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BODILY SENSATION AND EMBODIMENT: A CORPUS-BASED STUDY OF GUSTATORY VOCABULARY IN MANDARIN CHINESE

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ABSTRACT

Embodiment has been the tenet of several linguistic theories accounting for how language conceptualizes cognitive and bodily experiences. Studies on linguistic synesthesia and sensory lexicon strengthened the embodiment account by showing that the mapping patterns amongst sense modalities likewise exhibited a tendency from the more embodied to the less embodied. This paper reports a corpus-based study of gustatory vocabulary in Mandarin Chinese to explore the interaction between embodied senses and conceptual embodiment. We first observed that the perception of *là* 辣 'spicy' and *má* 麻 'numbing' was chemesthesis derived from a chemical reaction from the body. In addition, the concept of taste was found capable of being depicted by variegated non-taste lexical items from less embodied sensory domains. This study posits that gustatory properties as abstract cognitive categories are likely to be derived from more embodied senses, yet when the quality of gustatory sensation is the focus, less embodied senses can be adopted to modify it. Corroborated with other recent studies, this study underlines and clarifies the role of embodiment as a versatile

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tool of linguistic conceptualization among multiple conceptual layers instead of being a fixed set of conceptual objects to select from.

KEYWORDS
Embodiment **M**andarin gustatory vocabulary **L**inguistic synesthesia **S**ensory modality

1. INTRODUCTION

Human beings live by five senses to experience the world, namely, *visual*, *auditory*, *gustatory*, *olfactory*, and *tactile* sensations, or more commonly known as *vision*, *hearing*, *taste*, *smell*, and *touch* senses.[1] These five sense modalities are established as both the traditional and the scientifically conventionalized categories of basic human perception. How human beings perceive the world through the five physiological senses and how such perceptions are encoded in human language have received constant scrutiny, yet they have not been studied with the same intensity. Previous linguistic studies were voluminous on vision, notably on color terms (e.g., Berlin and Kay 1969; Wierzbicka 1990; Kay 2009). This can be attributed to the dominance of vision in Western culture (e.g., Classen 1997; Levinson and Majid 2014), as well as among perceptual qualities (e.g., Strik Lievers and Winter 2018). To bring in a slightly different perspective, this paper primarily investigates how gustatory sensation, or taste, is expressed in Mandarin Chinese, and its relationship with other senses. We attempt to present a more distinctive and fine-grained picture of how Chinese people discuss gustatory perception and its related concepts with support from corpus data.

Tastes of food are traditionally categorized into *wǔ-wèi* 五味 'five tastes; five flavors' in Chinese culture: *sweet*, *sour*, *bitter*, *spicy,* and *salty*, as exemplified in the classic text *Lüshi Chunqiu* 吕氏春秋 (Lü 2010, 279)[2]:

> 五味三材…调和之事，必以甘酸苦辛咸…
> *Wǔ wèi sān cái…tiáo hé zhī shì, bì yǐ gān suān kǔ xīn xián…*
> 'For the five tastes and the three ingredients…for the task of harmonizing and blending, one must use sweet, sour, bitter, spicy, and salty…'

Notwithstanding *gān* 甘 'sweet' and *xīn* 辛 'spicy' are superseded by *tián* 甜 'sweet' and *là* 辣 'spicy' in Modern Chinese over the years, the concept of the five tastes is deeply rooted in Chinese culture. Interestingly, modern science shows that the basic five taste qualities able to be detected by the gustatory sense only concern *sour*, *sweet*, *salty*, *bitter,* and *umami*[3] (Mouritsen and Styrbæk 2014), and spicy is merely considered one of the *chemesthesis*, which is a coined term indicating the chemical sensitivity of the skin and mucous membranes deriving primarily from the sensory systems classically defined as touch, temperature, and pain (Green 1996; 2016). In addition, although *gān* 甘 as umami is widely documented and commonly used in daily life, especially in the context of tea and other drinks[4] (cf. Kaneko et al. 2006), it is not typically included in the discussion of the five tastes in Modern Mandarin. Despite the incongruence between the five traditional tastes perceived by Chinese people and the basic taste senses recognized from a more scientific and rigorous viewpoint, Wu (1989) did not elaborate on it and continued treating *là* 辣 'spicy' as one of the taste senses. Moreover, though some research proposed that extensions of semantic meanings of the main gustatory adjectives in Chinese might be attributed to the regularity of transfer among senses (e.g., Jiang 2008; Pan and Zhang 2017), they lacked systematic and theoretical grounds. In general, how taste is depicted, where the gustatory sense stands amongst human senses, and how it interplays with other sensory modalities as reflected by the real use of language are still under-examined.

After embodiment cognition was proposed by Lakoff and Johnson (1980, 1999), subsequent researches concerning language and human senses substantially testified this theory and suggested that a more embodied domain tends to transfer to a less embodied domain, our bodily experience hence can be a primary source for the mapping from the more concrete concepts to the more abstract concepts (Lakoff and Johnson 1980; Lakoff 1987). Kövecses (2002) holds a similar view by claiming that the human body is an ideal source domain for semantic extensions and embodiment plays a key role in the emergence of metaphorical meaning in languages and cultures worldwide. Grounded on the intertwined connection between the human body and language, a revival of interest in studying interrelationships among the five senses through language

received considerable attention, giving rise to linguistic synesthesia. *Synesthesia* is derived from Greek *syn-* 'with; together' and *aesthesis* 'sensation', and it refers to the union of senses (cf. Shen and Eisenman 2008; Ronga et al. 2012). Generally speaking, linguistic synesthesia is realized when the conception from one sensory modality modifies the conception from other sensory domains. For instance, *sweet* in the phrase *sweet voice* is deemed a synesthetic metaphor and is used to modify *voice*, and the synesthetic directionality in such a phrase transfers from gustatory sensation (i.e., sweet) to auditory sensation (i.e., voice). It has been attested in many languages, including English and Chinese, that linguistic synesthesia normally follows a particular directionality, i.e., tactile and gustatory senses are considered the source domains that most frequently transfer to target domains of olfactory, visual and auditory senses (e.g., Ullmann 1957; Williams 1976; Zhao, Huang, and Long 2018; Strik Lievers 2015; Strik Lievers, Huang, and Xiong 2021). Such synesthetic directionality is claimed to be predicted by the universal notion of embodiment, i.e., from more embodied to less embodied concepts depending on their involvement and closeness of bodily contact (e.g., Shen 1997; Shen and Eisenman 2008). Whereas in recent linguistic synesthesia studies, especially in Mandarin Chinese, it has exhibited a more intricate mapping tendency (Huang and Xiong 2019; Zhao, Huang, and Ahrens 2019; Zhao, Xiong, and Huang 2019; among others). It is suggested that the directionality among sensory domains is not completely a linear model as identified in Ullmann (1957) nor a linear-hierarchical model as suggested by William (1976). Rather, it can be "unidirectional" (e.g., touch is always found transferring to hearing but not the other way around), "biased-directional" (two sensory domains can transfer to each other with a clear dominant mapping, e.g., vision exhibits a much higher transferability rate to touch than touch to vision), and "bi-directional" (two sensory domains can transfer to each other without a clear dominant mapping, e.g., between touch and taste) (Zhao, Huang, and Ahrens 2019).

Given the doubt cast by the above studies on the long-standing five tastes taxonomy and the embodiment-oriented explanation of linguistic synesthesia in Mandarin Chinese, the relationship between perception and language merits a closer look. This paper examines real-life uses of taste-related concepts on the biological basis of gustatory sensation. Given the

standard account of gustatory sense as the second most embodied sense after tactile sense (cf. Williams 1976; Zhao, Huang, and Long 2018; Zhao, Xiong, and Huang 2019), we try to explore the following three research questions:

a. Does Mandarin Chinese treat chemesthesis-based tastes, e.g., spicy (*xīn* 辛 and *là* 辣), as similar or different to other basic tastes?
b. Is the standard taxonomy of five tastes adequate for representing a full range of gustatory properties in the use of daily language in Chinese?
c. Does gustatory sense interact differently with more embodied sense (i.e., tactile sense) and less embodied senses (i.e., olfactory, auditory, and visual senses) in Mandarin Chinese?

