

An inclusive approach to art appreciation through visual-taste cross-sensory design by exploration with Kandinsky's *Grey Circle*

By Mingyan Wei

Submitted to OCAD University in
partial fulfilment of the requirements
for the degree of Master of Design
in Inclusive Design

Toronto, Ontario, Canada, 2023

Copyright notice

This work is licensed under the Creative Commons Attribution Noncommercial 4.0. International License. To view a copy of this license, visit <https://creativecommons.org/licenses/by-nc/4.0/>

You are free to:

Share — copy and redistribute the material in any medium or format

Adapt — remix, transform, and build upon the material

Under the following conditions:

Attribution — You must give appropriate credit, provide a link to the license, and indicate if changes were made. You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.

Noncommercial — You may not use the material for commercial purposes.

No additional restrictions — You may not apply legal terms or technological measures that legally restrict others from doing anything the license permits.

Notices:

You do not have to comply with the license for elements of the material in the public domain or where your use is permitted by an applicable exception or limitation.

No warranties are given. The license may not give you all of the permissions necessary for your intended use. For example, other rights such as publicity, privacy, or moral rights may limit how you use the material.

Note on the artwork image

Permission was granted from the Art Gallery of Ontario to reproduce the artwork *Grey Circle* for one time only for inclusion in this Major Research Project submission for OCAD University to fulfill course requirements.

Abstract

Cross-sensory translation enables people with diverse abilities to perceive and experience art through sensory modalities other than vision alone. While it is not difficult to find museums or art galleries that are beginning to incorporate auditory, tactile, olfactory, or even gustatory senses into their curatorial practice, findings from recent work on cross-modal correspondences have not been applied to the challenge of “translating” a specific visual artwork to taste sensations. This project seeks to explore a more inclusive approach to artwork appreciation by transforming visual experiences into tasting experiences, thus expanding the perceptual dimensions of artworks for a broader audience. First, this study synthesizes prior work on plastic semiotics with empirical findings from research on cross-modal correspondences to produce a conceptual model that suggests how a sensorial reading of a painting can inform a chef’s “translation” from visual cues of an artwork into a culinary experience. Then, this study practically examined the validity of the conceptual model through interviews and a co-design session with culinary professionals, seeking to understand how they recommend translating Wassily Kandinsky’s painting *Grey Circle* into a culinary experience. The research findings show how the interpretations of the specific painting through taste modalities echoed the cross-modal mappings from visual to gustatory experiences suggested by the conceptual model. Finally, the study tests the extent to which people can perceive the properties of the given painting through a gustatory experience by hosting a tasting session. The result reveals that participants can receive the intended interpretations mediated by the curated foods’ properties, which are designed to reflect and afford the sensorial expressions in the painting. Furthermore, the gustatory experience also helps visitors dive deeper into the artwork to a certain extent.

Acknowledgements

I would like to express my heartfelt gratitude to Dr. Peter Coppin, my Principal Advisor, for his invaluable guidance and support throughout my academic journey. His expertise and knowledge, including his Perceptual Artifacts Lab (PAL), have been an inspiration to me. I am deeply grateful for the time and energy he has invested in my project and for his unwavering support and encouragement. I feel privileged to have had the opportunity to learn from such a dedicated and passionate professor.

I also wish to express my sincere appreciation to my Secondary Advisor, Melissa Smith, for her wisdom, support, guidance, especially her advice always making my vague ideas come to fruition. Thank you for your Multisensory Seminars that inspired this project.

Special thanks are extended to everyone who participated in this project for their generosity in sharing their time, ideas, and expertise.

Thanks to my family and friends for their ongoing support during this inclusive journey.

Table of Contents

Copyright notice	2
Abstract	3
Acknowledgements	4
Table of Contents	5
List of Figures	6
List of Tables	6
1. Background	7
1.1 Embracing cross-sensory perception	7
1.2 Inclusive appreciation: “A Bite of Art”	9
1.3 Food as a tool for interpretation	10
1.4 Painting selection and limitations	12
1.5 Research questions	15
1.6 Research objectives.....	15
1.7 Overviews.....	16
2. Research design	18
2.1 Pragmatism	18
2.2 Concatenated exploration.....	18
3. Provisional conceptual model	19
3.1 Sensorial “code” lies in the painting	19
3.2 How forms “talk” about taste/mouthfeel	21
3.3 How colours “talk” about taste/flavour	23
3.4 Discussion of findings.....	24
4. One-on-one interviews	25
4.1 Objectives	25
4.2 Participant recruitment.....	25
4.3 Method	26
4.4 Discussion of interview findings.....	27
4.5 Conclusion.....	34
5. Online survey	35
5.1 Objectives	35
5.2 Participant recruitment.....	35
5.3 Method	36
5.4 Discussion of findings.....	36
5.5 Cross-modal correspondence wheels	39
6. Synthesis of sections three to five	41
7. Co-design and tasting session	43
7.1 Objectives	43
7.2 Participant recruitment.....	43
7.3 Method	44
7.4 Discussion of findings.....	47
7.5 Conclusion.....	50

8. Conclusion, limitations, and future study	51
8.1 Conclusion.....	51
8.2 Limitations and future studies	52
References.....	53

List of Figures

Figure 1: Reproduction of artwork <i>Grey Circle</i>	12
Figure 2: Illustration of “Takete and Baluba” or “Kiki and Bouba” model.....	22
Figure 3: A provisional conceptual model	24
Figure 4: A colour-taste cross-modal correspondence wheel	39
Figure 5: A shape-taste/mouthfeel cross-modal correspondence wheel	40
Figure 6: Apply the provisional conceptual model to the artwork <i>Grey Circle</i>	42
Figure 7: A three-tiered dessert tower with ten food items.	44
Figure 8: A photo of the event venue.....	46

List of Tables

Table 1: Descriptions of mouthfeel.....	23
Table 2: Participant demographic information	26
Table 3: The co-occurrence of colour-taste cross-modal correspondence of 4 interviewees.	31
Table 4: The co-occurrence of shape-taste cross-modal correspondence of 4 interviewees.....	32
Table 5: The co-occurrence of shape-mouthfeel cross-modal correspondence of 4 interviewees.	33
Table 6: The co-occurrence of colour-taste cross-modal correspondence.	37
Table 7: The co-occurrence of shape-mouthfeel cross-modal correspondences.	38
Table 8: The co-occurrence of shape-taste cross-modal correspondences.	38
Table 9: A table displays the descriptions and images of each food item	45
Table 10: A table shows how the tasters scored each food item.....	47

1. Background

1.1 Embracing cross-sensory perception

When Ludwig van Beethoven's Ninth Symphony was performed by the New York Symphony Orchestra at Carnegie Hall on February 1st, 1924, and broadcast live over the radio, the respected blind and deaf American author Helen Keller was in the audience. She "listened" to the symphony by putting her hand on the sensitive diaphragm of a receiver and then wrote the famous letter to describe her feelings:

What was my amazement to discover that I could feel, not only the vibration, but also the impassioned rhythm, the throb and the urge of the music! The intertwined and intermingling vibrations from different instruments enchanted me. I could actually distinguish the cornets, the roll of the drums, deep-toned violas and violins singing in exquisite unison. How the lovely speech of the violins flowed and plowed over the deepest tones of the other instruments! When the human voices leaped up thrilling from the surge of harmony, I recognized them instantly as voices more ecstatic, upcurving swift and flame-like, until my heart almost stood still. The women's voices seemed an embodiment of all the angelic voices rushing in a harmonious flood of beautiful and inspiring sound. The great chorus throbbed against my fingers with poignant pause and flow. (Keller, 1924, p.105)

While not everyone would be able to portray aesthetic emotions with graceful language as Helen Keller did, her story demonstrates how a love of art may transcend the constraints of the sensory modality for which it was originally intended by an artist. In this case, music enjoyment may not have to be restricted to the sense of hearing, and in the same vein, painting appreciation may not have to be limited to the sense of sight. Individuals may be able to engage a wider variety of sensory modalities to experience the beauty of art as long as effective strategies are available to do so. Therefore, the aim of this investigation is to discover and design a cross-sensory strategy to offer an aesthetic appreciation of visual artworks in museum collections through culinary art.

Equitable access in museum practice

In a society that increasingly respects and embraces human diversity, museums have started recognizing that they need to be more accessible, versatile, and innovative to meet the demands of visitors with varying abilities, ages and expectations. As a result, museum professionals have been exploring strategies to enable museumgoers to seek physical, social, and intellectual creative engagement rather than merely contemplative experiences (McGee & Rosenberg, 2014). A few decades ago, cross-sensory modalities were applied to participatory experiences in museum visits. Since its establishment in 1987, Art Beyond Sight (ABS, previously Art Education for the Blind) has fostered collaborations between museum practitioners and researchers with the goal of making museums and visual culture accessible to the blind and partially sighted visitors through developing multimodal tools such as touch collections and auditory descriptions (Levent & Pascual-Leone, 2014). Over the past several decades, with the rise of the field of sensory studies, investigating the aesthetic potential of the non-visual senses has been sweeping through the academy while also inspiring artists, designers, and museum curators to start incorporating auditory, tactile, olfactory, or even gustatory senses into their creations or exhibitions (Levent & Pascual-Leone, 2014).

This sensory turn may be synergistic with the definition of “aesthetics” by the German philosopher Alexander Gottlieb Baumgarten, the first to appropriate the word “aesthetics” in 1735 and describe it as the ability to judge through the senses rather than intellect (Guyer, 2007). In this view, the aesthetic appreciation of artworks during a museum visit could thus be enhanced through a multilayered (for example, cross-sensory) perceptual journey rather than merely an encounter between an enthusiastic visiting audience soaking up knowledge didactically described (via spoken or written language, for example) by the curatorial team (Levent & Pascual-Leone, 2014). Cross-sensory translation thus plays a role in this field by broadening the space for the perception, appreciation, and even the accessibility of artworks. In this study, cross-sensory translation refers to interpreting and converting perception from one sensory modality (such as sight) into another (such as

gustation) in order to provide multisensory or alternative modes of perception for people with diverse abilities and backgrounds.

1.2 Inclusive appreciation: “A Bite of Art”

The study aims to create an intuitive and intimate sensory connection between the viewers and a given artwork by using gastronomy as a perceptual medium. I am accordingly framing “a bite of art” to reflect the inclusive access to the museum collections with two dimensions: *perceptible* and *pleasurable*.

Perceptible. “A bite of art” provides a dimension of making the contents of a work of art perceptible through the tasting experience. According to James J. Gibson (1966), the mouth as a human organ is an active perceptual system that functions not only as a chemoreceptor to perceive the basic taste qualities such as sour, sweet, bitter and salty with its oral cavity or the odorous components with its retro-nasal pathway, but also an acute haptic organ for exploring a substance’s available information such as shape, size, texture, consistency, the temperature, the specific gravity, etc. with its complex musculature. Thus, assuming that the colours, forms, lights, and textures in a given painting can be rendered by the curated food through rational design, it would be possible for the guests to gain further insight and perception of the artwork by building a sensorial connection via having a “bite” of it. Specifically, the cross-sensory design will be employed to translate the given painting into curated food, thus aiding guests in perceiving the artwork by leveraging the affordances between the characteristics of the food, such as taste, odour, mouthfeel, and the plastic properties of the objects in the artwork, such as colour, light and texture, etc.

