

Qingqing Zhao\*, Chu-Ren Huang and Yunfei Long

# Synaesthesia in Chinese: A corpus-based study on gustatory adjectives in Mandarin

<https://doi.org/10.1515/ling-2018-0019>

**Abstract:** This study adopted a corpus-based approach to examine the synaesthetic metaphors of gustatory adjectives in Mandarin. Based on the distribution of synaesthetic uses in the corpus, we found that: (1) the synaesthetic metaphors of Mandarin gustatory adjectives exhibited directionality; (2) the directionality of Mandarin synaesthetic gustatory adjectives showed both commonality and specificity when compared with the attested directionality of gustatory adjectives in English, which calls for a closer re-examination of the claim of cross-lingual universality of synaesthetic tendencies; and (3) the distribution and directionality of Mandarin synaesthetic gustatory adjectives could not be predicted by a single hypothesis, such as the embodiment-driven approach or the biological association-driven approach. Thus, linguistic synaesthesia was constrained by both the embodiment principle and the biological association mechanism.

**Keywords:** synaesthetic metaphors, corpus-based, gustatory adjectives, Mandarin

## 1 Introduction

Synaesthesia, based on the Greek roots *syn* ‘together’ and *aisthesia* ‘perception’, describes a situation in which perceptions in different sensory modalities are associated in both perceptual experiences and verbal expressions (Cytowic 1993; Popova 2005; Shen and Eisenman 2008). Synaesthesia in perceptions is a phenomenon in which people manifest a capacity for hearing colors, touching sounds, tasting shapes, and so on (Cytowic 1993, 2002 [1989]). Neuroscientists, such as Ramachandran and Hubbard (2001) and Hubbard and Ramachandran

---

\*Corresponding author: **Qingqing Zhao**, Department of Chinese and Bilingual Studies, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, China, E-mail: zhaoqingqing0611@163.com

**Chu-Ren Huang**, Department of Chinese and Bilingual Studies, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, China, E-mail: churen.huang@polyu.edu.hk

**Yunfei Long**, Department of Computing, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong, China, E-mail: csylong@comp.polyu.edu.hk

(2005), have proposed that synaesthesia is a neural disorder caused by defective pruning of connections between brain regions. Synaesthesia in verbal expressions, also called synaesthetic metaphors which are employed cross-linguistically (Ullmann 1966 [1963]), involves the use of lexical items for perception in one sensory modality to describe perceptions in other modalities (Preminger et al. 1974 [1965]). For instance, the English gustatory adjective *sweet* can be used to describe an auditory perception, as in the phrase *sweet voice*, and the Mandarin tactile adjective 冷 *lěng* ‘cold’ can modify a visual perception, as in the phrase 冷色 *lěng sè* ‘cold color’.<sup>1</sup>

Linguistic synaesthesia has received less attention compared with the extensive studies on neurological synaesthesia (see Simner and Hubbard 2013). Studies on linguistic synaesthesia have often treated it as a specific type of metaphor (Geeraerts 2010). For example, researchers such as Shen (1997), Yu (2003), and Popova (2005) have claimed that synaesthetic metaphors, similar to other types of metaphors, are motivated by what and how our bodies experience the world, and that their tendencies are mapping from more embodied modalities (e.g., touch and taste) to less embodied ones (e.g., vision and hearing).<sup>2</sup> This embodiment-driven approach to linguistic synaesthesia, however, has been questioned in recent decades, since it neglects the structure of neural associations in the brain. Ramachandran and Hubbard (2001: 18) have proposed that linguistic synaesthesia is the same as neurological synaesthesia, as both are shaped by “anatomical constraints” that permit “certain types of cross-activation, but not others,” while Seitz (2005: 90) has pointed out that linguistic synaesthesia is an “inborn metaphorical association” “pre-wired” in brains. Many linguistic accounts, such as Williams (1976), Rakova (2003), and Yang and Zhang (2007), have also used the biological association-driven approach to search for synaesthetic metaphors.

---

<sup>1</sup> Synaesthesia involving cognitive perceptions will be referred to as neurological synaesthesia for convenience, while synaesthesia involving verbal expressions will be referred to as linguistic synaesthesia and synaesthetic metaphors, interchangeably, hereinafter.

<sup>2</sup> The notions of more embodied versus less embodied are parallel to the notions of more accessible versus less accessible in the framework of Cognitive Linguistics. Experiences involving more bodily contact and more bodily interactions with surrounding environments are proposed to be more embodied, and concepts representing these experiences are considered to be more accessible for humans, and these features are used to structure less embodied experiences and express less accessible concepts (Lakoff and Johnson 1980; Johnson 1987). This embodiment hypothesis has been supported in various studies on languages and other cognitive behaviors, such as memory, reasoning, imagination, and so forth (e.g., Gibbs 2005; Grady 2005; among others). The embodiment-driven approach to linguistic synaesthesia hypothesizes that sensory modalities also have different degrees concerning embodiment. We will present more details on this approach in the following sections.

The embodiment-driven and biological association-driven approaches both presuppose that we know exactly how sensory modalities are delineated biologically and linguistically, and how these two sets of concepts map to each other. The challenge, however, as noted by Cacciari (2008), is that none of the commonly held criteria on its own is sufficient in providing a clear and explicit definition to differentiate the five commonly accepted sensory modalities. In addition, past studies on these approaches to linguistic synaesthesia have mostly been based on Indo-European languages. Hence, more comprehensive data covering typologically diverse languages is sorely needed to establish more meaningful correlations between linguistic behaviors in general (and not just the behaviors of a few languages) and theoretical accounts. At the same time, the two approaches differ in their assumptions of how cognitive reality (i.e., synaesthetic metaphors) is mapped to linguistic expressions. The embodiment-driven approach assumes that synaesthetic metaphors, similar to other kinds of metaphors, reflect our ability to describe less accessible concepts with more embodied experiences. Thus, if the directionality of synaesthetic transfers from more embodied modalities to less embodied modalities is attested in linguistic expressions, the embodiment-driven approach is supported. The biological association-driven approach, however, suggests that cross-modal mapping in linguistic synaesthesia occurs because the described sensory modalities are associated biologically, which predicts the cross-lingual universality tendency of synaesthetic metaphors. The goal of this study was to explore the universality of directionality tendencies of synaesthetic metaphors to provide a comprehensive account of Mandarin Chinese (a Sino-Tibetan language, Chen 1999). Since this study focused on linguistic synaesthesia, we followed the definition of sensory modalities that seems to be the most intuitive to and compatible with linguistic uses provided by Miller and Johnson-Laird (1976), namely, the perceptions experienced by eyes for vision, ears for hearing, the tongue for taste, the nose for smell, and the skin, hands, and muscles for touch.<sup>3</sup>

While existing studies based on Indo-European languages have supported both directionality and universality (Ullmann 1957; Williams 1976), case studies on Mandarin synaesthetic metaphors have shown different results. For instance,

---

<sup>3</sup> Other major theories of different senses include Purves et al. (2001 [2000]), in which sensory modalities were categorized as somatic sensation which includes perceptions experienced from mechanical stimuli (e.g., light touch, pressure, cutaneous tension, etc.), painful stimuli, and temperature; vision; audition; vestibular sensation; and chemical sensation, which is associated with the nose and mouth. For further details about the relationship between modalities and languages, see Miller and Johnson-Laird (1976); how the neural system works for sensations, see Purves et al. (2001 [2000]); and the historical debate on touch, see Heller and Schiff (1991).

Xiong and Huang's study (2015) on the Mandarin gustatory adjective 苦 *kǔ* 'bitter' demonstrated that its transfer directions are different from its English counterpart. In this study, we adopted a corpus-based approach to focus on the synaesthetic metaphors of Mandarin gustatory adjectives. More specifically, this study explored (1) whether linguistic synaesthesia involving Mandarin gustatory adjectives exhibited directionality; (2) if so, whether Mandarin and English shared the same tendencies in linguistic synaesthesia; and (3) which of the two approaches to linguistic synaesthesia best predicted the generalizations of the distribution and directionality of synaesthetic uses of gustatory adjectives in Mandarin Chinese.

In what follows, this paper will present the tendencies that have been observed in linguistic synaesthesia and the two explanatory models for these tendencies in Section 2. This will be followed by a discussion of the methodology in Section 3, including extraction and classification of Mandarin gustatory adjectives from lexical thesauri and synaesthetic uses of these adjectives from a balanced corpus. Section 4 will present the generalizations of the distribution and directionality of the synaesthetic uses of Mandarin gustatory adjectives, while Section 5 will compare transfer regularities of synaesthetic gustatory adjectives between Mandarin and English. The last section will present the conclusion.

