

The multisensory science and aesthetics of teaware

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ABSTRACT

The last few years have seen a marked growth of research interest in the study of the influence of the drinking vessel on the consumer's experience of a wide range of different beverages, ranging from wine to beer, and from coffee to hot chocolate. Until recently, however, far less research has been directed toward studying the impact of the drinking vessel on people's experience of tea, no matter whether served hot, as an iced tea, or as a sparkling tea beverage. Nevertheless, an emerging body of rigorous scientific research now demonstrates the significant impact that the material properties of the drinking vessel, and the semantic associations that different groups of consumers may have with it, can exert over both the sensory discriminative and hedonic aspects of the tea-drinking experience. This narrative historical review therefore summarizes what is currently known concerning the impact of the drinking vessel on the tea-drinking experience, and a number of relevant directions for future research are also recommended. Given the breadth of the scope, the focus is primarily on the contemporary service of the hot beverage in the West.

1. Introduction

The last few years have seen growing interest in the study of the influence of the drinking vessel on the consumer's experience of a wide range of different beverages (see [Spence and Wan, 2015, 2016](#), for reviews), with interest stretching all the way from wine glasses (e.g., [Manska, 2018](#); [Spence, 2011](#); [Spielmann and Rossi, 2024](#); [Venturi et al., 2016](#)) to coffee cups (see [Spence and Carvalho, 2019](#), for a review), and from beer glasses ([Mirabito et al., 2017](#); [Sandilya et al., 2023](#)), through to hot chocolate cups/mugs ([Piqueras-Fiszman and Spence, 2012](#)). Until recently, however, it is the author's opinion that far less research has been directed toward studying the impact of the drinking vessel on people's experience of tea, no matter whether the beverage is served hot, as an iced drink, or else as sparkling tea. This is surprising inasmuch as tea is the world's second most consumed beverage after water (and ahead of beer; see [Mason, 2023](#)).

At the same time, however, an emerging body of rigorous scientific research has now started to demonstrate the profound impact that the material (i.e., sensory) properties of, and the semantic associations that consumers have with ([Schifferstein, 2009](#)), specific drinking vessels can have over both the sensory discriminative and hedonic aspects of the (tea-)drinking experience. In fact, everything from the material properties of the cup through to the thickness of the lip have been shown to influence people's ratings of tea. This narrative historical review summarizes what is currently known concerning the impact of the drinking

vessel on the tea-drinking experience (see [Ferrari, 2015](#); [Furley and Goldschmied, 2021](#); on the strengths of narrative literature reviews), and a number of directions for future research in this rapidly-evolving area are also highlighted. Given the breadth of ways in which tea-type beverages are consumed, the focus in this review is primarily on the contemporary service of the hot beverage amongst Westernized consumers. Note also that like many other areas in psychological science, the majority of the published research has tested those who are WEIRD (namely, Westernised, Educated, Industrialized, Rich, and Democratic; [Henrich, 2024](#); [Henrich et al., 2010](#)). As such, the focus of the majority of the research that is reviewed here has tended to be conducted with participants who are WEIRD.

In recent years, a reasonably extensive body of research has started to emerge concerning the impact of the sensory (e.g., [Carvalho et al., 2020](#); [Carvalho and Spence, 2018, 2019, 2021](#)) and semantic associations of coffee cups (cf. [Schifferstein, 2009](#)) on the coffee-drinking experience. That said, there has undoubtedly been far more research on the impact of coffee cups than on tea cups and mugs (see [Spence and Carvalho, 2019](#), for a review). Interestingly, when one looks around the world, there would appear to be a wider range of designs (and serves) for coffee beverages than there are for tea beverages. It is, though, an open question, as to just how different the culture of tea is from that of coffee (see [Blofeld, 2022](#); [Li, 1993](#); [Macfarlane and Macfarlane, 2009](#)). Just as for speciality coffee, the taste, aroma, mouthfeel, and flavour of tea beverages depends on a number of aspects of the preparation process

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(Lee et al., 2008). Furthermore, various other psychological factors have also been shown to influence people's perception of tea, such as the number of choices they are given (Onuma and Sakai, 2019), and whether they adopt an analytic versus a hedonic approach to tasting (Prescott et al., 2011). However, these kinds of psychological influences will not be reviewed here. The taste and texture of tea can be classified into 12 categories: strong, fresh, refreshing, sweet, smooth, rich, mellow, dull, coarse but plain, coarse but astringent, immature but astringent, bitter and astringent, and plain like water (see <https://www.tres.gov.tw/view.php?catid=1679>, 2018).