2. BACKGROUND

2.1 *Là* 辣'spicy' as a Non-taste Taste

As mentioned in the above section, *xīn* 辛 and the later use of *là* 辣 are pertinent to the taste sensation in Mandarin Chinese. According to the experimental results in Chen et al. (2019), the gustatory sense is rated by Mandarin speakers the most dominant for *là* 辣 'spicy' (with the score of 4.97, compared to 2.40 through smell, 1.41 via vision, 0.83 by touch, and 0.12 via hearing; the rating system is from 0 to 5). This significant score disparity indicates that *là* 辣 'spicy' is perceived as taste rather than any other sense in Mandarin Chinese. Moreover, in the series of linguistic synesthesia studies in Mandarin Chinese (e.g., Zhao, Huang, and Long 2018; Zhao, Huang, and Ahrens 2019; Zhao, Xiong, and Huang 2019), *là* 辣 'spicy' is treated as belonging to the gustatory sense. Their argument mainly stemmed from Archaic Chinese[5], such as the examples illustrated previously in *Lüshi Chunqiu* and the *Xunzi* 荀子[6]:

> 甘苦咸淡辛酸奇味，以口异。
> *Gān kǔ xián dàn xīn suān qí wèi, yǐ kǒu yì.*
> 'various tastes, such as sweetness, bitterness, the salty taste, the mild taste, the hot taste, sourness, are differentiated by the mouth.' (Zhao, Huang, and Long, 2018, 1175).

Since *là* 辣 'spicy' is developed from *xīn* 辛 and employs *xīn* 辛 as its radical (the semantic component of a Chinese character), both *xīn* 辛 and *là* 辣 were categorized as taste sense in their studies.

But it is also evident that *xīn* 辛 or *là* 辣 are not limited to the taste sense, or strictly speaking, they are not taste senses originally. Two main accounts support this argument. First, the Mandarin writing system is considered semantic-based orthography, suggesting the etymology of Chinese characters can be deduced from the semantic and/or phonetic components, and that the Chinese orthographical system encodes certain conceptual properties (Huang and Hsieh 2015; Chen et al. 2019). Based on the *Shuowenjiezi* 说文解字 (Xu 1963, 309), *xīn* 辛 is originally related with *tòng* 痛 'hurt'. In addition, the original character of *zuì* 辠 'crime; punishment' contains *xīn* 辛 as a radical (but not the modern form *zuì* 罪[7]), indicating that the basic meaning of *xīn* 辛 is related with bodily punishment. Thus, the later use of *xīn* 辛 and its successor *là* 辣 in the gustatory sensation is presumably through the severe pain associated with the bodily feelings caused by *xīn* 辛, analogous to feelings perceived via the oral cavity. The second account is from the neurological perspective. As mentioned previously, this spicy perception is something that does not correspond to any taste receptors; instead, it is a common chemical sense, which is a kind of sense as distinct and well defined as smell or taste (Parker 1912), or currently more often referred to as *chemesthesis*. If that is the case, either from the etymology of this word or from the biological account, the source domain of *xīn* 辛 and *là* 辣 in the synesthetic transfer is not from the gustatory sense but is derived from the tactile sense.

Apart from the feeling of *xīn* 辛 and *là* 辣, another feeling *má* 麻 'numbing' caused by Sichuan Pepper (*huājiāo* 花椒), is also deemed one of the tastes in Chinese. *Má* 麻 'numbing' is found frequently coordinated with *sour*, *sweet*, *bitter,* and *spicy* when searching in Google (accessed 21 May 2020, with hits indicated in the parentheses): *suān-tián-kǔ-má-là* 酸甜苦麻辣 (74,900), *suān-tián-kǔ-là-má* 酸甜苦辣麻 (55,400), *tián-suān-kǔ-là-má* 甜酸苦辣麻 (4,130), *tián-suān-kǔ-má-là* 甜酸苦麻辣 (280). However, the numbing feeling caused by Sichuan pepper is not a taste either, but rather tactile and thermal sensitivity (Bryant and Mezine 1999). The use of Sichuan pepper can be traced to the *Shijing* 诗经 (11th–7th century BCE). It was one of the main spices that ancient Chinese people

used to produce the *xīn* 辛 flavor, while the use of chili pepper came much later, with the first written record in the latter part of the Ming dynasty (1368−1644 CE) (Zhao 2006, 346−350), hence *xīn* 辛 might probably also denote the numbing feeling in Classical Chinese. This also explains why we choose *spicy*, but not *hot*, to interpret *xīn* 辛 and *là* 辣. In Classical Chinese, the flavors of pepper, ginger, onion, and garlic can all be described as *xīn* 辛; while in Mandarin Chinese, we also use *là* 辣 to depict the pungent feelings caused by such spices. The hot chili pepper, therefore, is just one of the spices that contribute to the flavor of *là* 辣, although the most predominant one.

In general, the spicy and numbing feelings caused by chili pepper and Sichuan pepper, traditionally known as taste senses in China, shall belong to chemesthesis, which, together with taste, smell, and mouthfeel, contributes to the integrated sensory impressions evoked in the oral cavity (Mouritsen and Styrbæk 2014). It hence triggers our desire to find out, even though these bodily sensations are deemed tastes in Chinese, how Chinese people would discuss their actual feelings when they perceive spicy and numbing flavors in the food.

2.2 *Wèi* 味 'taste' as a Non-taste Taste

In *The Contemporary Chinese Dictionary*, the literal meaning of *wèi* 味 is defined as "the gustatory sensation produced in the tongue by contact with a substance" and "the olfactory sensation produced in the nose by contact with a substance" (Dictionary Editing Office 2016, 1359−1360), indicating its inseparability from the gustatory and olfactory sensations. On the other hand, the original meaning of *wèi* 味 is elaborated as *zīwèi* 滋味 'flavor' in *Shuowenjiezi* (Xu 1963, 31), and the following sentence extracted from *Lüshi Chunqiu* (Lü 2010, 305) best explains what *zīwèi* 滋味 'flavor' means to Chinese people:

> 若人之于滋味，无不说甘脆…
> *Ruò rén zhī yú zīwèi, wú bù shuō gān cuì...*
> 'Speaking of flavors, everyone likes what is sweet and crisp…'

Sweet is what human beings can sense through the taste receptor cells found in the taste buds on the tongue, whereas there is no such taste receptor to account for *crisp*. The etymology of *cuì* 脆 'crisp' is from *cuì* 胞, referring to small, tender, and fragile things in the flesh (Xu 1963, 90). It hints that the original understanding of *wèi* 味 might involve both gustatory and tactile sensations.

It turned out that *wèi* 味 was instantiated as an "umbrella term" that went beyond the gustatory sensation to embrace all the sensory words in the early Chinese Buddhist texts (Xiong and Huang 2016). For example, *wèi* 味 in the *Āgamas* 阿含经 employs lexical items from all five senses to produce Buddhist expressions, i.e., *sèwèi* 色味 'form-taste', *shēngwèi* 声味 'sound-taste', *xiāngwèi* 香味 'smell-taste', and *chùwèi* 触味 'touch-taste'. In addition, when *wèi* 味 'taste' is collocated with *zhuó* 着 'attach' to form a verb *wèizhuó* 味着 'attach to; attract', it connects internal organs with external objects:

> 眼味着色…耳味着声…鼻味着香…舌味着味…身味着触…
> *yǎn wèizhuó sè…ěr wèizhuó shēng…bí wèizhuó xiāng…shé wèizhuó wèi…shēn wèizhuó chù…*
> 'eye-taste attracts forms…ear-taste attracts sounds…nose-taste attracts smell…tongue-taste attracts taste…body-taste attracts tangibles…'
> (Xiong and Huang 2016; Huang and Xiong 2019)

The ability of the gustatory sensation to transfer to other sensory modalities, as shown in the Buddhist texts, suggests that taste is probably the most accessible and culturally dependent sense to some extent (Huang and Xiong 2019).