Pleasurable. “A bite of art” also implies another dimension of inclusive access to museum collections by providing guests with a pleasing somatic experience in aesthetic appreciation of artworks through gastronomy, transforming the distant visual perception of art into a living bodily engagement. Even early as in the first half of the twentieth century, the well-known American philosopher John Dewey argued that art should be viewed as an

experience rather than just a static, isolated object and that experiencing art in a museum should be an active and participatory process (Dewey, 2005). Bringing art to life is a way of bridging the gap between art and the masses, allowing more people to partake in the pleasures that were once reserved for the few (Jay, 2002). This philosophy greatly influenced the inclusive concept of this study, which focuses on combining artistic appreciation and a dining experience through “a bite of art,” providing people with an aesthetic experience via familiar activities (such as eating and tasting). It is worth noting that while museums and galleries have adjusted their roles to serve the public and committed themselves to become more inclusive by providing opportunities for diverse participation, not everyone is trained in the more technical aspects of art history and theory. “A bite of art” thus provides a possible way for people of diverse abilities and backgrounds to feel, learn and appreciate artwork by evoking multiple senses and drawing upon their existing (more familiar) experiences, ultimately enabling them to construct new perceptions from a cross-modal translation. It is also important to acknowledge that bringing pleasure to the audience through a “bite of art” is the ideal goal the project aspires to achieve, as we cannot presuppose that visitors would respond positively to it. However, we can still evaluate whether this initiative to translate artworks through taste and food brings some degree of pleasure to the participants through appropriate research methods in this study.

1.3 Food as a tool for interpretation

The existing studies revealed that food as an interpretive tool to access exhibitions or museum collections had been widely used in the curatorial, culinary, or academic fields. One of those practices was the exhibition-inspired themed menu, a comprehensive collaboration between the museum curators and the museum restaurants. The rigorously designed themed menu, like the exhibition, tells the story of the artist’s life and practice, allowing visitors to interact through different sensorial modes, from sight to taste (Mihalache, 2016). One case Mihalache pointed out was that the Art Gallery of Ontario once provided a Jewish cuisine influenced by the Chagall and the Russian Avant-Garde exhibition (Fall 2011–Spring 2012), in which the audience was introduced to Jewish culture through a multisensorial

engagement of dining experience. Another example of enhancing the audience's visiting experience through food was in the Taizhou Museum of China. There was a multisensory area of the folk exhibition, where visitors could chew dried fish, the exceptional food as a typical symbol of Taizhou Shitang fishing village. A strong, fishy taste left a deep impression on the visitors after their first bites, and the fishy smell did not go away for the entire trip. This tasting experience formed a unique participatory approach to the folklore exhibition (Wang, 2020). As can be seen from these cases, food is considered as a typical role in interpreting specific exhibitions or cultures instead of building a sensorial connection with some specific artworks.

Besides, there are some meaningful practices to make food with inspiration from artworks. A good example is the famous Mondrian Cake by Caitlin Freeman, which is inspired by the Dutch painter Piet Mondrian's artwork and interpreted from the perspective of a pastry chef (Freeman, 2013). Although visually, the cake is a perfect reproduction of Mondrian's painting, it did not mean to connect to the art in terms of taste sensations. There was also a successful experiment in the U.K. of designing a salad to reproduce the artwork "Painting NO. 201" by Kandinsky, *"support[ing] the idea that presenting food in an aesthetically pleasing manner can enhance the experience of a dish"* (Michel et al., 2014, p.1). However, the study still interpreted the work from a visual perspective.

Based on existing studies, it can be found that there is little research on how specific artworks in museum collections can be interpreted primarily and directly through taste sensations. Therefore, by experimenting with the translation of a selected painting, this study investigates how visual aesthetics can be translated into a gustatory-based somatosensory experience, thereby expanding the inclusiveness of artworks for a wider audience.

1.4 Painting selection and limitations

About the artist and the artwork

The painting chosen for this study comes from the Russian-born artist Wassily Kandinsky (1866-1944), who is credited with pioneering abstract painting in the early 20th century that sought to overturn old notions of aesthetic representation and define a new era of modernity in the field (Henry, 2009). Kandinsky's works spanned over four decades which can conveniently be divided into four periods: the Munich years (1896-1914), when Kandinsky produced his early works and gradually shifted toward abstraction; the Russian interlude (1914-1921), when his works reflected an ambivalent sense of retrospection and tentative experimentation; the Bauhaus time (1922-1933), when geometric forms became a prominent feature of Kandinsky's works; and the Paris years (1934-1944) when he ultimately adopted a combination of biomorphic and geometric figures as the basis of his abstract style (Barnett, 1982). The artwork *Grey Circle* (see Figure 1) used in this study is a 1923 watercolour by Kandinsky from the Bauhaus period, characterized by its preponderance of geometric figures, with the circle, semicircle, triangle, square, quadrilateral, irregular sharp shape, straight and curved lines corresponding different colours and strewing over the canvas. While there is no available record of Kandinsky's aims for *Grey Circle*, we can make some inferences based on what is known about Kandinsky from the same period.

Figure 1: Reproduction of artwork *Grey Circle*



Wassily Kandinsky
Grey Circle, 1923
watercolour and ink on paper
Sheet: 46.8 × 42 cm (18 7/16 × 16 9/16 in.)
Art Gallery of Ontario
Gift of Anne Callahan, 2007
2007/61
Russian, 1866 - 1944
© Art Gallery of Ontario

During his time at Bauhaus, Kandinsky's exploration of the "geometric language" of his works was reflected in his 1926 book *Point and line to plane*, which continued his earlier ideas on colour-form correspondence in his 1912 written work *Concerning the spiritual in art* and elaborated more deeply on his theoretical deliberations about the analysis of individual pictorial elements (Düchting, 2018). For example, Kandinsky described yellow as a "keen" colour, and its outwardly aggressive properties made it correspond to the sharp, active triangle. Blue was a "deep," "retreating" colour that was well suited by the more roundness of the circle. The "inner tension" of red made it correspond with the right angle and square that carried the characteristics of cold and warm (Kandinsky, 1977, pp.29-37; 1979, pp.65-74). Kandinsky also empirically examined these correspondences through surveys at Bauhaus while teaching there. Although his findings are considered more of a subjective evaluation, what can be seen is that he experimented with various combinations of elements of forms and colours and infused his "geometric vocabulary" throughout his works of that period (Düchting, 2018). For Kandinsky, each colour-form combination has its unique spiritual value, which can be a certain harmonious interaction, but an unsuitable combination, when manipulated, may also show the way to fresh possibilities of harmony (Kandinsky, 1977).

As an artist who is considered to have a great interest in synesthesia (Ione & Tyler, 2003), Kandinsky also interpreted the cross-modal association between visual art and musical forms, such as that bright yellow is difficult to associate with bass notes while a dark lake is dissonant with treble. Also, he likened the colours to the sounds of different musical instruments, such as the keen lemon-yellow to the shrill sound of a trumpet and the restful dark blue to the deep sound of a cello (Kandinsky, 1977). Kandinsky's art and theory convey his more intuitive cross-modal approach and his desire to bring audiences the cross-sensory experience of the music in his works (Ione & Tyler, 2003), which serves as an inspiration for this project's aim to foster increased avenues for audiences to appreciate a work of art through cross-sensory translations. As more senses are activated, the audiences may gain more insight from the artwork, as different senses may have the potential to capture

different features of the work of art, and combining these perceptions may contribute to a more complete and nuanced comprehension of the piece.

Therefore, as an extension and experiment to experience Kandinsky's work across the senses, this project is dedicated to connecting the work *Grey Circle* with the viewer through taste modalities, providing a new perspective and somatic experience for engaging the artwork.

The 46.8 by 42 cm painting *Grey Circle* is in the Art Gallery of Ontario (AGO) collection, and this project has received permission from the AGO to display its digital copy.

Limitations

Although Kandinsky's interpretation of sensory association is highly illuminating, it should be noted that this study does not merely follow Kandinsky's theory, as it aims to establish a provisional conceptual model for translating visual art into taste modalities. The work *Grey Circle* was used as a sample to apply and test the model, providing a perspective and reference for translating more artworks by optimizing the model in the future.

In this cross-sensory design, the role of a translator is someone interpreting the artwork in the context of creating exhibits and experiences accessible to audiences with a wide range of abilities and sensory experiences. The translation process involves a team that may include professionals from multiple fields, such as the designer and the chef involved in this study. An obvious problem then arises with the subjective nature of cross-sensory translation, as it may reflect the translator's own sensory experiences, perspectives, and abilities. Another noteworthy limitation is that such translations are more directed to the visual content of the painting itself and may not sufficiently reflect the artist's original intention or the historical and cultural context in which the painting was created.

Nevertheless, the cross-sensory design still possesses the value of providing a means for a broader audience to appreciate a work of art, as long as that translation is well-informed and supported by adequate evidence. Therefore, this study is designed to focus on

translating the visual content of artworks and employing a range of research methods in an effort to establish a relatively concrete sensory connection between viewers and artworks by exploring and presenting a cross-modal correspondence between vision and taste. Additionally, it attempts to give the translators (chef or designer) a guide to inform their creative interpretations of visual artworks for perception through taste modalities and corresponding foods, allowing visitors to potentially establish a more and intimate connection with the painting based on familiar culinary experiences.

1.5 Research questions

This study was conducted with two questions in mind:

1. How can the visual content of artworks be translated into a gustatory experience and thus expand the perceptual dimensions of those artworks for the audiences?
2. To what extent can translating visual aesthetics into a gustatory experience increase the audience's engagement with a particular work of art?

1.6 Research objectives

There are three main objectives of this research:

The first objective is to develop a provisional conceptual model by drawing upon theories derived from a literature review focused on the possibility that visual depictions of a given painting can be perceived and translated through the sensory modalities of taste. This objective strives to develop a provisional conceptual model that could practically inform the cross-sensory translation of the specific painting.

The second objective is to translate Kandinsky's painting *Grey Circle* as an experimental sample. The provisional conceptual model will be tested during the translation by conducting expert interviews and an online survey.

The final objective is to create real food to translate the artwork based on the research findings through co-design with culinary professionals and to evaluate this translation from sight to taste by hosting a tasting session.

1.7 Overviews

Sections one and two present the project's background, methodology and research design, respectively.

Section three contributes a provisional conceptual model based on the literature review of plastic semiotics, describing cross-modal correspondences between discrete visual cues. On the one hand, chromatic categories are colours, structured in contrasts such as red/green, light/dark and correspond to taste/flavour. On the other hand, eidetic categories are binary oppositions, such as angular/round, convex/concave, etc. and correspond to taste/mouthfeel. The conceptual model suggests how food can be designed and configured to correspond to visual artwork.