In the West, tea is primarily served from a tea cup or mug. However, very different teaware is used to serve and consume the beverage in different countries/cultures: Consider only the thick-lipped earthenware cups that are used to serve hot green tea in Japan, or the rough textured brown clay cups used by workers for chai latte on the roadside in India (see Fig. 1). Nevertheless, the last few years have seen a rapid expansion in the number of studies on the impact of teaware; This is the literature that is summarized and critically evaluated here.

Even as a hot beverage, tea comes in many varieties, including black, green, red, and white tea (Wan et al., 2014a,b; Yilmaz and Acar-Tek, 2023), not to mention Darjeeling, Assam, Oolong (sometimes known as Rock tea), Earl Grey, English Breakfast tea, etc. All of that variety before one gets to the multitude of herbal, rose, fruit, and matcha teas that are becoming increasingly popular with consumers around the world.¹ With so many different varieties of tea available, and a well-developed high-end market (e.g., for white teas) and single estate, or batch, teas (e.g., <https://www.lalaniandco.com/>), one might wonder why, unlike in the case for wine stemware, there appears to be no market for specialized cup shapes for different ultra-premium teas.² Innovation in the area of tea beverages would appear to have focused on rather different research directions (Ikeda et al., 2007; Varma, 2013). Implicit in this lack of variation is perhaps the suggestion that the magnitude of the influence of the teaware on the customer's experience of the tea is less marked than is the case for other beverages, such as wine, coffee, or even beer (consider only how in Belgium a wide array of different glass shapes are matched with different beers).

2. Drinking vessels: their effect on people's expectations and tasting experience

Researchers have conducted both online and in-person research in order to assess the associations that people have with particular drinking receptacles. A number of in-person studies now demonstrate how a given beverage may be rated very differently depending on the receptacle in which it happens to be presented. Some studies first assess the expectations associated with different beverage serves before going on to assess the impact of teaware on the multisensory tasting experience itself (cf. Carvalho and Spence, 2019).

At the outset, one important distinction to bear in mind here that has emerged from the last decade's research on gastrophysics (see Spence, 2017, for a review) concerns the relative importance of beverage-related expectations and flavour experience. In particular, a consumer's expectations concerning the sensory discriminative and hedonic qualities of any food or drink product are typically established prior to tasting

(see Piqueras-Fiszman and Spence, 2015, for a review). Oftentimes, such expectations are established on the basis of various product-extrinsic cues, including packaging, labelling, as well as the receptacle in which a drink is presented etc. (Choi and Lee, 2019). The colour of a beverage can also provide some important cues to its likely identity, and thus flavour (identity), of a drink (Wan et al., 2014a; see also Rach, 2020). Colour provides an important cue for consumers as to the strength of their tea beverage (note that subtle gradations in the visual appearance of the beverage would appear to be much more revealing in the case of tea than is the case for coffee). At the same time, however, it is important to note that the meaning of a drink's colour may sometimes change as a result of the type of glassware in which that drink happens to be presented (see Wan et al., 2014a; Wan et al., 2015).

Consumers in particular cultures often establish associations between specific drinking vessels and particular beverages. As such, they are likely to build-up their expectations concerning the type of drink given the semantic associations that they may have with distinctive classes of drinking vessel (see Schifferstein, 2009; Spence, 2017). Serving a drink in a receptacle that happens to be more commonly associated with a different beverage is likely to give rise to a negatively-valenced disconfirmation of expectation response (see Raudenbush et al., 2002; Schifferstein, 2009). That said, there may well also be a number of important culture-specific differences in terms of the kinds of drinking vessel that are used (and hence considered congruent) for different tea beverages in different markets. Nevertheless, given the larger body of research that has been conducted on the associations that people have with, and the impact of, coffee cups, it is that literature we briefly summarize first.

