British Journal of Psychology (2012), 103, 293–301

The British Psychological Society

www.wileyonlinelibrary.com

The effect of background music on the taste of wine

Adrian C. North*

School of Life Sciences, Heriot Watt University, Edinburgh, UK

Research concerning cross-modal influences on perception has neglected auditory influences on perceptions of non-auditory objects, although a small number of studies indicate that auditory stimuli can influence perceptions of the freshness of foodstuffs. Consistent with this, the results reported here indicate that independent groups' ratings of the taste of the wine reflected the emotional connotations of the background music played while they drank it. These results indicate that the symbolic function of auditory stimuli (in this case music) may influence perception in other modalities (in this case gustation); and are discussed in terms of possible future research that might investigate those aspects of music that induce such effects in a particular manner, and how such effects might be influenced by participants' pre-existing knowledge and expertise with regard to the target object in question.

The research reported here investigated the impact of concurrent music on perception in another modality, in this case the taste of wine. Spence and Shankar's (2010) review notes that visual cues concerning food and drink (e.g., their colour) can influence perceptions of their identity and also the intensity of their flavour (e.g., DuBose, Cardello, & Maller, 1980; Duncker, 1939; Levitan, Zampini, & Spence, 2008; Zampini, Sanabria, Phillips, & Spence, 2007; Zampini, Wantling, Phillips, & Spence, 2008), the amount of time required before an individual reaches satiety when eating (Rolls, Rowe, & Rolls, 1982; see also Raghubir & Krishna, 1999), and other fundamental aspects of appetite (e.g., Wheatley, 1973). Moreover, previous research has indicated that experiences of food and drink are influenced by the temperature, texture, viscosity, and other tactile elements of both the food and drink in question and the containers in which they are served (Bult, deWijk, & Hummel, 2007; Green, 2002; Schifferstein, 2009; see Verhagen & Engelen, 2006, for a recent review). However, Spence and Shankar (2010) go on to note that, in contrast, auditory influences on dependent variables such as these have been neglected, such that less than 3% of Verhagen and Engelen's (2006) article on the subject is devoted to multisensory interactions that involve specifically audition.

Spence and Shankar go on to review those few studies that have addressed auditory influences on perception in other modalities, and particularly gustatory responses to

*Correspondence should be addressed to Adrian C. North, School of Life Sciences, Heriot Watt University, Edinburgh EH14 4AS, United Kingdom (e-mail: a.north@hw.ac.uk).

DOI:10.1111/j.2044-8295.2011.02072.x

food and drink. Perhaps, the most interesting and relevant aspects of their review to the present research are studies they describe concerning the mediation of flavour perception by sounds that people make when consuming food and drink and the sound of the packaging in which that food and drink is presented. For instance, Zampini and Spence (2004) found that potato chips were rated as tasting significantly fresher (or instead staler) when the sound made when biting into them was louder (or instead quieter) or even when only frequencies above 2 kHz were amplified (or instead attenuated); and several other studies show that discontinuous or uneven sounds made by foodstuffs during their consumption influences perception of how 'crispy' they are (e.g., Vickers & Wasserman, 1979).

Similarly, Spence, Shankar, and Blumenthal (2010) suggested that concurrent auditory stimuli might influence gustation. In their first experiment, participants were asked to eat bacon and egg flavour ice cream while hearing the sound of either bacon sizzling or farmyard chickens. Ratings of the relative strength of the bacon and egg flavours were consistent of these background sounds. In the second experiment, participants were asked to eat an oyster either presented in a wooden basket while a 'sounds of the sea' soundtrack played or an oyster served on a petri dish while a farmyard chicken soundtrack played: the oysters presented in a basket accompanied by the 'sounds of the sea' soundtrack were rated as tasting significantly more pleasant. Similarly, Crisinel and Spence (2009) found cross-modal associations between high-pitched sounds and the names of sour foods such as vinegar and lemon juice and between low-pitched sounds and bitter-tasting foods such as coffee or dark chocolate; Woods, Poliakoff, and Lloyd *et al.* (2010) report similarly that loud background white noise increases the perceived crunchiness of food; and Crisinel and Spence (2010) identified quasi-synesthesic correspondences among non-synesthesics between tastes and various pitches and musical instruments. 'Given such results, one might therefore expect that playing those specific sounds would have the greatest effect ... on participants' perception of flavour when they were either (synthetically) congruent or (synthetically) incongruent with the taste of the food being evaluated' (Spence & Shankar, 2010, pp. 415–416).

