

The influence of music on the perception of oaked wines
– A tasting room case study in the U.S. Finger Lakes Region

Wang, Q. J.¹, Frank, M.², Houge, B.³, Spence, C.¹, & LaTour, K. A.⁴

¹ Department of Experimental Psychology, University of Oxford, Oxford, UK

² General Manager, Dr. Konstantin Frank Winery, Hammondsport, NY, USA

³ Department of Electronic Production and Design, Berklee College of Music, Boston, MA, USA

⁴ Banfi Professor of Wine Education and Management, School of Hotel Administration, SC Johnson College of Business, Cornell University, Ithaca, NY, USA

ABSTRACT

Innovative wine makers/marketers increasingly see the consumers' multisensory experience in the tasting room as a means of differentiating themselves from the competition. With recent research demonstrating the influence of music on the wine-tasting experience, the present study introduced music as a unique aspect of a VIP tasting room experience at a family-owned Finger Lakes winery. A convenience sample of 46 participants tasted four oaked still wines (2 white, 2 red) in silence and with a complementary soundtrack, and rated the fruitiness, spiciness, and smoothness of each wine in both sound conditions. Undisclosed to the participants, the soundtrack had been designed to bring to mind woody/spiced elements of oak ageing. It was hypothesised that listening to the oak soundtrack would alter the evaluation of the wines to be smoother and spicier. The results revealed that the wines tasted while the soundtrack

were playing in the background were rated as significantly fruitier and smoother than the same wines when tasted in silence. These results are discussed in terms of the literature on crossmodal correspondences and the emotional mediation account. Moreover, the positive feedback from the attendees showcases music as a viable component of a multisensory experience when visiting a winery.

KEYWORDS: Wine marketing; Crossmodal correspondence; Music; Consumer psychology; Oak ageing.

Introduction

Enhancing consumer experience at the winery

Business scholars recognize that the market has moved on from selling products to selling experiences (Pine & Gilmore, 1998, 1999). This has resulted in marketers curating multisensory experiences to capture the attention and loyalty of consumers (Carbone 2004). With many thousands of different wine brands potentially available to the consumer, wine marketers increasingly see experiences as a means to differentiate themselves to consumers. For example, Mollydooker has marketed their “Mollydooker shake¹” for opening bottles to maximize taste and freshness. Their label and associated Youtube video work together to help the consumer engage with their wine in a unique and fun way. Others, like Dom Pérignon, use distinctive glow-in-the-dark labels on their Luminous² bottles with the lighting choreographed at clubs to integrate their brand into the customers’ multisensory experience.

One of the most direct ways in which wine marketers can influence the consumer experience is through the events that they provide in their respective tasting rooms. Recognizing wine as an aesthetic experience (Charters & Pettigrew 2005), wineries have started pairing their wines with art, music, and food in order to create unique experiences for their visitors in their tasting rooms (see Spence et al., 2014). For instance, Krug has been inviting musicians to curate playlists that match the various Krug cuvées, while their tasting room experience focuses on how different musical selections can alter the taste of their wines (Jones, 2014). However, in this case, it is worth stressing that the music is selected in an idiosyncratic way, relying only on the intuitions of the musicians concerned.

Crossmodal effect of music on wine tasting

A growing body of scientific evidence now demonstrates that what people taste when evaluating a wine, and how much they enjoy the experience, can be influenced by the music that happens to be playing at the same time (Hauck & Hecht, 2019; North, 2012;

¹ <https://www.mollydookerwines.com/MollydookerShake.aspx>

² <https://manofmany.com/lifestyle/whats-deal-dom-perignons-luminous-glowing-bottle>

