Institution: University of Nottingham

Unit of Assessment: 6; Agriculture, Veterinary and Food Science

Title of case study: Improving sensory science capability through industry training.

1. Summary of the impact

The University of Nottingham's international expertise and reputation in sensory science research has improved the skill-base of industry through targeted training courses. The courses were developed after a need for structured sensory training was identified within the UK food industry. Uptake for the training is excellent and demand for such training continues with sensory modules featuring as a popular component of the UoN-Cranfield-Harper Adams-Rothamsted BBSRC Agrifood Training Partnership (AATP). The food industry benefits from the transfer of research-based skills, delivered with a level of flexibility that meets the needs of businesses.

2. Underpinning research

Key researchers:
Professor Joanne Hort, Professor in Sensory Science (UoN 2002- present)
Professor Andy Taylor, Professor in Flavour Technology (UoN 1978-2010)

The sensory capability of the University of Nottingham was initiated with initial funding from a BBSRC grant **[a]**, employing a sensory scientist and a PhD studentship **[b; 1]**. This work demonstrated the capability to increase understanding of food flavour. This early research highlighted, for example, UoN expertise in understanding flavour perception by combining sensory and instrumental techniques, for example Atmospheric Pressure Chemical Ionisation Mass Spectrometry (APCIMS) and an ability to apply advanced sensory methodology. This also initiated a relationship with Campden BRI, which led to the initial development of the sensory modular training initiative. The academic appointment of Joanne Hort as Lecturer in Sensory Science in 2002 strengthened the sensory research group. A BBSRC grant to Hort **[c]** demonstrated Nottingham's ability to combine brain imaging and sensory science, showing how cortical response differs according to individual taster status and that fat in the oral cavity reduces cortical response in areas processing flavour **[2]**.

Professor Hort's work on multimodal perception **[d, e, f; 3,4]** combined APCIMS and sensory techniques to develop understanding of the sensory impact of changing ingredients in product formulations **[3]**. A DEFRA grant **[g]** enabled the application of consumer sensory methods leading to findings which showed exposure to food can increase liking, even when fat and salt content are reduced. More recently, funding to investigate the emotional response to food **[h & i]** has revealed how new methodologies such as temporal dominance of sensations can provide a fuller sensory profile of products **[5]**. This work highlighted that consumer emotional responses were often more discriminating across products than liking and that for some products the emotional response to the sensory properties was more important than the packaging **[6]**.

3. References to the research

1. Davidson, J.M., Hollowood, T.A., Linforth, R.S.T. and **Taylor, A.J.** (1999) Effect of sucrose on the perceived flavor intensity of chewing gum. *J Agr Food Chem*, 47: 4336-4340. **DOI:** 10.1021/jf9901082
2. Eldeghaidy, S., Marciani, L., Hollowood, T., Foster, T., Head, K., **Taylor, A.J.**, Busch, J., Spiller, R.C., Gowland, P.A., Francis, S.T. and **Hort, J.** (2012) Does fat alter the cortical response to flavor? *Chemosensory Perception*, 5: 215-230. **DOI**: 10.1007/s12078-012-9130-z
3. **Hort, J.** and Hollowood, T. (2002) Controlled flow continuous flow delivery system for investigating taste-aroma interactions. *J Agric Food Chem*, 52: 4834-4843. **DOI:** 10.1021/jf049681y
4. Clark, R., Hewson, L., Bealin-Kelly, F. & **Hort, J.** (2011) The interactions of CO_2, ethanol, hop acids and sweetener on flavour perception in a model beer. *Chemosensory Perception*, 4:42–54. **DOI**: 10.1007/s12078-011-9087-3
5. Ng, M., Lawlor, J.B., Chandra, S., Chaya, C., Hewson, L. and **Hort, J.** (2012) Using Quantitative Descriptive Analysis and Temporal Dominance of Sensations analysis as

complementary methods for profiling commercial blackcurrant squashes. *Food Quality and Preference*, 25: 121-134. **DOI:**.10.1016/j.foodqual.2012.02.004,

6. Ng, M., Chaya, C., and **Hort, J.** (2013) Beyond Liking: Comparing the Measurement of Emotional Response using EsSense Profile and Consumer Defined Check-All-That-Apply *Methodologies Food Quality and Preference*, **DOI**:10.1016/ j.foodqual.2012.08.012

Evidence of the international quality of the research is indicated by publication in international, peer-reviewed journals (Food Quality and Preference and Chemical sense are high-impact journals in Sensory Science).