3. Coffee cups: what impact do they have?

Online research has assessed whether people, when asked to rate their expectations associated with a number of different coffee cups, reveal different expectations when it comes to coffee-related beverages are associated different shapes and sizes of coffee mug (Van Doorn, Woods, Levitan, Wan, Velasco, Bernal-Torres and Spence, 2017). The various different shapes of coffee cup shown visually to participants in Van Doorn et al.'s online study were associated with quite different expectations in the minds of those who took part in the study. The colour and material qualities of the cup or mug from which coffee is drunk, or tasted, have been shown to influence the taste/flavour of beverages. So, for instance, Van Doorn, Willemin, and Spence (2014) demonstrated that the visual appearance of the mug affected people's rating of the taste of a milky coffee. In particular, two studies conducted in Australia demonstrated that a café latte was rated as having a more intense flavour when it was served in a white ceramic mug than from a clear glass beaker, or else a blue mug (Experiment 1). In a second experiment, coffee served in a transparent glass with a white rubber sleeve was rated as tasting less sweet than when the same drink was served to participants in a clear glass or a glass with a blue-sleeve instead. By contrast, no significant influence of the colour of the drinking vessel was reported on any of the other dependent measures (e.g., sweetness, aroma, bitterness, quality, or acceptability). The suggestion in this case was that the colour contrast between the mug and beverage may have altered the visual appearance properties of the drink itself (cf. Spence and Velasco, 2018).

In another study, this time conducted in France, Guéguen and Jacob (2012) demonstrated that the colour of the coffee cup exerted a small but significant impact on the evaluation of a coffee beverage's rated warmth (Guéguen and Jacob, 2012). These researchers had 120 French participants taste coffee from four different coloured cups (blue, green, red, and yellow) and indicate which coffee was warmest (in terms of its temperature): 38% of those quizzed rated the coffee served in the red cup as the warmest, followed by yellow (28%), green (20%) and, finally, the blue cup (13%). In this case, the suggestion was that the colour of the mug itself may have directly primed the related thermal associations (see also Sakarya and Dortyol, 2022; Spence, 2020b).

¹ As Yang, Peng, and Hsu (2019, p. 3) note: "The modern tea-drinking practice is heavily influenced by Western culture, becoming more diversified in terms of the method and teacup design. English afternoon tea, the Japanese tea ceremony, innovative beverages, and flower or fruit teas are part of this diversity."

² One can only wonder whether this might have something to do with the fact that speciality coffees and fine wines tend to be far more chemically complex than premium teas in terms of the number of volatiles that these various beverages contain (Buratti et al., 2013; Spence and Wang, 2018; Sunarharum et al., 2014).



Fig. 1. Rough textured Indian chai cup, Japanese earthenware green tea cup, and a decorated ceramic tea cup. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

A number of studies conducted over the last decade or so have demonstrated that varying the multisensory qualities of the coffee cup, including everything from the colour of the cup to its material qualities (Carvalho and Spence, 2019, 2021), its shape (Carvalho and Spence, 2018), through to its surface texture (Carvalho et al., 2020; see also Pramudya et al., 2020) can exert a significant influence over the multisensory coffee-drinking experience (see Spence and Carvalho, 2019, for a review). So, for example, people expect a coffee served in a cup with a pink outer surface to taste sweeter than when served from a cup with a yellow or green outer appearance instead (Carvalho and Spence, 2019). Moreover, depending on the beans and the roast, such sensory expectations may sometimes subsequently influence the experience on tasting the coffee.³ In summary, an emerging body of scientific research highlights the significant impact that aesthetically designed coffee cups can have on both people's expectations, and thereafter on their tasting experience, in the case of coffee. So what do we know when it comes to teaware?

4. Teaware: what impact does it have?

The last few years have seen the publication of a small number of studies concerning the impact of the visual appearance and feel of teaware on people's expectations and also on their tasting experience. That is, studies of the influence of teaware on subjective ratings of, and taste expectations concerning, tea have also revealed a number of significant effects (e.g., Li et al., 2020). In one such study, Li and colleagues presented 100 Chinese participants and a further group of 100 North Americans with online pictures of two types of green tea (one Chinese brand and another British brand) presented in both white-coloured British and also in a Chinese tea set (see Fig. 2). Participants rated the pleasantness, familiarity, the drink-receptacle congruency, their expectations concerning the taste (in particular, expected bitterness, astringency, sweetness, saltiness, and sourness on 7-point scales), as well as their willingness-to-pay (WTP) for the four tea beverages displayed. The style of teaware (i.e., Chinese vs. English) affected pleasantness ratings with the Chinese brand green tea rated as looking more pleasant when presented in the Chinese tea set than in the British tea set (5.2 vs. 4.6, respectively), whereas no such difference was observed for the British brand of green tea (4.4 vs. 4.6, respectively). The Chinese participants reported that they were significantly more familiar with the Chinese tea set than with the British set (4.5 vs. 4.3, respectively), whereas the reverse was true for the participants from the US (4.0 vs. 4.5, respectively). What is more, the Chinese participants reported that they were