Spence et al., 2013, 2014; Wang & Spence, 2015, 2017; Wang et al., 2017; see Spence et al., in press; Spence & Wang, 2015, for reviews). It has long been known that what we hear can influence the hedonic aspects of tasting. Beyond liking, however, what the recent research now illustrates is that by playing the “right” music, one can also impact specific sensory-discriminative aspects of tasting as well (Spence & Wang, 2015). The research that has been published to date has uncovered that these associations between musical attributes and tastes/flavours are surprisingly robust, and appear to be experienced by the majority of people (at least amongst the predominantly Western³ cultures where these studies have been conducted, see Knöferle & Spence, 2012, for a review). These so-called crossmodal correspondences – for instance, between high pitch and sourness (Crisinel & Spence, 2009; Mesz et al., 2011), or between harmonic consonance and sweetness (Wang & Spence, 2016) – then explains how a soundtrack playing in the background can change the way in which we perceive what is in the glass. Especially selected (and often specifically composed) music has been shown to influence the perceived acidity, sweetness, fruitiness, and length of wines (Spence et al., 2014; Wang & Spence, 2015, 2017; Wang et al., 2017).

Up to this point, the influence of music on the perception of oak in wines has yet to be elucidated. By providing low levels of oxygenation during the period when wine is maturing in the barrel, oak ageing can smooth out astringent tannins in the wine (Bird, 2011). More notably, exposure with new oak barrels can add distinct flavour compounds to the wine, including vanilla, cinnamon, clove, smoke, and coconut (Bird, 2011). It was therefore hypothesised that the inclusion of a background soundtrack corresponding with the flavour qualities of oak ageing should, as a result, make the wine taste smoother and enhance ‘baking spice’ characteristics in the wine. While untested in wine, the idea of using multisensory influences to bring out woodiness has been explored in the world of whisky. At a public whisky tasting experience in London, a “woody” audiovisual display showing images of pieces of wood while playing the sound of wood instruments and wood sounds (e.g. creaking wood doors, breaking twigs, wood crackling in a fire) was found to make the whisky taste significantly more woody as compared to a control condition with no audiovisual accompaniment (Velasco et al., 2013). More recently, Chivas has commissioned a series of whisky

³ Although participants from India have been shown to exhibit the same kind of sound-to-basic-taste crossmodal correspondences as participants from the U.S. (see Knoferle et al., 2015).

tasting events where specific soundtracks were composed to bring out sweet and woody elements in whisky (Houge, 2015). The same soundtrack associated with woody elements is used in the present study to evaluate whether the same effect can be transferred from whisky to wine.

Furthermore, with the growing emphasis on ecological validity in food-related research, a naturalistic study was conducted as part of a VIP tasting room experience at a family-owned Finger Lakes winery in upstate New York, showcasing music as a unique aspect of the wine tasting experience. More specifically, the study examined the crossmodal impact of wine-music pairings on the consumer taste experience. The goal of the study was two-fold; first, to evaluate the sensory influence of music on wine tasting, and second, to assess whether music could constitute a viable component of a multisensory winery visit experience.

Methods and materials

Participants

A convenience sample of forty-six participants signed up and paid to take part in a special tasting and tour experience at a family-owned winery. The participants would be considered “wine enthusiasts”, with many belonging to the wine club and/or having great interest in wine exhibited through their wine tourism destination and leisure choices. The age span was 25-70 years, and the sample was roughly gender split (24 female, 22 male). The participants signed consent forms at the start of the experience.

Auditory stimuli

A soundtrack was created to reflect the flavour qualities of oak ageing. It was originally intended to showcase bitter/woody elements in a whisky tasting event (Houge, 2015; the soundtrack can be streamed at <https://soundcloud.com/benhounge/chivas-bitter>). The instruments were cello, woodblocks, temple bells, some low percussion, a sustained woodwind texture, and a low drone sound comprised of several elements (including voice and string instruments). The low frequencies were emphasized to reflect bitterness (see Knöferle & Spence, 2012, for a review) by using the cello and low drone,

while the sounds of woodblocks were used to bring to mind the oaky quality in a wine/whisky.

