

RUNNING HEAD: ICE-CREAM AS AN EFFECTIVE MEANS OF FOOD DELIVERY IN
THE ELDERLY

**Using ice-cream as an effective vehicle
for energy/nutrient delivery in the elderly**

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ABSTRACT

In this article (submitted as a Proposal), we investigate the use of ice-cream as a potentially effective vehicle for the delivery of nutrition/energy to the elderly in hospital and in old people's facilities. Currently, there appears to be a general belief that ice-cream is an unhealthy product and so is not commonly considered in this capacity. That said, the cooling sensation, as well as the dynamic contrast, that ice-cream provides appears capable of providing positively-valenced sensory stimulation at mealtimes to those elderly individuals who, for whatever reason, might not otherwise eat enough (i.e., who may well be malnourished). After outlining the problem, we go on to provide recipes for those wishing to replace eggs and sugar using the latest ingredients and techniques from the field of food science/molecular gastronomy. We illustrate how widely available meal replacement powders and/or pureed vegetables can be incorporated into the recipe to make the ice-cream a more effective vehicle for the delivery of nutrients/vitamins while maintaining an appropriate texture/mouthfeel. We link to the savoury ice-creams that were popular historically, and are currently popular in Japan, not to mention in a number of high-end modernist restaurants. Furthermore, a number of other strategies for making ice-cream more appealing, including everything from improving the naming of the dish through to optimizing the plateware on which it is served, and the use of sonic seasoning, are also discussed briefly.

KEYWORDS: ICE-CREAM; DYNAMIC CONTRAST; ENERGY/NUTRIENT DELIVERY; NOSTALGIA; COMFORT FOOD; ELDERLY; HOSPITAL FOOD.

Introduction

It is noticeable that towards the end of life, much like at the end of the meal, ice-cream features heavily, both in anecdotal reports of what many people have been willing to eat in their dying days (e.g., Casas, León, Jovell, Gómez, Corvitto, Blanco, et al., 2012; Cockroft, Spillett, & Duell, 2016) but also in more formal analyses of the elderly's food preferences (see Spence, 2017b; see also Ferreira, Previdelli, de Freitas, Marques, Goulart, & de Aquino, 2017). Intriguingly, some years ago, Hyde and Witherly (1993) put forward the 'ice-cream hypothesis' in order to try and explain why it is that ice-cream so often comes towards the end of the meal (at least in the west).¹ The authors' preferred suggestion was that the sensory properties (in particular, the dynamic contrast that eating ice-cream provides) may be able to break through and stimulate craving in a way that other taste sensations simply cannot do when we are coming toward the end of the meal and are likely becoming full/satiated.

For the elderly, it may well be that gustatory, and more importantly olfactory, sensitivity has declined to such an extent that many regular foods have simply lost their flavour (see Doty, 1989; Stevens, Bartoshuk, & Cain, 1984; see also Doets & Kremer, 2016). In fact, it has been estimated that >75% of those with an age of 80-years or over exhibit evidence of a serious impairment in their olfactory abilities (Doty, Shaman, Applebaum, Giberson, Siksorski, & Rosenberg, 1984). Note here that the majority of what we think we taste we actually smell (see Spence, 2015b). As such, ice-cream, with its melting creamy mouthfeel and coolness in the mouth (Eccles, Du-Plessis, Dommels, Wilkinson, 2013; cf. Mendelson & Chillag, 1970), and/or its dynamic texture, may still break through and stimulate the ageing palate in a way that many other foods simply cannot do. Alternatively, however, one might also think of the desire for ice-cream in terms of some kind of regression back to comforting/nostalgic childhood tastes (cf. Gopnik, 2011). After all, for many people, especially women, ice-cream often comes near the top of the list as far as comfort foods that are capable of providing some emotional support are concerned (see Spence, 2017a; Wansink, Cheney, & Chan, 2003; Wansink & Sangerman, 2000). At the same time, however, it is also often considered to be something of a childish food and perhaps thought of as a naughty treat (e.g., see Wilson, 2016).