Fig. 2. Tea cups used in an online study by Li et al. (2020, Experiment 1).

willing to pay 20% more for a cup of Chinese brand tea when presented in a Chinese tea cup as compared to the same tea when presented in a British tea cup instead.

In a second study, a group of 56 Chinese participants were shown tea in British or Chinese teaware again (although this time the lid was removed from the Chinese tea set), with either a low or high price attached. In both studies, the teaware influenced the participants' ratings of the expected bitterness and astringency of the teas (even though it was the same cup of Chinese green tea in both cases). Furthermore, the Chinese participants in both studies expected the British brand green tea to be saltier and sourer than the Chinese brand. Taken together, such results clearly highlight the importance of the teaware (at least amongst Chinese participants) in terms of setting the appropriate product-related expectations.⁴

A further study, thus far only presented as a conference paper (Wan et al., 2019), expanded on the stimulus array now crossing three types of green tea, with the matching three styles of tea cup (see Fig. 3). In this online study, 111 Chinese participants rated the teas on expected intensity, aroma intensity, sweetness, sourness, bitterness, saltiness and astringency, as well as their WTP. The results showed that the tea presented in the Chinese tea cup was expected to have a higher aroma intensity, the tea presented in the British cup was expected to be sweeter

³ The key variable here may be the degree of discrepancy between the sensory expectations and the tasting experience (Piqueras-Fiszman and Spence, 2015).

⁴ One of the other ways in which teaware varies concerns the presence versus absence of a handle (Mathugama and Ranasinghe, 2023). However, this aspect of the design and functionality has not received much interest from those studying teaware's influence on the sensory-discriminative and hedonic aspects of tasting.



Fig. 3. The 9 tea samples shown to participants in a study reported by Wan et al. (2019).

and less astringent, and the tea presented in the Japanese cup was expected to be more sour, bitter, salty, and intense. Participants also reported being willing to pay more for the tea in the Chinese cup. These results once again highlight the impact of the cultural style of the tea cup on Chinese consumers' WTP.

Other researchers have investigated the relationship between the shape of the cup and the taste of the tea (Yang and Peng, 2021). In particular, these Taiwanese researchers studied the influence of the shape of the teacup on people's perception of tea, and the sustainability value of the aesthetic and practical design of the teacup (Peng and Yang, 2017; Yang et al., 2019) (see Fig. 4). Yang et al. tested 12 experts (including five tea ceremony teachers, one tea merchant, three tea critics and professional tea ceremony teachers, one tea maker and tea critic, one professional tea ceremony teacher and ceramic designer, and one tea merchant and professional teacher of the tea ceremony). The participants answered questions concerning the strength of taste, the intensity of bitterness, the intensity of astringency, the intensity of sweet aftertaste, overall tea presentation, and their preference for the teacup (on a 5-point Likert scale). The results revealed that a participant's preference for a particular shape of teacup was sufficient to explain its impact on their perception of the taste, bitterness, sweet aftertaste, astringency, and overall presentation of the tea. Crucially, when the same tea was presented in cups that had been made of the same material but had different designs not only was the taste affected, but also the bitterness, the sweet aftertaste, and the astringency which influenced the experts' ratings of the overall presentation of the tea.

Yang and Peng (2021) studied oolong tea taste data from 34 participants. The findings indicated that the mouthfeel of teacups (i.e., the thickness of the cup's rim; see Fig. 5) influenced the reported taste and flavour of the tea. For those consumers lacking professional tea evaluation training, the taste and the aroma of the tea was better appreciated when the diameter of the cup was wider. For regular consumers, their preference of teacup directly affected their perception of all the tastes and fragrances associated with the tea. That is, the taste and fragrance of the tea was rated more highly when served in the participant's favourite cup. The regular consumers' liking for a cup's shape was affected by the diameter of the cup and the thickness of its rim. By contrast, the professionals' ratings of the taste and fragrance of the tea appeared to be unaffected by their preference for a particular teacup.