This fuzzy meaning of *wèi* 味 or *wèidào* 味道 'taste; smell' in Chinese is tantamount to the loose and interchangeable use of *taste* and *flavor* in English. Scientifically and strictly speaking, *taste* refers to the recognition of substances by the taste buds, which relates to gustatory sensation only; while *flavor* is multimodal and engages a combination of all five senses (e.g., Spence 2016; Mouritsen and Styrbæk 2017), and is especially influenced by "tactile, thermal, painful, and/or kinesthetic effects" (Klosse 2014, 22; Spence 2016, 374). It is also noted in Rhee and

Koo (2017) that lexicalization of taste vocabulary in Korean goes beyond the "primary taste category" that is predominantly originated in the gustatory sensation but recruits extensive tactile-related and auditory terms (i.e., onomatopoeia) to denote tastes and flavors of food. Given the only word *wèi* 味 or *wèidào* 味道 'taste; smell' in Chinese accounting for both *taste* and *flavor*, it further suggests that linguistically speaking, *wèi* 味 or *wèidào* 味道 'taste; smell' is not limited to gustatory sensation, other sensory descriptors may also contribute to the understanding of tastes and flavors in Chinese.

3. METHOD AND DATA

Following the dictum of "you shall know a word by the company it keeps" (Firth 1957, 11; Yang 2019), we focus on the collocations and concordances of the key concepts we target. All the data and sentence examples presented in this paper, unless otherwise specified, were extracted from a Chinese online corpus, Chinese Web 2017 (zhTenTen11) in the Sketch Engine (Kilgarriff et al. 2014).[8] This is an annotated web-based corpus consisting of a total of 17 billion Simplified Chinese script texts. It is considered the largest and latest tagged corpus to the best of our knowledge, so a comprehensive and contemporary epistemology of taste-related expressions can be sketched.

Moreover, a corpus containing food reviews specifically on hotpot restaurants was built to cater for the analysis of chemesthesis. First, five hotpot (*huǒguō* 火锅) and five skewer hotpot (*chuànchuànxiāng* 串串香) restaurants in each of the two cities, Chongqing and Chengdu, i.e., 20 in total, were chosen from the largest restaurant review website in Mainland China, *Dazhong Dianping* 大众点评.[9] This is because Chongqing and Chengdu are the two biggest cities in the core region of Sichuan cuisine which is unique for its spicy and numbing flavor, and the two kinds of chosen food contain the most concentrated spicy and numbing flavor amongst dishes served in Sichuan cuisine restaurants. The shops were listed in descending order according to the rates of positive comments. Only comments under the category of Positive Review were collected since this category has accounted for around 80% of total comments generally.[10] After the restaurants and comments were decided, a third-party web crawler *Bazhuayu* 八爪鱼 (Octoparse)[11] was used to automatically scrape

the data from the website. With repeated comments excluded, a total of 9,141 comments were collected in June 2018. A tagged corpus was later compiled in the Sketch Engine, consisting of 1,255,649 Chinese characters, 723,502 words, and 866,968 tokens, named HOTPOT corpus in short, in what follows.

The Word Sketch function in the Sketch Engine will be adopted as the primary tool in this study. A Word Sketch portrays the grammatical and collocational behavior of a word by sorting with the logDice score.[12] Some other functions, e.g., Concordance, Word Sketch Difference, and Keywords, will also be used to scrutinize the data further. Concordance tells the context where a keyword would appear; Word Sketch Difference is utilized to compare the use of two different lemmas via their collocates; while Keywords is used to identify individual words (tokens) which appear more frequently in the target corpus HOTPOT corpus than in the reference corpus Chinese Web 2017 (zhTenTen11).

4. PERCEPTION OF SPICY AND NUMBING

In this section, the HOTPOT corpus was mainly consulted to account for the perception of spicy and numbing. Contrary to the common belief among Chinese people, our data indicate that the spicy and numbing flavors are perceived more toward chemesthesis than the taste sense. This finding is supported by the following subsections.

4.1 Collocations with Hurt and Irritation

First, the words for spicy and numbing, i.e., *làwèi* 辣味 'spicy taste' and *má* 麻 'numbing', yielded a high score of collocation with words referring to hurt and irritating, as shown in the first two rows in Table 1. The words in the remaining rows suggest that verbs comprising different kinds of hurt or irritation can affect various body parts. For instance, chilies in the hotpot can *shāng* 伤 'hurt', *shāo* 烧 'burn' or *xūn* 熏 'smoke', and *qiàng* 呛 'irritate' the stomach, throat, mouth, nose; while the spicy and numbing flavors can be *cìjī* 刺激 'irritating'. The collocations indicate that Chinese people realize spicy and numbing are associated with chemesthesis, and they can use language to explicitly describe such feelings.

Table 1 Collocations with hurt and irritation

Keyword	Collocated Words	logDice score
làwèi 辣味 'spicy taste'	*chòng* 冲 'pungent'	11.67
	shāo-xīn 烧心 'heart-burning'	11.67
má 麻 'numbing'	*cìjī* 刺激 'irritating'	9.41
shāng 伤 'hurt'	*wèi* 胃'stomach'	11.19
	sǎngzi 嗓子 'throat'	10.82
shāo 烧 'burn'	*wèi* 胃 'stomach'	10.82
	liǎn 脸 'face'	10.14
	zuǐ 嘴 'mouth'	9.27
	dùzi 肚子 'belly'	9.06
qiàng 呛 'irritate'	*sǎngzi* 嗓子 'throat'	12.29
	bízi 鼻子 'nose'	11.83
chòng 冲 'pungent'	*bí* 鼻 'nose'	10.82
cìjī 刺激 'irritating'	*shuǎnglà* 爽辣 'refreshingly spicy'	12.68
	làdù 辣度 'spicy degree'	9.75
	má 麻 'numbing'	9.41
	là 辣 'spicy'	9.24
	málà 麻辣 'numbing and spicy'	5.23
xūn 熏 'smoke'	*làyóu* 辣油 'chili oil'	12.68
	làjiāo 辣椒 'chili pepper'	8.91

4.2 Collocations with Acceptance, Tolerance, and Emotion

When analyzing the predicates collocated with a series of spicy and numbing related items, i.e., *là* 辣 'spicy', *làwèi* 辣味 'spicy taste', *làdù* 辣度 'spicy degree', *làjiāo* 辣椒 'chili pepper', *má* 麻 'numbing', and *huājiāo* 花椒 'Sichuan pepper', four main categories were identified, as demonstrated in Table 2.

The first category of predicates contains verbs related to acceptance of spicy and numbing flavors, e.g., *néng-chī* 能吃 'able to eat' and *jiēshòu* 接受 'accept'. In fact, when we use *wàidì* 外地 'non-local' as the keyword, we found that it is frequently collocated with *chī-bu-dé-là* 吃不得辣 'cannot eat spicy', *wēilà* 微辣 'slightly spicy', and *shìhé* 适合 'suitable', showing non-local people may not be used to the strong spicy and numbing flavors, and have to choose a suitable degree which is frequently slightly spicy.