¹ The following quote from chef Ferran Adrià quoted by Gopnik (2011) is relevant on this theme: "*Ferran's question still counts How do we finish the meal? But then how do we finish anything?*"

72 Whatever the reason for its popularity, ice-cream would likely seem to be an effective vehicle
73 for the delivery of calories in many elderly populations (e.g., those in care facilities or hospital)
74 who tend not to get sufficient nutrition so potentially prolonging their hospital stay longer than
75 otherwise need be the case (see Jones, 2014; ‘National Academies of Sciences, Engineering,
76 and Medicine’, 2017; Spence, 2016). So, the question we address here is whether ice-cream
77 can be used as an effective vehicle for the delivery of nutrients?² Certainly it is an effective
78 vehicle for the delivery of sugar, but traditional recipes typically involve ingredients that in the
79 proportions used are currently considered unhealthy. Technically, however, one of the
80 problems is how to retain texture without sugar and eggs using modernist techniques and
81 ingredients (e.g., see Youssef 2013). Such a modernist approach to food design may well help
82 those caring for elderly patients to be more successful in their attempts to feed the latter (Horan
83 & Coad, 2000).

84 One of the other problems that many elderly individuals face is that they no longer have their
85 own teeth, and consequently foods are often turned into purees to facilitate eating. What this
86 means is that such meal solutions will lack the sonic textural cues that are normally such a key
87 part of the eating experience (Bonnell, 1966; see Spence, 2015, for a review). Note here,
88 though, that while pureeing the meals provides an effective solution to the problem, the meals
89 may lose interest for those who are forced to eat such meal preparations on a regular basis.
90 Furthermore, problems with such quiet/silent eating include the fact that people tend to be
91 incredibly bad at identifying what they are eating in the absence of the appropriate texture cues.
92 Even commonly-eaten vegetables are hard to identify when delivered in pureed form (Van
93 Stockkom, Blok, van Kooten, de Graaf, & Stieger, 2018). What is also worth bearing in mind
94 here is that other research has demonstrated that we tend to adapt to the flavour of noisy foods
95 more slowly than we do to silent foods (Lockett, Meullenet, & Seo, 2016). No wonder, then,
96 that a number of researchers have been investigating high-tech solutions in order to try and
97 bring back the sounds associated with those foods (Endo, Ino, & Fujisaki, 2016, 2017). Thus,
98 one might think that another benefit of using ice-cream as a sensorially-stimulating vehicle for
99 nutrient/energy delivery is that it is a more or less silent food. One does not need teeth to
100 consume it. Instead, it can simply be allowed to melt on the tongue and swallowed. That said,

² Here, one needs to be a little bit careful around the fake news relating to the beneficial effects of consuming ice-cream (e.g., for breakfast; see Letzter, 2016).

one might also want to consider incorporating other noisy elements into the ice cream (such as, for example, popping candy).

Undernutrition is a common problem

According to one survey conducted by Age Concern in 2006, six out of every 10 elderly hospital patients are at serious risk of malnutrition. Furthermore, one in five hospitalized patients over the age of 65 years of age was found to have an average nutrient intake that was below half their daily requirements. Undernutrition is a particularly common problem amongst the older hospital population, with significant weight loss documented in 40% of patients with Alzheimer's disease (Wang, 2002; see also Amarya, Singh, & Sabharwal, 2015; Busse, 1980; West, Ouellet, & Oullette, 2003). The problem for long-term care (LTC) residents is just as bad (Rudman & Feller, 1989), with 40-85% of the latter being malnourished. For instance, according to Coulston (1995). Elsewhere, concerns about high rates of malnutrition in surgical patients have also been raised (Hill, Pickford, Young, Schorah, Blackett, Burkinshaw, Warren, & Morgan, 1977).