Lago et al. (2021) investigated the impact of tactile stimuli on the perception of sweetness in samples of black tea. In their study, 96 participants tasted four iced-tea beverages, one extra-sweetened, and three having a normal level of sweetness. The disposable plastic cup in which the latter three beverages were served had a soft surface, no special

finish, or else a rough surface feel. The textured surface that was described as woolly, silky, and velvety was associated with sweetness whereas the texture that had been described as rough and sandy was associated with bitterness instead (cf. Pramudya and Seo, 2019; Van Rompay, Finger, Saakes and Fenko, 2017). The participants in Lang et al.'s main study had to rank the four tea samples in terms of their sweetness and also in terms of their preference. The feel of the paper cup exerted a significant influence over the consumer's experience of the iced tea beverage. The results revealed that 59% of the respondents preferred the extra-sweet sample, followed by 18% who preferred the tea in the soft finish disposable cup, 12% preferred the no treatment cup, and 11% preferred the tea in the cup with a rough finish. Intriguingly, the ranked sweetness of the beverages was similarly affected with the tea in the soft finish cup being ranked as tasting significantly sweeter than the other two samples that were actually equi-sweet.⁵

The thickness of the lip and weight of a glass also appears to exert a subtle effect on people's ratings of a bottled green tea beverage (Ichimura et al., 2023). In one experiment, 56 participants tasted four samples of cold unsweetened green tea from either a thick or thin-lipped glass (1.2 vs. 2.8 mm).⁶ The blindfolded participants had to rate sweetness, bitterness, mellow, rich, refreshing, sour, and tasty using 7-point scales (1 = not at all, 7 = extremely). Depending on how the data were analysed, the thin-lipped glass accentuated bitterness whereas the thicker-lipped glass significantly enhanced the perceived sweetness of the green tea beverage instead. It should, however, be noted that the effects were very subtle and only evident in an analysis of the data that had not been pre-registered. What is more, the variation in the thickness of the lip was confounded with the weight of the glasses (228 vs. 159 g). No effect of lip thickness/weight variation was demonstrated for any of the other rating measures, nor, crucially, when the weight difference between the thick and thin-lipped glasses was artificially eliminated in a subsequent study.⁷

⁵ It is interesting to note how the rough texture of outer surface of India chai cup will likely help to accentuate the spicy notes of the tea (see Biggs et al., 2016; cf. Tu et al., 2015, on the role of packaging texture on the evaluation of a green tea beverage).

⁶ Note that in Japan such beverages are commonly consumed from a clear glass.

⁷ It is interesting to note how baristas have recently been presenting coffee cups with a varying thickness lip (and a pink colour top enhance sweetness); see <https://www.instagram.com/reel/C7yHJDQtbIo/?igsh=MWNseHVwOGp00WJxaQ>.



Fig. 4. The five tea cups used in the study by Yang et al. (2019).



Fig. 5. The five tea cups used in the study by Yang and Peng (2021).

Researchers have shown that the material properties of the drinking vessel interact with the consumers' Need-for-Touch (NFT; Peck and Childers, 2003a, b) to influence tea-drinking experience (C. Wang et al., 2020). A total of 72 blindfolded Chinese participants (split into three groups of 24 participants tasting Chinese, Japanese, or British green tea) sampled room-temperature green tea beverages served in a cup made of ceramic, glass, paper, or plastic (see Fig. 6). Each participant sampled one of the three tea samples in each of the four cups. The participants rated how familiar they were with the taste of the beverage, how pleasant the taste, and they also specified their WTP for the tea. Additionally, the participants rated bitterness, astringency, sweetness, saltiness, sourness, familiarity, pleasantness, and their WTP.

The material of the receptacles used to serve the tea significantly influenced the rated pleasantness of the tea. In particular, the tea samples sampled from the ceramic cup was rated as more pleasant ($M = 4.8$) than those sampled from a paper cup ($M = 4.2$, on a 9-point scale); None of the other pairwise comparisons reached statistical significance. Furthermore, the material of the cup interacted with the participants' NFT, exerting a significant influence over their WTP for the tea. Specifically, high-NFT participants reported that they were willing to pay significantly more for the same cup of tea when it happened to be served in a ceramic cup rather than in a paper cup; whereas the low-NFT participants' WTP for the tea was unaffected by the material of the receptacles (cf. Krishna and Morrin, 2008).