Table 2 Collocations with acceptance, tolerance, and emotion

Keyword	Collocated Words	logDice score
là 辣 'spicy'	*jiě* 解 'relieve'	11.56
	pà 怕 'fear'	9.71
	kū 哭 'cry'	9.59
	sǐ 死 'die'	9.22
	néng-chī 能吃 'able to eat'	7.99
	jiě-jiě 解解 'relieve'	7.7
	sǐ (rén) 死(人) 'die'	7.66
làwèi 辣味 'spicy taste'	*shāo-jiǎn* 稍减 'slightly reduce'	9.19
	huǎnjiě 缓解 'relieve'	9.19
	jiě-jiě 解解 'relieve'	9.14
	jiēshòu 接受 'accept'	9.1
làdù 辣度 'spicy degree'	*huǎnchōng* 缓冲 'buffer'	10.68
	chéngshòu 承受 'bear'	10.68
	jiēshòu 接受 'accept'	10.09
	jiǎnhuǎn 减缓 'slow down'	9.41
	rěn 忍 'bear'	9.38
	tiǎozhàn 挑战 'challenge'	9.27
	shòu-de-liǎo 受得了 'can bear'	8.81
làjiāo 辣椒 'chili pepper'	*gǎn* 敢 'dare'	8.43
má 麻 'numbing'	*guàn* 惯 'get used to'	10.51
	cìjī 刺激 'irritating'	9.41
	bù-pà 不怕 'not scared of'	9.16
	tang-hàn 淌汗 'sweat'	8.93
	dǎozhì 导致 'lead to'	8.82
huājiāo 花椒 'Sichuan pepper'	*jiēshòu* 接受 'accept'	8.55

The second category is related to tolerance, involving verbs related to the action or the ability to tolerate such flavors, including *rěn* 忍 'tolerate', *chéngshòu* 承受 'bear', and *shòu-de-liǎo* 受得了 'can bear'.

The third category of verbs indicates reducing the degree of intense feelings, such as *huǎnjiě* 缓解 'relieve', *shāo-jiǎn* 稍减 'slightly reduce', and *jiǎnhuǎn* 减缓 'slow down'. These verbs are normally used when diners have to consume other things to soothe the burning or irritating feeling caused by spiciness. These usually are sweet or cold foods. When the Keywords function was applied to compare our current corpus with the reference corpus, *bīngfěn* 冰粉 'icy jelly', *cíbā* 糍粑 'glutinous rice cake',

hóngtáng-cíbā 红糖糍粑 'brown sugar glutinous rice cake', *yín'ěrtāng* 银耳汤 'tremella soup', etc. were found. More examples can be seen in the words collocated with *jiě-là* 解辣 'to relieve spiciness', including *dòunǎi* 豆奶 'soy milk', *suānméi(tāng)* 酸梅(汤) 'sour plum (soup)', *tāngyuán* 汤圆 'glutinous rice ball',[13] *hóngtáng* 红糖 'brown sugar', *liángshuǎng* 凉爽 'cool', *bīng-bīng-liáng-liáng* 冰冰凉凉 'icy and cool', *bīng* 冰 'ice', and *tián* 甜 'sweet'. This phenomenon could be explained by the findings that the burning sensation produced by capsaicin, the primary pungent compound in chili pepper, can be reduced by lower temperatures and sweetness (Prescott and Stevenson 1995; Mouritsen and Styrbæk 2017, 20).

Last but not least, some words that imply emotions are found frequently collocated with the perception of spiciness. For instance, people are afraid of or worried about something being too spicy by using *pà* 怕 'fear' and *dānxīn* 担心 'worry', while *gǎn* 敢 'dare' and *bù-pà* 不怕 'not scared of' are used to show the association with the fear/dare emotion with spiciness. In addition, people tend to use *là-kū* spicy-cry 辣哭 'too spicy', *là-sǐ (rén)* spicy-die (people) 辣死(人) 'too spicy' to express extreme feelings.

4.3 Collocations with Latency of Onset and Time Course

In addition, it is intriguing that people think the degree or intensity of spicy and numbing foods is much higher at the later stage of dining, as presented in Table 3. The collocations showed that the flavors of spicy and numbing foods are not so strong at the beginning, but the more you eat, the more intense the taste will become, and subsequently, it will slowly come out, appear and release. The reason may be that capsaicin in chilies has a slow onset speed and the spiciness persists for prolonged periods, and successive capsaicin stimuli at short intervals will continue to produce increasing irritation in the burning intensity, which is a phenomenon known as "sensitization" (Prescott and Stevenson 1995).

As shown in the previous section, some people may be not used to spicy and numbing flavors, but this is something they can learn to adapt to. Once they can accept and tolerate it, they will become accustomed to it. This phenomenon may be due to "desensitization", which occurs when the interval of stimulation is relatively long, and subsequent stimuli of capsaicin are perceived as less intense. Another possibility proposed by

Prescott and Stevenson (1995) is that the greater range of sensation intensities experienced by frequent chili users may make them judge capsaicin burn as less intense than infrequent users.

Table 3 Collocations concerning the latency of onset and time course

Keyword	Collocated Words	logDice score
làwèi 辣味 'spicy taste'	*chūlai* 出来 'come out'	9.93
	hòumian 后面 'later'	9.93
	mànmàn 慢慢 'slowly'	9.35
	xiǎnxiàn 显现 'appear'	9.12
	shìfàng 释放 'release'	9.04
là 辣 'spicy'	*kāishǐ* 开始 'beginning'	7.92
làdù 辣度 'spicy degree'	*xiǎnlù* 显露 'appear'	8.81
máwèi 麻味 'numbing taste'	*biàn-zhòng* 变重 'become intense'	12.68
	hòumian 后面 'later'	9.27
má 麻 'numbing'	*hòumian* 后面 'later'	8.01

To sum up, with the collocations of items related to *là* 辣 'spicy' and *má* 麻 'numbing' identified in the above sections, it is confirmed that spicy and numbing feelings are closely related to chemesthesis rather than taste sense in the use of language. This is mainly manifested by the irritation and hurting ability carried by the spiciness, which is not shared by other true qualities of taste sense. Apart from that, when spicy and numbing foods are served in certain quantities, intense feelings need to be relieved. Moreover, spicy and numbing feelings are hard to tolerate, courage is thus required if people are not used to these feelings, and negative emotions such as fear will be expressed. It is, however, not to say all the words listed above are not acceptable for genuine taste-related items. For example, those words expressing one's preference (e.g., *pà-chī-tián* 怕吃甜 'afraid of eating sweetness'[14]) and extremity (e.g., *tián-sǐ-le* 甜死了 'too sweet') are also acceptable for the gustatory qualities. Note that some of the verbs indicating endurance can also collocate with one of the genuine taste senses, *kǔ* 苦 'bitter', such as *bǎoshòu* 饱受 'suffer', *rěnshòu* 忍受 'bear', so on and so forth. However, in the corresponding contexts, *kǔ* 苦 'bitter' normally elicits its metaphorical meaning of suffering in life and does not literally refer to the bona fide gustatory sensation.

5. PERCEPTION OF TASTE

As mentioned in Section 1, the five traditional tastes, i.e., *suān* 酸 'sour', *tián* 甜 'sweet', *kǔ* 苦 'bitter', *là* 辣 'spicy', and *xián* 咸 'salty' constitute the major qualities of taste sense in Chinese culture, even though *là* 辣 'spicy' is testified being treated as chemesthesis rather than the gustatory sensation in the preceding section. In this section, we would like to check whether the concept of *wèidào* 味道 'taste; smell' strictly or loosely follows its definition with the data presented in the corpus Chinese Web 2017 (zhTenTen11). It is noted that the vocabulary being categorized into different sensory domains mainly follows two lines: (1) if their original meaning is pertinent to that sense (cf. Zhao, Xiong, and Huang 2019); for example, even though *měi* 美 'beautiful' is commonly used in the visual domain in modern Chinese, its etymology originated in the taste sense (denoting the delicious taste of a big sheep[15]) made it a gustatory adjective in Zhao, Xiong, and Huang (2019); (2) if the perception is deemed dominating in that word (cf. Chen et al. 2019), for instance, the ratings received by the adjective *nóngliè* 浓烈 'of intense taste-scorching' in gustatory and olfactory senses were extremely close to each other - 4.48 versus 4.40, we had no choice but to choose the more dominant one that won out by a tiny margin. Other words not listed in Zhao, Xiong, and Huang (2019) or Chen et al. (2019) will mainly be categorized in terms of their original meanings that can be traced in *Shuowenjiezi* (Xu 1963) or their frequent usages as demonstrated by the corpus data.