Such findings are consistent with several other studies within consumer psychology that have shown that background music can apparently influence participants to behave in a manner consistent with the connotations of that music. For example, both Areni and Kim (1993) and North, Hargreaves, and McKendrick (1997) found that music could influence wine purchasing. The former found that playing background classical music rather than pop music in a wine cellar was associated with the purchase of more expensive wines; and the latter found that playing music with connotations of France in a supermarket apparently primed selection of French wines by customers, whereas music with German connotations apparently primed selection of German wines. Similarly, North, Shilcock, and Hargreaves (2003) found that playing classical rather than pop music in a restaurant led to customers spending more, and argued that this was attributable to the 'upmarket' connotations of classical music; and Yeoh and North (2010) found that, when given a choice between Indian and Malay food, participants were inclined strongly to select the former when they had just heard Indian music and the latter when they had just heard Malay music.

What is perhaps most interesting about this research is that it is the shared cultural understanding of the music in question that led to it having the effect that it did. To reiterate, Spence *et al.* (2010) found that playing the literal 'sounds' of the flavours in question (namely, bacon and eggs) influenced flavour perception: however, the findings

by Crisinel and Spence (2009) and North and colleagues seem to rest on the notion that gustation (in the case of Crisinel & Spence, 2009) and consumer behaviour (in the case of North and colleagues) were influenced by rather more abstract knowledge of the music that was shared by the participants. This distinction is perhaps best approached from the perspective of semiotics. Several semioticians (see, e.g., Nöth, 1994) have argued that communicative messages contain three components. The *object* is the focus of the message, such as a particular foodstuff. The *sign* is an image or sound that functions as a metaphor in assigning a particular meaning to the object, such as a concurrent auditory stimulus. Finally, the *interpretant* is the meaning that the person actually ascribes to the object as a consequence of associating it with the sign. For example, a box of chocolates (the object) might be wrapped using a red velvet ribbon (the sign), which leads to perception of the chocolates as being luxurious and upmarket (the interpretant). A sign can influence perception of an object because it activates the person's broader knowledge of the world, which in turns becomes associated with the object, and colours the person's interpretation of it.

Signs can relate to objects in several ways. An icon is a sign that literally resembles the product in some way: a box of chocolates may feature a stylized picture of the chocolates themselves, and Spence *et al.*'s (2009) demonstration that the sound of bacon enhances bacon flavours is another good example of this. In contrast, other research cited above involves auditory stimuli functioning as different types of signs. An index is a sign that shares a property with the product: a box of plain chocolate may be black in order to prime the interpretant that there are no milk chocolates. Similarly, the use of French and German music to prime selection of French and German wine (North *et al.* 1997) is another good example of a musical sign operating as an index; and another is provided by Crisinel and Spence's (2009) identification of an association between high-pitched sounds and the names of sour foods, and between low-pitched sounds and bitter-tasting foods. Finally, a symbol is a sign that relates to a product via a culturally agreed stereotypical association (e.g., the notion that a red velvet ribbon is 'luxurious'). The use of classical music to prime higher rates of spending (Areni & Kim, 1993; North *et al.*, 2003) is a good example of the use of auditory stimuli as a symbol, drawing on the upmarket symbol of classical music as an indicator of the upmarket nature of the premises and products in question.

The research reported here considers the possibility that the emotional connotations of music may be able to function as a symbol that influences perceptions of taste. Specifically, the present research investigated whether the emotional connotations of a piece of music as 'powerful and heavy', 'subtle and refined', 'zingy and refreshing', or 'mellow and soft' could have corresponding effects on the perceived taste of a red wine and a white wine. Although the present research did not set out to test these directly, it is also worth noting that such a finding would be consistent with several theoretical mechanisms. North and Hargreaves (2008), for instance, refer to the notion of 'musical fit' and draw on cognitive priming theory to propose that the symbolic connotations of music can raise the salience of related schema in commercial contexts. Viewed through this lens, North *et al.*'s (1997) finding that French and German supermarket music prime sales of wine from those countries is explained by the music raising the salience of all French or German products and stereotypes, thus priming the selection of the congruent wine. In a similar vein, Yeoh (2009) has argued that the effects of music as a signifier that guides selection of commercial products may be attributable to the recognition heuristic (see Goldstein & Gigerenzer, 2002). This states that a known alternative will be selected over an unknown one, and when both alternatives are unknown, participants should

search for a cue to aid them in decision making: under these circumstances, participants choose the brand associated with the music playing in the background.