Nutritionally-enhanced ice cream

Ice cream is a popular food around the world (Shaviklo, Thorkelsson, Sveinsdottir, & Rafipour, 2011), and eating this frozen food is normally considered a positively-valenced activity. People typically categorize ice cream as a treat or dessert (e.g., Farouk et al., 2018), and associate eating it with positive social activity (Berry, Beatty, & Klesges, 1985; Casas et al., 2012). That said, regular ice cream provides only a moderate source of protein and typically carries a significant calorie load from sugar and fat (Farouk et al., 2018, p. 135). However, over the last decade or so, a number of research groups around the world have been working on the development of nutritionally-enhanced ice creams with the appropriate texture and storage properties (e.g., Chandan & Shah, 2007). The idea, in many cases, is that fortified ice cream might provide a successful vehicle for the delivery of protein and other essential dietary elements to the elderly and/or to hospital patients. For instance, Costa, Resende, Abreu, and Goff (2008) studied the physical properties of ice cream that had been fortified with calcium using calcium chloride; Patel, Baer, and Acharya (2006) assessed the consequences for ice crystal creation of enhancing the protein content of ice cream using whey protein concentrate

or milk protein concentrate powders; Shaviklo et al. (2011) assessed the consequences of increasing the protein content of Persian ice cream by incorporating various amounts of fish protein powder; others, meanwhile, have been working with soy protein concentrate instead (Akesowan, 2009; Dervisoglu, Yazici, & Aydemir, 2005).

Of course, having developed enhanced, or fortified, ice-creams with the appropriate textural and storage properties, the next question becomes one of whether the elderly/patients like the resulting product offering and, moreover, whether it can be shown to have a measurably beneficial effect on their health and/or well-being. In fact, as Farouk et al. (2018, p. 135) noted recently, one of the major challenges in this space is that: *“The range of acceptable flavours is likely to be narrower and consumers may balk at overtly novel or challenging tastes.”* Nevertheless, promising preliminary work in this direction (suggesting a beneficial effect to adapted ice cream as a vehicle to effective nutrient delivery) was reported a few years ago by Casas et al. (2012) in a research collaboration between two Spanish hospital oncology departments and the Alicia Foundation (a culinary research centre co-founded by Ferran Adrià, based just outside of Barcelona; <http://www.alicia.cat/en/>). This group of researchers conducted a study in which advanced stage malnourished cancer patients were given either a nutritional supplement (2 or 3 x 200 ml shots, daily; N = 31) or else a couple of 90-gram servings of a specially adapted ice cream (with a higher fat content per day; N = 39) as a dietary supplement for a period of somewhere between 6 and 21 days, on average. The patients were required to fill in a number of questionnaires relating to their mental well-being both before and after the treatment, including the Hospital Anxiety and Depression Scales (HADS), and the Quality of Life Questionnaire (QLQ). Additionally, objective measures of malnutrition, such as levels of albumin, cholesterol, or triglycerides, were also assessed.

Intriguingly, the patients in the adapted ice cream group were found to be significantly less anxious and depressed after the treatment according to the results of the self-report measures. By contrast, no such differences were observed in the group of patients that had been given the nutritional supplement instead. That said, it is worth noting that a large number of participants (N = 45) had to be excluded during the course of Casas et al.’s (2012) study (this one of the challenges of working with this kind of patient population), thus making it a little harder to unequivocally interpret the results. Additionally, the study revealed no difference between the two treatment groups in terms of objective indices of malnutrition. Two further differences between the groups that should probably be noted here include the fact that those in the ice cream group received the treatment for roughly only half as many days, on average, as those

in the nutritional supplement group. Second, those in the ice-cream group were given different flavours (cream, vanilla, nougat, cinnamon, chocolate, coffee, or hazelnut) whereas those in the nutritional supplement groups had no choice/variety in terms of what they were required to consume. That is, they were given exactly the same 200ml of nutritional supplement two or three times every day during the course of the study. Adults are generally happier with what they eat and drink if they are given choice/variety (see Spence, 2017c, for a review), This and the other limitations means that even the authors of the study themselves suggested that their results should be regarded as nothing more than preliminary/exploratory in nature. This, then, is undoubtedly an area where further research is needed, despite the many challenges that conducting such research undoubtedly presents.