5.1 Collocations with Gustatory and Olfactory Vocabulary

Since the meaning of *wèidào* 味道 'taste; smell' comprises both the gustatory and olfactory senses according to the definition in the dictionary, the collocations that fall into these two categories will be examined first. For our current purpose, we limited the grammatical relations to the words that *wèidào* 味道 'taste; smell' modifies and the modifiers of *wèidào* 味道 'taste; smell', which are mostly adjectives. Following an exhaustive search for collocations in the two grammatical relations with all irrelevant words excluded, 55 gustatory related and 19 olfactory related items were identified, as presented in Tables 4 and 5.

Table 4 Gustatory related items to describe *wèidào* 味道 'taste; smell'

	Gustatory related Modifies/Modifiers	logDice score		Gustatory related Modifies/Modifiers	logDice score
1	*tián(tián de)* 甜(甜的) 'sweet'	9.02	29	*qīngdàn* 清淡 'of light taste'	5.4
2	*dàn(dàn de)* 淡(淡的) 'of mild taste'	8.19	30	*xiāngcuì* 香脆 'fragrant and crispy'	5.4
3	*xiāngtián* 香甜 'fragrant and sweet'	7.83	31	*là(là de)* 辣(辣的) 'spicy'	5.14
4	*nóngyù* 浓郁 'of intense taste-dense	7.58	32	*xiándàn* 咸淡 'degree of saltiness'	5.04
5	*nóngliè* 浓烈 'of intense taste-scorching'	7.38	33	*gānxiāng* 甘香 'sweet and fragrant'	5
6	*suān(suān de)* 酸(酸的) 'sour'	7.29	34	*kǔsè* 苦涩 'bitter and astringent'	4.72
7	*nóngxiāng* 浓香 'aroma'	7.19	35	*gānkǔ* 甘苦 'sweetness and bitterness'	4.54
8	*málà* 麻辣 'spicy and numbing'	6.95	36	*xiāngsū* 香酥 'appetizing and crispy'	4.45
9	*nóngzhòng* 浓重 'of intense taste-heavy'	6.72	37	*xiánxiāng* 咸香 'salty and fragrant'	4.44
10	*guǎdàn* 寡淡 'of mild taste'	6.54	38	*xiānchún* 鲜醇 'savory and mellow'	4.33
11	*xián* 咸 'salty'	6.28	39	*tiánzīzī* 甜滋滋 'pleasantly sweet'	4.09
12	*gāntián* 甘甜 'sweet'	6.23	40	*yóunì* 油腻 'oily'	4.08
13	*xiānglà* 香辣 'spicy'	6.17	41	*suānsè* 酸涩 'sour and astringent'	4.06
14	*nónghòu* 浓厚 'of intense taste-thick'	6.14	42	*suānlà* 酸辣 'sour and spicy'	3.95
15	*tiánxiāng* 甜香 'sweet and fragrant'	6.06	43	*xiāngtián-kěkǒu* 香甜可口 'sweet and tasty'	3.94
16	*qīngtián* 清甜 'limpid-sweet'	6.02	44	*shuǎngkǒu* 爽口'tasty and refreshing'	3.93
17	*jí xiān* 极鲜 'extremely savory'	6.01	45	*sè* 涩 'astringent'	3.53
18	*chúnhòu* 醇厚 'of intense taste of wine-thick'	5.99	46	*suānshuǎng* 酸爽 'sour and tasty'	3.45
19	*tiánsuān* 甜酸 'sweet and sour'	5.97	47	*má* 麻 'numbing'	3.43

Table 4 (*continued*)

	Gustatory related Modifies/Modifiers	**logDice score**		**Gustatory related Modifies/Modifiers**	**logDice score**
20	*xiánxiān* 咸鲜 'salty and savory'	5.85	48	*gānliè* 甘冽 'sweet'	3.36
21	*tiánnì* 甜腻 'sweet and cloying'	5.81	49	*huǒlà* 火辣 'hot and spicy'	2.98
22	*chúnhé* 醇和 'mellow and mild'	5.57	50	*chúnměi* 醇美 'mellow and tasty'	2.69
23	*nì* 腻 'fatty; greasy'	5.55	51	*xiānnèn* 鲜嫩 'savory and tender'	2.61
24	*suānliūliū* 酸溜溜 'sour'	5.53	52	*gānměi* 甘美 'sweet and tasty'	2.53
25/ 26	*chúnxiāng* 醇香/ *xiāngchún* 香醇 'mellow and fragrant'	5.51	53	*tiánrùn* 甜润 'sweet and moist'	2.17
27	*suāntián* 酸甜 'sour and sweet'	5.51	54	*féiměi* 肥美 'fatty and tasty'	2.13
28	*kǔ* 苦 'bitter'	5.42	55	*gānchún* 甘醇 'sweet and intense taste of wine'	2.06

Most of the gustatory-related words adopt morphemes that are categorized as gustatory adjectives in Zhao, Huang, and Long (2018) and Zhao, Xiong, and Huang (2019), e.g., *tián* 甜 'sweet', *dàn* 淡 'of mild taste', *nóng* 浓 'of intense taste', *suān* 酸 'sour', *xián* 咸 'salty', *gān* 甘 'sweet', *xiān* 鲜 'savory', *chún* 醇 'intense taste (of wine)', *nì* 腻 'fatty; greasy', *kǔ* 苦 'bitter', and *měi* 美 'tasty'. One noticeable phenomenon is that these monosyllabic morphemes can be freely compounded to describe certain preferable tastes and flavors. In addition to these words that rigorously pertain to the gustatory sensation, morphemes from other sensory domains also contribute to building the gustatory vocabulary, especially the recurring olfactory item *xiāng* 香 'fragrant'. This word initially portrays aroma and fragrance; but in Chen et al.'s (2019) ratings, although *xiāng* 香 'fragrant' is mainly perceived by the olfactory sense (scored 4.84), gustatory perception shows a very competitive score of 4.32. In fact, gustatory and olfactory perceptions demonstrated a strong positive correlation in their ratings of the lexical items, and this can be partly explained by the neurological fact that the olfactory receptors can also be stimulated when food is tasted in the mouth (Spence, Auvray, and Smith

2014). Moreover, tactile-dominant adjectives (e.g., *zhòng* 重 'heavy', *cuì* 脆 'crisp', *sū* 酥 'crisp; flaky', *rùn* 润 'moist', and *nèn* 嫩 'tender') and visual-dominant adjectives (e.g., *hòu* 厚 'thick', *qīng* 清 'limpid', and *féi* 肥 'fat') also participated in constituting gustatory-related items.

Table 5 Olfactory related items to describe *wèidào* 味道 'taste; smell'

	Olfactory related Modifies/Modifiers	**logDice score**		**Olfactory related Modifies/Modifiers**	**logDice score**
1	*qīngxiāng* 清香 'faint scent'	9.56	11	*yānxūn* 烟熏 'smoky'	5.46
2	*cìbí* 刺鼻 'pungent'	9.42	12	*chòng* 冲 'pungent'	5.07
3	*shāo-jiāo* 烧焦 'scorched'	7.86	13	*qiàngbí* 呛鼻 'pungent'	4.93
4	*fāngxiāng* 芳香 'aromatic'	7.21	14	*èchòu* 恶臭 'stinking'	4.85
5	*qiàngrén* 呛人 'pungent'	6.26	15	*xīnxiāng* 馨香 'fragrant'	4.78
6	*xiāngpēnpēn* 香喷喷 'sweet-smelling; savory'	6.18	16	*xīngchòu* 腥臭 'fishy-smell and stinking'	4.3
7	*fēnfāng* 芬芳 'fragrant'	5.98	17	*suānchòu* 酸臭 'acidic and stinking'	3.37
8	*xiāng(xiāng de)* 香 (香的) 'fragrant; savory'	5.94	18	*jiāohú* 焦糊 'scorched and burnt'	2.69
9	*xiāngnóng* 香浓 'fragrant'	5.75	19	*xīnxiāng* 辛香 'spicy and fragrant'	2.69
10	*fùyù* 馥郁 'strong fragrance'	5.57			

In terms of olfactory-related items, most of them denote olfactory qualities, i.e., *xiāng* 香 'fragrant' and *chòu* 臭 'stinking' (cf. Table 5). Predicates related to irritation were also identified, all of them refer to pungent smells, for example, *cìbí* 刺鼻 'pungent', *qiàngbí* 呛鼻 'pungent', and *chòng* 冲 'pungent'. Note that *jiāo* 焦 'scorched' was rated as gustatory dominant in Chen et al. (2019), but in the corpus, we noticed that *jiāowèi* 焦味 'scorched and burnt smell' and also *húwèi* 糊味 'burnt smell' could only collocate with *wén-dào* 闻到 'smell' (284 instances) instead of *cháng-dào* 尝到 'taste' (0 instance). Therefore, these two words are categorized as olfactory words here.

