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A Feast for The Eyes: Visualising Flavour-to-Vision Synesthesia

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Abstract

Flavour-to-vision synesthesia is a rare neurological phenomenon, where a person consistently and involuntarily visualises abstract shapes, colours, or even textures whilst tasting the flavours of food. As this rare condition is currently still largely unknown to and misunderstood by many, this project aims to gain an insight into perceptual experiences of those diagnosed with synesthesia (also known as synesthetes) and to convey these findings to the general public in the form of an artefact. After comparing related projects on the representation of synesthesia, the use of 3D design, and 3D printing in combination with real props was chosen as a suitable medium to produce the final artefact. By conducting first-hand qualitative participant studies with three synesthetes, it was found that every synesthete had consistent visual depictions of flavours. Due to the idiosyncratic nature of flavour-to vision synesthesia, trends could only be found within individual cases, and not across the sampled participants. Consequently, the final artefacts were designed as a set of three sculptures to represent each participant's unique cases of flavour-to-vision synesthesia. The production of 3D-printed sculptures involved both digital and traditional art and design practices. Modifications were required to improve the otherwise less believable surface of the printed sculptures, which were generally unhindered by the chosen medium. This paper discusses the chosen methods, and practical challenges in the production process of the 3D printed research outputs.

Introduction

Synesthesia is a neurological anomaly where one sensory stimulus triggers another ‘normally’ unrelated sensory experience. Synesthesia is an umbrella term that encompasses all types of jointed experiences [11], some examples include seeing colours when listening to music (also known as chromesthesia), seeing colours projected onto numerals and alphabets (grapheme-colour synesthesia), and even tasting flavours on the tongue when reading words (lexical-gustatory synesthesia).

In this paper, we focus on flavour-to-vision synesthesia, which is when flavours of food evoke visions of abstract visual elements – this rarer subtype of synesthesia has a prevalence of approximately 0.0021% of the population [3]. People who have this type of synesthesia (also known as synesthetes) have a gift for experiencing flavours in an unbiased yet abstract way, allowing many of them to become great chefs [16]. Many synesthetes, however, tend to refrain from sharing their extra-ordinary experiences, often out of fear of being considered psychologically ill by others, since these neurological phenomena are not normally experienced by most people. This ultimately sparked our interest in finding an effective way of representing or conveying the experiences of flavour-to-vision synesthesia to a non-synesthetic audience.

Background and Related Works

Neurologist Dr Richard E. Cytowic's book [2] provides a comprehensive introduction to synesthesia, in particular, it indicates that synesthetic experience is involuntary and immediate, which means that when a synesthete receives the stimuli of an inducer (e.g the taste of chicken), the concurrent (e.g pointy shape) will occur almost immediately without any effort of imagination. The associations between the inducer and the concurrent are consistent throughout a synesthete's lifetime [14], but these experiences are also idiosyncratic [2] - this means that two synesthetes will never have the same visual experience when tasting the same flavour.

To date, it is still not clear what exactly causes synesthesia [10], nor why certain flavours are synesthetically associated with certain shapes or colours. However, recent studies have also shown the possibility of underlying cross-sensory associations in every culture that influence humans to subconsciously associate certain visual cues with preconceived flavours [15][18]. Synesthetic visions are often compared to the 'Bouba-Kiki Effect' which suggests that humans have innate ability to associate the sharp sound of the word 'Kiki' to a spiky shape, and the deeper sound of 'Bouba' to a more rounded shape. This correlation was also found between flavours and shapes, where sweet and creamy flavours (such as cheese) are often associated with the rounded shape of 'Bouba', while spicy or sour tastes (such as cranberries) are associated with the sharp shape of 'Kiki' [8][12].

One of the most famous references to flavour-related synesthesia in pop culture is perhaps in Pixar's animated movie "*Ratatouille"* [6]. In one scene (see Fig. 1, left), the main character Remi eats a strawberry and a block of cheese, while simultaneously hearing music and 'seeing' movements of shapes and colours in a non-physical black space, similar to the 'mind's eye' that is often described by synesthetes.

An example of the use of Virtual Reality (VR) technology to explain the experience of chromesthesia is "*What's It Like To Hear Colors?"* directed by Mario de la Vega [13]. Here, the use of immersive 360° video allows the viewers to see the visual experience of a chromesthesia synesthete from a first-person perspective (see Fig. 1, right). In both examples mentioned above, the use of an audio-visual medium made it possible to directly communicate the otherwise indescribable personal experiences to its viewers.