Wines

Four wines from the host winery with various levels of oak treatment were used in the study: the 2015 Chardonnay, the 2014 Hilda Chardonnay, the 2014 Pinot Noir, and the 2014 Cabernet Sauvignon. The alcohol, total acid, residual sugar, and oak maturation information are shown in Table 1.

Table 1. Technical information of the four wines used in the study.

	Alcohol (%)	Total acidity (g/L)	Residual sugar (g/L)	Maturation
2015 Chardonnay	12	7.2	2.1	30% - 10 months aging in European oak 70% - aged in stainless steel
2014 Hilda Chardonnay	12	7.9	8.0	12 months aging in European oak
2015 Pinot Noir	13	7.6	< 1	18 months aging in European oak
2014 Cabernet Sauvignon	12	6.4	< 1	18 months aging in European oak

For each wine, the participants were invited to rate the fruitiness, spiciness (in terms of spices like cloves and cinnamon, rather than the trigeminal chili/heat association with spiciness), and smoothness. These dimensions were chosen because they are commonly encountered and spiciness and smoothness are related to oak treatment (Bird, 2011). An online study was conducted (N=147, 83 women, $M_{age}=36.45$ years, $SD_{age}=9.54$) to evaluate people's attitude towards these wine attributes (see Figure 1). Each attribute was rated on a 9-point hedonic scale (1 = 'Hate it', 9 = 'Love it'). A significant difference was documented between all three attributes ($F(2,292) = 33.98$, $p < .0005$, $\eta_p^2=0.19$), with smoothness liked the most and spiciness liked the least.

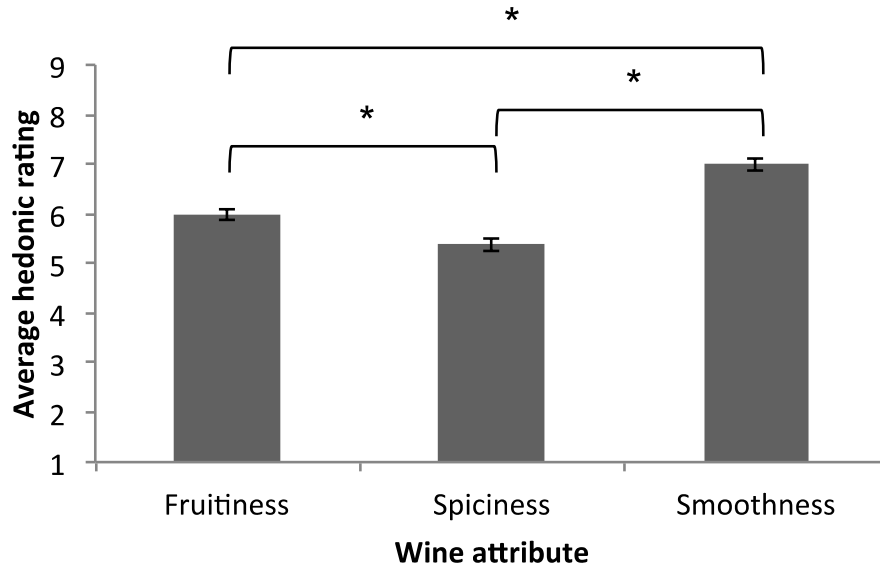


Figure 1. Participants' average hedonic ratings of fruitiness, spiciness, and smoothness (on 9-point scales) in the online pre-study. Error bars indicate standard errors. Asterisks denote statistical significance (* $p < .05$).

Procedure

The winery special experiences were offered on weekends during the high (tourism) season and presented as a means of attracting the more involved consumer (as the session involved a much higher fee than the regular tasting room). The sessions were designed to be both fun and informative, with each month featuring a different theme. "Oak ageing" was the theme in the target month, and participants visited the barrel room, learning about the oak regime at the winery, and tasting samples from the barrels during the tour.

