

Report on the Collaborative Science & Technology Workshop  
A UCL Grand Challenges – French Embassy partnership activity  
Fifth Annual Call for Proposals: Academic Year 2016-17

**PHOOD:**  
**Bringing together pharma and food through sensory science**  
**towards health and wellness**  
**17-18 May 2017**

**Led by**

- Dr Catherine TULEU, Docteur en Pharmacie, PhD
- Dr Anne-Marie Pensé-Lhéritier, Docteur en Pharmacie, PhD, HDR

**Background**

The global pharmaceutical market could be worth nearly \$1.6 trillion by 2020 [1] but the food and agriculture sector is even larger (est. worth \$4.8 trillion, World Bank, 2007). Despite the pharma market being comparatively smaller, yet global but with development geared towards more developed countries and not driven by competitive sales (with the exception of the Over-The-Counter OTC and nutraceuticals market), there is undeniable parallels that can be made with food market. The importance of sensory properties is that products have to be liked and preferred by consumers for repeat purchase and hence market success [2] which translates to patient compliance and treatment success in the pharma world. With the focus on treating better our children including adolescent and optimising treatment for the elderly, there is a real regulatory steer around acceptability and palatability of medicines to meet the needs of the society. Yet this aspect of sensory science is new to the industry and much is to be learned from the food industry where it has been a dynamic and fast evolving discipline.



Pharma vs Food



candy vs medicines [3]

Sensory science is a relatively new “*scientific discipline used to evoke, measure, analyze and interpret those responses to products that are perceived by the senses of sight, smell, touch, taste and hearing.*” [2] Focusing on food, sensory scientists in companies work closely with product developer to understand what consumers like and why, or if consumers can tell a difference when they change a product. Whereas In academia, sensory scientists try to understand how our senses work and how our senses respond to stimuli (both from food and chemicals) and improve testing methodology. Therefore this is a S&T challenge that sits at the frontiers of basic and applied science.

Diverse factors influence our physical and emotional wellbeing, such as ageing, behaviour and social interaction, affected by our biology, the environment (built and natural) in which we live, and how we relate to and look after one another. This workshop directly aims to address themes within the UCL Grand Challenge of Human Wellbeing that specifically considers: Adolescent Wellbeing; Demographic Change (Healthy ageing), Disability (such as sensory impairments). A positive feedback was received from the Office of the Vice-Provost (Research) that there are ‘*all sorts of angles across UCL that could be usefully captured*’(Dr Aarathi Prasad).

Medicines contribute towards prevention, cure, but also well-being and longevity and the reciprocal importance of nutrition on health is undeniable. Looking at the trends in food sensory science [3], there are various related topics which require input from researchers from diverse disciplinary and methodological backgrounds. To list a few:

- Health and wellness: Mechanisms of Food Intake, Food Choice and Consumer Behaviour, Sensory Drivers for Health and Wellbeing
- Customisation [*research on the physiological mechanisms of sensory perception to elucidate the genetic basis of taste and smell, making individual sensory customisation a real possibility*] and contribute towards making food healthier while retaining its appeal (eg. Ways to lowers salt, sugar, and fat content. This is timely in an era with computer-controlled and additive-layer-manufacturing (3D printing) techniques to provide this personalisation.
- Age-related Sensory Perception and Food Behaviour
- Neuroscience

- Cross Cultural Sensory and Consumer Research
- Developments in techniques [*Modelling Sensory Responses by Instrumental Data; Frontiers and Innovations in Sensometrics*]
- New Challenges from Sensory Science and Methods/tools with Non-food Products [*acceptability of medicines in the young and the elderly*]

Therefore the **aims of this initial workshop on sensory science between UCL and French academics and group leaders** were to

- **Landscape the expertise of UCL and French participants and scope commonalities and map areas of synergy in research**
- **Develop plans for future collaborations**
- **Understand French and UK (and international) organisation of sensory science with in mind exploring funding opportunities to enable and sustain future endeavours**

