

INVITED REVIEW

Extraordinary emotional responses elicited by auditory stimuli linked to the consumption of food and drink

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Abstract: A growing number of food and beverage brands have recently started to become interested in trying to link extraordinary emotional experiences to their product offerings. Oftentimes, such extraordinary responses are triggered by product-extrinsic auditory and, to a lesser extent, visual stimuli, such as music or videos having particular sensory qualities or semantic meaning. While much of the interest in this area recently has been linked to the Autonomous Sensory Meridian Response (ASMR), it is worth noting that there are also a number of other responses, such as chills, thrills, and so-called ‘skin orgasms’ that have been documented previously, if not always in a food-related context. Elsewhere, both multisensory dining experiences and experiential events have also been reported to bring people to tears. There are, in other words, a number of extraordinary emotional responses that can or, in some cases, already have been linked to the consumption of food and drink. While such responses to auditory stimuli (increasingly mediated by technology) in the context of food are by no means widespread, they nevertheless hold the potential of delivering dramatic food and beverage experiences that offer the promise of being more stimulating, more memorable, and more emotionally-engaging than anything that has gone before.

Keywords: Extraordinary emotional response, ASMR, Crying, Food & drink, Sonic seasoning

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1. INTRODUCTION

There is a long, if sporadic, history of extraordinary emotional responses being induced by food-related sounds, such as lip-smacking and chewing (see [1,2], for early observations). Away from the context of food and drink, other distinctive sounds, such as, for example, the sound of fingernails screeching on a chalkboard have also been documented as being a highly-aversive sound for many people [3–6]. In the latter case, the suggestion is that the physical properties of the auditory stimulus may be similar to the auditory distress signals made by many animals [7].

In recent years, those individuals who experience an extreme aversive emotional response to specific sounds has been given the name of ‘misophonia,’ meaning literally a hatred of sound (e.g., [8–10]). Misophonia is often triggered by other people’s food-related sounds, such as eating, chewing, drinking, and lip-smacking (see [8]). That said, pen clicking, sniffing, and whistling have all been known to trigger an episode too. Crucially, though, it is the sounds of eating that are normally the most effective triggers for

those suffering from this condition (see Fig. 1). As Cohen [11], writing in *The New York Times*, put it a few years ago: “For people with a condition that some scientists call *misophonia*, mealtime can be torture. The sounds of other people eating—chewing, chomping, slurping, gurgling—can send them into an instantaneous, blood-boiling rage.” The anomalous physiological response (a kind of autonomic arousal), often manifests itself as a kind of involuntary “fight-or-flight”-like response.

Indeed, such extreme reactions have, on rare occasion, been so severe as to lead to murder (e.g., as when popcorn-eating sounds irritate others in the cinema; see [11–13]). In 2011, a man was shot dead in a cinema in Riga, Latvia, after the person sitting next to him objected to the noise he was making while eating popcorn during a screening of the movie *Black Swan*. Meanwhile, in 2014, a retired US police captain, Curtis Reeves, shot a man dead in a cinema in Tampa, Florida, for making too much noise while texting; according to certain press reports, a bucket of popcorn was also involved. As one witness who saw the incident unfold was quoted as saying: “I can’t believe people would bring a pistol to a movie. I can’t believe they’d argue, fight and shoot one another over popcorn, a cellphone.” [14]. Notice here, though, that this type of

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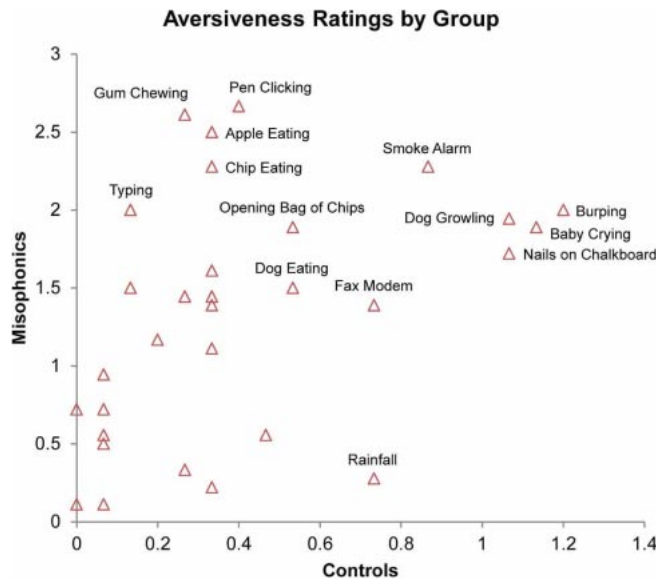