The important point to note here is that in many of the above-mentioned cases, increasing the protein content of the ice-cream through the incorporation of meat products (e.g., Farouka, Yoob, Hamid, Staincliffe, Davies, & Knowles, 2018; Ledda & Dossena, 2011) or fish protein (e.g., Shaviklo et al., 2011) can all too easily shift the flavour profile more toward the savoury (i.e., meaty/fishy) end of the flavour spectrum. Similarly, fortifying ice cream with whey protein also tends to give rise to an unpleasant tasting end product unless carefully masked. Crucially, savoury flavour profiles are likely to be unfamiliar to many in the west currently. This is especially likely amongst the older population who may have had less exposure to the world of molecular gastronomy (though see Spence & Youssef, in press), and the savoury ice creams that are sometimes found therein. As such, this may be expected to act as a major barrier to the acceptance of fortified ice creams, even assuming any textural/mouth-feel consequences of the modified formulation have been adequately dealt with.

Avoiding disconfirmed expectation

One of the dangers here is that if a person, be they a regular consumer, an elderly individual, or even a hospital patient, expect a sweet-tasting ice-cream (a natural assumption given the prevalence of ice cream served as a dessert), and get something savoury instead, it may well lead to a negatively-valenced ‘disconfirmation of expectation’ response (Schifferstein, 2001; see Piqueras-Fiszman & Spence, 2015, for a review). Furthermore, it is easy to imagine how the impaired taste and smell perception that afflicts many elderly individuals/hospital patients (e.g., Doets & Kremer, 2016; Doty, 1989; Stevens et al., 1984, 1991) may well also make them more apprehensive when it comes to trying unusual foods, or rather unusual flavour-substrate

combinations (such as savoury-flavoured ice cream, as discussed here). That said, we are unaware of any published research that has specifically addressed this point.

Relevant here, research conducted by Yeomans, Chambers, Blumenthal, and Blake (2008) a decade ago, now, assessed psychological issues associated with the acceptance of an unusual savoury ice cream. The dish in question was a pinkish-looking smoked-salmon ice-cream that had been created by top chef Heston Blumenthal's research kitchen at The Fat Duck restaurant in Bray (<https://www.thefatduck.co.uk/>). Their research demonstrated how without giving the dish a name/description, consumers initially disliked the ice cream's savoury taste profile. In particular, they rated it as tasting overly salty. The problem, in this case, was that the bright pink colour of the ice-cream led people to expect (incorrectly in this case) something fruity and sweet (maybe a strawberry-flavoured ice cream). Expecting something sweet while experiencing something savoury led to the 'disconfirmation of expectation' response. However, further experimentation revealed that simply by describing the dish as a frozen savoury mousse resulted in acceptance where a strong dislike had been recorded if described as ice-cream. Labelling the dish simply as ice cream also led to higher ratings of perceived saltiness than when described as a frozen savoury mousse. It is important to note here that while the development of this particular dish had nothing to do with providing enhanced ice cream for the elderly/hospital patients, the implications for the delivery of savoury (and/or otherwise unusually-flavoured) ice creams that consumers find acceptable should be clear. One needs to make sure to set the appropriate expectations via the naming of the dish.

In fact, it is interesting to note how a number of so-called molecular gastronomy chefs (including world famous chefs such as Ferran Adrià and Heston Blumenthal), have, in the last couple of decades, become famous, in part for the savoury-flavoured ices that they have been serving in their restaurants. One need think here only of parmesan flavoured ice-cream popularized by both star chefs (e.g., Gopnik, 2011). Intriguingly, the origins of the dish can be dated in print at least as far back as 1824 to a book entitled the Mary Rudolph's cookbook *The Virginia Housewife* (see Campbell-Schmitt, 2017; Swerdloff, 2016). Cucumber ice cream also has a long history. Gopnik (2011) also mentions saffron ice cream being served as far back as 1985 by Adrià. Meanwhile, over in London, chef Jozef Youssef has been experimenting with serving oyster ice-cream and bone marrow ice-cream at his Gastrophysics chef's table (<https://gastrophysics.co.uk/>). Previously, Heston Blumenthal also popularized bacon and egg (see the Nitro-scrambled egg and bacon ice cream; Blumenthal, 2008, pp. 256-263), crab, and mustard-flavoured ice-creams (note that while these dishes still contain sugar, the overall

flavour profile is savoury). It is interesting to note that while savoury ice creams may well have been repopularised in a number of so-called molecular gastronomy restaurants, the trend has since started to filter down to the mainstream. According to Martin (n.d.), for instance, Purbeck Ice-Creams of Dorset, UK, has been selling non-sweet iced treats in flavours such as wasabi, sweet fennel, watercress and the award-winning ChilliRED for a number of years now. Meanwhile, Heston Blumenthal has been promoting a number of savoury ice cream flavours through the Waitrose supermarket chain in the UK (e.g., https://waitrose.pressarea.com/pressrelease/details/78/PRODUCT%20NEWS_12/3004)