Underpinning research projects:

a. 1999-2002 PhD studentship Flavour Perception, Funder: Masterfoods Johann Pfeiffer. PI Prof A Taylor.
b. 2001-2004 BBSRC GRANT with UCL D14541 (total) Title Flavometrics: Relating flavour perception to flavour release. £348,264 PI Prof Andy Taylor.
c. 2005-2008 BBSRC IPA RESEARCH GRANT: Perception of flavour in fat emulsions. Funder: BBSRC and Unilever, PI Dr P Gowland UoN & CI J Hort UON - £372,321.
d. 2002 UoN New lecturers Fund**:** Developing a flow delivery system for investigating multi-modal flavour perception. £5300.
e. 2007-2012 PhD Studentship Multimodal Perception in Beer. Funder BBSRC SABMIller, PI J Hort UoN - £116,000.
f. 2007-2011 PhD Studentship Multimodal perception in a Citrus Beverage. Funder GalxoSmithkline, PI J Hort- £70,500.
g. 2006-2007 DEFRA BRIDGE LINK GRANT Designing foods using consumer reward strategies. Funder: DEFRA, PI J Hort UoN £114,770.
h. 2009-2012 Investigating emotional response to blackcurrant squash. Funder: GlaxoSmithkline, PI J Hort UoN, - £45,000.
i. 2011-2012 Investigating emotional response to beer. Funder SABMIller PI J Hort - £69,750.

4. Details of the impact

Sensory science is an essential aspect of the food industry, particularly in terms of product development and maintaining quality once a product is launched. The success of a product, the developing company and their contribution to the UK economy is dependent on the quality of the sensory testing and sensory research carried out by industry. It is not uncommon for UK companies to recruit sensory specialists from abroad due to the lack of trained home-based individuals, and this demand continues (**Source 1**). The University of Nottingham developed a sensory training programme, which now plays an important role in providing a broad, but postgraduate level of training in sensory and consumer science. The training was initially developed using funding from a 'BBSRC Modular Training for Industry Programme' grant (Ref BIG/3/1/1, £40K), in collaboration with Campden BRI. Campden BRI are still significant partners in the programme and see the relationship with Nottingham as very beneficial through access to research understanding and its dissemination to their members. This has been achieved through additional workshops, at which Nottingham researchers have been invited to present (**Source 1**).

Registrants to the UoN industry training courses may take a full PG Certificate in Sensory Science, or can access stand-alone modules for continuing professional development. There are 6 modules related to the Sensory training courses; *Sensory evaluation and Techniques*; *Sensory Evaluation*: *Statistical methods and interpretation*; *Psychophysics, Perception and Physiology; Consumer Studies and Market Research*; *Food Flavour* and a final industrial based project module for those taking the full post graduate certificate. Each of these modules comprise lectures, practical activities or draw upon datasets that link directly to research programmes carried out at Nottingham. For example since 2008, Nottingham's work on brain imaging has been an element of the *Psychophysics* module and is a unique offering on sensory training courses in the UK. Prof. Hort's research on multimodal perception forms a significant element of the *Psychophysics* module and provides industry with an understanding of the sensory impact of changing ingredients in product formulation. The new consumer methodology developed at UoN is incorporated into the *Consumer Studies and Market Research* module. The investigations students carry out for the

project module draw upon the research expertise of their tutors, founded in UoN research programmes.

Recent delegates on the course have highlighted its importance in underpinning their own research. For instance JTInternational **(Source 2)** commented that the course has enabled them to '*apply effective state of the art sensory science in the Fast Moving Consumer Good Market*'. Similarly, a senior Mars Associate described '*Through attendance I have been able to directly transfer the theory and practical experiments to our research at WALTHAM. The regular contact with the University of Nottingham and demonstration of academic excellence has given us the confidence to fund research. The outcome of the research has enabled us to jointly publish and patent research which is a first for sensory science at Mars. Having been able to prove the value in Sensory Science, my budget has grown from £0 in 2009 to £100K in 2013*' **(Source 3)**. Although sensory science is taught on some food related degree courses most individuals working in sensory departments, at all levels, enter the profession via a different route and so do not have the important training required. UoN influence on industry is summarised by Tesco's International Quality Manager **(Source 4)**: "*The reputation of Nottingham University in sensory science and its link with the industry and involvement in research, encouraged Tesco to send five of its members of staff on its PGCert in Sensory Science. The valuable knowledge and insight into the various sensory methodologies gained has led this to be a compulsory course for Tesco sensory scientists, who help shape the future of the Quality Team. Furthermore, a key learning and benefit to Tesco is the end project our staff undertake on the PGCert. This project has enabled our team to develop specialist panels such as profiling that has added value to the business and also allowed our staff to experience what it is like to create business proposals and identify solutions to problems*. *The course has allowed us to further strengthen processes we have in place e.g. panel performance and monitoring of profiling panels. It has also allowed us to keep up to speed with the latest methodologies, statistical software and thinking. We have also gained a strong network of those in the industry whereby we are able to bounce ideas and share common problems*".

The flexibility of the programme means that those working at a technical level can attend relevant modules as stand-alone courses (they run intensively over 4 days to meet industry needs) or those at a management and research and development level can attend all modules to gain a postgraduate certificate. This further improves upon their professional development. "*Completing the Post Graduate Certificate in Sensory Science part-time has been one of the best things that I have done for my career. All the modules have given me valuable information and guidance which I use every day. I particularly enjoyed the statistics, descriptive profiling and consumer studies modules; these have given me the information I need to advise clients on the best test for their products and ensure that I get the best out of my panel. Although it is hard work the benefits are definitely worth the effort and the course has the added advantage of allowing me to meet fellow sensory colleagues. I would recommend anyone who is starting out in the sensory science field or those who want to gain more knowledge complete this course*" (Sensory Dimensions delegate 2010-2013) **(Source 5)**. Delegates have up to four years to complete the PGCert. To date, 27 students have graduated, with 14 currently registered. As shown in **Figure 1**, since the inception of the Sensory Science courses (2002) Nottingham has provided training to over 200 industrial delegates. The influence of the courses has increased markedly since 2008 and numbers of new registrations for the PGCert and Professional development courses increased 20% between 2009 and 2013.