Figure 1: *Methods of representing synesthesia, left to right: Taste Visualization for Pixar's* ***Ratatouille****,* ***What's It Like To Hear Colors?*** *by Seeker.*

Terri Timely's experimental short animation "*Synesthesia"* [17] uses a mixture of live-action, stop-motion, and practical effects to visualise several types of synesthesia in a surreal manner that is bizarre yet memorable (see Fig. 2, left). While this animation does not accurately represent synesthetic experiences, it does effectively deliver the abstract concept of synesthesia in an entertaining way. The use of real props and live actors in this work emphasises that synesthetic experiences are in fact real.

Another interesting project was the advertising campaign "*Heinz Beanz Flavour Experience"* created by Bompas & Parr in 2013 [1]. The campaign presented five custom-designed physical bowls that were

intended to serve the five flavours of Heinz canned beans in (see Fig.2, right). Each bowl was designed with tactile and visual elements relevant to each of the representative flavours, with the intention that if one was to eat the beans from these bowls, they would be experiencing the visual and tactile stimuli produced by the bowls concurrently to the consumption of the beans – thereby artificially creating a multi-sensory experience similar to synesthesia. The use of 3D printing technology in product design allowed freedom for the architects to sculpt bowls with unusual structural and tactile qualities that would otherwise be more challenging to achieve through traditional means. We decided to make use of 3D printing in combination with real props to produce the artefact that represents flavour-to-vision synesthesia, as the result could be more intimate and believable, which is a quality that otherwise would be difficult to achieve through an audio-visual medium that solely exists on a screen.

Figure 2: *Methods of representing synesthesia, left to right:* ***Synesthesia*** *by Terry Timely,* ***Heinz Beanz Flavour Experience*** *by Bompas & Parr.*

Participant Studies and Artefact Designs

In order to understand the actual flavour experiences of synesthetes, we conducted participant studies to collect more qualitative insights through interviews and visual diaries. The interviews followed a structured list of explorative questions, and the participants were asked to keep a verbal or visual log of their synesthetic visions over the course of one week. Verbal depictions were often limited by the choice of words and required a more personal interpretation, but on the other hand, the sketches from the participants relayed a clearer visualisation of individual participant experiences. Three qualifying participants were recruited, who were able to synesthetically see flavours in very different ways. This reinforces the theory that synesthesia is idiosyncratic and can be different for everyone. For this reason, multiple designs were created to emphasize the variety of synesthetic experiences, as opposed to attempting to summarise the full spectrum of flavour-to-vision synesthesia within a single design. Below we detail three case studies with the participants.

Case Study 1: Participant A's Flavour-to-Shape Synesthesia

The first participant (who will be referred to as Participant A) possessed the ability to visualise flavours in the form of 2-dimensional shapes as an overlay to his normal vision. These synesthetic visions are always described as a line originating from one point, travelling clock-wise and eventually enclosing to form an abstract shape; the course of the line's travel seems to be influenced in real-time by the participant's reaction to the intensity and flavours of the food, almost like an indicator of his "flavour journey". 25 different flavour depictions were collected from Participant A, and a trend was found within the data that complex flavours produced a less defined shape, and vice versa; sweet and creamy flavours produced rounder and thicker shapes, while sharper flavours such as bitterness and sourness produced pointier and flatter shapes.

Notably, Participant A's depictions of different types of coffee all had a common hat-like shape (see Fig. 3). Here, the bulbous top part of the shape is believed to be linked to the creamy and sweet flavours of the milk, and the flat shape at the bottom would most likely belong to the bitter flavours of the coffee itself. With this in mind, a design was created that surreally combines the appearance of a cup of cappuccino coffee with the literal form of the hat-like shape as perceived through Participant A's synesthetic perception.

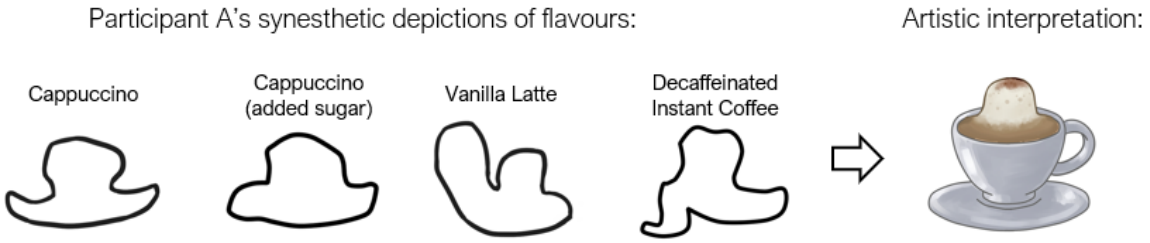

Figure 3: *Participant A's synesthetic depictions of various types of coffee and chosen design.*

Case Study 2: Participant B's Flavour-to-Colour and Flavour-to-Texture Synesthesia

The second participant's synesthesia allows him to identify flavours in colours and textures. His synesthetic vision not only can have different depth or special qualities in his field of vision, but also can have surface textures of oil, powder, cream etc... Participant B's food diary was verbally recorded and aided by the personal synesthetic colour depictions. From the data collected, it was noticeable that items belonging to the same food groups tend to produce similar colours (and therefore flavours). For example, many of the vegetables produce shades of purple to pink, while seafood was mostly depicted to be orange, and meat and dairy blue.