In order to build on existing, or establish new, links between UCL and French academic and research organisations to ultimately develop sensory science project ideas and initiate distinctive cross-disciplinary collaborations, drivers for Health and Wellbeing. This unique trans channel network aimed at acting as a platform within UCL in UK and key institutions in France to communicate opportunities in the wider academic community and rally exceptional researchers. In this first event, the topics suggested for discussion (but not limited to) were:

- Improving foods for the elderly
- Customizing food for Adolescents
- Learning from the modern sensory and consumer science of food industry for non-food products:
  - + Exploring palatability and nocebo/ placebo effect to enhance compliance
  - + Sensory-driven pharmaceutical/nutraceutical product design and optimization and how to use or derive food methodologies
  - + Taste chemistry [aversiveness eg *bitterness* of pharmaceuticals and structure-activity relationship]
  - + Implications of co-administration of medicines with food
  - + Sensory interface with devices used for administration

#### References

- [1] pwc.com report <http://www.pwc.com/gx/en/industries/pharmaceuticals-life-sciences/pharma-2020/market-opportunities-outlook.html>
- [2] Stone, H and Sidel, JL. 1993. Sensory Evaluation Practices. 2nd ed. Academic Press: San Diego
- [3] from Tuleu, C. 'Challenges of sensory evaluation (palatability/acceptability) of pharmaceutical products for adults and children'; IFST Sensory Science Group Conference June 16 2016
- [4] <http://fstjournal.org/features/29-1/sensory-science>

#### PREWORKSHOP ACTIVITIES

In order to start engaging, all participants CVs were circulated for pre-workshop reading and 3 key words/sentences/ questions were sought on what people would like to ask in person on the day.

#### PARTICIPANT LIST (n=11)

##### 5 From France

Dr Arnaud Aubert  
Senior Lecturer in Behavioural Psychology and Neurosciences (University of Tours, France)  
Scientific Director at Emospin  
Department of Psychology and Department of Neurosciences, University of Tours, France

*Dr Agnès Giboreau, PhD, HDR  
Research Director at Institut Paul Bocuse, The centre for food and Hospitality research, Ecully  
(She had to pull out 24h before the workshop due to personal circumstances)*

Dr Anne-Marie Pensé-Lhéritier,  
Full time professor of formulation and sensory analysis at l'Ecole de Biologie Industrielle, Cergy

Dr Claire Sulmont-Rossé  
Research Director, INRA  
Centre des Sciences du Goût et de l'Alimentation, Dijon 'Development and dynamics of food preferences and behaviour'  
Chairman of the European Sensory Network : <http://www.esn-network.com/>

Dr Thierry Thomas-Danguin

Senior Research Scientist at INRA (French National Institute for Agricultural Research)  
Affiliation: Centre for Taste and Feeding Behavior (Centre des Sciences du Gout et de l'Alimentation) / DIJON - FRANCE  
Team: Molecular interactions

## 6 From UCL

Dr Ben Hanson <http://www.benhanson.com/>  
Senior Lecturer, Departmental Tutor, Mechanical Engineering

Dr Mark Miodownik <http://www.ucl.ac.uk/mecheng/people/academic-staff/mark-miodownik>  
Professor of Materials & Society, UCL Institute of Making

Dr Mine Orlu <https://www.ucl.ac.uk/pharmacy/people/academic-research-staff-profiles/mine-orlu-gul>  
Lecturer in Pharmaceutics for Older people  
UCL School of pharmacy

Dr Smita Salunke  
Post-doctoral researcher in sensory pharmaceutics <sup>TM</sup>

Prof Mark G. THOMAS <https://www.ucl.ac.uk/mace-lab/people/mark>  
Professor of Evolutionary Genetics  
Research Department of Genetics, Evolution and Environment, UCL

Dr Catherine TULEU, <https://www.ucl.ac.uk/pharmacy/people/academic-research-staff-profiles/catherine-tuleu>  
Reader in Pharmaceutics  
Director, Centre for Paediatric Pharmacy Research  
UCL School of pharmacy

*Please note that Dr Joerg T Albert (Professor of Sensory Biology and Biophysics - UCL Ear Institute) was invited but could not attend. This was a shame as there is a lot of connection points and overlap with his SenSyT programme.*

## PROGRAMME/VENUES

- **Day 1: 17/05/2017**  
*Morning travel of French participants*

### 14.00 Arrival at UCL School of Pharmacy Room PSL2 (1<sup>st</sup> Floor)

14.00-18.00 Introductions of all participants (15min+5min Q&A / participants) to lay out the research landscape.  
incl. an Afternoon break

### 19.00 Networking Dinner in Dans le noir?

This was a continuity of the workshop: Dining in pitch darkness, being hosted and served by a visually impaired waiter and change our perspective of the world by inverting our point of view. It is a sensory experience that awakened senses and enabled to completely re-evaluate your perception of taste and smell as well as social interaction.