## 2 Studies on linguistic synaesthesia

### 2.1 Transfer tendencies of linguistic synaesthesia

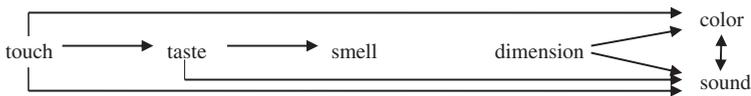
Many studies based on Indo-European languages have demonstrated that linguistic synaesthesia follows directionality tendencies (Ullmann 1957; Williams 1976; among others). Such tendencies are described in the literature using two different models. The first model originated from work by Ullmann (1945, 1957, 1966 [1963]), who found that 80% of the synaesthetic examples collected from English, French, and Hungarian poems in the nineteenth century followed the directional tendency described by the model in Figure 1.

Touch → Taste → Smell → Hearing → Vision

**Figure 1:** A linear model for linguistic synaesthesia.

Shen (1997) confirmed this model for Hebrew poetry. In addition, Shen and his colleagues (Shen 1997; Shen and Cohen 1998; Shen and Eisenman 2008) demonstrated the validity of this model with experimental studies on ordinary Hebrew and English involving tasks such as interpretation generation, recall, naturalness judgements, and so forth. For instance, they showed that expressions that conform to a directional tendency (e.g., *stinking paleness*) are easier to recall and are judged as more natural than expressions that violate that tendency (e.g., *pale stink*). Strik Lievers (2015) also supported this model in a study on English and Italian examples from the ukWaC and itWaC corpora.

The second model for the directional tendencies of synaesthetic transfers, shown in Figure 2, was proposed by Williams (1976), who suggested that English sensory adjectives would follow this model when they changed their meanings among sensory modalities, and also suggested that if synaesthetic transfers violated the pattern, the resultant sensory meanings tended to become obsolete in the language.<sup>4</sup> For instance, although the adjective *eager* was attested to have a tactile meaning as the result of a transfer from taste to touch in the history of English, the tactile meaning of this adjective was not retained in Standard English (see Williams 1976: 476). Furthermore, Williams (1976) claimed that this hierarchy should be applicable in any language in the world. Lehrer's synchronic study (1978) on sensory adjectives supported this model, but added that some unpredicted transfers could still be used in English, such as the visual item *fat* employed for taste (Lehrer 1978: 120).



**Figure 2:** A model for linguistic synaesthesia transfers (Williams 1976: 463).

<sup>4</sup> Some of the adjectives in Williams' (1976) study might not have been sensory items originally, but instead came from alternative metaphorical sources. For example, as pointed out by a reviewer, *brisk* is a loanword from French *brusque*, meaning 'sudden', which is used for taste in English through metaphor. It is important to note, however, that the historical sensory origin was not the critical factor in Williams (1976); instead, what he focused on was the fact that these adjectives involved more than one sensory domain in the history of English, with different citation dates in the OED and MED dictionaries. For example, the English adjective *faint* originally meant 'feigned, simulated' but took into consideration its descriptions of smell, color, and sound cited in the dictionaries at different times (Williams 1976: 468). In fact, we excluded *brisk* in our study, as reported in Section 5. This exclusion, however, did not lead to any fundamental changes in Williams' model.

The two transfer models of linguistic synaesthesia assign identical directionality involving touch, taste, and smell, as seen in Figures 1 and 2. The main difference between the two models is the relationship between vision and hearing: while hearing precedes vision in Figure 1, both directions between hearing and vision are attested in Figure 2. This discrepancy is not, strictly speaking, contradictory, as Williams' (1976) model in Figure 2 classified vision into two different domains: dimension and color. Since both are models of directional tendencies that do not claim to be strict rules, the same set of data could be consistent in both models. In sum, studies on linguistic synaesthesia based on Indo-European languages have confirmed that tendencies of directionality in synaesthetic transfers are shared by different languages.

## 2.2 Explanatory models for linguistic synaesthesia

One of the explanatory models for linguistic synaesthesia is the embodiment-driven approach. Studies following this approach have claimed that synaesthetic transfers are grounded on the perceived similarity of the intensity and subjective evaluation of sensory stimuli (Lehrer 1978; Osgood et al. 1978 [1957]; Viberg 1983), and synaesthetic tendency (i.e., directionality) is determined by the embodiment principle for other types of metaphors (Shen 1997; Yu 2003; Popova 2005; among others).

Shen (1997), Shen and Cohen (1998), and Shen and Eisenman (2008) have argued that sensory modalities can be classified according to different degrees of embodiment. For instance, touch and taste necessarily involve physical contact between the sensory organ and the perceived object, while the other three modalities do not require such physical contact. In addition, tactile perception, unlike other senses, does not require a specialized sensory organ. Those studies thus suggested that the direction of synaesthetic transfers as described in Figure 1 is constrained by the embodiment principle, from more embodied modalities to less embodied ones. Popova (2005: 416) further claimed that embodiment is realized “at its strongest in touch,” since scalarity and a subjective evaluation of sensory stimuli dominate the perceptual experiences of touch (including taste), but not those of vision and hearing. Therefore, Popova (2005) assumed that the conceptualization of perceptual properties in vision and hearing using concepts from touch and taste illustrated the move from more embodied to less embodied.

The embodiment-driven approach, however, has been criticized for its disregard of neural associations in the brain, as well as earlier occurrences of synaesthetic metaphors in the speech of young children compared with other

types of metaphors, which might indicate that biological factors are at work (Marks et al. 1987; Seitz 1997, 2005). Rakova (2003) has argued that linguistic synaesthesia has a biological motivation based on the evidence obtained in physiological research. For instance, Rakova (2003) pointed out that the tactile meaning and gustatory meaning of the English adjective *hot* are associated because of the same neural pain-detecting mechanism (i.e., VR1, Caterina et al. 1997), rather than through metaphorical mapping. In addition, Rakova (2003: 64) suggested that neurological synaesthesia is a “strong synaesthesia” and linguistic synaesthesia is a “weak synaesthesia,” both of which, however, are analogous to the innate nervous association between senses (Ramachandran and Hubbard 2001).

Day (1996) compared types of neurological synaesthesia documented in Cytowic (2002 [1989]) with linguistic synaesthesia collected from English and German novels and found that the two kinds of synaesthetic phenomena did not share the same pattern; for example, colored sounds were the most common for neurological synaesthesia, while tactile sounds were the most frequent for linguistic synaesthesia. Another challenge to the biological association-driven approach is that it does not provide any explanation for the directional tendency of linguistic synaesthesia (Popova 2005).

The debate on the mechanism underlying linguistic synaesthesia, however, remains, because the embodiment-driven and the biological association-driven approaches have both been challenged, and the different implications and predictions of the two explanatory models have not been disproved. Case studies on Mandarin specific synaesthetic examples (e.g., Wang 2002, 2008; Xiong and Huang 2015; Zhao and Huang 2015; among others) and specific genres (Yu 2003), nevertheless, have shown different characteristics when compared with linguistic synaesthesia based on English, particularly gustatory adjectives. Our study, therefore, employed the corpus distribution of Mandarin synaesthetic gustatory adjectives to explore the tendency of the synaesthetic metaphors of these adjectives, as well as the explanatory power of the two approaches.

## 3 Methodology: corpus-based

### 3.1 Data collection

Our collection of synaesthetic data in Mandarin Chinese was carried out in two steps following the well-established corpus-based approach described in Strik

Lievers et al. (2013) and Strik Lievers and Huang (2016). First, a list of Mandarin adjective morphemes used for gustatory sensations or gustation-associated objects (i.e., edible objects) etymologically was compiled; and second, the synaesthetic usages of adjectives composed of morphemes obtained in the first step were collected from a balanced corpus.

Specifically, two Chinese lexical thesauri were employed, namely, 哈工大信息檢索研究中心同義詞詞林擴展版 HIT-CIR Tongyici Cilin (Extended) (Che et al. 2010) and 知網 HowNet (Dong and Dong 2003), to extract gustatory words. Then, each morpheme in the extracted gustatory words was manually examined to identify morphemes that are used for gustation or gustation-associated objects etymologically.<sup>5</sup> To ensure that the correct etymology was identified, we consulted both 說文解字 *Shuōwénjiězì* (Xu 1963 [156]) and 說文解字注 *Shuōwénjiězìzhù* (Duan 2007 [1735–1815]) through the online interface of 漢典 *Hàndiǎn* and Hantology (Chou and Huang 2010).<sup>6</sup> Lastly, additional Chinese philological resources, such as 王力古漢語字典 *Wánglìgǔhànyǔzìdiǎn* (Wang 2000) and 漢語大字典 *Hànyǔdàzìdiǎn* (Xu 1986, incorporated in Hantology), were consulted to double-check the original meaning of the morphemes and to identify the original meaning of morphemes that were not included in 說文解字 *Shuōwénjiězì* or 說文解字注 *Shuōwénjiězìzhù*.