Section four describes interviews with chefs practically translating the painting *Grey Circle*, revealing their viewpoints for deconstructing visuals into taste modalities through segmented descriptions, such as tone, composition, and other detailed interpretations. Their responses also show similarities in the cross-modal perception of colours, such that yellow tends to be associated with a sour taste. Meanwhile, there is relative consistency in the Kiki and Bouba effects on geometric shapes, such that the angular or spiky shapes reflect a distinct Kiki effect corresponding to a relatively sharp mouthfeel, the rounded or curved shapes respond to an apparent Bouba effect corresponding to a relatively mild mouthfeel. The findings in this section echo the conceptual model in Section three.

Section five is designed to reinforce section four's results in finding the patterns of cross-modal correspondences between discrete visual cues in the painting. An online survey of a larger data sample is used to find each visual clue's most representative taste or mouthfeel

through the lens of chromatic and eidetic categories. The eight colours in the painting were grouped into the chromatic category, with each colour corresponding to one of the most representative tastes/flavours. And the roughly eight geometric shapes were categorized in the eidetic category, with each shape corresponding to its most representative taste as well as the mouthfeel corresponding to the Kiki and Bouba effect.

Section six aggregates the findings from Sections three to five by visually illustrating the application of the conceptual model to the painting *Grey Circle* through an intuitive diagram. The diagram shows the painting being disassembled into discrete visual elements and grouped into the chromatic and eidetic categories according to their attributes. The cross-modal correspondence approach is then employed to find foods that could trigger the taste sensations corresponding to these elements in each category.

Section seven describes the co-design and the subsequent tasting sessions used to evaluate the translation results. Two culinary professionals co-create an afternoon tea menu, presented as a dessert tower, in which each of the ten treats corresponds on a taste and a visual level to the visual cues in the painting *Grey Circle*. The tasters' participation and feedback from the questionnaire indicate that the tasting experience led participants to a more detailed observation of the painting. Moreover, they can grasp the information mediated by the curated foods' properties that are designed to reflect and afford the sensorial expressions in the given painting. The findings demonstrate the possibility of a painting being perceived through the experience of taste.

Finally, section eight summarizes the entire study and points out the limitations, as well as future research.

2. Research design

2.1 Pragmatism

This project is rooted in the pragmatism research paradigm, which is concerned with utilizing the most appropriate methodological approaches to find solutions to answer the research questions, allowing researchers to draw liberally from quantitative and qualitative strategies when engaging in their studies (Creswell, 2014). Accordingly, this study adopts a mixture of methods to gather both qualitative and quantitative data in order to present a comprehensive analysis of the research findings.

2.2 Concatenated exploration

Since this study consists of a series of research phases, with each relatively independent of the other, it also is an example of concatenated exploration, which is a longitudinal research process resulting in a set of studies that are linked together (Stebbins, 2010). Concatenated exploration in this study is described as conducting a series of research phases, each with its specific research objective, method, analysis and conclusion, and unfolding through separate sections. As the findings of the phased research accumulate, the overall research purpose is achieved.

The research process was carried out through the following four concatenated phases, as noted in the introduction:

- A literature review provides the building blocks for a provisional conceptual model to inform the sections that follow (Section 3).
- One-on-one interviews with culinary professionals serve as a bottom-up inductive process to uncover a pattern of findings that are consistent with the predictions of the model (Section 4).
- A survey of cross-modal correspondence perception is served to examine whether the research findings of the previous interviews show up in a broader sample of people. (Section 5)

- A co-design task and a subsequent tasting session are conducted to practice the cross-sensory translation and evaluate the research results. (Section 7)

Specific procedures for each concatenated investigation are detailed in the appropriate sections.

The OCAD University Research Ethics Board reviewed and approved this research (REB reference number #2022-37). To ensure confidentiality, all participant data in this study has been anonymized.

3. Provisional conceptual model

To suggest how culinary experiences can be designed and configured to correspond to visual artworks, this section synthesizes plastic semiotics theory, which focuses on non-figurative abstract elements of artworks (Greimas, Collins & Perron, 1989), with recent empirical work identifying cross-modal correspondences between visual phenomena and gustative phenomena of food (Spence & Ngo, 2012).

3.1 Sensorial “code” lies in the painting

The interpretation of the artwork in this study attempts to capture and analyze the sensorial aspects in the painting from the perspective of plastic semiotics, an approach that emerged in the realm of visual semiotics (Žemaitytė, 2017).

The field of visual semiotics is concerned with the way visual images convey messages and meanings, while Floch (1985) proposed distinguishing visual semiotics in terms of figurative and plastics levels (Aiello, 2020). Figurative meaning refers to the visual depictions representing objects in the real world, such as a tree, a table, a figure, etc., that can be recognized as signs in a representational painting (Nöth, 2011). However, when a figurative reading or referential impression of an image is challenged or even rejected, as is the case with Kandinsky, who seeks to free the objects from any figurative traces, the plastic semiotic approach will aid in interpreting the “surface” reading of the artwork (Greimas et al., 1989),

such as brushwork, textures, shapes, colours, light, and the overall composition, etc. (Žemaitytė, 2017).

Building on Floch (1985), Žemaitytė (2017) indicates that plastic semiotics is about searching and describing the sensorial logic of visually perceived objects, for example, the “treatment of forms and colours” and the “trace of brushwork” of a painting, from which to analyze how these visual cues “speak” in terms of sensorial expression (p.154). Plastic semiotics also offers the instrument to expand the perceptual dimensions from one sensory phenomenon to others through the oppositional nature of the sensorial expressions of plastic qualities and the “synaesthetic use in the language” (p.158). For example, “[as] the tactile categories ‘soft/hard,’ ‘round/sharp,’ ‘warm/cold’ are habitual terms to describe the qualities of audial, visual and olfactive phenomena: a soft light, a warm voice or colour, or a sharp smell” (p. 158). Therefore, in this study, it is not difficult to make a similar analogy that in interpreting the abstract elements of a painting through the oppositional plastic expressions, such as a smooth/rough plane, we likewise may bring in the taste perception in terms of a smooth or rough mouthfeel.

According to Greimas et al. (1989), it is possible for an image to be topologically segmented into discrete substructures for identification in terms of eidetic and chromatic categories. This process of topologically segmenting and clustering substructures under plastic categories is an application of the Topological Mechanism, according to Greimas. The eidetic categories pertain to the forms that consist of binary oppositions, such as angular/round, convex/concave, etc., while the chromatic categories are related to the perception of colours, structured in contrasts such as saturated/unsaturated, light/dark, etc. (Nöth, 2011). This contrastive analysis of the visual elements of the image “surface” under the plastic categories can be extended to the analysis of the perception of other sensory substances as well. In music, for example, “notes as units of certain tones would be treated as eidetic categories, and the qualities of sound itself ‘inside’ the note, such as timbre, hue or ‘colour,’ would be seen as units making up chromatic categories” (Žemaitytė, 2017, p.156). Similarly, I argue that the sensorial expressions of taste sensations can also be analyzed in analogy to

these two categories, in which the mouthfeel of the object's texture, shape, etc., could be seen as eidetic categories, and the taste or flavour of specific colours would be regarded as the chromatic categories. Specifically, this study sought to target a given painting with the mouthfeel to associate forms as discrete units in eidetic categories and with the gustation to correspond to the colours in chromatic categories.

Plastic semiotics provides us with a strategy for possible sensory interpretations of a visual image, and the next step is synthesizing the discrete units that are attributed to the two plastic categories into cross-sensory correspondences.

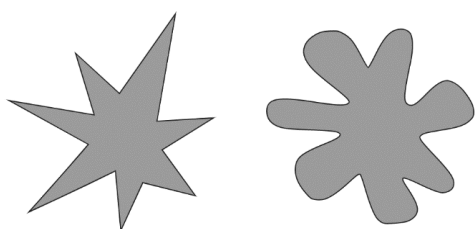
3.2 How forms “talk” about taste/mouthfeel

Spence & Ngo (2012) define cross-modal *correspondences* “as a tendency for a sensory feature, or attribute, in one modality, either physically present or merely imagined, to be matched (or associated) with a sensory feature in another sensory modality” (p.1). This concept is used in this study to associate the visual elements of the given painting with sensory modalities of taste/mouthfeel.

According to Spence & Ngo (2012), there are a variety of cross-modal correspondences between abstract shapes and gustative phenomena. A series of recently published experiments have started to document the existence of some robust and easily demonstrated cross-modal correspondences between shapes and various sensory properties of a variety of real foods and beverages. For example, there is a tendency to match sweet foods to organic or rounded shapes and more angular shapes to bitter and sour foodstuffs. This association is largely relevant to the famous “Baluba and Takete” model (see Figure 2) of the German psychologist Wolfgang Köhler in 1929, whose findings from the model exhibited that people showed a strong preference for associating jagged shapes with the “harsher” sound of the word “Takete” and rounded shapes with the rounded sound “Baluba” (Spence & Ngo, 2012). While Köhler's initial model is about the cross-modality between shapes and sound, later studies have shown that the model is also

applicable to other sensory modalities, such as between shapes and tastes. Notably, Köhler's model was originally tested with a native Spanish-speaking population, so in a later series of successfully replicated experiments, a number of different term pairs, such as "Takete and Maluma" and "Kiki and Bouba," were used to accommodate participants with different native languages (Gallace et al., 2011). The word pair "Kiki and Bouba" was applied in this study for this model.

Figure 2: Illustration of "Takete and Baluba" or "Kiki and Bouba" model



In parallel to establishing cross-modal correspondences between tastes and forms, the mouthfeel can also be associated with specific forms based on the "Kiki and Bouba" effect. In addition to being able to sense tastes and odours (through the retro-nasal cavity), the mouth is also a somatosensory receptor to explore "a range of sensory sub-modalities that include touch, pressure, temperature, and pain" (Shepherd, 2013, p.128). Thus, it is conceivable that our mouths would be capable of receiving the intended interpretation mediated by the curated foods' physical properties, which are designed to reflect the sensorial expressions in a given painting. For example, we might use food with a delicate mouthfeel to make a sensory connection with a smooth surface created by even, unbroken brushstrokes, or use a food with a creamy, viscous mouthfeel to associate with thick brushstrokes that apply a sense of depth and substance in an impasto painting.

To more accurately represent the mouthfeel and delineate the range, the study drew on Shepherd (2013)'s terminology (listed in Table1) of how the somatosensory system tested the state of food.

Later sections apply these terms to the "Kiki and Bouba" model. Relatively "sharp" mouthfeel descriptions, such as "stiff," "rough," and "pain," etc., were assigned to the "Kiki"

category, and relatively mild descriptions, such as “soft,” “smooth,” and “lukewarm” etc., were assigned to the “Bouba” category.

Table 1: Descriptions of mouthfeel

Qualities of Mouth-Sense: Touch, Feel, and Texture		
Smooth	Soft	Pain (burning)
Creamy	Slippery	Pain (sticking)
Viscous (thick)	Rough	Pain (aching)
Crunchy	Gritty	Ease of fragmentation
Crisp	Astringent	Sticky
Springy	Hot	Dry
Chunky	Cold	Crumbly
Stiff	Lukewarm	

Note. The table from “*Neurogastronomy: How the Brain Creates Flavor and Why It Matters*,” by G.M. Shepherd, (p. 130) 2013. Columbia University Press.