- **Day 2: 18/07/2017**

09.00-13.00 Workshop activities at **UCL school of Pharmacy (room 228 -2<sup>nd</sup> floor)**  
(post it notes brainstorming questions/themes)  
incl a Morning break

13.00-14.00 Networking Lunch at the UCL School of pharmacy

### 14.00 Depart

*Afternoon Travel of French participants*

## OUTCOME and FOLLOW UP ACTIVITIES

All the participants were asked to introduce themselves, their broader affiliation and their personal research/interest. The expertise in the room around sensory science was wide but encompassing perception by the senses of sight, smell, touch, taste but not so much hearing (apart from one project exploring the sound of metals). But for the purpose

of this report TASTE can be word used for meaning sensory impressions related to food uptake and probing, and that mostly with respect to the chemical sensing (taste and smell).

Children, adult and elderly were topics that seemed to be more common to all but adolescent was more of a subset of interest than real research expertise in the room. Hence it was not discussed so much.

When we looked into commonality Food/Pharma it felt that the oral phase and understanding the extent of the role of saliva in taste was probably a common theme of interest.

A discussion also took place around the interaction of the digestion and taste experience. This was linked to a lack of understanding of AFTER-TASTE which can be very prolonged with some medicines or even delayed with some food (eg garlic). For example it was hypothesised that drug Metabolism could be part of taste sensing with the potential for the latter to affect the former. Could there be a cephalic phase of digestion where the mouth warns the rest of the body and prime detoxification? This hypothesis could be tested with strongly aversive drugs that are tasteless) or not if any) when administered via another route (eg parentally or rectally) for example. In other words is there a link pharmacology (PK-PD) and sensory biology of taste?

Some in vitro (lab based) method and in vivo (animal or human based methods) are used in both field but were not necessarily the same for Pharma and Food - hence more dialog and exchange are probably necessary.

We tried to integrate wellbeing in our discussions but it felt that main difference of food over medicines was the notion of choice: food can be a medicine (prebiotics drink, redbull or protein drinks...) but not vice-versa and when you take a medicine you lose to a large extent this 'right or ability to choose': you are prescribed a drug in a specific dose/regimen. It was also recognised that emerging technologies such as 3D printing can be applied to food/medicines and add an element of choice eg colour, flavours so is of interest. There is this expertise at UCL Psychology of taste and pleasure/aversiveness was another parallel topic of discussion. And it was queried if the fact if the bad taste of medicines was a good thing or a bad thing (Nocebo effect?). There was also some reflections around:

-Palatability/perception of food: could taste sensitivity be a marker for health status? Could taste malfunction be a predictor of disease? Examples were discussed: obesity linked to cytokines and responsiveness to taste (sweet) or mice able to tolerate higher levels of quinine in case of malaria. Large long cohort study could answer these questions via an app platform or example if well designed but the possible influence of sex, age, ethnicity, environment and genetics etc on taste perception will require a very robust study design.

Neophobia and level of acceptance were also touch upon as it is often seen in children in food eg bitter vegetables or medicines. Finding an 'intervention' to minimise this would be key.

This went on to discuss what could be then common strategies in between healthy eating and a good pharmaceutical compliance. This fell under the emotional side of well-being and a solution could be to create (directly or indirectly) a positive ritual:

- via positives believes and trust eg healthier food labelled low Na, low fat, low sugars; in that respect undesirable excipients (sweeteners) could be decreased by developing a scientific approach of flavour optimisation for bitterness masking in medicines where flavouring is still very empirical. Cross modality between olfaction and taste was seen as a topic maybe better understood for food that could translate to pharma.