It is important to note that although the philological information of Chinese characters can be considered explicit etymological evidence, it cannot be taken at face value; that is, glyphic composition information is an orthographical rule, not necessarily a lexical representation. In other words, the conceptual motivation of the glyph provides a commonly accepted way to conventionalize the basic meaning of that lexical unit, and the original meaning of that unit is equal to or closely related to the conceptual motivation of the character (Xu 1963 [156]; Huang and Hsieh 2015). Take the character 美 *měi* ‘beautiful/tasty’, for example. It is composed of 羊 + 大 ‘sheep + big’, but with supporting historical textual evidence, the conceptual ‘big/fat sheep is tasty’ is motivated (rather than the meaning of ‘beautiful’). We thus concluded that the character had an original meaning of ‘tasty’ but later developed the meaning of ‘beautiful’ through linguistic synaesthesia. Hence, in addition to

5 One of the most challenging issues in the identification of original gustatory adjectives is to decide whether one or both morphemes of a disyllabic gustatory adjective have the attested gustatory etymology. In principle, we included only morphemes with attested uses of taste or taste-associated objects when used alone etymologically. For instance, 澀 *kǔ-sè* ‘bitter’ was excluded because 澀 *sè*’s etymological meaning of ‘not flowing smoothly’ did not seem to be directly relevant, although the gustatory origin of 苦 *kǔ* as ‘bitter vegetable’ can be attested.

6 Accessed at: <http://www.zdic.net/> and <http://hantology.ling.sinica.edu.tw/>.

the orthographic composition rules of the glyph of a character, evidence from how the character was used in pre-Qin classical texts also offered important information. For example, one particularly important piece of evidence came from 荀子 *Xúnzǐ* (third century BC): 甘苦鹹淡辛酸奇味以口異 *gān kǔ xián dàn xīn suān qí-wèi yǐ kǒu yì* ‘sweetness, bitterness, the salty taste, the mild taste, the hot taste, sourness, the different taste are differentiated by the mouth’, which indicates the six gustatory perceptions.

After careful analysis, 15 morphemes with gustatory meanings were identified, as shown in Table 1. Some had the etymological meaning of taste, such as 甘 *gān* ‘tasty’, while others had the etymological meaning of taste-associated objects, such as 酸 *suān* ‘vinegar’, a kind of edible object. These morphemes were employed to describe gustation in Mandarin, in which some conceptualized the perceptual quality of gustation, such as 苦 *kǔ* ‘bitter’, while others focused on the perceptual intensity of gustation, such as 濃 *nóng* ‘of intense taste’. The Mandarin adjective 淡 *dàn*, however, conceptualized both gustatory quality, such as 菜不鹹不淡 *cài bù xián bù dàn* ‘the dish is not salty or tasteless (just right)’, and gustatory intensity, such as 淡淡的甜味 *dàn-dàn de tián wèi* ‘the slight sweetness’. Moreover, gustatory quality use was predominant for the adjective 淡 *dàn*, with about 86% (161/188) of usages in quality of taste found in the Sinica Corpus<sup>7</sup> (Chen et al. 1996).

We extracted synaesthetic examples for Mandarin gustatory adjectives composed of 15 morphemes from the Sinica Corpus by manually checking whether the adjectives were used for perceptions in other modalities, including smell, vision, hearing, and touch.<sup>8</sup> For instance, the collocation of the phrase 甜白 *tián bái* ‘sweet white’ was included since 甜 *tián* ‘sweet’ was characterized as color in the visual modality, which illustrates a synaesthetic transfer from taste to vision.

<sup>7</sup> The Sinica Corpus (Academia Sinica Balanced Corpus of Modern Chinese, 4th edition), which can be accessed at <http://lingcorpus.iis.sinica.edu.tw/modern/>, contains 10 million word tokens.

<sup>8</sup> The gustatory domain is not the only possible source domain of linguistic synaesthesia for morphemes denoting edible objects etymologically. For example, 濃 *nóng*, originally meaning ‘dense dew’ in 說文解字 *Shuōwénjiězì*, can be used to describe both intense taste (taste) and intense color (vision) in Mandarin, and thus the visual modality is also a possible source domain of the synaesthetic metaphor for 濃 *nóng*. We assigned 濃 *nóng* to the gustatory domain based both on the distribution of its usage in pre-Qin texts and on the strong evidence that 淡 *dàn* ‘thin taste’ has a gustatory etymology, as shown in the passage above. Since 濃 *nóng* and 淡 *dàn* are closely related both in meaning and in orthography, the null hypothesis is that they should belong to the same sensory modality.

**Table 1:** Morphemes meaning gustation and gustation-associated objects etymologically.

Morphemes	Original meaning	Gustatory meaning in Mandarin	Gustatory type in Mandarin
甘 <i>gān</i>	'tasty'	'sweet'	Quality
甜 <i>tián</i>	'tasty'	'sweet'	Quality
美 <i>měi</i>	'tasty'	'tasty'	Quality
鹹 <i>xián</i>	'taste of salt'	'salty'	Quality
辛 <i>xīn</i> <sup>a</sup>	'hot (in taste)'	'hot (in taste)'	Quality
辣 <i>là</i>	'hot (in taste)'	'hot (in taste)'	Quality
鮮 <i>xiān</i>	'a kind of fish'	'tasty'	Quality
苦 <i>kǔ</i>	'bitter vegetable'	'bitter'	Quality
酸 <i>suān</i>	'vinegar'	'sour'	Quality
雉 <i>juàn</i>	'tasty flesh of birds'	'tasty'	Quality
鹹 <i>cuó</i>	'salt'	'salty'	Quality
淡 <i>dàn</i>	'thin taste'	'not salty'	Quality
醃 <i>yān</i>	'thick taste'	'of mild taste'	Intensity
濃 <i>nóng</i>	'dense dew'	'of intense taste'	Intensity
醇 <i>chún</i>	'pure wine'	'of intense taste'	Intensity

<sup>a</sup>The most likely original meaning of 辛 *xīn*, listed in 說文解字 *Shuōwénjiězì* and based on the analysis of the glyph, is related to cutting as a punishment for a crime. However, there are two important pieces of information that support our analysis of it having a gustatory sense as one of its basic meanings. The first is the cited passage from 荀子 *Xúnzǐ* (third century BC) discussed earlier in this section. Here, 辛 *xīn* is among the six listed gustatory perceptions. Second, note that 辣 *là* has 辛 *xīn* as its radical/semantic component and has the basic meaning of being spicy. In fact, its gloss in 說文解字 *Shuōwénjiězì* is 辛甚為辣 *xīn shèn wéi là* '辣 *là* is 辛 *xīn* to the extreme'. Since it was established that the original meaning of a character is related to the basic concept of the radical (Xu 1963 [156]; Huang and Hsieh 2015), this pairing suggests that 辛 *xīn* does represent the basic concept of being spicy.

### 3.2 Data summary

There are 17 gustatory adjectives with synaesthetic uses in the Sinica Corpus, as shown in Table 2, of which 11 words are composed of one morpheme or two duplicated morphemes (e.g., 酸 *suān* 'sour' and 淡淡 *dàn-dàn* 'not salty/of mild taste'), and six adjectives are compound words (e.g., 甜美 *tián-měi* 'tasty'). In total, 1,002 synaesthetic examples were obtained for these adjectives.

Smell was the highest target, with 76% (13/17) in terms of transferability based on Table 2, which means that 13 of the total 17 gustatory adjectives can be used for smell. Vision, however, was the largest target, with examples occupying

**Table 2:** Distributions of synaesthetic data for gustatory adjectives in the Sinica Corpus.

Source domain	Target domain			
	SMELL	VISION	HEARING	TOUCH
TASTE				
Adjectives (17)	13	8	6	3
Transferability	76%	47%	35%	18%
Transfer tokens (1002)	100	720	113	69
Percentage	10%	72%	11%	7%

72% (720/1,002) of the total synaesthetic tokens.<sup>9</sup> (A more detailed summary of the distribution of synesthetic uses for each adjective can be found in the Appendix.)

## 4 Synaesthetic tendencies of Mandarin gustatory adjectives

### 4.1 Intensity and quality adjectives

There are two aspects of gustation in Mandarin that are conceptualized in adjectives: gustatory intensity and gustatory quality. We will discuss intensity adjectives composed of intensity morphemes and quality adjectives composed of quality morphemes separately (cf. Table 1 for the list of intensity morphemes and quality morphemes). Moreover, 淡 *dàn* ‘not salty/of mild taste’ only describes perceptual intensity for modalities in synaesthetic uses. We therefore assigned it to the category of gustatory intensity adjectives for discussion.