Afterwards, the participants went to the VIP tasting room where the study described here was conducted. There, they were presented with four wines on a placemat, two white (Chardonnay) and two red (Pinot Noir and Cabernet Sauvignon). Each wine was served as 50 mL samples in standard 350 mL wine glasses. As the focus of the study was on whether the music would influence the tasting experience, the participants rated the wines both with music and without. In order to randomise the order of music presentation, the participants were divided into two groups. In one group ($N = 24$), they were directed to smell and taste the wines first without music, rating each wine on three

characteristics: fruitiness (1 = not at all fruity, 7 = extremely fruity), spiciness (1 = not at all spicy, 7 = extremely spicy), and smoothness (1 = not at all smooth, 7 = extremely smooth). Next, they were invited to turn over their survey and to rate the wines again as the music played and were specifically instructed not to view their ratings on the previous side. In the other group (N=22), the order was reversed so that the wines were tasted and evaluated with the music first, and then without. The participants were instructed not to talk during the evaluations. The participants were told that the music had been specially selected to complement the flight of wines, but no other information about the music (for instance, that it was produced to evoke oak flavours) was disclosed. At the end of the questionnaire, the participants had the opportunity to give their thoughts about the entire experience in an open-ended response text box. The study lasted for around 30 minutes, and the participants were debriefed afterwards.

Data Analysis

Data from all 46 participants were included in the analyses, with no missing data. A repeated-measures multivariate analysis of variance (RM-MANOVA) was conducted with sound condition (with or without music) and wine type (2015 Chardonnay, 2014 Hilda Chardonnay, 2014 Pinot Noir, 2014 Cabernet Sauvignon) as the within-participants factors, order (silence first or music first) as the between-participants factor, and fruitiness, spiciness, and smoothness as measures. Post-hoc comparisons were performed with Bonferroni corrections.

Results

Overall, there was a significant main effect of sound condition ($F(3,42)=11.85$, $p<.0005$, Wilks' Lambda=0.54), and wine type ($F(9,36)=14.02$, $p<.0005$, Wilks' Lambda=0.22), but no effect of sound order ($F(3,42)<1$, *n.s.*), nor any significant interaction between music and wine ($F(9,36)=1.19$, $p=.33$).

Further univariate ANOVAs revealed that the sound condition had a significant effect on both ratings of fruitiness ($F(1,44)=31.15$, $p<.0005$, $\eta_p^2=0.41$) and smoothness ($F(1,44)=15.63$, $p<.0005$, $\eta_p^2=0.26$), where tasting the wines with music was associated with both higher fruitiness ($M_{\text{music}}=4.34$, $SE=.14$ $M_{\text{silence}}=3.66$, $SE=.14$, $p<.0005$) and

smoothness ratings ($M_{\text{music}}=4.85$, $SE=.15$, $M_{\text{silence}}=4.38$, $SE=.15$, $p<.0005$; see Figure 2).



Figure 2. Participants' average rating scores of fruitiness, spiciness, and smoothness (on 7-point scales) for the four wines in the silent and music conditions. Error bars indicate standard errors. Asterisks denote statistical significance (* $p<.05$).

Wine type had a significant effect on ratings of fruitiness ($F(3,132)=16.24$, $p<.0005$, $\eta_p^2=0.18$), spiciness ($F(3,132)=32.99$, $p<.0005$, $\eta_p^2=0.43$), and smoothness ($F(3,132)=6.57$, $p<.0005$, $\eta_p^2=0.13$). Overall, the 2015 Chardonnay was rated as tasting significantly more fruity than the other wines, the red wines were (unsurprisingly) spicier than the white wines, and the 2015 Chardonnay was rated as smoother than either of the red wines (see Table 2 for comparisons).

Table 2. Average ratings and standard errors of all four wines used in the study. Within each rating group (fruity, spicy, smooth), wines that do not share a letter are significantly different from each other ($p<.05$).

