks industry shows that her expertise is considered unique and is actively sought after.		

In 2011, Sünram-Lea published the results of a study investigating which dose of sugar is most beneficial to memory performance and mood (3.2). These questions were under-researched and were of relevance for the theoretical framework and applied knowledge base.

The key findings from Sünram-Lea's underpinning research are that:

- Small variations in central glucose availability can affect human cognitive performance (3.1, 3.2, 3.3, 3.4, 3.5, 3.6)
- The effects of glucose availability are not restricted to conditions of low glucose levels (3.1.)
- Effects are dose-dependent (3.2)
- Certain aspects of cognitive performance are influenced to a higher degree by glucose availability (3.1, 3.2, 3.5, 3.6)
- Impaired glucose control linked to lower cognitive performance even in young adults (3.3)

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

3.1 **Sünram-Lea, S.I.**, Foster, J.K., Durlach, P. & Perez, C. (2001). Glucose facilitation of cognitive performance in healthy young adults: examination of the influence of fast-duration, time of day and pre-consumption plasma glucose levels. *Psychopharmacology* 157(1), 46-54.

3.2. **Sünram-Lea, S.I.**, Owen, L, Finnegan, Y., Hu, H. (2011). Dose-response investigation into glucose facilitation of memory performance and mood in healthy young adults. *Journal of Psychopharmacology* 25(8), 1076-87.

3.3. **Sünram-Lea, S.I.** and Owen, L. (2017). The impact of diet-based glycaemic response and glucose regulation on cognition: evidence across the lifespan. *Proceedings of the Nutrition Society*, 76, 4,466-477. Based on a presentation to the Royal Society of Medicine and Nutrition Society to which Sünram-Lea was invited. The journal is truly multidisciplinary and has allowed exposure to a wider academic and professional audience.

3.4. **Sünram-Lea, S.I.**, Foster, J.K., Durlach, P. & Perez, C. (2004). The influence of fat administration on the glucose memory facilitation effect. *Nutritional Neuroscience* 7(1), 21-32.

3.5. **Sünram-Lea, S.I.**, Foster, J.K., Durlach, P. & Perez, C. (2002). The effect of retrograde and anterograde glucose administration on memory performance in healthy young adults. *Behavioural Brain Research* 134 (1-2), 505-516.

3.6. **Sünram-Lea, S.I.**, Foster, J.K., Durlach, P. & Perez, C. (2002). Investigation into the significance of task difficulty and divided allocation of resources on the glucose memory facilitation effect. *Psychopharmacology* 160 (4), 387-397.

Research Funding

Industry:

- 2017-2018 - Nestle (Lausanne, Switzerland) on Assessment of glycaemic response to breakfast interventions (GBP113,194)
- 2013-2014 - Danone Research Centre for Specialised Nutrition 'An investigation into the acute glycaemic and cognitive effects of breakfast cereals with different fibre conditions in young healthy adults' (GBP80,095)
- 2011-2011 - GSK – An investigation into the effects of glucose and caffeine alone and in combination on cognitive performance, fatigue and mood in healthy volunteers (GBP59,552)
- 2007-2008 - GSK – The effect of caffeine-and-glucose-containing drinks on biochemical and cognitive measures during physically demanding and stressful situations (GBP43,818)
- 2004-2006 - GSK – Functional neuroimaging pilot study into the glucose facilitation effect (GBP3,383)
- 2000–2001 - Unilever Research Grant: Glucose and cognitive 'refreshment' (GBP49,677)

Research Council:

- 2013-2018 - ESRC - Self-control and inhibition: moderating and mediating factors (GBP55,360)
- 2011-2015 - BBSRC – Glucose and caffeine: effects on cognition and underlying mechanisms (GBP105,922; BB/J50029X/1).
- 2006-2009 - BBSRC – Factors affecting glucose enhancement of cognitive performance (GBP162,967; BB/D012597/1)
- 2005-2008 - Juvenile Diabetes Research Foundation - Blood glucose, recurrent hypoglycemia and memory; an fMRI study. (USD491,136)
- 2006-2008 British Psychological Society Research Seminar Competition – ‘Exploring the nutrition-behaviour axis’ (GBP3,000)
- 2001-2006 - NH&MRC/Juvenile Diabetes Grant: Optimizing Glycaemic Control and Preventing Hypoglycaemia in Type I Diabetics (AUS2,700,000)

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

Sugar-sweetened soft drinks are a major component of daily energy intake. They represent the largest single source of calories in people's diets; accounting for more than 7% of daily energy consumption. The impact of dietary sugars has become an increasingly problematic public health issue in recent years. The World Health Organization reported that in 2016, 1.9 billion adults were overweight and 650 million of these were obese. Excessive sugar consumption is a key contributing factor in these statistics. Sünram-Lea has shown through collaboration with the food and drink manufacturing industry that dietary sugar can also negatively impact glycaemic response and cognitive performance. Her work has directed industry efforts to reduce sugar content in their products.