<sup>9</sup> These two interesting directionality tendencies are not the focus of this study and thus will not be discussed in depth. We suspect that they might involve different motivations. The first tendency that gustatory items are used for olfaction, with the highest transferability of adjectives, can also be evidenced by the fact that what people perceive by the tongue in Mandarin, namely, 味 *wèi* ‘taste’, can also mean what people perceive by the nose, which might indicate the intimate relationship between taste and smell in Mandarin. The second tendency is likely to have resulted from vision, which is multidimensional, including sizes, colors, facial expressions, and so on, and attracts more synaesthetic modifications.

#### 4.1.1 Synaesthetic metaphors of intensity adjectives

The four Mandarin gustatory intensity adjectives identified in this study had synaesthetic distributions to smell, vision, and hearing, as shown in examples (1) through (3), but not to the tactile perception. The gustation intensity adjectives for olfactory perceptions, as shown in (1), had synaesthetic distributions to vision and hearing (i.e., 濃 *nóng* ‘of intense taste’ and 淡 *dàn* ‘of mild taste’), both in the same direction, as illustrated in (2) and (3), respectively. The transfer pattern of the synaesthetic metaphors of Mandarin gustation intensity adjectives is summarized in Figure 3 below.

TASTE → SMELL → VISION/HEARING

**Figure 3:** The synaesthetic pattern for gustatory intensity adjectives in Mandarin.

- (1) Intensity adjectives used for smell
- a. 酒 *jiǔ* 的 *de* 甘 *gān* 醇 *chún*<sub>[TASTE/SOURCE]</sub>  
 wine GEN sweet of intense taste  
 香味 *xiāng-wèi*<sub>[SMELL/TARGET]</sub>  
 fragrant-flavor  
 ‘the sweet and intense aroma of wine’
  - b. 迸發 *bèng-fā*<sub>[SMELL/TARGET]</sub> 出來 *chū-lái* 的 *de*  
 spurt-out come-out NOM  
 香郁 *xiāng-yù*<sub>[SMELL/TARGET]</sub> 濃醇 *nóng-chún*<sub>[TASTE/SOURCE]</sub>  
 fragrant-lush of intense taste-of intense taste  
 ‘the intense emitting aroma’
  - c. 女子 *nǚ-zǐ* 的 *de* 體味 *tǐ-wèi*<sub>[SMELL/TARGET]</sub> 真 *zhēn*  
 female GEN body-odor really  
 濃 *nóng*<sub>[TASTE/SOURCE]</sub>  
 of intense taste  
 ‘The odor of the woman is quite strong.’
  - d. 淡淡 *dàn-dàn*<sub>[TASTE/SOURCE]</sub> 的 *de* 花香 *huā-xiāng*<sub>[SMELL/TARGET]</sub>  
 of mild taste-of mild taste NOM flower-fragrance  
 ‘the light fragrance of flowers’
- (2) Intensity adjectives used for vision
- a. 葉色 *yè-sè* 濃 *nóng*<sub>[TASTE/SOURCE]</sub> 綠 *lǜ*<sub>[VISION/TARGET]</sub>  
 leave-color of intense taste green

‘The color of leaves is deep-green.’

- b. 淡 *dàn*<sub>[TASTE/SOURCE]</sub> 藍色 *lán-sè*<sub>[VISION/TARGET]</sub> 的 *de*  
 of mild taste blue-color NOM  
 眸子 *móu-zi*  
 pupil-PAR  
 ‘light-blue pupils’

(3) Intensity adjectives used for hearing

- a. 濃濃 *nóng-nóng*<sub>[TASTE/SOURCE]</sub>  
 of intense taste-of intense taste  
 廣東腔 *guǎngdōng-qīāng*<sub>[HEARING/TARGET]</sub>  
 Guangdong-accent  
 ‘the strong accent of Cantonese’
- b. 淡 *dàn*<sub>[TASTE/SOURCE]</sub> 了 *le* 喧鬧聲 *xuān-nào-shēng*<sub>[HEARING/TARGET]</sub>  
 of mild taste ASP clamor-noisy-sound  
 ‘The noise is weakened.’

All four intensity adjectives conceptualized perceptual intensity regarding the interpretation of these adjectives in synaesthetic metaphors. Moreover, their polarity on the intensity scale was retained. For example, 醇 *chún* ‘of intense taste’, 濃醇 *nóng-chún* ‘of intense taste’, and 濃 *nóng* ‘of intense taste’ on the positive side of the intensity scale for gustation originally, still retained positive polarity in what was perceived by the nose, eyes, or ears, such as (1a), (1b), (1c), (2a), and (3a). By contrast, 淡 *dàn* ‘of mild taste’, on the negative side of the intensity scale for gustation, characterized the faintness of perceptions in smell, vision, and hearing, as illustrated in (1d), (2b), and (3b).

The embodiment-driven approach was thus supported by the transfer pattern and interpretation of these intensity adjectives in linguistic synaesthesia. All of the synaesthetic transfers of these intensity adjectives were consistent with the embodiment principle, following the trend from more embodied to less embodied, namely, from the sensory domain needing physical contact with perceived objects (i.e., taste) to the sensory domains without such requirements (i.e., smell, vision, and hearing). The unobserved direction from taste to touch was also predicted by the approach, since touch is more embodied with sensory receptors all over the body compared with taste, which has sensory receptors only in the mouth (Lehrer 1978; Shen 1997). Moreover, the interpretation and preservation of the polarities of these gustatory adjectives also attested the claim that the perceived similarity of intensity grounded the association of perceptions in different modalities, as suggested by the embodiment-driven approach.

#### 4.1.2 Synaesthetic metaphors of quality adjectives

The Mandarin gustatory quality adjectives identified in the Sinica Corpus had distributions to smell, vision, and hearing, just as the gustatory intensity adjectives did. The nine gustatory quality adjectives of olfactory perceptions are shown in (4). These adjectives described perceptual quality perceived by smelling, and their polarities on the evaluation scale (i.e., sentiment) were preserved, except for 苦 *kǔ* ‘bitter’ and 酸 *suān* ‘sour’ when modifying the odor of specific food.<sup>10</sup> For example, 苦 *kǔ* ‘bitter’, as an unpleasant sensation in taste, was found to describe the pleasant perception of smell (i.e., 香 *xiāng* ‘fragrance’), as illustrated in (4d), where the odor is from tea or coffee. In addition, the collocation of 酸 *suān* ‘sour’ and 香 *xiāng* ‘fragrance’ was related to the odor of vinegar, as illustrated in (4g).

(4) Quality adjectives used for smell

- a. 撲鼻 *pū-bí*<sub>[SMELL/TARGET]</sub> 的 *de* 甜 *tián*<sub>[TASTE/SOURCE]</sub>  
 rush.to-nose                      NOM    sweet  
 香 *xiāng*<sub>[SMELL/TARGET]</sub>  
 fragrant  
 ‘the tangy sweet fragrance’
- b. 甜美 *tián-měi*<sub>[TASTE/SOURCE]</sub> [...] 氣香 *qì-xiāng*<sub>[SMELL/TARGET]</sub>  
 sweet-tasty                      [...] air-fragrant  
 ‘the sweet fragrance of air’
- c. 甘 *gān*<sub>[TASTE/SOURCE]</sub> 滑 *huá* 與 *yǔ*  
 sweet                      smooth and  
 果熟 *guǒ-shú* 的 *de* 香氣 *xiāng-qì*<sub>[SMELL/TARGET]</sub>  
 fruit-mature    NOM    fragrant-air  
 ‘the sweet, smooth, and ripe fragrance’

<sup>10</sup> Lehrer (1978) has suggested that the sentiment of gustatory words, namely the pleasantness and unpleasantness of gustation, is not determined by an individual’s appetite, but rather it is intrinsically encoded by polarity in lexical semantics. For instance, *sweet* is pleasant, while *sour* and *bitter* “generally connote unpleasantness” in English, where contrasts among them can be seen when they are applied to the personality of humans, such as *a sweet girl*, *a sour puss*, and *a bitter man* (Lehrer 1978: 98). The sentiment of Mandarin gustatory items actually can be detected in the expression of emotions, such as 心裡很甜 *xīn-lǐ hěn tián* ‘feel sweet in heart (happy)’, 心裡很苦 *xīn-lǐ hěn kǔ* ‘feel bitter in heart (sad, despondent)’, and 心裡很酸 *xīn-lǐ hěn suān* ‘feel sour in heart (disappointed)’, which can indicate that 甜 *tián* ‘sweet’ is pleasant, while 苦 *kǔ* ‘bitter’ and 酸 *suān* ‘sour’ are more likely to be unpleasant. Adjectives like 鹹 *xián* ‘salty’ and 辣 *là* ‘hot (in taste)’ are seldom used to express emotions in Mandarin and are more likely to be neutral concerning sentiment.