		Mean	Std error	Comparison
Fruity	2015 Chardonnay	4.56	.15	<i>a</i>
	2014 Hilda	3.99	.17	<i>b</i>
	2014 Pinot Noir	3.91	.18	<i>b</i>
	2014 Cabernet Sauvignon	3.54	.19	<i>b</i>
Spicy	2015 Chardonnay	3.18	.17	<i>a</i>

	2014 Hilda	3.47	.19	<i>a</i>
	2014 Pinot Noir	4.51	.18	<i>b</i>
	2014 Cabernet Sauvignon	4.77	.18	<i>b</i>
Smooth	2015 Chardonnay	5.03	.14	<i>a</i>
	2014 Hilda	4.68	.18	<i>ab</i>
	2014 Pinot Noir	4.37	.17	<i>b</i>
	2014 Cabernet Sauvignon	4.39	.19	<i>b</i>

Table 3 shows the effect of music on each of the four wines. While the presence of music influenced fruitiness of all four wines, it only influenced smoothness rating of the first three wines (and not for the Cabernet Sauvignon). This is possibly because the latter wine was already fairly tannic and concentrated; therefore, it is more difficult for the background soundtrack to make a difference (i.e., there may have been a ceiling effect).

Table 3. Average ratings and standard errors of all four wines, in both sound conditions. Pairwise comparisons with Bonferroni corrections were applied for each wine and each rating type, with significance ($p < .05$) indicated in bold.

		No music	Music	Sig
Fruity	2015 Chardonnay	4.08	5.04	<.0005
	2014 Hilda	3.65	4.33	.002
	2014 Pinot Noir	3.58	4.25	.003
	2014 Cabernet Sauvignon	3.34	3.74	.04
Spicy	2015 Chardonnay	3.14	3.22	.72
	2014 Hilda	3.29	3.66	.10
	2014 Pinot Noir	4.46	4.55	.69
	2014 Cabernet Sauvignon	4.86	4.68	.36
Smooth	2015 Chardonnay	4.74	5.31	.006
	2014 Hilda	4.35	5.00	.001
	2014 Pinot Noir	4.15	4.59	.02
	2014 Cabernet Sauvignon	4.28	4.50	.26

In terms of participant feedback, 15 out of the 46 participants gave qualitative feedback concerning their experience. Fourteen were positive about the experience, noting how the music changed the taste of the wine (for instance, “music made the wine spicier”, “in some wines the fruit seemed brighter and more expressive, in others the spice

became more dominant”, “more flavour to the wine”). One participant did not find that the music enhanced the experience and “did not like having to drink the wines during the music”.

Discussion

Overall, the present study illustrates the influence of music on the wine-tasting experience and demonstrates the viability of studies that are conducted in an ecologically valid setting (namely a tasting room at a winery). In general, those wines tasted while a piece of music (reflecting oak elements) was playing in the background were rated as significantly fruitier and smoother than the same wines when tasted in silence, regardless of the order in which the auditory condition was presented.

It should be noted that the intensity of spices in the four wines did not vary significantly with music, even though spiciness is a flavour often associated with oak ageing. This is possibly because spiciness is a more ambiguous concept for novice wine tasters to pick up in a wine, as compared to the more widely used concepts of “fruitiness” and “smoothness”. Future studies in this area could use a more widely understood oak attribute “woody” instead of “spiciness”, although woodiness may be more applicable for oaked spirits such as whisky (where extraction of oak flavours is prolonged, see Broom, 2013) rather than for wines (where relatively short and gentle extraction of oak flavours usually result in vanilla and baking spice flavours instead, see Bird, 2011).

When the soundtrack was playing, the wines were rated as smoother, which is consistent with the idea of oak ageing, especially with long periods in the barrel⁴ (Bird, 2011). However, the fact that fruitiness was enhanced by music is the opposite of what would be expected from increased oak perception, which suggests that it is possible that the music did not enhance oak-related characters *per se*, but that another mechanism might have been at play to account for the changes in wine ratings.