We focused on this participant's depiction of Chili Mac which illustrated the depth and textural quality of his synesthesia (see Fig. 4). The depictions were interpreted into a three-dimensional design where a pile of grey ash was used to represent the tomato base of the chilli, with blobs of blue produced by beef, and then dusted with a puce powder. During the interview the second participant also mentioned that chilli peppers cause him to see '*a scattering of very tiny, finely cut gemstones (rubies, garnets, emeralds, sapphires)*', which were also added to the final design.

Figure 4: *Participant B's synesthetic depictions of Chili Mac and chosen design.*

Case Study 3: Participant C's Flavour-to-Colour and Flavour-to-Shape Synesthesia

Varying from the two other participants, Participant C experiences flavours in the form of shapes and colours, including dots, lines, as well as 'open' shapes that fade away (see Fig. 5). Due to the limited timeframe of the project, only a small sample of the participant's synesthetic depictions were able to be obtained, which made it more difficult for interpreting the elements within the drawings later. The only consistency found in the participant's drawings was between the cranberry sauce and cranberry cookie, which both contained elements of the same colour – the colour of red also coincidentally matches the appearance of cranberry itself. Synesthetic visions of flavours rarely conform to the actual colour of the

food themselves - this is called the 'alien colour effect' [4][9]. Because of this, many synesthetes find it rather delightful whenever the colours do coincide with their synesthetic visions. A design was created based on Participant C's synesthetic vision of cranberry sauce. The design is a visual combination of both realistic cranberry sauce and the participant's abstract depiction of its flavour.

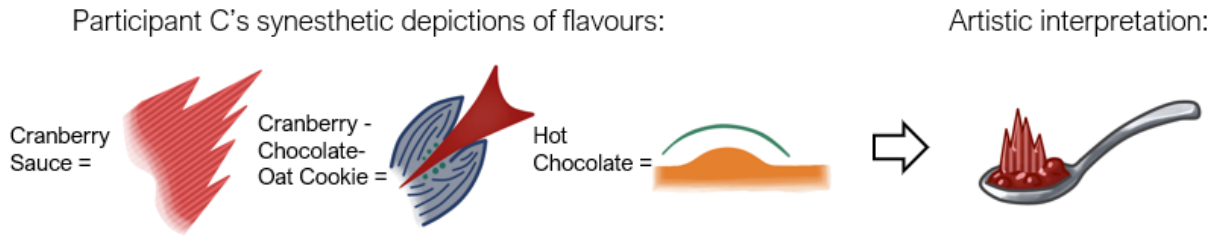

Figure 5: *Participant C's synesthetic depictions of various flavours and chosen design.*

Implementation of the Final Artefact

Initially during the design stage, the artefact was intended to be a series of sculptures that could be displayed in various exhibitions for public accessibility. The sculptures were meant to be life-sized and almost resembling real food – whilst also having an abstract form. By utilizing real tableware and cutlery that could be found at home, 3D printing was only needed to produce the more abstract portions of the designs - this would not only greatly reduce the amount of printing time and material cost. We hoped to close the perceived gap between the concept of synesthesia and reality through an artefact that is surreal yet familiar.

3D-printing allowed the creation of almost any 3-dimensional shapes, but the appearance of the printed and painted sculptures lacked the reflectivity that of real-world food items. In order to improve the photorealism of the final artefact, various types of clear surface varnish were tested to add reflectivity to surfaces while also serving as a surface protection. It was found that acetone spray paint created a surface reflectivity similar to grease (suitable for recreating surfaces of cake, cream etc.), while resin produced glassy reflectivity (suitable for recreating surfaces of jam and liquid).

The 3D model of *Synesthetic Cranberry Sauce* was also blocked out in Maya, then exported into Zbrush where the shapes merged and sculpted into the organic form jam-covered cranberries; a gradient between lighter and deeper red colours was used to paint the sculpture to mimic the subsurface scattering of real cranberry sauce. Finally, resin was used to coat the entire painted sculpture to create a syrup-like reflectivity (see Fig. 6).