- d. 微 *wēi* 苦 *kǔ*<sub>[TASTE/SOURCE]</sub> 氣香 *qì-xiāng*<sub>[SMELL/TARGET]</sub>  
 slightly bitter air-fragrant  
 ‘the slightly bitter fragrance of air’ (in the coffee context)
- e. 洋溢 *yáng-yì* 辛 *xīn*<sub>[TASTE/SOURCE]</sub> 香 *xiāng*<sub>[SMELL/TARGET]</sub>  
 vast-emit hot (in taste) fragrant  
 的 *de* 高湯 *gāo-tāng*  
 NOM concentrated-soup  
 ‘the stock emitting the spicy fragrance’
- f. 聞 *wén*<sub>[SMELL/TARGET]</sub> 起來 *qǐ-lái* 刺激 *cì-jī*  
 smell COP stab-stimulate  
 辛辣 *xīn-là*<sub>[TASTE/SOURCE]</sub>  
 hot (in taste)-hot (in taste)  
 ‘It smells pungent.’
- g. 酸 *suān*<sub>[TASTE/SOURCE]</sub> 香 *xiāng*<sub>[SMELL/TARGET]</sub> 撲鼻 *pū-bí*  
 sour fragrant rush.-to nose  
 ‘The pleasant sour odor is strong.’ (in the vinegar context)
- h. 鮮 *xiān*<sub>[TASTE/SOURCE]</sub> 香味 *xiāng-wèi*<sub>[SMELL/TARGET]</sub>  
 tasty fragrant-flavor  
 ‘the tasty fragrance’
- i. 聞 *wén*<sub>[SMELL/TARGET]</sub> 起來 *qǐ-lái* 鹹鹹 *xián-xián*<sub>[TASTE/SOURCE]</sub> 的 *de*  
 smell COP salty-salty PAR  
 ‘It smells salty.’

Six quality adjectives of taste transferred to vision and four to hearing, as shown in (5) and (6), respectively. These adjectives focused on the perceptual quality of visual or auditory perceptions, and sentiment was retained with no exceptions. For instance, 甜 *tián* ‘sweet’ always implied that the objects were pleasing to visual and auditory senses, as in (5a) and (6a), whereas 苦 *kǔ* ‘bitter’ indicated unpleasant perceptions in vision and hearing, as illustrated in (5e) and (6d).

(5) Quality adjectives used for vision

- a. 甜 *tián*<sub>[TASTE/SOURCE]</sub> 白 *bái*<sub>[VISION/TARGET]</sub>  
 sweet white  
 ‘the sweet-white color’
- b. 甜美 *tián-měi*<sub>[TASTE/SOURCE]</sub> 的 *de* 笑容 *xiào-róng*<sub>[VISION/TARGET]</sub>  
 sweet-tasty NOM smile-appearance  
 ‘the sweet smile’
- c. 鮮 *xiān*<sub>[TASTE/SOURCE]</sub> 黃色 *huáng-sè*<sub>[VISION/TARGET]</sub>  
 tasty yellow-color  
 ‘the bright yellow’

- d. 顏色 yán-sè<sub>[VISION/TARGET]</sub> 鮮美 xiān-měi<sub>[TASTE/SOURCE]</sub>  
 face-color tasty-tasty  
 ‘The color is bright and beautiful.’
- e. 苦 kǔ<sub>[TASTE/SOURCE]</sub> 著 zhe 臉 liǎn<sub>[VISION/TARGET]</sub>  
 bitter ASP face  
 ‘with bitter facial expressions’
- f. 辣 là<sub>[TASTE/SOURCE]</sub> 死 sǐ 人 rén 的 de 身材 shēn-cái<sub>[VISION/TARGET]</sub>  
 hot (in taste) dead human NOM body-material  
 ‘the sexy body figure’

## (6) Quality adjectives used for hearing

- a. 甜 tián<sub>[TASTE/SOURCE]</sub> 而 ér 輕柔 qīng-róu 的 de  
 sweet and light-soft NOM  
聲音 shēng-yīn<sub>[HEARING/TARGET]</sub>  
 voice-voice  
 ‘the sweet and soft voice’
- b. 甜美 tián-měi<sub>[TASTE/SOURCE]</sub> 的 de 歌聲 gē-shēng<sub>[HEARING/TARGET]</sub>  
 sweet-tasty NOM song-sound  
 ‘the sweet singing’
- c. 音色 yīn-sè<sub>[HEARING/TARGET]</sub> 都 dōu 具有 jù-yǒu 了 le  
 sound-color already possess-have ASP  
 晦澀 huì-sè 的 de 甘美 gān-měi<sub>[TASTE/SOURCE]</sub>  
 dark-rough NOM sweet-tasty  
 ‘The tone has become obscurely pleasing to listen [to].’
- d. 苦 kǔ<sub>[TASTE/SOURCE]</sub> 調 diào<sub>[HEARING/TARGET]</sub>  
 bitter tune  
 ‘the bitter tune’

The Mandarin gustatory quality adjectives not only exhibited the transfer from taste to less embodied modalities, including smell, vision, and hearing, but also were used for the more embodied modality. There were three gustatory quality adjectives that transferred to touch. The Mandarin adjective 苦 *kǔ* ‘bitter’ collocated with the word for temperature, 寒 *hán* ‘cold’, occurred only once in the Sinica Corpus, as illustrated in (7a). All of the synaesthetic usages of the adjective 酸 *suān* ‘sour’ in the tactile domain focused on pain, particularly the sore perception in muscles, as shown in (7b). The polarity on the evaluation scale for 苦 *kǔ* ‘bitter’ and 酸 *suān* ‘sour’ was also preserved in touch, both of which still retained an unpleasant sensation.

The Mandarin adjective 辣 *là* ‘hot (in taste)’ showed an interesting regularity, as it focused on the perception generated when the tongue is in contact with a chilli pepper in Mandarin. Studies such as Wu (1989) and Wang (1996) have demonstrated that the adjective 辣 *là* ‘hot (in taste)’ is a later use of 辛 *xīn* ‘hot (in taste)’, originally related to taste, which is different from the English gustatory adjectives *pungent* and *hot* that describe gustation through the synaesthetic transfer from touch (Williams 1976). The tactile use of 辣 *là* ‘hot (in taste)’ conceptualized a combinative perception of high temperature and pain, as shown in (7c). The biological association between pain and a spicy taste (Caterina et al. 1997) thus has a linguistic realization in both English and Mandarin. In sum, the English adjectives *pungent* and *hot* exhibited the transfer from touch to taste (Rakova 2003), while the Mandarin adjective 辣 *là* ‘hot (in taste)’ demonstrated the opposition direction, from taste to touch.<sup>11,12</sup>

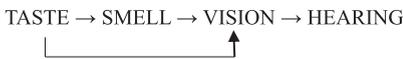
(7) Quality adjectives used for touch

- a. 苦 kǔ<sub>[TASTE/SOURCE]</sub> 寒 hán<sub>[TOUCH/TARGET]</sub>  
 bitter cold  
 ‘bitter cold’
- b. 覺得 jué-de 鼻子 bí-zi<sub>[TOUCH/TARGET]</sub> — 一 yī 酸 suān<sub>[TASTE/SOURCE]</sub>  
 feel-received nose ASP sour  
 ‘feeling sore in the nose’
- c. 感覺 gǎn-jué 眼 yǎn<sub>[TOUCH/TARGET]</sub> 辣 là<sub>[TASTE/SOURCE]</sub>  
 feel-feel eye hot (in taste)  
 手 shǒu 冷 lěng  
 hand cold  
 ‘feeling burning pain in eyes and cold in hands’

<sup>11</sup> A reviewer’s comment pointed us towards another possible biological explanation for the English adjectives *pungent* and *hot*, and the Mandarin adjective 辣 *là* ‘hot (in taste)’. Hirasa and Takemasa (1998: 10) found that there are two different chemical compounds that cause two different sensations for pungency: the ‘hot’ sensation and the ‘sharp’ sensation. Hence, as observed by the reviewer, the English adjective *pungent* captures these two sensations, and the adjective *hot* represents more of a thermal ‘hot’ sensation. The Mandarin adjective 辣 *là* ‘hot (in taste)’, on the other hand, focuses more on the gustatory ‘sharp’ sensation. This comment on the biological mechanism between temperature and a spicy taste provided additional support to the biological motivation of linguistic synaesthesia for these three adjectives apart from the association between pain and a spicy taste proposed by Rakova (2003).

<sup>12</sup> We thank a reviewer for the comment that there seems to be a link to the gustatory sense of pain. Although there are a few isolated and tantalising Chinese lexical items that show this relationship, such as the tactile meaning of 酸 *suān* ‘sour’ and 辣 *là* ‘hot (in taste)’, as well as the glyphic etymology of 辛 *xīn* ‘hot (in taste)’, which refers to punishment by knife cuts discussed previously, we were not able to find consistent mapping generalizations. Hence, we will leave this topic for future studies.