Fig. 1 Graph from Edelstein *et al.* [8] highlighting the most effective triggers eliciting an aversive response in a group of misophonic participants and a group of control participants. Notice how it is the eating sounds (gum chewing, crisp and apple eating) and the opening of food packaging (opening a bag of chips) that are especially aversive to those suffering from misophonia. Reprinted with permission.

extraordinary behaviour is not so tightly linked to a specific kind of auditory (multisensory) stimulation.

While misophonia is most definitely a chronic adverse reaction to certain specific triggering sounds [15], there is also a section of the population for whom listening to many of the same sounds (e.g., lip smacking, chewing, pen clicking etc.), is a pleasurable and relaxing activity leading to a positively-valenced flow-like mental state and triggering head and body tingling dubbed the Autonomous Sensory Meridian Response (ASMR; e.g., [16,17]). ASMR has been defined as “*a feeling of well-being combined with a tingling sensation in the scalp and down the back of the neck, as experienced by some people in response to a specific gentle stimulus, often a particular sound.*” In fact, some people experience both kinds of response (i.e., misophonia and ASMR). Particularly effective ASMR triggers have been shown to include intimate actions such as whispering, hair brushing, the crinkling of tissue paper, as well as tapping, and other repetitive deliberate actions.

In this review, I summarize those unusual, or extraordinary, responses to food and drink experiences that have been elicited by, or linked to, specific auditory, and in certain cases, audiovisual stimuli. As we will see below, such responses have also been elicited away from the context of specifically food-related sounds. However, while unisensory auditory and, on occasion, visual content have been reported to trigger a range of extraordinary responses

(e.g., [18–21]), the focus here is specifically on those that are somehow related to food and drink. As shown below, a growing number of companies across the globe have recently started to try and induce such extraordinary responses via acoustic stimuli typically presented digitally (i.e., via technology).

2. INVESTIGATING EXTRAORDINARY AUDITORY EXPERIENCES

2.1. Extraordinary Emotional Responses Occasionally Elicited at the ‘Pitch of Harmony’

At the outset, here, it is important to note that extraordinary emotional responses are not only triggered by food-related (i.e., product or packaging) sounds. In fact, both researchers and practitioners have occasionally, reported that pulsating tones, atmospheric soundscapes, and/or specially composed pieces of music also elicit extraordinary responses in a few individuals, at least when deliberately paired/matched with a specific tasting experience. Seminal early work in this area was reported half a century ago by Kristan Holt-Hansen [22,23] working out of the University of Copenhagen. In his original study, a small group of participants was asked to pick the frequency on a tone generator than matched the taste of one of two beers. The intriguing result to emerge from this study was that Carlsberg Elephant Beer was consistently matched to a higher-pitched tone than regular Carlsberg lager (640–670 vs. 510–520 Hz, respectively). Note that such a result might well be explained in terms of the existence of a crossmodal correspondence between increasing alcohol content and higher pitch.

A few years later, Holt-Hansen [23] gave a new group of students ($N = 9$) six different lagers and ales to taste in the setting of the science lab. Once again, the participants had to report the frequency at which harmony was experienced. Not only did the beers apparently taste better at the so-called ‘pitch of harmony’ (or ‘pitch of fit’) than when evaluated in silence (cf. [24], for a similar observation), but when the frequency of the tone changed, the beers were reported as tasting different too. Indeed, away from the ‘pitch of fit,’ the beers apparently tasted watery, strong, bitter, etc. Such results may well have seemed more-or-less bizarre to other researchers at the time these findings were first published. Nowadays, however, they can be seen as fitting in with a growing body of empirical research on the topic of ‘sonic seasoning’ (see [25] for a recent review).