That gustatory- and olfactory- related items used to describe *wèidào* 味道 'taste; smell' suggest that even though at the lexical level, they are mainly referring to gustation and olfaction; at the sub-lexical level (e.g., root morphemes), there exists a considerable number of synesthetic transfers in which firstly, gustatory and olfactory senses transfer to each other; and secondly, lexical items rooted in tactile and visual sensations engage in forming gustatory concepts as well.

5.2 Collocations with Tactile Vocabulary

15 lexical items related to the tactile sense were found in the descriptions of *wèidào* 味道 'taste; smell', as exhibited in Table 6. As briefly raised in Section 5.1, tactile adjectives play a part in building up gustatory items, while the additional phrases presented in this section further affirms that the tactile sense, deemed the most embodied sense, frequently gives rise to less embodied concepts.

Table 6 Tactile related items to describe *wèidào* 味道 'taste; smell'

	Tactile related Modifies/Modifiers	**logDice score**		**Tactile related Modifies/Modifiers**	**logDice score**
1	*zhòng* 重 'heavy'	7.88	9	*qīnglěng* 清冷 'chilly'	3.21
2	*cháoshī* 潮湿 'moist'	5.29	10	*shīlùlù* 湿漉漉 'wet'	2.99
3	*ruǎnnuò* 软糯 'soft and fluffy'	4.28	11	*liángshuǎng* 凉爽 'cool'	2.54
4	*shuǎnghuá* 爽滑 'refreshing and slippery'	3.86	12	*rùnhuá* 润滑 'moist and slippery'	2.53
5	*wēnhé* 温和 'warm'	3.75	13	*bīngliáng* 冰凉 'icy cold'	2.48
6	*cìjī* 刺激 'irritating'	3.56	14	*gānzào* 干燥 'dry'	2.44
7	*shīrùn* 湿润 'moist'	3.54	15	*róuhuá* 柔滑 'soft and smooth'	1.5
8	*xìnì* 细腻 'fine and smooth'	3.38			

Neurological science corroborates that tactile receptors all over our body are mainly split into four categories, including "mechanoreceptor" picking up sensations such as pressure, vibration, and texture; "thermoreceptor" concerning temperature such as hot and cold;

"nociceptor" aka pain receptor for perceiving pains; and "proprioceptor", which is the deep pressure sense felt by muscles, tendons, and joints when we make movements (Popova 2005). When *wèidào* 味道 'taste; smell' is described, it is found that texture and temperature-related vocabulary are mainly adopted. For example, *wēnhé* 温和 'warm' and *liángshuǎng* 凉爽 'cool' are to describe certain preferred temperature, i.e., neither too hot nor too cold, it is therefore used to express mild and suitable taste, as exemplified in the following instances (1) and (2):

(1) 奶酪温和的味道可以中和一下辣味。
Nǎilào wēnhé de wèidào kěyǐ zhōnghé yīxià làwèi.
cheese warm DE taste can balance once spicy-taste
'The mild taste of cheese can balance the spicy taste.'

(2) 夏季特有的豆面，其香喷喷又凉爽的味道绝对是美味。
Xiàjì tèyǒu de dòumiàn, qí xiāngpēnpēn yòu
summer exclusive-have DE bean-noodle it savory and
liángshuǎng de wèidào juéduì shì měiwèi.
cool DE taste absolutely is tasty
'The bean noodle exclusively for summer is absolutely tasty with its delicious and cool taste.'

In addition, items related to texture, such as *ruǎnnuò* 软糯 'soft and fluffy', *shuǎnghuá* 爽滑 'refreshing and slippery', and *xìnì* 细腻 'fine and smooth', are commonly employed to describe the taste. It is notable that words rated as dominant in gustatory sensation in Chen et al. (2019) also contain a large number of adjectives denoting texture, e.g., *làn* 烂 'mushy', *sè* 涩 'astringent', *sū* 酥 'crisp; flaky'. We suggest that these words describe *kǒugǎn* 口感 'mouthfeel', which is a concept closely related to taste and aroma but also greatly influenced by "the structure, texture and responsible for the overall impression of the food" (Mouritsen and Styrbæk 2014, 6). *Kǒugǎn* 口感 'mouthfeel' ranks first in the list of "and/or" relation to *wèidào* 味道 'taste; smell' in the corpus (with the highest logDice score of 8.68), it, therefore, shares a very similar meaning with *wèidào* 味道 'taste; smell'. It can be shown that people consistently confuse *kǒugǎn* 口感 'mouthfeel' with *wèidào* 味道 'taste; smell', as in the following sentence:

(3) 蛋糕散发着浓郁的巧克力香气，轻轻品尝一口，香甜软滑的口感，味道醇正而细腻。

Dàngāo sànfà zhe nóngyù de qiǎokèlì xiāngqì, qīngqīng
cake exude ZHE rich DE chocolate aroma light-light
pǐncháng yī kǒu, xiāngtián ruǎnhuá de kǒugǎn wèidào
taste one mouth sweet smooth DE mouthfeel taste
chúnzhèng ér xìnì.
mellow and delicate
'The cake exudes a rich chocolate aroma. Take a little bite, and you can feel the sweet and smooth texture, and the taste is mellow and delicate.'

Although mouthfeel- and taste-related words exhibit an interchangeable usage, Zhong and Huang (2018) and Zhong and Huang (2020) suggested that descriptors of desserts in Mandarin Chinese are most likely related to *kǒugǎn* 口感 'mouthfeel' rather than *wèidào* 味道 'taste; smell', with nearly half of the mouthfeel items belonging to the tactile perception. Jurafsky (2014) likewise suggested it is not the gustatory or olfactory faculty but the tactile sense that plays a major role in describing desserts in English. Nevertheless, the findings in this study and previous studies all point to the influence and significance of tactile sensation in bodily feelings of gustatory sensation.

5.3 Collocations with Visual Vocabulary

The remaining modifiers of *wèidào* 味道 'taste; smell' consist of adjectives pertaining to the visual sense, as presented in Table 7. Zhao, Xiong, and Huang (2019) claimed that instantiations of vision transferring to taste sense were not frequent and common in Mandarin Chinese as well as violated the embodiment-/biological-driven approaches in explaining the transfer tendencies of linguistic synesthesia; therefore, this type of transfer was not highlighted in the synesthetic directionality (e.g., Williams 1976; Zhao, Huang, and Ahrens 2019; Zhao, Xiong, and Huang 2019). However, the data illustrated in Table 7 display a considerable number of visual items modifying *wèidào* 味道 'taste; smell':

Table 7 Visual related items to describe *wèidào* 味道 'taste; smell'