Spence and Shankar (2010) argue that such effects may be attributable to sensory dominance by which judgements are based predominantly on the information available in one sensory modality; and they point to recent evidence (e.g., Suzuki, Gyoba, & Sakamoto, 2008) that auditory cues can dominate in some cases (e.g., dominating tactile cues in perceptions of surface texture). In the context of the present research, the effects of all three mechanisms would be difficult to distinguish, and what is perhaps the most important point to take from these is their convergence on the notion that music might well be able to influence taste perceptions, and is not such an improbable hypothesis as may first appear.

To test this notion, a pre-test allowed selection of four pieces of music that had connotations of being, respectively, 'powerful and heavy', 'subtle and refined', 'zingy and refreshing', or 'mellow and soft'. One of these was then played to four independent groups while they drank a glass of either red wine or white wine. Participants then rated the taste of the wine in terms of whether it was 'powerful and heavy', 'subtle and refined', 'zingy and refreshing', or 'mellow and soft'. It was predicted that ratings of the taste of the wine should be congruent with the connotations of the music played. That is, the highest ratings of the wine as 'powerful and heavy' should be found among those who drank it while hearing 'powerful and heavy' music; and that corresponding effects should be found concerning ratings of the wine when the background music was 'subtle and refined', 'zingy and refreshing', or 'mellow and soft'.

Method

Pilot study

The music employed in the research was selected via a small pilot study. A group of five students aged under 25 years were played the four candidate pieces of music selected by the researcher and asked to write in confidence which of these corresponded to each of the four perceptions investigated by the research, namely, 'powerful and heavy', 'subtle and refined', 'zingy and refreshing', and 'mellow and soft'. These adjectives were selected following discussion with the manufacturer of the wine investigated by the research on the grounds that they might reasonably describe both music and wine, and two adjectives per rating scale (e.g., 'powerful and heavy') were used in an attempt to minimize ambiguity. Responses from each of the five participants were identical and corresponded with the expectations of the experimenter. Subsequently, the four pieces of music (and connotation) adopted for use in the study were *Carmina Burana* by Orff (powerful and heavy), *Waltz of the Flowers* from Tchaikovsky's 'Nutcracker' (subtle and refined), *Just Can't Get Enough* by Nouvelle Vague (zingy and refreshing), and *Slow Breakdown* by Michael Brook (mellow and soft).

Main study

Participants

A total of 250 students (125 males, 125 females) all aged under 25 years (mean age = 21.66 years, $SD = 2.49$) were recruited on a university campus between 12.00 p.m. and 3.00 p.m. over 15 successive working days and offered a free glass of wine in return for answering questions about its taste. Participants were recruited from a busy thoroughfare

Table 1. Summary of design

Number of participants	Type of wine	Type of music
25 (12M, 13F)	White wine	Powerful and heavy
25 (13M, 12F)	White wine	Subtle and refined
25 (12M, 13F)	White wine	Zingy and refreshing
25 (13M, 12F)	White wine	Mellow and soft
25 (12M, 13F)	White wine	No music
25 (13M, 12F)	Red wine	Powerful and heavy
25 (12M, 13F)	Red wine	Subtle and refined
25 (13M, 12F)	Red wine	Zingy and refreshing
25 (12M, 13F)	Red wine	Mellow and soft
25 (13M, 12F)	Red wine	No music

on the campus that commonly featured promotional events (e.g., student societies enlisting new members, book sales, etc.) using a random number list to determine which people should be approached and asked to participate; and each successive participant was allocated to each condition in turn (e.g., participant 1 allocated to condition 1, participant 2 allocated to condition 2, etc.). Participants were recruited only on agreeing not to drive or undertake similar activities for the following 3 hr (as approved by the local ethics committee).