1) Directly informed development of new lower- and low- sugar versions of Lucozade

Sünram-Lea's underpinning research was picked up by **GlaxoSmithKline (GSK)** at a time when the company wanted to reposition **Lucozade**, a glucose-containing drink, away from its association with athletic fitness and towards everyday benefits on mental energy and performance. GSK approached Sünram-Lea and commissioned research that demonstrated that the 60g of sugar content in the original formulation of Lucozade was not optimal for cognitive performance (3.2). This research directly informed the reduction in the sugar content of the Lucozade product. Through further consultancy and commissioned research, Sünram-Lea provided the scientific evidence that guided GSK to reposition their marketing to focus on the brand's benefits for brain energy and mental performance. This work preceded discussions and legislation surrounding sugar content of food products and drinks and formed a crucial input to the company's strategy (5.1a). In Sept 2013, GSK made a commercial decision to sell the product (together with Ribena) to **Suntory** for GBP1.35 billion (5.1b, 5.2). Following GSK's divestment of its nutritional drinks brand (Lucozade), Sünram-Lea continued research funded by Suntory into the effects of further lowering sugar content on mental energy. This enabled the company to deliver their products' core functional claims (benefit to mental energy) and maintain consumer appeal. (5.1b).

The impact of her research resulted in category-leading reformulations of sugar content in energy drinks, with Lucozade Energy now containing 50% less sugar, as the Principal Scientist at Suntory Beverage & Food Europe states, Sunram-Lea: *“helped to guide our discussions around sugar and its use which ensures we can make the healthiest possible beverages for our consumers while still fulfilling their needs for energy and enjoyment while helping us in agreeing minimum sugar-levels we could aim towards.”* (5.1b). The annual sales of Lucozade drinks alone surpass 400 million units, with Lucozade Energy replacing Red Bull (estimated 3.7 million consumers) in 2019, as the most popular energy drink brand in the UK (5.3). Thanks to Sünram-

Lea's work, approximately 25 million people are now consuming drinks with 50% less sugar content, according to the recent figures provided by Suntory (5.4a). It has also had a lasting impact on the company's research and development approaches, particularly around the impact of high-sugar content on general health, as it puts it on their website, Lancaster University (Sunram-Lea) and partners have helped *"to develop and inspire our knack for innovation."* (5.4a and b).

Sünram-Lea's work with GSK and Suntory were at the forefront of developing drinks with reduced sugar content and this effort on the part of the companies, directly informed by Sunram-Lea's research, was welcomed as part of a wider debate on the childhood obesity strategy by the House of Commons in 2016 (5.5). Sünram-Lea's research and contributions in these areas have also attracted global attention through media engagement and outreach. Through this medium, she challenged conventional wisdom that sugary drinks increase alertness ([Südwestdeutscher Rundfunk](#), Germany (2018), [Undisciplined-political-scientist-and-experimental-psychologist](#), Public Radio Utah, USA (2019), and [Poland's Polska Swiat TV News 24](#) (2019), [New York Post](#), (2019) [Daily Mail](#) (2019)) and raised awareness of the effects of sugar and caffeine on brain, behavior and mood (e.g., Sünram-Lea was [interviewed by the BBC Naked Scientist programme](#) (2016) (BBC 5 live science, ABC Radio National Australia, and podcast) (5.6).

2) Guided industry innovation and research development on the effects of the glycaemic response on cognitive function and its implications for well-known food and drink manufacturers