The Agrifood Training Partnership (AATP) is one of four higher-level training partnerships that have been awarded 5 years of funding by BBSRC to deliver skills and training to businesses in the agrifood sector. UoN is one of four leading internationally recognised university and research institute partners (the others are, Cranfied University, Harper Adams and Rothamsted Research) working with industry partners including Campden BRI and Cambridge University Farm. The AATP scheme **(Source 6)** has attracted additional delegates to the Sensory Science training; about 2 per course and Nottingham have had 3 enquiries to begin Masters in Research in Sensory science through this scheme. In addition to the PGCert attendance, UoN have had between 8 and 20 additional short course delegates each year attending the modules as CPD training from similar and additional companies, and some educational establishments (See **Table 1**). Thus it is evident that the sensory training Nottingham provides and the research that supports this is far reaching in terms of its effect in the UK food industry. Importantly, several of these individuals and companies

are based in Europe, e.g. JT International, Mars, Diageo, RHM, and consequently, the course is extending the impact of the research and training across the globe **(Source 2)**. Joanne Hort's 2013 appointment as Chair of the European Sensory Science Society has also added to the reach and consequent impact these courses attain.

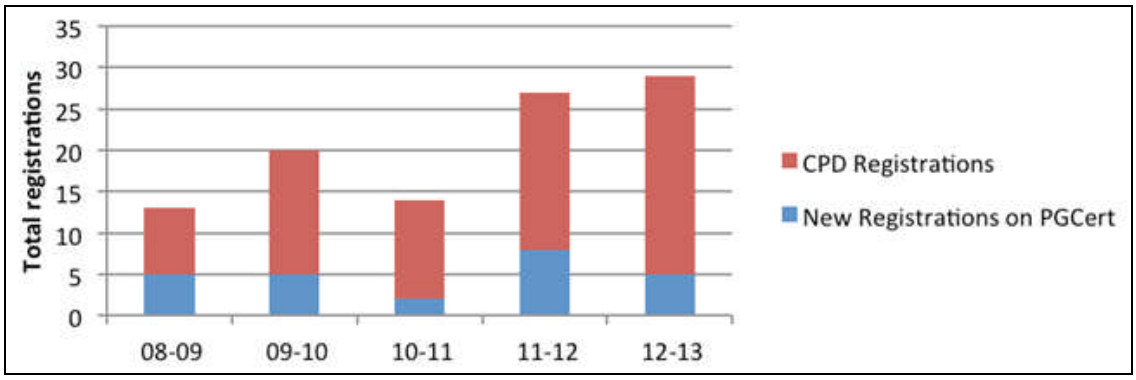

Figure 1. Increasing registrations on sensory modules and PGCert 2008-2013

Table 1 Examples of Companies sending staff for sensory training

MULTINATIONALS / MANUFACTURERS		INGREDIENTS
Unilever	Proctor & Gamble	Drogheda Concentrates IFF
Pepsico	Glaxosmithkline	Givaudan Sensient Flavours
Mars	Reckitt Bensicker	Quest Kerry Ingredients
Cadbury's	General Mills	**CONSULTANCIES / RESEARCH INSTITUTES**
RHM	Heinekin	Sensory Dimensions/ Brewing Research institute
Muller	McCain	**RETAILERS**
Barr	McCormick	Tesco
Diageo	Cereal Partners	**EDUCATION ESTABLISHMENTS**
United Biscuits	Twinings	Birmingham University
JTInternational		Harper Adams (Agriculture)
British American Tabaco		Plumpton College (Wine)
Campbells Grocery Products		

5. Sources to corroborate the impact

1. Head of Sensory and Consumer Science, Campden BRI UK- *Corroborates demand for trained UK Sensory specialists and transfer of research knowledge to industry*. 2013
2. Manager R&D/PD/Sensory, JT International Germany GmbH-*Corroborates application of state of art sensory research into industry*. 2013
3. Research Scientist, Waltham Pet Nutrition Centre, Mars, UK- *Corroborates transfer of research to business and impact of increase in research budget at Mars*. 2013
4. International Quality Manager, Tesco, UK- *Corroborates reputation of Nottingham for Sensory research, impact on career progression for attendees and benefit of research projects in providing business solutions*. 2013
5. Senior Project Manager, Sensory Dimensions Ltd Reading, UK- *Corroborates importance of course for professional development*. 2013.
6. Agrifood Advanced Training Partnership (AATP) website (http://www.agrifoodatp.ac.uk/aatp/courses/food/index.aspx) - *Highlights impact on industry and increased capability in UK industry*. 2013.