3.3 How colours “talk” about taste/flavour

“One might say that keen yellow looks sour, because it recalls the taste of a lemon” (Kandinsky, 1977, p.24).

A fascinating corpus of empirical research undertaken over the past three decades now reveals that all of us (whether synaesthetes or not) do match colours to basic tastes (salty, sour, sweet, bitter, and umami) in a way that is far from arbitrary, but tends to be regular across individuals and remains consistent over time (Spence et al., 2015). For example, Spence et al. tell a very consistent story based on data from a series of colour-taste cross-modal correspondence studies, with black or purple being widely associated with bitterness, white and possibly blue with saltiness, yellow or possibly green with sourness, and red and pink with sweetness. Besides, at least over the past thirty years, there is also good evidence to suggest that the colour-taste cross-modal correspondences are consistent across different cultures and over time, despite substantial cultural differences in the usage of colours across cuisines (Spence et al., 2015).

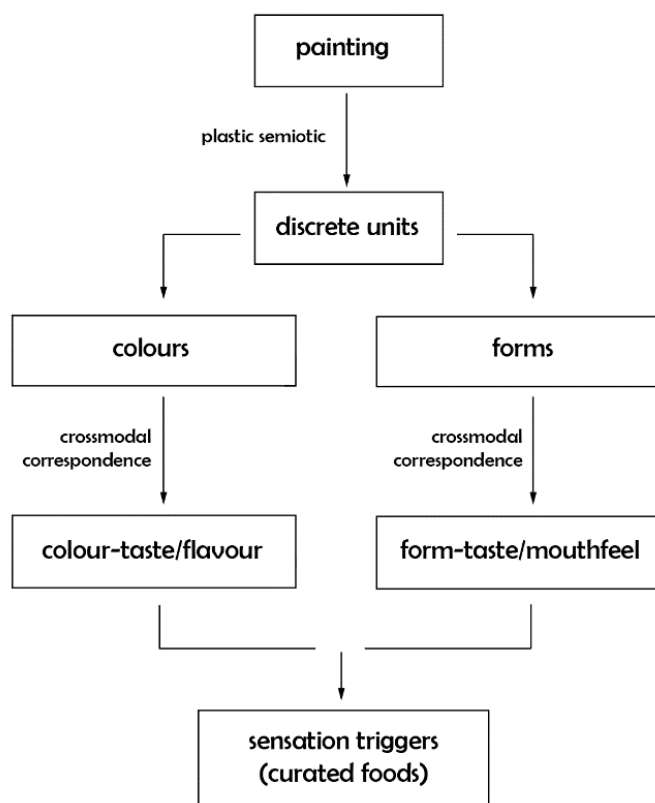
Notably, the correspondences between colours and tastes are also intriguingly diverse since it is evident that colours are not uniquely associated with a certain food source. For example, although the red colour commonly corresponds to sweetness based on research data, it is not just a characteristic of sweet ingredients, which also brings to mind chilli peppers and red meat (Spence et al., 2015). Even so, the concept of cross-modal correspondence has proved the possibility of interpreting colours in a given painting through the sensory modalities of taste, as it suggests that the colour-flavour match works for most people.

3.4 Discussion of findings

Based on the abovementioned theories derived from the literature review, a provisional conceptual model emerged that shows how a painting can be translated from visually to

Figure 3: A provisional conceptual model

A Provisional Conceptual Model



the sensory modalities of taste sensation. An illustration of the conceptual model can be found in Figure 3. A given painting is decomposed into discrete units in terms of forms (eidetic category) and colours (chromatic category) through plastic semiotic analysis. In the eidetic category, units of forms can be described as opposites of hard/soft, sharp/round, rough/smooth, etc., in analogy to the sensorial expression of the mouthfeel. While in the chromatic category, the colours are the discrete units that can be described in analogy to the sensorial expression of tastes or flavours. And the units in each

category can correspond to the food that triggers the senses by means of cross-modal correspondence. The validity of the conceptual model will be tested in the following research process.

4. One-on-one interviews

4.1 Objectives

Whereas the foregoing Section three contributes a provisional conceptual model, this section begins the process of applying the model to practical culinary situations through one-on-one interviews with culinary professionals engaged in translating the painting *Grey Circle* into taste modalities. Interviews were conducted to achieve three goals:

1. To learn general insights from culinary professionals in interpreting artworks through culinary arts.
2. To test the conceptual model through culinary professionals' impromptu translation of the painting *Grey Circle*.
3. To find the sensory pattern of taste modalities in the given painting as a reference for later co-design use.

4.2 Participant recruitment

Four professional chefs/cooks were recruited to participate remotely in the one-on-one interviews. Participant inclusion criteria were defined as professionals who worked in the culinary industry for at least one year. At least one or two of them attended the following co-design activity in person in Toronto. The professionals were recruited within the researcher's social networks and by word of mouth. Recruitment invitation letters were sent through social media and emails to whom might be interested in the research.

All four individuals who participated were professionals with various years of experience in the culinary industry. The demographic information of participants is shown in Table 2, including the four interviewees' positions, years of work, residence, and the pseudonyms.

Table 2: Participant demographic information

Participant	Years of work	Residence	Pseudonym
Secondary cook	more than 1 year	Toronto	C1
Pastry cook	more than 1 year	Toronto	C2
Chef	more than 30 years	Beijing	C3
Chef & Nutritionist	more than 10 years	Melbourne	C4

4.3 Method

The one-on-one interview consisted of three stages. The first stage of the interviews was semi-structured in order to offer more flexibility for interviewees to emphasize their own perspectives. Additionally, this stage served as a warm-up activity that allowed the participants to open their minds and aimed to learn their perspectives, willingness, or experiences with interpreting artworks through culinary arts. The prompt questions are as follows:

- Could you introduce the relationship between cooking and art from your point of view?
- Have you ever created any dish inspired by a piece of art?
 - If the answer was “yes”: Could you tell me more about it?
 - If the answer was “No”: Could you tell me about any dishes you know of that were inspired by art?
- How do you understand the use of food to present artworks?
- How do you understand the use of the sense of taste to present artworks?

The second and third stages of the interview were designed to observe and analyze the interviewees’ translation processes and thus test the prediction of whether the provisional conceptual model applies the practical operation of the translation of a specific painting. In the second stage, the researcher showed each participant the digital image of Kandinsky’s painting *Grey Circle* and asked them to improvise a translation of the painting through a recipe or ingredients from their professional perspective.

The third stage involved asking them to complete a pre-prepared online questionnaire to explore the tendencies in cross-modal correspondences between taste sensations and abstract elements in the painting. In the questionnaire, the overlapping geometric figures in the painting were separated into eight individual colour and eight individual shape units using Photoshop software. Each colour or shape unit was presented independently in the questionnaire and corresponded to one or two multiple-choice questions to capture the interviewees' intuitive perceptions. To simplify the questionnaire, similar shapes, such as triangles, were not repeated in the questions, and all the lines were grouped together in one question.

Each of the eight colours in the painting corresponds to a multiple-choice question:

- "Please choose the taste of the colour." The five options of the question are "Sour," "Sweet," "Salty," "Bitter," and "Umami."

Each of the eight shapes in the painting corresponds to two multiple-choice questions:

- "Please choose the taste of the shape." The five options of the question are "Sour," "Sweet," "Salty," "Bitter," and "Umami."
- "Please choose the mouthfeel of the shape." The options of the qualities of the mouthfeel for the question are listed in Table 1.

The colour and shape units were reproduced as close as possible to the ones in the painting.

The four one-on-one interviews were conducted via ZOOM virtual meetings, and the online questionnaire was conducted through the Typeform platform. Each interview lasted 60 to 90 minutes in length.

4.4 Discussion of interview findings

At the first stage of the interview, the four interviewees freely expressed their perspectives, willingness, or experiences of interpreting artworks through culinary arts. Their views are reflected in the following facets:

Culinary art is a creative process that can convey messages. Chefs can be inspired to develop new dishes from many sources, including a painting, a film, a sculpture, or even architecture. When chefs present their dishes, they also want to convey to their customers the inspiration for their creations and the concepts they want to express. - C1

Culinary art is to stimulate the multisensory enjoyment of diners by presenting and conveying a dish's colour, aroma, form, taste and meaning. The chef is able to convey something through a dish from a multisensory perspective, including the message of art. - C2

Art can convey beauty, and so can food. Just as dance is a form of expressing art through body language, cooking is a form of expressing art through food, and it can be appreciated and give a sense of beauty. - C3

It can be observed from the interviewees' descriptions that they agreed that food could convey their intended interpretations (based on visual cue they observed when examining artworks) through culinary art. After the warm-up stage, the interviewees all opened their minds and proceeded to the next interview stage.

Entry Points for Translation: Plastic analysis

From each interviewee's improvised translation process of the painting *Grey Circle*, it was found that they had three distinct entry points: the tone, the composition, and the segmented interpretation (colours and shapes). Without being informed of any analysis methods (the Provisional Conceptual Model), it can be observed that the interviewees could instinctively segment the painting topologically in a way they thought was reasonable to find the sensory expressions in it and translate it accordingly.

- Viewpoints of colour tone

When asked about the overall sensation of the painting, two interviewees expressed that the cold tone of the painting made them want to interpret it in terms of some cold cuts or frozen desserts.

The tone of this painting is a bit dark; the colours are not that sharp and bright, so I tend to use cured or aged ingredients... This painting gives me a cold and salty feeling, so I might present it with a platter of cheese and prosciutto. - C1

Most of this painting is in cold tones, so I would think of some frozen desserts, like ice cream soufflé. -C2

- Viewpoint of composition

Two interviewees had their interpretations from the perspective of the composition. One of them expressed that the white background of the painting looked like a white square plate. The composition of geometric shapes in the paintings inspired her to forage through her recipe database to consider many possibilities for combinations of ingredients on that plate. The other one said that the perfect composition of the painting reminded him of an essential part of culinary art: plating (decorating the plate) and presenting.

- Viewpoints of segmented interpretation

When asked to translate the painting in terms of a recipe of specific ingredients, all four participants addressed separate elements of the painting, such as a certain colour, form or specific detail, interpreted with their understanding of the ingredients.

I will use cheese to explain it mainly in terms of its texture without considering the colour. Grana cheese has a hard texture and salty taste, which can somehow interpret the triangles or the forms with sharp corners in a painting. Of course, it can also be shaped into forms in line with the ones in the painting. - C1

As a pastry cook, each geometric figure in the painting can be presented as a French dessert for me. The blue and yellow triangle in the picture makes me instantly think of opaline, a kind of transparent sugar flake used in dessert decorations. It would be a good idea to present this painting with an afternoon dessert tower. -C2

In my imagination, the black “lightning” figure in the painting can be interpreted as the skin of the duck breast being roasted at a high temperature into a crispy texture. ... I think designing a tasting menu with multiple dishes to interpret the different elements in the painting would give the chef better creative space. -C3

The circle represents the meatball or might be a vegetarian meatball. We can use spaghetti to interpret some elements because we can do free-colour of it, such as squid ink spaghetti. - C4

The four interviewees’ translations of the painting reveal that their interpretive perspectives and processes resemble the analytical approaches of plastic semiotics, what Greimas referred to as the topological mechanism, in which the content of a painting is broken down into substructures that lead to the possible directions of reading (Žemaitytė, 2017). Meanwhile, it can also be observed that when interviewees tried to interpret these units in terms of specific ingredients, they naturally made associations through cross-modal correspondences. To further understand the cross-modal correspondences between visual and taste senses in this painting, a closed-end questionnaire was conducted in the interview’s final stage.