It is important to note that instances of violation of the embodiment principle (i.e., the transfer from taste to touch) occurred relatively infrequently. The directionality tendency of linguistic synaesthesia from more embodied to less embodied was attested based on most of the distributions of Mandarin gustatory quality adjectives. More specifically, 69% (9/13) of the adjective types and 84% (372/442) of the synaesthetic tokens from the Sinica Corpus agreed with the pattern described in Figure 4. Exceptions included one adjective with one token example that omitted visual modality and transferred from taste to hearing (i.e., 甘美 *gān-měi* ‘tasty’), and three adjectives with 69 examples transferred from taste to touch (i.e., one occurrence of 苦 *kǔ* ‘bitter’, two occurrences of 辣 *là* ‘hot [in taste]’, and 66 occurrences of 酸 *suān* ‘sour’).



**Figure 4:** The synaesthetic pattern for gustatory quality adjectives in Mandarin.

The embodiment-driven approach therefore successfully predicted 84% of all synaesthetic transfers involving gustatory quality adjectives in Chinese. In addition, the claim of perceived similarity of the subjective evaluation associated with synaesthetic metaphors was also verified, since the synaesthetic transfers retained the polarity of Mandarin gustatory quality adjectives on the evaluation scale, with only two exceptions (i.e., the olfactory use of 苦 *kǔ* ‘bitter’ and 酸 *suān* ‘sour’). It should be noted, however, that 16% of the synaesthetic examples were not predicted by the embodiment-driven approach, and these examples exhibited a transfer from less embodied to more embodied, that is, from taste to touch. In addition, exceptions such as the use of the Mandarin gustatory adjective 辣 *là* ‘hot (in taste)’ in touch could have been motivated by the biological association between taste and touch, thus supporting the biological association-driven approach.

## 4.2 Summary

We analyzed gustatory intensity and quality adjectives separately in this section because of their different aspects of conceptualization for gustation. It is also important to note that even though the gustatory quality adjectives had a small but significant number of exceptions to the directionality tendency, the gustatory intensity adjectives followed the tendency in general. Since the number of gustatory quality adjectives was very small, we were not able to draw any conclusions on their



study by Williams (1976): *sweet, dulcet, mellow, brisk, acrid, tart, eager, austere,* and *sour*. The adjective *brisk*, however, was excluded from our study as its etymology in taste was doubtful.<sup>13</sup>

Table 3 summarizes the distribution of synaesthetic uses of the remaining eight gustatory adjectives based on the British National Corpus (BNC),<sup>14</sup> which was used for the generalization of the synaesthetic tendency of English gustatory adjectives.

In this study, we included perception of facial expressions for the visual domain in addition to the color and dimension aspects considered by Williams (1976). The English gustatory adjectives thus had a synaesthetic use in vision, such as *a sweet face*. Moreover, the adjective *eager* did not have synaesthetic distributions in the BNC, as shown in Table 3.

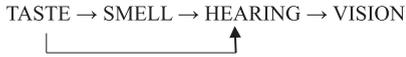
**Table 3:** Distributions of synaesthetic data for gustatory adjectives in the BNC.

Source	Target (Transfer Tokens)			
	SMELL	HEARING	VISION	TOUCH
<i>sweet</i>	123	23	30	0
<i>dulcet</i>	0	5	0	0
<i>mellow</i>	0	8	0	13
<i>acrid</i>	68	0	0	3
<i>tart</i>	1	16	1	0
<i>eager</i>	0	0	0	0
<i>austere</i>	0	0	7	0
<i>sour</i>	31	20	20	0

The model for English gustatory adjectives in Williams (1976) has been attested for most synaesthetic transfers, apart from a small number of exceptions (i.e., from taste to touch: two lexical types, 16 synaesthetic tokens), as shown in Table 3. The synaesthetic transfer hierarchy of English gustatory adjectives has thus been refined as a frequency-based tendency in Figure 6, with the agreement of 71% (5/7) of lexical types and 96% (353/369) of lexical tokens.

<sup>13</sup> This was pointed out by a reviewer and confirmed by Etymology Online, accessed at: <http://www.etymonline.com/>.

<sup>14</sup> The BNC is a general corpus dealing with Modern English and is comparable with the Sinica Corpus we relied on for Mandarin. The BNC can be accessed at: <http://www.natcorp.ox.ac.uk/>.



**Figure 6:** The synaesthetic hierarchy of gustatory adjectives in English.

The interpretation of the English gustatory adjectives regarding synaesthetic metaphors was the same as for the Mandarin gustatory quality adjectives, which conceptualized perceptual quality, as illustrated in (8) through (11). Moreover, all of these English gustatory adjectives preserved their polarity on the evaluation scale. For instance, the positive gustatory adjective *sweet* described the pleasant perception of smell in (8a), hearing in (9a), and vision in (10a), while the negative gustatory adjective *sour* focused on the unpleasant perception of smell in (8d), hearing in (9e), and vision in (10d).

(8) English adjectives used for smell

- a. *the sweet<sub>[TASTE/SOURCE]</sub> perfume<sub>[SMELL/TARGET]</sub>*
- b. *the acid<sub>[TASTE/SOURCE]</sub> smell<sub>[SMELL/TARGET]</sub> of wood smoke*
- c. *the tart<sub>[TASTE/SOURCE]</sub> smell<sub>[SMELL/TARGET]</sub> of burned crops*
- d. *the sour<sub>[TASTE/SOURCE]</sub> smell<sub>[SMELL/TARGET]</sub> of the sheets*

(9) English adjectives used for hearing

- a. *a lovely sweet<sub>[TASTE/SOURCE]</sub> voice<sub>[HEARING/TARGET]</sub>*
- b. *the dulcet<sub>[TASTE/SOURCE]</sub> tones<sub>[HEARING/TARGET]</sub> of a group of children*
- c. *mellow<sub>[TASTE/SOURCE]</sub> tone<sub>[HEARING/TARGET]</sub> of his voice*
- d. *at her tart<sub>[TASTE/SOURCE]</sub> tone<sub>[HEARING/TARGET]</sub>*
- e. *a sour<sub>[TASTE/SOURCE]</sub> note<sub>[HEARING/TARGET]</sub>*

(10) English adjectives used for vision

- a. *rewarded with a sweet<sub>[TASTE/SOURCE]</sub> smile<sub>[VISION/TARGET]</sub>*
- b. *Maria retorted with a tart<sub>[TASTE/SOURCE]</sub> smile<sub>[VISION/TARGET]</sub> for his childishness.*
- c. *austere<sub>[TASTE/SOURCE]</sub> appearance<sub>[VISION/TARGET]</sub>*
- d. *He gave me a sour<sub>[TASTE/SOURCE]</sub> look<sub>[VISION/TARGET]</sub> and growled.*

(11) English adjectives used for touch

- a. *mellow<sub>[TASTE/SOURCE]</sub> textures<sub>[TOUCH/TARGET]</sub> of the renovated building*
- b. *the acid<sub>[TASTE/SOURCE]</sub> tingling<sub>[TOUCH/TARGET]</sub>*

The embodiment-driven approach was therefore also supported on a frequency-based level by the distribution of synaesthetic uses of English gustatory

adjectives. Of the tokens of the synaesthetic examples, 4% (16/369) of these adjectives exhibited the trend from less embodied to more embodied (i.e., from taste to touch), which, contrary to Williams' (1976) prediction, did not become obsolete.

## 5.2 Similarities and differences of Mandarin and English synaesthetic tendencies

The synaesthetic transfer tendency of the gustatory adjectives exhibited both similarities and differences between Mandarin and English, in relation to the updated and similar transfer hierarchies in Figure 5 for Mandarin and Figure 6 for English.

Specifically, for the similarities: (1) directionality from a more embodied modality (i.e., taste) to less embodied modalities (i.e., smell, vision, and hearing) existed in both Mandarin and English synaesthetic gustatory adjectives; and (2) the directional tendencies for Mandarin and English were both frequency-based, not rules-based, since counterexamples (i.e., transfers from taste to touch) were found in both languages. The difference between Mandarin and English synaesthetic tendencies was in vision and hearing in the hierarchy of synaesthetic metaphors: vision preceded hearing for Mandarin gustatory adjectives because if one of these adjectives had a synaesthetic distribution in hearing, it could also be used for visual perception, while vision followed hearing for English gustatory adjectives because visual distributions tended to also have distributions in hearing.

As neither hearing nor vision requires the sensory organ to be in physical contact with sources of sensations, such variations were not counterexamples of the embodiment-driven approach. This contrast, however, was not predicted in the biological association-driven approach.