4.1. The tea ceremony: serveware beyond the cup

It should be remembered that the drinking receptacle only forms a part of the serveware, especially in more elaborate tea preparations (see also <https://twinings.co.uk/blogs/news/ceramic-glass-metal-teaware-make-a-difference>; Kwan, 2016; Wade, 2024). Looking back over the centuries, various ritualistic practices have built up around the preparation and appreciation of tea.⁸ Think here of the Japanese Tea Ceremony which has enshrined a rich multisensory approach to the appreciation of the tea beverage. In terms of the history of Chinese tea culture (which stretches back over 5000 years; see Hsu, 1985; Sumuduni

and Piyumali, 2015; Suzuki, 2005; Weng, n.d.; Zhao, 2018; Zhao, 2015, for more on the history of tea-drinking and teaware in China), Yang et al. (2019, p. 2) note how: "The drinking vessel for tea has evolved from a tea bowl in the Tang Dynasty, to a teapot in the Song Dynasty, and a teacup in the Ming Dynasty, to the contemporary design of different forms of teacups."

One needs also to consider the historical context of ceramics, porcelain, and teaware in the West in the 18th Century. Note that British Porcelain teapots were a staple of a British middle-class household in the 18th and 19th centuries as one of a number of material items that emphasised a person's wealth, class and politeness (Richards, 1999, p. 1). As such, it would be interesting to determine whether the material properties, and visual appearance (see Fig. 7), of the teapot from which tea is served might also affect a tea-drinkers sensory-discriminative and/or hedonic ratings (cf. James, 2018).⁹ At the same time, however, it is interesting to consider how the traditional design of bone-china teacups (e.g., in the UK) would appear to emphasize the whiteness of the inner surface of the cup. This presumably allows the tea drinker to distinguish the appearance properties of the tea itself. As was mentioned earlier, variations in the visual appearance appear to play a more important role in people's evaluation and enjoyment of hot tea beverages than it does in the case of black coffee.

For a hot beverage, one should perhaps also consider how the drinking vessel allows consumer to experience the warmth of the contents,¹⁰ and how that may, in turn, affect their mental state (Williams and Bargh, 2008; though see Chabris et al., 2019, for doubts concerning the replicability of this particular finding). More recently, other researchers have also highlighted the influences of product temperature on emotional responses to, and sensory attributes of, coffee and green tea beverages (Pramudya and Seo, 2018; see also Hornak, 2018). In the context of iced tea preparations, the presence of a straw and lid have

⁹ Note that analogous research has demonstrated that the colour of the pot from which coffee is poured can also exert an influence over people's ratings of the taste/aroma (Dichter, 1964). Two hundred North American consumers compared and evaluated four cups of coffee served from a brown, red, blue, and yellow pot. 73% of those tested rated the coffee from the brown pot as 'too strong'; 84% of the female consumers described the coffee from the red pot as rich and full-bodied. The coffee served from the blue jar was rated as having a milder aroma. The coffee in the yellower container was described as coming from a weaker blend. However, the coffee was the same in all cases (see Favre and November, 1979, p. 64, for a summary).

¹⁰ One might also consider the presence versus absence of a handle on the tea cup (Mathugama and Ranasinghe, 2023), and how that might change a drinker's experience of the warmth of the beverage.

⁸ In the UK, for example, there has been quite some debate over the question of whether the milk should be added to the cup before, or after, the tea has been poured. In the first edition of his classic *Design of Experiments*, Sir Ronald Fisher described a hypothetical experiment which tested the ability of an aristocratic lady to distinguish between cups of tea that had been poured with the milk before the tea and those that had been poured with the milk after the tea (see Fisher, 1960, pp. 11–26). It is, though, unclear whether the proposed study was ever conducted (though see also Allingham and Coughlan, 2024).