	Visual related Modifies/Modifiers	logDice score		Visual related Modifies/Modifiers	logDice score
1	*chún* 纯 'pure'	7.32	12	*qīngliè* 清冽 'limpid'	3.8
2	*fā-méi* 发霉 'go moldy'	7.07	13	*yōuyōu* 幽幽 'faint'	3.4
3	*fǔlàn* 腐烂 'rot'	6.52	14	*fēngyú* 丰腴 'full and round'	3.39
4	*qīngshuǎng* 清爽 'refreshing'	6.1	15	*chúnjìng* 纯净 'pure and clean'	3.28
5	*dànyǎ* 淡雅 'simple and elegant'	5.53	16	*yōuyuǎn* 悠远 'distant'	2.93
6	*qīngchún* 清纯 'pure'	4.99	17	*qīngyōu* 清幽 'quiet and beautiful'	2.48
7	*céngcì* 层次 'layer'	4.82	18	*qīngchè* 清澈 'limpid'	2.39
8	*hòuzhòng* 厚重 'thick'	4.56	19	*qīngyíng* 轻盈 'lithe'	2.32
9	*gānjìng* 干净 'clean'	4.44	20	*sùyǎ* 素雅 'simple and elegant'	2.2
10	*céngcìgǎn* 层次感 'layering'	4.4	21	*qīngyǎ* 清雅 'elegant'	2.15
11	*jīngzhì* 精致 'delicate'	3.92	22	*hòushí* 厚实 'thick and solid'	1.47

The above table shows that the main feature of these visual-related adjectives is that they are much more abstract than words from other sensory domains, and most of them are related to simplicity, purity, and elegance (e.g., *chún* 纯 'pure', *qīngshuǎng* 清爽 'refreshing', *dànyǎ* 淡雅 'simple and elegant', *jīngzhì* 精致 'delicate'). In addition, when these words are used to describe *wèidào* 味道 'taste; smell', they give rise to personification, and the target domain *wèidào* 味道 'taste; smell' is portrayed as a human, as illustrated in the following instances (4) and (5):

(4) 这道茶最适合配点心来用，因为茶味不浓，相比其他性格强烈的饮品，它清新淡雅的味道不会抢了点心的风头。
Zhè dào chá zuì shìhé pèi diǎnxīn lái yòng, yīnwèi
this CL tea most suit match dim-sum come use because
cháwèi bù nóng, xiāngbǐ qítā xìnggé qiángliè de yǐnpǐn,
tea-taste no intense compare other personality strong DE drink

tā qīngxīn dànyǎ de wèidào bù huì qiǎng le diǎnxīn
it fresh simple-elegant DE taste no will grab LE dim-sum
de fēngtóu.
DE limelight
'This tea goes best with dim sum. As it is not too overbearing, unlike other strong-flavored drinks, its fresh and elegant taste will not outshine dim sum.'

(5) 让白兰地微妙而精致的味道取悦你的味蕾。
Ràng báilándì wéimiào ér jīngzhì de wèidào qǔyuè
let brandy delicate and exquisite DE taste please
nǐ de wèilěi.
you DE taste-bud
'Let the delicate and exquisite taste of brandy please your taste buds.'

6. EMBODIMENT OF BODILY SENSATIONS

From the two sections above analyzing perceptions of spicy and numbing and *wèidào* 味道 'taste; smell' of the food, we have attested that Mandarin Chinese treats chemesthesis-based tastes different to other basic taste senses and the traditional taxonomy of five tastes is far from adequate to present a full range of gustatory properties in Mandarin Chinese. This supports the claim that we can discover cognitive mechanisms underlying natural languages with semantic analysis (Ji 2020). However, the above analysis additionally gave rise to the following questions: (1) Why do the tactile and gustatory senses tend to be easily confused when describing bodily feelings? (2) Why can the less embodied senses, i.e., the olfactory and visual senses, transfer to the more embodied sense, i.e., gustatory sense? (3) Why are no auditory-related adjectives used to modify the gustatory sense? Accounting for these doubts might help to address our last research question of how gustatory sense interacts with those more embodied and those less embodied senses.

First, the reason for spicy and numbing being misunderstood as taste sense might be the similarity between them and those bona fide taste senses in terms of acquiring method. Just as how we perceive sweetness and bitterness, the spicy and numbing feelings are also perceived through the oral cavity in the process of eating. Such feelings, moreover, are produced by spices such as chili pepper and Sichuan pepper, which Chinese people

normally consider as condiments together with salt, sugar, MSG, vinegar, etc. that create various tastes. Therefore, although spiciness and numbness activate different receptors from genuine tastes, ordinary Chinese people would and could not distinguish these receptors from taste buds which are all located in the oral cavity, and would simply regard the spicy and numbing feelings as flavors added to the food akin to the sweet, sour, or salty taste. With such tactile members in the gustatory family, it is thus natural to use the more embodied tactile sense to express bodily tastes such as spiciness and numbness. In addition, being non-taste chemesthesis, the spicy and numbing feelings yet do interact with tastes, which makes the tactile and gustatory senses more intertwined. Except for the relieving effect of sweetness on the burning sensation produced by capsaicin as mentioned earlier, spicy and numbing also display a close relation with bitterness in the later stage of consuming hotpot, instantiated by phrases such as *yuè-zhǔ-yuè-kǔ* 越煮越苦 'the longer it cooks, the bitterer it gets'. The cause of this phenomenon can be found in Green and Schullery (2003) that capsaicin is capable of stimulating a subset of taste neurons that respond to bitter substances, and when applied to small areas of the tongue, capsaicin can produce a bitter taste as well as a sensory irritation. Based on language use, furthermore, Dong, Zhong, and Huang (2018) found that the spicy and numbing flavors usually make it harder for diners to perceive tastes. It can be backed by neurological findings that chili pungency and anesthetic constituents containing Sichuan pepper may reduce the taste intensity of foods (Prescott and Stevenson 1995; Rong et al. 2016).

In addition to the aforementioned biological interpretation of a close relationship between tactile and gustatory sensations, the second notion we propose is that the gustatory sense category, although bodily experienced, is conceptually abstract. For instance, apart from the original meaning denoting gustation and olfaction, *wèidào* 味道 'taste; smell' is also conceptually associated with the visual and hearing senses (cf. instances [6] and [7]), and shows great versatility in its ability to map to various abstract concepts (cf. instance [8]):

(6) 这款燃气灶亮丽的外观设计，充满着时尚的味道。(VISION)
Zhè kuǎn ránqìzào liànglì de wàiguān shèjì, chōngmǎn zhe
this CL gas-stove bright DE exterior design full-of ZHE
shíshàng de wèidào.
fashion DE taste
'The external design of this brand of gas stoves is full of fashionable taste.'

(7) 每一首歌都能听出用心的味道。(HEARING)
Měi yī shǒu gē dōu néng tīng chū yòngxīn de wèidào.
each one CL song all can listen out attentive DE taste
'Each song sounds very attentive.'

(8) 爱情故事真的很美好，像是找回了青春的味道。
Àiqíng gùshì zhēn de hěn měihǎo, xiàng shì zhǎo huí le
love story really DE very beautiful seem is find back LE
qīngchūn de wèidào.
youth DE taste
'Love stories are really beautiful; it is like rediscovering one's youthful days.'

Grounded on the versatility of *wèidào* 味道 'taste; smell', it makes perfect sense that when the bodily sensation is the focus, it is open to being described by more embodied concepts (e.g., mouthfeel items related to temperature and texture), and it is natural to use more embodied senses, such as tactile sense, to describe gustatory perception. Since the feelings in the mouth are considered concrete bodily sensations, confusing concepts from these two closely connected senses is a matter of convenience.

On the other hand, when the focus is on the quality of sensation, i.e., the desirability and pleasantness of taste, as shown in the visual-related examples, it is reasonable to use more conceptual and basic senses to modify the less embodied sense. For example, apart from the visual adjectives discussed above, various personality-related items were also identified in the corpus that echo the depiction of taste as a human being. These items include *pǔshí* 朴实 'sincere and honest', *huópō* 活泼 'vivacious', *tiáopí* 调皮 'naughty', *bàdào* 霸道 'overbearing', *zhāngyáng* 张扬 'unabashed', *hánxù* 含蓄 'introverted', and *dānchún* 单纯 'simple',

which in actuality illustrate either plain/bland or strong/rich tastes, see (9) – (11):

(9) 尽管味道很朴实，但是松软的饼体已经让人爱不释口。
Jǐnguǎn wèidào hěn pushí, dànshì sōngruǎn de bǐngtǐ
although taste very simple but fluffy DE cake-texture
yǐjīng ràng rén ài-bù-shì-kǒu.
already let people eat-more-of-it
'Although its taste is very simple, the fluffy texture is enough to make one want to eat more of it.'