However, the most interesting result to emerge from Holt-Hansen’s later study was that a number of the participants also reported having extraordinary experiences while tasting the beer when listening to a tone presented at the pitch of harmony. The following quotes give a sense of the extraordinary responses elicited in a third of those who

took part: *“Thrills of pleasure ran through my body”; “I felt as if my head was expanding in all directions”; “I felt as if I was floating in the air”; “The tone was intensified to such a degree that it sounded like a symphony orchestra and the room was filled with it”; “The tone expanded and became wonderfully sonorous.”* (all from [23], p. 1026). One other interesting point to note here is that Holt-Hansen talks of the sensations associated with the sound and with the tasting experience somehow becoming unified at the pitch of fit/harmony whereas, as one might expect, separate sensations (one gustatory and the other audible) were experienced at non-matching, sound frequencies (cf. [26]). We will return to the theme of the unification of disparate signals from different modalities a little later on.

One other problem that the scientists sometimes worry about is the role of experimenter, or participant, expectancy effects, and/or response biases (e.g., see [27]). To what extent do participants respond in the way in which they think that the experimenter wants them to? Note here that Holt-Hansen most definitely did expect that his participants would experience harmony between sound and taste. Just take Holt-Hansen’s ([23], p. 1023) experimental description to his participants which includes the following: *“Your task is to perceive simultaneously the sound and the taste of the beer. The pitch of the sound will be varied during the experiment. Describe your experience of the two stimuli. The purpose is to determine the frequency at which you experience harmony between the taste and the sound. By harmony we mean that the taste and the sound go so well together that they are experienced as an entity.”*

While such extraordinary first person reports elicited by tasting at the pitch of harmony are undoubtedly striking, it is important to stress that subsequent research suggests that their occurrence is extremely rare—at least when tested within the (anti-social) confines of the science lab (see also [28,29]). Indeed, when Rudmin and Cappelli [27] attempted both to replicate and to extend Holt-Hansen’s intriguing early work, these researchers were only able to demonstrate the consistent crossmodal matching of different pitches of sound with different tastes/flavours. The foods that the participants in the latter study tasted included non-alcoholic beer, Carlsberg beer, grapefruit juice, hard candy, and dill pickle. Crucially, however, none of Rudmin and Cappelli’s participants experienced anything surprising at, or around, the ‘pitch of harmony.’ As the authors themselves unequivocally stated in their brief report: *“The task was difficult. Subjects reported low confidence in their judgments. None had rich or extraordinary experiences.”* ([27], p. 118). Similarly, in our own research here at the Crossmodal Research Laboratory in Oxford, while we have repeatedly demonstrated a number of statistically consistent crossmodal correspondences between sound and taste/aroma/flavour, we have yet to

observe (or come across) any extraordinary responses in the laboratory (or online) setting either (e.g., see [30,31]).

That said, it is unclear whether any extraordinary responses, should they have occurred, would necessarily have been detected by those conducting these studies since the participants were not given the opportunity to report freely on their own experience during the experiment itself. In fact, the problem here, at least for those interested in studying extraordinary experiences, is that there has been much academic scepticism surrounding the use/value of such unconstrained introspective first-person reports over the last half century or so (see [32]). In the field of experimental psychology, this scepticism may, in part, be linked to the seemingly bizarre statements that a number of the participants in serious academic studies sometimes came out with if probed by the experimenter. Just take the quotes from Holt-Hansen’s [23] study, cited above, as but one example. For a couple of other intriguing examples of bizarre-sounding participant reports in early multisensory laboratory research (see, for example, Jackson [33] and Spence, Sanabria, and Soto-Faraco [34], for a review mentioning a number of such reports in the early literature on intermodal Gestalten). For instance, it is interesting to note how a number of the participants in Jackson’s early study of spatial ventriloquism reported feeling *“distinctly confused and harassed. . . I began to think I was ‘hearing’ things. . . . I noticed a detached feeling.”* when the sight and sound of a steam kettle were artificially presented from different spatial locations. Jackson compares the detached feeling elicited in some of his participants by this lack of unity to a kind of depersonalized state. Furthermore, of course, the staid and serious context/atmosphere of the science laboratory may itself not be especially conducive to the having (or reporting) of unusual experiences either.