Design

Twenty-five participants (12 males, 13 females, or *vice versa*) tasted each type of wine in conjunction with each type of music (or a no music control condition) in an independent subjects design. A summary of this design is shown in Table 1. On finishing the wine, participants were asked to rate its taste by giving a rating from 0 to 10 for each of four ratings scales, namely, 'powerful and heavy', 'subtle and refined', 'zingy and refreshing', and 'mellow and soft', respectively: on these scales, a rating of 0 represented, 'The wine definitely does not have this characteristic', and a rating of 10 represented, 'The wine definitely does have this characteristic'. Participants were also asked to rate how much they liked the wine on a scale from 0 = 'Not at all' to 10 = 'Very much'. Participants were then asked to turn the page on the questionnaire, and to then rate how much they liked the music using the same 0–10 rating scale. Finally, participants were shown a list of the four rating scales and asked to circle the one that best described the music that they heard: four participants selected the 'wrong' rating scale (i.e., which did not correspond with the intended meaning of the music) and so their data were not analysed further and four new participants were recruited in their place.

Procedure

Participants were asked to gargle twice for 10 s with tap water in order to clear away any other taste. They were then given a 125 ml glass of either Montes Alpha 2006 cabernet sauvignon (red wine) or chardonnay (white wine). These Chilean wines retailed for approximately £10 per bottle. Once they had been given their wine, participants were taken to one of the five rooms located off the thoroughfare, in which, to drink it. Each room contained four chairs and had a table in the corner on which sat an mp3 player and loudspeaker, which played the appropriate music at 70 dB. Each of the five rooms

featured one of the four types of music (or no music) that played on a continuous loop, and the music x room combination was changed every 3 days. Participants were asked to pace their drinking so that they finished the entire glass in approximately 5 min (and were shown a clock on the wall) and to not converse with any other people in the room. They were then asked to complete the questionnaire and reminded not to drive or undertake other similar activities for 3 hr.

Results and Discussion

A 5 (audio condition) x 2 (type of wine – red vs. white) MANCOVA was carried out on the four ratings assigned to the wine, treating ratings of liking for the music and liking for the wine as covariates. There was no significant interaction and nor was there a significant main effect of type of wine. However, there was a significant main effect of the audio condition ($F(16, 952) = 9.23$, $p < .001$). Means are shown in Table 2. The univariate tests for each rating scale (where $p < .001$ in each case) and subsequent *post hoc* tests confirmed that the highest mean on each given rating scale resulted when the corresponding music was played. That is, the wine was perceived as significantly more 'zingy and refreshing' when the 'zingy and refreshing' music was played rather than any other, the wine was perceived as significantly more 'powerful and heavy' when the 'powerful and heavy' music was played rather than any other, and so on for each of the two other rating scales. More simply, participants appeared to perceive the taste of the wine in a manner consistent with the connotations of the music.

This pattern of results is consistent with the results of previous research indicating that auditory stimuli can influence flavour perception. Although evidence concerning auditory influences on cross-modal perception is itself scarce, the present data are among the first to indicate an effect of the specifically symbolic functions of these auditory stimuli. This contrasts with the limited amount of previous research that has been carried out on the subject which has manipulated physical elements of music, such as loudness, in considering the effect of this on what is an arguably more objective assessment criterion than that employed here, namely, perceptions of freshness; and other research (i.e., Spence *et al.*, 2010) which has employed an auditory stimulus as an icon that has a more literal association with the target stimulus (i.e., the impact of the sounds of bacon sizzling on the perceived strength of a bacon flavour). The present data are also consistent with those studies of consumer behaviour described above that have identified an impact of employing music as a symbol on various commercial behaviours.

Table 2. Main effect of type of music on ratings of wine*

	Music				
Rating	No music	Zingy/Fresh	Powerful/Heavy	Mellow/Soft	Subtle/Refined
Zingy/Fresh	4.91	6.91	5.25	5.51	5.47
Powerful/Heavy	4.38	4.71	6.78	4.35	5.88
Mellow/Soft	5.53	5.51	6.31	7.12	6.68
Subtle/Refined	4.96	4.86	5.61	4.78	6.47

*A rating of 0 represented, 'The wine definitely does not have this characteristic', and a rating of 10 represented, 'The wine definitely does have this characteristic'.