- via a sensory interface with devices used for or around administration eg an ear blue tooth device to remind to chew food for longer

- via a post ingestion reward eg apps to score points like a game for children – similar to score stickers for good behaviours

In conclusion we manage to landscape the expertise of UCL and French participants and scope commonalities/overlapping interest but it felt difficult in such a short amount of interactive time to map areas of synergy in research and think of concrete plans for future collaborations. However from the aforementioned discussion reported above there is few ideas that needs to be explored further.

However already 2 UCL participants have made some plans and met after the meeting to discuss. Just at UCL level it shows the need for a more integrated approach around sensory research as for example Metabolism & Society @ UCL is an active network that could maybe have been better tapped into for the purpose of this workshop.

It was very interesting to have stimulating conversations at the time, but no specific outputs were created and this was one of the main feedback from participants who were very satisfied personally with what they gained from the workshop, but would have liked to concretely tackle major challenges. This shows the momentum and the need and the appetite for collaboration.

Therefore a follow up will be done to try to group interested parties and ask them to write very short sketches of potential applications for further funding and explore funding opportunities to do so.

A tracker of attributable further developments within 12 months following the date of the workshop will be kept.

#### 1 month Post Workshop:

On the UCL side

-Behavioural Science at UCL should be linked in as their expertise in a research program would be invaluable

-The SenSyT (Sensory Systems, Technologies & Therapies) is a multi-disciplinary research network dedicated to the study of auditory and visual systems and their disorders. It would be interesting to discuss how this Sensory Biology dimension at UCL could link in with TASTE if we open up the modality range to include mechanical and possibly nociceptive pathways and also the visual sense, of course, not to restrict the modalities.

*Prof Albert angle of attack would be coming from a primary research perspective. What generates the likability or dislike aversion or attraction of particular food components on the sensory level? What does it mean it tastes good on the sensory level? Most certainly this is only partly related to gustatory receptors but the nose, mechanoreceptors on our tongue, visual impressions together create a complex, hypermodal, 'gestalt'-type stimulus. This process and the contributions of identified sensory elements would indeed be of interest and this could also be part of the SenSyT scheme. In insects, and many arthropods (e.g. spiders) the gustatory hair sensilla also harbour a single mechanoreceptive neuron, so the same mini organ at the same time mediates the chemosensory and mechanical analysis of a food item. All of this is rather detached from our more purpose-oriented and more directly application interested approaches, but adding a distinct basic research could be beneficial. He commented that at UCL there are not many people whom he could immediately identify as relevant parties. Maybe someone who could give a commanding overview over the tongue and its multiple mechanical and sensory operations? Such a perspective would surely inspire the other, more directly invested, attendants. I heard that Adrian Fourcin (emeritus Professor of Linguistics) used to give a compelling introduction to this topic. Other people at UCL, such as Sophie Scott ([sophie.scott@ucl.ac.uk](mailto:sophie.scott@ucl.ac.uk)) and Patrick Haggard ([p.haggard@ucl.ac.uk](mailto:p.haggard@ucl.ac.uk)) have done some relevant work in the past and might be able to recommend a suitable colleague or team member.*

Having done a Leadership course with him I am aware of Prof Albert's intention (leadership task) to 'promote sensory sensory biology (in research and teaching) at UCL and beyond (with his sponsor Dr Jonathan Gale).

## **FINANCE**

We are grateful for the French Embassy for financing this exciting workshop. The funds provided were spent for the travel and stay at the Goodenough Club [<http://club.goodenough.ac.uk/>, few minutes away from UCL School of Pharmacy and Kings Cross St Pancras] of the French participants: two participants from Dijon, one from Tours and one from Cergy Pontoise near Paris. *Unfortunately one participant had to pull out 24h before the meeting because her father died, following a stroke 48h before.* The funds were also spent for lunch and light refreshments for all participants during the workshop and a dinner on Day 1 at the DAND LE NOIR restaurant <http://london.danslenoir.com/en/concept-eng/> was also organised.

The final costing details are being calculated as not all expenses have been received and will be reported in a follow up email as soon as possible.