2.2. Extraordinary Experiences Outside the Lab

Relevant here, therefore, are the striking subjective responses that have, on occasion, been documented in experiential multisensory tasting events that have taken place out there in the real world, where those involved would seem to be more open to reporting on their experience and/or have actively been encouraged to do so. For example, in the Campo Viejo Colour Lab in 2014 (see [35]), nearly 3000 participants were given a glass of red wine to taste from a black tasting glass while the lighting and music playing in the background was changed periodically. Over the course of a multisensory tasting experience lasting for no more than 10 minutes, the colour of the lighting was changed from white to red and then green and back again, or vice versa, while sweet or sour music was played (sweet music with the red lighting and sour music with the green lighting). The responses on the visual analog scales that participants were requested to

complete under each of the different environmental conditions revealed the expected effect of the audiovisual atmosphere on the tasting experience. That is, the wine was rated as tasting significantly fruitier under red than green lighting, and with sweet rather than sour background music. Interestingly, the scorecard on which the participants entered their responses also had a small space for those who took part to reflect on their experience. The first person reports once again highlight the striking nature of the change in tasting experience that some of the participants experienced on sampling the wine under the different environmental conditions: “*Fantastic experience. Really interesting. Changed perceptions completely.*”; “*Yes, amazing experience.*”; “*Great experience. I didn’t think the colour/sound would alter my perception as much as that!*” (all quotes from [35], pp. 9–10).

Similarly, one finds James John, Director of the Bath Wine School, talking about what it is like to taste Chardonnay while listening to Mozart’s *Laudate Dominum*: “[...] Just as the sonant complexity is doubled, the gustatory effects of ripe fruit on toasted vanilla explode on the palate and the appreciation of both is taken to an entirely new level” (quoted in [36]). This sounds a lot like another extraordinary experience elicited by carefully combining music and tasting. It can be argued that such reports provide one answer to the question that is sometimes posed of why people might want to pair music with wine (see [37]).

Intriguingly, responses that were even more dramatic occur spontaneously at the following year’s event Campo Viejo Streets of Spain festival. In particular, at the 2015 event, also held in London, members of the public were invited to taste three different wines while listening to soundscapes that had been specially composed to match each of the wines by BAFTA-award-winning synaesthetic composer Nick Ryan. One of the first journalists to report on the event noted that: “...the experience appears to take wine drinking to a new emotional level. The first volunteers to try listening to the scores while drinking said they felt transported to a different place. Others wept.” ([38], p. 7). Crying, note, presumably counts as an extraordinary emotional experience [39–41], and is not something that normally happens when people taste mid-priced wine. Nor is it necessarily the kind of response that the serious scientist, worried about what their ethics panel will say, is all that well-placed to deal with (cf. [42]).

A few of the diners at Heston Blumenthal’s The Fat Duck restaurant in Bray (<http://www.thefatduck.co.uk/>) have also been brought to tears on being presented with the signature ‘Sound of the sea’ seafood dish (see [43], pp. 78–81; [44], pp. 206–215). This is a dish that comes to the table looking like the seashore with sand, foam, seaweed, and seafood (sashimi). As the dish is placed on the table,

the waiter offers the diner a conch shell, out of which dangles a pair of earbuds. The diners are encouraged to insert the earbuds before they start the dish. On so doing, the sound of the waves crashing on the beach can be heard along with a carefully calibrated number of seagulls squawking overhead. The multisensory experience that ensues has been reported to bring some diners to tears. For instance, just take Catherine de Lange’s [45] description that appeared in the *New Scientist*: “*You are at a restaurant, enjoying a meal with friends, when the main course arrives. The plate of seafood in front of you looks incredible, but nothing prepares you for what happens next. After a few mouthfuls, a lump begins to rise in your throat and your eyes well up. By the time the waiter comes to take the plate away, you are weeping into a tear-sodden napkin. The secret ingredient? Seaside noises.*”

Once again, this is not something that normally happens when people hear the sounds of the seaside, nor when they eat seafood, no matter how beautifully it has been prepared. Nor am I aware of other dishes on the menu at The Fat Duck that induce tears in the diner either. In other words, it would seem to be something about the pairing of a particular tasting experience with matching auditory stimulation that is so powerful (at least for some diners). Of course, one possibility that should be acknowledged here is that the extraordinary emotional response experienced by a few diners in response to the Sound of the sea dish might have been triggered by the feelings of nostalgia associated with childhood holiday memories by the seaside [46–48]. However, I would argue that the response may well result instead from a unification of sensations that gives rise to a sudden increase in processing fluency (see below). In a sense, the dish can be seen as fitting with the Russian formalist Viktor Shklovsky’s ([49], p. 280) claim that: “*The technique of art is to make objects ‘unfamiliar’ [...] to increase the difficulty and length of perception [...]. Art removes objects from the automatism of perception in several ways.*”