One explanation for why an enhancement of fruitiness and smoothness (but not spiciness) was observed has to do with the idea of hedonic transfer. The online pre-study showed that fruitiness and smoothness are more positive traits compared to spiciness, especially amongst relative wine novices. It has been demonstrated that

⁴ As a qualification, it should be noted that smoothness is not an idea exclusive to oak ageing. Moreover, while long periods of oak ageing can soften tannins, contact with new oak can also impart oak tannins.

customers enjoy the tasting experience more, and are willing to pay more, for novel chocolates when a matching soundtrack is presented as part of the chocolate's identity (Reinoso Carvalho et al., 2015). Similarly, Spence and colleagues (2013) reported that participants rated the same wine as tasting roughly 10% more pleasant when it was tasted with 'matching' music playing in the background. Therefore, it is possible that complementary music served to highlight only the more positively perceived attributes in the wine. Moreover, as we did not assess whether participants in the present study actually associated the soundtrack with woody elements, it is possible that the music only enhanced the participants' emotional experience. In other words, any piece of music that the participants found pleasant might have delivered the same results. Further testing will be required in order to validate this suggestion – for instance, by varying the information communicated to the tasters so that only some of them are told that the music is complementary, by adding a second piece of music with different pleasantness ratings, and, most importantly, by measuring the participants' flavour associations with the soundtracks.

In the worthwhile pursuit of ecological validity, there are certain methodological limitations that need to be addressed with the present study. First, the number of participants was limited (N=46) since the study was conducted as part of a special winery tour experience; we were unable to recruit a larger number of participants since the tour itself was limited to specific dates and times (i.e., we are looking at a convenience sample). Furthermore, while the participants were instructed not to consult each other while answering the questionnaire, there was a lack of separation between the participants since they were sat together in the winery tasting room. To maximise internal validity, participants would have tasted the wines in individual sensory booths, but this was understandably simply not possible at the winery and went against the purposes of the field test. Similarly, we decided it would be the least intrusive to give participants the entire questionnaire and instruct them not to view their previous ratings, instead of collecting each sheet after each wine was tasted.

Despite drawbacks in terms of the methodological setup, the winery received positive response from those who took part in this multisensory tasting experience (see also Spence, 2019). As discussed in the Results section, written feedback collected at the end of the questionnaire revealed that the majority of those who left feedback experienced a change in the taste of the wine as a result of music. Aside from such

written feedback, after participants had been debriefed, one said it was “interesting and shocking how much the music affected the wine taste”, while another commented “the music brought more flavour to the wine.” More generally, though, it is worth stressing that the participants enjoyed the music matching experience, saying that it affected the overall experience, not just the taste of the wine. The winery had just started offering music and wine pairing that summer, and several participants had been to earlier sessions, saying that these type of experiential learning sessions added value and a reason for visiting.

More and more, in order to differentiate the tasting room experience and educate consumers about wines, wineries are looking for innovative techniques that go beyond the technical aspects of wine making. Adding music and other atmospheric cues can not only change the overall ambiance of the multisensory experience in the tasting room, but can also change how consumers experience the taste of the wine. This can be educational for the consumer as they seek to find wines that match the experiences that they have when they consume wine. It also offers a different way to educate the consumer about wine. Offering special multisensory experiences can thus potentially help a winery to build loyalty, so that consumers have a reason to return and experience something new.