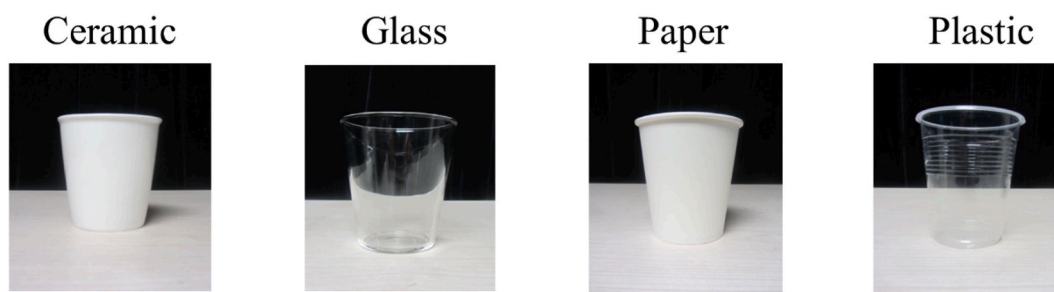


Fig. 6. The four cups used in the study reported by C. Wang et al. (2020).



Fig. 7. Would the same tea served from these two tea pots actually taste different to consumers? Photos reprinted with permission from Maia Ming Designs.

been shown to exert an influence on the consumer's drinking experience (Beekman et al., 2021; Pramudya et al., 2021), although discussing such findings falls beyond the scope of the present review.

5. Conclusions

The last few years has undoubtedly seen growing research interest in the impact of teaware on the sensory-discriminative and hedonic responses to tea beverages, including both hot and cold serves. Nevertheless, there has been far more research on the design of coffee cups than on the design of teaware, despite the fact that tea is undoubtedly currently a more popular (albeit less chemically complex) drink, globally (see Joshi, 2023; Patton, 2011). Tea is the most commonly drunk beverage in the world after water, which is typically not considered a beverage (Mason 2023). In 2018, tea consumption in China alone was estimated at approximately 212 million tons, accounting for one-third of the world's total consumption. An emerging body of scientific research has now started to highlight how the material properties and shape of the drinking vessel including everything from its shape (e.g., Cavazana et al., 2017) to the surface texture (e.g., Tomic et al., 2024; Van Rompay et al., 2017) can influence people's expectations concerning, and thereafter their experience of, tea beverages (see Yang and Hsu, 2024). This has been shown for hot tea beverages, as well as for iced tea (Lago et al., 2021). It would seem likely that the consumer experience of the increasingly popular sparkling tea beverages would also be affected by the drinking vessel as much as by the packaging format in which the product is presented (<https://www.datamintelligence.com/research-report/carbonated-ready-to-drink-tea-market>; see also Spence and Wang, 2017).

The latest findings concerning the impact of the drinking receptacle on the tea-drinking experience would appear to be consistent what has been demonstrated previously in the context of beverages as diverse as coffee (Spence and Carvalho, 2019), beer (Mirabato et al., 2017), and, of course, wine (see Spence, 2011, for a review; though see Ichimura et al., 2023, Footnote 3 for a note of caution in this regard).¹¹

5.1. Cross-cultural differences

There are likely to be a number of culture-specific variations in the meaning of, and thus the likely influence associated with, different types of teaware, not to mention the rituals associated with its preparation and presentation in different contexts (Li et al., 2020; cf. Sproesser et al., 2022). Consider here only the contrast between the thin-lipped bone china that has long been popular amongst upper-class English tea drinkers (cf. Spielmann and Rossi, 2024), and the rough-textured small terracotta (i.e., clay) cups that are typically used on the street to serve chain in India. Green tea tends to be served in earthenware cups having a thicker lip in Japan (see Fig. 1). As such, the drinking vessel might be expected to influence a tea beverage's perceived ethnicity/authenticity (although this has not been assessed to date). It is not always easy to separate the material quality of the cup from the cultural style it embodies. Given the long history of teaware in different cultures,

¹¹ It would also be interesting to determine whether the generalization that heavier is generally rated as better, and as having a more intense fragrance is also observed in the case of tea, as has been shown previously in many other product categories (Gatti et al., 2014; Kampfer et al., 2017).

experimenting on the more traditional examples of teaware represents an interesting area for future research (i.e., rather than the disposable cups, and glasses that have formed the basis of so many of the studies that have been published recently). Here, it could also be worth comparing the impact of more traditional forms of teaware as a function of whether participants are made aware of the cultural history linked to them.