It is important to stress here that extraordinary emotional experiences can, of course, be elicited by listening to music in the absence of food or drink. Indeed, the music psychology literature is replete with examples of specific pieces of music, or musical transitions, having been reported to elicit a range of unusual responses (i.e., intense emotional and psychophysiological responses) including, musical chills, thrills, frissons, spine-tingling awe responses, and even so-called ‘skin orgasms’ or ‘brain orgasms’ (e.g., [50–57]). So, for example, Sloboda ([58], p. 114) has reported that the most common types of musical phrases to elicit frisson are chord progressions descending the circle of fifths to the tonic, melodic appoggiaturas, the onset of unexpected harmonies, and melodic or harmonic sequences. Meanwhile, it has been reported that tears were

most likely to be elicited by appoggiaturas, and shivers or goose-bumps by the onset of new harmonies (see also [54]). However, in the examples reported earlier, there would seem to be something special about the curated nature of the multisensory tasting experience that is key to triggering such extraordinary emotional responses in a small subset of individuals.

Simply listening to music that is liked, while eating or drinking something that is also liked, is unlikely in and of itself to give rise to any kind of extraordinary emotional experience. That said, there have been examples of people trying to deliver the same emotional hit simply by using a highly-charged soundtrack while diners consume a particular dish [59]. So, for example, in this category, just take the Roca brothers in Spain who served a football-themed dessert accompanied by the emotive sound of Lionel Messi scoring the match-winning goal in the annual derby match between F. C Barcelona (the chef's favourite team) and their arch rivals Madrid in the Bernabéu stadium. The sound was presented over earbuds from a MP3 player. In this case, it would seem as if it is the sudden burst of positive emotion associated with 'resolving' or 'establishing' some kind of connection between the sonic backdrop and the tasting experience that is key, as in many of the other cases reported above. This might perhaps link to Holt-Hansen's [22,23] earlier discussion of the unification of sensations that sometimes occurs while tasting the beer at the pitch of harmony. Indeed, one might think of this as a version of the positively-valenced 'aesthetic aha' reported in the visual arts when an initial discrepancy between expectation and reality resolves itself after a change of schema/expectations/world view (e.g., see [60,61]). Pelowski [21] has argued that being brought to tears may well be a natural response to the having of an insightful or "aesthetic" experience with (visual) art. Indeed, elsewhere it has been shown that intense aesthetic experiences can activate the medial prefrontal cortex (specifically, the default mode network), a brain region that is associated with self-referential thoughts [62]. Note that the default mode network has also been implicated in ASMR [63].

Meanwhile, according to Barbalet ([64], p. 139), the "*function of weeping [is] to communicate to the self an incident of transformation.*" The suggestion is that it acts to reduce the likelihood that the person who is crying will engage in other activities. This thereby means that it is more likely that the cognitive resources needed for reflection and reorganization will be available. Barbalet ([64], pp. 128–131) concludes that while "*joyful weeping [may] register a positive transformation of self, just as tears of suffering register loss as a negative transformation of self,*" in all cases, crying "*can be regarded as essentially expressing transformation.*" Meanwhile, Sloboda [58] talks of aesthetic experience as involving some kind of violation

of expectation, perhaps associated with a profound novel experience. So, for example, there might be a discrepancy between expectation and experience, thus leading tension/anxiety following be re-assessment information processing.

It might therefore be possible that the participants who listened to the sound of the sea while eating the dish of the same name, or listened to matching soundscapes while drinking wine, experienced such a change of mental framework: That is, from an initial expectation that music and taste are separate entities to the sudden, or growing, realization that the music/soundscape and taste are one (i.e., unified in some sense) that resulted in tears? Whatever the most appropriate explanation turns out to be, what is not in doubt is that some of those who experience the combined multisensory input of a certain taste/flavour experience together with a particular piece of music, soundscape, or even a tone, have had strong experiences that go far beyond what one would have expected merely from combining individual response to the taste and to the sonic stimuli. Perhaps, then, these strong emotional experiences can be seen as examples of what happens when processing fluency increases suddenly (perhaps due to the establishment of some kind of intersensory Gestalt; [34]), following a period of what Muth calls 'semantic instability' [65]. Normally, congruent stimuli make it easier for participants to evaluate the sensory properties of the component parts (i.e. processing fluency is higher) hence resulting in the component stimuli being rated as more pleasant (e.g., [66,67]).