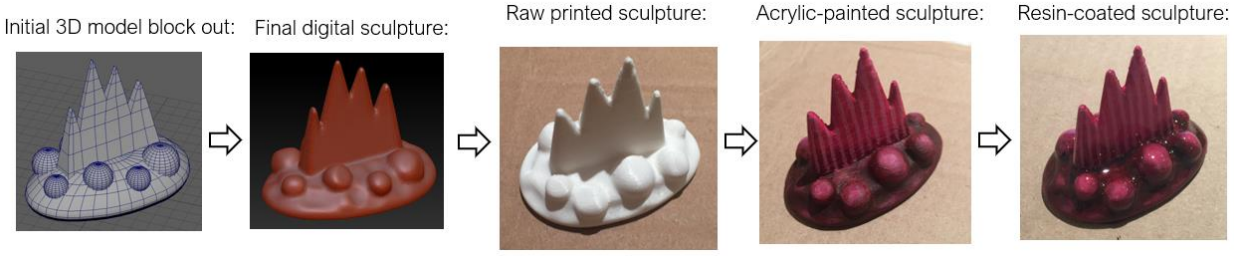

Figure 6: *Making of Synesthetic Cranberry Sauce.*

For *Synesthetic Cappuccino*, the model was sculpted in Zbrush to create the organic and airy appearance of the foam; the base of the model is a disc that is scaled to match the diameter of an existing coffee mug. *Synesthetic Chili Mac* on the other hand, involved the creation of a pile of ash, which was difficult to sculpt and 3D print as the grainy texture of ash was below the 3D printer resolution. However, that was avoided by using the hardware's ability to print the surface of a model in a jittering motion, thus giving the printed model a fuzzy surface. The rest of the design were also printed and painted separately, with the blue cube sprayed with a matte varnish to look 'waxy'; the printed diamonds were coated in resin to have more reflectivity like real gemstones - however, they could not achieve the refractive property of real gemstones as the printing material was not transparent. Finally, the smaller shapes were glued onto the model of pile of ash, and then 'dusted' with dots of light puce-coloured paint.

The final artefact is a set of three sculptures (see Fig. 7) that are meant to be appreciated together (also known as a triptych). The artefact is a result of a study of three real cases of synesthesia, as well as a personal exploration of 3D printing and model-making practice.

Figure 7: *Final sculptures, left to right: Synesthetic Cappuccino, Synesthetic Cranberry Sauce, Synesthetic Chili Mac.*

The sculpture of *Synesthetic Chili Mac* turned out to be much smaller in comparison to the other two sculptures due to the limited time available for 3D printing - this can however be justified by the fact that *Synesthetic Chili Mac* is not meant to represent the real dish, but an abstract interpretation of Participant B's synesthetic vision. To compensate for the smaller size of the sculpture, it was decided that by arranging the sculptures closer to the viewing point, it would seem bigger through perspective in an exhibition (see Fig. 8).

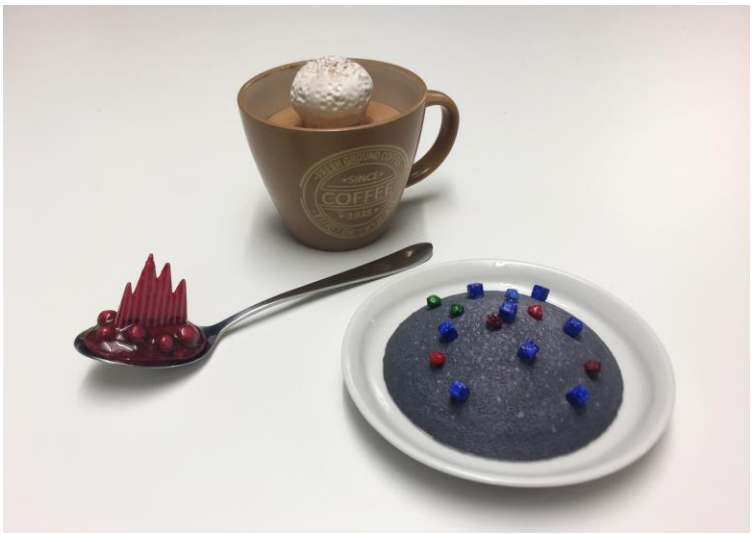

Figure 8: *Final Artefact (A triptych of sculptures) and intended exhibition layout.*

Conclusions and Discussion

The goal of the project was to conceptualise flavour-to-vision synesthesia and find a way to creatively visualise the abstract phenomenon in a way that would be accessible to the general public. The main challenge was to identify a suitable method to artistically represent synesthesia; after analysing several examples, the conclusion arrived at creating 3D-printed sculptures combined with the use of real props, with consideration for the nature of the type of synesthesia in question. 3D printing proved to be a successful method of creating physical sculptures with a freedom of design. Most obstacles were overcome during the production stage using 3D sculpting techniques, printer settings, and painting techniques. A large contributing factor to the believability of the final artefact was the use of surface varnish which added more realistic reflectivity to the surface of the sculptures. This however does not mean that physical sculptures are the best method of representation for all types of synesthesia, as the choice of medium should be made with regards to the types of sensory modalities involved.