It is worth pointing out here that unusually-flavoured savoury ice-creams are also quite popular in some parts of Japan. There, for example, one can find such unusual flavours as raw horse meat, fried chicken, cow tongue, squid ink, or shark fin ice cream (Ashcraft, 2016). Furthermore, fish ice cream with crab, eel, saury fish, octopus, or shrimp can all be found in the Japanese marketplace (Shaviklo et al., 2011; see also https://gurunavi.com/en/japanfoodie/2016/08/Japanese-Ice-Cream.html?_ngt_ =TT0ebc90487006ac1e4aecefZXRxE1P1_fqf_v_7Rq3mP). Green tea flavoured ice-cream is also very popular in Japan these days (<https://grapee.jp/en/52321>), though apparently the increase in popularity in this case may actually be traced back to California rather than Japan (see <https://pogogi.com/green-tea-ice-cream-popularity-started-california-and-not-japan>).

Hence, when thinking about enhanced ice-cream (especially when fortified with fish or meat protein), it is worth noting that while the idea might seem strange to many people in the West today, at other points in history, and in other parts of the world today, savoury ice-creams were actually popular/the norm. Furthermore, the mainstream rise in popularity of savoury ice creams amongst foodies suggests that public opinion may be changing with regard to the acceptability of this kind of frozen food in the west.

Fortified savoury ice cream recipes

Having reviewed the reasons as to why savoury and fortified ice creams would seem like a good idea when feeding the elderly/hospital patients, we now describe the approach to creating the adapted ice creams. The technical challenge being to replace the less healthy ingredients with nutritionally beneficial ingredients while maintaining desirable oral-somatosensory qualities of ice-cream. Our idea is to use the most relevant materials/ingredients and techniques

from molecular gastronomy/modernist cuisine in order to help solve some of these technical formulation challenges (see Morgan-Jones, 2018; Youssef, 2013).

Ice cream is a frozen food, typically a dessert, made by freezing a pasteurised mix of milk, sugar, corn syrup, flavouring, stabiliser, emulsifier, with or without eggs (Shaviklo et al., 2011). A large body of research has assessed the effects of milk fat and sucrose substitutes on selected physical and sensory properties of a frozen dessert system have been evaluated by sensory and instrumental methods (Prindiville, Marshall, & Heymann, 1999, 2000; Specter & Sester, 1994; see also Guinard, Zoumas-Morse, Mori, Panyam, & Kilara, 1996; Koeflerli, Piccinali, & Sigrist, 1996; Li, Marshall, Heymann, & Fernando, 1997). Part of the solution outlined here involves the use of widely-available supplements such as Huel (see <https://uk.huel.com/>). This will constitute c. 5% of total mass. Note that the recently commercially-released Soylent also provides an easily available alternative here (Poulter, 2018). The use of the starch maltodextrin in the recipe, in place of sugar, helps to reduce the sweet ‘taste’ and thus making the taste profile more suitable for a savoury ice cream. It should be noted though that maltodextrin is higher on the glycemic index than sugar meaning that it leads to a more rapid release of blood sugar (Brand-Miller et al., 2003).

In order to replace the sugar and eggs for those who need to, we will rely on the sweetness from natural sugars, including roasted sweet potato, beetroot or butternut squash. Note also that ice creams can be made in a *Pacojet* (see <https://pacojet.com/en/>) without the need to add sugar. The flavour options here are endless, the main point to stress is that fresh ingredients can be added to further load the ice cream with nutrients. While it is possible to make an adapted ice cream using regular household kitchen equipment, the use of a *PacoJet* machine enables the removal of as much or little sugar as desired. This strategy might, for instance, allow for the addition of much more nutritional supplement (such as, for example, Huel). Use of a Pacojet also helps ensure a perfect ice cream texture. The downside, however, is that it is expensive (starting at c. £3400 currently) and hence is not widely available in kitchens.