The tendency of cross-modal correspondence perception in painting

The questionnaire’s result reveals how the cross-modal correspondence between visual sense and taste or mouthfeel influences the perception of the painting among the four participants. The analysis shows their tendency to associate colours or shapes with certain taste sensations. For example, when mentioned yellow, most thought it was sour or sweet,

but none of them considered it bitter or umami. And bitterness and umami were the overwhelming choices for the perception of black colour.

Colour-taste correspondences

Table 3 illustrates the data extracted from the questionnaire that reflects the distribution of the colour-taste cross-modal correspondence of the painting among the four interviewees. The digits in the cells represent the co-occurrence of the eight colours of the painting (yellow, ochre, red, crimson, blue, navy, grey and black) and the five basic tastes (sour, sweet, salty, bitter and umami). The larger the number in the cell, the higher the frequency of co-occurrence and the higher the saturation of its corresponding cell colour, while a cell with no color means that the frequency of co-occurrence is zero.

Table 3: The co-occurrence of colour-taste cross-modal correspondence of 4 interviewees.

		8 colours in the painting							
		YELLOW	OCHRE	RED	CRIMSON	BLUE	NAVY	GREY	BLACK
5 basic tastes	SOUR	3	1	0	2	0	0	0	0
	SWEET	2	3	1	2	1	2	1	0
	SALTY	1	2	0	0	2	1	0	0
	BITTER	0	2	0	0	1	0	1	3
	UMAMI	0	0	0	1	0	0	2	3
	(SPICY)	0	0	3	0	0	0	0	0

As can be seen from the table, the most frequent gustatory sensation corresponding to the yellow colour was acidity, with a co-occurrence value of 3. The next most frequent sensation was sweetness, with a value of 2. Only one person perceived the colour as salty, while no one perceived the colour as bitter or umami. For the colour ochre, most of the interviewees associated it with sweetness. The crimson was perceived as sweetness or sourness. Two participants felt the colour blue was salty, and also two considered the navy blue sweet. The

colour grey tended to be an umami taste. For the black colour, they had a strong commonality that it was bitter or umami.









It is worth noting that although spiciness is not one of the basic tastes and falls into the cross-modal correspondence between visual and trigeminal sensations (Shermer & Levitan, 2014), the bright red colour in the painting was a distinct colour cue that participants associated with spicy foods during the interview. Therefore, the table also shows the sensory modality regarding spiciness. As previously mentioned in section three, the correspondence between color and food source is not unique in nature. While participants tended to associate red with spicy foods during the interview, respondents also tended to associate red with sweetness in the next survey session when spicy options were not available.

Form-taste/mouthfeel correspondences

In terms of the form-taste/mouthfeel cross-modal correspondences that lie in the painting, Wolfgang Köhler’s “Kiki and Bouba” model was applied in the analysis.

Table 4 illustrates how the participants matched the different shapes with the five basic tastes. The number in the cells indicates the frequency that participants paired the shape with the corresponding taste sensation. The cell with the largest number means the participant made matches more frequently and accordingly shown in the darkest shade. As the number decreases, the shading gradually becomes lighter. While the cell showing 0 means the match rate is 0 and is not coloured.









Table 4: The co-occurrence of shape-taste cross-modal correspondence of 4 interviewees

								
sour	0	1	1	0	0	2	1	0
sweet	2	2	1	0	0	1	0	1
salty	0	1	0	1	1	1	1	0
bitter	0	0	0	0	1	2	1	1
umami	1	1	0	1	0	0	0	

The results show that the participants tended to match angular or spiky shapes with relatively harsh tastes, such as sourness or bitterness (Kiki effect) and rounded shapes with relatively mild tastes, such as sweet or umami (Bouba effect).

Table 5 is presented similarly to illustrate the distribution of shape-mouthfeel cross-modal correspondence among the four interviewees.

Table 5: The co-occurrence of shape-mouthfeel cross-modal correspondence of 4 interviewees.

		Bouba ←————→ Kiki								
										
Bouba	slippery	0	1	0	0	0	0	0	0	
	crumbly	0	1	1	1	0	0	0	0	
	smooth	1	0	1	0	0	0	0	0	
	creamy	2	0	1	0	0	1	0	0	
	soft	2	2	0	1	0	0	0	0	
	lukewarm	2	2	2	0	0	0	0	0	
	crunchy	0	0	1	1	0	1	0	0	
	sticky	1	2	0	0	0	0	0	0	
	viscous(thick)	0	0	0	0	1	0	0	0	
		0	0	1	1	0	0	2	0	crispy
	0	0	0	0	1	1	1	1	stiff	
	0	0	0	1	1	1	0	0	rough	
	0	0	0	1	0	0	1	0	cold	
	0	0	0	0	0	0	1	1	hot	
	0	0	0	0	0	0	0	1	dry	
	0	0	0	0	0	1	0	1	Pain (aching)	
	0	0	0	0	1	0	1	1	pain(burning)	

When asked the participants to match the shape with mouthfeel, it can be seen that they preferred to use expressions closer to the sense of “Bouba,” such as “soft,” “smooth,” or “crumbly,” etc. in depicting the relatively rounded shapes, while using words closer to the sense of “Kiki,” such as “stiff,” “rough,” or “crispy” etc. to describe the relatively pointy shapes.

By capturing participants’ perception of colours and forms in the painting through sensory modalities of taste/mouthfeel, a pattern gradually emerged in which participants shared a degree of perceptual commonalities. This pattern provides a living experience from actual

participants that can be used as a reference to translate the painting through culinary practices, thus conveying the intended sensory interpretations of the painting through food to viewers. To make this living pattern more representative and referential, a survey was implemented to examine the cross-modal correspondences between discrete visual cues of the painting and taste sensations through a larger sample size in section 5.

4.5 Conclusion

From the one-on-one interviews with the four participants, the following conclusions can be drawn:

- The use of food as a medium for presenting artwork is feasible from the perspectives of culinary experts.
- The conceptual model afforded the translating process from visibility into a sensory modality of taste in terms of the painting *Grey Circle*.
- Interviewees showed relatively consistent gustatory-modality perceptions of the colours involved in the paintings and apparent commonalities in the cross-sensory perceptions of geometric forms regarding the Kiki and Bouba effect. For each of the abstract elements in the painting, its most significant cross-modal taste characteristic can be summarized in the following two categories:

For colour-taste cross-modal correspondences, the study found the tendency for participants to associate:

- yellow colours with sourness,
- ochre colours with sweetness,
- red colours with spiciness,
- crimson colours with sourness or sweetness,
- blue colours with saltiness,
- navy colours with sweetness,
- grey colours with umami, and
- black colours with bitterness or umami.

For Shape-taste/mouthfeel cross-modal correspondences, the study found the tendency for participants to associate:

- angular or spiky shapes with the Kiki effect, and
- rounded or curved shapes with the Bouba effect.

Overall, the interviews' results suggest some commonalities among the diverse interpretations, foreshadowing the possibility of a more systematic strategy for providing culinary experiences based on visual artworks for museum audiences.

5. Online survey

5.1 Objectives

An online survey extending the results of Section 4 examines the degree to which the pattern of cross-modal correspondences between discrete visual cues of the painting *Grey Circle* and chef's interpretations persists with a larger sample size that also includes non-culinary experts. More specifically, the online survey is used to find each visual cue's most representative taste or mouthfeel modalities through the lens of chromatic and eidetic categories, as well as to further demonstrate a more representative pattern to inform the lived experience of translating the painting *Grey Circle* through taste sensations. The two objectives in this section are as follows:

- To obtain a broader sample of public perceptions of the cross-modal correspondence between the visual elements (colors and shapes) in the painting *Grey Circle* and the taste sensations.
- To build a lived pattern in the form of sensory wheels that reflect the taste sensory properties in the painting.

5.2 Participant recruitment

Recruitment of survey participants was conducted within the researcher's network by posting information on social media platforms frequented by friends and acquaintances. Survey recruitment was conducted in Canada and China simultaneously. A bilingual survey

was provided for the recruitment in China, to overcome linguistic barriers. All results are translated and presented in English. Responses to this survey are anonymized.

5.3 Method

The online questionnaire was conducted anonymously and remained available from June 1st until the end of the month in 2022, resulting in the collection of 80 valid samples. The questionnaire builds upon the semi-structured interviews with the chefs in the previous section. The survey questions for describing the qualities of the mouthfeel corresponding to the shapes in the painting were simplified in order to make the questionnaire more concise. Since the purpose of the questionnaire was to collect sensory perceptions regarding the elements in the painting from the general public, there were no restrictions on the demographic characteristics of the participants.

5.4 Discussion of findings

Through data analysis, the following three tables demonstrate how the general public tends to identify cross-modal associations among visual elements in the artwork *Grey Circle* to taste perception.

Colour-taste correspondences

Table 6 shows how the eighty respondents paired the colours with tastes. The digits in the cells represent the co-occurrences of the eight colours (yellow, ochre, red, crimson, blue, navy, grey, and black) with the five basic tastes (sour, sweet, salty, bitter, and tasty). Cells with co-occurrences greater than 30 present the highest saturation whereas cells with co-occurrences lower than 10 have the lowest saturation. Other clusters of co-occurrences that fall in between display saturations that fall in between, with each saturation corresponding to the co-occurrence labeled in the cell.

Table 6: The co-occurrence of colour-taste cross-modal correspondence.

		8 colours in the painting							
		YELLOW	OCHRE	RED	CRIMSON	BLUE	NAVY	GREY	BLACK
5 basic tastes	SOUR	37	26	12	10	12	13	8	4
	SWEET	11	10	36	29	10	7	7	4
	SALTY	9	13	9	19	25	36	22	14
	BITTER	18	21	5	13	25	11	39	56
	UMAMI	5	10	18	9	8	13	4	2

≥30
20-29
10-19
1-9









As can be seen from Table 6, the colour yellow was strongly cross-modally associated with sour tastes, with 37 co-occurrences (out of 80 respondents). The colour ochre was cross-modally associated with sourness or bitterness, with 26 and 21 co-occurrences, respectively. There was a solid cross-modal association between the colour red and sweetness (with no spiciness option), with 36 co-occurrences. The colour crimson was cross-modally associated with sweetness, showing 29 co-occurrences. The co-occurrences of blue with saltiness and bitterness were 25, respectively. Navy blue was strongly cross-modally associated with saltiness, with 36 co-occurrences. Both grey and black had a strong cross-modal association with bitterness, with co-occurrences up to 39 and 56, respectively.

In general, each colour in the painting seems to generally correspond to tastes. This apparent convergence of cross-modal associations will serve as a reference for translating the painting and choosing foods that trigger these senses.