(10) 茶瓦纳冰摇桃桃绿茶带来了清新活泼的味道。
Cháwǎnà bīngyáo táotáo lǜchá dài lái le qīngxīn
TEAVANA ice-shake peach green-tea bring come LE fresh
huópō de wèidào.
lively DE taste
'TEAVANA shaken iced peach green tea brings a fresh and lively taste.'

(11) 这锅霸道的味道充斥了每个人的鼻腔。
Zhè guō bàdào de wèidào chōngchì le měi gè rén
this pot overbearing DE taste fill-up LE each CL person
de bíqiāng.
DE nasal-cavity
'The strong smell from this pot fills up everyone's nose.'

This finding is also consistent with the analysis of mouthfeel items used to describe desserts in Mandarin Chinese in Zhong and Huang (2018) and Zhong and Huang (2020), in which words that stemmed mainly from impressions of personalities gained through social interactional contact were often adopted to illustrate the mouthfeel of desserts.

Regarding the relationship between the gustatory sense and auditory modality, although the hearing sense may occupy a place in the perception of food in terms of textural properties, for example, crispness and crackliness (Auvray and Spence 2008), Zhong and Huang (2018) and Zhong and Huang (2020) also found a few examples of onomatopoeia describing the mouthfeel of desserts, e.g., *gēzhī-gēzhī* 咯吱咯吱 'crunching sound', *shāshā* 沙沙 'rustling sound', *zāzā* 咂咂 'smacking

sound'. The lack of instantiation in the current corpus of auditory adjectives describing the gustatory sense might be due to an insufficient number of adjectives in the auditory sense: only 18 reported in Chen et al. (2019) and 4 in Zhao, Xiong, and Huang (2019). It might also be that the hearing sense was reported to be the most distant sense in previous perceptual strength norms studies, where the ratings for how strongly one experiences a concept via vision, hearing, taste, smell, and touch senses were collected (e.g., Lynott and Connell 2009, 2013; Chen et al. 2019; Lynott et al. 2019). Hearing sense in such tests was constantly argued to be the most distinct among all the basic senses since no clear correlation with other senses was found. Given its distant relationship to the gustatory sense and the other senses, it partly explains absent examples in this corpus where auditory lexemes are used to describe the taste.

To sum up, regarding interactions among the gustatory sense and tactile, olfactory, and visual senses, our data show that tactile and gustatory sensations reveal an intimate and intertwined correlation with each other when concrete bodily sensations are being discussed; while olfactory and visual senses, which are deemed more distant and less embodied senses, participate in picturing taste when the focus is on the quality of sensation. Since there is no instantiation in the corpus showing hearing-related lexical items being used to describe gustatory sense, the relationship between gustatory and auditory senses revealed in language awaits future studies.

7. CONCLUSION

We demonstrate in this study that the traditional view of spicy and numbing being one of the basic taste senses is not valid linguistically. Furthermore, we also showed that the Chinese language contains a versatile taxonomy of gustatory properties by using variegated non-taste lexical items from other sensory domains to depict the perception of taste. This tendency to embellish or elaborate gustatory properties might be the reason why the more abstract flavor - umami, corresponding to *gān* 甘 'sweet; tasty', has receded into the background in the discussion of tastes in Chinese. Yet, this argument may require a separate study to validate. We also found an intertwined relationship between tactile and gustatory items as a result of mixing up chemesthesis and mouthfeel words with genuine taste vocabulary. Those more embodied senses, i.e., olfactory and visual

sensations, likewise manifest a substantial tendency to transfer to gustatory sense, and it is argued that it is because the quality of sensation is highlighted in such transfers. In the context of the cross-sensory description of taste, the only sense domain not attested is the auditory sense. This confirms that auditory modality is predominantly used as the target domain in the cross-sensory mapping (e.g., Strik Lievers and Winter 2018; Zhao, Huang, and Ahrens 2019). With assumptions of the intricate interactions among the embodied senses and several remaining issues raised in the study, it should be promising to further disentangle these complexities in the interrelationship between language and perception.

NOTES

1. In what follows, names of sensations and their commonly known forms will be used interchangeably, for example, *gustatory sensation/sense* and *taste sense* both refer to the perception of taste.

2. It is an encyclopedic Chinese classic text and a compendium of philosophical works compiled under the Qin Dynasty (3rd century BCE).

3. A word in Japanese combines the concept of *umai* 'delicious' and *mi* 'essence'. It echoes the original meaning of *gān* 甘 'tasty' or 'savory' as defined in Duan (2007, 358) as well as the etymology of the orthography (the character 甘 *gān* is formed through association by a diagram of tongue with the center marked to indicate the location of tastes). Note that *gān* 甘 also carries the meaning of *sweet* despite it was later replaced by *tián* 甜 'sweet' and is normally used as a morpheme forming disyllabic words in Modern Chinese.

4. For instance, we will use *huígān* back-umami 回甘 'to have a sweet and mellow aftertaste' to describe the taste of tea and other beverage in Chinese.

5. Also known as Old Chinese, the oldest attested stage of Chinese language ranging from Shang Dynasty to Han Dynasty (16th century BCE–220 CE) (Huang and Shi 2016, 3).

6. An ancient Chinese collection of philosophical writings composed by Xun Kuang in the 3rd century.

7. According to *Shuowenjiezi* (Xu 1963, 157), the original meaning of *zuì* 罪 is 'fish-net' (similar to *luó* 罗 'bird-net') and the borrowing of this character to stand for 'crime; punishment' happened in Qin Dynasty (3rd century BCE).

8. Accessed at https://app.sketchengine.eu/.

9. It was established in 2003 and acts as a leading online city life guide and one of the first online consumer service rating sites worldwide to provide restaurant, shopping, entertainment, leisure, and day to day living services through its interactive platform. Accessed at http://www.dianping.com/.

10. Other two categories include Medium Review and Negative Review.

11. Accessed at https://www.octoparse.com/.

12. logDice score indicates how strong the collocation is; the higher the score, the stronger the collocation (for the algorithm of logDice score, please see Rychlý 2008).

13. The above-mentioned foods are almost always served with sugar in Chongqing and Chengdu cities.

14. But it is more equivalent to do not like or do not want to eat sweetness.

15. The character *měi* 美 is composed of 羊 'sheep' and 大 'big' and is originally defined as *gān* 甘 'tasty; sweet' in *Shuowenjiezi* (Xu 1963, 78).

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感官体验与具身认知
——基于语料库的汉语味觉词汇研究

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摘要

具身认知(Embodiment)是研究人类语言概念表征的重要途径。前人对语言中的通感(linguistic synesthesia)及感官词汇的实证研究发现感官之间会因感官体验(bodily sensation)程度的不同呈现不同的映射规律。一般来说感官体验度较高(more embodied)的感官(如触觉、味觉)会更趋向于映射至体验度较低(less embodied)的感官(如视觉、听觉等)。本文基于语料库对汉语味觉词汇进行详尽考察，并对感官体验与具身认知问题展开讨论。我们主要分析两种现象：1)从生理学角度看不属于味觉感知的“辣”和“麻”长期被汉语母语者视为味觉；2)汉语母语者在描述食物味道时，会使用大量不属于味觉的其他感官词汇，而这些词汇有些更是来自感官体验度较低的感官。本文提出，味觉作为较为抽象的认知范畴，可借助感官体验度较高的词汇对其进行描述；但当人们需要强调味觉特性时，体验度较低的感官词汇同样也可对味觉加以表达。本文的分析进一步说明了具身认知对语言概念化研究的多重功能。

关键词

具身认知 **汉**语味觉词汇 **通**感 **感**官体验