2.3. Interim Summary

Summarizing what we have seen thus far, a number of different kinds of extraordinary emotional response (to use Holt-Hansen's [22,23], early terminology) have been reported in the literature over the years when people have been exposed to certain (often carefully-curated) food-related sonic experiences. Such responses may, on occasion, be induced by the sounds of other people eating and/or by various rustling sounds (e.g., tissue paper or food packaging). However, there have also been occasional reports of participants in laboratory studies as well a small number of those attending multisensory experiential tasting effects having most unusual responses, such as, for example, being brought to tears [38,45]. However, beyond these more-or-less accidental extraordinary food-related sonic experiences, it is interesting to note how a growing number of food and beverage brands have recently started to try and deliberately elicit positively-valenced emotional responses in those listening to (and perhaps also watching) carefully crafted audiovisual content. In the majority of such cases, it is ASMR that the designers/marketers concerned have been trying to trigger via their communications. Such developments undoubtedly build on the

growing online popularity of ASMR videos online. These days, there are literally millions of ASMR videos on YouTube (over 10 million according to O’Leary, [68]; see also [69]), and Google searches for ASMR have risen dramatically year-on-year since 2010 (see also [50]). These videos typically show people rustling and crinkling paper (e.g., think of the crinkling sound of the removal of the silver paper on an old-fashioned Kit Kat chocolate-covered biscuit wrapper), tapping and scratching surfaces, and/or making a range of wet sounds with their mouths. And hard though it may be to believe, watching such content sends some, as yet unspecified, proportion of the population into a tingly and relaxed pleasurable state. In fact, according to the evidence, many people tend to watch such content late at night as an aid to going to sleep [68].

2.4. Deliberately Triggering ASMR Responses in the Context of Food and Drink-related Experiences

Early reports of such brand-related content in videos comes from Dove chocolate over in China, as well as from KFC and Pepsi in Asia (see [68,70,71]). It is not just the food and beverage brands who are getting in on the act; last year, IKEA also launched a number of well-received ads in this space [72]. One of the Dove chocolate videos shows a woman crinkling a chocolate wrapper, unwrapping it, and then putting a piece of chocolate in her mouth, accompanied by rustling and chewing sounds [70]. BBDO-Beijing, the agency who developed the Dove chocolate adverts have explicitly claimed that the pleasure induced by watching the video may match the pleasure of eating the chocolate. There are also a number of ASMR videos on YouTube showing close-ups of KFC and the faces and sounds of those eating it (e.g., https://www.youtube.com/watch?v=BGYCO_6gAKY). This is reminiscent of the Mukbang videos watched by so many South Koreans [71]. Mukbang, the name given to the trend of people eating their meals at home while watching another reasonably attractive broadcast jockey eating large portions of energy-dense food, think fried chicken or big bowls of noodles (e.g., [73,74]). More recently, a Swedish beer brand created an ASMR video linked to drinking beer, called “Ear beer” [75].

Independently, Glenmorangie commissioned research in order to determine the optimal sensory triggers for ASMR that linked to a Scottish themes appropriate for their whisky [76]. The key triggers identified by this research, including slow-paced close-ups with realistic sound and an absence of background music, were then used by three video artists (Thomas Traum, Julie Weitz, and Studio de Crécy) to create films designed in order to evoke the whisky’s “*terroir, creation and character*” through ASMR techniques, using ‘triggers’ that relate to whisky and the Highlands in order to elicit emotional reactions [77].

Intriguingly, while a number of ASMR triggers would seemingly be characterized by higher frequency sounds, low frequency sounds were identified by a number of our respondents as providing effective triggers. Similarly, it turns out that low frequency auditory components have also been implicated in the nails screeching on a chalkboard phenomenon [4].