Form-taste/mouthfeel correspondences

Table 7 and Table 8 separately illustrate the sensory modality distribution of taste sensations corresponding to the shapes in the painting in terms of taste and mouthfeel. The darker the shading in the cell, the greater the number of people making the corresponding pair. Conversely, the lighter the shading in the cell, the fewer people make the pairing.









Table 7: The co-occurrence of shape-mouthfeel cross-modal correspondences.

		Bouba ←————→ Kiki								
										
Bouba	soft	22	17	23	5	7	12	1	4	
	smooth	36	22	21	4	4	8	3	5	
	viscous(thick)	8	10	12	13	9	1	5	9	
		11	18	7	17	18	17	4	15	crispy
		1	7	7	27	35	14	16	15	stiff
		2	6	10	14	7	28	51	32	pain

≥ 30	20-29	10-19	1-9
------	-------	-------	-----

The questionnaire delineated a range of choices for cross-modal correspondences between the shapes and the relevant mouthfeel. Respondents matched each of the eight geometric shapes in the painting to the six terms describing the mouthfeel, which were “soft,” “smooth,” “viscous,” “crispy,” “stiff,” and “pain.” The distribution of shades in the table shows that people tended to match the rounded shapes with relatively mild mouthfeel descriptions like “soft,” “smooth,” and “viscous,” while matching shapes with pronounced angles with a relatively sharp mouthfeel such as “crispy,” “stiff,” and “pain.”

Table 8: The co-occurrence of shape-taste cross-modal correspondences.

								
sour	9	19	50	15	15	23	30	15
sweet	49	33	14	6	17	18	3	7
salty	5	8	2	29	23	17	14	29
bitter	4	9	6	19	10	12	25	22
umami	13	11	8	11	15	10	8	7

≥ 30	20-29	10-19	1-9
------	-------	-------	-----

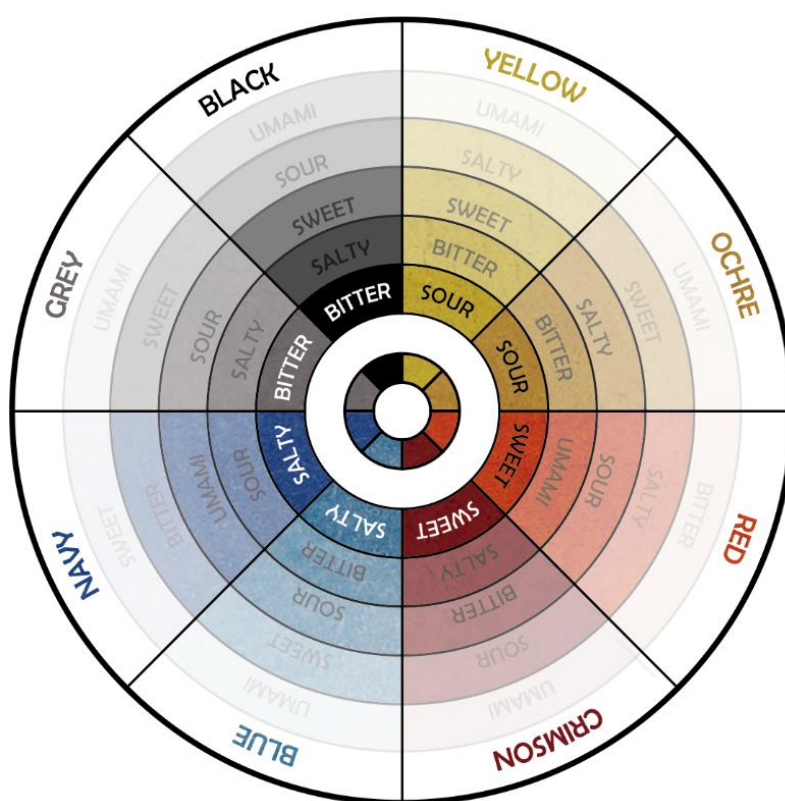
The shade distribution in Table 8 shows the tendency to match the rounded shapes with relatively mild tastes, such as sweet or umami, and to match relatively angular or spiky shapes with sour or bitter tastes.

5.5 Cross-modal correspondence wheels

The above analysis shows a more evident pattern for cross-sensory correspondences between taste/mouthfeel and visual cues of the painting *Grey Circle*. The pattern corroborated some previous research in terms of cross-modal correspondences between the visual sense and taste modalities. More importantly for this study, the results suggest that a visual-taste sensory translation of a given painting by means of cross-modal correspondence is feasible to some extent.

In order to illustrate an intuitive sensorial map of the painting, two sensory wheels were made based on the data analysis of the research. The two wheels demonstrate how the colours and shapes in the painting correspond to the taste modalities, respectively.

Figure 4: A colour-taste cross-modal correspondence wheel

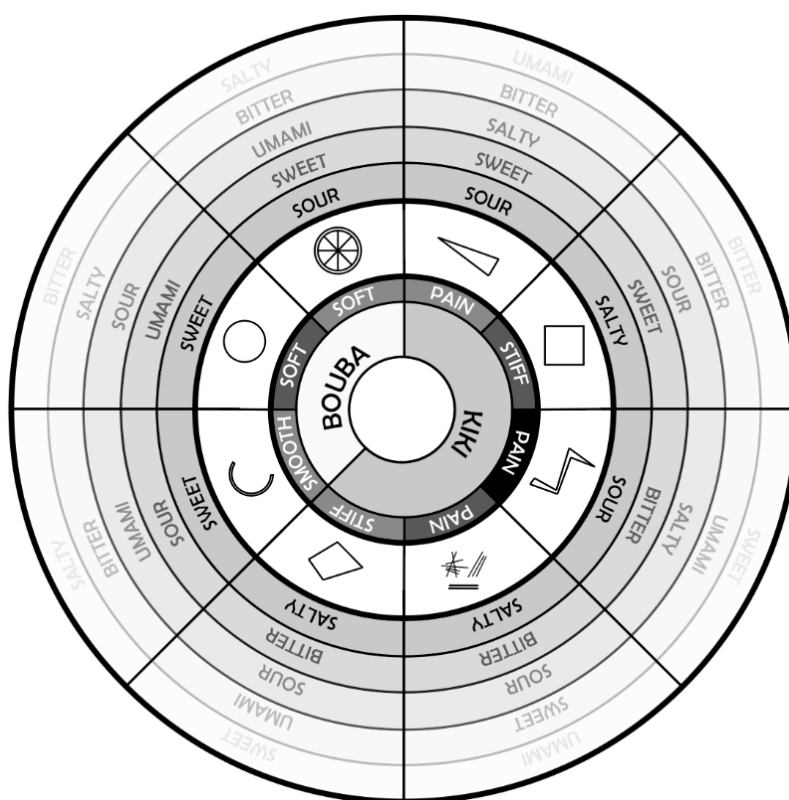


The first wheel (see Figure 4) illustrates how the eight colours correspond to the sense of taste. The inner ring with the highest saturation indicates the taste that best represents that

colour. As the saturation decreases, the degree of cross-modal perception of that colour with the corresponding taste declines.

The second wheel (see Figure 5) illustrates how the eight shapes correspond to the sense of tastes as well as to the mouthfeel through the Kiki and Bouba model. The inner circles represent how each shape corresponds to the Kiki and Bouba effect in terms of its key mouthfeel. The circles against the outside shows how the shapes correspond to the five basic tastes. The darkest shading indicates the taste that best represents that shape. As the shading becomes lighter, the degree of cross-modal perception of that shape with the corresponding taste decreases.

Figure 5: A shape-taste/mouthfeel cross-modal correspondence wheel



As a reference that reflects the cross-sensory modalities in the painting, the above two sensory wheels were used as an aid for the next step of translating the painting with real food through co-design with two culinary professionals.

6. Synthesis of sections three to five

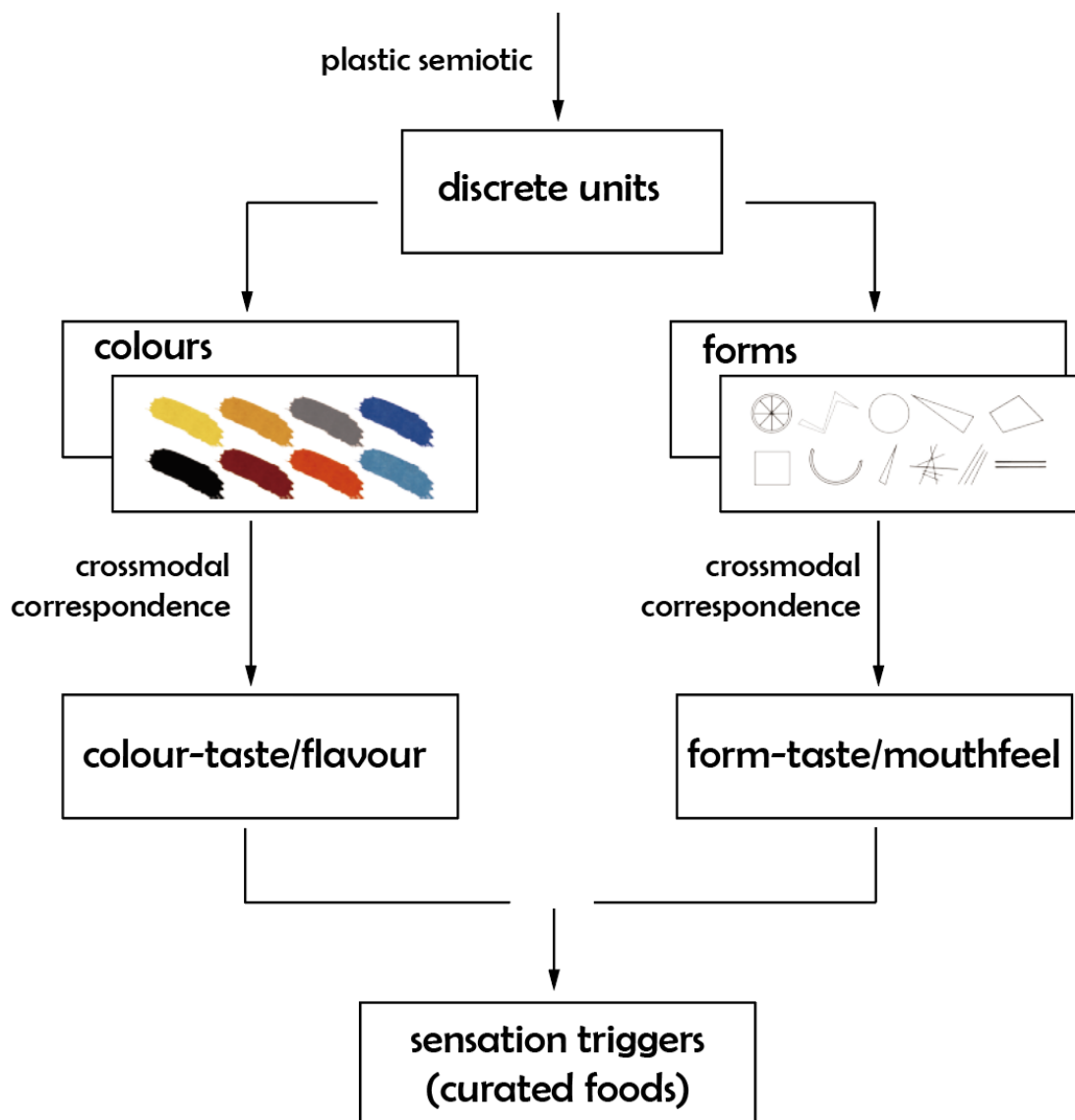
Sections three to five of this study describe the process from developing the provisional conceptual model to validating it in practice. This process suggests an approach to transforming the visual perception of a painting into a gustatory experience. In section three, a provisional conceptual model is built based on the plastic semiotics and cross-modal correspondences, which theoretically indicates how a visual image can be decomposed into discrete units and lead to a sensorial reading of them in terms of chromatic and eidetic categories. These discrete units then correspond to certain gustatory senses through the concept of cross-modal correspondence. Through one-on-one interviews with four culinary professionals, the process of translating the painting *Grey Circle* confirmed the viability of the provisional conceptual model in practice. The questionnaire that followed further consolidates the feasibility of gustatory reading of plastic elements in paintings through cross-modal correspondences. Figure 6 illustrates how the provisional conceptual model can be applied to the cross-sensory translation of the painting *Grey Circle* and also visually reflects a synthesis of the three sections.