5.2. Multiple factors affecting the tea-drinking experience

It is important to note that the drinking vessel is but one of the many factors that have been shown to affect the consumer's expectations concerning, and experience of, hot beverages such as tea or coffee (e.g., Motoki et al., 2021; Spence, 2021; Spence and Carvalho, 2020; Van Doorn, Colonna-Dashwood, Hudd-Baillie and Spence, 2015; Wu et al., 2024). Indeed, everything from the colour scheme of the drinking environment through the background music, or noise, that happens to be playing in the background has been shown to affect the coffee tasting experiences (Bravo-Moncayo et al., 2020). That said, it is noticeable how the sonic aspects of tea preparation are far less distinctive than in the case of speciality coffee beverage preparation. Just consider the sound of a kettle boiling which doesn't have any of the sensory appeal, nor associated anticipation, that may be associated with a coffee machine's operations, say (see Knöferle, 2012; McDermott, 2013; Spence, 2019). Further research is undoubtedly needed in order to further compare the impact of a variety of product-extrinsic cues on the consumers' perception of tea and coffee beverages.

5.3. Future research directions

In terms of future research, it would be interesting to consider how the receptacle interacts with the beverage over and above any semantic meaning that might be associated with the style, or type, receptacle itself. So, for example, one might wonder whether the desire for a thin lipped tea cup in the West is sensorially or culturally determined (i.e., meaning that it stems from the flavour profile of the tea itself vs. being determined by cultural factors instead)? It will also be interesting to determine whether virtual reality (VR) techniques can be used to provide useful insights in the context of teaware (cf. Huang et al., 2019; Q. J. Wang et al., 2020).

There is growing interest in the health benefits of various kinds of tea (e.g., Khan and Mukhtar, 2013; Li et al., 2022; Pan et al., 2017; Yao et al., 2024). It would therefore be interesting to consider the role of the serving/drinking vessel in encouraging the consumer acceptance of (e.g., green tea; see Lee et al., 2010). Given the growing calls to reduce sugar consumption, one might consider ways in which perceived sweetness could be accentuated by the serving vessel, so that the sugar content of the tea beverage itself could be reduced (see Carvalho and Spence, 2019).¹²

It would also be interesting to compare the uplift to tea ratings relative to those associated with serving in one's own favourite mug (Daily Mail Reporter, 2009; Spence, 2017). One of the other lines of research that it would be interesting to pursue concerns the impact of serving a sparkling tea beverage in different kinds of glassware. It is noticeable how a number of these products are packaged in Champagne-type bottles with a cork stopper, and marketed as a low or no alcohol alternative to sparkling wine (cf. Moore, 2021). As such, one might imagine that the glassware would exert a particularly pronounced impact on sparkling (or carbonated) tea ratings under such conditions (see Spence and Wang, 2017). One other area where there has been virtually no research as yet, concerns the context of serving? How, one might ask, does the environment in which tea happens to be served interact with the effects of teaware on the sensory-discriminative and

hedonic aspects of the tasting experience (cf. Spence, 2020a)? One final consideration here concerns whether a more analytic versus hedonic approach to tasting tea is adopted (Prescott et al., 2011).

Ultimately, given that tea is the world's second most popular drink (after water; Mason, 2023), it clearly makes sense to try and understand more about the impact that the sensory and semantic associations of the tea-drinking receptacle have on the tea-drinking experience, so that the latter can be optimized. Doing so is likely to depend on more than just sensory factors but also taps into the rich cultural and ritualistic associations of this most historic and popular beverage.

Implications for gastronomy

Tea beverages are amongst the most popular drinks globally, and yet there has been little attempt to study the impact of teaware on the sensory-discriminative and hedonic aspects of tasting to date. The majority of the research on hot beverages has tended to focus on studying the impact of coffee cups. Nevertheless, an emerging body of research now demonstrates significant effect of teaware on the perception of consumers around the world. Interestingly, there would appear to be more cultural variation in what counts as appropriate teaware than in the case for coffee. The research that has been published to date highlights the importance of both sensory and cultural determinants of teaware appropriateness, and thus its impact on the perception of consumers. Crucial for those working in gastronomy, the research provides concrete suggestions concerning ways to optimize the serviceware to enhance the customer's drinking experience.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

No data was used for the research described in the article.

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¹² Note that RTD tea beverages tend to have quite a lot of sugar added (see Dubey et al., 2020).

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