## 5.3 From Mandarin synaesthetic tendencies to competitive explanatory models

As demonstrated, the synaesthetic metaphors of Mandarin gustatory adjectives exhibited directionality that followed the embodiment principle, from more embodied to less embodied, based on distributional tendencies (i.e., greater than 90%). Counterexamples to this explanatory model, however, were well attested. These exceptions, such as the transfer from taste to touch for the adjective 辣 *là* 'hot (in taste)', could be accounted for by biological associations.

This explanatory advantage, nevertheless, was negated by the difference in the transfer hierarchy of Mandarin and English gustatory adjectives, since our study showed that the relative directional tendency between vision and hearing was reversed for English and Mandarin. Thus, it would be difficult to predict this lack of cross-lingual universality of synaesthetic tendencies using the biological association-driven approach. In sum, based on the results of the current study, neither explanatory models could fully predict the distribution of synaesthetic gustatory adjectives in Mandarin Chinese.

The distribution of Mandarin synaesthetic metaphors of gustatory adjectives, however, could be predicted using an incorporated approach, as elaborated previously. In addition, many studies have indicated the impact of neuro-cognitive experiences on linguistic behaviors. For example, Lehrer (1978) and Shen (1997) proposed that because both touch and taste require physical contact between the sensory organs and the perceived objects, this facilitates the sensory association between them; Caterina et al. (1997) found that the neural mechanism associated pain with a spicy taste; Marks et al. (1987) demonstrated the neural association for synaesthetic transfers between brightness in vision and pitch in hearing; and Osgood (1966 [1963]) and Peng and Bai (2008) suggested that the perceived similarity of experiences and biological associations are both at work in linguistic synaesthesia. Furthermore, Cacciari (2008) made a strong case that exploration in neuro-cognitive activities will find an explanatory account of linguistic synaesthesia and metaphors, while Marks and Mulvenna (2013a) further postulated that the hyper-connectivity exhibited in neurological synaesthesia may be the same mechanism that enables metaphorical mappings.

All of these studies cited extensively the recent scientific breakthroughs in neuro-cognitive sciences, which have shown a correlation between senses and between sensory perceptions and linguistic expressions. Following this strong hypothesis in neuro-cognitive studies, the embodiment-driven approach thus does not contradict the neural experience. Rather, embodiment-driven directionality tendencies are simply the linguistic conventionalization of certain neuro-cognitive experiences. On the other hand, studies such as Marks and Mulvenna (2013b) and Banissy et al. (2014) have proposed that the neural association between senses is not the only mechanism underlying neurological synaesthesia, and Brewer et al.'s (2013) experimental study has demonstrated that linguistic labels can affect sensory representations. The neuro-cognitive experience thus cannot motivate the associations between senses exclusively, and determine the linguistic behaviors (e.g., linguistic synaesthesia and metaphor) in a unidirectional manner. Thus, descriptively, linguistic synaesthesia is constrained by both the embodiment principle and the biological association mechanism.

## 6 Conclusion

This study employed the distribution of synaesthetic uses in the Sinica Corpus to explore the tendency of synaesthetic metaphors of Mandarin gustatory adjectives and the explanatory power of two competitive approaches to linguistic synaesthesia. We demonstrated that the synaesthetic metaphors of gustatory adjectives in Mandarin exhibited directionality, and the directionality of these adjectives showed both commonality and specificity when compared with the attested directionality of English gustatory adjectives. The directionality and distribution of synaesthetic uses of Mandarin gustatory adjectives could not be predicted by a single hypothesis, since embodiment-driven directionality was found to be frequency-based and the biological association-driven universality of synaesthetic tendencies in different languages was not confirmed when the synaesthetic tendencies of gustatory adjectives were compared between Mandarin and English. The distribution of synaesthetic metaphors of Mandarin gustatory adjectives could be predicted when both of the approaches were taken into consideration. Therefore, the linguistic behavior of Mandarin synaesthetic metaphors supports that neuro-cognitive mechanisms constrain creative uses of language and interact with linguistic conventions.

A corpus-based approach such as the one used in the current study would be ill-suited to study linguistic synaesthesia in relation to how neuro-cognitive mechanisms work. However, if linguistic synaesthesia (and metaphors) does involve linguistic conventionalization based on neuro-cognitive motivations, then corpus-based distributions could offer direct evidence of how the bridge between neuro-cognitive activities and linguistic conventions could be built, and how such conventions could be formed differently for different languages.

**Acknowledgements:** This research is supported by a grant from the Chiang Ching-kuo Foundation for International Scholarly Exchange (RG-12-D-16) and the Hong Kong Polytechnic University Central Research Grant G-YBGM.

## References

- Banissy, Michael, Clare Jonas & Roi Cohen Kadosh. 2014. Synesthesia: An introduction. *Frontiers in Psychology* 5(1414). 1–3.
- Brewer, Jennifer, Adam Shavit, Timothy Shepard, Maria Veldhuizen, Roshan Parikh & Lawrence Marks. 2013. Identification of gustatory – Olfactory flavor mixtures: Effects of linguistic labeling. *Chemical Senses* 38(4). 305–313.
- Cacciari, Cristina. 2008. Crossing the senses in metaphorical language. In Raymond Gibbs (eds.), *The Cambridge handbook of metaphor and thought*, 425–443. New York: Cambridge University Press.

- Caterina, Michael, Mark Schumacher, Makoto Tominaga, Tobias Rosen, Jon Levine & David Julius. 1997. The capsaicin receptor: A heat-activated ion channel in the pain pathway. *Nature* 389(6653). 816–824.
- Che, Wanxiang, Zhenghua Li & Ting Liu. 2010. LTP: A Chinese language technology platform. Proceedings of the 23rd International Conference on Computational Linguistics: Demonstrations, 13–16.
- Chen, Baoya. 1999. *Ershi shiji zhongguo yuyanxue fangfalun: 1898–1998* [Chinese linguistics methodology in the 20th century: 1898–1998]. Jinan: Shangdong Education Press.
- Chen, Keh-Jiann, Chu-Ren Huang, Li-Ping Chang & Hui-Li Hsu. 1996. Sinica corpus: Design methodology for balanced corpora. Proceedings of the 11th Pacific Asia Conference on Language, Information and Computation (PACLIC 11), 167–176.
- Chou, Ya-Min & Chu-Ren Huang. 2010. Hantology: Conceptual system discovery based on orthographic convention. In Chu-Ren Huang, Nicoletta Calzolari, Aldo Gangemi, Alessandro Lenci, Alessandro Oltramari & Laurent Prévot (eds.), *Ontology and the lexicon: A natural language processing perspective*, 122–143. Cambridge: Cambridge University Press.
- Cytowic, Richard. 1993. *The man who tasted shapes: A bizarre medical mystery offers revolutionary insights into emotions, reasoning and consciousness*. New York: G. P. Putnam's.
- Cytowic, Richard. 2002 [1989]. *Synesthesia: A union of the senses*, 2nd edn. Cambridge, MA: The MIT Press.
- Day, Sean. 1996. Synaesthesia and synaesthetic metaphors. *Psyche* 2(32). 1–16.
- Dong, Zhengdong & Qiang Dong. 2003. HowNet – A hybrid language and knowledge resource. Proceedings of Natural Language Processing and Knowledge Engineering, 820–824.
- Duan, Yucui. 2007 [1735–1815]. *Shuowen jiezi zhu* [Commentary on explaining graphs and analyzing characters]. Nanjing: Phoenix Press.
- Geeraerts, Dirk. 2010. *Theories of lexical semantics*. Oxford & New York: Oxford University Press.
- Gibbs, Raymond. 2005. *Embodiment and cognitive science*. New York: Cambridge University Press.
- Grady, Joseph. 2005. Primary metaphors as inputs to conceptual integration. *Journal of Pragmatics* 37(10). 1595–1614.
- Heller, Morton & William Schiff (eds.). 1991. *The psychology of touch*. Hillsdale, NJ: Lawrence Erlbaum.
- Hirasa, Kenji & Mitsuo Takemasa. 1998. *Spice science and technology*. New York: Marcel Dekker.
- Huang, Chu-Ren & Shu-Kai Hsieh. 2015. Chinese lexical semantics: From radicals to event structure. In William S.-Y. Wang & Chao-Fen Sun (eds.), *The Oxford handbook of Chinese linguistics*, 290–305. New York: Oxford University Press.
- Hubbard, Edward & Vilayanur Ramachandran. 2005. Neurocognitive mechanisms of synesthesia. *Neuron* 48(3). 509–520.
- Johnson, Mark. 1987. *The body in the mind: The bodily basis of meaning, imagination, and reason*. Chicago, IL: University of Chicago Press.
- Lakoff, George & Mark Johnson. 1980. *Metaphors we live by*. Chicago, IL: University of Chicago Press.
- Lehrer, Adrienne. 1978. Structures of the lexicon and transfer of meaning. *Lingua* 45(2). 95–123.