As can be seen from Figure 7, the geometric figures in Kandinsky's painting *Grey Circle* are decomposed and analyzed in analogy to the plastic categories in terms of eidetic and chromatic ones. For the eidetic category, the shape of the geometry in the painting creates a cross-modal correspondence with taste and mouthfeel, while for the chromatic category, the colours involved in the painting create a cross-modal correspondence with taste or flavour. And the taste modalities in each of these two categories can be associated with certain real food to trigger the corresponding sensations.

Figure 6: Apply the provisional conceptual model to the artwork *Grey Circle*



Wassily Kandinsky
 Grey Circle, 1923
 watercolour and ink on paper
 Sheet: 46.8 × 42 cm (18 7/16 × 16 9/16 in.)
 Art Gallery of Ontario
 Gift of Anne Callahan, 2007
 2007/61
 Russian, 1866 - 1944
 © Art Gallery of Ontario



1

¹ While forms can easily correspond to geometric figures for this Kandinsky painting, when applying this model to other genres of paintings, forms also refer to other details such as brushstrokes, textures, etc.

7. Co-design and tasting session

7.1 Objectives

In the previous three sections, the study explored a theoretical approach to transforming the visual perception of the given painting into gustatory perception and tested it through expert interviews and an online survey. This section describes the co-design based on the study findings and the subsequent tasting session used to evaluate the translation results.

The two objectives to be achieved in this section are as follows:

- To translate the visual elements of the painting *Grey Circle* into real food through co-design with two culinary professionals.
- To evaluate the actual effect of perceiving painting through food based on the feedback of the tasters by holding a tasting session.

7.2 Participant recruitment

Co-design

The two participants involved in the interviews also engaged in the co-design activity. The two co-designers are professional cooks in different culinary fields: a general cook (C1) and a pastry cook (C2), living and working in downtown Toronto.

Tasting session

The requirements for eligibility to participate in the tasting session are being above the age of 18, residing in downtown Toronto, and not having any allergies, food intolerances or dietary contraindications to the ingredients used in the research. The ingredients used in the tasting session were sent to potential participants in advance. The list of ingredients included egg, milk, butter, cream, Gouda cheese, mascarpone, chocolate, mayonnaise, caviar, smoked salmon, tuna, sour cherry, strawberry, blueberry, lime, lemon, olive, purple potato, beets, sesame, pepper, dill, flour, whole wheat flour, corn starch, sugar, glucose, salt, canola oil, Korean Gochujang. The Recruitment platforms included Dr. Peter Coppin's Perceptual Artifacts Lab and the social media of the researchers' networks. Eight

participants from Canada, India and China, took part in the event and accordingly filled out the questionnaire used to evaluate the design of the project.

7.3 Method

Co-design

The two co-designers led the whole co-design process. They created an afternoon tea menu consisting of four savouries and six sweets, which separately represented the ten geometric

Figure 7: A three-tiered dessert tower with ten food items.























figures in the painting. The ten food items were presented in the form of a three-tiered dessert tower (see Figure 7). Each food item visually reflected the corresponding geometric element, either through the design of the food item itself or through a toothpick flag, which facilitated the participants to identify when taking the questionnaire. Descriptions and images of each item are listed and displayed in Table 9. The co-design process lasted about two weeks, including asynchronous menu

design, ingredient sourcing and synchronous culinary practice taking place on the day of the tasting session.

Although the researchers shared the previous study findings as co-design references, the co-designers were provided with creative freedom to work together to interpret the paintings based on their own understanding and expertise. Thus, each food item may not embody all the sensory characteristics of the corresponding geometric figure provided by

the research data. However, whether it was the visual, taste senses, or the figurative storytelling of a food item based on the co-designer’s own interpretation, each of the ten food items carried the sensorial expressions of the painting to a certain degree and presented as a dessert tower to offer tasters a dining experience of perceiving Kandinsky’s work through “a bite of art.”

Table 9: A table displays the descriptions and images of each food item

Geometric figures	Food item description	Food item images
	Blueberry pavlova cake (blue opaline, pavlova, blueberry compote, chantilly cream and Baumkuchen)	
	Yellow opaline, key lime curd and lemon popping candy	
	Sesame ice cream scoops	
	Toast, Smoked Gouda cheese with flat bread chips	
	Caviar and Black olive with shaped whole wheat bread	
	Smoked Salmon with Korean Gochujiang with shaped whole wheat bread	
	Meringue, sour cherry fruit roll, chantilly cream and fresh strawberry	
	Blue potato chips with beet hummus	
	Paris Brest (pate a choux, strawberry cremeux, strawberry coulis)	
	Chocolate Pockey and brownies	

2

Tasting session

After translating the painting into an afternoon tea menu through the co-design with two cooks, the next step was to evaluate the extent to which the curated food conveyed the

² The geometric figures in the table were created by the author of this project for research purposes and were inspired by the painting *Grey Circle*.

intended interpretations of the painting. A tasting event was thus held to gather feedback from the tasters.

On July 12th, 2022, the tasting session named “A Bite of Art” was held with eight participants. Each of them was given a dessert tower with ten treats and an envelope consisting of a questionnaire, a brief introduction of the event and the consent form. The participants had two tasks with the questionnaire. The first task was ten closed-ended questions that asked participants to score the extent to which each food item presented the corresponding geometric figure. The second one was to ask participants to answer four open-end questions to freely express their opinions. All eight participants had tasted the dessert towers and left seven completed questionnaires and one partially completed.

The tasting activity alone took around one hour, with another several hours of busy preparation beforehand. Two co-designers were there in charge of preparing the food. In order to provide the food in their best condition, most of them must be stored in the refrigerator and prepared just before the event starts. Thus, the event venue with a full

Figure 8: A photo of the event venue













kitchen was essential because of the abovementioned cooking requirements. Besides, it must be a clean place to hold around ten people who need to eat without any gustatory or olfactory interruption. Appropriate tables and chairs were also needed for participants to eat and fill out questionnaires. At the same time, the location should not be too far away for the convenience of the participants. The researcher finally confirmed an appropriate venue that met all the requirements above (see Figure 8).

7.4 Discussion of findings

For task one, Table 10 shows how the participants rated the ten food items corresponding to the geometric figures. Participants scored how the food translated the colour and shape of the geometric figure separately. The higher the score, the better the translation; the lower the score, the worse the translation. The final score for the degree of interpretation of the food was obtained by adding the two scores together.

After the analysis of the table of Task 1 and the answers to Task 2, there were three conclusions drawn as follows:

Table 10: A table shows how the tasters scored each food item.

Food items (Figures)	Colour scores	Shape scores	Total Scores
	Subtotals	Subtotals	
	14	15	29*
	34	33	67*
	37	39	76*
	26	24	50
	37	34	71*
	21	22	43
	32	34	66
	21	27	48
	14	25	39
	31	33	64

“*” indicates the three highest scoring and one lowest scoring geometric figures, which are discussed in the following section.

1. The foods afforded the sensorial expressions of geometric figures in the painting

According to the result of Table 10 and the feedback from the open-ended questions, analyses reveal how the curated food items afforded the sensorial expressions of geometric figures in the painting. The three geometric figures with the highest scores and the one with the lowest score are analyzed as follows.

The grey circle was considered the best-represented figure in the painting, which was presented as a black sesame ice cream scoop. “The grey circle/ice cream was probably the one that most felt like an accurate and sensible translation between the artwork’s visual elements and the taste of the dish. The cloudy, grey appearance makes me anticipate a dull, neutral flavour, and the ice cream did match that quite well,” as one participant described. Another one said that “the taste is soft and gentle, which gives me a sense of the round shape.” One believed “the grey colour ice cream represented the element in shape and colour, as well as the cold tone through its taste.” Also one participant wrote, “the taste perfectly blows in my mouth and translates grey in the artwork.” The conclusion matched the result of Task 1, where the grey circle hit the highest score of 76.

The black zigzag (also called the “Z” shape by the participants) form served with black caviar also received good feedback. One participant described, “the ‘Z’ shape is the biggest shape that appears in the painting, and in the meantime, the flavour of caviar stands out from other items.” Another thought was that “the use of caviar is also consistent with the colour black, which is normally linked to elegant and high-end features.” The conclusion matched the result of Task 1, where the black zigzag form had the second highest score of 71.

The yellow triangle translated by the key lime curd and lemon popping candy belonged to one of the most welcomed items. One participant thought the “exploding” feeling of the popping candies well interpreted the sharp corner of the triangle, and the lemon flavour of the dessert also reminded of the yellow colour. Another participant wrote, “the lemon-flavoured dish also matched quite well to the physically sharp appearance of the yellow figure from the artwork, although this one relies more on the abstractness of the flavour metaphorically translating to a ‘shape,’ whether visual or not.” This food item was rated with the third highest score of 67 in Task 1.

The blue triangle made of candy flake, cream and blueberry jam was the least popular one. Participants believed “sharpness is the essence of a triangle, and it is just too sweet for

representing a cool colour and sharp shape,” and “the sweetness is more often linked to red, white or brown or some soft colours.” In Task 1, the blue triangle only scores 29, as the bottom one.

As can be seen from the above descriptions, when participants consciously used their mouths to receive the information, they paid attention to the sensory details expressed in the painting, such as the “cold tones,” “sharp corners,” and “certain colours,” etc. Moreover, they could easily discriminate whether the food properties reflected the sensory expressions in the painting and showed a strong consistency in judging the degree of translation of the food. This finding can prove that the curated food can afford the sensorial message in a given painting. Meanwhile, the audience can also perceive the sensory information carried in the food.