The idea here is that fresh fruit and vegetable purees can also be added to the recipe so that the nutritional value of the end product can be adjusted according to one’s desire. Here again, though, getting the name (and colour) right is likely to be key to acceptance of these ices, especially amongst the elderly. After all, using more dynamic and evocative language has recently been shown to increase people’s purchasing of vegetable dishes in the student canteen (e.g., Turnwald, Boles, & Crum, 2017). Ensuring the name right is likely to have a large impact

on people's response to enhanced ice-creams too (see Yeomans et al., 2008). Think here only of the way in which red velvet cake has seemingly become much more popular than carrot cake over the last few years (e.g., Burn-Callander, 2015; Severson, 2014). Both derive part of their sweetness from the vegetables (carrots and red beetroots, respectively). Indeed, colour and naming have both been shown to play an important role in how people perceive ice cream (e.g., Scheide, 1976; Yeomans et al., 2008; see also Moon, 2014; Youssef, Juravle, Youssef, Woods, & Spence, 2015), and this is equally true in older populations. So, for example, researchers have demonstrated that older participants are significantly influenced in their rating of the taste intensity and flavour identity of food and drink by the use of colour cues (see Spence, 2012, for a review). In fact, it is possible that colour cues and clear naming may become all the more important once olfactory, and to a lesser extent gustatory, perception start their inevitable decline.

Nostalgia flavours: We will also be introducing a number of nostalgia flavours here too, targeted at triggering memories, and hopefully feeling familiar to those who are in their 70s and beyond (see Hirsch, 1992; Leonor, Lake, & Guerra, 2018). In particular, we are currently working on developing Heinz Tomato soup ice cream;³ Prawn cocktail with *marie rose ice cream*; Duck salad with *orange zest ice cream*; Steak with *bone marrow ice cream*; Vanilla (with Huel 5%);⁴ There will also be a chocolate (with Huel 5%; cf. Strandberg, Stranberg, Pitkälä, et al., 2007). We have already conducted some limited pilot testing with these flavours as part of a demonstration event for Denville Hall (<https://www.denvillehall.org.uk/>) at the Kitchen Theory Gastrophysics Chef's Table.

Modernist no egg recipe

³ The hope is that the ice cream version of tomato soup will allow us to add less salt than the 5-12 times increased salt levels documented being added to soup by the elderly (the higher figure for those elderly individuals who were also on medication, which turns out to be most of them; Stevens, Cain, Demarque, & Ruthruff, 1991).

⁴ Note that the adapted vanilla-flavoured ice-cream was the most popular amongst the late stage cancer patients in Casas et al.'s (2012) study.

Grams	Ingredients
580	milk
175	cream
50	sugar
79	dextrose
20	glucose syrup
47	huel
10	vanilla extract
Yield	1000g

Method

Weigh out all the ingredients; Mix all the liquids together; Mix the solids together; Mix the solids with the liquids with the help of a hand-blender; Leave the mix to rest overnight; Next day, churn it with the ice-cream machine.

Nutritional Value (91g Serving):

Vanilla flavoured Huel ice cream		
Energy	145.6	Kcal
Protein	3.4	gr
Carbs	17.5	gr
of which, sugars	15.5	gr
fat	7.0	gr
of which, saturates	4.6	gr

Paco Jet Carrot & Citrus Ice Cream recipe

Grams	Ingredients
700	Carrot
40	Cirtus reduction
100	Cream
18	Gelatine
150	Whey protein

Method

Place the carrots in a vacuum pouch and seal; Cook the carrots sous vide (water bath/steam oven) at 75C for 3 hours; Just before the carrots are cooked, bring the veg stock to a boil and add the bloomed gelatine; Once the carrots are cooked, place in a blender with the vegetable stock and gelatine mixture till a smooth puree is achieved; Pour the puree into a 'Pacotizing' beaker and freeze at -22C for at least 24 hours; 'Pacotize' the mix in the beaker twice and serve immediately; Nutritional value (100g Serving):