It is interesting to see how a number of chefs and sound designers working with food-related stimuli have also stumbled across ASMR-like stimuli/responses, seemingly by accident [71,78]. Just take the following from Holt-Hansen ([23], p. 1025): “*Most Ss also reported experience of tickling, prickly, or quivering sensations in the cheeks, the lower jaws, the mouth, the tongue, the palate, the neck, or the ears.*” The video of Massimo Bottura making lasagne in an anechoic chamber is interesting in this regard (e.g., see [79]). To me, this recording would also seem to emphasize the subtle sounds, the close-up shots, the repetitive stirring actions, and the crunching in front of the in-ear microphone. Note that these kinds of auditory stimuli have all been associated with ASMR content. What is more, it is also worth highlighting here that ‘Watching others cook’ was shown to be a particularly effective trigger of ASMR responses in a group of nearly 300 people with the condition [80].

Similarly, some years ago, in our own work with sound design agency *Condiment Junkie* (<http://condimentjunkie.co.uk/>), we too came close to inducing ASMR-like responses in cocktail makers at a workshop. The event was a multisensory experiential tasting event for bar tenders and mixologists held at the internationally renowned cocktail bar *69 Colebrooke Row* in London (<http://www.69colebrookerow.com/>). On that occasion, we had people tasting a barbershop-inspired cocktail while listening via overear headphones to the original binaural auditory Virtual Barber Shop soundtrack (created by QSound in 1996, <https://www.youtube.com/watch?v=IUDTlvagJA>). As it turns out, virtual haircuts and other binaural content [80,81] are a particularly effective ASMR trigger, presumably, in part, because it indicates close-up activity [76].

2.5. Individual Differences in Responsiveness

Extraordinary emotional responses are undoubtedly rare occurrences, thus making it hard to study them. Indeed, one of the things that soon becomes apparent when reading the research in this area is the fact that there are large individual differences in people’s susceptibility to these extraordinary food-related sonic responses (of both the positive and the negative variety). The key question here is why some individuals are seemingly more susceptible than others. Recent neuroimaging research on those individuals with (vs. without) misophonia has highlighted

significant differences in neural connectivity between the two groups ([82]; see also [8,83]). In particular, misophonia appears to be associated with hyperconnectivity between the auditory and limbic systems [84]. Kumar *et al.* also documented exaggerated activity in the anterior insula in the misophones they scanned.

In terms of ASMR-like responses, researchers suggest that individual differences in people's openness to experience may be an important factor (e.g., [52]; see also [80,85]). To date, it must be said, the majority of research has focused squarely on individual differences in people's susceptibility to auditory-induced unusual/extraordinary responses. As such, it will be particularly interesting, moving forward, to determine whether individual differences in the openness to experience, say, might also be relevant to the multisensory case, as when trying to explain why some people are brought to tears by multisensory tasting experiences such as the Sound of the Sea dish served at The Fat Duck, or the music composed to accompany the wines at the 2015 Campo Viejo colour lab.

3. CONCLUSIONS

As has hopefully been made clear in this review, a variety of food-related auditory stimuli have been shown to elicit extraordinary emotional responses in certain people. These responses can be either positively- or negatively-valenced. While early reports occurred/documentated a rare occurrence, it would seem that the online ASMR community is expanding rapidly [86,87]. It is easy to see why a growing number of brands are interested in triggering such responses while people are consuming their food and drink products. It is, for instance, easy to imagine how the positive flow-like state induced in those who experience ASMR [16,83] may well help to improve people's perception of the product tasted while in that positively-valenced state. The suggestion put forward here is that a number of the reports of extraordinary responses when seemingly unconnected auditory content is combined with food and drink experiences results from the unification, or harmonization, of sensations, that may bring with it a sudden increase in processing fluency.

Ultimately, then, acoustic stimuli, often mediated by technology, are increasingly being paired with food and drink in order to try and evoke a range of extraordinary emotional experiences. While such experiences are undoubtedly still rare, they are, I believe, nevertheless worthy of study. However, that being said, in order to move forward in this area, it may be necessary to listen more to what it is our participants say about their experience, given half a chance. In closing, it is also worth noting that we are also left with the intriguing, and as yet unanswered, question of what it is about the sounds of eating and drinking that makes them such powerful triggers for both

misophonia and ASMR. As always the case, then, it is a case of more research needed.

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