Carbohydrates are digested and absorbed in the gastrointestinal tract causing an increase in the level of glucose in the blood: the postprandial glycaemic response. Foods with low glycaemic index (GI), which contain carbohydrates that break down slowly during digestion, have been proposed as a useful means for creating healthier food choices. Latest findings have shown that the prevalence of diabetes has increased globally - with diagnoses rising by 129.7% from 211.2 million people in 1990 to 476.0 million in 2017, which has called for new approaches. Multi-national food companies were looking for evidence-based solutions to the challenge of producing products that have an advantageous glycaemic profile. In 2013, Sünram-Lea's research on the effects of GI on cognition and glycaemic response (3.1, 3.2) led her to be approached by **Nutricia Danone** (5.7) for a research-based consultancy. They commissioned research into the effect of adding fibre to breakfast cereals. The inclusion of dietary fibre to carbohydrate-based products (such as cereals) can alter the glycaemic response and provide healthier food choices. The commissioned research demonstrated that the products tested did not have the desired effects in terms of glycaemic profile and cognitive benefits. This work was critical to showing that the standard solution of adding isolated fibre did not result in the desired glycaemic profile and that such products cannot be introduced to the market, saving the company costs of new ingredients, reformulation of existing products and alterations to established manufacturing processes (5.8).

In 2016, Sünram-Lea was approached by **Nestlé** (since 2014 the largest food company in the world, as measured by revenues, product range and share of global market) to advise on research strategy for optimising breakfast composition for children (5.9). Breakfast has been promoted in public discourse to improve academic performance in schoolchildren, leading to the provision of breakfast initiatives by public health bodies. When considering what type of breakfast may be most beneficial, the rate at which food increases and maintains blood glucose (i.e., GI), appears to be important. However, few studies have profiled the glycaemic response in younger children. Nestlé commissioned Sünram-Lea to undertake research into the effect of

substituting glucose and sucrose with a low-glycaemic index carbohydrate (isomaltulose) on glycaemic response in 5- to 7-year-old children. The outcome of the research demonstrated that the prototypes did not have the desired effects, which resulted in a priority shift in **Nestlé's R&D strategy** (5.10).

Sünram-Lea has engaged with healthcare professionals to broaden the reach of her research findings. She was an invited speaker at the **Nestlé Nutrition Institute** International Workshop in the Philippines 2018 ("Nurturing a healthy generation: Research gaps and opportunities") which was streamed live online to a global audience of >10,000 people, including representatives from various food and drink manufacturing companies (5.11). The institute also published an interview with Sünram-Lea, where she provided information about the kind of breakfast that might be beneficial to children, posted on the institute's website (5.12). The Nestlé Nutrition Institute is a not-for-profit association with a mission of educating and building the capabilities of healthcare professionals with a membership of 300,000 worldwide. Sunram-Lea's engagement with this group has helped to broaden the reach of her research with an engaged and influential audience, whose key roles in major food and drink manufacturing organisations offers a critically important avenue for changing perceptions and understandings of sugar content in popular food and drink.

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

- 5.1. Testimonials (a) from GSK Director for Medical Affairs showing impact of Sunram-Lea on GSK thinking around sugar content, cognitive performance; (b) Principal Scientist at Suntory Beverage & Food Europe outlining contribution made by Sunram-Lea to the research underpinning reduction in sugar content in Lucozade following its acquisition.
- 5.2. GSK website describing the sale of Lucozade to Suntory ([link to website](#)) (09/2013)
- 5.3. Study of Leading Brands of Energy Drinks UK: showing growth of Lucozade via Statista: ([link](#)) (2018/19).
- 5.4. (a) Suntory annual report ([link](#)) demonstrating reductions made to Lucozade informed by engagements with Sunram-Lea's research (2016); (b) Suntory Website ([link](#)): Behind the Scenes – Always Learning references contribution of Lancaster University (Sunram-Lea) to their R&D approach (accessed 01/01/2021).
- 5.5. House of Commons Parliamentary Debate on Childhood Obesity Strategy referencing decision to lower sugar content: ([link](#)). (15/11/2016)
- 5.6. Media pack including all engagements by Sunram-Lea between 2013 and 2020 (can be provided on request)
- 5.7. Invitation to Round Table Discussion by Danone (11/2013)
- 5.8. Internal Signed Report to Danone demonstrating impact arising from the round table and Sunram-Lea's other engagements with the company (confidential) (10/2014)
- 5.9. Invitation to Nestlé (25/04/2016)
- 5.10. Testimonial from Nestlé confirming contribution made by Sunram-Lea to their research on sugar reduction in cereals (contact details provided)
- 5.11. Recording of presentation provided by Sunram-Lea to Nestlé Nutrition Institute with an audience of over 10,000 members including representatives from a range of food and drink manufacturing companies ([link](#)) (subscription to institute required, for access contact institution)
- 5.12. Interview with Nestlé Nutrition Institute demonstrating Sunram-Lea's engagement with the company on risks associated with high sugar content in cereals and school-age children's cognitive function: ([link](#)) (subscription to institute required, for access contact institution)