Paco Jet protien ice cream		
Energy	141	Kcal
Protein	14.5	gr
Carbs	9.9	gr
of which, sugars	4.3	gr
fat	5.1	gr
of which, saturates	3.1	gr

Gastrophysics solutions to help make ice-cream more appealing

It is important to note that the emerging science of gastrophysics (see Spence, 2017c, for a review) also provides a number of other potentially relevant suggestions concerning ways in to further encourage the consumption of (e.g.) ice cream, and that go beyond the formulation and naming/description of the ice cream itself. For instance, as far as the choice of plateware is concerned, serving ice cream out of a red bowl or plate may not be a particularly good idea, given people's perception of ice-cream as being an unhealthy food. This is because several published research studies have now shown that people tend to eat less unhealthy food off a red plate due to the avoidance motivation that is apparently triggered by seeing the colour red (e.g., Reutner, Genschow, & Wänke, 2015; see also Akyol, Ayaz, Inan-Eroglu, Cetin, & Samur, 2018; see Spence, 2018, for a review).

At the same time, however, ensuring that the elderly eat with high-contrast plateware has been shown to help those who might otherwise struggle to see their food to eat better (i.e., more; Dunne, Nearing, Cipolloni, & Cronin-Golomb, 2004; Robbins, 2015; though see also Hannan-Jones & Capra, 2018). Elsewhere, meanwhile, Van Rompay, Kramer, and Saakes (2018) have demonstrated that serving ice-cream from a receptacle with a smooth and rounded, outer surface can help to make it taste sweeter than when the same ice cream is served from a 3D-printed receptacle with a sharp and angular surface instead. The hope is that by adopting the latest insights from research in the field of gastrophysics, it may be possible to increase the

consumption of adapted ice-cream, no matter what the formulation, amongst the elderly and/or amongst hospital patients.⁵ The sonic backdrop is also relevant given research showing that people's responses to gelati can be impacted by the music playing in the background too. For instance, there is evidence of sensation transference, such that the more people like the music they are listening to, the more they like the ice cream they are eating too (Kantono, Hamid, Shepherd, Yoo, Grazioli, & Carr, 2016; Kantono, Hamid, Shepherd, Hsuan, Lin, Brard, Grazioli, & Carr, 2018).

Future perspectives

It can be argued that because of the dynamic contrast experienced by those eating ice-cream (Hyde & Witherly, 1993), and because of the residual sensitivity to cold (together with a possibly nostalgic/comfort food angle; see Spence, 2017a), this food makes an excellent medium for the transmission of nutrients/energy to the growing number of elderly individuals in care/hospital who are malnourished. Serving more ice-cream, if it can be made healthy, might then, in some small way, help to address the shocking suggestion that 70% of the food served in British hospitals is thrown away uneaten (see Leith, 2015; Malm, 2015). Intriguingly, one Danish company has recently started operating in this space (<https://isfraskaroe.dk/>). They have started developing a range of ice creams for various special populations, including pregnant women, cancer patients and those other patients in need of extra energy. (The flavours apparently include curry, tomato/mushrooms, elderflower, strawberry etc.). Ultimately, one needs to ask why we do not serve more of those foods to the elderly/infirm that they actually desire to eat, and that work with their residual sensory capacities, that trigger nostalgia and may be associated with comfort food, rather than trying to force them to eat something that they have little desire to consume? It is important to stress, in closing that the challenges associated with affecting such a change in nutritional delivery to vulnerable populations is as likely to be much a matter of molecular gastronomy/food science as it is gastrophysics (see Spence, 2017c; Spence & Youssef, 2018).

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⁵ That all being said, it is important to note that certain of the suggestions to increase consumption that have gained attention in the press in recent years, such as, for example, the use of bottomless bowls (Wansink, van Ittersum, & Painter, 2006) have come into question recently (e.g., Lee, 2018; Resnick & Belluz, 2018).

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