REFERENCES

- Bird, D. (2011). *Understanding wine technology: The science of wine explained*. San Francisco, CA: Board and Bench Publishing.
- Broom, D. (2013). *Distilling knowledge: A professional guide to spirits and liqueurs*. London, UK: Wine and Spirits Education Trust.
- Carbone, L. P. (2004). *Clued in: How to keep customers coming back again and again*. Upper Saddle River, NJ: Prentice Hall
- Charters, S., & Pettigrew, S. (2005). Is wine consumption an aesthetic experience? *Journal of Wine Research*, **16**, 121-136.
- Crisinel, A.-S., & Spence, C. (2009). Implicit association between basic tastes and pitch. *Neuroscience Letters*, **464**, 39-42.
- Hauck, P., & Hecht, H. (2019). Having a drink with Tchaikovsky: The crossmodal influence of background music on the taste of beverages. *Multisensory Research*, **20**, 336-342.
- Houge, B. (2015). Tasting notes. *New Music Box*, **November 2nd**. <https://nmbx.newmusicusa.org/tasting-notes/>.
- Jones, S. (2014). Krug uses music to communicate Champagne taste digitally. *Luxury Daily*, **August 9th**. <https://www.luxurydaily.com/krug-uses-music-to-explore-differences-between-champagne-varieties/>
- Knoeferle, K. M., Woods, A., K  ppler, F., & Spence, C. (2015). That sounds sweet: Using crossmodal correspondences to communicate gustatory attributes. *Psychology & Marketing*, **32**, 107-120.
- Kn  ferle, K. M., & Spence, C. (2012). Crossmodal correspondences between sounds and tastes. *Psychonomic Bulletin & Review*, **19**, 992-1006.
- Mesz, B., Trevisan, M. A., & Sigman, M. (2011). The taste of music. *Perception*, **40**, 209-219.

- North, A. C. (2012). The effect of background music on the taste of wine. *British Journal of Psychology*, **103**, 293-301.
- Pine, II, B. J., & Gilmore, J. H. (1998). Welcome to the experience economy. *Harvard Business Review*, **76(4)**, 97-105.
- Pine, II, B. J., & Gilmore, J. H. (1999). *The experience economy: Work is theatre & every business is a stage*. Boston, MA: Harvard Business Review Press.
- Reinoso Carvalho, F., Van Ee, R., Rychtarikova, M., Touhafi, A., Steenhaut, K., Persoone, D., & Spence, C. (2015). Using sound-taste correspondences to enhance the subjective value of tasting experiences. *Frontiers in Psychology*, **6**:1309.
- Spence, C. (2019). Multisensory experiential wine marketing. *Food Quality & Preference*, **71**, 106-116. <https://doi.org/10.1016/j.foodqual.2018.06.010>.
- Spence, C., Reinoso-Carvalho, F., Velasco, C., & Wang, Q. J. (in press). Extrinsic auditory contributions to food perception & consumer behaviour: An interdisciplinary review. *Multisensory Research*.
- Spence, C., Richards, L., Kjellin, E., Huhnt, A.-M., Daskal, V., Scheybeler, A., Velasco, C., & Deroy, O. (2013). Looking for crossmodal correspondences between classical music & fine wine. *Flavour*, **2**:29.
- Spence, C., Velasco, C., & Knoeferle, K. (2014). A large sample study on the influence of the multisensory environment on the wine drinking experience. *Flavour*, **3**:8.
- Spence, C., & Wang, Q. (J.). (2015). Wine & music (II): Can you taste the music? Modulating the experience of wine through music and sound. *Flavour*, **4**:33.
- Velasco, C., Jones, R., King, S., & Spence, C. (2013). Assessing the influence of the multisensory environment on the whisky drinking experience. *Flavour*, **2**:23.
- Wang, Q. J., Mesz, B., & Spence, C. (2017). Assessing the impact of music on basic taste perception using time intensity analysis. In *Proceedings of 2nd ACM SIGCHI International Workshop on Multisensory Approaches to Human-Food Interaction (MHFI'17)*. New York, NY: ACM Press.

- Wang, Q. (J.), & Spence, C. (2015). Assessing the effect of musical congruency on wine tasting in a live performance setting. *i-Perception*, **6**:3.
- Wang, Q. (J.), & Spence, C. (2016). ‘Striking a sour note’: Assessing the influence of consonant and dissonant music on taste perception. *Multisensory Research*, **29**, 195-208.
- Wang, Q. (J.), & Spence, C. (2017). Assessing the influence of music on wine perception amongst wine professionals. *Food Science and Nutrition*, **52**, 211-217.