The project examined flavour-to-vision synesthesia through three participants – this is a relatively small sample, but each participant provided very different case studies, which demonstrated the vast spectrum of possible experiences of flavour-to-vision synesthetes. Due to the lack of scientific explanations of synesthesia, interpretations of the participant's depictions may be inaccurate and misleading; it should be emphasised that the artefacts for this project are merely artistic attempts to interpret and visualise specific cases of flavour-to-vision synesthesia, they are not to be taken literally.

With the vast potential of synesthesia's scope, more work should be pursued with regards to creating a more accurate representation of synesthetic experiences – if time nor resources were limited, then a VR experience project should definitely be considered, to provide the public with more immersive and more accurate visual representations of synesthesia; moreover, with the modern '4D cinema' methods (where physical effects are combined with 3D films), more complex types of synesthetic experiences (such as those that involve sensations of temperature, touch, smell etc.) could perhaps also be conveyed to non-synesthetic audiences.

References

[1] Bompas & Parr. *Heinz Beanz Flavour Experience*. Bompas & Parr, 2013. http://bompasandparr.com/projects/view/heinz-beanz-flavour-experience/

[2] R. E. Cytowic. *The Man Who Tasted Shapes*. 2. Cambridge, Massachusetts: MIT Press, 2003.

[3] S. A. Day, 2007. "Demographic aspects of synesthesia", http://www.daysyn.com/Types-of-Syn.html

[4] S. A. Day, 2011. "The human sensoria and a synaesthetic approach to cooking", Collapse. VII, 378-409.

[5] S. A. Day, 2015. Sean Day: Flavor -> Color; Smell -> Color. http://www.daysyn.com/sean-syn-foods-and-odors.html

[6] M. Gagné, 2007. *Taste Visualization for Pixar's Ratatouille* https://www.gagneint.com/Final%20site/Animation/Pixar/Ratatouille.htm

[7] Sensology by Michel Gagné. https://youtu.be/UVWKtXDvr04

[8] A. Gallace, E. Boschin, and C. Spence. "On the taste of 'bouba' and 'kiki': An exploration of word-food associations in neurologically normal participants". *Cognitive Neuroscience*, 2 (1), 2011, 34–46.

[9] J. Gray, M. Parslow, J. Brammer, S. Chopping, N. Vythelingum, and D. Ffytche. Evidence Against Functionalism from Neuroimaging of the Alien Colour Effect in Synaesthesia. *Cortex*, 42, 2006, 309-318.

[10] J. M. Hupé and M. Dojat. "A critical review of the neuroimaging literature on synesthesia". *Frontiers in human neuroscience*, 9, 103, 2015.

[11] S. Novich, S. Cheng, and D. M. Eagleman. "Is synaesthesia one condition or many? A large-scale analysis reveals subgroups". *Neuropsychology*, 5 (2), 2011, pp 353-371.

[12] V. S. Ramachandran, and E. M. Hubbard. "Synaesthesia: A window into perception, thought and language". *Journal of Consciousness Studies*, 8 (12), 2001, pp 3–34.

[13] What's It Like To Hear Colors? - A VR 360° Synesthesia Experience. https://youtu.be/obrBAysVef0

[14] J. Simner, and E. Bain. "A longitudinal study of grapheme-color synaesthesia in childhood: 6/7 years to 10/11 years". *Frontiers in Human Neuroscience*, vol 7, 2013, pp 603

[15] C. Spence, and O. Deroy. "On the shapes of flavours: A review of four hypotheses". *Theoria et Historia Scientiarum*, 10, 2014, 207-238.

[16] C. Spence, J. Youssef, O. Deroy. Where are all the synaesthetic chefs?. *Flavour*, 4, 29, 2015.

[17] Terri Timely, *Synesthesia*. https://vimeo.com/5297531

[18] R. W. Wang, M. C. Chou, C. H. Sun, and C. C. Hsu. Research into the Differentiation of Package Design: Taste Synesthesia induced by Packaging Shapes. *Japanese Society for the Science of Design*, 57 (5), 2011, pp 117-126.