Future research might investigate several specific aspects of music that could trigger the effects identified here. A well-known debate exists within musicology concerning referentialism versus absolutism (see Sloboda & Juslin, 2001): the former position argues that the meaning of a piece of music is located within the extra-musical, contextual associations that listeners have with the music, whereas absolutists (e.g., Meyer, 1956) argue that music has meaning as a direct consequence of its physical elements, such as the extent to which they confirm the listener's expectations as to how the piece in question should develop. Cooke (1959), for instance, argued famously that certain structural properties of music communicate clear symbolic meaning to (Western) listeners. For instance, an ascending melodic line is, Cooke argues, perceived as, 'An outgoing, active, assertive emotion of joy' (p. 115). The extent to which such absolute 'rules' really do exist, they suggest a possible means by which those effects identified here might be induced reliably; and it seems reasonable also to suspect that other, non-musical sounds could be used similarly. Certainly, without such clear guidance, the only means of inducing the effects described here rely upon pre-testing to ensure that the auditory stimulus in question generates the desired symbolic meaning.

There may be three interesting caveats to the present findings that suggest a limit on their generalizability. First, Yeoh and North (2010) found that the effect of congruent music on selections between Indian and Malay food were limited to ethnically Chinese participants: ethnically Indian and Malay participants, who arguably came to the research with pre-existing favourable dispositions towards the food from their own culture, did not demonstrate the effect. It is arguable that a similar process could be relevant to the effects identified within the present data. Specifically, would any influence of music on perception be moderated among participants who have predispositions or a good deal of knowledge concerning the target stimulus? Such findings would certainly be consistent with the results of numerous studies showing that biases in judgement are influenced by the expertise or confidence of the participant making that judgement. It is unfortunate the present research did not collect data on participants' knowledge of wine in order to test this (although note also that since participants were assigned randomly to groups, we would not expect any systematic bias of this factor in the data). Similar to this, the effects described here might be identified more commonly among target stimuli, which are of more ambiguous value or quality: wine might be such an ambiguous stimulus.

Second, music can only be an effective influence on perception to the extent that its communicative intent is understood by participants. If participants misinterpret the specific message that the music is attempting to communicate then the effects identified in the present data would not be repeated. The present methodology checked that participants had indeed understood the intended message to be communicated by the music. However, future research or attempts to apply the present findings would be advised to employ homogeneous groups of participants (who would all likely take the same message from a given piece of music) or employ music that has symbolic meaning that is otherwise very widely understood. Third, the design employed here featured only one example of each type of music. Future research might investigate whether the same results would be obtained with, for instance, other 'powerful and heavy' musical selections. Specifically, the present design did not feature 'a' and 'b' versions of each condition in which half the participants were exposed to one exemplar piece and the remaining participants in that condition were exposed to another exemplar piece. Although there is a danger that the two pieces within each condition could communicate subtly different messages, this could nonetheless be an interesting addition to future

research designs. Finally, the effects described here might be identified more commonly when the target stimulus in question is ambiguous.

Acknowledgement

The author is grateful to Montes for providing the wine used in the research.

References

Areni, C. S., & Kim, D. (1993). The influence of background music on shopping behavior: Classical versus top-forty music in a wine store. *Advances in Consumer Research*, *20*, 336–340.

Bult, J. H. F., DeWijk, R. A., & Hummel, T. (2007). Investigations on multimodal sensory integration: Texture, taste, and ortho- and retronasal olfactory stimuli in concert. *Neuroscience Letters*, *411*, 6–10.

Cooke, D. (1959). *The language of music*. Oxford: Oxford University Press.

Crisinel, A. S., & Spence, C. (2009). Implicit association between basic tastes and pitch. *Neuroscience Letters*, *464*, 39–42.

Crisinel, A., & Spence, C. (2010). As bitter as a trombone: Synesthetic correspondences in nonsynesthetes between tastes/flavors and musical notes. *Attention, Perception, and Psychophysics*, *72*, 1994–2002.

DuBose, C. N., Cardello, A. V., & Maller, O. (1980). Effects of colorants and flavorants on identification, perceived flavor intensity, and hedonic quality of fruit-flavored beverages and cake. *Journal of Food Science*, *45*, 1393–1399.

Duncker, K. (1939). The influence of past experience upon perceptual properties. *American Journal of Psychology*, *52*, 255–265.