2. The food enhances the perceptual dimension of the painting

Some participants agreed that the dessert tower helped them learn more about the painting *Grey Circle*. One participant wrote that the dessert tower contributed to a multisensory experience of the painting, as the senses of sight, taste, touch and smell were all invoked, such as the “exploding” feeling of the popping candy plus sour lemon-flavoured pudding instantly brought out the sense of the sharp corner and yellow colour of the triangle in the painting. Another participant said the experience opened another door to understanding a painting, helping to dig deeper into the colours, shapes and their combinations, like the cold texture of the grey ice cream ball, which made one aware of the cold tone of the grey circle in the painting. And in turn, what kind of feeling this cool-toned grey circle conveys in the painting triggered more observation and reflection. One participant added that the foods allowed one to experience each individual element of the painting and even notice things that might have been missed, such as sharp or smooth sensations caused by taste but ignored by visual perception. It can be observed from their expressions that the incorporation of the taste experience allowed them to find more perspectives on the painting, and the perceptible dimension of artwork accordingly expanded.

In addition, the analysis revealed that most participants found the idea of interpreting a painting through food or taste enjoyable, describing it as “an unforgettable experience,” “creative approach,” “an effective interaction,” or “a pleasant surprise.” These statements reflect the inclusive philosophy of this study, providing a possible way for audiences to feel joy from the artwork through the tasting experience.

3. Applying the study to museum scenarios

Some participants liked the idea of holding this event in a museum because of its ambiance. They “would be thrilled to experience it in a museum” and believed “museum is the right place to have an event like this, sitting next to the painting and tasting the dessert tower at the same time would enhance the experience.” Some others worried they “might spend more time to look at the painting instead of paying more attention to the food and vice versa.” Nevertheless, it was an exploratory attempt to create a cross-sensory appreciation of the museum artwork collections and offered the audience a multilayered interactive experience. As one participant put it, “this attempt would create an environment where the perspectives of others with different opinions, cultural backgrounds, abilities and knowledge of artwork and art history could share an experience and build a shared language around this ‘non-visual’ experience of art. A community formed around this would be very appealing and create interest in artwork and art history that does not exist in the museum status quo.”

7.5 Conclusion

Feedback from the participants revealed that they could grasp intended interpretations mediated by the curated foods’ properties, which are designed to reflect and afford the sensorial expressions in the painting. They have an evident tendency to associate abstract elements (colours and forms) in the painting with relatively consistent taste modalities. The data suggest that participants were optimistic about the interpretation when the curated food conveyed sensations consistent with their taste modalities for the abstract elements in the painting and negative when the food conveyed sensations contrary to their expected

perceptions. For example, they tended to perceive the sour lemon-flavoured dish as a good match for the yellow colour and physically sharp appearance of the triangular figure in the painting, while the dessert used to interpret the blue triangles was too sweet and soft to represent well the cool tones and sharp shapes of the blue triangle. At the same time, it was evident from the study that the participants were more willing to observe the details of the painting through the tasting experience and establish sensory connections with them through their taste perception, thus experiencing and perceiving the painting more deeply. Therefore, it can be said that the study, to some extent, broadened the perceptual dimension of the painting for the participants and opened a new perspective for them to appreciate it. In addition, most participants believed that applying this study to the museum scenario would be more conducive to increasing the experience of the artwork and leaving a lasting memory. An inclusive environment might be accordingly created where people with different cultural origins, abilities and knowledge of artworks could build a shared language around the non-visual appreciation of art.

8. Conclusion, limitations, and future study

8.1 Conclusion

This research embraces cross-sensory perception and is dedicated to translating the visual art of the museum collections into an engaging tasting experience in terms of “a bite art,” thus expanding the perceptual dimensions of those artworks.

The study explored how to translate visual art in museum collections into tasting experiences by developing a provisional conceptual model. The model demonstrates the process of translating visual cues of artwork into taste modalities, and its affordances were confirmed through one-on-one interviews and an online survey. Through the co-design and tasting session, the study reveals that people can capture information mediated by the properties of curated foods that are intended to reflect and afford sensory expressions in painting. Thus, it can be argued that the visual information of a painting, to a certain extent, can be presented through taste modalities and the foods that can embody them, and the

viewers can also perceive the sensory expressions in the painting through their sense of taste.

In addition, participants were generally positive about this exploratory attempt to perceive museum artwork through their sense of taste, believing that the experience enhanced their perception of the painting to a certain degree and brought them closer to the painting and that the experience, as well as the artwork, would be memorable to them. Therefore, it can be argued that this study proposes a way to increase the perceptual dimension of museum collections through cross-sensory design that breaks through sensory constraints from a taste perspective, thereby increasing the inclusive appreciation of art collections and satisfying and enhancing the diversity of museum visitors.

8.2 Limitations and future studies

While this study has encouraging results, it also has its obvious limitations as follows:

1. While the study confirmed the provisional conceptual model's applicability for the cross-modal translation of Kandinsky's geometric artwork *Grey Circle* in terms of taste sensation, the feasibility of the model to translate paintings of other styles and genres has not been validated.
2. As the study is more qualitative in nature, the extent to which perception through food and taste helps visitors improve their understanding of the paintings cannot be quantified.
3. The limited conditions resulted in co-designed works that did not more accurately represent the sensory properties of the visual elements of the painting, which may have affected the assessment of the experimental effects.
4. The size and diversity of the participation sample used to evaluate the tasting sessions should be improved.
5. Given the study's aim to enhance inclusive experiences with museum collections, the study was unable to collaborate with museums or restaurants within museums to obtain valuable field research data.

Future research will break through the above limitations. As cross-modal gustatory translation is attempted for more styles and genres of paintings, the model established in this study will be gradually validated and refined so that it can be used for a broader range of translations of artworks. It is foreseeable that with the establishment of a more professional team, including chefs, art historians, cognitive scientists, and curators, more accurate and rigorous cross-modal translations of visual arts in terms of taste sensations will become possible. At the same time, museums or art galleries and their restaurants could open up a new business model by creating menus for some of their art collections that offer cross-sensory appreciation through a sophisticated dining experience, breathing new life into artworks and opening new doors for more people to experience art.

References

- Aiello, G. (2020). Visual semiotics: Key concepts and new directions. *The SAGE handbook of visual research methods*, 367-380.
- Barnett, V. E. (1982). Kandinsky: Vasily Kandinsky (1866-1944): A selection from the Solomon R. Guggenheim Museum and the Hilla von Rebay Foundation: Kandinsky, Wassily. Retrieved November 15, 2022, from <https://archive.org/details/kandinskyvasilyk00kand>
- Creswell, J.W. (2014) *Research design: Qualitative, quantitative, and mixed methods approaches (4th ed.)*. Thousand Oaks, CA: SAGE Publications.
- Dewey, J. (2005). *Art as experience*. Perigee Books.
- Düchting, H. (2018). Wassily Kandinsky, 1866-1944: A revolution in painting. Taschen.
- Floch, J. M. (1985) *Petites mythologies de l'oeil et de l'esprit pour une sémiotique plastique*. Paris: Hatje-Benjamins.

Freeman, C. (2013). *Modern Art Desserts: Recipes for Cakes, Cookies, Confections, and Frozen Treats Based on Iconic Works of Art [A Baking Book]*. Ten Speed Press.

Gallace, A., Boschini, E., & Spence, C. (2011). On the taste of “Bouba” and “Kiki”: An exploration of word–food associations in neurologically normal participants. *Cognitive Neuroscience*, 2(1), 34-46.

Gibson, J.J. (1966). *The senses considered as perceptual systems*. Houghton Mifflin.

Greimas, A. J., Collins, F., & Perron, P. (1989). Figurative semiotics and the semiotics of the plastic arts. *New Literary History*, 20(3), 627-649.

Guyer, P. (2007). *18th Century German Aesthetics (Stanford Encyclopedia of Philosophy)*. Plato.stanford.edu. Retrieved April 31st 2022, from <https://plato.stanford.edu/entries/aesthetics-18th-german/>.

Henry, M. (2009). *Seeing the invisible: on Kandinsky*. A&C Black.

Ione, A., & Tyler, C. (2003). Was Kandinsky a synesthete?. *Journal of the History of the Neurosciences*, 12(2), 223-226.

Jay, M. (2002). Somaesthetics and democracy: Dewey and contemporary body art. *Journal of Aesthetic Education*, 36(4), 55-69.

Kandinsky, W. (1977). *Concerning the spiritual in art: Wassily Kandinsky; translated and with an introduction by M. T. H. Sadler*. Dover Publications.

Kandinsky, W. (1979). *Point and line to plane*. Dover Publications.

Keller, H. (1924, February 10) “HELEN KELLER GETS MUSIC BY RADIO,” *The New York Times*, p. 105.

Levent, N., & Pascual-Leone, A. (Eds.). (2014). *The multisensory museum: Cross-disciplinary perspectives on touch, sound, smell, memory, and space*. Rowman & Littlefield.

McGee, C., & Rosenberg, F. (2014). Art making as multisensory engagement. *The Multisensory Museum: Cross-disciplinary Perspectives on Touch, Sound, Smell, Memory and Space*, edited by N. Levent and A. Pascual-Leone, 29-44.

- Mengoni, A. (2021). Visual Semiotics. *The Palgrave Handbook Of Image Studies*, 641-654. https://doi.org/10.1007/978-3-030-71830-5_39
- Michel, C., Velasco, C., Gatti, E., & Spence, C. (2014). A taste of Kandinsky: Assessing the influence of the artistic visual presentation of food on the dining experience. *Flavour*, 3(1), 1-11.
- Mihalache, I. D. (2016). Critical eating: Tasting museum stories on restaurant menus. *Food, Culture & Society*, 19(2), 317-336.
- Nöth, W. (2011). Visual semiotics: Key features and an application to picture ads. *The Sage handbook of visual research methods*, 298-316.
- Shermer, D. Z., & Levitan, C. A. (2014). Red hot: The cross-modal effect of color intensity on perceived piquancy. *Multisensory research*, 27(3-4), 207-223.
- Spence, C., & Ngo, M. (2012). Assessing the shape symbolism of the taste, flavour, and texture of foods and beverages. *Flavour*, 1(1). <https://doi.org/10.1186/2044-7248-1-12>
- Spence, C., Wan, X., Woods, A., Velasco, C., Deng, J., Youssef, J., & Deroy, O. (2015). On tasty colours and colourful tastes? Assessing, explaining, and utilizing cross-modal correspondences between colours and basic tastes. *Flavour*, 4(1). <https://doi.org/10.1186/s13411-015-0033-1>
- Shepherd, G. M. (2013). *Neurogastronomy: how the brain creates flavor and why it matters*. Columbia University Press.
- Stebbins, R. A. (2010). Encyclopedia of Case Study Research: Concatenated Theory (A. J. Mills, G. Durepos, & E. Wiebe, Eds.). Thousand Oaks, CA: SAGE Publications. 195-196. <http://dx.doi.org/10.4135/9781412957397.n72>.
- Wang, S. (2020). Museum as a Sensory Space: A Discussion of Communication Effect of Multi-Senses in Taizhou Museum. *Sustainability*, 12(7), 3061.
- Žemaitytė, G. (2017). Plastic semiotics: From visuality to all the senses. *Sign Systems Studies*, 45(1/2), 152-161. <https://doi.org/10.12697/sss.2017.45.1-2.10>