- Marks, Lawrence, Robin Hammeal, Marc Bornstein & Linda Smith. 1987. Perceiving similarity and comprehending metaphor. *Monographs of the Society for Research in Child Development* 52(1). i–100.
- Marks, Lawrence & Catherine Mulvenna. 2013a. Synesthesia on our mind. *Theoria et Historia Scientiarum* 10. 13–36.
- Marks, Lawrence & Catherine Mulvenna. 2013b. Synesthesia, at and near its borders. *Frontiers in Psychology* 4(651). 1–4.
- Miller, George & Philip Johnson-Laird. 1976. *Language and perception*. Cambridge, MA: Harvard University Press.
- Osgood, Charles. 1966 [1963]. Language universals and psycholinguistics. In Joseph Greenberg (eds.), *Universals of language*, 2nd edn. 299–328. Cambridge, MA & London: The MIT Press.
- Osgood, Charles, George Suci & Percy Tannenbaum. 1978 [1957]. *The measurement of meaning*, 4th edn. Urbana, IL & Chicago, IL: University of Illinois Press.
- Peng, Yi & Jiehong Bai. 2008. Tonggan renzhi xinlun [A new idea on synaesthesia and cognition]. *Foreign Language and Their Teaching* 1. 14–17.
- Popova, Yanna. 2005. Image schemas and verbal synaesthesia. In Beate Hampe & Joseph Grady (eds.), *From perception to meaning: Image schema in cognitive linguistics* (Cognitive Linguistics Research 29), 395–420. Berlin & New York: Mouton de Gruyter.
- Preminger, Alex, Frank Warnke & O. B. Hardison Jr (eds.). 1974 [1965]. *Princeton encyclopedia of poetry and poetics*, 2nd edn. Princeton, NJ: Princeton University Press.
- Purves, Dale, George J Augustine, David Fitzpatrick, Lawrence C. Katz, Anthony-Samuel LaMantia, James O. McNamara & S. Mark Williams (eds.). 2001 [2000]. *Neuroscience*, 2nd edn. Sunderland, MA: Sinauer Associates.
- Rakova, Marina. 2003. *The extent of the literal: Metaphor, polysemy and the theories of concepts*. New York: Palgrave Macmillan.
- Ramachandran, Vilayanur & Edward Hubbard. 2001. Synaesthesia – A window into perception, thought and language. *Journal of Consciousness Studies* 8(12). 3–34.
- Seitz, Jay. 1997. The development of metaphoric understanding: Implications for a theory of creativity. *Creativity Research Journal* 10(4). 347–353.
- Seitz, Jay. 2005. The neutral, evolutionary, developmental, and bodily basis of metaphor. *New Ideas in Psychology* 23(2). 74–95.
- Shen, Yeshayahu. 1997. Cognitive constraints on poetic figures. *Cognitive Linguistics* 8(1). 33–71.
- Shen, Yeshayahu & Michal Cohen. 1998. How come silence is sweet but sweetness is not silent: A cognitive account of directionality in poetic synaesthesia. *Language and Literature* 7(2). 123–140.
- Shen, Yeshayahu & David Eisenman. 2008. “Heard melodies are sweet, but those unheard are sweeter”: Synaesthetic metaphors and cognition. *Language and Literature* 17(2). 101–121.
- Simner, Julia & Edward Hubbard (eds.). 2013. *The Oxford handbook of synesthesia*. Oxford: Oxford University Press.
- Strik Lievers, Francesca. 2015. Synaesthesia: A corpus-based study of cross-modal directionality. *Functions of Language* 22(1). 69–95.
- Strik Lievers, Francesca & Chu-Ren Huang. 2016. A lexicon of perception for the identification of synaesthetic metaphors in corpora. Proceedings of the 10th Language Resources and Evaluation Conference (LREC 2016), 4032–4036.

- Strik Lievers, Francesca, Ge Xu & Hongzhi Xu. 2013. A methodology for the extraction of lexicalized synaesthesia from corpora. Paper presented at the 19th International Congress of Linguists, Université de Genève, 21–27 July.
- Ullmann, Stephen. 1945. Romanticism and synaesthesia: A comparative study of sense transfer in Keats and Byron. *Publications of the Modern Language Association of America* 60(3). 811–827.
- Ullmann, Stephen. 1957. *The principles of semantics*. Oxford: Basil Blackwell.
- Ullmann, Stephen. 1966 [1963]. Semantic universals. In Joseph Greenberg (eds.), *Universals of language*, 2nd edn. 217–262. Cambridge & London: The MIT Press.
- Viberg, Åke. 1983. The verbs of perception: A typological study. *Linguistics* 21(1). 123–162.
- Wang, Li. 2000. *Wangli guhanyu zidian* [Wang Li's dictionary on classic Chinese]. Beijing: Zhonghua Book Company.
- Wang, Ning. 1996. *Xunguxue yuanli* [The principle in etymological studies on Chinese]. Beijing: China International Radio Press.
- Wang, Shaohua. 2002. Tonggan lianxiang renzhi [Synaesthesia, association and cognition]. *Modern Foreign Languages* 25(2). 187–194.
- Wang, Yuhong. 2008. Tonggan yinyu de renzhi jichu he zhexue yiyi [The cognitive basis and philosophical meaning on synaesthetic metaphors]. *Foreign Languages and Their Teaching* 4. 13–16.
- Williams, Joseph. 1976. Synaesthetic adjectives: A possible law of semantic change. *Language* 52(2). 461–478.
- Wu, Tiejing. 1989. Butong yuyan de weijueci he wenduci dui keguan xianshi de butong qiefen – Yuyan leixingxue yanjiu [Different categorizations to the world through gustatory and temperature words in different languages – A typological study]. *Language Teaching and Linguistic Studies* 1. 120–137.
- Xiong, Jiajuan & Chu-Ren Huang. 2015. Being assiduous: Do we have BITTERNESS or PAIN? The synaesthetic and conceptual metaphors of BITTERNESS and PAIN in Chinese and English. In Qin Lu & Helena Hong Gao (eds.), *Chinese lexical semantics* (LNAI 9332), 15–23. Cham: Springer International.
- Xu, Shen. 1963 [156]. *Shuowen Jiezi* [Explaining graphs and analyzing characters]. Beijing: Zhonghua Book Company.
- Xu, Zhongshu. 1986. *Hanyu da zidian* [Great compendium of Chinese characters]. Chengdu & Wuhan: Sichuan Dictionary Publishing Company and Hubei Dictionary Publishing Company.
- Yang, Bo & Hui Zhang. 2007. Kua ganguan ganzhi yu tonggan xingrongci yanjiu [A study on the cross-modal cognition and synaesthetic adjectives]. *Foreign Language Education* 28(1). 16–21.
- Yu, Ning. 2003. Synesthetic metaphors: A cognitive perspective. *Journal of Literary Semantics* 32(1). 19–34.
- Zhao, Qingqing & Chu-Ren Huang. 2015. A corpus-based study on synaesthetic adjectives in Modern Chinese. In Qin Lu & Helena Hong Gao (eds.), *Chinese lexical semantics* (LNAI 9332), 535–542. Cham: Springer International.

## Appendix The distribution of Mandarin synaesthetic gustatory adjectives based on the Sinica Corpus

Source domain	Target domains			
	TASTE	SMELL	VISION	HEARING
<b>Intensity adjectives</b>				
淡 <i>dàn</i> 'not salty/ of mild taste'	27	247	78	0
濃 <i>nóng</i> 'of intense taste'	29	175	2	0
醇 <i>chún</i> 'of intense taste'	1	0	0	0
濃醇 <i>nóng-nóng</i> 'of intense taste'	1	0	0	0
<b>Quality adjectives</b>				
甜 <i>tián</i> 'sweet'	11	11	5	0
甘甜 <i>gān-tián</i> 'sweet'	1	0	0	0
甜美 <i>tián-měi</i> 'tasty'	0	28	26	0
甘 <i>gān</i> 'sweet'	3	0	0	0
甘美 <i>gān-měi</i> 'tasty'	0	0	1	0
鮮 <i>xiān</i> 'tasty'	1	84	0	0
鮮美 <i>xiān-měi</i> 'tasty'	0	2	0	0
辛 <i>xīn</i> 'hot (in taste)'	3	0	0	0
辣 <i>là</i> 'hot (in taste)'	0	89	0	2
辛辣 <i>xīn-là</i> 'hot (in taste)'	7	0	0	0
鹹 <i>xián</i> 'salty'	7	0	0	0
苦 <i>kǔ</i> 'bitter'	1	84	1	1
酸 <i>suān</i> 'sour'	8	0	0	66