Goldstein, D. G., & Gigerenzer, G. (2002). Models of ecological rationality: The recognition heuristic. *Psychological Review*, *109*, 75–90.

Green, B. G. (2002). Studying taste as a cutaneous sense. *Food Quality and Preference*, *14*, 99–109.

Levitan, C., Zampini, M., Li, R., & Spence, C. (2008). Assessing the role of color cues and people's beliefs about color-flavor associations on the discrimination of the flavor of sugar-coated chocolates. *Chemical Senses*, *33*, 415–423.

Meyer, L. B. (1956). *Emotion and meaning in music*. Chicago: University of Chicago Press.

North, A. C., & Hargreaves, D. J. (2008). *The social and applied psychology of music*. Oxford: Oxford University Press.

North, A. C., Hargreaves, D. J., & McKendrick, J. (1997). In-store music affects product choice. *Nature*, *390*, 132.

North, A. C., Shilcock, A., & Hargreaves, D. J. (2003). The effect of musical style on restaurant customers' spending. *Environment and Behavior*, *35*, 712–718.

Nöth, W. (1994). *Handbook of semiotics*. London: Sage.

Raghubir, P., & Krishna, A. (1999). Vital dimensions in volume perception: Can the eye fool the stomach? *Journal of Marketing Research*, *36*, 313–326.

Rolls, B. T., Rowe, E. A., & Rolls, E. T. (1982). How sensory properties of foods affect human feeding behaviour. *Physiology and Behavior*, *29*, 409–417.

Schifferstein, H. N. J. (2009). The drinking experience: Cup or content? *Food Quality and Preference*, *20*, 268–276.

Sloboda, J. A., & Juslin, P. N. (2001). Psychological perspectives on music and emotion. In P. N. Juslin & J. A. Sloboda (Eds.), *Music and emotion: Theory and research* (pp. 71–104). Oxford: Oxford University Press.

Spence, C., & Shankar, M. (2010). The influence of auditory cues on the perception of, and responses to, food and drink. *Journal of Sensory Studies*, *25*, 406–430.

Spence, C., Shankar, M. U., & Blumenthal, H. (2010). 'Sound bites': Auditory contributions to the perception and consumption of food and drink. In F. Bacci & D. Mecher (Eds.), *Art and the senses* (pp. 207–238). Oxford: Oxford University Press.

Suzuki, Y., Gyoba, J., & Sakamoto, S. (2008). Selective effects of auditory stimuli on tactile roughness perception. *Brain Research*, *1242*, 87–94.

Verhagen, J. V., & Engelen, L. (2006). The neurocognitive bases of human multimodal food perception: Sensory integration. *Neuroscience and Biobehavioral Reviews*, *30*, 613–650.

Vickers, Z. M., & Wasserman, S. S. (1979). Sensory qualities of food sounds based on individual perceptions. *Journal of Texture Studies*, *10*, 319–332.

Wheatley, J. (1973). Putting colour into marketing. *Marketing*, *67*, 24–29.

Woods, A. T., Poliakoff, E., Lloyd, D. M., Kuenzel, J., Hodson, R., Gonda, H., . . . Thomas, A. (2011). Effect of background noise on food perception. *Food Quality and Preference*, *22*, 42–47.

Yeoh, J. P. S. (2009). *The limitations of musical fit effects*. Unpublished doctoral thesis, Heriot-Watt University.

Yeoh, J. P. S., & North, A. C. (2010). The effects of musical fit on choice between two competing foods. *Musicae Scientiae*, *14*, 127–138.

Zampini, M., Sanabria, D., Phillips, N., & Spence, C. (2007). The multisensory perception of flavor: Assessing the influence of color cues on flavor discrimination responses. *Food Quality and Preference*, *18*, 975–984.

Zampini, M., & Spence, C. (2004). The role of auditory cues in modulating the perceived crispness and staleness of potato chips. *Journal of Sensory Science*, *19*, 347–363.

Zampini, M., Wantling, E., Phillips, N., & Spence, C. (2008). Multisensory flavor perception: Assessing the influence of fruit acids and color cues on the perception of fruit-flavored beverages. *Food Quality and Preference*, *19*, 335–343.

Received 16 December 2010; revised version received 18 July 2011